Biofuel Legislative and Policy Framework and Sustainable Development: From Perspectives of Developing Countries

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Abstract

Biofuel development has a strategic significance in various fields, including national energy security, climate change mitigation, environmental conservation and protection, as well as agricultural revival and rural development. The production and trade of biofuels have entered a new era of global growth, with both the scale of the industry and the number of countries involved reaching unprecedented levels. Developing countries have advantages over developed countries in biofuel production, as many of them have apparent relative availability of land and feedstocks, as well as good climate conditions in that biomass production potential is much higher and production costs can be lower. However, a biofuel expansion in these countries raises concerns about potential added environmental and socio-economic pressures. A massive scale-up in the production and use of biofuels could speed up deforestation and biodiversity loss, and possibly accelerate climate change, while creating a distortion on the traditional agricultural market and the emerging agro-energy market, and increasing the concentration of economic wealth.

Against this background, the central aim of this thesis is to collate a variety of guidance, legislation and policies relevant to the regulation of biofuels in developing countries, to provide a comprehensive and coherent legislative and policy framework for these countries. As the rise of the biofuel economy has linked together many complicated environmental and social-legal relations in various topics, it is impossible to regulate biofuels within a single legal regime. In envisaging the legislative and policy framework for biofuel sustainability, it is necessary to consider and balance various values and interests from at least four legal areas, namely biotechnology development and diffusion, the environment, agro-energy economy, as well as trade liberalization on the biofuel market. Within the interdisciplinary regulatory framework, the biofuel industry in developing countries would not lead to a scenario in which it provided a solution to one specific problem/legal area, while creating many more in other legal areas. As a result, this regulatory framework will help policy makers to ensure that environmental and socio-economic sustainability considerations are taken into account in the production, promotion and consumption of biofuels, with a view to minimizing risks of negative impacts and maximizing benefits in the Global South, and in turn to benefit developing countries and the whole world in the immediate and long term.

Copyright Declaration

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Finally, many thanks are owed to my colleagues and friends in the Durham Law School and the Ustinov College for their companionship and constant support.

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5. Montreal Protocol on Substances that Deplete the Ozone Layer (adopted 16 September 1987, entered into force 1 January 1989) 1522 UNTS 3; 26 ILM 1550.

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9. Council Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC [1998] OJ L 350/58.

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List of Abbreviations

ACCS	Assured Combinable Crops Scheme
AMS	Aggregate Measure of Support
AoA	Agreement on Agriculture
AQEG	Air Quality Expert Group
CAP	Common Agricultural Policy
CBD	Convention on Biological Diversity
CDM	Clean Development Mechanism
CEN	European Committee for Standardisation
COP	Conference of the Parties of UNFCCC
CSBP	Council on Sustainable Biomass Production
CUP	Cambridge University Press
EGTT	UNFCCC Expert Group on Technology Transfer
EIA	United States Energy Information Administration
EISA	Energy Independence and Security Act
EPA	Energy Policy Act
ETS	Emissions Trading System

FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign Direct Investment
FSC	Forest Stewardship Council
GATT	General Agreement on Tariffs and Trade
GGDP	Global Governance Programme for Development
GHG	Greenhouse Gas
HCV	High Conservation Value
HLPE	High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security
IAKP	South Centre's Innovation and access to Knowledge Programme
IATP	Institute for Agriculture and Trade Policy
ICTSD	International Centre for Trade and Sustainable Development
IEA	International Energy Agency
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IISD	International Institute for Sustainable Development
(i)LUC	(In)direct Land-Use Change
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectual Property Right

ISCC	International Sustainability and Carbon Certification
IUCN	International Union for Conservation of Nature
JI	Joint Implementation of GHG emission Reductions
LCA	Life-Cycle Assessment
LDC	Least developed country
NGO	Non-governmental Organization
OECD	Organisation for Economic Co-operation and Development
OJ C/L	Official Journal of the European Union
OUP	Oxford University Press
PEFC	Programme for the Endorsement of Forest Certification
RED	Directive for Renewable Energy
RFA	Renewable Fuels Agency
RFQD	Revised Fuel Quality Directive
RFS	Renewable Fuel Standard
RSB	Roundtable on Sustainable Biofuels
RSPO	Roundtable on Sustainable Palm Oil
RTFO	Renewable Transport Fuels Obligation
RTRS	Roundtable on Responsible Soy Production
SAN/RA	Sustainable Agriculture Network/Rainforest Alliance

SCM	WTO Agreement on Subsidies and Countervailing Measures
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UNEP-WCMC	United Nations Environment Programme World Conservation Monitoring Centre
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UNCTAD	United Nations Conference on Trade and Development
WCED	World Commission on Environment and Development
WIPO	World Intellectual Property Organization
WEC	World Energy Council
WMO	World Meteorological Organization
WRM	World Rainforest Move

CHAPTER ONE INTRODUCTION TO THE THESIS AND OVERVIEW OF BIOFUELS DEVELOPMENT

1.1 Introduction to the Thesis

1.1.1 Background Information

Biofuel industry is developing at an astounding speed in every corner of the world. More and more countries have realized its strategic significance in various fields, including in national energy security, climate change mitigation, environmental conservation and protection, as well as agricultural revival and rural development.[1] The perceived benefits of biofuels are reflected in the surging investment in biofuel production and increasing number of countries introducing or planning to introduce polices to increase the proportion of biofuels within their energy portfolio.[2] However, despite enthusiastic views on the potential of biofuels development, awareness is emerging about the complexity of biofuel chains and their impacts on the environment, economy and society. The consequences and effectiveness of biofuel on sustainable development is the subject of serious debate: a massive scale-up in the production and use of biofuels could speed up deforestation and biodiversity loss, and possibly

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[1] Nuffield Council on Bioethics, *Biofuels: Ethical Issues* (Nuffield Council on Bioethics 2011) 8-22 <http://nuffieldbioethics.org/wp-content/uploads/2014/07/Biofuels_ethical_issues_FULL-REPORT_0.pdf> accessed 11 November 2012. See also, UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (UNCTAD/DITC/TED/2013/8, UNCTAD 2014) <http://unctad.org/en/pages/PublicationWebflyer.aspx?publicationid=1059> accessed 30 July 2015.

[2] Patrick Lamers and others, 'International Bioenergy Trade – A Review of Past Developments in the Liquid Biofuel Market' (2011) 15 Renewable and Sustainable Energy Reviews 2655; James Murray, 'Clean Tech Investment Surges Back in 2014' *The Guardian* (London, 9 January 2015) <http://www.theguardian.com/environment/2015/jan/09/solar-power-led-clean-energy-investment-surge-in-2014> accessed 23 March 2015.

accelerate climate change, while creating a distortion on the traditional agricultural market, increasing the concentration of economic wealth.[3] As a result, Biofuels are currently presented in academic and public policy debates both as a solution to problems and as a creator of problems.[4] In order to promote the production and consumption of biofuels as well as minimizing all sorts of negative implications on the environment, economic and society, the industrialized nations, lead by the European Union and the United States, have being in the process of developing advanced biofuel-related technologies and establishing appropriate legislative and policy frameworks.[5]

Governments and non-government organizations (NGOs) in developing countries also attach great importance to the new-born renewable energy industry. Unfortunately, biofuel industries in developing nations do not develop as well as in the developed world. Many biofuel programs and projects in developing countries are being launched without considering and enacting long-term policy, and therefore will not have a long-term sustainable effect on the industry.[6] There are many factors restricting biofuel

[3] David Zilberman and others, 'The Impact of Biofuels on Commodity Food Prices: Assessment of Findings' [2012] American Journal of Agricultural Economics <http://ajae.oxfordjournals.org/content/early/2012/06/07/ajae.aas037.short> accessed 30 July 2015; James Speight and Kamel Singh, *Environmental Management of Energy from Biofuels and Biofeedstocks: Energy and Environment Book Series* (John Wiley & Sons 2014).

[4] Bruce Gardner and Wallace Tyner, 'Explorations in Biofuels Economics, Policy, and History: Introduction to the Special Issue' (2007) 5 Journal of Agricultural and Food Industrial Organization <http://www.colby.edu/economics/faculty/thtieten/ec476/Econ_Hist.pdf> accessed 21 April 2011.

[5] Stavros Afionis and Lindsay Stringer, 'European Union Leadership in Biofuels Regulation: Europe as a Normative Power?' (2012) 32 Journal of Cleaner Production 114; Brent Yacobucci, 'Biofuels Incentives: A Summary of Federal Programs' (Congressional Research Service Report for Congress R 40110, CRS 2012) <https://www.fas.org/sgp/crs/misc/R40110.pdf> accessed 12 June 2013.

[6] There is no established convention for the designation of developed and developing countries in the United Nations system. The United Nations Development Program's (UNDP) annual Human Development Index (HDI) is probably the most widely recognized to tool for measuring development and comparing the progress of developed and developing countries. The HDI scores and ranks each country's level of development based on three categories of development indicators, which are income, health and education. Accordingly, with regards to this research, the European Union, the United States, Canada, Japan, Korea, Australia and New Zealand are considered as developed countries or regions; while most of Africa countries, Asian countries, as well as South American countries are developing

industry development, such as lack of technology, public support and access to foreign direct investment (FDI). The most fundamental and fatal factor is that, most developing countries are in the early stages of considering biofuels policies and there is a lack of uniform and appropriate legal framework to support/regulate biofuels development in a sustainable manner.

1.1.2 Research Questions

Against this background, this thesis aims to collate a variety of guidance, legislation and other information relevant to the regulation of biofuels, and to develop a comprehensive and coherent legislative and policy framework for biofuel sustainable development from perspectives of developing countries. It is hoped that gathering together the relevant information, regulations and principles within the suggested strategic legal management model will help to ensure a greater understanding of the measures required to comply with biofuel policy and legislation, as well as provide suggestions for policy makers in developing countries to build up their own legislative and policy framework for their biofuel industries based on this legal framework model, as well as the circumstances of their local context. In this way, this research is hoped could help biofuel lawyers and policy makers to regulate biofuel development in a

countries or areas. For more information presents HDI data for a selection of developed and developing countries, see UNDP Human Development Report Website, <http://hdr.undp.org/en/countries> accessed 27 January 2016. It is worth noting that issues surrounding the categories of global players (developed and developing countries) are very controversial, particularly about a new category of so-called ‘emerging country’: China, India and Brazil for instance. These countries remain ‘developing countries’ in this research, as significant sections of their populations live in poverty, and in that they are not considered ‘developed countries’ according to the UNDP’s Human Development Index. For more information about challenges of biofuel development in developing countries, see Joachim von Braun and R K Pachauri, *The Promises and Challenges of Biofuels for the Poor in Developing Countries: IFPR 2005-2006 Annual Report Essay* (IFPRI 2006); Anna Locke and Giles Henly, ‘Scoping Report on Biofuels Projects in Five Developing Countries’ (The Overseas Development Institute Annual Report, ODI 2013) <http://www.epure.org/sites/default/files/publication/8394.pdf> accessed 30 July 2015.

sustainable way, and in turn to benefit developing countries and the whole world in the long term. A particular focus is on issues that might be of interest to developing countries.

In order to provide the framework for biofuel sustainable development, four areas of law which are closely related to biofuel production and trade are identified in this thesis, which are Intellectual Property Law, Environmental Law, Agricultural Law and International Trade Law. Based on the knowledge of and issues related to the four areas of law, leading questions of this research are as following:

- As biofuel science and technology has developed rapidly during the past few decades, what is the role of intellectual property rights (IPRs) in advancing technology development and diffusion? Is it possible for developing countries to access clean energy technologies under the current intellectual property framework? Under the context of climate change, are any reforms needed for further facilitating biofuel technology development and diffusion in the developing world? What is the attitude of and efforts made by relevant international conventions?

- What is the relationship between energy law and environmental law in the context of sustainable development? Are there implications for biofuel regulation? What are the impacts of biofuel production on the environment? How can we minimize negative impacts on the environment and regulate biofuel production in an environmentally sustainable manner? Can any lessons be learned from the existing practices for new player developing countries?

- What are the impacts of biofuel production and policy on the agricultural sector and rural community? What are the impacts of biofuel expansion on food prices and food security? Is the biofuel subsidy policy in main producer countries trade distorting? Are current agro-energy policies socio-economic sustainable? What implications exist for developing countries and the global biofuel market?

- What is the relationship between international trade law and international environmental law? Is it a matter for policy makers to consider when designing their biofuel regulations? Is unilateral biofuel sustainability regulation compatible with the WTO rules? Are there any implications for biofuel production and exportation in developing countries and the global biofuel market?

1.1.3 Research Design and Structure

After an introduction and overview of biofuels development in the world in Chapter One, the opportunities and challenges faced by biofuel industry associated with the four different areas of law are discussed respectively in the following chapters. The main obstacles and potential problems of biofuels development are discussed, and the relevant legislation and legal efforts of regulating them are examined in each chapter. After the analysis and evaluation, the effectiveness of these legal instruments is illustrated, and the implications for developing countries are highlighted in each chapter. However, it is worth noting that issues included in this research are illustrative rather than exclusive. This research does not pretend to cover all the possible impacts of biofuel industry, but to highlight some key areas in which impacts are to be expected. It seeks to provide an identification of the main issues involved in the debate around production and trade in biofuels. The thesis is organized as follows:

Chapter Two focuses on the technological aspects of biofuel production and the related intellectual property issues. The most prominent developments in biofuel science and technologies from the first-generation biofuels to the second-, third- and future-generation biofuels are introduced in this chapter, followed up with the intellectual property landscape and the patent opportunities in biofuel industry. After that, it explores how IPRs affect biofuels innovation and biotechnology transfer, highlights the necessity of, and challenges to, developing countries gaining access to biofuel technologies in the context of climate change and sustainable development. Different perspectives of developing countries and industrialized economies, as well as international communities' attitude and efforts, are closely analyzed in this chapter.

Chapter Three explores issues of the impact of biofuels on global climate change and its close ties to environmental sustainability. This chapter provides a thoughtful description of various biofuel-related environmental problems and the current biofuel sustainability regulations in developed countries, mainly the EU and the US. Biofuel sustainability certification schemes are highlighted and recommend to developing countries with some suggestions based on the instruments' limitation and shortcomings. Last but not the least, a possible approach, the meta-approach of biofuel certification designing which has been initiatively used in the UK is also evaluated.

Chapter Four analyses relevant aspects of the agricultural market and trade in biofuels. Two issues are focused upon in this chapter: Firstly, the increased competition over agricultural crops for biofuels purposes instead of food production is highlighted as a concern for the issue of food security, especially for the developing world. Secondly, the issue of developed countries' domestic support and agricultural subsidies for production of biofuels and biofuel feedstocks is discussed, as well as its implications for developing countries' biofuel industry, and the WTO's attitude towards these subsidies.

Chapter Five analyses the links between biofuel production, trade and sustainable development. Domestic biofuel policies indubitably had a tremendous effect on global biofuel markets. A main concern in this chapter is that the proliferation of different biofuel sustainability standards with no mutual recognition between them operates as non-tariff barriers blocking developed countries' markets for developing county exporters. The attitude of the WTO and the implications for developing countries are highlighted in this chapter.

After the analysis of the above issues, it is expected that a legal framework for biofuels which includes the most important and imperative areas of law will have been formulated. Therefore, it is hoped that this research can help to provide a better understanding of the biofuel needs and aspirations of developing countries, viewed in a global context. It worth noting that this research has touched only on what I take to be the major issues affecting biofuels development in developing countries and globally. There may be some other issues of importance to them, although these issues are beyond the scope of this research.

1.1.4 Research Methodology

The thesis is conducted primarily through a library-based method, consisting of a range of documents related to biofuels from richly diverse sources, including legal documents, press releases, position papers, technical standards, official reports and documents, non-government reports, books, journals, conference publications, theses, newspaper articles, websites and blogs. Particularly, with regard to the quality of research in non-law disciplines such as Bioscience, Environmental Science, Social Science and Political Relations, library resources and materials are carefully selected and evaluated with considerations of ranking of academic journals, authority of reporting organization, maturity of theories, as well as consultation from experts when necessary. And also, instead of providing a literature review in a separate chapter in this thesis, the relevant literature is reviewed while demonstrating and analysing the issues in every chapter throughout the whole thesis.

Moreover, this is an interdisciplinary work which includes legislation, policy-making, biotechnology and bioethics aspects. In relation to law, principles and regulations of different areas of law concerning biofuel development are included. It mainly covers the areas of intellectual property law and technology transfer; environmental law, climate change and sustainable development law; agricultural economic law and rural development; international trade law and the WTO regulations. Therefore, a trans-disciplinary approach is imperative for this research.

In addition, this research applies a 'country-selected comparison' approach. It is worth noting that it is not conducted with a typical comparative study approach. It demonstrates the issues around biofuels selected and focuses on the US and the EU countries, as they have made great efforts on biofuel technology development and biofuel legislative and policy framework design. It is not my intention to describe the laws of the United States and the European Union and then simply compare them to the laws of one particular developing country. Instead, the thesis focuses on several selected issues, including intellectual property and technology transfer, environmental sustainability and climate change, the 'food versus fuel' dilemma and rural communities' rights to benefit from biofuel industry, and open fair trade market establishment. Developing countries are viewed simply as a whole group to be explored. By observing and explaining how legislative and policy instruments facilitated biofuel industry in developed counties, the thesis identifies gaps and weaknesses in the current biofuel legislative framework. It explores whether the future development of biofuels industries in the Global South can be inspired by the US's and EU countries' experiences. However, it also recognizes that developing countries are a diverse group, and that any design in policy may be beneficial for some while damaging to others. This is inevitable, and should be attended to by further studies that are capable of providing country-specific assistance.

Last but not the least, the doctrinal analysis approach is a main and imperative method in this thesis, as these research includes substantial legal articles and the relevant case law. Moreover, the effectiveness of these legal articles in different legal systems and societies are also considered in this work. Therefore, social-legal approach is also an important methodology for this research.

In sum, all the above identified methodologies are essential and necessary for conducting and finishing this research, and any single one of them would not be workable itself. With the package of these methodologies, this research begins from the biotechnology and scientific part mainly through a library methodology, as it is the base of biotechnology issues and a variety of other social-legal issues surrounding biofuel development. After that, biotechnology related intellectual property issues are discussed (Chapter Two) with both doctrinal analysis method (when examining key articles under UNFCCC and TRIPS Agreements) and social-legal method (when analyzing the affection of IPRs on technology transfer on the legal theoretical level and the political level). Furthermore, more complicated issues regarding to environmental sustainability (Chapter Three) as well as social-economic sustainability (Chapter Four and Five) are explored in the sustainable development framework in the following parts of this thesis. Interdisciplinary methodology is important and imperative to address these sustainability issues, when exploring the relationship of energy and environmental law (Chapter Three) for example, or the linkages of energy market and agricultural market (Chapter Four), or the relationship of trade and environmental regulations (Chapter Five). Lastly, country-selected comparison method is also significance. As mentioned, the US and the EU are the two main selected targets for this research as they are the most successful countries/regions globally that worth to be learned from by other countries when developing biofuels.

1.2 Overview of Biofuels

1.2.1 Introduction

There has been an unprecedented increase in the production, use, and international trade of biofuels over the last few decades. Consequently, biofuels have attracted increasing interest in both the academic and political agenda, as there are many potential benefits but also risks to the rapid development of biofuel economy. Debates on biofuels focus on a wide range of technological, environmental, social and economical concerns. However, before focusing on any of the specific social-legal issues related to the biofuel industry, it is essential to get to know more about the biofuel sector itself. The following section will introduce some important background information about biofuel development. It will seek to answer what are biofuels, why do we need them, and what is the current status of biofuel production and biofuel trade.

1.2.2 What are Biofuels?

Generally, biofuels refer to renewable fuels that are predominately derived from agricultural, forest or any other organic material, and can often be mixed with other elements such as diesel, to create a source of power.[7] They could be used for transport, electricity, cooking and heating purposes, and they can be in solid form such as bio-char, or liquid form such as ethanol, methanol, or biodiesel, or gaseous fuels such as methane, biodimethylether, biogas or hydrogen.[8] The raw materials used to produce biofuel are referred to as feedstock.

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[7] UNCTAD, *The Biofuels Market: Current Situation and Alternative Scenarios* (UNCTAD Report UNCTAD/DITC/BCC/2009/1, United Nations 2009) ix. <http://unctad.org/en/docs/ditcbcc20091_en.pdf> accessed 2 June 2011.

[8] Ayan Demirbas, 'Biorefineries: Current Activities and Future Developments' (2009) 50 Energy Conversion and Management 2782.

In this research, the term of 'biofuels' will only refer to liquid fuels for the transportation sectors derived from biological sources. Biofuels are currently the only form of renewable energy usable by the transport industry. Although there are various forms of biofuels, only ethanol and biodiesel will be discussed in the work, as they are by far two of the most widely used biofuels for transportation in the current market worldwide, and account for more than 90% of global biofuel use.[9] The increasing market for biofuels is based primarily on demand from the transportation sector, especially road vehicles.[10] Biofuels may be in pure form (100%) for dedicated vehicles or blended fuels in such a proportion that they can substitute conventional motor fuels without affecting car performance. For example, a fuel mixture of 90% gasoline and 10% ethanol, is commonly referred to gasohol or E10, and are used directly in modern automobiles with no engine modification. Ethanol can be blended with gasoline without problems with as much as 15-20 alcohol by volume (E15-20).[11] Although biofuels have a lower energy density than diesel and petrol, both ethanol and biodiesel are reported to have higher combustion efficiency.[12]

Bioethanol is a distilled liquid produced by fermenting sugars from sugar plants, such as sugarcane and sugar beet, or cereal crops, such as maize, wheat cassava and

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[9] WEC, *Biofuels: Policies, Standards and Technologies* (WEC 2010) <http://www.worldenergy.org/wp-content/uploads/2012/10/PUB_Biofuels_Policies_Standards_and_Technologies_2010_WEC.pdf> accessed 12 January 2015.

[10] UNCTAD, 'The Global Biofuels Market: Energy Security, Trade and Development' (UNCTA D 2014) <http://unctad.org/en/PublicationsLibrary/presspb2014d3_en.pdf> accessed 12 January 2015.

[11] IEA, *Renewable in Global Energy Supply* (IEA Fact Sheet, IEA 2002) <https://www.iea.org/publications/freepublications/publication/renewable_factsheet.pdf> accessed 21 March 2011; Ayhan Demirbas, 'Biofuels Sources, Biofuel Policy, Biofuel Economy and Global Biofuel Projections' (2008) 49 Energy Conversion and Management 2106, 2107.

[12] IEA, *Biofuels for Transport: An International Perspective* (IEA 2004) <http://www.cti2000.it/Bionett/All-2004-004%20IEA%20biofuels%20report.pdf> accessed 21 March 2011; Christian Bomb and others, 'Biofuels for Transport in Europe: Lessons from Germany and the UK' (2007) 35 Energy Policy 2256, 2258.

sorghum.[13] A second-generation ethanol, known as lignocellulosic ethanol or cellulosic ethanol, is mainly produced from a range of lignin and cellulose materials such as short rotation coppices and energy grasses.[14] Bioethanol can be used in pure form in specially adapted vehicles, or blended with gasoline.

Biodiesel is mainly produced from organic oil, which usually comes from the feedstock of oil crops or trees such as rapeseed, sunflower, soya, castor, palm, coconut or jatropha. The three largest fractions in global vegetable oil production in 2008 were palm, soybeans, and rapeseed oil.[15] Biodiesel also can be produced from animal fats, tallow or waste cooking oil, although the quality of these products cannot be guaranteed to be of the same level.[16] A second-generation biodiesel utilising new technologies, such as the Fischer-Tropsch process, synthesises diesel fuels from wood and straw to a gasification stage.[17] Moreover, a third-generation of biodiesel uses oils from algae is under research and development in some developed countries.[18] Biodiesel can be blended with automotive diesel or be used in pure form in any diesel engine.[19]

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[13] Avinash Kumar Agarwal, 'Biofuels (Alcohols and Biodiesel) Applications as Fuels for Internal Combustion Engines' (2007) 33 (3) Progress in Energy and Combustion Science 233.

[14] For more information about second-generation ethanol, see Section2.2.3.

[15] For a detailed assessment of vegetable oil markets regarding biodiesel, see, Frank Rosillo-Calle, Luc Pelkmans and Arnaldo Walter, 'A Global Review of Vegetable Oils, with Respect to Biodiesel' (A Report for the IEA Bioenergy Task 40, IEA 2009) <http://www.bioenergytrade.org/downloads/vegetableoilstudyfinaljune18.pdf> accessed 21 March 2011.

[16] Lijun Wang, *Energy Efficiency and Management in Food Processing Facilities* (CRC Press 2008) 421; Gemma Toop and others, 'Trends in the Used Cooking Oil Market' (ECOFYS 2013) 22 <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/266089/ecofys-trends-in-the-uco-market-v1.2.pdf> accessed 30 July 2015.

[17] Anselm Eisentraut, 'Sustainable Production of Second-Generation Biofuels: Potential and Perspectives in Major Economies and Developing Countries' (Information Paper, IEA 2010) 22-23 <https://www.iea.org/publications/freepublications/publication/biofuels_exec_summary.pdf> accessed 30 April 2011; See also, Section 2.2.3.

[18] Carla S Jones and Stephen P Mayfield, 'Algae Biofuels: Versatility for the Future of Bioenergy' (2012) 23 Biotechnology 346. For more information about third-generation biofuels, see, Section2.2.4.

[19] Jeremy Gehring, 'Biofuels, What are the Issues for a Trading Company?' (Bachelors of Business

1.2.3 Why Biofuels?

Biofuels are now a key option in energy policies for both industrialised countries and developing countries.[20] Increasing the use of biofuels can improve energy security, reduce greenhouse gas (GHG) and pollutant emissions, enhance rural economic development and, under the right circumstances, protect ecosystems and soils. Over the last decade, many events have had an impact on the biofuels industry, and many countries have undergone a fundamental reassessment of the sector. However, the fundamental factors that have pressed countries to promote biofuels as a new or expanding component of their energy mix are still there, which are improving energy security and mitigating climate change, as well as promoting agriculture and rural development.

1.2.3.1 Energy Security

The motivations for promoting biofuels development are various, ranging from mitigating climate change through the reduction of GHG emissions, restoration of degraded lands, reducing land abandonment, to expanding new trade markets, diversifying income for farmers and forest owners, and improving employment opportunities in rural areas. Amongst these potential benefits accounting for the increased focus on biofuels promotion, the desire for energy security and self-sufficiency have been recognised as the most direct benefits which drive countries to start actively looking for alternatives, and switch from conventional fuels to biofuels.[21]

Administration Project Report, Geneva School of Business Administration 2008) 3 <http://doc.rero.ch/record/11379> accessed 21 March 2011.

[20] Ayhan Demirbas, 'Progress and Recent Trends in Biofuels' (2007) 33 Progress in Energy Combustion Science 1, 18.

[21] Commission, 'Green Paper: Towards a European Strategy for the Security of Energy Supply' COM (2000) 769 final, 3.

Energy underpins almost every aspect of our economy and day-to-day lives. Energy security is one of the main targets of energy policy.[22] The International Energy Agency (IEA) defines 'energy security' as the uninterrupted availability of energy sources at an affordable price.[23] Energy security has many aspects: long-term energy security mainly deals with timely investments to supply energy in line with economic developments and environmental needs. Short-term energy security focuses on the ability of the energy system to react promptly to sudden changes in the supply-demand balance.[24]

The first promotion and development of large-scale biofuels was triggered by the 1973-1974 oil export embargo proclaimed by the Organization of the Petroleum Exporting Countries (OPEC). As the Arab members of OPEC restricted the export of crude oil to the US and other western countries, the global oil prices met a sharp increase from $3 to $12 per barrel.[25] This oil crisis caused great concern over dependence on oil-based fuel imports in the western world, and then became a recipe for the initial bioethanol programmes in Brazil and the US, which are the largest two producers of ethanol in the world.

After that, at the beginning of the new millennium, energy security has become a constant and universal challenge to all countries, particularly to large emerging countries such as India and China, and industrialization nations such as the US and the EU countries. Energy insecurity seems to exist in every corner of the modern world. The world is now heavily dependent on only a few energy resources. According to the World Energy Council (WEC), about 80% of the world's energy needs are currently

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[22] Christian Winzer, 'Conceptualizing Energy Security' (2012) 46 Energy Policy 36.

[23] Available at: <http://www.iea.org/topics/energysecurity/> accessed 30 July 2015.

[24] Ibid. For more discussion about the definition of 'energy security', see, Winzer (n 22); Daniel Yergin, 'Ensuring Energy Security' (2006) 85(2) Foreign Affairs 69; Jessica Jewell, Aleh Cherp and Keywan Riahi, 'Energy Security under de-carbonization scenarios: An Assessment Framework and Evaluation under Different Technology and Policy Choices' (2014) 65 Energy Policy 743.

[25] Ralph Pettman, *Handbook o International Political Economy* (World Scientific 2012) 236.

covered by fossil resources such as petroleum, natural gas and coal.[26] For instance, the net import of oil in India in 2006 was about 78 million tons and cost INR 760 billion, and future oil consumption in India is expected to grow rapidly, because India has now embarked on what the economist Vijay Kelkar calls the 'growth turnpike'.[27] India therefore is attempting to limit its dependence on oil imports by expanding domestic exploration and production.[28] China's energy consumption, as the second largest energy consuming country after the US, is heavily dominated by coal and other fossil fuels. The high dependence on imported oil, which exceeded 50% in 2008, has caused a significant problem regarding energy security.[29] In the US and EU, the picture is pretty much the same. The US has been heavily reliant on imports of Middle Eastern oil for a long time. But now, there has been rapid development of fracking technology allowing the recovery of natural gas from shale formations.[30] Since 2000, rapid growth in the production of natural gas from shale formations in North America has dramatically altered the US energy market landscape, and enhanced US energy security to a large extent.[31] In 2011, the US imported just 45% of the liquid fuels it used, down from a record high of 60% in 2005.[32] However, the US still needs to import large

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[26] WEC, *World Energy Resources: 2013 Survey* (WEC 2013) <https://www.worldenergy.org/wp-content/uploads/2013/09/Complete_WER_2013_Survey.pdf> accessed 7 July 2014.

[27] Yergin (n 24) 72.

[28] R S Deshpande, 'Biofuels and WTO: An Emerging Context' (2006) 8(2) Asian Biotechnology and Development Review 77, 84.

[29] Jian Zhang, 'China's Energy Security: Prospects, Challenges, and Opportunities' (The Brookings Institution Center for Northeast Asian Policy Studies, The Brookings Institution 2011) <http://www.brookings.edu/~/media/research/files/papers/2011/7/china%20energy%20zhang/07_china_energy_zhang_paper.pdf> accessed 7 July 2014.

[30] For more information about 'fracking' as a new energy extraction method, see, Russell Gold, *The Boom: How Fracking Ignited the American Energy Revolution and Changed the World* (Simon and Schuster 2015).

[31] Kenneth B Medlock III, Amy Myers Jaffe and Peter R Hartley, 'Shale Gas and U.S. National Security' (James A Baker III Institute for Public Policy of Rice University 2011) <https://www.efmidstream.com/sites/default/files/resources/resources_shalegassecurity.pdf> accessed 30 July 2015.

[32] Clifford Krauss and Eric Lipton, 'U.S. Inches Toward Goal of Energy Independence' *The New York Times* (New York, 22 March 2012) <http://www.nytimes.com/2012/03/23/business/energy-environment/inching-toward-energy-independence-in-america.html?_r=0> accessed 31 July 2015.

amounts of energy every year and therefore, the energy security issue will be continually carefully addressed by US policy makers.[33] While the US has more supplies of cheap gas than ever before thanks to the 'shale revolution', the EU remains dependent on energy imports.[34] The EU imports more than half of all the energy it consumes. Its import dependency is particularly high for crude oil (more than 90%) and natural gas (66%).[35] Many countries are heavily reliant on few or a single supplier(s), such as Russia, Norway and Middle East.[36] This dependence leaves them vulnerable to supply disruptions caused by political or commercial disputes.

As energy is so important for the economy, energy security is closely tied to national security. However, world oil reserves are concentrated in just a few countries, in particular in the Middle East, and the supply of these fossil resources is inherently finite. It is argued that the world production of petroleum will reach its maximum production level in this century, and then the world production rate of fossil fuels will inevitably start to decline.[37] Campbell and Laherrere, well-known petroleum experts, pointed out in 1998 that our society faces the end of the abundant and cheap oil.[38] It might well be a basis for future conflicts between nations aiming to secure the remaining reserves for

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[33] Amy Below, 'Obstacles in Energy Security: An Analysis of Congressional and Presidential Framing in the United States' (2013) 62 Energy Policy 860; EIA, 'Annual Energy Outlook 2015: With Projections to 2040' (EIA 2015) 17 <http://www.eia.gov/forecasts/aeo/pdf/0383%282015%29.pdf> accessed 30 July 2015.

[34] Gregor Erbach, 'Shale Gas and EU Energy Security' (European Parliamentary Research Service PE 542.167, EPRS 2014) <http://www.europarl.europa.eu/RegData/etudes/BRIE/2014/542167/EPRS_BRI%282014%29542167_REV1_EN.pdf> accessed 30 July 2015.

[35] European Commission, 'In-depth Study of European Energy Security' (Commission Staff Working Document SWD 300 final/3, European Commission 2014) <https://ec.europa.eu/energy/sites/ener/files/documents/20140528_energy_security_study.pdf> accessed 30 July 2015.

[36] Gehring (n 19) 3.

[37] Colin J Campbell and Jean H Laherrère, 'The End of Cheap Oil' 278 Scientific American Magazine 78, 83.

[38] Ibid.

themselves.[39]

Regarding the demand for energy, factors such as rapid growth of population, urbanization and changes in lifestyle have resulted in the global demand for energy increasing to unprecedented levels and all the signs are that demand will continue to grow worldwide. In 2012, around 31 billion barrels of oil were produced, which corresponds to an increase of 2% in previous year's production.[40] In addition, it is estimated that oil production capacity may peak in the next 5 to 15 years before stating to decline.[41] Global primary energy demand is estimated to increase by 56% from 2010 to 2040 led mostly by emerging economies, where robust economic growth and expanding populations are accompanied by increased demand for energy.[42] This has implications for increasing dependence on insecure, expensive and ultimately limited fossil fuel supplies.

The development of various sectors has been restricted because of the energy crisis, especially those energy-intensive businesses including the transport sector, which is presently about 96% based on petroleum fuels while the rest is from biofuels, natural gas, and electricity.[43] In 2010, the global transport sector consumed about 2,200 million tons of oil, constituting about 19% of global energy supplies.[44] (See Figure 1)

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39 Ibid.

40 UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 2; IEA, *Key World Energy Statistics 2013* (IEA 2013) <http://www.qibebt.cas.cn/xscbw/yjbg/201312/P020131219323434673634.pdf> accessed 21 June 2014.

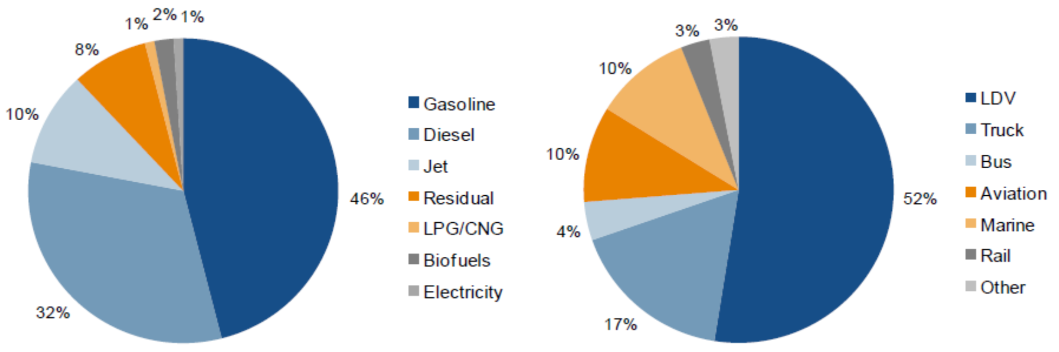
41 Ibid.

42 EIA, *International Energy Outlook 2013: With Projections to 2040* (EIA 2013) <http://www.eia.gov/forecasts/ieo/pdf/0484%282013%29.pdf> accessed 30 July 2015.

43 See also, Stephan Slingerland and Lucia van Geuns, 'Drivers for an International Biofuels Market' (2005) Clingendael Internaitonal Energy Programme Future Fuel Seminar Discussion Paper 12/2005, 6 <http://clingendael.info/publications/2005/20051209_ciep_misc_biofuelsmarket.pdf> accessed 3 December 2011.

44 WEC, *Global Transport Scenarios 2050* (WEC 2011) <https://www.worldenergy.org/wp-content/uploads/2012/09/wec_transport_scenarios_2050.pdf> accessed 30 July 2015.

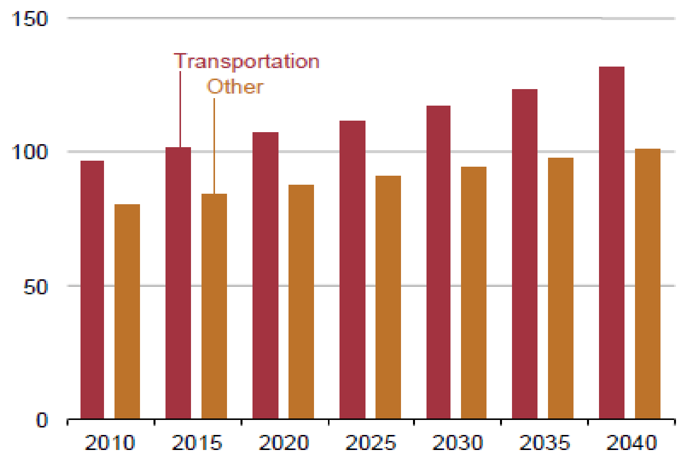
Figure 1: 2010 transport energy by source and by mode (total ~2,200 Mtoe)



Source: WEC, 2011.

In addition, according to a report in 2013, world energy consumption in the transportation sector increases by an average of 1.1% per year.[45] The transportation sector accounts for the largest share (63%) of the total growth in world consumption of petroleum and other liquid fuels from 2010 to 2040 (Figure 2), increasing by 36 quadrillion Btu as compared with an increase of 25 quadrillion Btu in the industrial sector and declines in all other end-use sectors.

Figure 2: World liquids consumption by end-use sector, 2010-2040 (quadrillion Btu)



Source: EIA, 2013.

[45] EIA, *International Energy Outlook 2013: With Projections to 2040* (n 42).

Accordingly, the transportation sector is likely to suffer badly because of the depletion and the volatile prices of oil, as well as increasing energy consumption. Consequently, this situation makes the transport sector the frontrunner in diversifying its energy supply sources, by increasing the use of biofuels. As Sharpe and Hodgson pointed out, 'the indefinite extension of "life as usual" is highly vulnerable to the growing constraints of energy availability, pollution and congestion'.[46]

The transportation sector is only one example of a sector that has suffered from energy insecurity. There is some urgency in enhancing energy security, building up a local supply of energy and diversity in the energy mix for both industrialized countries and developing countries. Biofuels, which come from biomass that can be grown domestically or abroad, could improve diversity within the global transport fuel mix, that are expected to help address the growing worldwide energy security dilemma. Another relevant advantage of biofuels is that it is a ready-to-use fuel with the current technologies and the existing engines, distribution infrastructures, and supply chains (such as fuelling stations and tankers), and they can bring an answer to the energy issue immediately. Consequently, they became a significant component of the domestic fuel supply as well as other alternative energy sources in both developing and industrial countries. Although by now, biofuel industries in the main producing countries heavily rely on government support, biofuels appear to have significant economic potential provided that fossil fuel prices increase in the future.[47]

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[46] Bill Sharpe and Tony Hodgson, 'Intelligent Infrastructure Futures: Technology Forward Look – Towards a Cyber-Urban Ecology' (Project on Intelligent Infrastructure Systems, Foresight Programme of the Office of Science and Technology 2006) <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300337/06-520-intelligent-infrastructure-technology.pdf> accessed 3 December 2011.

[47] Alfredo Cadenas and Sara Cabezudo, 'Biofuels as Sustainable Technologies: Perspectives for Less Developed Countries' (1998) 58 Technological Forecasting and Social Change 83-103.

1.2.3.2 Environmental Concerns and Climate Change Mitigation

Another motivation for governments to develop biofuels is that biofuels have great environmental merits. Biofuels are easily available from common agricultural and forest sources, and they are biodegradable contributing to sustainability. It is argued that biofuels are 'non-polluting, locally available, accessible, sustainable and reliable fuel obtained from renewable sources'.[48] Among various environmental friendly potentials, one of the most considerable is that biofuels have great potential to reduce greenhouse gas (GHG) emissions, such as carbon dioxide (CO2), methane (CH4), and nitrogen oxides (NOx), by partial replacement of fossil fuels as in the transportation sector, and in that way to mitigate climate change.[49]

Climate change is a significant issue related to energy and environmental concerns. It is also a sustainable development problem concerning all countries, developed and developing nations alike, as unpredictable climate change will adversely affect all aspects of human beings and human welfare. The Intergovernmental Panel on Climate Change (IPCC) defines climate change as 'a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity'.[50] The United Nations Framework Convention on Climate Change (UNFCCC) describes climate change as 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the

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[48] Ayhan Demirbas, 'Biofuels Sources, Biofuel Policy, Biofuel Economy and Global Biofuel Projections' (2008) 49 Energy Conversion and Management 2106. However, there are extensive criticisms on how biofuels may have a negative impact on the environment in terms of land-use change, biodiversity loss, and deforestation. This issue will be discussed in Section 3.3.3.

[49] Daniel Puppan, 'Environmental Evaluation of Biofuels' (2002) 10 Periodica Polytechnica Ser Soc Man Sci 95.

[50] IPCC, *Climate Change 2007: Synthesis Report* (IPCC 2007) 30 <http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf> accessed 30 July 2015.

global atmosphere and which is in addition to natural climate variability observed over comparable time periods'.[51] Climate change mitigation is now recognised as one of the great global challenges of the 21st century. There is an unprecedented need for appropriate policy measures to limit GHG emissions and combat rising global temperatures.[52] This need has been clearly reflected in some famous international agreements, such as the Kyoto Protocol and Copenhagen Accord.[53] It is also reflected in some countries' climate or energy policy, such as the EU Renewable Energy Directive (RED), and the US Renewable Fuel Standard (RFS). Both the EU RED and the US RFS concerns climate change mitigation by setting a minimum rate/level of GHG reduction.[54]

Transport is one of the main energy consuming sectors. There are 700 million light duty vehicles, automobiles, light trucks, SUVs and minivans, on roadways in the world. These numbers are projected to increase to 1.3 billion by 2030, and 2 billion vehicles by 2050.[55] As illustrated in Figure 1, the transport sector is almost entirely dependent on fossil fuels, particular petroleum based fuels such as gasoline and diesel fuels.[56] Biofuels provide merely around 2% of total transport energy worldwide. Land transport (road and rail transport) accounts for around 76% of the transportation energy consumption, and it contributes to around 16% of global GHG emissions, and that share is rising.[57] In particular, road transport, which accounts for, about 73% of transport

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51 United Nations Framework Convention on Climate Change (adopted 3-14 June1992, entered into force 21 March 1994) 1771 UNTS 107, art 1 [hereinafter UNFCCC] <http://unfccc.int/resource/docs/convkp/conveng.pdf> accessed 12 May 2011.

52 For more information about climate change, see, Section 3.2.4.2.

53 For more discussion about the UNFCCC, Kyoto Protocol and Copenhagen Accord, see, Section 2.4.5.1 and Section 3.2.5

54 For more information about the EU RED and US RFS, see, Section 3.3.4.

55 Mustafa Balat and Havva Balat, 'Recent Trends in Global Production and Utilization of Bioethanol Fuel' (2009) 86(11) Applied Energy 2273.

56 See also, Ayhan Demirbas, 'Political, Economic and Environmental Impacts of Biofuels: A Review' (2009) 86 Applied Energy S108.

57 Worldwatch Institute, *Biofuels for Transport: Global Potential and Implications for Sustainable Energy and Agriculture* (Earthscan 2007) xix.

energy consumption, is by far the biggest emitter in the transport sector, making road transportation the frontrunner in biofuel use.[58] It is also contended that air quality problems are caused mainly by vehicle emissions.[59] Therefore, the transport sector is linked with the issue of GHG emissions and fossil fuel consumption.

Biofuels combined with energy efficiency improvements offer a feasible alternative to dramatically reduce both the consumption of crude oil and environmental pollution generated from the transport sector. Known as a low-carbon alternative to fossil fuels, biofuels could mitigate the effects of climate change and help countries meet their commitments under the Kyoto Protocol and other international climate agreements. Biofuels are generally less toxic than conventional petroleum fuels. Biofuels can provide air quality benefits when used either as pure fuels or, more commonly, when blended with petroleum fuels.[60] Many studies reviewed find significant net reductions in CO2-equivalent emissions for both types of biofuels.[61] Benefits from ethanol and biodiesel blending into petroleum fuels include lower emissions of carbon monoxide (CO), sulphur dioxide (SO2) and particulate matter (PM).[62] Ethanol and biodiesel in the EU has been calculated to result in 15-70% GHG savings when compared to fossil fuels, while ethanol from Brazil results in over 90% GHG savings.[63] Percentages of biofuels in the fuel mix are tiny.[64] With the Kyoto Protocol's entry into force and the

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58 UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 6.

59 Kai Zhang and Stuart Batterman, 'Near-road Air Pollutant Concentrations of CO and PM2.5: A Comparison of MOBILE6.2/CALINE4 and Generalized Additive Models' (2010) 44 (14) Atmospheric Environment 1740.

60 Annie Dufey, *International trade in biofuels: Good for development? And Good for the Environment?* (International Institute for Environment and Development Policy Briefing, IIED 2007) <http://pubs.iied.org/11068IIED.html> accessed 21 March 2011.

61 Heather L MacLean and others, 'A Life-Cycle Comparison of Alternative Automobile Fuels' (2000) 50 Journal of Air and Waste Management Association 1769.

62 Ibid.

63 Bomb (n 12) 2266.

64 For biofuel share of the global fuel/energy mix, see Section 1.2.3.1.

worldwide implementation of national targets for biofuels, it is expected that by 2030 biofuels will account globally for 7% of road transport fuel use.[65] It may end up encouraging more fossil fuel consumption in the transport sector which contributes significantly to the release of GHG emissions.

Transport-related emission is particularly a sever issue in rapid emerging countries, because emissions are increasing significantly since the last century as a consequence of rapid urbanization and economic growth.[66] The combustion of petroleum based fuels has adverse impacts on the environment as well as human health. In recent years, exhaust emissions in developing countries have been growing strongly which is adversely affecting many populations. It is estimated that approximately 0.8 million annual deaths are caused from ambient air pollution in cities of developing countries.[67] For example, China's air pollution has received great attention. Ranked as second in CO2 emissions worldwide, China is confronted with severe pressure to reduce CO2 emissions. The strategy to supply energy in the form of biofuels for transport and other sectors would help enable China to achieve its climate change objectives, as the use of biofuels can lead to a reduction in harmful pollutants, including sulfur oxides (SOx), carbon monoxide (CO), and nitrogen oxides (NOx). A Chinese government report in 2008 shows a 46% reduction in SOx emissions from vehicles using E10 (a 10% blend) compared with the same vehicles running on gasoline, a 36% reduction in CO and a 12% reduction in other GHG emissions.[68] Therefore, as a green and renewable energy,

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[65] IEA, *Biofuels for Transport: An International Perspective* (n 12); Nuffield Council on Bioethics (n 1) 141.

[66] Jonathan Kohler, 'Transport and the Environment: Policy and Economic Consideration' (Foresight Intelligent Infrastructure System Project, 2006) <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.110.3296&rep=rep1&type=pdf> accessed 21 March 2011.

[67] Manoj Roy, 'Planning for Sustainable Urbanisation in Fast Growing Cities: Mitigation and Adaptation Issues Addressed in Dhaka, Bangladesh' (2009) 33 (3) Habitat International 276.

[68] Global Subsidies Initiative of the IISD, 'Biofuels – At What Cost? Government Support for Ethanol and Biodiesel in China' (IISD 2008) 40 <https://www.iisd.org/gsi/sites/default/files/China_Biofuels_Subsidies.pdf> accessed 30 November

biofuels could be a good choice for China to reduce its GHG emissions, as well as improve its air quality for the urban population.

1.2.3.3 Rural Development

The promotion of greater energy security and the mitigation of climate change combine to place biofuels at the top of many countries' most pressing agendas. IPCC (2007) highlighted the potential for biofuels to meet the growing energy needs as well as contribute to GHG emissions reduction, especially in the transportation sector.[69] They are two of the significant driving forces for biofuel research and development. Moreover, another significant driving force behind the biofuel industry development is the demand for rural development.[70] Production of biofuels from crops such as corn and wheat for ethanol and soy and rape for biodiesel provides an additional product market for farmers and brings economic benefits to rural communities.[71]

Developing countries are endowed with rich and diverse nature resources, fairly abundant land resources, and suitable temperate zones for biofuel feedstocks. It makes many developing countries have higher biomass production potential and lower production costs. It is an important prerequisite for many developing countries to put

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2011.

[69] Michel Beuthe and others, 'Transport and its infrastructure' in B Metz and others (eds), *Climate Change 2007-- Mitigation of Climate Change: Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (CUP 2007) <http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter5.pdf> accessed 21 March 2011.

[70] J C Aantjes, 'Driving Biofuels in Europe. A Research on the Interaction between External Regulation and Value Chain Governance' (MSc Thesis, Erasmus University Rotterdam 2007).

[71] Production of biofuels can also draw crops away from other uses such as food production and can increase their price. This may translate into higher prices for consumers. This is demonstrated in Chapter 4. See, Sachin Chaturvedi, 'Opportunities for Biofuel in Select Asian Economies: Emerging Policy Challenges' in ICTSD (ed), *Linking Trade, Climate Change and Energy*, (ICTSD Trade and Sustainable Energy Series, ICTSD 2006).

biofuel promotion policy into their national strategy. As a result, biofuels industries could provide new opportunities for developing countries to boost their agricultural sector and to export products with a higher added-value.[72]

Moreover, biofuels development indeed could provide the prospect of new economic opportunities for people in rural areas in oil importer and developing countries. The production and use of biofuels in developing countries have potential additional benefits, such as promotion of rural development by producing a locally generated form of energy for processing and transportation; creation of rural employment and wealth; reduction of deforestation and land degradation, as biofuels are also a substitute for the energy currently derived from wood.[73] As a crop-based energy industry, it could help to revitalize agricultural markets by increasing demand and prices for agricultural produce. In developing countries, raising rural incomes and alleviating rural hardship is a key policy priority for the government, because in these countries the economy is based on agricultural production and most people live in rural areas. For instance, in China around two thirds of China's population lives in rural areas and works in the agricultural sector. Biofuels could help build a 'new socialist countryside' by providing rural development opportunities, which would help lift incomes or absorb surplus labour force for famers in rural areas.[74] Firstly, small-scale biofuel cultivation could provide significant benefits to farmers by potentially increasing yields and incomes in rural areas. Large-scale biofuels cultivation is also good news for developing countries' rural poor, as it can provide benefits in the form of employment, skills development and secondary industry. Therefore, it might have further effect on long-term poverty

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[72] Rocio A Diaz-Chavez, 'The Role of Biofuels in Promoting Socio-economic Rural Development' in Frank Rosillo-Calle and Francis X Johnson (eds), *Food versus Fuel: An Informed Introduction to Biofuels* (Zed Books 2010).

[73] Mateete Bekunda and others, 'Biofuels in Developing Countries' in Robert W Howarth and Stefan Bringezu (eds), *Biofuels: Environmental Consequences and Interactions with Changing Land Use: Proceedings of the Scientific Committee on Problems of the Environment (SCOPE) International Biofuels Project Rapid Assessment* (Cornell University 2009) 250.

[74] Global Subsidies Initiative of the IISD (n 68) 1.

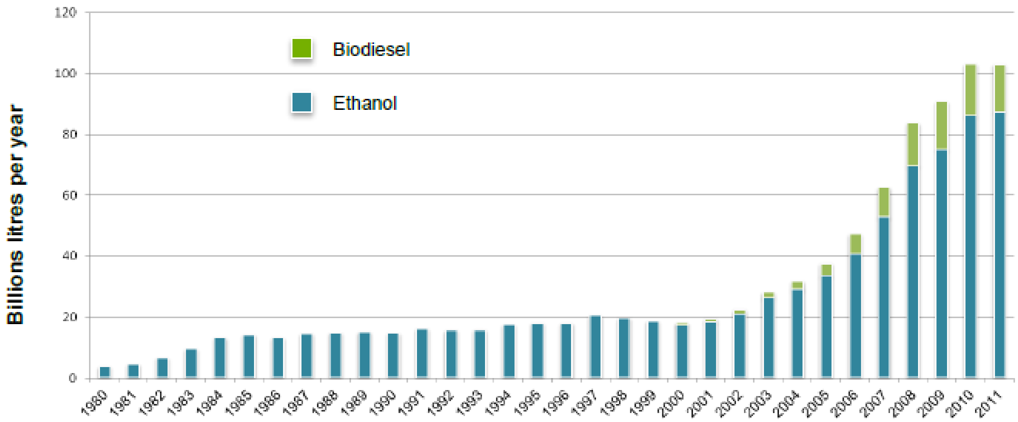
reduction.[75]

1.2.4 Where are We Now? -- Current Scenario for Biofuels

1.2.4.1 Global Biofuel Production and Market

Because of the motivations described above, a growing number of industrialised and developing countries have introduced policies to increase the proportion of biofuels within their energy portfolio. The percentage of biofuels in the fuel mix has been growing, and the trend is expected to continue in the future. Over the last decade, biofuels production has increased dramatically. (See Figure 3)

Figure 3: Global biofuel production, 1980-2011



Source: HLPE, 2012.[76]

As illustrated in Figure 3, between 2000 and 2011, fuel ethanol output experienced an increase from 16.9 billion litres a year to 88.7 billion litres, while biodiesel grew from

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[75] More discussion about biofuels and rural development can be found in Chapter Four.

[76] HLPE, *Food Security and Climate Change* (A Report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, HLPE 2012) <http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE_Reports/HLPE-Report-3-Food_security_and_climate_change-June_2012.pdf> accessed 12 February 2013.

0.8 to 22.4 billion litres.[77] Ethanol is by far the most widely used biofuel for transportation worldwide.[78] Ethanol made up 93% of global biofuels production in 2006, while the remaining 7% was biodiesel.[79] Global ethanol production doubled between 2006 and 2011. The US and Brazil together account for 87% (61% and 26%, respectively) of global production, but other countries also have significant and growing industries.[80] The top five ethanol producers in 2012 were the US, Brazil, China, Canada, and France.[81] While biodiesel large-scale production began only in the 1990s. Since then production has increased steadily, reaching a record 3.7 billion litres in 2005, 14.7 billion litres in 2009, and finally 22.4 billion litres in 2011. Biodiesel now accounts for about 20% of global biofuel production.[82] Despite strong growth of 7% in biodiesel production in the last couple of years, global volumes of biodiesel production, however, is still fairly small compared to bioethanol.[83] The increment in production has been driven by governmental interventions, as biofuel production is unprofitable in most producing countries and it needs to be promoted via tax exemptions, subsides or other forms of financial incentives. The OECD estimated that in its member countries biofuel subsidies amounted to $ 15 billion in 2007.[84] As the only direct substitute for fossil fuels, it is expected biofuels continue to grow in the future.

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77 See also, IEA, *World Energy Outlook 2006* (IEA 2006) 390 <http://www.worldenergyoutlook.org/media/weowebsite/2008-1994/WEO2006.pdf> accessed 21 March 2011.

78 Ibid.

79 UNCTAD, *The Emerging Biofuels Market: Regulatory, Trade and Development Implications* (UNCTAD Report UNCTAD/DICT/TED/2006/4, UNCTAD 2006) <http://unctad.org/en/Docs/ditcted20064_en.pdf> accessed 21 March 2011.

80 Tom Prugh, 'Biofuel Production Declines' in The Worldwatch Institute (ed), *Vital Signs Volume 21: The Trends That Are Shaping Our Future* (Island Press 2014) 15.

81 Ibid.

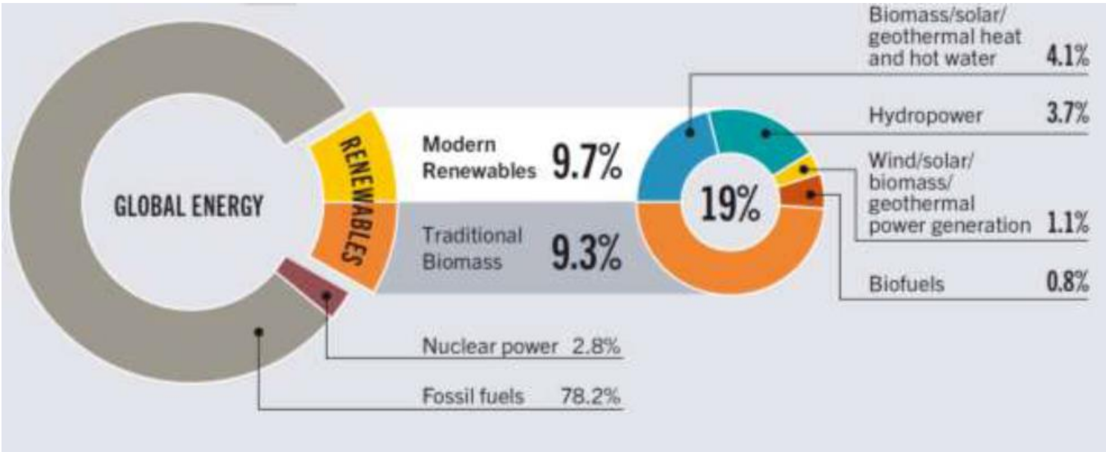
82 Ibid.

83 Ibid; See also, UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 9.

84 Giovanni Sorda, Martin Banse and Claudia Kemfert, 'An Overview of Biofuel Policies across the World' (2010) 38 Energy Policy 6977.

In 2010, global consumption of biofuels represented 3% of total fuel consumption, which is 55 million tons oil equivalent - Mtoe. This total figure for biofuels breaks down into 73% bioethanol and 27% biodiesel.[85] However, percentages of biofuels in the total global final energy consumption mix are tiny. Fossil fuels still remain dominant, accounting for more than 78% of global final energy consumption by the end of 2011. While renewable energy supplied an estimated 19% of global final energy consumption, from which merely 0.8% came from biofuels.[86]

Figure 4: Estimated renewable energy shares of global final energy consumption in 2011.



Source: UNCTAD, 2013.

With regards to the biofuel trade, trade amounts remained relatively small compared to overall biofuel production. Ethanol and biodiesel contribute much of biofuel trade as the most established biofuels. Ethanol has been traded for decades and was mostly characterized by fuel trade *per se*. In contrast, biodiesel trade is less established and has been encouraged by increases in policies and incentives that promote biofuels, particularly in the EU.[87] Biodiesel trade was to a large extent made of feedstock trade,

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[85] IFP Energies Nouvelles, 'Biofuels Update: Growth in National and International Markets' (IFP Energies Nouvelles 2012) <http://www.ifpenergiesnouvelles.com/> accessed 7 July 2014.

[86] UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 2.

[87] J Heinimo and M Junginer, 'Production and Trading of Biomass for Energy -- An Overview of the

such as soybeans and vegetable oil. Until recent, there had not been much scientific analysis on the net international trade volumes of biofuels. According to a UNCTAD report 2014, in the year of 2012, bioethanol trade amounted to 12 billion litres while biodiesel trade represented about 2 billion litres.[88] Therefore, the international biofuel market still remains small, very little biofuel enters international markets since at least 90% of biofuel production is consumed domestically.

However, trade in biofuels is expected to expand rapidly over the next decade, mainly with exports from developing countries to the US and EU.[89] It is mainly because developed countries will not have the required available area, and therefore not the sufficient feedstocks, to supply their internal markets. In addition, the costs associated with biofuel production in developed countries are very high. Subsidies and tax exemptions are costly for taxpayers and governments.[90] In the US, for instance, tax credits represented an average loss of $2.2 billion per year for the 2006 - 2010 period, which is costly for the federal government.[91] As a result, governments in developed countries will need to look to other countries to fill the gap, to create the conditions both at global and national levels for increased production and trade, in turn to meet their ambitious targets. In the Netherlands, for example, it is expected that 80% of the necessary feedstock will be imported due to the small arable crop area available and the ambitious biofuels goal set by the government.[92]

Global Status' (2009) 33 (9) Biomass and Bioenergy 1310.

[88] UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 66.

[89] However, it is worth noting that South-South trade and transfer of technology is also taking place between numerous developing countries around the world, especially between Brazil, China and India. See, ibid.

[90] See also, Section 4.4.2.

[91] Marcos J Jank and others, 'EU and US Policies on Biofuels: Potential Impacts on Developing Countries' (GMF Paper Series, The German Marshal Fund of the United States 2007) 25 <http://www.gmfus.org/publications/eu-and-us-policies-biofuels-potential-impacts-developing-countries> accessed 21 March 2011.

[92] Roger Wentzel, 'Netherlands Oilseeds and Products Biofuels Situation in the Benelux' (Global Agriculture Information Network Reports NL6005, USDA Foreign Agricultural Service, GAIN

1.2.4.2 Who are the Main Players?

United States

As the world's biggest petroleum consumer, the US utilizes over 3.2 billion litres (840 million gallons) of petroleum products each day. Although the US itself is an oil producer, 64% of its oil consumption needs to be imported from other countries.[93] The concern over energy security is the most direct and powerful motivation for biofuel development in the US. In 2005, the Energy Policy Act (EPA) set a target of 28.4 billion litres consumption of renewable fuels by 2012, which represents around 5% of gasoline consumption projected that year. Moreover, the year of 2007 called for a mandatory fuel standard that will require 132.5 billion litres of renewable and alternative fuels by 2017, nearly 5 times the 2012 target, and which would displace 15% of the projected annual conventional gasoline use.[94] These two Renewable Fuel Standards (RFS1&2) mandates created a guaranteed market for the product.[95] With other sorts of government policies, such as heavy tax incentives, subsidies and loans, the RFS mandates contributed to an incredible increase in US production.[96]

The biofuel (mainly ethanol) industry in the US is entirely based on corn. The growth rate of ethanol fuel production and consumption has been extremely elevated in the past years. The US is now the world's largest producer and consumer, accounting for 61% of world bioethanol production in 2012.[97] Bioethanol started to be produced from corn in the early 1970s, but only recently began to be more widely used. Between 2002 and

2006) <http://apps.fas.usda.gov/gainfiles/200602/146176725.pdf> accessed 21 March 2011.

93 Jank, 'EU and US Policies on Biofuels: Potential Impacts on Developing Countries' (n 91) 9-10.

94 Ibid.

95 For more information about US RFS, see Section 3.3.4.4.

96 For all sorts of US biofuel policy, see Section 4.4.2.

97 Prugh (n 80) 15.

2006, production increased by an annual average of 23%, while consumption has grown by 27% per year. As a result, ethanol blend in gasoline rose from 1.5% in 2002 to 3.8% in 2006, representing a consumption of 20.4 billion litres.[98] From 2006 to 2012, the bioethanol production in the US increased from 18 billion litres to 50 billion litres.[99] Corn also plays an important role as feedstock for biodiesel production in the US. In the same period, the US biodiesel production increased from 0.9 billion litres to 4 billion litres.[100] The corn-based biofuel development in the US has had a strong impact on feedstock prices, and a negative effect on the global food market and the food security of developing countries.[101]

Despite the rapid increase in production, ethanol consumption has been outpacing production in the last few years. In 2012, biofuels accounted for roughly 7.1% of total transport fuel consumption in the US.[102] Moreover, the number of vehicles using biofuels is growing. It is almost certain that consumption levels in the US will be continually increasing, and the production capacity will probably not see any significant increases without a new technological breakthrough.[103] As a result, it may open a window of opportunity for developing countries that are interested in developing a significant export market for their biofuel industry.[104]

European Union

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[98] Jank, 'EU and US Policies on Biofuels: Potential Impacts on Developing Countries' (n 91) 10.

[99] UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1).

[100] Ibid.

[101] Detailed analysis about this issue is conducted in Chapter Four.

[102] UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 13.

[103] Ibid.

[104] However, it is also argued that the heavy subsidy for biofuel and its feedstocks in the US formulate severe barriers for developing country producers for accessing the US market. The issue of biofuel subsidy is fully addressed in Chapter Four.

The EU is the world's biggest producer and user of biodiesel, accounting for about 95% of global biodiesel production. Climate change mitigation and the environmental sustainability concerns are strong motivations for biofuel development in the EU. The EU biofuel industry received significant support for its climate policy. In 2007, the European Commission proposed that the minimum target for biofuels for 2020 should be 10% of transport petrol and diesel.[105] This target was subsequently mandated in the EU Renewable Energy Directive (RED) of 2009. Moreover, the Fuel Quality Directive (RFQD) also required Member States to reduce life cycle GHG emissions of transport fuels by 6% by the end of 2020. The EU RED and RFQD have indirectly affected the biofuels market.[106]

The take-up of biofuels in the EU started off from a limited number of Member States. By 2006, more than 80% of total EU biofuels were produced by only four Member States namely Germany, France, Italy and Spain.[107] Germany produced over half of the EU's biodiesel. France and Italy were also important biodiesel producers, while Spain is the EU's leading ethanol producer.[108] Germany, France, Austria and Sweden accounted for 84% of the total biofuel consumption at that time.[109] But after that, biofuel production and consumption was increasing rapidly throughout Europe pushed by a variety of political support, high oil prices and consumer awareness. EU biodiesel

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105 EU leaders endorsed an integrated approach to climate and energy policy in 2007 by setting a package of targets to be met by 2020, collectively known as the '20-20-20' targets. For more information, see, European Commission, 'Renewable Energy Road Map Renewable Energies in the 21st Century: Building a More Sustainable Future' (European Commission 2007) <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0848:FIN:EN:PDF> accessed 3 July 2012.

106 More European biofuels policy can be found in Section 3.3.4.3 (regulatory policy of biofuel sustainability) and in Section 4.4.2 (supportive policy for biofuel production and market).

107 Tobias Wiesenthal and others, 'Biofuel Support Policies in Europe: Lessons Learnt for the Long Way Ahead' (2009) 13 Renewable and Sustainable Energy Reviews 789, 790.

108 UNCTAD, *The Emerging Biofuels Market: Regulatory, Trade and Development Implications* (n 79); Demirbas, 'Political, Economic and Environmental Impacts of Biofuels: A Review' (n 56) S109.

109 Wiesenthal (n 107) 790.

production capacity has been increasing by an average of 81% annually since 2002. In 2004, the EU production of biofuels amounted to around 2.9 billion litres with biodiesel totalling 2.3 million litres.[110] Growth in biofuel consumption between 2005 and 2006 almost reached 80%, leading to a share of biofuels in transport fuel consumption of 1.8% in 2006.[111] Biodiesel represents about 82% of the EU biofuel market. More than 80% of EU biofuel production is manufactured from rapeseed oil. In 2004, EU biodiesel production used 27% of EU rapeseed crop.[112] However, fierce competition within the food sector has dramatically increased the price of rapeseed oil and it has begun to be replaced by soya oil and palm oil. It still cannot satisfy the production level and the EU binding targets of biofuels, as the EU does not have geographical conditions.[113] Depending on the availability of vegetable matter for conversion, it is estimated that biodiesel could cover as much as 10% of the road transport requirements in the EU by 2020. The EU production of biofuels amounted to around 14.3 billion litres in 2012, with ethanol totalling 4.6 billion litres and biodiesel 9.7 billion litres.[114] Regarding consumption, biodiesel consumption in the EU increased from 5.5 billion litres to 12 billion litres in the period between 2006 and 2012. In the same period, the EU ethanol consumption increased from 1.7 billion litres to 5.6 billion litres.[115] The EU is not only the world's biggest biodiesel producer but also the largest net importer of biofuels, especially biodiesel.[116] A significant amount of biofuels used by the EU needs to be imported from developing countries.

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[110] Demirbas, 'Political, Economic and Environmental Impacts of Biofuels: A Review' (n 56) S109.

[111] Wiesenthal (n 107) 790.

[112] Ibid. See also, IEA, *World Energy Outlook 2006* (n 77).

[113] The European Commission proposed in 2007 targets that: supply 20% of energy needs by 2020 from renewable energy sources, including the use of 10% renewable energy in transport. See, Section 4.4.2; Pantelis Capros and others, 'Analysis of the EU Policy Package on Climate Change and Renewable' (2011) 39 Energy Policy 1476.

[114] UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 16.

[115] Ibid.

[116] Ibid, 17.

Brazil

Brazil has been the most viable and efficient ethanol producer globally for decades. It is now the second largest bioethanol producer after the US.[117] Brazilian experience in ethanol production dates back to the subsidies in the 1930s. However, it was not until the 1970s that ethanol started to replace a significant share of petrol in transport fuel supply.[118] Its biofuels industry has been propelled by appropriate government policy interventions and massive investment in infrastructure and research. In 1975, the initial programme in Brazil was launched to provide subsidies to the sugarcane and ethanol industry, as a reaction to the oil crisis and aimed to replace gasoline with blends of bioethanol produced from sugarcane.[119] In the early 1990s, Brazil liberalised its biofuels market by reducing subsidies on ethanol blend gasoline producers, changing the monopolistic distribution way, and liberalising bioethanol prices. However, the government still fixes minimum rates of blending with petrol oil which is currently at 20% to 25%.[120] In early 2005 the government passed a bill, making the production of a 2% biodiesel fuel blend made from castor oil and soya oil compulsory by 2007. This obligation will be increased to 5% to 20% by 2013 and 2020, respectively. The current policies supporting biofuels include blending mandates, tax breaks, low-interest government loans and licensing of biofuel producers to ensure quality standards are met.

Production cost and prices for biofuels cannot compete with petrol and diesel without

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[117] Brazil has been the world's largest ethanol producer for decades and was surpassed by the US in 2006.

[118] Lamers (n 2) 2660.

[119] Annie Dufey, *Biofuels Production, Trade and Sustainable Development: Emerging Issues* (Sustainable Markets Discussion Paper 2, IIED 2006) <http://www.iied.org/pubs/pdf/full/15504IIED.pdf> accessed 12 March 2011. The initial programme was called the Pro-Alcool program. For more information about government support policy in Pro-Alcool and current policies supporting biofuel development in Brazil, see Section 4.4.2.

[120] Arnaldo Walter and others, 'Perspectives on fuel ethanol Consumption and Trade' (2008) 32 Biomass and Bioenergy 730.

heavy subsidy in most producing countries. The only biofuels that are price competitive presently are bioethanol in Brazil produced from sugarcane.[121] Ethanol production in Brazil is primarily through commercial farming, with little input from local stakeholders. Sugarcane production jumped from 5.6 Mt in 1950 to more than 500 Mt per year in 2008.[122] Brazil's biofuel programme has become a role model for developing countries worldwide aiming at the establishment of domestic biofuel production. Brazil has been the most successful in biofuel expansion among developing countries and globally due to its historic ethanol production and use for road transportation, as well as the competitive advantage from the presence of feedstock, availability of land, good climate conditions, technology, capital, know-how, and a relatively cheap labour force.[123] However, on the other hand, Brazil has several environmental and social challenges to address if it is to continue increasing its already significant production. Brazilian ethanol expansion has met some international criticism due to its potential impact on land-use change, air pollution, workers' rights and other sustainability concerns.[124]

All in all, the US, EU and Brazil are the top three players in the international biofuel market. Currently, most trade of biofuels in the world happened between the markets of the US, the EU and Brazil. Between 2006 and 2013, the trade relationship between the US, Brazil and the EU became the backbone of the international biofuels market.[125] Moreover, it is observed that trade flows between the three dominant markets are

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[121] Bomb (n 12) 2258.

[122] Bekunda (n 73) 260.

[123] Perrihan Al-Riffai, Betina Dimaranan and David Laborde, 'European Union and United States Biofuel Mandates: Impacts on World Markets' (Inter-American Development Bank 2010) <http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=35529623> accessed 12 December 2010.

[124] Edward Smeets and others, 'The Sustainability of Brazilian Ethanol – An Assessment of the Possibilities of Certified Production' (2008) 32 Biomass and Bioenergy 781.

[125] UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 67- 68.

becoming stronger.[126] The strong trade relationship would raise concerns over the impact on world food security, heavy subsidy and support for domestic markets, as well as the environmental sustainability of biofuels.[127]

1.2.4.3 Potential and Perspectives of Biofuels in Developing Countries

Today, the major players in the world biofuel markets are mainly developed countries (with Brazil being the main exception). However, in the longer term, it is estimated that Asia and Africa are likely to have the largest potential as consuming and exporting markets.[128] It is because in many of these countries, there is significant potential for biofuels production as tropical and subtropical feedstocks for biofuels usually have better energy and environmental balances than crops grown in countries in the Northern Hemisphere.[129]

As concerns about high oil prices and energy independence also affect developing countries, energy security is a strong driver force for developing countries starting their biofuel industry. Countries, like China, India, Indonesia, Malaysia, the Philippines, Thailand and most Sub-Saharan countries, are also focused on reducing their dependence on oil, and base their resources on using surplus agricultural capacity, substituting part of their domestic consumption of fossil fuels.[130] Biofuel programs are established in these countries to develop an internal market without the need for imports. Some of them will also be able to export biofuels or biofuel feedstocks to developed countries.[131] In addition, agricultural-economic prospects and rural development is

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126 Ibid.

127 These issues are examined further in the following chapters (Chapter Three, Four and Five).

128 Jank, Géraldine Kutas, Luiz Fernando do Amaral and André M Nassar, 'EU and US Policies on Biofuels: Potential Impacts on Developing Countries' (n 91)15.

129 Ibid.

130 Ibid.

131 Ibid.

another direct motivation that contributes to a mounting interest in biofuels production and use across Global South, especially in Africa and Southeast Asia.[132] Biofuels development can contribute to agricultural development by not only diversifying their production but also alleviating poverty by generating employment in rural areas.[133] Biofuel potential in terms of energy security and agriculture development has more significant meaning for developing countries than developed countries.[134] What is striking is that environmental concerns have played only a minimal role.[135] Therefore, compared with climate change mitigation, energy security and rural development are more direct motivations for developing countries in considering biofuels.[136]

In Africa, fuel ethanol production increased from 70 to 135 million litres from 2006 to 2011. Biodiesel production started in 2008 and it increased from 2.3 to about 11.7 million litres.[137] In Africa, biofuel consumption is about 40% of the production and its surplus is exported.[138] Compared with biofuel markets of the US, EU and Brazil, the African biofuel market is still modest and mostly dominated by several southern and eastern African countries, such as Madagascar, Zambia and Tanzania.[139] In 2012,

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132 Thematic Group 7 of the SDSN, *Solutions for Sustainable Agriculture and Food Systems: Technical Report for the Post-2015 Development Agenda* (Sustainable Development Solutions Network 2013) <http://unsdsn.org/wp-content/uploads/2014/02/130919-TG07-Agriculture-Report-WEB.pdf> accessed 3 June 2014.

133 This discussion is subject to the content of Chapter Four.

134 Alexandros Gasparatos and others, *Biofuels in Africa: Impacts on Ecosystem Services, Biodiversity and Human Well-being* (UNU-IAS Policy Report, United Nations University 2012) <http://archive.ias.unu.edu/resource_centre/Biofuels_in_Africa.pdf> accessed 3 September 2013.

135 Janice S H Lee, John Garcia-Ulloa and Lian Pin Koh, 'Biofuel Expansion in Southeast Asia: Biodiversity Impacts and Policy Guidelines' in Alexandros Gasparatos and Per Stromberg (eds), *Socioeconomic and Environmental Impacts of Biofuels: Evidence from Developing Nations* (CUP 2012) 192.

136 However, the issue of GHG emission is significant and has caught the attention of policy makers in some emerging countries.

137 UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 23.

138 Ibid.

139 UNCTAD, 'The Global Biofuels Market: Energy Security, Trade and Development' (n 10).

Africa produced 125 million litres of ethanol which represents 0.59% of the Brazilian production in the year.[140] Although biofuel production is seen as a high potential sector in Africa, the production of biofuels in Africa remains marginal and does not follow a continuous growth pattern.

There are several obvious challenges faced by its biofuel sector. First, a significant challenge which hinders biofuel production in Africa comes with water and soil limitation.[141] For example, jatropha is a major feedstock for biofuel production in Africa (as well as sugarcane). Many jatropha cultivation projects have been abandoned in Africa because they require better quality soils and greater water intake than initially expected so as to generate sufficient returns on investment.[142] Another import challenge is related to widespread customary land tenure regimes and poor farmers' land-right losing. Existence of communal lands creates uncertainties regarding the ability of local communities to control and benefit from biofuels projects.[143] Moreover, the African biofuel industry faces additional challenges, including lack of adequate development capacity, direct foreign investment, and government financial support. The greatest challenge is that the region is still lacking an adequate regulatory framework. Until 2012, only a few countries had developed national strategies and action plans to promote and regulate the expansion of biofuels. Without complete legislative and policy frameworks to regulate biofuel development, there is a risk that

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[140] UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 27.

[141] HLPE, *Biofuels and Food Security* (A Report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, HLPE 2013) 13 <http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE_Reports/HLPE-Report-5_Biofuels_and_food_security.pdf> accessed 26 January 2015.

[142] For more information about biofuel feedstock plantation and water use, see Chapter Three.

[143] In Mozambique and Tanzania, for instance, some biofuels projects lead to the displacement of poor families. The Land-right issue is a significant socio-economic issue associated with biofuel production in Africa, but it is not the subject matter of this thesis. For more information, see Prosper B Matondi, Kjell Havnevik and Atakilte Beyene(eds), *Biofuels, Land Grabbing and Food Security in Africa* (Zed Books 2011).

biofuels industrialization could have negative impact on the environment, or further exacerbate poverty and food insecurity in Africa.[144]

In Asia, the picture of biofuel development is not as unified as in Africa. Among all these countries, China has quickly established itself as Asia's leading producer of biofuels, having introduced programmes in 2000. The fact that ethanol is by far the most dominant biofuels in the market, compared with biodiesel, is largely a result of China being the world's 3rd largest producer of ethanol after the US and Brazil.[145] In China, a significant challenge to biofuel production comes from the issue of 'food versus fuel'. In 2008, Chinese government decided that food production should always be given priority over biofuel production in China to meet national food security requirements. Consequently, inedible crops and a variety of non-food crops such as jatropha are already being used or explored for its biofuel potential.[146] China is a potentially strong market for ethanol, as it has E10 requirements in place in nine provinces and its ethanol industry focuses largely on non-food feedstock materials.[147] The contribution of China to the biofuel industry in production and utilization can dramatically change the biofuel market worldwide, as well as contribute to carbon cuts, as their automotive market is rapidly increasing with a soaring proportional rise of GHG emissions.

Moreover, Malaysia, Indonesia, the Philippines and Thailand also have outstanding performance in biofuel development among Asian countries, as these countries have abundant oil-producing potential.[148] Particularly, Malaysia and Indonesia both belong

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[144] Donald Mitchell, *Biofuels in Africa: Opportunities, Prospects, and Challenges* (World Bank 2011) 143. More issues about rural development and food security are further examined in Chapter Four.

[145] China is the world's largest food oil importer and is unlikely to develop vegetable oil- based biodiesel production.

[146] Qiang Wang, 'Time for Commercializing non-food biofuel in China' (2011) 15 Renewable and Sustainable Energy Reviews 621.

[147] Walter (n 120). For more discussion about biofuel production and food market, see Chapter Four.

[148] IFP Energies Nouvelles (n 85).

to the category of countries which have made biofuels a factor in their economic development. While Malaysia and Indonesia are rather new players on the global biodiesel market, they have a long history of palm oil production and trade. These two nations are effectively the world's leading producers of palm oil, and both of the governments became significantly interested in palm oil derived biodiesel production around 2006 and have developed a significant export market built essentially on supplying raw materials to the EU.[149] Palm oil produced in the tropics in Southeast Asia has high oil yields; and hence entails quite low production costs and contributes to the expansion of biofuel industry in this area.[150] However, palm oil production in Southeast Asia is located within the tropics, where the majority of the world's remaining and most imperilled biodiversity is located.[151] This is a worrying sign for many tropical biologists, because without a proper regulatory framework and responsible management practices, the rapid expansion of biofuel feedstock plantation in tropical forest could easily have a negative impact on the environment, like threaten the native biodiversity.[152]

The biofuel policies of developed countries, especially the EU and the US, are partly driving and defining biofuel programs in developing countries. Besides Malaysia and Indonesia, the biofuel programs in African countries such as Ethiopia, Mozambique and Tanzania are also (in part) export-driven and prompted by investment from external agencies.[153] On the contrast, the influence of external policies and export-driven biofuel production is less well defined in emerging economies, such as China and India. To some extent, the current national policies enacted by the major biofuels consumers

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[149] Steven Lim and Lee Keat Teong, 'Recent Trends, Opportunities and Challenges of Biodiesel in Malaysia: An Overview' (2010) 14 Renewable and Sustainable Energy Reviews 938.

[150] Lee, 'Biofuel Expansion in Southeast Asia: Biodiversity Impacts and Policy Guidelines' (n 135) 192.

[151] Ibid.

[152] For more discussion about environmental impacts of biofuel plantation, such as land use change, deforestation and biodiversity loss, see Chapter Three.

[153] Bekunda (n 73) 249.

in the developed world offer opportunities to some developing countries. However, it is argued that, in fact, the EU and the US have both established policies to promote and protect their national biofuel production through a variety of trade policy measures, such as tariffs, subsidies, as well as technical norms, which seriously reduce the export opportunities for developing countries.[154]

Biofuel production opportunities in developing countries are being fuelled by the large areas of arable land as well as good climate conditions (tropical) with a decent amount of rainfall in large parts of temperate zones where biomass production potential is much higher and production costs can be lower.[155] However, as discussed in the above, most of the main players in biofuel markets currently are developed countries. Developing countries' performances are still not as good as we expected. Moreover, many of the biofuel programmes in developing countries are being launched without considering and enacting long-term polices, generating a variety of sustainability problems. Therefore, it is argued in this research that, a comprehensive and coherent legislative and policy framework is needed for developing countries to regulate their biofuel industries developing sustainably in the long term. In order to develop a coherent regulatory framework, the thesis has identified key issues in four areas, namely intellectual property, the environment, agricultural economy and trade of biofuels. These will be discussed in the following chapters.

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[154] It will be discussed in Chapter Four and Chapter Five.

[155] Christopher B Field, J Elliott Campbell, and David B Lobell, 'Biomass Energy: The Scale of the Potential Resource' (2008) 23(2) Trends in Ecology & Evolution 65.

CHAPTER TWO BIOFUELS, INTELLECTUAL PROPERTY RIGHTS AND TECHNOLOGY TRANSFER TO DEVELOPING COUNTRIES

2.1 Introduction

Hard science is a key motivation for promoting a deliberate move to biofuel industry. The rapid development of the biofuel industry is result of the recent scientific breakthroughs in genomics and bioengineering.[156] Current biofuels (mainly the first-generation biofuels) have caused a variety of problems in the environmental, economic and societal aspects. With this in mind, there is currently a great deal of impetus to create new generations of biofuels. It is hoped that the development of new biofuel technology can help to circumvent the shortcomings identified in some of the current biofuels established today.

In order to make advancements, low carbon technology must play a larger role in the development of a sustainable biofuel industry, and intellectual property rights (IPRs) management must be addressed. With increased biofuel technology-related patent applications, the management of agricultural-energy biotech IPRs affect both developed and developing countries. Tensions exist between strong IP protection systems in industrialized nations and the rights of access to the inventions and technologies essential to the basic welfare of the public (climate change mitigation and environmental protection) in developing countries. International efforts are needed to bridge these disparate IP management paradigms to facilitate the transfer of biofuel technology from the industrialized world to developing countries.

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[156] Ramasamy Mannan, 'Intellectual Property Landscape and Patenting Opportunity in Biofuels' (2009) 16 Journal of Commercial Biotechnology 33; Allison A Snow and Val H Smith, 'Genetically Engineered Algae for Biofuels: A Key Role For Ecologists' (2012) 62(8) BioScience 765.

This chapter is structured in three parts. The first part introduces the most prominent developments in biofuel science and technologies, which are expected to help mitigate the problems associated with current biofuel industry. Before the discussion, it is worth noting that there is a large range of biofuel feedstocks and relevant new technologies. Each of them has its own problems and challenges at different stages in the production pathway. This chapter covers some main feedstocks and the related issues, such as lignocellulosic biofuels and algal biofuels. The coverage is illustrative rather than exhaustive. The second part introduces the emerging IP landscape of biofuel sector, particularly focusing on patenting opportunities in the biofuel industry. It explores the relationship between IP protection and the biofuel innovation and biotechnology transfer. The last section focuses on the issue of IPRs and the transfer of biofuel technologies to developing countries in the context of climate change and sustainable development.

2.2 Scientific Development in Biofuel Industry

2.2.1 Introduction

A recent explosion of knowledge in the areas of plant and microbial biotechnology significantly promoted the current development of the biofuel industry.[157] In the last few decades, essential technical skills were developed to a quite high level enabling the genetic make-up of microbial organism and crop plants to be precisely manipulated.[158] These technological breakthroughs are prerequisites for the

[157] Lawrence P Wackett, 'Microbial-based Motor Fuels: Science and Technology' (2008) 1 (3) Microbial Biotechnology 211.

[158] Petra Stamm and others, 'Manipulation of Plant Architecture to Enhance Lignocellulosic Biomass' [2012] AoB Plants <http://aobpla.oxfordjournals.org/content/2012/pls026.full> accessed 30 June 2013.

development of biofuels, especially for the advanced biofuels. Although the use of agricultural and forest residues has a role in the initial adoption of cellulosic biomass technologies, the application of biotechnology to some plant species, such as perennial grasses and algae, could result in a more environmentally friendly, societal desirable and economically competitive biofuel feedstock, and will enable the biofuel industry to scale to a point where it can meet sustainable requirements of environmental friendly, societal desirable and economic viable.[159]

In the literature, there is no uniform definition of 'biofuel technology', but usually it is referred to as part of a climate-friendly/related technology, low carbon technology, environmentally sound technology (EST), or agricultural biotechnology. Biofuel industry involves a large variety of feedstocks, and the production processes are complex and comprehensive, as a result, the related technologies are various as well. Within a relatively short period of time, biofuel development has advanced from first generation biofuels to second-generation, third-generation and even future-generation biofuels. However, it is worth noting that the structure of biofuel itself does not change from generation to generation. The only thing that changes is the source from which the biofuel is extracted.[160] Each generation has its own advantages and disadvantages in relation to different environmental and social-legal issues. Therefore, in this section, different generations of biofuel technologies and feedstocks are reviewed and examined to set a baseline of this research in an effort to distinguish a variety of issues in the following sections and chapters.

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[159] Richard Hamilton, 'Biotechnology for Biofuels Production' (The Aspen Institute Energy and Environment Program Articles, Wye Woods, March 2015) <http://www.aspeninstitute.org/sites/default/files/content/docs/ee/EEEethanol5.pdf> accessed 30 July 2015.

[160] John A Christian II, 'Feasibility of Second and Third Generation Biofuel in General Aviation: A Research Report and Analysis' (2014) 1(4) McNair Scholars Research Journal <http://commons.erau.edu/mcnair/vol1/iss1/4/> accessed 17 January 2015.

2.2.2 First-Generation Biofuels: Production Chain and Traditional Technology

The start of biofuel development came with the first-generation of renewable fuel sources. The first-generation biofuels for the transportation sector commonly refer to liquid ethanol and biodiesel produced from edible agricultural resources, including starches, sugars, animal fats and vegetable oils.[161] Corn, wheat and sugar cane are the most commonly used feedstock source for first-generation biofuels. Other crop-based feedstocks include sugar beets, rapeseed, and soybeans.

There are three main stages involved in producing biofuels: upstream stage, midstream stage and downstream stage.[162] The upstream stage refers to the stage of feedstock production, in which energy crops such as corn, soybean, sugar cane or oilseed plant are growing and harvesting using established agricultural practices and technologies. After the harvesting, those feedstocks then need to be stored and transported to the conversion facility.[163] Midstream stage is about converting the feedstocks into biofuels. Ethanol production from corn grain is achieved either by a wet milling or dry milling process.[164] In the wet milling process, the feedstock is firstly soaked in water to separate the grain into its component parts such as starch, protein and kernel fibres. Then the separated parts need to be subject to enzyme digestion to be broken down to glucose.[165] This process is referred to as saccharification.[166] In the dry milling process, the corn grain needs firstly to be ground into fine powder, and then to be liquefied to produce a mash. The resulting mash needs to be subjected to high temperatures, and enzymes are added to break down the starch into glucose. This process is called the

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161 Ibid, 6.

162 Nuffield Council on Bioethics (n1) 25.

163 Ibid.

164 Mannan (n 156) 33.

165 Ibid.

166 Ibid; See also, S N Naik and others, 'Production of First and Second Generation Biofuels: A Comprehensive Review' (2010) 14 Renewable and Sustainable Energy Reviews 584, 585.

fermentation process.[167] Biodiesel, with its chemical name of fatty aid methyl or ethyl ester (FAME), is made from plant oils or animal fats using the process of transesterification.[168] The last stage, the downstream stage involves blending, distributing and selling biofuel end products. In this stage, biofuels usually need to be blended with petrol or gasoline.[169]

The transesterification for biodiesel and the saccharification and fermentation process for ethanol production have been in existence for quite some time. The production of first-generation biofuels, such as sugarcane ethanol in Brazil, corn ethanol in US, oilseed rape biodiesel in Germany, and palm oil biodiesel in Malaysia, have been characterised by mature commercial markets and well understood technologies. Current research and development (R&D) efforts in first-generation biofuel have mainly focused on improving the efficiency of the overall process with an eye to reducing costs.[170]

The first-generation biofuel products have been widely commercialized because the production technologies are well developed. Biofuel production in 2012, was 88.2% of biodiesel (mainly from rapeseed and soybean) and 99.93% of ethanol production (largely produced from sugarcane and corn) both deriving from the first-generation of biofuels.[171] However, they have a number of associated problems or limitations. From the environmental aspect, firstly, they are quite controversial as purported 'green

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[167] Ibid.

[168] Nuffield Council on Bioethics (n1) 25.

[169] For more information about technologies for the first-generation biofuels processing, see also, Hannes Schwaiger and others, *Technologies to Produce Liquid Biofuels for Transportation: An Overview* (2011) Center for International Forestry Research Working Paper 72 <http://www.cifor.org/publications/pdf_files/WPapers/WP72CIFOR.pdf> accessed 30 July 2013; Sunggyu Lee and Y T Shah, *Biofuels and Bioenergy: Processes and Technologies: Green Chemistry and Chemical Engineering* (CRC Press 2012) 9-14.

[170] Mannan (n 156).

[171] Vladimir Strezov, 'Properties of Biomass Fuels' in Vladimir Strezov and Tim J Evans (eds), *Biomass Processing Technologies* (CRC Press 2014) 26.

energy', because some biofuels can produce negative net energy gains, releasing more carbon in their production than their feedstock's capture in their growth.[172] Therefore, they may not reduce GHG emissions, or only provide limited GHG reduction benefits.[173] Secondly, problems associated with first-generation biofuels concern the large amounts of arable land required for crops and low land-use efficiency.[174] It is demonstrated that starch-based first generation biofuels have the lowest land-use efficiency; sugar-based biofuels are better, with about double of the land-use efficiency. Second-generation biofuels provide an additional increase of 50% or more in land-use efficiency.[175] There is much debate over their long-term sustainability and their potential negative impacts on the environment, such as deforestation, peat land conversion and threats to biodiversity.[176] From the societal aspect, the most contentious issue with first-generation biofuels is it risks food security and affordability, as the first-generation biofuel production process involves the use of large land area and food crops.[177] This issue has generated much controversy in many countries, especially where the limited area of arable land and grain reserves contribute to skyrocketing food prices. The negative impact it has on food security makes first-generation biofuel a less appealing option as a long term solution to fossil fuels.[178] From the energy balance aspect, first-generation biofuels have generally lower energy performance than second-generation biofuels. It means that first-generation biofuels

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172 Ibid.

173 Ralph Sims and others, 'From 1st and 2nd Generation Biofuel Technologies and Current Industry Activities' (IEA 2008) 6 <http://www.iea.org/publications/freepublications/publication/2nd_Biofuel_Gen_Exec_Sum.pdf> accessed 24 October 2012.

174 Ibid.

175 UNCTAD, *Biofuel Production Technologies: Status, Prospects and Implications for Trade and Development* (UNCTAD Report UNCTAD/DITC/TED/2007/10, UNCTAD 2008) vii <http://www.princeton.edu/pei/energy/publications/texts/Biofuels-Status-and-Prospects-2008.pdf> accessed 20 April 2012.

176 Further discussion can be found in Chapter Three.

177 See Chapter Four.

178 For more information on the difficulties that need to be overcome in relation to first-generation of biofuels, see, Sims (n 173).

require higher amounts of fossil energy inputs for each unit of energy output delivered.[179] As a result of these problems, a consensus among all stakeholders, including governments, corn producers, biofuel producers, scientists, environmentalists, oil companies, entrepreneurs, and institutional investors, is that priority must be given to the development of advanced biofuels and the relevant technologies that are capable of delivering a biofuel product that does not compete with food supply, and is economically as well as environmentally sustainable.

2.2.3 Second-Generation Biofuels: Lignocellulosic Biofuels

As pointed out by the IEA in its report 2008:

> 'It is increasingly understood that 1st-generation biofuels (produced primarily from food crops such as grains, sugar beet and oil seeds) are limited in their ability to achieve target oil-product substitution, climate change mitigation, and economic growth…Their sustainable production is under review, as is the possibility of creating undue competition for land and water used for food and fibre production…'[180]

Similar comments are made by David Morris:

> 'We are nearing the end of the corn-to-ethanol era. Ethanol production has doubled since 2005 and will double again by 2010. It is unlikely that any new corn-to-ethanol plants will be built beyond those currently in the construction pipeline. After 2012, all additional ethanol capacity must be based on non-corn crops'[181]

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179 Ibid, 80.

180 Sims (n 173) 5.

181 For here, 'non-corn crops' could be understood as a more general concept: 'non-food crops'. David Morris, 'Give Ethanol a Chance: The Case for Corn-Based Fuel' (Alternet. 13 June 2007) <http://www.alternet.org/story/53956/give_ethanol_a_chance%3A_the_case_for_corn-based_fuel>

Second-generation biofuels belong to 'non-corn crops' biofuels. They are referred to as lignocellulosic biofuel or cellulosic biofuel, which are mainly derived from non-edible crop residues such as corn stover and wheat straw, or from grass, timber and lumber residues.[182] Second-generation biofuel technologies are starting to be developed in an attempt to overcome the major shortcomings of the production of first-generation biofuels.[183] Compared to the first-generation biofuels, the significant advantage of lignocellulosic biofuels is that: Firstly, second-generation biofuels could be produced from a much larger array of feedstock options, including a variety of cellulose-rich feedstocks, as well as abundant forest and agricultural residues and wastes. Secondly, second-generation biofuel has better performance than first-generation biofuel in terms of their carbon footprint in the environment. One study found that the carbon footprint of conventional biofuel reduces the GHG effect by 78% while cellulosic biofuels reduce GHG by 94% when compared to the GHG caused by fossil fuels.[184] Thirdly, in relation to the land-use concern, second-generation feedstock is mostly grown on marginal land, or land that is not suitable to produce food crops. And also, as forest and agricultural residues are largely available that can be used as feedstocks, second-generation biofuel does not need to displace land from other uses in many cases. Lastly, they would not be competing with food production, as lignocellulosic biofuels use all kinds of non-edible plants instead of crops or sugary plants.[185] Therefore, in theory, these can solve food competition, land conversion problems and the associated environmental damage

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accessed 25 October 2012.

[182] Sims (n 173) 33-61.

[183] For detailed discussed about the processing and technology of second-generation biofuels, see Vijai Kumar Gupta and Maria G Tuohy (eds), *Biofuel Technologies: Recent Developments* (Springer Science & Business Media 2013).

[184] B K Highina, I M Bugaje and B Umar, 'A Review of Second Generation Biofuel: A Comparison of Its Carbon Footprints' (2014) 2 (2) European Journal of Engineering and Technology 117.

[185] It is observed that the second-generation biofuels grown on non-agricultural lands are likely to have a much smaller impact on food prices than the expansion of first-generation biofuels. However, the issue of linkages of biofuel production and food prices are complicated will be subject of the discussion in Chapter Four. See, Zilberman (n 3) 6.

that arise in connection with first-generation biofuel production.

However, second-generation biofuel feedstock also has its limitations. Firstly, the water requirement is the biggest drawback for these sources. For example, switchgrass and jatropha are favoured contenders among second-generation feedstocks, as both of them possess a high net energy potential yield. However, when grown on marginal land that lacks water resources, the yield of these feedstocks diminishes substantially compared with being grown on fertile, well-watered land.[186] Secondly, land requirement is still a limitation for production of the second-generation biofuels. Although second-generation biofuel feedstocks could be planted on marginal land, it still requires a large area of land for cultivation.[187] Lastly, although second-generation biofuel feedstock is widely abundant, and its price is much lesser as compared to food crop-based crops, the process for efficiently converting the feedstock into ethanol is much more problematic and expensive.[188] It depends on skilled human capital and sophisticated technologies for their production. Therefore, they require larger capital costs per unit of production when compared to biofuels produced through first-generation processes.[189]

Despite this, there is a growing interest in many countries in developing second-generation biofuels. For example, the US has delivered great financial support to funding projects of second-generation biofuel production, and even began to produce cellulosic ethanol on a pilot level.[190] In 2007, the US Department of Energy awarded total grants of $ 385 million to develop second-generation biofuels.[191] In 2013, the US

[186] Christian II (n 160). Further discussion about biofuels and water use is included in Chapter Three.

[187] Peer M Schenk and others, 'Second Generation Biofuels: High-Efficiency Microalgae for Biodiesel Production' (2008) 1(1) BioEnergy Research 20.

[188] For a comparative study on the production and process of the first- and second-generation biofuels, see Naik (n 166).

[189] Jose Goldemberg and others, 'Ethanol Learning Curve - the Brazilian Experience' (2004) 26(3) *Biomass & Bioenergy* 301.

[190] UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 53.

[191] Mannan (n 156).

EPA called for 22.7 million litres of cellulosic ethanol to be blended in the gasoline pool in 2013 in the US, although the volume of cellulosic ethanol corresponds to less than 0.04% of the total bioethanol production in the US in 2013.[192]

Developing a cost-effective, commercial-scale cellulosic biofuel industry will require transformational science to significantly streamline current production processes.[193] However, at present, both the R&D on second-generation biofuels and the production of ethanol from cellulosic materials is in a relatively early stage of development and has not been commercially available. More efforts need to be taken to improve technologies and bring down costs of second-generation biofuels. For example, although the potential oil yields and quality of many trees and non-edible oil crops from the woodlands and arid lands are beginning to be investigated, very few of their oil properties have been determined. Even for well recognized biofuel crops such as jatropha, there is little information on the yield potential. It is because the energy potential varies under different agro-climatic zones and soil types. Therefore, though second-generate feedstocks have potential, research is still needed on their domestication and conversion into biofuels.[194] Moreover, it requires a large range of advanced and improved technologies for the production and processing of lignocellulosic biofuels.[195] The majority of second-generation biofuel processing

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[192] UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 53.

[193] For discussion about cellulosic biofuel production and technology, see Abdellatif Barakat and Xavier Rouau, 'New Dry Technology of Environmentally Friendly Biomass Refinery: Glucose Yield and Energy Efficiency' (2014) 7 (138) Biotechnology for Biofuels <http://www.biotechnologyforbiofuels.com/content/7/1/138> accessed 30 July 2015.

[194] Bekunda (n 73) 253.

[195] See Parveen Kumar and others, 'Methods for Pretreatment of Lignocellulosic Biomass for Efficient Hydrolysis and Biofuel Production' (2009) 48(8) Industrial and Engineering Chemistry Research 3713; Rakesh Koppram and others, 'Lignocellulosic Ethanol Production at High-Gravity: Challenges and Perspectives' (2014) 32(1) Trends in Biotechnology 46; Nadav Sorek and others, 'The Implications of Lignocellulosic Biomass Chemical Composition for the Production of Advanced Biofuels' (2014) BioScience <http://bioscience.oxfordjournals.org/content/early/2014/02/11/biosci.bit037.full.pdf+html>

technologies are not yet available on a fully commercial scale. Therefore, technical barriers exist for harnessing the second-generation biofuel and its mass production.

For developing countries, when considering the major advantages of the second-generation biofuels from both the environmental aspect and the social aspect, as well as the availability of second-generation feedstocks in developing countries, it could be highly interesting for them to move from first-generation biofuels to second-generation biofuels.[196] It is necessary for them to have access to the second-generation processes and technologies. However, R&D of second-generation biofuel technology is a costly endeavour. It might be difficult and costly for them alone to engage in all R&D, demonstration and deployment phases of second-generation biofuel technologies. Although several emerging economies, such as Brazil, India and China, have begun to invest in second-generation biofuel R&D, many poorer developing countries and less developed countries (LDCs) have been mostly absent from this technology race.[197] Therefore, there could be an urgent need for developing countries to engage international cooperation to share R&D costs, to improve research ability, and to gain access to the advanced technology from other countries.[198]

2.2.4 Third-Generation Biofuels and Beyond

'Third-generation biofuels' is a fairly recent term in the biofuel world. Third-generation biofuels represent an improvement over second-generation biofuels in terms of the feedstock used in the biofuel production. They are commonly derived from transgenic

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accessed 30 July 2015.

[196] Biofuel-related (mainly the first-generation biofuel-related) environmental issues, such as land-use change, deforestation, biodiversity loss, and social issues like food insecurity have given great attention. Further discussion can be found in Chapter Three.

[197] Eisentraut (n 17) 7, 21.

[198] Further discussion about the technology transfer to developing countries is conducted in Section 2.4.

energy crops, and the production process requires sophisticated knowledge in various fields, such as system biology, synthetic biology, and synthetic genomics.[199] It is expected that third-generation biofuels could have similar physical and chemical properties to current fossil fuels in terms of energy content.[200]

Algae are favoured contenders among third-generation biofuel sources due to their high production capacity of lipids, ease of cultivation and rapid growth rate.[201] Some studies directly refer to algal biofuel as the third-generation biofuel.[202] There are two categories of algae: macroalgae and microalgae. Macroalgae is commonly known as seaweed, and microalgae refers to many different species that live as either single cells or colonies.[203] Compared with macroalgae, microalgae received more consideration and investigation as a viable alternative energy resource.[204] Algae could offer a diverse collection of fuel options, as algae can be genetically manipulated to create various types of biofuels, such as ethanol, biodiesel, butanol, gasoline, and methane.[205] An incredibly attractive notion of algae as biofuel feedstock is that it can produce a high energy yield and a high quantity volume, but require much less land area, fresh water and other resources; and can reduce environmental effects on soil and water pollution

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199 Harald König, Daniel Frank, Reinhard Heil and Christopher Coenen, 'Synthetic Genomics and Synthetic Biology Applications between Hopes and Concerns' (2013) 14 Current Genomics 11.

200 Giuliano Dragone and others, 'Third Generation Biofuels from Microalgae' in A Mendez-Vilas (ed), *Current Research, Technology and Education Topics in Applied Microbiology and Microbial Biotechnology* (Formatex Research Center 2010) 1358.

201 Firoz Alam, Saleh Mobin and Harun Chowdhury, 'Third Generation Biofuel From Algae' (2015) 105Procedia Engineering 763; Richard Sayre, 'Microalgae: The Potential for Carbon Capture' (2010) 60 BioScience 722; Ao Xia, Christiane Herrmann and Jerry D Murphy, 'How Do We Optimize Third-Generation Algal Biofuels?' (2015) 9(4) Biofuels, Bioproducts and Biorefining 358.

202 Christian II (n 160) 10.

203 Nuffield Council on Bioethics (n 1) 56.

204 Ibid. See also, Dragone (n 200) 1355.

205 Christian II (n 160) 10; Shuvashish Behera and others, 'Scope of Algae as Third Generation Biofuels' (2015) 2 Frontiers in Bioengineering and Biotechnology 1 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4324237/> accessed 30 July 2015.

compared with the first- and second-generation feedstocks.[206] Algae can be cultivated anywhere where the climate is warm enough, even in the desert and they can grow even in wastewater instead of fresh water.[207] Studies have shown that microalgal biofuels is capable of meeting the global demand for transportation.[208] It is estimated that it would only take about 0.42% of US land area to plant algae, and could meet all the fuel needs in the US, which is the largest fuel consumer in the world.[209] Therefore, future progress in algal biofuels may bring a new energy revolution, that would enable new, green energy to entirely replace fossil fuels whilst overcoming the drawbacks of first- and second-generation biofuel production.

Similar to the second-generation biofuels, third-generation biofuels also face significant technical challenges. Third-generation biofuels commonly involve genetically engineered biomass crops and precise sciences. There are two main considerations when creating transgenic energy crops. Firstly, the transgenic energy crops should have an improved productivity in terms of total biomass produced for each acre of the land planted. In other words, the crops should show a faster growth rate. Secondly, it requires biomass that could be processed at biofuel refineries with little effort.[210] That is to say, it requires combining both traits into a single energy crop, which is very difficult to achieve under the current technologic condition. Currently, most of the third-generation biofuel projects are still in the R&D stage and are years away from commercialization. This is, especially in the case of synthetic biology and microorganisms in relation to

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206 Strezov (n 171) 28.

207 For more information about the characteristics of microalgal fuels, and the future research and development, see Dragone (n 200); A L Ahmad and others, 'Microalgae as a Sustainable Energy Source for Biodiesel Production: A Review' (2011) 15(1) Renewable and Sustainable Energy Reviews 584; Anita Kirrolia, Narsi Bishnoi and Rajesh Singh, 'Microalgae as a Boon for Sustainable Energy Production and its Future Research & Development Aspects' (2013) 20 Renewable and Sustainable Energy Reviews 642; Ashok Pandey and others (eds), *Biofuels from Algae* (Newnes 2013).

208 Dragone (n 200) 1358.

209 Christian II (n 160) 10.

210 Mannan (n 156).

which regulatory and other issues need to be addressed before widespread use.[211]

Third-generation biofuel is not the 'end-generation biofuel'. As biofuel technology is developing at an outstanding speed, new technological innovation could just happen in the next second. Research has begun on 'fourth-generation biofuels',[212] and there may be research on fifth- and sixth-generation biofuels in the near future. For present purposes, all of them will be referred to as future-generation biofuels. In addition, by reviewing the status of algal biofuel technology, some research suggests that it is currently unsuitable for developing countries to place emphasis on third-generation (and also future-generation) biofuel technologies, because there are large uncertainties within both the technological and legal context. Most developing countries lack the technological and financial capacity to develop their own algal biofuel industry, and lack adequately prepared policies to support imported algal biofuel technologies.[213]

2.2.5 Conclusion

The conversion of biomass to liquid biofuels is currently at its first-generation biofuel stage at a commercial level, with the second-, third- and future-generation biofuels emerging from their current position mainly at the R&D stage. The first-generation

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211 Claire Marris and Catherine Jefferson, 'Workshop on "Synthetic Biology: Containment and Release of Engineered Micro-organisms": Summary of Discussions' (London, April 2013) <http://www.kcl.ac.uk/sspp/departments/sshm/research/Research-Labs/CSynBI@KCL-PDFs/Publications-page/SB-Containement-and-Release-Workshop-Summary-of-Discussions-Final.pdf> accessed 3 March 2014.

212 The fourth-generation biofuel production is based on metabolic engineering of algae from oxygenic photosynthetic microorganisms. For more information, see, Jing Lu, Con Sheahan and Pengcheng Fu, 'Metabolic Engineering of Algae for Fourth Generation Biofuels Production' (2011) 4(7) Energy Environmental Science 2451.

213 Ademola A Adenle, Gareth E Haslam and Lisa Lee, 'Global Assessment of Research and Development for Algae Biofuel Production and its Potential Role for Sustainable Development in Developing Countries' (2013) 61 Energy Policy 182.

biofuel products have been widely commercialized and the production technologies are well developed. However, it is increasingly understood that first-generation biofuels are limited in their ability to achieve sustainable targets in the environmental, social and economic aspects. Particularly, the cumulative impacts of the concern that their production may create undue competition for food production have increased the interest in developing second-generation biofuels produced from non-food biomass.

The second-generation biofuels, or cellulosic biofuels, could address many of the problems associated with the first-generation biofuel. The most significant advantage of biofuel production manufactured from agricultural and forest residues and from non-food crop feedstocks, is that they will not create direct competition with food and feed production. However, second-generation biofuel also has its limitations. It may still generate a verity of environmental problems and land use problems, and may also indirectly affect food production.

Third-generation biofuel, such as algal biofuel, can be produced with much less land, water and other resources, and will not create competition with food and feed production. However, under the current technological conditions, third-generation biofuels still cannot be commercially deployed in the near future. Although each generation of feedstocks has its own limitations and challenges in the biofuel production process, they are commonly expected to be produced with minimal natural resources (especially land and water), less negative effects on the environment and minimal competition with food and feed. In addition, they are expected to be processed efficiently to yield high-quality liquid biofuels with less effort in sufficient quantities.[214]

To some extent, the biofuel industry could be recognized as a high-tech driven sector. Technological development is significantly important for biofuel industry, and especially for the advanced biofuels and their commercialization. For example,

[214] Nuffield Council on Bioethics (n1) 47.

woodchips, grasses, stalks and other cellulosic biomass are more difficult to break down into sugars than corn grain. Biological technology, such as genetic modified technology, is key to accelerating the deconstruction of cellulosic biomass into sugars that can be converted to biofuels.[215] Industry promises future technologies that will yield cheap abundant biofuels from all plant material or even plant waste. That being the case, as well as new feedstock and technologies emerging, the problems which are hard to deal with in the current technological climate might be solved without legal regulations. Therefore, technology is as important as legislation and policy for biofuel development. Technology and regulation are like two wheels running the industry. Two of them need to work together to promote biofuel development.

However, there are very few incentives or governance approaches for new technological methods for developing biofuels. For example, the Renewable Energy Directive (RED) and Renewable Transport Fuels Obligations (RTFO) are two of the most important pieces of legislation promoting biofuels in Europe, but technology incentives are not included in either of them. IPRs, which are the most relevant rights among others to protect technology innovations since the industrial revolution,[216] are rarely included in biofuel policy strategies.

2.3 The Role of IPRs in Biofuel Technology Development and Transfer

2.3.1 Introduction

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215 Sharlene Weatherwax, 'U.S. Department of Energy's Bioenergy Research Centers: An Overview of the Science' (U.S. DOE. 2010 DOE/SC-0127, DOE Office of Science 2010) 1 <http://genomicscience.energy.gov/centers/BRCbrochure2010webFinalURLs_LR.pdf> accessed 12 March 2012.

216 Estelle Derclaye, 'Intellectual Property Rights and Global Warming' (2008) 12 Marquette Intellectual Property Law Review 263, 264.

IP protection is imperative for science and technology innovation and development, because of its function in encouraging investment in R&D and commercialization. However, it is also a very controversial issue that has provoked intensive debate in relation to protecting innovators' rights, and also achieving a balance between the exclusive private rights and public interests.[217] Biotechnology is an area in which this balance needs to be carefully considered, as many morally controversial inventions are generated.[218] For the biofuel industry, the context-related IP issues are not yet fully discussed and understood as they are often left out of biofuel policy framework in the initial stage of biofuel development. But now, with increased biofuel technology-related patent applications, the management of agricultural-energy biotech IP rights affects widely the global biofuel market. As a result, the IPR issues are more frequently considered by biofuel policy makers.

One of the most significant issues that may need to be carefully managed is the fragmented ownership of IPRs related to advanced biofuel technologies. A concern is that fragmented patent ownership of biofuel technology across multi-stakeholder from both public and private sectors and the patent thickets in biofuel sector may represent potential constraints on advancing biofuel technology transfer and development. Therefore, it is reasonable to ask: are IPRs effective in promoting the development and diffusion of biofuel technologies or do they act as a barrier to new technologies in the biofuel field?

In order to answer this question, this section begins with the justifications for IPRs on a theoretical level, to explore whether and why we need IP protection for biofuel

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[217] See, Maja Andjelkovic, 'Intellectual Property Rights and Access to Knowledge Models: Managing Innovation, Public Goods and Private Interest' (2006) 3 Brussels Journal of International Studies 1; J H Reichman and Jonathan A Franklin, 'Privately Legislated Intellectual Property Rights: Reconciling Freedom of Contract with Public Good Uses of Information' (1998) 147 University of Pennsylvania Law Review 875.

[218] Margo A Bagley, 'Patent First, Ask Questions Later: Morality and Biotechnology in Patent Law' (2003) 45 William & Mary Law Review 469.

technology development. After that, it introduces the recent emerging IP opportunities for innovations and technologies in the biofuel field and particularly the patent booming of the first-, second- and third-generation biofuel technologies. Among all kinds of controversial issues around biofuel issues and patent regime, it focuses on the issue of fragmented ownership of patent rights over advanced biofuels, and its potential effects on diffusion and transfer of technology. Lastly, it explains two opposite sides of the IPR debate relating to its implications on biofuel technology diffusion and development.

2.3.2 Justifications for Intellectual Property Protection

IPRs have been challenged as they have been associated with a series of limitations to the access and dissemination of technologies, due to the inherent structure of the IPR system.[219] Why should we grant IPRs to biofuel innovations? Generally, legal and political philosophers have often debated the status and legitimacy of intellectual property for a long time in a more general and wide scope.[220] It is important that this question is answered because the decision of whether we should grant such rights in relation to intangibles closely ties in with the interests of biofuel producers, traders, the new market and the public.

Over time, a variety of legal opinions and arguments have been made to support the IPRs. Most of them have been based on the two main classical justifications of IP protection. One of the main justifications is that IPRs aim to induce or encourage desirable activities, such as new technologies and create original works.[221] It is known

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[219] Ahmed Abdel-Latif, ‘Intellectual Property Rights and the Transfer of Climate Change Technologies: Issues, Challenges, and Way Forward’ (2015) 15 Climate Policy 103.

[220] Adam D Moore, ‘Toward a Lockean Theory of Intellectual Property’ in Adam D Moore (ed), *Intellectual Property: Moral, Legal and International Dilemmas* (Rowman & Littlefield 1997), 81.

[221] Edwin C Hettinger, ‘Justifying Intellectual Property Rights’ (1989) 18 Philosophy & Public Affairs 31; Tom G Palmer, ‘Are Patents and Copyrights Morally Justified?’ (1990) 13 Harvard Journal of Law and Public Policy 817.

as the incentive theory or utilitarian argument, in which IPRs are seen as neutral. This argument is based on the principle of utility and the writings of late 18th and 19th century philosophers and economists Jeremy Bentham and John Stuart Mill.[222] Under this justification, inventors can obtain an exclusive right that allows them to exclusively exploit their intellectual property and reap the monetary benefits from it. At the same time, general social welfare could be achieved, as there would be better products. The other main justification for IPRs was first developed by Locke in the 17th century. It views IPRs as natural rights, because an inventor or a creator obtains an intellectual property right to the fruits of his or her labour.[223] In addition, another recently developed but important justification for IPRs is based on human rights theory. It believes IPRs are types of human rights that must be balanced with each other and, cannot be absolute, because human rights all have the same rank.[224]

What implications do these theories have for biofuel IPR issues? Or what are justifications for IPRs in this specific 'green energy' market? Under the incentive theory, the idea is to grant exclusive rights to creators and inventors in the public interest. Therefore, it indicates that IPRs should not damage social welfare. In the context of climate change, it should not damage the environment and the progress of the green energy revolution. Under the natural rights theory, it seems that any inventor or creator has a property right to his or her intellectual labour, whatever the consequence it has on green technology development and climate change. However, it is contested, as there is a 'non-waste' condition developed by Locke applied with this theory.[225] It

[222] John Stuard Mill, *Principles of Political Economy: With Some of Their Applications to Social Philosophy* in Stephen Nathanson (ed), (Hackett 2004).

[223] Arthur RMiller and Michael H Davis, *Intellectual Property: Patents, Trademarks, and Copyright in a Nutshell* (5th edn, West Publishing 2012) 16.

[224] Paul L C Torremans, 'Copyright as a Human Right' in Paul L C Torremans (ed), *Copyright and Human Rights: Freedom of Expression, Intellectual Property, Privacy* (Kluwer Law International 2004) 17; Thomas Dreier, 'Contracting Out of Copyright in The Information Society: The Impact on Freedom of Expression' in Jonathan Griffiths and Uma Suthersanen (eds) *Copyright and Free Speech: Comparative and International Analyses* (OUP 2005) 385, 395.

[225] Jone Locke, 'The Second Treaties of Government: An Essay Concerning the True Original, Extent,

requires that 'the owner leaves in the commons enough and as good for others and that he or she may not remove more out of the commons than she or he can use'.[226] Under the human rights theory, IPRs need to be limited if they conflict with interests of general human well-being. Therefore, under all these theories, it seems that IPRs should not be given for inventions if it hinders the process of green technology development and climate change mitigation. Or at least a balance should be made between the exclusive rights and benefits of the invention and its impact on 'green revolution' and the climate.[227]

The justification of IPRs is a philosophical question, which would take too long to debate here.[228] But under a certain view, it is hard to deny the value of IPRs as the most relevant and workable legal instruments for technology and innovation since the Industry Revolution. For the biofuel market, at present, much of the biofuel industry is still in the R&D stage, or mainly research-driven. Under such circumstances, a viable IP system is very necessary and essential as it can secure the investment needed to move the industry from the R&D stage to commercialization. The real question is how IPRs, and alternatives to IPRs, might operate in these green energy innovations. If it is not easy to answer this now, at least, it is worth keeping in mind that the objective of any IP system is to achieve a balance between the right granted and the benefit to society of the invention.[229]

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and End of Civil Government' in Peter Laslett (ed) *Two Treatises of Government* 267, 285-302.

226 Derclaye, 'Intellectual Property Rights and Global Warming' (n 216) 268.

227 It is worth noting that climate change is just one of many issues related to the social welfare. Other issues include general environmental impacts and food security.

228 For more discussion about the justification of IPRs, see, Tanya Aplin and Jennifer Davis, Intellectual Property Law: Text, Cases, and Materials (OUP 2013) 2-23.

229 Developed and developing nations may have different opinions on this issue. This will be explored in the next section of this chapter.

2.3.3 Emerging IP Landscape for Biofuels: Fragmented and Diverse Ownership

The growth of IPRs, especially in patents related to agricultural biotechnology has been on the rise since about 1980.[230] Both private companies and public research institutions involved in the biotech developing progress, though the land grant universities and public research funding took a more outstanding position in the beginning years.[231] Over the last 30 years, they have greatly contributed to the increasing use of legally formal IP protection, mainly patenting and licensing biotechnology inventions, to support the translation of basic research into markets.[232] As a result, the IPRs in biotechnology have gradually been legislated in developed world. For instance, the US passed the Patent and Trademark Law Amendments Act in 1980, known as the Bayh-Dole Act.[233] This Act explicitly encouraged US universities to patent their innovations and license them to private sector companies to encourage their commercial use.[234] Another point outstanding is that, in the economics of agricultural biotechnology innovations, the private sector is playing a more pivotal role. A large number of private biofuel companies have emerged and are involved in the progress of moving the emerging technologies past the R&D stage and into commercialization.[235] The cooperation between public sector and private firms is increasing as well. A form of collaboration between the public sector and private sector, called the public-private partnership or PPP, has been adopted as one favoured model of modern agriculture

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230 Cecilia L Chi-Ham and others, 'An Intellectual Property Sharing Initiative in Agricultural Biotechnology: Development of Broadly Accessible Technologies for Plant Transformation' (2012) 10 Plant Biotechnology Journal 105.

231 Ibid.

232 Ibid.

233 Patent and Trademark Law Amendments Act, Public Law 96-517; 35 U.S.C. § 200-212, 94 Stat. 3015 (1980).

234 WIPO, *Technology Transfer, Intellectual Property and Effective University-industry Partnerships: The Experience of China, India, Japan, Philippines, the Republic of Korea, Singapore and Thailand* (WIPO 2007) 9 <http://www.wipo.int/uipc/en/partnership/> accessed 21 December 2012.

235 Christian Friis Bach, 'Intellectual Property Rights: Blocking an Equitable Solution to the Climate Crisis?' (Dan Church Aid Report June 2009, Dan Church Aid 2009) 6 <https://www.danchurchaid.org/> accessed 21 December 2012.

(including biofuel) project execution in many countries.[236] This is because PPP model offers a way of introducing private sector technology and innovation in providing better public services through improved operational efficiency; and it also offers a way of developing local private sector capabilities through joint ventures with large international firms.[237]

The IP landscape for biofuel industry is very new, but it is developing at an outstanding speed. There is a variety of species of intellectual property, from patents and plant varieties, to licences, trade secrets and trademarks, that can be invoked to provide IP protection for inventors' rights in biofuel field.[238] Among all of them, the most widely used one is probably patents. Generally, patents are granted for new, useful, and non-obvious inventions, and given the patent holder the exclusive right to commercially exploit the invention for a specified time period (usually twenty years).[239] It has been long established that micro-organisms, plants, and even animals (concerned subject matter in biofuel industry) are patentable subject matter under US patent law, and in many other jurisdictions.[240] Patents are intended to protect functional concepts,

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236 For example, a large-scale PPP has been launched to promote for its ethanol production in India. It is also being carefully considered by academics and decision-makers in the Africa. See, Mandy Ewing and Siwa Msangi, 'Biofuels Production in Developing Countries: Assessing Tradeoffs in Welfare and Food Security' (2009) 12 Environmental Science and Policy 520, 526; Charles B L Jumbe and Maxwell Mkondiwa, 'Comparative Analysis of Biofuels Policy Development in Sub-Saharan Africa: The Place of Private and Public Sectors' (2013)50 Renewable Energy 614.

237 For more information about PPP, see, Larry Witters, Revital Marom and Kurt Steinert, 'The Role of Public-Private Partnerships in Driving Innovation' in Soumitra Dutta (ed), *The Global Innovation Index 2012: Stronger Innovation Lenkages for Global Growth*, (INSEAD and WIPO 2012) 81.

238 Matthew Rimmer, 'Climate Ready Crops: Intellectual Property, Agriculture, and Climate Change' in Matthew Rimmer and Alison McLennan (eds), *Intellectual Property and Emerging Technologies: The New Biology* (Edward Elgar 2012) 320 - 60.

239 Miller (n 223) 10, 12.

240 There is much uncertainty about the boundaries and the limits of patentable subject matter particularly when grappling with emerging technologies, but this issue is not the subject matter of this research. See, Matthew Rimmer and others, 'Intellectual Property and Biofuels: The Energy Crisis, Food Security, and Climate Change' (2015) working paper 30 <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2610985> accessed 30 July 2015.

methods, or processes.[241] Therefore, both biofuel end-products and the process could be patentable. Lazarus commented in 2010 that: 'The biomass/biogas/biofuel technology area for which patent protection was most actively obtained in both 2009 (based upon number of claims granted) is "patent protection", which was closely followed by 'system/process for making a biofuel.'[242]

As mentioned above, one important justification of the IP system is that it induces or encourages desirable activities. Similarly, a patent system is justified on the basis that it provides inventors with an incentive to invest in R&D of new products, processes and machines; or an incentive to disclose valuable technical information to the public, which would otherwise have remained secret.[243] A patent is a monopoly right for the patentee, which could increase capital intensity for him or her by blocking unauthorized access to a patented technology.[244] The monopoly right is argued as a 'hard' form of IPR, because it permits the first innovator to exclude subsequent inventors of the same product or process, even if those subsequent inventors had no knowledge of the first innovator's activities.[245] However, at the same time, IP systems need to balance interests of the public through information disclosure and exclusivity benefits of the monopoly right to the innovator.[246] Despite the justification of patent law, there is still

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[241] Ibid, 20, 22.

[242] John Lazarus 'Cleantech Patent Energy Landscape Report' (Foley and Lardner LLP 2010) <http://www.foley.com/2010-cleantech-energy-patent-landscape-report-05-12-2010/> accessed 14 March 2012.

[243] Derclaye, 'Intellectual Property Rights and Global Warming' (n 216) 264; W Landes and R Posner, 'An Economic Analysis of Copyright Law' (1989) 18 Journal of Legal Studies 325; Lionel Bently and Brad Sherman, *Intellectual Property Law* (3rd edn, OUP 2009) 3.

[244] Frederic M Abbott, *Innovation and Technology Transfer to Address Climate Change: Lessons from the Global Debate on Intellectual Property and Public Health* (Programme on IPRs and Sustainable Development, Issue Paper No. 24, ICTSD 2009) 4 <http://www.iprsonline.org/New%202009/innovation-and-technology-transfer-to-address-climate-change.pdf> accessed 4 April 2012.

[245] Ibid.

[246] Rimmer, 'Intellectual Property and Biofuels: The Energy Crisis, Food Security, and Climate Change' (n 240) 31-32.

little discussion about patent policy as part the global biofuels market in official documents and international initiatives.[247] Patent issues of biofuels are left out of the equation by national policy makers as well. As commented by Barton: 'Patent issues are likely to arise primarily with the newer technologies, because the older ones are long off-patent, and there is enormous patenting activity in the new areas.'[248]

Therefore, it has not been a long time since patent policy was tied in with technology in the biofuel field. But from the last two decades, there is a clear increase in biofuel R&D activity, as well as the accompanied significant increase in patenting activity. A recent study has shown that, patents granted in industrial biotechnology, largely for biofuels production, increased from 6,000 in 2000 to 22,000 in 2005, with another thousands of patent applications awaiting approval.[249] The majority of these patents are in developed countries, such as the US, EU, Japan and South Korea, and several emerging countries, including China, India and Brazil.[250]

It is worth noting that the biofuels patent growth was not evenly split between the three generations of biofuels. When Rimmer and his colleagues conducted research in 2013, they classified almost 8,000 among 11,129 biofuel patents by different generations.[251] They found that the number of first-generation biofuel patents was 4,710, followed by the second-generation biofuel patents 2,907, and the third-generation biofuel patents

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247 Abbott, *Innovation and Technology Transfer to Address Climate Change: Lessons from the Global Debate on Intellectual Property and Public Health* (n 244) 4.

248 John H Barton, *Intellectual Property and Access to Clean Energy Technologies in Developing Countries: An Analysis of Solar Photovoltaic, Biofuels and Wind Technologies* (Trade and Sustainable Energy Series Issue Paper No 2, ICTSD 2007) 13-14 <http://www.iprsonline.org/ictsd/docs/New%202009/CC%20Barton.pdf> accessed 21 March 2011.

249 Steve Suppan, 'Patents: Taken for Granted in Plans for a Global Biofuels Market' (2007) Institute for Agriculture and Trade Policy Working Paper 10/2007, 2 <http://www.sarpn.org/documents/d0002900/Patents_Biofuels_Suppan_Oct2007.pdf> accessed 24 October 2012.

250 Rimmer, 'Intellectual Property and Biofuels: The Energy Crisis, Food Security, and Climate Change' (n 240).

251 Ibid,13.

merely 350. (See Table 1)

Table 1: Outcomes of classification of biofuels into different generations

Row Labels	Count of Patent Number
1st Generation	4,710
2nd Generation	2,907
3rd Generation	350
Other	3,162
Total	11,129

Source: Matthew Rimmer, 2013

According to Table 1, the number of first-generation biofuel patents is significantly more than the total number of the second- and third-generation patents. The main technique processes of the first-generation biofuels have been in existence for quite some time. Therefore, a company's patent for first-generation biofuels focuses on improving the efficiency of the overall process, as well as reducing production costs.[252] A modification to the saccharification, fermentation or transesterification processes leading to an improvement in efficiency could be patentable.[253] Such research may include biomass feedstock, reagents and methods used to break down starch into glucose, as well as the genetically engineered microorganisms and the processes used to improve ethanol tolerance and production efficiency.[254] For example, Syngenta has applied a patent for a maize variety containing an enzyme which could rapidly break down starch, in turn improving ethanol production efficiency and reducing production cost.[255] Another famous company which made great efforts on R&D of biofuel

252 Mannan (n 156) 36.

253 Hal Alper and others, 'Engineering Yeast Transcription Machinery for Improved Ethanol Tolerance and Production' (2006) 314 Science 1565.

254 For more information, see ibid.

255 Biofuelwatch and others, 'Agrofuels: Towards a Reality Check in Nine Key Areas' (Report submitted to the Secretariat of the CBD in preparation for the twelfth meeting of the SBSTTA, 2007) 6

technology is Novozymes. This Danish company is the patent holder of US Patent No. 7,713,723, which is called 'alpha amylase mutants with altered properties'. According to the patent application: 'The variants of the invention are suitable for starch conversion, ethanol production, laundry wash, dish wash, hard surface cleaning, textile desizing, and/or sweetener production.'[256]

In contrast to the first-generation biofuel technologies, there are more opportunities to patent the second- and third-generation biofuel technologies, not only for the novel processes involved in the manufacture, but also for the end products which include novel chemical compositions. Although at present, there are not as many advanced biofuel patents as there are conventional biofuels, it is expected that advanced biofuel patents will increase, because it is widely accepted that R&D should be focused upon new generation biofuels, given the negative impact of first-generation biofuels upon the environment and food security. Both public research and private companies have shown more interests in advanced biofuels. Barton observed: 'There also appears to be a technology race in the use of algae as a source for fuel.'[257] Therefore, it could imagine that in the near future, the patent register for biofuel technology will continue to grow steadily.[258] For the first-generation biofuel technology, it will become increasingly crowded and cluttered.

In addition, not only are the number of biotechnology patents increasing; the types of biotechnology patents are also increasing. Or in other words, types of biotechnology

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<http://www.econexus.info/publication/agrofuels> accessed 23 July 2012.

[256] Novozymes also has strong interests in advanced biofuel technology R&D, for more information, see, Novozymes' Annual Report 2013 <http://www.novozymes.com/en/investor/financial-reports/Documents/The-Novozymes-Report-2013.pdf> accessed 30 July 2015.

[257] Barton, *Intellectual Property and Access to Clean Energy Technologies in Developing Countries: An Analysis of Solar Photovoltaic, Biofuels and Wind Technologies* (n 248) 13-14.

[258] It is predicted that biofuel patents will continue to grow steadily because of increasing climate legislation and government funding. See Sangeeta Shashikant and Martin Khor, *Intellectual Property and Technology Transfer Issues in the Context of Climate Change* (Third World Network 2010) 26.

patents would have to be varied. As mentioned earlier, there is a mixture of private and public ownership of biofuel patents. Among private companies, there is a mixture of energy companies, agricultural companies and biotechnology companies filing in respect of biofuels patents.[259] For these companies, the IP strategy and its patenting opportunities may vary considerably from one company to another depending on the different core business. This is because the biofuel production chain is quite comprehensive and long, beginning from production of biomass feedstocks to the final stage of end biofuel products. There are specific and comprehensive sciences from different fields involved in biofuel technologies and patents. It is unlikely that a single biofuel company will be involved in all stages of this production chain, instead, a company is usually just involved in one stage, such as feedstock manufacturing or biofuel production in the refineries. In 2008, Ward and Hall noted that: '[T]here are at least 850 biofuel patents and pending applications in the US, Europe and Japan, divided among 285 companies with only 35 companies owning more than five patens.'[260] Accordingly, the pair argued that the biofuel patent landscape was becoming fragmented.

The fragmented ownership of IPRs across multi-stakeholder from both public and private sectors produces a situation where the transfer and diffusion of biotechnology is extremely difficult, because few single institutions can provide a complete set of IPRs.[261] It has happened in GM technology development. A famous example of the complexity resulting from fragmented IP ownership of GM technology is the case of 'Golden Rice'. In this case, the transgenic 'Golden Rice' with vitamin A-enriched grain was intended to benefit poor people in developing world. However, there were over 40

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[259] Rimmer, 'Intellectual Property and Biofuels: The Energy Crisis, Food Security, and Climate Change' (n 240) 19.

[260] Michael R Ward and Timothy J Young, 'Protecting Inventions Involving Biofuel Feedstock' (JD Supra Business Advisor 2008) 2 <http://www.jdsupra.com/documents/2055e1f3-a237-42d2-9b94-f2183d529524_searchable.pdf> accessed 2 July 2012.

[261] Chi-Ham (n 230) 150.

patents associated with the GM rice, including patents related to the use of transgenes, methods of isolating and cloning DNA and methods of regenerating transgenic plants from transformed cells.[262] As a result, they represented potential constraints and slowed the commercial development of the 'Golden Rice'.[263] Similar situations could also arise in the new emerging biofuel context. Some studies have shown their concern about the crowded and fragmented biofuel patent landscape.[264]

As demonstrated above, the biofuel patent landscape is increasingly crowded and fragmented, with a mixture of private and public ownership, and striking national affiliations to the patents, with the majority of them belonging to developed countries and several emerging countries. This situation raised a concern that the patent thickets for biofuels would become a barrier for the freedom to operation. As concluded by Ward and Hall: 'In such a congested IP environment, freedom to operate issues become crucial to any entity in the space.'[265] There has been much discussion about the issue of 'patent thickets'. Shapiro described a patent thicket as a 'dense web of overlapping intellectual property rights that a company must hack its way through in order to commercialise new technology'.[266] The Nuffield Council on Bioethics noted: 'Given the range of technologies likely to be involved in the production of new biofuels, the area seems particularly prone to patent-stacking and patent-thickets.'[267]

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262 Stanley P Kowalski and R David Kryder, 'Golden Rice: A Case Study in Intellectual Property Management and International Capacity Building' (2002) 13 Risk: Health, Safety & Environment 47.

263 Ibid.

264 Jim M Dunwell, 'Intellectual Property Aspects of Plant Transformation' in Charles Neal Stewart and others (eds), *Plant Transformation Technologies* (John Wiley & Sons 2011) 251; Mannan (n 156) 40.

265 Ward (n 260) 2.

266 Carl Shapiro, 'Navigating the Patent Thicket: Cross Licenses, Patent Pools and Standard-Setting' in Adam Jaffe, Josh Lerner and Scott Stern (eds), *Innovation Policy and the Economy* (MIT Press 2001)119-150.

267 Nuffield Council on Bioethics (n 1) 153.

Some argue that even if the fragmented patent ownership of advanced biofuel technology and the patent thickets represents potential constraints on advanced biofuel technology transfer and development, other legal instruments could be used, such as patent pools and a compulsory licensing strategy.[268] de Beer has observed: 'So-called patent thickets – multiple upstream patents where overlapping rights may impede the development or commercialization of technology – are an issue of some concern for which cross-licensing and patent pooling have been suggested as a possible solution.'[269]

A compulsory license is an authorization given by a national authority to a natural or legal person for the exploitation of the subject matter protected by a patent; the consent of the patent title holder is not necessary.[270] Compulsory licensing may be an option when there are no close substitutes for a biofuels technological product or process. Compulsory licenses are usually granted in order to attain public policy objectives, such as counteracting anticompetitive business practices.[271] For example, in the US, the Clean Air Act mandates the compulsory licensing of patented technologies when they are needed to meet agreed standards.[272] Accordingly, no patent holder can refuse to share a patented technology if it is necessary to meet required standards. However, others have pointed out, that even with a licensing system, the patent thickets and large numbers of licensing agreements still limit scientific communication and technology

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[268] Matthew Rimmer, *Intellectual Property and Climate Change: Inventing Clean Technologies* (Edward Elgar 2011), 312-42, 396-97.

[269] Jeremy De Beer, 'Network Governance of Biofuels' (2011) VALGEN Working Paper Series 2/2011, 11<http://jeremydebeer.ca/wp-content/uploads/2012/02/Network_Governance_of_Biofuels%20VALGEN%20Working%20Paper.pdf> accessed 12 March 2012.

[270] Calestous Juma and Bob Bell, Jr., 'Advanced Biofuels and Developing Countries: Intellectual Property Scenarios and Policy Implications' (2009) Belfer Centre for Science and International Affairs 76 <http://belfercenter.ksg.harvard.edu/files/ditcbcc20091_en_Juma_Bell_chapter.pdf> accessed 12 March 2012.

[271] Ibid.

[272] Stanley P Kowalski and R David Kryder, 'Golden Rice: A Case Study in Intellectual Property Management and International Capacity Building' (2002) 13 Risk: Health, Safety & Environment 47. See also, Clean Air Act Amendments of 1970, Public Law 91-604, § 211, 42 U.S.C. § 7545.

transfer. It is because there are too many patent holders and for use there has to be numbers of licenses and cross-licenses that increase the transaction cost and time.[273]

Patent pools are a mechanism for sharing technology covered by patents. The relevant patents are pooled together from a patent pool and shared through a licensing strategy.[274] Compared with a licensing strategy, which has been a commonly used instrument for agricultural biotechnology, patent pools in biotechnology have not developed as a response to fragmented patent ownership.[275] There is no example of functioning patent pools in the life sciences or biotechnology.[276] As a result, it is unclear yet, on a practical level, whether patent pools can resolve the issue of patent thickets being barriers for biofuel technology transfer. Juma and Bell commented that: 'If patent pools are a possibility in the area of biofuels, they are probably unlikely to change the underlying structural barriers to technology transfer. Patent pools are difficult to establish because of the divergent strategic interests of industry players…' Therefore, they believe that patent pools 'may assist with the process of licensing intellectual property but not necessarily with the sharing of know-how and trade secrets.'

IPRs do have significant meaning for the development of biotechnology. This point has been demonstrated deeply in many sectors. Some commentators have been enthusiastic about the use of patents in respect of biofuels.[277] However, as the biofuel patent landscape becomes increasingly crowded and fragmented, some other commentators expressed their concerns about the potential negative impacts of patents in this

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273 Suppan (n 249) 3.

274 Indrani Barpujari, 'Facilitating Access or Monopoly: Patent Pools at the Interface of Patent and Competition Regimes' (2010) 15 Journal of Intellectual Property Rights 345.

275 Charles Clift, 'Patenting and Licensing Research Tools' in Anatole Krattiger and others (eds), *Intellectual Property Management in Health and Agricultural Innovation: A Handbook of Best Practices* (MIHR and PIPRA 2007) 79-88; Juma (n 270) 77.

276 Arti Rai and James Boyle, 'Synthetic Biology: Caught between Property Rights, the Public Domain, and the Commons' (2007) 5(3) PloS Biology 0389.

277 Rimmer, 'Intellectual Property and Biofuels: The Energy Crisis, Food Security, and Climate Change' (n 240) 31.

discipline: Patents could be barriers for the translation and diffusion of biofuel technology.[278] In other words: Will a strong IP protection impede the transfer of biofuel technology? This issue has provoked debate with the rapid development of biofuel technologies, but epitomises the lack of empirical evidence available to guide decision making.

2.3.4 Two Sides of the IPRs Debate about Diffusion and Development

The relationship between intellectual property and innovation is far from straightforward.[279] A debate has begun in the pharmaceutical, semiconductor, and software industries over the role of intellectual property in innovation and technology transfer, but such a controversy has all but been ignored by the bioenergy or any other energy policy literature.[280] As a result, the role of IPRs in biofuels is particularly uncertain and dynamic.

There are essentially two sides to the IPR debate in relation to innovation and technology transfer in biofuels. Some observers claim that IPRs play a key role in both the R&D investment of biofuel technology and the diffusion of these advanced technologies. Firstly, it is well accepted that businesses drive innovation, and a good portion of intellectual property is produced as a result of financial investment.[281] R&D will only be procured on a meaningful level if there are financial incentives to do so and IPRs provide these incentives.[282] Therefore, it is risky to undermine an IPR system

[278] Suppan (n 249) 3.

[279] Ibid.

[280] Benjamin K Sovacool, 'Placing a Glove on the Invisible Hand: How Intellectual Property Rights May Impede Innovation in Energy Research and Development (R&D)' (2008) 18 Albany Law Journal of Science & Technology 381, 384.

[281] Justin Hughes, 'The Philosophy of Intellectual property' (1988) 77 Georgetown Law Journal 287, 291.

[282] Jonathan M W W Chu, 'Developing and Diffusion Green Technologies: The Impact of Intellectual

because this may discourage investors from supporting the technology in the first place, thereby running the risk of losing R&D financial support. That said, IPRs provide a guarantee to technology developers that their investment in developing technology will result in guaranteed rights to exploit them exclusively and rights to prevent others from using their technology without authority.

It is particularly true in the biofuel context. The Nuffield Council on Bioethics also observed: 'For biofuels in many cases, financial return will only be possible after the investment of very large sums of money, and intellectual property will play a key role in attempts to secure such a return.'[283] Wolek argued that patents are critical for companies wanting to engage in 'empire-building' in the area of biofuels. He argues that: 'The right to exclude competitors from using a patented technology for twenty years should draw substantial investment and ameliorate many investment concerns, as the potential gains of patenting a technology that becomes an industry standard may outweigh the risk.'[284]

Secondly, IPRs are also helped with technology diffusion. There are many persuasive arguments that strong IP regimes in developing countries will be critical to support the biotechnology innovations.[285] With this viewpoint, IPRs are seen as a catalyst rather than a barrier to the development of technologies, because strong IP protection can provide legal clarity and certainty, and the incentive to invest in risky industries, like the biofuel sector.[286] The argument is made that it is very important for investors to

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Property Rights and their Justification' (2012) Journal of Energy, Climate and the Environment 74.

283 Nuffield Council on Bioethics (n1) 62-63.

284 Adam Wolek, 'Biotech Biofuels: How Patents May Save Biofuels and Create Empires' (2011) 86(1) Chicago-Kent Law Review 256, 257.

285 Jane Payumo and Howard Grimes, 'Institutional Responses on Strengthened Intellectual Property Rights in Agriculture and Needs' Assessment on Intellectual Property Management of Public Research Institutions in Asian Developing Countries' (2011) 42 Journal of Research Administration 42.

286 IEA, *World Energy Outlook 2009* (OECD/IEA 2009) 48 <http://www.worldenergyoutlook.org/media/weowebsite/2009/WEO2009.pdf> accessed 11

make sure that their ability to commercialize products and technology is not impaired by third-party patents. It is also equally important for investors to make sure that their products and technologies are appropriately protected in relevant countries.[287] Clearly, investors are unlikely to deploy cutting-edge technologies that they have spent significant resources developing in countries where they cannot ensure adequate patent protection. With this in mind, IPRs are seen as a catalyst rather than a barrier to the transfer and diffusion of technologies.

However, some others argue that it is not likely to be correct. They believe that IPRs may impede innovation and access to new technologies in biofuel markets, as has happened in the pharmaceutical sector.[288] First, there are some structural barriers related to IPRs and innovation that arise naturally in market transactions. These include the perception of onerous intellectual property hurdles that prevent collaboration as well as high transaction costs, cognitive bias among researches, and low returns on energy related intellectual property.[289] Some argue that, IPRs are negative in nature, to some extent, setting exclusive rights to particular parties and excluding others from infringing on their monopoly.[290]

Second, compared with the structural and economic problems inherent in the IP system, more significant barriers related to IPRs arise from intentional, anti-competitive patent

November 2011.

287 Ibid.

288 Abbott, *Innovation and Technology Transfer to Address Climate Change: Lessons from the Global Debate on Intellectual Property and Public Health* (n 244); John H Barton, *International Diffusion of Climate Change Technologies in the Transport Sector* (Chartham House 2008) <https://www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy,%20Environment%20and%20Development/220408climate_transport.pdf > accessed 4 April 2012.

289 Sovacool (n 280) 381.

290 Such exclusive rights can be generally transferred, licensed, or mortgaged to third parties. See, Roger E Schechter and John R Thomas, *Intellectual Property: The Law of Copyrights, Patents and Trademarks* (Thomson/West 2003) 5, 105, 111-12,770, 779.

techniques.[291] Firms may intentionally use IPRs as tools to impede innovation and competition, it may happen because IPRs enable firms which own patented technologies to price products prohibitively high, or use trade secret rights instead of refusing to file for a patent, to keep a novel process or product out of the reach of the market.[292] Therefore, the market power provided by IPRs, by allowing owners to limit the availability, use, or development of a process or product, may result in prices that exceed the socially optimal level and hamper the access and transfer of these technologies.[293]

The intentional barriers related to IPRs are likely to arise in the biofuel field. As demonstrated, plenty of biofuel technology patents are dominated by a limited group and mixture of private-public ownership.[294] The combination of patents over enzymes, incur-organisms and plant varieties in biofuels has, to some extent, resulted in a patent thicket, which makes it difficult for the public to access to such innovation. Consequently, it impedes biofuels innovation and technology diffusion. Although governments can use options like patent pools and compulsory licensing to make these technologies available for use by public sector breeders and others, it argues that the effect of doing so is still limited.[295]

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291 Marilyn A Brown and others, 'Carbon Lock-in: Barriers To Deploying Climate Change Mitigation Technologies' (Report ORNL/TM-2007/124, Oak Ridge National Laboratory 2007) 73-76 <http://www.researchgate.net/publication/228597730_Carbon_Lock-In_Barriers_To_Deploying_Climate_Change_Mitigation_Technologies> accessed 30 July 2015.

292 Ibid.

293 Bernard M Hoekman, Keith E Maskus and Kamal Saggi, 'Transfer of Technology to Developing Countries: Unilateral and Multilateral Policy Options' (2004) Institute of Behavioral Science Research Program on Political and Economic Change Working Paper PEC2004-0003 <http://www.colorado.edu/ibs/pubs/pec/pec2004-0003.pdf> accessed 12 March 2012.

294 It also illustrated that these technologies are dominated by a small group of countries, which excluded the poorest developing countries. The issue of technology transfer between countries will be discussed later in this chapter.

295 Cynthia Cannady, 'Access to Climate Change Technology by Developing Countries: A Practical Strategy' (IPRs and Sustainable Development Issue Paper 25, ICTSD 2009) 4, 7-11 <http://www.ictsd.org/downloads/2009/11/access-to-climate-change-technology-by-developing-countries-cannady.pdf> accessed 30 July 2015.

That is to say, instead of determining the value of the IP system or view IP protection as an absolute obstacle that should be moved, it is believed that the existence of IP protection does not guarantee or suffice for effective transfer of biofuels technology. One position is to 'keep the status quo, but implement it more effectively, such as through improved flow of information about patented technologies, and licensing opportunities'.[296] This position is adopted by Taubman, he suggested that the current patent system needed to reform in the field of clean technologies and climate change.[297] He viewed biofuel technologies as public goods, contributing as they do to the mitigation of future carbon emissions. Therefore, there is a need for the use of more flexible and effective IP instruments, including compulsory licensing and patent pools, to provide increased access to and diffusion of clean technology in the biofuel field.

2.3.5 Conclusion

IPR is the primary policy mechanism for encouraging innovation. They undoubtedly have a critical role to play in facilitating technology transfer in the biofuel sector, and broader bio-agriculture contexts. Among the variety of IP instruments, patent protection is closely link to biofuel technology. With increasing numbers of biofuel technology-related patent application, there is much confusion relating to the relationship between IP protection and biofuel technology development and transfer. Some argue that strong IPRs might work as barriers to public access to clean energy technologies, and impede the development and diffusion of biofuel technologies. On the contrary, some others believe that strong IPRs induce innovations and technology transfer is deeply embedded in many countries' history, culture and law, and essential for supporting biotechnology innovations. The key question relating to the two sides of the debate over IPRs and biofuel technology is how to balance IPR holders' private rights and the public

[296] Antony Taubman, *A Practical Guide to Working with TRIPS* (OUP 2011) 191.

[297] Ibid.

rights, but a clear conclusion will not be easy. The reason needs to be further explored within the climate change context, and needs consideration of all the different group interests of developed countries and developing countries.

2.4 Climate Change, IPRs, and Biofuel Technology Transfer

2.4.1 Introduction

In order to meet their objectives for mitigation and adaptation in climate change, and move towards a clean, sustainable energy future, developing countries need access to green energy technologies, including biofuel technologies at affordable prices. However, it is argued that IPRs work as a barrier to transfer these low carbon technologies, and in turn impede the process of climate change mitigation. This issue falls in the centre of the dividing point between developed nations and developing nations. In order to facilitate the transfer and development of the climate-related technologies in developing countries, provisions were enacted in both the United Nations Framework Conventions on Climate Change (UNFCCC) and the 1994 Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) to highlight the importance of technology transfer to developing countries.

This section firstly discusses the relationship between technology transfer and climate change, to show why and how important it is to make great efforts in facilitating low carbon technology transfer and diffusion in the context of climate change. Continually, it highlights the significance of climate-related technology transfer for developing countries. After that, it reanalyses the issue of IPRs and biofuel technology transfer. Conflicting perspectives from developing countries and developed countries about this issue are carefully examined in this part. Lastly, it discusses the relevant parts of two significant international treaties: the UNFCCC and the TRIPS Agreement of the WTO, to illustrate what efforts the international community has made to transfer low carbon technologies for developing countries, and whether it is enough.

2.4.2 Climate Change and Rational of Biofuel Technology Transfer

Climate change will bring 'increased deaths, disease and injury due to heat waves, floods, storms, fires and droughts.'[298] 'There is medium confidence that approximately 20 to 30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in the global average temperature exceed 1.5 to 2.5°C over 1980–1999 levels.'[299] According to UNDP, 'Climate shocks such as drought and floods can cause grave setbacks in nutritional status as food availability declines, prices rise and employment opportunities shrink.'[300] These vivid descriptions indicate the scope and scale the threat that climate change poses to our survival.[301] The Stern Review on *The Economics of Climate Change* and the fourth assessment report by the IPCC catapulted climate change to the very top of public awareness and political agendas in many countries and indeed internationally.[302] As awareness of the serious and far-reaching consequences of climate change continues to grow, communities are looking for solutions to slow down, halt and mitigate these effects.

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298 Elizabeth Burleson, 'A Climate of Extremes: Transboundary Conflict Resolution' (2008) 32 Vermont Law Review 477, 499. See also, Martin Parry and others, *Climate Change 2007: Impacts, Adaptation and Vulnerability* (Working Group II Contribution to the Fourth Assessment Report of the IPCC, CUP 2007) 12 <https://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4_wg2_full_report.pdf > accessed 2 September 2012.

299 IPCC, *Climate Change 2007: Synthesis Report* (n 50) 64.

300 United Nations Development Programme, *Human Development Report 2007/2008: Fighting Climate Change: Human Solidarity in a Divided World* (Palgrave Macmillan 2007), 86 <http://hdr.undp.org/sites/default/files/reports/268/hdr_20072008_en_complete.pdf> accessed 12 September 2012. This issue will be further discussed in Chapter Three.

301 For more discussion about climate change, see also Chapter Three.

302 Ingolfur Bluhdorn, 'Introduction: International Climate Politics Beyond the Copenhagen Disaster' (2012) 11 European Political Science 1.

Industrialization, modernization and technological breakthrough are posing a greater challenge in contemporary international policies.[303] Technology transfer has long been seen as the integral component among these solutions of effective climate change mitigation and adaptation strategies.[304] There is no single definition for 'technology transfer'. According to IPCC 2000, 'technology transfer' is the 'broad set of processes covering the flows of knowledge, experience and equipment amongst different stakeholders such as governments, private sector entities, financial institutions, NGOs and research/educational institution'.[305] Accordingly, the issue of transfer of technology is not exhausted in the transmission of the hardware, but includes technologies being adopted locally, know-how being shared, and the human skills using and learning how to use it effectively. It usually takes many efforts with varied approaches generally tailored to the local particular circumstances. Therefore, technology transfer is a process that cannot occur overnight or forced upon participants, because it requires the domestic capacities to absorb and master the received knowledge, innovate knowledge, and commercialize the results.[306]

As well as the uncertain definition of 'technology transfer', the definition of 'climate friendly technology transfer' is also unclear. Although it is widely accepted that technology development and diffusion is necessary for achieving the goal of climate change mitigation and adaptation, there is no universally accepted method to assess

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303 Sheriff Ghali Ibrahim and Iro Iro Uke, 'From Kyoto Protocol to Copenhagen: A Theoretical Approach to International Politics of Climate Change' (2013) 7(3) African Journal of Political Science and International Relations 142.

304 Charles Ebinger and Govinda Avasarala, 'Transferring Environmentally Sound Technologies in an Intellectual Property-Friendly Framework' (ESI Policy Brief 09-08, Brookings Energy Security Initiative 2009) 11 <http://www.brookings.edu/~/media/research/files/papers/2009/11/environmental-technology-ebinger/11_environmental_technology_ebinger.pdf> accessed 11 November 2011.

305 Bert Metz and John K Turkson, *Methodological and Technological Issues in Technology Transfer: Special Report of IPCC Working Group III* (CUP 2000).

306 Ravi Srinivas Krishna, 'Climate Change, Technology Transfer and Intellectual Property Rights' (2009) RIS Discussion Paper Series, RIS-DP #153, 3 <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1440742> accessed 11 March 2011.

whether a technology is really climate/environmentally friendly or not.[307] In general, technologies that result in reduction of GHG emissions and technologies that increase the energy efficiency can be considered as climate/environmentally friendly technologies. A definition is given by Agenda 21 of UNFCCC. It states that environmentally sound technologies are the ones that 'protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they were substitutes'.[308] Accordingly, it may be found that the scope of 'environmentally sound technologies' is wider than 'climate friendly technologies'. However, for this research, it does not make much difference and they can be viewed as referring to the same thing. Therefore, other terms such as 'clean technologies', 'green technologies', 'environmental technologies', 'climate related technologies', and 'mitigation and adaptation technologies', or variations thereof, could be used as alternative names of this conception. Biofuel technology is viewed as climate-friendly technology, as some new approaches to biofuel development are likely to fare well in terms of their GHG emissions savings. For example, the use of algal biofuels produced using nutrient-rich wastewater and carbon dioxide-rich flue gas from power stations could enable the scaling up of production and significant GHG emission savings.[309]

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[307] Ibid, 2.

[308] Agenda 21 is a proposal which was reached as an inclusive agreement that 'crystallized' the conspicuous North-South dichotomy after a 15-month long negotiations process in June 1992 in Rio. See, UN Development Programme, 'Agenda 21: Earth Summit-The United Nations Programme of Action from Rio (1993) <https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf> accessed 13 June 2013. See also, Gaetan Verhoosel, 'Beyond the Unsustainable Rhetoric of Sustainable Development: Transferring Environmentally Sound Technologies' (1998) 11 Georgetown International Environmental Law Review49, 62-66.

[309] Nuffield Council on Bioethics (n 1) 96. Although biofuel technologies are climate-friendly, they could have negative impacts on the environment in some circumstances. It will be discussed in Chapter Three.

The importance of technology transfer as one of numerous components required to tackle climate change has been mentioned at many international environmental summits since the 1972 Stockholm Convention.[310] At Stockholm, leaders thoughtfully discussed the importance of the transfer of resources, including capital, technology, and scientific expertise, from richer to poorer countries.[311] Since that summer, the importance of technology transfer to global cooperation on the environment was recognized from the start.[312] Moreover, 1987 Montreal Protocol, was implemented fully in 1989 and, amended in 1990 in London to establish the Multilateral Fund (MLF).[313] At the time of implementation, the MLF was the most comprehensive mechanism for facilitating technology transfer.[314]

After the creation of the Montreal Protocol, the 1992 Rio Earth Summit was another important meeting for the promotion of technology transfer.[315] Technology transfer posed a greater point of contention than expected. More and more international efforts are made to facilitate climate-related technology transfer and development in developing countries with the great challenged of climate change and sustainable

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[310] Declaration of the United Nations Conference on the Human Environment 1972 (5-16 June 1972) UN Doc A/Conf48/14 Rev 1(1973) Principle 1 <http://www.un-documents.net/aconf48-14r1.pdf> accessed 23 June 2012.

[311] Paul Kennedy, *The Parliament of Man: the Past, Present, and Future of the United Nations* (Random House 2007) 160.

[312] Ebinger (n 304) 11.

[313] Montreal Protocol on Substances that Deplete the Ozone Layer (adopted 16 September 1987, entered into force 1 January 1989) 1522 UNTS 3; 26 ILM 1550. The MLF is the first financial mechanism to result from an international treaty. Available at: <www.multilateralfund.org> accessed 21 March 2012.

[314] Ebinger (n 304) 12.

[315] There also are some other important climate change conferences and conventions after the Montreal Protocol, including a 1988 conference in Toronto, the 1989 Basel Convention, and the 1991 Convention in Espoo, Finland. See, Ibid, 13.

development.[316] As a result, the UNFCCC was established after 1992 Rio Summit.[317] Significant attention has also been paid to technology transfer in the texts of Agenda 21[318] and the UNFCCC framework proposal. Agenda 21 declares: '[T]he availability of scientific and technological information and access to and transfer of environmentally sound technology are essential requirements for sustainable development.'[319] Furthermore, the UNFCCC document went into even more detail. Instead of simply mentioning the importance of technology transfer, significant attention was paid to technology transfer in the texts of the UNFCCC proposal. For example, it made technology transfer as an Annex II party's responsibility.[320] Moreover, it made a specific draft for the method of implementation.[321]

The 2009 United Nations Climate Change Conference, commonly known as the Copenhagen Summit, was also an important international climate meeting for technology development and transfer.[322] There were vigorous discussions between developed and developing countries on concrete issues of technology development and transfer, including address the role of R&D and IPRs, market access, and technology

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316 Paul Lewis, 'U.S. at the Earth Summit: Isolated and Challenged' *New York Times* (New York, 10 June 1992) <http://www.nytimes.com/1992/06/10/world/us-at-the-earth-summit-isolated-and-challenged.html> accessed 11 April 2011.

317 UNFCCC, art 4.5.

318 UN Development Programme, 'Agenda 21: Earth Summit-The United Nations Programme of Action from Rio de Janeiro' (1993) <https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf> accessed 13 June 2013.

319 Ibid, Section 4, Chapter 34.7.

320 Annex II parties are Annex I OECD members responsible for providing financial resources to non-Annex I parties.

321 Further discussion about the UNFCCC is conducted in Section 2.4.5.1.

322 Zhou Chen, 'Climate Change: Legal Impediments to Technology Transfer' in Paul Martin, Zhiping Li and Tianbao Qin (eds), *Environmental Governance and Sustainability: IUCN Academy of Environmental Law Series* (Edward Elgar Publishing 2012) 278; Adam Jolly and Jeremy Philpott, *The Handbook of European Intellectual Property Management: Developing, Managing and Protecting Your Company's Intellectual Property* (3rd edn, Kogan Page Publishers 2012) 91.

financing on the conference.[323] Submitted proposals for discussing included a multilateral technology fund, compulsory licensing, patent pooling, and government incentives for technology transfer to developing countries.[324] Although many of them were firmly rejected by developed countries, the fact that the strong presence of IPRs in clean technology, owned by the developed countries, constituted a major barrier to developing economies' GHG abatement efforts was an issue that was significantly highlighted after the Copenhagen Summit.[325]

2.4.3 IPRs, Climate change and Developing Countries

The relationship between climate change and developing nations has been highlighted at the international level. On the one hand, climate change will have varying and disproportionate effects across the globe. Developing countries are more vulnerable to the negative impacts of climate change because their economies are still largely driven by the agricultural sector. It means developing countries have greater dependence on the natural environment.[326] Nevertheless, they commonly have lack of access to appropriate adaptation technologies compared with developed nations. The negative impacts of climate change are more sever and less predictable for low-lying small island countries, such as the Maldives and Bangladesh, as they are threatened by rising sea levels.

On the other hand, industrialization and economic activities in developing countries have enormous implications for climate change. Many developing countries, especially

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323 Radoslav S Dimitrov, 'Inside UN Climate Change Negotiations: The Copenhagen Conference' (2010) 27(6) Review of Policy Research 795.

324 Ibid.

325 Copenhagen Economics and The IPR Company, 'Are IPR a Barrier to the Transfer of Climate Change Technology?' (Copenhagen Economics 2009) <http://trade.ec.europa.eu/doclib/docs/2009/february/tradoc_142371.pdf> accessed 19 June 2013.

326 Ebinger (n304) 12.

the emerging economies such as India and China, are in the early stages of unprecedented levels of economic growth.[327] From 1990 to 2001, industrialization resulted in a 61% increase in carbon emissions for India, and a 111% increase in carbon emissions for China.[328] It is predicted that foreseeable growth in global emissions will come predominantly from developing countries.[329] The industrialized world has voiced its displeasure about proposed abuses of developing countries' responsibility from an environmental perspective. They aim at ensuring that developing nations, especially India and China, pay for their steep emissions growth rates over the past two decades. Therefore, clean energy technologies are important for developing countries to maintain economic development, as well as take their responsibility in climate change. It is now widely recognized that one of the imperative ways in which to mitigate climate problems is through the development and diffusion of clean, low carbon technologies.[330] However, many environmentally sound technologies are owned by private firms in developed countries.

More attention has been paid on issues of transferring these technologies to developing countries. It is a familiar issue for both national policymakers and multilateral rulemaking in the WTO, but technology transfer across countries is never easy. The technological dominance of the developed nations is a major factor that cannot be ignored. More than 95% of global R&D currently takes place in OECD countries.[331]

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327 David G Ockwell and others, 'Key Policy Considerations for Facilitating Low Carbon Technology Transfer to Developing Countries' (2008) 36 Energy Policy 4104.

328 Ebinger (n 304) 16.

329 IEA, *World Energy Outlook 2009* (n 286) 361.

330 IPCC, *Climate Change 2007 - Mitigation of Climate Change: Working Group III to the Fourth Assessment Report of the International Panel on Climate Change* (CUP 2007) <https://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg3_report_mitigation_of_climate_change.htm> accessed 11 November 2011.

331 Jerome Reichman and others, 'Intellectual Property and Alternatives: Strategies for Green Innovation' (2008) Energy, Environment and Development Programme Paper 2008/03, 4 <https://www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy,%20Environment%20and%20Development/1208eedp_duke.pdf> accessed 11 July 2014.

The US remains the world's largest R&D investor with projected $465 billion spending in 2014.[332] In relation to renewable energy technologies, the great majority of patents worldwide are also held by companies in western economies. In 2005, the EU countries held 36.7% of patents linked to renewable energy, the US and Japan held 20.2% and 19.8% respectively.[333] For biofuel patents, as illustrated in the last section, the picture is similar: an overwhelming majority of them was held by developed countries. Clearly, developed countries have absolute supremacy with patent rights of climate-related technologies.[334]

However, it is argued that developed nations which hold patent rights have been using the IP supremacy and strong IP protection schemes to restrict transfer and diffusion of technology to developing countries for decades. In the international negotiations on climate change, developing countries came up with proposals asking for access to renewable energy technologies at an affordable price, to ensure that the IP protection in developed world did not impede the measures that needed to be taken to reduce the GHG emission and mitigate climate change.[335] The role of IPRs in development and transfer of technologies in the context of climate-change has attracted much attention in the recent literature and debates on climate change.[336] Therefore, biofuel technology

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332 Martin Grueber and Tim Studt, '2014 Global R&D Funding Forecast' (Battelle and R&D Magazine 2013) 4 <http://www.battelle.org/docs/tpp/2014_global_rd_funding_forecast.pdf> accessed 11 July 2014.

333 OECD, *Compendium of Patent Statistics* (OECD Publishing 2008) 21.

334 It is reasonable to ask why there are so many R&D activities and patents in developed countries. Is it evidence that a strong IPR system in developed countries facilitates technology development? Is the current strong system also workable for developing countries? It is worth keeping these questions in mind. These issues are further explored in the next section.

335 Krishna (n 306).

336 Gregory N Mandel, 'Promoting Environmental Innovation with Intellectual Property Innovation: A New Basis for Patent Rewards' (2005) 24(1) Temple Jounral of Science, Technologoy & Environmental Law <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=756844&download=yes> accessed 11 March 2011; Brad Sherman and Nicola Atkinson, 'Intellectual Property and Environmental Protection' [1991] European Intellectual Property Review 165; F Scott Kieff, 'Patents for Environmentalists' (2002) 9 Washington University of Law and Policy 307.

transfer is concerned with making sure these technologies diffuse throughout developing economies and that this transfer occurs as rapidly as possible in order to respond to the urgency of climate change. From this perspective, international cooperation and policy interventions to encourage wide and rapid biofuel technology transfer to developing countries without barriers is necessary.

2.4.4 Conflicting Discourses of Developing and Developed Countries

2.4.4.1 Conflict Political Position behind the Issue of Technology Transfer

As demonstrated in Section 2.3.4, there are two conflict opinions in the IPR debate in relation to technology transfer in the biofuel industry. On the one side, commentators assert that biofuel technologies are public goods that should be freely available, because of their potential for avoiding future GHG emissions and mitigating climate change. Therefore, strong IP protection should not be encouraged as it will impede the transfer of biofuel technology. On the other side of the debate, some argue that low carbon technology transfer will be better facilitated if (developing) countries tighten up their legal frameworks for IPR protection, and the enforcement thereof. Both sides of the argument are made from persuasive evidence. This section will go further pursuing the issue as to why there are two conflicting opinions on this issue.

In general, it is because whether stronger IP protection results in more transfer and better development of technology is a controversial issue. It has been argued that: 'The results are far from definitive as a consequence…it would be premature to make strong claims on the basis of the limited evidence to date…'[337] In the biofuel sector, different

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[337] Rod Falvey and Neil Foster, 'The Role of Intellectual Property Rights in Technology Transfer and Economic Growth: Theory and Evidence' (2006) UN Industrial Development Organization Working Papers, 45 <https://www.unido.org/fileadmin/user_media/Publications/Pub_free/Role_of_intellectual_property

stages of development of biofuel technologies, from R&D through to commercial diffusion, introduce new and unique barriers, opportunities and policy challenges which are not yet properly understood. The relationship between IPRs and technology transfer is complex that there is no general accepted method to analyze or describe it. When different factors, modules and methodologies apply, it could lead to different or even conflicting conclusions.[338] Furthermore, the results are likely to be different when applied to individual nations. No adequate empirical evidence exists upon which to get a clear conclusion. IPRs do have positive and negative impacts on technology transfer. However, the impacts need to be analyzed case by case.

More importantly, two conflicting arguments are presented by developing countries and developed economies respectively. Although individual country positions on how to implement technology transfer differ within the group of developing and the group of developed countries, there are strong similarities amongst developed countries and strong similarities amongst developing countries regarding the policies for IP protection and mechanisms for technology transfer.[339] In the UN climate negotiations over the past decades, it is widely agreed that developed countries must provide more financial and technological support to developing countries in reducing their emissions. But the level of support, the mechanisms for providing it and the relative burden across countries is matter for negotiation.[340] One of the central dividing points is the attitude to IPRs to climate-related technologies. Developing countries assert the need to address IPR issues within the negotiations on technology transfer. By contrast, developed countries, especially the US, insist that strong IP protection is a catalyst that could facilitate technology transfer, instead of acting as a barrier to it.[341] It is argued that, the

_rights_in_technology_transfer_and_economic_growth.pdf> accessed 19 June 2013.

338 Ibid.

339 David G Ockwell and others, 'Intellectual Property Rights and Low Carbon Technology Transfer: Conflicting Discourses of Diffusion and Development' (2010) 20 Global Environmental Change 729, 730.

340 IEA, *World Energy Outlook 2009* (n 286) 48.

341 Xiaolan Fu and Jing Zhang, 'Technology transfer, indigenous innovation and leapfrogging in green

conflicting opinions on IPRs and biofuel technology transfer have their roots in a historical North-South divide concerning economic development and environmental responsibility.

2.4.4.2 Developed Countries Discourse

A north-south gap historically exists in terms of technology ownership and technological capacity, with developed countries having a clear technological advantage.[342] Developed countries agreed that it is important to transfer ESTs to developing countries, to achieve rapid and widespread diffusion of these technologies so as to reduce GHG emissions associated with future economic development in these countries. However, they approach the issue from a very different perspective to developing countries, which is through a strong IPR system.

Firstly, developed nations espouse the view that the process of diffusing technology need to be conducted via providing market mechanisms and incentives to overcome higher costs, instead of government intervention. It is believed that private firms' (patent holders') responses to market based mechanisms is the primary vehicle for achieving technology transfer.[343] Public interventions in the form of international and intergovernmental support which directly help access to technologies have just a very limited role.[344] One example of market mechanisms is the provision of carbon credits

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technology: the solar-PV industry in China and India' (2011) 9 Journal of Chinese Economic and Business Studies 329.

[342] David Ockwell and others, 'Enhancing Developing Country Access to Eco-Innovation: The Case of Technology Transfer and Climate Change in a Post-2012 Policy Framework' (2010) OECD Environment Working Papers No. 12, 18 <http://www.oecd-ilibrary.org/docserver/download/5kmfplm8xxf5.pdf?expires=1428941815&id=id&accname=guest&checksum=99CA53DBFDE7D4FB6D78918D9A7DED24> accessed 19 June 2013.

[343] Ockwell, 'Intellectual Property Rights and Low Carbon Technology Transfer: Conflicting Discourses of Diffusion and Development' (n 339).

[344] Ibid.

under the Clean Development Mechanism (CDM).[345] It provides regulations for investment in new technology based infrastructure in developing countries, which is argued as a possible way for achieving technology transfer.[346] Moreover, Brunnermeier and Cohen used US manufacturing industry data and empirically analyzed factors that determined environmental technological innovation.[347] They found that international competition stimulates environmental innovation, therefore, being positive to the development of ESTs.[348]

In addition, developed countries tend to emphasise the endogenous capacities of developing countries. They are in favour of encouraging developing countries to implement domestic policies to support biofuel technology development rather than contributions to international supports for technology acquisition.[349] It is argued that legislation and broad-based public policy plays a significant role in determining patent applications in the renewable energy field. More targeted subsidies, such as feed-in tariffs, are needed to induce innovation on more costly renewable energy technologies.[350]

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345 The CDM is a market-based instrument for carbon trading, which allows emission-reduction projects in developing countries to earn certified emission reduction, known as CER credits, each equivalent to one tonne of CO2. These CERs can be traded and sold, and used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol. For more information about the CDM and carbon trading, see, Gurmit Singh, *Undersatnding Carbon Credits* (Aditya Books Pvt. Ltd. 2009).

346 However, there is a lack of evidence that the intentions of many CDM projects to transfer technologies have been realised through improved low carbon capabilities in developing country firms. Ibid, 732.

347 Smita B Brunnermeier and Mark A Cohen, 'Determinants of Environmental Innovation in US Manufacturing Industries' (2003) 45(2) Journal of Environmental Economics and Management 278.

348 Ibid.

349 Ockwell, 'Key Policy Considerations for Facilitating Low Carbon Technology Transfer to Developing Countries' (n 327).

350 For more discussion, see Nick Johnstone, Ivan Haščič and David Counts, 'Renewable Energy Policies and Technological Innovation: Evidence Based on Patent Counts' (2010) 45 Environ Resource Econ 133.

2.4.4.3 Developing Countries Discourse

Compared with developed countries, developing nations do not have enough funds to support R&D of new generation biofuel technology, which makes them heavily depended on imported technology. However, it is believed that strong IPR in the developed world on advanced technology (including biofuel technology) would reduce the scope for informal technology transfer via imitation, which was an important form of learning and technical change in developing countries.[351] Kim pointed out that in the initial stages Korea acquired and assimilated mature technologies and undertook duplicative imitation. He argues that at the initial stages strong IP protection would hinder rather than enable technology development of local capacities of developing countries.[352] Moreover, although it is generally accepted that strong IP protection provides incentives for firms from developed countries, there is no clear evidence to show that it will also benefit developing countries at the initial stages of their development.[353] Furthermore, it has been argued that the experience of development of Asia (mainly Japan) shows that weak IP protection helped in building up local indigenous capacity when countries were at low levels of development. Stronger IP protection, however, would only benefit the technologically dominant countries.[354]

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351 Bach (n 235) 10-12.

352 Linsu Kim, *Technology Transfer and Intellectual Property Rights: the Korean Experience* (UNCTAD-ICTSD 2003) <http://www.ictsd.org/downloads/2008/06/cs_kim.pdf> accessed 19 June 2013.

353 Cristina Tébar Less and Steven McMillan, 'Achieving the Successful Transfer of Environmentally Sound Technologies: Trade-Related Aspects' (2005) OECD Trade and Environment Working Paper No. 2005-2 <http://www.oecd.org/tad/envtrade/35837552.pdf> accessed 19 June 2013.

354 Nagesh Kumar, 'Intellectual Property Rights, Technology and Economic Development: Experiences of Asian Countries' (2003) 38(2) Economic & Political Weekly 209. For more information about the relationship between level of the IPRs and economic development, see, Carlos Alberto Primo Braga, Carsten Fink and Claudia Paz Sepulveda, *Intellectual Property Rights and Economic Development* (Word Bank Publications 2000) 41-49.

Developing countries clearly understand the significance of technology for economic development, and have begun to highlight the value of sustainable development and environmental protection. They have an ambitious wish to develop significant indigenous expertise in environmentally sound technologies. In the biofuel sector, developing countries have begun to emphasize the importance of clean, low carbon energy technologies in the process of reducing GHG emissions and mitigating climate change. At the same time, they have been very vocal at international conventions on climate change. The negotiating positions of developing countries on technology transfer focus on policy mechanisms that prioritise access to advanced technologies.[355] One important proposal from developing countries under the TRIPS Agreement is about the extension of compulsory licensing flexibilities on public health to climate change, by arguing that an improved environment is a public good, which is much like public health.[356]

For industrialized countries, the key factor for mitigating climate change is recognition of a need for global action so as to avoid future costs.[357] Every nation needs to take responsibility even if it is costly and slows down domestic economic growth. However, developing countries have a very different perspective. They are acutely aware that developed nations are the foremost culprits of anthropogenic climate change. If emerging economies need to pay any climate change abatement costs caused by their economic development, developed nations should pay more, because the majority of the current stock of atmospheric GHGs and the associated warming over the next few decades is a result of the economic activity of developed nations since the Industrial Revolution.[358]

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355 Ockwell, 'Intellectual Property Rights and Low Carbon Technology Transfer: Conflicting Discourses of Diffusion and Development' (n 339) 729.

356 Copenhagen Economics and The IPR Company (n 325) 7.

357 Nicholas Stern, *The Economics of Climate Change: The Stern Review* (CUP 2007) 473,552.

358 -- -- 'Global Climate Change: General Issues' (Worksheets on Climate Change, Germanwatch 2014) 7 <https://germanwatch.org/en/download/9004.pdf> accessed 13 March 2015.

Moreover, as large populations in developing countries still struggle for food and basic standard of living, these countries feel fully justified in pursuing the primary goal of economic development and poverty alleviation. It is unfair to require developing countries to take the same responsibility of emission reduction as industrialized nations at the expense of such development. Developed nations never faced such constraints. This opinion has been supported by some international research groups and conventions. For example, the IPCC argued in its 'Response Strategies' report that 'rapid transfer, on a preferential basis to developing countries of technologies to monitor, limit or adapt to climate change without hindering their economic development is an urgent requirement'.[359] The report listed a range of impediments to effective technology transfer, including high capital costs, lack of resources, shortcomings of local institutions, and social factors.[360] It also highlighted that the existing international arrangements should be strengthened and expanded to facilitate technology transfer to developing countries.[361]

However, many studies have suggested that access to cutting-edge technologies by developing countries is still limited.[362] This is because, firstly, as demonstrated above, a vast majority of advanced biofuel patents are concentrated in developed countries and several emerging economies, but very little or no activity in most developing countries. The limitation of R&D capacity makes those small developing countries and LDCs lose their opportunity to access advanced technologies in the first stage. Secondly, developed world has a strong regime of IPR protection, while developing countries as a whole have 'weak' IPR laws that are often denied access to innovations. It is because

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359 IPCC, *Climate Change: The IPCC Response Strategies* (WMO/UNEP 1990) 225 <https://www.ipcc.ch/ipccreports/far/wg_III/ipcc_far_wg_III_full_report.pdf> accessed 7 June 2013.

360 Ibid.

361 Ibid.

362 Barton, *Intellectual Property and Access to Clean Energy Technologies in Developing Countries: An Analysis of Solar Photovoltaic, Biofuels and Wind Technologies* (n 248) 13-14.

the private sector is playing a significant role in biofuel patents, strong IP protection generally is a pre-requisite for companies introducing their technologies to new markets, as it can provide clarity and certainty to the market that is required by private foreign investors.[363] As a result, it means that the only way developing countries can access the most advanced version of biofuel technologies is by importing from a limited number of firms in developed countries through purchasing or licensing. It means that in the process of technology transfer and development, to a large extent, developing countries are in a position of passive acceptance. However, companies holding patents to new technologies and enzymes for advanced biofuels may be hesitant to make these available on the markets of developing countries, or they may charge developing country firms a cost licensing fee outside the market price.

Even some efforts were made by developed countries to transfer technologies to the developing world via international agreements. The technologies transferred were usually not 'cutting-edge'. This is because generally old/normal technologies and advanced technologies raise different issues. For normal technologies, there is still a chance for developing countries to access them, although they may have to face a higher price than the marginal value. Advanced technology is never easily to accessed by developing countries because of the protection of strong IP systems in the developed world. This is because companies in developed countries prefer that their patent rights have absolute supremacy. They are willing to sell their technologies only when the transfer would not increase technological capacity of developing country firms that risk their dominant position in market. As a result, they are more likely to use IPRs to prohibit access to the cutting-edge technologies.[364]

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363 Lily Fang, Josh Lerner and Chaopeng Wu, 'Intellectual Property Rights Protection, Ownership, and Innovation: Evidence from China' (2015) INSEAD Working Paper No. 2015/54/FIN <http://socialsciences.cornell.edu/wp-content/uploads/2015/03/Intellectual-Property-Protection.pdf> accessed 30 July 2015.

364 Ockwell, 'Intellectual Property Rights and Low Carbon Technology Transfer: Conflicting Discourses of Diffusion and Development' (n 339) 736.

The control of biofuel technologies by firms in developed countries can impede the ability of developing countries to have meaningful and affordable access to advanced biofuel technologies. As a result, a small number of firms in developed countries control the global biofuel market, as has happened in many other sectors, such as the pharmaceutical sector and automobile sectors.[365] Although developed country governments argue that the strong IP protection is necessary and essential to facilitate technological development and attract FDI, developing countries see the strong IPR system in the developed world as simple protectionism on behalf of powerful western economies. For example, the US manufacturing sector in 1995 had in excess of a $20 billion trade surplus on licence fees and royalties on industrial processes sold abroad.[366] Ockwell pointed out that the strong IPR scheme works as 'a strong political incentive for pushing for stricter patent enforcement in developing countries, particularly within rapidly expanding markets such as China and India'.[367]

As is demonstrated above, it is difficult to make developed and developing countries agree with each other on the issue of IPRs and technology transfer, as it is deeply rooted in the historical conflict between political positions. Enhanced technological capacity and facilitating economic development in developing countries is never a priority for developed countries. On the contrary, the powerful Western economies and their

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365 Abbott, *Innovation and Technology Transfer to Address Climate Change: Lessons from the Global Debate on Intellectual Property and Public Health* (n 244); Barton, *International Diffusion of Climate Change Technologies in the Transport Sector* (n 288).

366 UNCTAD-ICTSD, *Intellectual Property Rights: Implications for Development* (UNCTAD-ICTSD, 2003) 37 <http://www.iprsonline.org/unctadictsd/Policy%20Discussion%20Paper/PP_Introduction.pdf> accessed 19 July 2013.

367 David Ockwell, *Intellectual Property Rights and Low Carbon Technology Transfer to Developing Countries – A Review of the Evidence to Date* (UK-India Collaboration to Overcome Barriers to the Transfer of Low Carbon Energy Technology: Phase 2, Sussex Energy Group, TERI and IDS 2008) 4 <https://www.sussex.ac.uk/webteam/gateway/file.php?name=spru-teri-ids-phase-2-iprs-and-low-c-tt-final.pdf&site=264> accessed 19 July 2013.

companies want to maintain competitive advantage in the global market via a strong IP protection and absolute technological advantage. This kind of political consideration is common in developed nations, most notably the US, in climate negotiations. Although developed nations have made some efforts to support low carbon technology deployment in developing nations under some international agreements, these efforts have not directly contributed to any significant 'catching up' by potential competitor firms in developing countries. Therefore, in developing country firms, it is generally not possible to have access to the most recent 'cutting-edge' variants or vintages of the particular biofuel technologies. The competing discourses imply very different policy options on IPRs, and it is a challenge for developing countries to overcome IP as a barrier to the technology transfer. Ockwell suggests that IPRs play a part in prohibiting developing country firms access to variants of clean, low carbon technologies, even if they do not prohibit the access *per se* to these technologies.[368]

2.4.5 Treaties Calling for Technology Transfer to Assist Developing Nations

2.4.5.1 The UNFCCC

To resolve the North-South tension, significant efforts are made by the international community. This is reflected in numerous documents produced over time in the implementation and negotiating processes of the UN Framework Convention on Climate Change (UNFCCC). The UNFCCC was ratified by one hundred ninety five countries, and entered into force on March 21, 1994.[369] It recognizes that technology transfer is a fundamental component of its framework.[370] The conflicting positions for low carbon technology transfer described in the above section go to the very heart of

368 Ibid.

369 Available at: <http://unfccc.int/essential_background/convention/items/6036.php> accessed 14 April 2012.

370 UNFCCC, art 4.

the negotiating positions of different Parties to the UNFCCC. The UNFCCC contains generally worded provisions on climate-related technology transfer.

Article 4.5 of the UNFCCC calls for nations to transfer environmentally sound technology, it states the following:

> [t]he developed country Parties… shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention. In this process, the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country Parties. Other Parties and organizations in a position to do so may also assist in facilitating the transfer of such technologies.[371]

Accordingly, the special needs of developing countries and the enhanced capacities of developed countries are central to these obligations under Article 4.5. Furthermore, Article 4.7 of the UNFCCC highlights developed countries' obligation. It states:

> The extent to which developing country Parties will effectively implement their commitments under the Convention will depend on the effective implementation by developed country Parties of their commitments under the Convention related to financial resources and transfer of technology.[372]

Article 4.5 and 4.7 of UNFCCC reveal how technology transfer, climate change and IPRs arguments combine, but may not really help with the conflicting opinions of developed and developing countries. Developing countries could make those provisions

[371] UNFCCC, art 4.5.

[372] UNFCCC, art 4.7.

more expansive and intrusive and undermine IPRs integrity by emphasizing the importance of technology transfer. On the contrary, developed countries could argue that IPRs are privately held and therefore outside the competence of State parties to diffuse, illulstrating it is hard to implement this provision.[373] As Ghaleigh notes, the technology transfer commitments imposed on developed countries are both modest and qualified.[374] The requirements for targeted technologies are only 'environmentally sound', instead of the 'best available' or 'appropriate to host country circumstances' or 'new and innovative'.[375] It is not enough to guarantee that developing countries have access the cutting edge biofuel technologies. Moreover, Ghaleigh also argued that the language of Article 4.5, such as 'practicable' and 'appropriate' further dilutes the force of the provision.[376] Therefore, the real challenge, in the UNFCCC context, is of how to move beyond language to concrete consideration of the problems and the potential solutions.

The Bali Action Plan was adopted at the thirteenth Conference of the Parties to the UNFCCC (COP 13) in December 2007 in Bali. It reached a global consensus to adopt deep reductions of GHG emissions in line with the IPCC's initial target of 25% to 40% reductions below 1990 levels by the year 2020.[377] In order to do so, technology transfer has been identified as a key element in the Bali Action Plan. Paragraph 1 (b) and (d) of the Plan call for nationally appropriate actions by developing countries on mitigation and adaptation to be supported by technology in a measurable, reportable and verifiable manner.[378] The UN Development Program states that:

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[373] Ibid, 226.

[374] Navraj Ghaleigh, 'Barriers to Climate Technology Transfer - The Chimera of Intellectual Property Rights' (2011) 5(2) Carbon & Climate Law Review 220, 225.

[375] Daniel Bodansky, 'The United Nations Framework Convention on Climate Change: A Commentary' (1990) 18 Yale Journal of International Law 451.

[376] Ghaleigh (n 374) 225.

[377] UNFCCC, Report of the Conference of the Parties on its thirteenth session, held in Bali from 3 to 15 December 2007 (14 March 2008) UN Doc FCCC/CP/2007/6/Add1, Decision -/CP13 <http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf> accessed 17 April 2012.

[378] Ibid.

> [t]he world has less than a decade to change course. No issue merits more urgent attention--or more immediate action. Climate change is the defining human development issue of our generation. All development is ultimately about expanding human potential and enlarging human freedom... Climate change threatens to erode human freedoms and limit choice.... The world lacks neither the financial resources nor the technological capabilities to act. If we fail to prevent climate change it will be because we were unable to foster the political will to cooperate.[379]

In the UNFCCC negotiations the issue of relationship between IPRs and technology transfer have moved from a position of some marginality to one of considerably more importance, especially since the Bali Action Plan. The UNFCCC and the Bali Action Plan provisions which related to climate-related technology transfer are essential components of global action necessary to address mitigation and adapt aspects of climate change through the development, diffusion and innovation of clean technology in developing countries. In order to promote access to affordable environmentally sound technologies, the Bail COP calls for the scaling up of the development and transfer of technology to developing country parties, and makes notable progress in the form of its focus on new institutional mechanisms.

However, the UNFCCC Expert Group on Technology Transfer (EGTT) pointed out that the technology transfer-related provisions of UNFCCC have yet to be reflected in 'concrete, practical, results-oriented actions' in specific sectors and programs.[380] The

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379 UN Development Programme, 'Human Development Report 2007/2008: Fighting Climate Change: Human Solidarity in a Divided Word' (2007) [hereinafter Human Development Report] 1-2 <http://hdr.undp.org/sites/default/files/reports/268/hdr_20072008_en_complete.pdf> accessed 14 August 2012.

380 The EGTT has been created in order to assist in the implementation of the technology transfer provisions of the UNFCCC. See, South Centre, 'Accelerating Climate-relevant Technology Innovation and Transfer to Developing Countries: Using TRIPS Flexibilities under the UNFCCC' (South Centre Analytical Note, IAKP and GGDP 2009) 1 <https://www.iisd.org/pdf/2011/tri-

value of creating a multilateral acquisition fund to buy up IPRs for low carbon technologies continues to represent a sticking point in negotiations between developed and developing countries on this issue. An agreement is hard to get, due to the lack of empirical evidence on how climate technology transfer might effectively be achieved. Instead, the IPCC special report can only focus on the theoretical level.[381] The technology framework has had limited impact on technology transfer mechanisms for the reasons that it is information-oriented rather than action-oriented.[382] It is suggested that countries can negotiate a particular technology agreement as an amendment to the UNFCCC, or a more specific clean technology transfer treaty are needed to facilitate the transfer of biofuel technologies as well as a wide range of other crucial clean technologies.[383]

2.4.5.2 The TRIPS Agreement

The 1994 Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) is the most recent multi-regime international instrument on IPRs. By harmonizing international minimum standards of IP protection under the WTO framework, it aimed to improve the baseline conditions for the transfer of knowledge and technology in a global marketplace.[384] TRIPS can be read as an agreement that provides some space for countries to balance the competing demands and to circumscribe IPRs.[385] Several

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cc_conf_2011_trips.pdf> accessed 14 April 2012..

381 Ockwell, 'Key Policy Considerations for Facilitating Low Carbon Technology Transfer to Developing Countries' (n 327).

382 Steve Thorne, 'Towards a Framework of Clean Energy Technology Receptivity' (2008) 36 Energy Policy 2831.

383 Elizabeth Burleson, 'Energy Policy, Intellectual Property, and Technology Transfer to Address Climate Change' (2009) 18 Transnational Law & Contemporary Problems 69, 93.

384 Frederick Abbott, 'Protecting First World Assets in the Third World: International Property Negotiations in the GATT Multilateral Framework' (1989) 22(4) Vanderbilt Journal of Transnational 689; J H Reichman, 'Free Riders to Fair Followers: Global Competition under the TRIPS Agreement' (1996) 29 New York University Journal of International Law and Politics, 11.

385 Robert Howse, 'The Canadian Generic Medicines Panel: A Dangerous Precedent in Dangerous

Articles of TRIPS directly and indirectly addresses environmental concerns, therefore relevant to biofuels and climate talk. Article 7 provide a general safeguards that could ensure the IPRs do not harm climate change.[386]

Article 7 states that:

> [t]he protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a *manner conducive to social and economic welfare, and to a balance of rights and obligations*.

Article 7 is an important article that provides an interpretation of the TRIPS Agreement as a whole.[387] According to Article 7, IPRs should work 'in a manner conductive to social and economic welfare' and 'the recognition and enforcement of intellectual property rights are subject to higher social values'.[388] It means that the Agreement is to protect the rights of patent holders but also to promote the transfer and dissemination of technology to the mutual advantage of producers and users. Furthermore, Article 8 allows parties to 'protect public health and nutrition and to promote the public interest in sectors of vital importance to their socio-economic and technological development, provided that such measures are consistent with the provisions of this Agreement'.[389]

The importance of Article 7 and 8 in interpreting TRIPS is confirmed in many other

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Times' (2000) 3 Journal of World Intellectual Property 493,494.

386 Agreement on Trade Related Aspects of Intellectual Property Rights (15 April 1994) [hereinafter TRIPS] art 7 <https://www.wto.org/english/tratop_e/trips_e/t_agm0_e.htm> accessed 12 August 2012.

387 Carlos M Correa, *Trade Related Aspects of Intellectual Property Rights: A Commentary to the TRIPS Agreement* (OUP 2007) 93.

388 Ibid, 99.

389 TRIPS, art 8.

international documents, such as the Ministerial Declaration of the TRIPS Agreement and Public Health and the Doha Declaration.[390] It is argued that these articles provide a basis for construing the exceptions to exclusive rights, such as research and access to pharmaceuticals in the context of patent rights.[391] As Howse argued, the TRIPS Agreement contains a balance between rights and obligations for 'providing some significant scope for Members to circumscribe intellectual property rights in the name of competing public values'.[392] That is to say, in addition to the minimum standards of IP protection, the TRIPS Agreement also incorporates certain flexibility, allowing countries to position IP rights in the context of their public policy objective and priorities. Therefore, these articles form the foundation of interpreting the exceptions that favour climate-friendly technology transfer, including biofuels technology transfer, in the patent rights context.

The issue of TRIPS flexibilities has already come up in ongoing discussions, concerning rise about whether these flexibilities sufficient to ensure a rapid and widespread transfer of technology worldwide.[393] Article 66 is one notable provision which is related to the issue of TRIPS flexibilities. Article 66 of TRIPS requires developed Members to help facilitate technology transfer to developing member states. This article gives LDCs greater latitude concerning the agreement, it states:

1. In view of the special needs and requirements of least developed country Members, their economic, financial and administrative constraints, and their need for flexibility to

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[390] The Doha Public Health Declaration states that 'each provision of the TRIPS Agreement shall be read in light of the object and purpose of the Agreement as expressed […] in its object and principles.' See, Declaration on the TRIPS Agreement and Public Health (14 November 2001) WTO Doc WT/MIN(01)/DEC/2 (2001) para 5(a) <http://www.wto.org/English/thewto_e/minist_e/min01_e/mindecl_trips_e.htm> accessed 12 August 2012.

[391] Correa (n 387) 103.

[392] Howse, 'The Canadian Generic Medicines Panel: A Dangerous Precedent in Dangerous Times' (n 385) 494.

[393] Krishna (n 306) 5.

create a viable technological base, such Members shall not be required to apply the provisions of this Agreement, other than Articles 3, 4 and 5, for a period of 10 years from the date of application as defined under paragraph 1 of Article 65. The Council for TRIPS shall, upon duly motivated request by a least-developed country Member, accord extensions of this period.

2. Developed country Members shall provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to least-developed country Members in order to enable them to create a sound and viable technological base.[394]

Accordingly, Article 7 set a foundation for coordinate effective efforts to cope with climate change by international environmental law and international economic legal institutions. Article 66 explicitly highlighted the importance of technology transfer to developing countries, especially to LDCs. It recognizes the special needs and requirements of LDCs and awards a special transition period for the implementation of the TRIPS Agreement. During the period, it allows immediate and free access to some knowledge and facilitates the building of productive capacities. Accordingly, developed countries are obliged to create incentives for the technology transfer to these poorest countries. These flexibilities are particularly important for the LDCs to access to second-generation biofuel technologies. It is because in many these countries, second-generation feedstocks are available, such as jatropha in African countries. However, their R&D capability is not enough to support the required technology improvement or innovation, and other channels of technology transfer, such as FDI and licensing, are not effective.[395] Therefore, as an important agreement under the WTO framework,

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394 TRIPS, art 66.

395 See, Keith Maskus, 'Transfer of Technology and Technological Capacity Building' (The ICTSD-UNCTAD Dialogue, 2nd Bellagio Series on Development and Intellectual Property, 18-21 September 2003) <http://www.iprsonline.org/unctadictsd/bellagio/docs/Maskus_Bellagio2.pdf> accessed 12 March

which aims to facilitate free trade globally, the TRIPS agreement made it clear that it will not be an obstacle to environmentally sound technology transfer.

However, when thinking about potential problems in advance of their becoming acute in the environmental sector, it must be remembered that although the TRIPS Agreement sets up a baseline of environmental protection and low carbon technology transfer, it failed to result in much concrete action beyond a technical program to implement IP law.[396] It is pointed out that the technology transfer-related provisions contained in the TRIPS Agreement have been largely disregarded and inefficient, because they give developed countries too much flexibility in addressing the issues.[397] TRIPS Agreement received the criticism that it is hard to be in favour of developing countries in practice. Despite biofuel technology transfer and development, there is evidence that the TRIPS Agreement has produced an adverse impact on developing countries on access to essential public goods in some other areas, such as in areas of public health and agriculture.[398] It has been widely argued that the IP protection-related provisions of TRIPS Agreement threaten poor people's access to life-saving drugs at an affordable price. For example, it has been highlighted by the controversy regarding the availability of AIPS drugs in South Africa.[399] Although the picture then changed after 2011 'Declaration on TRIPS and Public Health' by reaffirming the rights of member

2012.

396 Frederick Abbott, 'The Future of IPRs in the Multilateral Trading System' in Christophe Bellmann, Graham Dutfield and Ricardo Meléndez-Ortiz (eds), *Trading in Knowledge: Development Perspectives on TRIPS, Trade and Sustainability* (Earthscan 2003) 37.

397 Ibid. See also, Suerie Moon, (UNCTAD – ICTSD Project on IPRs and Sustainable Development Policy Brief No. 2, UNCTAD 2008) <http://unctad.org/en/docs/iprs_pb20092_en.pdf> accessed 21 August 2012.

398 Duncan Matthew, 'WTO Decision on Implementation of Paragraph 6 of the Doha Declaration on the TRIPS Agreement and Public Health: A Solution to the Access to Essential Medicines Problem?' (2004) 7(1) Journal of International Economic Law 73; Ellen R Shaffer and others, 'Ethics in Public Health Research: Global Trade and Public Health' (2005) 95 American Journal of Public Health 23.

399 Kumar 'Intellectual Property Rights, Technology and Economic Development: Experiences of Asian Countries' (n 354).

countries to produce generic versions of patented drugs in order to promote public health, it is worth remembering that it took years of struggle to loosen the big pharmaceutical companies' stranglehold in developed countries on the WTO.[400] In the context of biofuels technology and climate change, one of the controversies is about the conflict between IP protection and technology access in the case of public health needs. The most relevant article is Article 27.

It is in Article 27 of TRIPS where the morality and *ordre public* issues and therefore implicitly the more specific problem of climate change and biofuel technology transfer can be found. It states:[401]

1. Subject to the provisions of paragraphs 2 and 3, patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application. Subject to paragraph 4 of Article 65, paragraph 8 of Article 70 and paragraph 3 of this Article,[402] patents shall be available and patent rights enjoyable without discrimination as to the place of invention, the field of technology and whether products are imported or locally produced.

2. Members may exclude from patentability inventions, the prevention within their territory of the commercial exploitation of which is necessary to protect *ordre public* or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment, provided that such exclusion is not made merely because the exploitation is prohibited by their law.

Paragraph 1 of Article 27 simply expressed the obligation of ensuring patents should be granted in all fields of technology. Paragraph 2 is a 'moral utility' doctrine which

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[400] Ibid.

[401] TRIPS, art 27.

[402] These articles are about the transitional provisions relating to developing countries and patent protection for pharmaceutical and agricultural products. See TRIPS, art 65 and art 70.

allows Member States to prohibit the patentability of inventions in order to protect *ordre public* or morality. Based on Article 27.2 directly, it could go further by including the prejudice to the environment as contrary to *ordre public* or morality. This article has the merit to exist for climate change-related technology transfer, as it could be a gatekeeper of patent subject matter eligibility.[403] Article 27.2 provides a right direction to promote domestic legislatures to adopt specific measures to mitigate climate change.[404] It provides developing countries with a legal base to argue that those strong patent systems which work as barriers to biofuel technology transfer should be changed.

Although this clause makes a clear point that Members have the authority to refuse to grant a patent to environmentally risky inventions, the language of it is so vague and unclear that it raises many practical questions.[405] It is also argued that the seriousness standard of Article 27.2 is imprecise. It does not provide a clear standard to assess when there is a 'serious prejudice to the environment'.[406] Consequently, it leaves too much room to individual Members to decide whether they take a broad or restrictive view and how they would like to explain and imply the 'moral utility' doctrine. Moreover, Article 27.2 is not mandatory, and Members are free to prohibit immoral inventions or not.[407] Therefore, because the clause is unclear and not mandatory, its use may be susceptible to challenge by another member state. More important, this article provides a right to Member States, instead of setting an obligation, to exclude inventions from patentability.

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[403] Estelle Derclaye, 'Patent Law's Role in the Protection of the Environment- Re-Assessing Patent Law and Its Justifications in the 21st Century' (2009) 40 International Review of Intellectual Property and Competition Law 249.

[404] Derclaye, 'Intellectual Property Rights and Global Warming' (n 216), 272; Richard Ford, 'The Morality of Biotech Patents: Differing Legal Obligations in Europe?' (1997) 6 European Intellectual Property Review 315, 317.

[405] Michael L Doane, 'TRIPS and International Intellectual Property Protection in an Age of Advancing Technology' (1994) 9 American University Journal of International Law and Policy 465.

[406] M Bruce Harper, 'TRIPS Article 27.2: An Argument for Caution' (1997) 21 William & Mary Environmental Law and Policy Review 381-84.

[407] Derclaye, 'Intellectual Property Rights and Global Warming' (n 216) 272; Bagley (n 218) 469.

It is for the individual nation to decide if an invention is patentable or not. If developed countries believe biofuel technologies are patentable and granted patent rights, developing countries will still find it hard to get access to those technologies according to this provision.

The IPR debate is one of the thorniest issues within the current international negotiations on low carbon technology transfer, and it represents a central dividing point between developed and developing countries. International standard-setting within an IP paradigm dominated by powerful western economics, even the minimum standards of IP protection set in TRIPS Agreement under WTO are actually in favour of developed nations.[408] It took years of struggle to loosen the big companies' stranglehold on the WTO in pharmaceutical sector. Therefore, it may also take a long period to solve the IPR related problems in the biofuel sector. Nevertheless, there is no evidence in favour of extending TRIPS flexibilities such as those provided for in the pharmaceuticals context to environmentally-friendly technologies.[409]

2.4.6 Conclusion

In conclusion, most of the advanced biofuel technologies are being developed in developed countries. However, much of the potential for these technologies to make significant reductions in carbon emissions is in developing countries where fossil fuel consumption is increasing rapidly. The transfer of low carbon technologies to developing nations has a key role to play in reducing carbon emissions and tackling

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[408] Peter Drahos, 'Developing Countries and International Intellectual Property Standard-Setting' (2002) 5 The Journal of World Intellectual Property 765.

[409] Daniel K N Johnson and Kristina M Lybecker, 'Challenges to Technology Transfer: A Literature Review of the Constraints on Environmental Technology Dissemination' (2009) Colorado College Working Paper 7/2009, 12, 21 <http://papers.ssrn.com/sol3/Papers.cfm?abstract_id=1456222> accessed 21 July 2012.

climate change. It has been widely accepted that in order to mitigate climate change and achieve sustainable development globally, developing countries need to have access to the clean, low carbon renewable energy technologies without barriers.

However, despite the fact that both developed countries and developing countries accept the necessity of developing low carbon technologies to cope with climate change, they have different opinions about IPRs issues. It makes IPRs become a critical issue in ensuring access to new technologies for climate mitigation and adaptation, and an important issue in the climate negotiations. There are conflicting arguments about whether IPRs could facilitate or impede the development and transfer of green technologies. Developed countries commonly have a strong IP system, and they believe stronger IPR protection may have some beneficial effects on technology transfer, investments and innovation in developing countries. This may be true in middle-income and larger developing countries, but there is no evidence of such positive effects in the poorest countries.[410] Evidence suggests that it may even have negative effects on research and innovation of climate change technologies.[411] Conversely, developing countries argue that the strong IP protection in industrialized nations may already be hampering access to cutting edge technology in biofuels.[412] This IPR debate is perhaps the thorniest issue within the current international negotiations on low carbon technology transfer and represents a central dividing point between many developed and developing countries. The reason behind the conflicts rooted in the historical North-South conflict.

Yet while global climate change negotiations have made some progress in the area of environmentally sound technology transfer, as reflected in the UNFCCC and the TRIPS, the role of IPRs has remained a particularly divisive issue between developed countries

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[410] Bach (n 235) 3.

[411] Ibid.

[412] Ibid.

and developing countries. The path to a constructive and meaningful discussion between the two group economies seems elusive. The achievements of the UNFCCC and the TRIPS Agreement under WTO by now have not fundamentally solved the dilemma faced by developing countries in the technical aspects. Therefore, it is still difficult for developing countries to get access to the real cutting edge technologies in biofuel sector under the current IP framework. The problem may be worsened by a significant increase in IPRs for biofuel technologies.

2.5 Conclusion

The development of new biofuels technology is a rapidly growing field. Within a relatively short time, biofuel development has advanced from first-generation biofuels (current/conventional biofuels) to second-, third-generation and future-generation biofuels (advanced biofuels). It is hoped that these advanced biofuels could contribute more to efforts to reduce net GHG emissions, and thus to mitigate climate change, while at the same time circumventing the shortcomings identified for some of the current biofuels established today.

With rapid biofuel technology development, and increased biofuel technology-related IP applications, the management of agricultural-energy biotech IP rights affects widely in the global biofuels market. It is undoubtedly that IPRs have a critical role to play in facilitating technology transfer in biofuel sector. However, the increase in the patenting activity in advanced biofuel technology has given rise to many questions including the possibility of patent thickets, freedom to operate, and use of standards to create essential/critical technology. Patent thickets can result in concentrated ownership under monopoly/duopoly market conditions, restrictions in licensing, and holding up further innovation.

The role of IPRs in biofuels is fairly uncertain and dynamic, and the Global North and South seems to hold opposite opinions on this issue. From the perspective of developing countries, the IP ownership, particularly the patent thickets, of advanced biofuel technologies represents potential constraints on advanced biofuel technology transfer to developing countries. From perspectives of developed countries, as most of the advanced biotechnologies are holding in private sector of developed countries, and most of North countries established strong IP protection systems, they believe strong IP system is imperative for biofuel technology development. To resolve the tension, international communities have made significant efforts by the UNFCCC and the TRIPS Agreements. However, as argued in this chapter, it is still difficult for developing countries to get access to the real cutting edge technologies in biofuel sector on the current international forums, and more efforts of negotiations are needed in the future.

It is commonly recognized that in the course of the rise of the biofuel economy, technology plays a significant and indispensable role. However, with the fact that developing countries commonly have no ability to get involved in the R&D activities of advanced biofuel technologies, the real challenge from the science and technology perspective for biofuel development is how to further deepen the course of biofuel technology transfer and diffusion worldwide. Although there are tensions and different opinions between the Global North and South towards approaches to access to biofuel technologies under the current IP framework, both sides could not deny that without the participation of developing countries, it could be very difficult to get the transition of our fossil fuel dominated economy to a more clean and safe future. Moreover, the difficulties or the challenges faced by developing countries in the biofuel sector not only come from science and technology. What is equally necessary and important as technology develops is legal and policy frameworks that keep pace with scientific and technological advances.[413] As well as intellectual property law, there are legitimate

[413] For more discussion about the links between technology and law, see, Emilie Cloatre and Martyn Pickersgill, *Knowledge, Technology and Law* (Routledge 2014); For further reading about

concerns from (at least) also environmental law (Chapter Three), agricultural-economic law (Chapter Four) and international trade law (Chapter Five) that must be considered by decision-makers.

technology development and the function of legal regulation under a sustainable development framework, see, Rafiqul Islam (ed), *Perspectives on Sustainable Technology* (Nova Publishers 2008).

CHAPTER THREE BIOFUELS AND ENVIRONMENTAL SUSTAINABLE DEVELOMENT

3.1 Introduction

The connection between energy and the environment has been the subject of many studies, and it is sometimes possible to establish a 'cause and effect' relationship between energy use and environmental damage.[414] In Africa, for example, soil degradation and desertification were observed due to the use of fuelwood as a source of energy.[415] Another infamous example is the 1952 London Smog. The thick fog engulfed London in December of 1952, and killed approximately 12,000 people. The main reason for the disaster was energy consumption through heavy coal combustion.[416] In fact, all manners of producing and consuming energy have environmental impacts, which make the energy and environmental sector inextricably linked. However, energy policy is economic-centric designed. The temptation, in some circumstances, is to overlook the concerns for energy-environment connection, especially during times of economic difficulty.[417] The disjunction of energy and environment sectors could pose an obstacle to a transition from traditional energy strategy to a sustainable energy future, and to biofuel development in the long term.[418]

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[414] Jose Goldemberg and Oswaldo Lucon, *Energy, Environment and Development* (Earthscan 2010) 1.

[415] Ibid.

[416] For more reading about the London Smog of 1952, see, Devra L Davis, Michelle L Bell and Tohy Fletcher, 'A Look Back at the London Smog of 1952 and the Half Century Since' (2002) 110(12) Environmental Health Perspectives A374.

[417] See, further the Commission's webpage on environmental integration into the energy sector: <http://ec.europa.eu/environment/integration/energy/index_en.htm> accessed 30 July 2015.

[418] Lincoln L Davies, 'Alternative Energy and the Energy-Environment Disconnect' (2010) 46 Idaho Law Review 473; Uma Outka, 'Environmental Law and Fossil Fuels: Barriers to Renewable Energy' (2012) 65 (6) Vanderbilt Law Review 1679.

However, fortunately, greater global attention to issues of sustainable development and climate change has inspired intensive discussion about the rethinking of the relationship between energy and environmental law. The requirements of sustainable development in the energy sector, as well as threats from climate change and global warming are imperative factors that have driven governments to concentrate on making policy that promotes energy efficiency and to develop renewable energy sources. As a new-born renewable energy sector, biofuel industry represents important opportunities and challenges for sustainable development and climate change mitigation. The relationship between biofuels development and sustainable development is comprehensive and complicated. As a socio-economic and environmental sensitive industry, biofuels could be a solution for many severe environmental problems. However, it might have significant negative effects on the environment as well.[419] A primary concern is the potential for biofuels to accelerate climate change, rather than combat it. Production involves considerable GHG emission from soils, carbon sink destruction and fossil fuels inputs, and is already causing significant issues of deforestation, land use change, destruction of biodiversity, air pollution, water consuming and soil degradation.[420] As a result, how to regulate the biofuels industry in a sustainable manner in the long term becomes a key issue for decision-makers. It is generally accepted that biofuels production needs to be regulated with the close cooperation of energy economic experts and environmentalists, to balance energy needs and costs with environmental impacts within an appropriate legal framework. Global North, especially the EU and US, has adopted more legislative and policy instruments to ensure biofuel sustainability, especially in relation to the environment.[421]

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[419] The socio-economic sustainability issues related to biofuels will be subject to further discussions in Chapter Four and Five.

[420] Environmental Protection Agency (US) and National Centre for Environmental Assessment (US), *Biofuels and the Environment: First Triennial Report to Congress* (Government Printing Office 2012).

[421] It is worth noting that the concept of 'environmental sustainable development' and the concept of 'sustainable development' is different. The first one is focused on the environmental aspects, while the second concept includes three dimensions of environmental, social and economic aspects. For

Among all biofuel sustainability legislation, 'one of the most innovative features of the package[s]' is certification schemes and sustainability criteria for biofuels.[422] This comprehensive set of rules could specify the negative impact of biofuels on the environment in different aspects, including GHG emissions, land use change, deforestation, biodiversity loss, air pollution, and water and soil degradation. Biofuel certification scheme could be a possible option for developing countries to manage the biofuel related environmental issues, minimize the negative impacts of biofuel expansion, and regulate their biofuel industry to develop in a sustainable manner. However, a biofuel sustainability regulation framework based on a certification scheme and sustainability criteria would never be easy for developing countries. The UK Meta-standard Approach could be considered by developing countries, as it offers a way to regulate biofuel sustainability based on local contexts and existing certification schemes.

This chapter comprises three sections. The first section demonstrates the relationship between energy law and environment regulations, as well as the relationship's new development under the context of climate change, to illustrate a bigger picture in which the biofuel industry is developing. The second sector demonstrates the relationship between biofuel production and sustainable development as well as the issue of climate change. A factural description of the environmental degradation problems related to biofuels will be included in this section, as well as the legal and policy initiatives in the EU and US for biofuel environmental sustainability. The last section focuses on the existing biofuel certification schemes and the variety of sustainability standards and

more information, see Section 3.2.4.1.

[422] Elisa Morgera, Kati Kulovesi and Miquel Munoz, 'The EU's Climate and Energy Package: Environmental Integration and International Dimensions'(2010) Edinburgh Europa Paper Series 2010/07, University of Edinburgh School of Law Working Paper No. 2010/38, 31 <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1711395&download=yes> accessed 30 July 2015.

criteria. The UK meta-standard approach is examined in this section, as it is potentially a possible approach for developing countries to develop their own biofuel sustainability systems.

3.2 Energy-Environment Disjunction and the New Development

3.2.1 Introduction

Production and consumption of energy is one of the most severe causes of global warming, air pollution, and many other devastating environment issues; these issues make the energy sector and the environment intertwined. However, energy law and environmental law rarely merge or work together, and this disconnect is rooted in the fields' histories. Issues of sustainable development and climate change are deservedly receiving great attention globally, it inspiring intensive discussion about the rethinking of the relationship between energy and environmental law. Countries have made great efforts to combat climate change, to fight the energy crisis, but neither of the issues has been properly settled. The disconnect between energy and environmental law has massive implications for the energy sector and the environment, and is a fundamental barrier to the energy policy reform and the development of renewable energy. In order to tackle the problem of climate change and achieve the sustainable development in the long term, the disconnect between energy and environmental law must be mended.

This section focuses on this general but fundamental challenge to energy policy and renewable energy development. It contends that, the problem we are facing is not an emergency in the short term; it needs to be altered with careful design for the long term to address root causes. Regulation of energy and environment need to be melded to work together to get a new and green energy future. This argument builds in three parts. Firstly, it demonstrates the intertwined relationship between the energy sector and nature. It provides a factual basis for arguing the necessity of energy-environmental policy integration. Secondly, it traces the historical disconnect between energy law and environmental law. And particularly identifies the problems that disconnect creates for biofuel development. After that, it illustrates the evolution of energy-environmental regulation with the development of sustainable development law and the rising issue of climate change. From an energy perspective, the section will explain why it is time to call for more synergy between energy and environmental law, and how this will facilitate the development of biofuels in a more sustainable manner.

3.2.2 Energy and Environment: Intertwined Issues

Energy and environmental issues often intertwine with each other in reality. Firstly, energy resources come from nature. When we talk about energy, we may think about traditional fuels: oil, coal, and natural gas, which account for the vast majority of the world's energy supply; or we may think about alternative energy: solar power from the sun's rays, wind energy generated by turbines, geothermal energy from heat of the Earth, or bioenergy from plants. The key observation here is that every source of energy is based on a natural resource, and is from the environment. 'Energy…is not the product of magic. Instead, every time we create energy, the central ingredient is some part of nature.'[423] Indeed, energy comes from nature, and is part of the environment.

Moreover, as *part* of the environment, energy is *limited* by the environment. Oil, coal and natural gas, which are called fossil fuels or non-renewable fuels, typically formed from the decay of animals or plants by exposure to heat and pressure in the Earth's crust over millions of years. As three main energy resources for the globe's energy supply, the global usage per year is staggering, and is incremented.[424] According to EIA's

[423] Amy J Wildermuth, 'The Next Step: The Integration of Energy Law and Environmental Law' (2011) 31 Utah Environmental Law Review 369.

[424] Ibid. See also, G Maggio and G Cacciola, 'When will oil, natural gas, and coal peak?' (2012) 98

International Energy Outlook 2010, total world primary energy consumption was 495 quadrillion Btu in 2007 and is expected to increase by 49% from 2007 to 2035.[425] However, as non-renewable resources, once we burn them, they are gone. It is speculated that oil, coal and gas will be depleted in approximately 35, 107 and 37 years, respectively.[426] This is not an optimistic speculation, but it true they will be depleted sooner or later; it is nature's limits posed on energy using.

Furthermore, all energy resources must be extracted or gathered from nature in order to be useable. For using fossil fuels as energy, we must dig or pump these substances from within the Earth, under the ocean, in mountain tops, or somewhere deep in the ground. The process of extracting these energy resources has an unavoidable impact on the surrounding environment. The extraction of fossil fuels leads to fugitive GHG emissions which have potent impact on climate change.[427] It may also yield harmful gases and 'produced water', which pollute the air, water and offshore.[428]

In addition to the problems resulting from energy production, energy consumption also has devastating environmental consequences. The combustion of coal, oil and natural gas produces significant quantities of carbon dioxide (CO2), methane (CH4), nitrogen

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Fuel 111.

425 EIA, *International energy outlook 2010* (EIA 2010) <http://large.stanford.edu/courses/2010/ph240/riley2/docs/EIA-0484-2010.pdf> accessed 12 February 2013.

426 ErkanTopal and Shahriar Shafiee, 'When Will Fossil Fuel Reserves be Diminished?' (2009) 37 Energy Policy 181.

427 Egbert Boeker and Rienk van Grondelle, *Environmental Physics: Sustainable Energy and Climate Change* (3rd edn, John Wiley & Sons 2011) 77.

428 The extraction related environmental problem is happening all the time. When accidents happen, the impacts can be extremely severe. One example is the BP's Deepwater Horizon oil rig explosion in 2010 which released over four million gallons of oil into the Gulf of Mexico. For more information, see, Maria Gallucci, 'BP Says Gulf Of Mexico Recovering From 2010 Oil Spill, But Federal Scientists Dispute Company's Claims' (*International Business Times*, 17 March 2015) <http://www.ibtimes.com/bp-says-gulf-mexico-recovering-2010-oil-spill-federal-scientists-dispute-companys-1849546> accessed 17 March 2015.

oxides (NOx), sulfur dioxide (SO2), particulate matter (PM) and others. CO2 and CH4 emissions are the main GHG emissions, and have an enormous negative impact on climate change. NOx, SO2, and PM emissions are harmful for people's health, plant growth, and can result in acid rain.[429] As a result of rapid economic development, energy-related air pollution has become a severe environmental hazard in many developing countries. One example recently is the haze in Beijing. On the 10th of October, 2014, Beijing raised its pollution alert from yellow to orange (the second highest), as pollution levels reached 20 times the World Health Organization's recommended limits. In Beijing and the neighbouring Hebei province dangerous PM2.5 particles climbed above 500 micrograms per cubic meter.[430] The smog was blamed on 'unfavourable' weather conditions. The heavy air pollution blanketed northern China, reaching hazardous levels. These gases can be dangerous both for the environment and human health.[431]

Compared with traditional energy resources, renewable energy, such as solar, wind, hydropower and biofuels are recognized as 'green energy', which is generally considered as environmental friendly. However, 'green energy' may not always be 'green', and may also have a negative impact on the environment. Firstly, solar, wind, biomass and hydropower are all land consuming.[432] The landscape becomes occupied

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429 EIA, *Renewable Energy Annual 1995* (EIA 1995) xii <http://www.eia.gov/totalenergy/data/annual/archive/038495.pdf> accessed 12 February 2013.

430 PM 2.5 particles lodge deep inside the lungs and are considered the most dangerous kind of air pollution to human health. The recommended expose is 25 micrograms of PM 2.5 per cubic meter. See, World Health Organization, *Health Effects of Particulate Matter: Policy Implications for Countries in Eastern Europe, Caucasus and Central Asia* (WHO 2013) <http://www.euro.who.int/__data/assets/pdf_file/0006/189051/Health-effects-of-particulate-matter-final-Eng.pdf> accessed 12 March 2014.

431 -- -- 'Heavy Air Pollution Blankets Northern China, Reaches "Hazardous" Levels' (*UK-RT*, 10 October 2014) <http://rt.com/news/194956-air-pollution-china-hazardous/> accessed 12 October 2014.

432 See, Troy A Rule, *Solar, Wind and Land: Conflicts in Renewable Energy Development* (Rutledge 2014); Bezuayehu Tefera and Geert Sterk, 'Hydropower-Induced Land Use Change in Fincha'a Watershed, Western Ethiopia: Analysis and Impacts' (2008) 28(1) Mountain Research and

by large-scale solar power installations, wind turbines, biofuel feedstock plants, and dams and aside areas for reservoir behind dams. Moreover, these energy installations may cause harmful ecosystem alteration, impacting upon endangered species. Take a hydropower dam as an example: The Three Gorges Dam on Yangtze River in China severely disrupts the migration of endangered Chinese Sturgeons, as the fish needs to go upstream to spawn. And the Dam can change the natural water temperatures, chemistry, flow characteristics, and silt loads.[433] All these results can lead to harmful changes in the ecology of Yangtze River upstream and downstream.

Given the picture above, it is an inescapable fact that energy and environment are intertwined in life. Energy comes from nature; energy utilization is restricted by nature's limits. All energy production and consumption is based on natural resources, and it imposes numerous environmental impacts. One might expect that we would think carefully about how to deal with the energy issues and energy-related environmental issues together. Indeed, one can imagine that the law could provide a regulatory framework to do exactly that. Unfortunately, legislation has not developed in this way. '[G]overnmental regulation of energy development…and of the environment is often uncoordinated and in conflict.'[434] Ironically, there are various linkages between energy and environmental issues, however, energy law and environmental law grew as two separate fields with separate goals and regulatory mechanisms.

3.2.3 The Historical Divorce of Energy and Environmental Law

Energy law, as a generic topic of law, is essentially only a few decades old. Its roots are

Development 72.

433 Peter H Gleick, 'Three Gorges Dam Project, Yangtze River, China' [2009] Brief 3 The World's Water 2008–2009: The Biennial Report on Freshwater Resources139 <http://worldwater.org/wpcontent/uploads/sites/22/2013/07/WB03.pdf > accessed 16 April 2013.

434 Marla E Mansfield and James E Hickey, Jr, 'Oil' in James E Hickey, Jr (ed) *Energy Law and Policy for the 21st Century* (Rocky Mountain Mineral Law 2000).

in oil and gas law and public utility law.[435] Its birthdate can arbitrarily be established as October 1973, the date of the Arab Oil Embargo. In the 1970s and early 1980s, a series of oil price hikes brought into stark relief the dependence of many industrialized economies on supplies of cheap oil from the OPEC region. These shocks sparked a variety of legislation and policy response; including efforts by individual countries to further developing indigenous fossil and renewable energy resources, seeking greater independence from world markets. The legal response in the area of energy law resulted in programmers for energy efficiency improvement and renewable energy development.[436] It was the first time people realized the importance of energy law for the national and global economy and our everyday life.

Since the 1970s, energy law has undergone substantial transformations. Moreover, at the domestic level, particular objectives of energy law in each country could be very different from others based on the different energy resources and particular national conditions. Compared with laws in other areas, energy law increasingly has focused on particular sources rather than adopt a more comprehensive approach as they generally linked with separate markets and different issues. However, the nature and main objectives of energy law never change significantly. Professor Tomain in his article, *The Dominant Model of United States Energy Policy*, identified that all the objectives of energy policy in the US are focused on the economic considerations: energy market, monopolistic presumptions, and national economy.[437] He also acknowledged that 'short-term prices are the key driver in our domestic energy policy'.[438] Short-term energy prices are the key driver of the US energy policy, and of most other nations'

[435] Joseph P Tomain and Richard D Cudahy, *Energy Law in a Nutshell* (2nd edn, West 2011) 1.

[436] Kazuhiro Nakatani, 'In Search of the Optimum Energy Mix: Japanese Laws Promoting Non-Fossil-Fuel Energy' in Donald N Ziliman, Catherine Redgwell, Yinka O Omorogbe and Lila K Barrera-Hernandez (eds), *Beyond the Carbon Economy: Energy Law in Transition* (OUP 2008) 482.

[437] For more discussion about the five aims of US energy law, see Joseph P Tomain, 'The Dominant Model of United States Energy Policy' [1990] Faculty Articles and Other Publications 130 <http://scholarship.law.uc.edu/fac_pubs/130> accessed 12 December 2013.

[438] Ibid.

energy policy. From the picture of US, the key nature of energy law is focus on economy. An economic-centered approach, detached from environmental considerations and policies, is adopted by most of economies of the world to regulate the energy field.

The environmental law framework as we know it today was largely developed from the 1950s and 1960s with the early air pollution legislation.[439] In the UK, the notorious Great Smog of 1952 prompted the movements of environmental protection and the introduction of environmental legislation.[440] The UK Government introduced its Clean Air Act in 1956, which intended to control domestic sources of smoke through the introduction of zones in which only smokeless fuels could be burned.[441] In the 1970s, a great onslaught of legislation of environmental regulation was passed in developed nations. In Europe, the Control of Pollution Act 1974 was enacted to provide a comprehensive framework for pollution control and provided a model for European Community waste legislation.[442] In the US, the most remarkable events for 1970 were the enactment of the National Environmental Policy Act and the Clean Air Act, as well as the creation of the US Environmental Protection Agency.[443] It is commonly believe that the 1970s was an extraordinary decade for the evolution of environmental law. It is because, prior to 1970, environmental protection was evident in only a handful of fledgling legislation efforts.[444]

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[439] M H Fulekar, 'Global Status of Environmental Pollution and Its Remediation Strategies' in M H Fulekar (ed), *Bioremediation Technology: Recent Advances* (Springer Science & Business Media 2012) 1. The diversity of modern environmental law stems from a rich history of the field. For discussion about the early legal controls of environmental law, see Richard J Lazarus, *The Making of Environmental Law* (2nd edn, University of Chicago Press 2004) 47-67; see also, Susan Wolf and Anna White, *Environmental Law* (Cavendish 1995) 3; Robert V Percival, 'Regulatory Evolution and the Future of Environmental Policy' [1997] University of Chicago Law Forum 159.

[440] Ben Daley, *Air Transport and Environment* (Ashgate Publishing 2012) 90.

[441] Ibid.

[442] Ibid Wolf 4.

[443] Lazarus, *The Making of Environmental Law* (n 439) 67.

[444] Robert V Percival and others, *Environmental Regulation: Law, Science, and Policy* (5th ed, Panel 2006) 61–64, 75–76.

Unlike energy law which is primarily focused on the economy, environmental law is marked by its diversity of objectives. In general, the main objective of environmental law is environmental protection. However, environmental law envelopes a vast array of subjects, and there exists a variety of sub-level environmental law which are aimed at specific areas such as climate change, air pollution, and biodiversity loss. That is to say, it does not have a comprehensive statute that regulates impacts on the environment as a whole; different statutes govern different media. As a result, environmental law is largely fragmented, and most of the current environmental laws typically do not consider the inputs to a process as a whole.[445] In reality, the fragmentation of dividing environmental impacts into discrete pieces and parts in this way creates a danger that we will simply move a pollutant from one media to another: '[E]nd-of-the-pipe controls sometimes achieve pollution reduction in one medium, in part, by transferring the pollution problem to another medium.'[446]

With the general outline of energy law and environmental law in mind, we can observe that energy law and environmental law trace to different traditions. Energy law was born largely from public utility and antitrust law, which emphasizes economic analysis, monopolistic presumptions, and market preferences.[447] Energy law has an economic focus, aimed at ensuring abundant energy supplies at a reasonable price. Environmental law was derived from the same time as energy law, but it attempts to protect the public and the environment from severe harms, and reduce the risk of any potential harms. It traditionally concentrates on pollution, risk and land use. That is to say, energy

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[445] Amy J Wildermuth, 'The Legacy of Exxon Valadez: How Do We Stop the Crisis?' (2009) 7 University of St. Thomas Law Journal 130, 148-149. For a discussion of fragmentation within international environmental law, see Harro van Asselt, 'Managing the Fragmentation of International Environmental Law: Forests at the Intersection of the Climate and Biodiversity Regimes' (2011) 44(4) New York University Journal of International Law and Politics 1205.

[446] Ibid. However, recent decades have shown environmental law's increasing shift to economic- and market- based mechanisms that seek to reduce the inefficiency, chunkiness, and ineffectiveness. See, Henry N Butler, 'A Defense of Common Law Environmentalism: The Discovery of Better Environmental Policy' (2008) 58 Case Western Reserve Law Review 705.

[447] American Bar Association, *Energy Antitrust Handbook* (2nd edn, ABA 2009) 19.

regulators focus on economics, while environmental regulators put much attention on the interests of public health and environmental protection. The different goals drive the two laws in different directions; they are disconnected concept under the current regulatory framework. Environmental law treats energy like any other industry that it regulates; there is no special relationship between the two. Therefore, energy law and environmental law historically have been distinct, and the fields' disjunction is clear.[448] However, the question is: Is the disconnection really that problematic?

The disconnect between energy law and environmental law could create many problems in the general regulation of the entire energy sector. For the development of renewable energy, the problem seems especially acute. This disconnect is a fundamental barrier to the development of renewable energy, as it restrains the adoption of more renewable energy instead of fossil fuels.[449] Consequently, it can be a barrier to transition from traditional energy strategy to a clean and sustainable energy future. From the perspective of environmental law, biofuels should be largely adopted in the transportation sector because they cause less pollution and provide for more conservation than fossil fuels. However, energy law focuses on reliability of energy resources and the cost of energy production. From the perspective of energy law, biofuels are not as reliable as traditional fuels, and have comparably high capital costs. Biofuel industry is currently driven heavily by government policies, such as mandates, subsidies and tax credits. When policies change, the priority of biofuels will disappear on the markets. As a result, energy law pushes in the opposite direction to environmental law. Thus, the environmental benefits that could be achieved by switching to biofuels have been slow to come, because energy and environmental law stand at cross purposes.

[448] Cooperation between energy and environmental regulations does exist in life, but the degree is not big. It is argued that the occasional cooperation is not enough yet for a systemic integration. See, Lincoln L Davies, 'Energy Policy Today and Tomorrow—Toward Sustainability?' (2009) 29 Journal of Land, Resources & Environmental Law 71, 76.

[449] Outka (n 418) 1681.

Therefore, where we stand today is actually a careful legislative balance of competing economic and environmental considerations. Policy makers talked for a long time about how they would be in favour of transforming the current energy economy. As the economic-centric approach is currently dominated by energy regulation, and energy law and environmental law remain separate, the actions they take would be fractured and inefficient, not coordinated and sustainable; our pattern of energy consumption is hardly to change without more integration. In short, a sustainable energy future needs the shared goals of both energy and environmental law, or the future of biofuels development will be very unpredictable.

3.2.4 Energy, Sustainable Development and Climate Change: Combination of Energy-Environmental Regulations

3.2.4.1 Sustainable Development and a Different Picture of Energy Regulations

As well as the development of sustainable development law and rising concerns over the issue of climate change, the disconnected picture of energy and environmental regulations has changed a lot. As commented by H E Judge Christopher G Weeramantry, the former vice-president of the International Court of Justice: 'Sustainable development is one of the most vibrant current topics in the development of domestic and international law. It is also one of the least developed topics in international law, legal jurisprudence and scholarship.'[450] With the concept of sustainable development becoming increasingly an accepted part of scientific and political discourse, the notion of sustainable development truly gathered much strength from both the academic

[450] Marie-Claire Cordonier Segger and Ashfaq Khalfan (eds), *Sustainable Development Law: Principles, Practices and Prospects* (OUP 2004) ix.

context and policy making aspect.[451] What is sustainable development? What is it in nature? Could it be 'soft' law or just be a legal theory? Weeramantry believes that: '[S]ustainable development is a substantive area of the law in a very real sense. Courts and countries must endeavour to administer and implement sustainable development law, just as is done with other "hard" and established rules.'[452] The international community has come a long way towards reaching a common global understanding on the concept of sustainable development.[453]

A commonly accepted definition of sustainable development was given by the Brundtland Commission in its 1987 report *Our Common Future* as: 'Sustainable development is development that meets the needs of the present generation without compromising the ability of the future generations to meet their own needs.'[454] This concept of sustainable development contains two imperative elements, which are:

(i) The concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and

(ii) The idea of limitations imposed by the states of technology and social organization on the environment's ability to meet present and future needs.[455]

These two elements refer to two different theories applied to sustainable development, which are the theory of *inter-generational equity* and *intra-generational equity*.[456] A successful policy need to address both of them at the same time. Inter-generational equity is mankind's duty towards future generations. The Stockholm Declaration

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[451] Afionis (n 5).

[452] Segger (n 450).

[453] Ibid, 15-44.

[454] WCED, *Our Common Future* (Brundtland Commission Report, OUP 1987).

[455] Ibid.

[456] The theory of inter-generational equity and inter-generational responsibility has been declared in many international instruments, such as the Rio Declaration, the Convention on Climate Change, the Convention of Biological Diversity, and Agenda 21.

clarifies the need to protect and improve the environment for future generations as an imperative goal for mankind.[457] It argues that the present generation has no absolute right to excessively exploit the natural resources. There is a moral and legal obligation to preserve and protect the planet's environment for posterity.

The theory of intra-generational equity refers to the obligation of well-off states towards have-nots countries. The inequity between wealthy and poor countries is a major obstacle to achieving sustainable development globally. It is argued that the current welfare achieved by the developed countries came from massive resource exploitation and environmental degradation all over the world for centuries. Moreover, when wealthier countries access resources at very low costs for production, poor people in undeveloped regions could be easily lose access to land or markets. Consequently, they may place great pressure on their environments by moving into the forest, occupying marginal land or adopting some non-environmental friendly way of production. Therefore, developed countries should take more responsibility for environmental protection than developing countries. Developed economies should help developing countries to take responsibility for the environment by covering some implementation protection costs or providing essential technological and financial support.[458] The theory of intra-generational could formulate a good basis for addressing the relationship between developed countries and developing countries.[459] As such, the two theories of *inter-generational equity* and *intra-generational equity* work together, to represent a delicate balancing of competing interests.

Sustainable development essentially requires that, the process of human development, policies of regulating trade expansion, resource exploration, financial investment, and

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[457] Declaration of the United Nations Conference on the Human Environment 1972 (n 310).

[458] Ibid.

[459] Sumudu Atapattu, 'International Human Rights and Poverty Law in Sustainable Development' in Marie-Claire Cordonier Segger and Ashfaq Khalfan (eds), *Sustainable Development Law: Principles, Practices, & Prospects* (OUP 2004) 311-21.

new technology creation, are all in harmony to meet human needs and aspirations in the long term.[460] These requirements of sustainable development are comprehensive and multidimensional. Three highly important core dimensions of sustainable development law are: the social, the economic and the environmental dimensions.[461] A sound policy or strategy which represents sustainable development requirements should take the collective considerations of economic development, environmental protection and social justice when formulating.[462] The three-core dimension theory is very important in sustainable development law, which has been widely adopted in domestic legal and policy strategies. Reconciling these various dimensions and operationalizing them is however a major challenge, since all three pillars interacting with each other, must be considered and balanced with a holistic and integrated approach. Munasinghe's illustration aptly depicts the inter-linkages and interactions among the economic, social and environmental considerations of sustainable development.[463] (Figure 5)

Figure 5: Approaches to Sustainable Development

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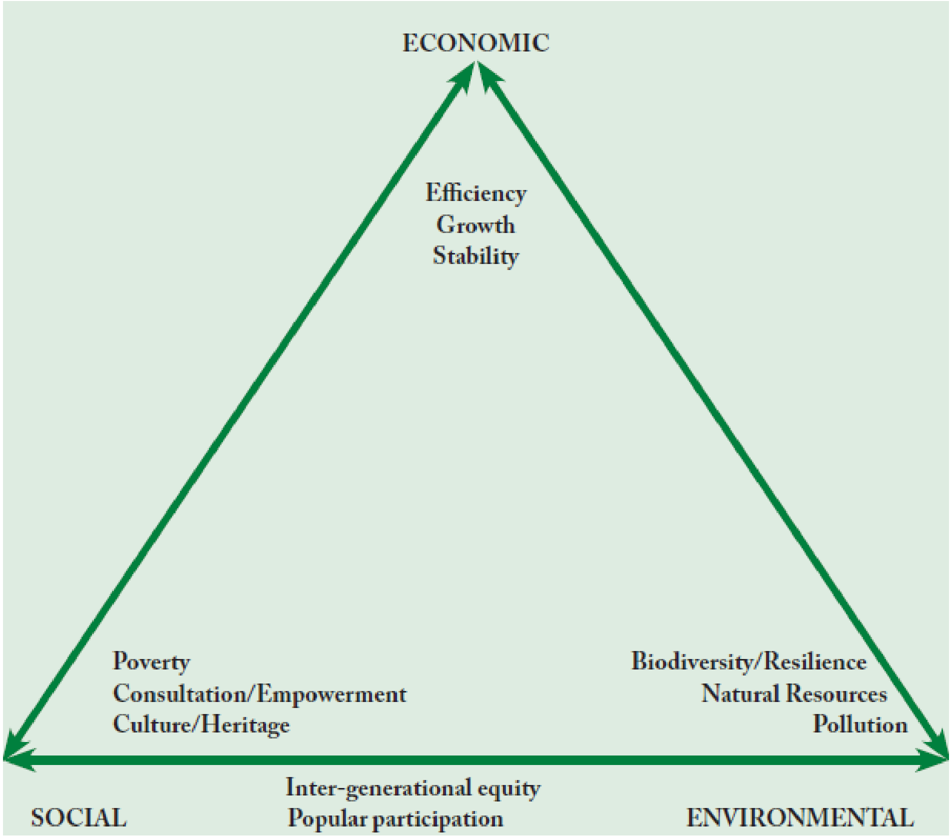
[460] Economic Commission for Africa, *Sustainable Development Report on Africa: Managing Land-Based Resources for Sustainable Development* (United Nations Economic Commission for Africa 2011) 2-3 <http://www.uncsd2012.org/content/documents/SDRA1%20managing%20land-based%20resources.pdf> accessed 12 March 2013.

[461] Segger (n 450) ix.

[462] Gordon Mitchell, 'Forecasting Environmental Equality: Air Quality Responses to Road User Charging in Leeds, UK' (2005) 77 Journal of Environmental Management 212.

[463] Mohan Munasinghe, 'An Overview of the Environmental Impacts of Macroeconomic and Sectoral Policies' in Mohan Munasinghe (ed), *Environmental Impacts of Macroeconomic and Sectoral Policies* (World Bank Publications, 1996) 13.



Source: Munasinghe, 1996

The importance and necessity of sustainable development and the value of its three core dimension theory have been highlighted on both national and global levels. Energy is the most important component of any development strategy; energy production and consumption is at the central stage of achieving sustainable development goals.[464] When applying sustainable development concept and theories to the energy sector, today's energy regulations should be different from when it was born. As discussed, energy law is economic-centric designed, and all forms of energy have their price. However, the price is formed mainly from economic considerations, without taking into account the heavy burden of environmental degradation caused by energy production and consumption. Current patterns of energy threaten the environment on local and

[464] George (Rock) Pring, Alexandra Suzann Haas, and Benton Tyler Drinkwine, 'The Impact of Energy on Health, Environment, and Sustainable Development: The TANSTAAFL Problem' in Donald N Zillman and others, *Beyond the Carbon Economy: Energy Law in Transition* (OUP 2008) 13.

global scales. The burning of fossil fuels is contributing to a higher concentration of GHGs and climate change for example. As the world now has an excessive reliance on fossil fuels, under sustainable development theory, there should be an excessive cost to the environment, and maybe social well-fare as well.[465]

By now, there have been many significant legal efforts to reform the picture of the energy sector under the sustainable development three-core dimension theory. At the international level, for example, at 2002 World Summit on Sustainable Development, energy issues were specifically addressed. The Johannesburg Plan of Implementation at this Summit called for 'improved access to reliable, affordable, socially acceptable, and environmental sound energy services, cleaner alternative energy resources, conservation and energy efficiency, and phasing out subsidies'.[466] From the national and regional level, governments also began to add environmental considerations into their energy strategies. There are great efforts made to promote energy efficiency and alternative energy supply in countries. Sustainable standards and certificates for the renewable energy sector have become prerequisites for subsidy and other public supports in many developed economies.

3.2.4.2 The Challenges of Climate Change in the 21st Century

Another motivation for driving energy regulations and environmental considerations together is the rising concern of the issue of climate change. Climate change is a significant issue related to energy and environmental concerns. It is also a sustainable development problem as unpredictable climate change will adversely affect all aspects of human beings and human welfare. Use of fossil fuels increases atmospheric

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465 Ibid.

466 UN Division for Sustainable Development, 'Johannesburg Plan of Implementation' <http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/WSSD_PlanImpl.pdf> accessed 12 March 2012. See also, Pring (n 464) 14.

concentrations of GHGs, which in turn warm the world and change climate systems.[467] There is increasingly compelling evidence that the current rate of consumption of fossil fuels is causing a significant warming of the temperature at the surface of the earth.[468]

Since the 1950s, scientists began to record the atmospheric concentrations of greenhouse gases. Records demonstrate that since the beginning of the Industrial Revolution the atmospheric concentrations of GHGs, such as CO2 and methane, have increased dramatically.[469] Once a GHG is emitted, it can rapidly mix with the atmosphere and begin to trap infrared radiation, meaning the 'heat', and will continue to do so for as long as it remains in the atmosphere. This is how GHG emissions relevant for global warming.[470] Some major gases can remain in the atmosphere for up to two centuries, such as nitrous oxide (N2O), which has an atmospheric lifetime of about 120 years.[471]

There is an increasing abundance of data collectively showing the fact that the earth is becoming warmer globally. The Third Assessment Report of IPCC shows that since the late 19th century, the global surface temperature has increased by about 0.6° ±0.2°C. The 20th century has been the warmest century over the last 1000 years, and the 1990s was the warmest decade, with 1998 being the warmest year over the past 100 years in the northern hemisphere.[472] Moreover, evidence of global warming keeps appearing.

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467 Ibid Pring15-18.

468 Ibid.

469 David R Hodas, 'Energy, Climate Change and Sustainable Development' in Adrian J Bradbrook and Richard L Ottinger (eds) *Energy Law and Sustainable Development* (IUCN 2003) <http://works.bepress.com/david_hodas/10/> accessed 12 April 2012.

470 For a general background on climate change issues, see Ved Nanda and George (Rock) Pring, *International Environmental Law & Policy for the 21st Century* (2nd edn, Martinus Nijhoff 2012) 331-426.

471 Ibid.

472 IPCC, *Climate Change 2001: The Scientific Basis* (Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change, CUP 2001) <http://www.ipcc.ch/ipccreports/tar/wg1/pdf/WG1_TAR-FRONT.PDF> accessed 21 July 2013; Hodas (n 469) 11, 16-18.

The year 2001 was the second hottest year on record, nine of the ten warmest years since 1860 have occurred since 1990, global temperatures are now rising three times as fast as they were in 1900.[473] Therefore, it is evidenced that GHG concentrations in the atmosphere have increased dramatically. A variety of significant climate change phenomena have been observed that are consistent with the warming of the atmosphere.

The adverse consequences of climate change driven by this warming could be dramatic. Although neither the timing of a major climate change nor its impacts can be predicted with confidence yet, such an event presents a plausible and non-negligible risk.[474] The IPCC predicts that, the disintegration of the West Antarctic Ice Sheet could raise the sea level 4–6m; small island nations may be flooded or even disappear under rising seas; runaway warming could ensue if the oceans and biosphere became less able to absorb carbon; El Niño becoming a permanent condition, and major 'destabilization of international order by environmental refugees and emergence of conflict as a result of multiple climate change impacts'.[475] The IPCC concerns are sobering: 'The change would be largely irreversible on a time scale of centuries, the onset could be relatively sudden, and the damage potential could be very high.'[476]

The reasons for global warming are complicated. Is this warming primarily due to natural causes (such as climate cycles of hundreds of thousands of years, changes in the sun's intensity from sun spot cycles) so that human society can do little to alter the climate trends? Or, are the increases of GHGs primarily anthropogenic, meaning that we can reduce the damage by changing emission patterns? To tease out whether the

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[473] Ibid. See also, WMO, *WMO Statement on the Status of the Global Climate in 2001* (WMO 2002) <http://www.wmo.int/pages/prog/wcp/wcdmp/statement/documents/wmo940e.pdf> accessed 12 January 2015.

[474] United Nations, *2002: Natural Disasters Set to Cost Over $70 Billion* (UNEP, 2002) <http://www.unep.org/Documents.Multilingual/Default.Print.asp?DocumentID=266&ArticleID=3157> accessed 12 January 2015; Ibid WMO.

[475] IPCC, *Climate Change 2001: The Scientific Basis* (n 472) 950-51.

[476] Ibid.

observed rapid global warming is driven by natural cycles or by society's release of GHGs, the scientific community has turned to computer models of the climate under various conditions.[477] The models' improvements in accuracy and detail have been dramatic. They demonstrate that the combined predicted temperature effects of human and natural sources of GHGs most closely fit with the actual global temperature over the last 150 years.[478]

The IPCC report confirmed that the Earth's climate is changing as a result of human activities, particularly from fossil fuel combustion. The burning of fossil fuels in developed countries and emerging developing countries, such as China and India, accounts for the overwhelming majority of human-caused emissions of Carbon dioxide.[479] Thus, the climate issue is intimately linked to the modern energy sector, especially the transport sector. Emissions from the transport sector represent the fastest growing source of GHG emissions, it accounts for 26% of global CO2 emissions, and that share is increasing.[480] Policy makers face growing pressure to make a behavioural change in transport and provide sustainable transport model to tackle the issue of GHG emissions and climate change. To achieve a reduction and stabilisation of GHG emissions from transport, a mixture of comprehensive technological and political supports are needed instead of a single technology/policy fix. One widely used option is for, policy makers to begin focusing on biomass energy due to their carbon-low nature.

3.2.5 International Legal Responses to the Challenges of Low-Carbon Future

As the global impact on human-included climate change is now widely recognized,

[477] Hodas (n 469) 11.
[478] Ibid.
[479] Pring (n 464) 13-37.
[480] IEA, *CO2 Emissions from Fuel Combustions 1971–1998* (OECD 2000); Lee Chapman, 'Transport and Climate Change: A Review' (2007) 15 Journal of Transport Geography 354.

great efforts are made at the international policy level to combat climate change. International law has to a large extent responded to these challenges in moving towards a totally different carbon-based energy future. Among all the international agreements and conventions, the most significant are the UNFCCC 1992, the Kyoto Protocol 1997.

In response to the evidence that GHG concentrations are increasing and threaten to change the earth's climate, the UNFCCC was created to:

> [a]chieve…stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner.[481]

On May 29, 1992, at Rio, the leaders of all the nations of the world signed the UNFCCC to stabilize 'greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'.[482] As a result, the UNFCCC entered into force in March 1994, the industrial nations agreed to 'tak[e] the lead in modifying long-term trends in anthropogenic emissions' by taking steps to reduce GHGs 'with the aim of returning…to their 1990 levels of …anthropogenic emissions of carbon dioxide and other greenhouse gases' by the year 2000.[483] The UNFCCC envisioned the need for protocols to establish future targets, timetables, commitments and rules. It obligates all parties to adopt GHG emission programmes and to address GHG emissions within their energy, transportation, industry, agriculture, forest and waste management sectors. Developing countries are voluntarily beginning to address climate change.[484] However, there is no binding target developed under the

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481 UNFCCC, art 2.

482 Ibid.

483 Ibid, art 4, (2) (a) and (b).

484 Ibid, art 12-18.

UNFCCC, and according to the Conference of the Parties (COP), at its first meeting (COP-1 in 1995), it concluded that the UNFCCC's non-binding approach was not going to achieve GHG reductions.

Years of intense negotiations finally led to the adoption of the Kyoto Protocol to the UNFCCC in December 1997 in Kyoto, which was entered into force in February 2005.[485] This is an amendment to the UNFCCC, which intended to bring countries together to reduce global warming and to cope with the effects of temperature increases that were unavoidable after 150 years of industrialization.[486] The main achievement of the Kyoto Protocol was the creation of binding national targets for Annex 1 nations (mainly developed countries) to reduce their overall emissions of GHGs at least 5.2% below 1990 levels between 2008 to 2012, the first commitment period.[487] The achievement of this target required Annex 1 parties 'individually or jointly' to reduce their 'aggregate anthropogenic carbon dioxide equivalent emissions of greenhouse gases listed in Annex A'.[488] Moreover, the Kyoto Protocol also envisioned a variety of flexible, market-based implementation measures that allowed countries to use emission trading to meet their binding targets if they maintained or increased their GHGs. These measures included emissions trading system (ETS)[489], Joint Implementation (JI)[490] of GHG emission reductions between Annex 1 nations, and a Clean Development Mechanism (CDM).[491] The Kyoto Protocol was a big step in developing the UNFCCC

485 UNFCCC, Kyoto Protocol to the United Nations Framework Convention on Climate Change (adopted 11 December 1997, entered into force 16 February 2005) UN Doc FCCC/CP/1997/7/Add1, 37 ILM 22, Article 3(1) <http://unfccc.int/resource/docs/convkp/kpeng.pdf> accessed 11 June 2012.

486 Ibrahim (n 303) 143.

487 Ibid.

488 Ibid. Six GHGs are identified: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride.

489 For more information about ETS, see, World Bank, *State and Trends of the Carbon Market 2012* (World Bank 2012) 134.

490 For detailed discussion about JI, see, Tema Nord, *Joint Implementation as a Measure to Curb Climate Change: Nordic Perspectives and Priorities* (Nordic Council of Ministers 1995).

491 For more discussion about CDM, see, Nijavalli H Ravindranath and Jayant A Sathaye, *Climate*

for sustainable development cooperation and climate change mitigation. However, at the insistence of the US in 2001, the world's biggest GHG emitter which accounts for more than 25% of GHGs generated by humans worldwide, it was left to future COP meetings to establish the specific rules for how GHG emission reductions would be measured and verified, how the ETS, JI and CDM mechanisms would actually work, and how each country's compliance with its duties would be verified and enforced.[492]

It is for this reason that a UNFCCC (COP15) was held in Copenhagen, Denmark, in December 2009, known as the Copenhagen Summit. Copenhagen Summit had widely been hoped to make history as the turning point in the battle against climate change.[493] The much-hyped Copenhagen climate talks in 2009 were meant to deliver a new legally binding, global deal to replace the Kyoto Protocol. However, the conference was unable to accomplish this objective: a binding climate change agreement was not established.[494] Instead, the conference resulted in a non-binding agreement called the Copenhagen Accord.[495] The Copenhagen Accord does not set a global or national emissions limit, but rather recognizes the necessity to immediately achieve a suppression of emissions. Parties of the Copenhagen Accord would set their own emissions targets individually or jointly. In that way, the Copenhagen Accord was not a binding deal that could effectively regulate the actions of the Parties. Moreover, the Accord was also considered to be less ambitious and provided limited financial aid for developing countries.[496] As a result, the Copenhagen Summit is widely seen as an

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Change and Developing Countries (Springer Science & Business Media 2006) 197-225.

492 Ibrahim (n 303) 143.

493 Bluhdorn (n 302).

494 For more information about the failure of the Copenhagen Summit, see, Brad R King, 'The Failure of Copenhagen: A Neo-Liberal Institutionalist Perspective' (2011) 3 Mapping Politics <http://journals.library.mun.ca/ojs/index.php/MP/article/viewFile/207/175> accessed 30 July 2015.

495 UNFCCC, Copenhagen Accord to the United Nations Framework Convention on Climate Change (18 December 2009) UN Doc FCCC/CP/2009/L.7 <http://unfccc.int/resource/docs/2009/cop15/eng/l07.pdf> accessed 11 June 2012.

496 Andrew Bell and others, 'Low Carbon Land Development: Is There a Future for Integration across Sectors?' (2014) 11 Environmental Development 175.

event which failed to ensure the effectiveness of the Kyoto Protocol beyond 2012.[497] But on the other hand, the Accord indeed 'recognised' the need for countries to tackle climate change, and set the deadline to review existing agreements by the end of 2015.[498] Therefore, a bit more time is needed to fully evaluate the Copenhagen Accord's contributions toward climate change mitigation and renewable energy development.

The Copenhagen Accord is not a complete failure. Both the Kyoto Protocol and the Copenhagen Accord constituted a good initial step in terms of a global effort of combating climate change, reducing GHG emissions, and promoting renewable energy development, that including biofuels industry. However, they do leave a question unanswered: how many first steps do we need before we decide to fully commit to the effective and collective efforts of climate change mitigation?[499]

3.2.6 Conclusion

Energy comes from nature, and is restricted by nature's limits. Energy production and consumption is based on natural resources, and it imposes numerous environmental impacts. Energy law and environmental law trace to different traditions; the two areas of law historically have been distinct. As the economic-centric approach dominates

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[497] For more information, see, Peter Christoff, 'Cold Climate in Copenhagen: China and the United States at COP 15' (2010) 19(4) Environmental Politics 637; Charles F Parker and others, 'Fragmented climate change leadership: making sense of the ambiguous outcome of COP-15' (2012) 21(2) Environmental Politics 268.

[498] A positive aspect of the Copenhagen Summit was that developing countries played an important role in negotiations with the US in an effort to mitigate climate change, although many of their proposals were finally denied. See, Lee Chung Lau, Keat Teong Lee and Abdul Rahman Mohamed, 'Global Warming Mitigation and Renewable Energy Policy Development from the Kyoto Protocol to the Copenhagen Accord – A Comment' (2012) 16(7) Renewable and Sustainable Energy Reviews 5280, 5283.

[499] Ibid Lau 5284.

energy regulation, and energy law and environmental law remain separate, it could create many problems in the general regulation of the entire energy sector in the 21st century. It is a fundamental barrier to the development of renewable energy, to push against a transition from traditional energy strategy to a sustainable energy future, as it restrains the adoption of more renewable energy instead of fossil fuels. A sustainable energy future needs a shared goal of both energy and environmental law. Wide cooperation is essential between energy experts and environmentalists within a common framework of sustainable development. Our current energy sector needs to reform or be evaluated under the sustainable development three-core dimension theory to a clean and sustainable future.

Regulation of climate change has been highlighted in many important international agreements and forums. UNFCCC has established the Kyoto Protocol and the Copenhagen Accord as measures of combating climate change due to the emissions of GHG. It is well understood that climate change is not simply a result of GHG emissions, but is a result of the choice of energy policy, the way we build our society, and it cannot be successfully addressed if we put energy and environmental regulations in two different pockets. In order to fundamentally combat climate change and the other challenges to achieving sustainable development, a new approach is needed for the energy sector. There needs to be energy policy aims of not just economics but environmental protection. In other words, the disconnection between environmental law and energy regulation need to be mended. It is the only way to address the deleterious effects of climate change, to balance energy needs and costs with environmental impacts. This approach would have a significant impact on the development of the emerging biofuel industry.

3.3 Biofuels and Environmental Sustainable Development

3.3.1 Introduction

Generally speaking, biofuels are environmentally-friendly fuels, and have great potential of benefiting climate change mitigation. It is an important reason why the new industry received so much support of governments and the public during the last few decades worldwide. The need to address the growing challenge of climate change is a powerful driver behind the development of biofuels and other renewable energy. The potential for reducing GHG emissions has made biofuels become competitive energy products on the market even when the producing cost is higher than for fossil fuels. On the other hand, the negative impacts of biofuels on the environment through deforestation, spread of monocultures, loss of biodiversity and possible higher GHG emissions under uncontrolled land-use change cause significant concerns. The relationship between biofuels and environmental sustainability is therefore complex.[500]

Given this background, it is reasonable to ask: Does biofuel benefit the environment or not? What kinds of biofuel are environmentally friendly? How do we make sure biofuel productions contribute to environmental protection and climate change mitigation? As a result, 'environmental sustainability' has been promoted as an essential condition for biofuels long-term viability and for continued public support for renewable energy and for climate change mitigation. A range of biofuels legislation emerged to promote the new industry developing in an environmentally sustainable way.

This section firstly demonstrates the relationship between biofuels and sustainable development in three core dimensions: the economic, social and environmental dimensions. Secondly, it focuses on the environmental dimensions of biofuel production. It illustrates six significant environmental issues caused by biofuel

[500] A more general issue is the relationship between biofuels and sustainable development in three core dimensions. The socio-economic issues related to biofuel sustainability will be subject to Chapter Four and Five.

production, which include GHG emissions, deforestation, land use change, biodiversity protection, air quality, as well as water and soil management. Lastly, legal responses and initiatives on biofuel sustainability in the EU and US are reviewed and analysed.

3.3.2 Biofuels and Three Core Dimensions of Sustainable Development

The biofuel sector is at the crossroads of sustainable development as it, on the one hand, offer new opportunities to domestic energy security, climate change mitigation, and rural development; and on the other hand, causes various new troubles, such as negative effects on the environment and the food market. Many governments and NGOs take great efforts to search for legislative and policy measures, programmes, strategies and appropriate institutional mechanisms to ensure the sustainability of biofuel development on the social, economic and environmental dimensions. However, it is worth noting that a common definition of 'sustainable biofuels' does not exist. Internationally recognized principles and standards for 'sustainable biofuels' have not yet been enacted or implemented into national or regional legislation. However, it could be argued that, in general, a sustainable biofuel production system should be one that is economically viable, conserves the natural resource base and ensures social well-being. The three core dimensions are interlinked and can best be approached holistically.[501]

The economic dimension of biofuel sustainability aims to ensure the long-term economic viability of the production and trade systems. It refers to three important aspects for consideration in both the short and long term, which are profitability, efficiency and equity.[502] Profitability requires that the price of the biofuel exceeds the production costs; efficiency requires that the maximum amount of yield is obtained with

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[501] Aziz Elbehri, Anna Segerstedt and Pascal Liu, *Biofuels and the Sustainability Challenge: A Global Assessment of Sustainability Issues, Trends and Policies for Biofuels and Related Feedstocks* (FAO 2013) 5 <http://www.fao.org/docrep/017/i3126e/i3126e.pdf> accessed 18 June 2014.

[502] Ibid, 54-62.

a given quantity of resources; and equity means distribution of benefits or value added among actors along a biomass-biofuel value chain or across generations.[503] The economic issues include impacts of biofuel economy on agricultural market and food prices, the consistency of subsidy policy and international trade law, and the consistency of production standards with the WTO.

The social or socio-institutional dimension of biofuel sustainability is the most complex and comprehensive one among the three core dimensions.[504] It covers a large range of interlinked issues, and in turn this raises a number of methodological difficulties including the challenge of distinguishing between direct and indirect social issues, such as of the issue of rural development, land ownership rights and labour rights. All these issues more or less tacked a common goal: the need to integrate poor farmers in rural areas within biofuel development and ensure inclusive benefit sharing, safeguarding of basic rights and local means of livelihood consequent to the introduction of biofuel.[505]

The environmental dimension of biofuel sustainability refers to the issues of GHG emissions and air quality, land and water management, biodiversity and ecosystem stress; and how to address criteria for these issues. It is worth making it clear that environmentally sustainable development is not an alternative name for 'sustainable development'; 'environmental sustainability' is just one dimension of the concept of 'sustainable development'. Compared with economic and social dimensions, issues related to the environmental sustainability are more direct and specific. However, there is significant controversy about establishing standards and criteria, and calculation methods.

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503 Ibid.

504 Ibid, 85-94.

505 Ibid.

3.3.3 Environmental Sustainability Concerns of Biofuels

It is believed that biofuels offer obvious advantages to the environment compared with traditional energy. Biofuels can help reduce GHG emissions, improve air quality in cities, contribute to mitigating climate change, and substitute part of the scarce fossil fuel resources. However, biofuel expansion may generate its own undesirable environmental sustainability consequences. Production of biofuel crops could result in many environmental problems, such as the GHG emissions and deforestation, expansion of the agricultural frontier and land use change, monocropping and biodiversity loss, as well as air pollution and water and soil erosion. The impacts involved vary depending on the type of biofuel crops, cultivation method, conversion technology and country or region under consideration. Thus, the review of issues provided below is by no means exhaustive, but rather aims to highlight the major issues of the biofuels, environmental protection and sustainable development debate requiring further investigation. Moreover, it is also worth noting that none of the environmental issues introduced below exist independently, as all of them are linked to one another. For example, the land use change from a biofuel project can cause deforestation, and increase GHG emission and damage on biodiversity and natural ecosystems, and in turn cause soil erosion and the pollution of watercourses.

3.3.3.1 GHG Emissions

At present, biofuels have been a commercially viable decarbonisation option in the transport sector. It is suggested that sugarcane production for ethanol can achieve 80-100% GHG saving compared to fossil fuels, and oilseed rape production for biodiesel can achieve emissions saving of 20-85%.[506] However, biofuels can only contribute to

[506] Robert Howarth and others, 'Rapid Assessment on Biofuels and Environment: Overview and Key Findings' in Robert Howarth and Stefan Bringezu (eds), *Biofuels: Environmental Consequences and Interactions with Changing Land Use* (Cornell University Press 2009) 1-13.

climate change mitigation when grown in appropriate areas in a sustainable manner. In order to prove biofuel products are environmentally sustainable, biofuel producers or suppliers are required to demonstrate that the net effect is lower GHG emissions compared to conventional fuels in the whole lifecycle, from crops to cars.

A commonly used method is Life-Cycle Assessment (LCA).[507] In an LCA, all input and output data in all phases of the product's life cycle including biomass production, feedstock storage, feedstock transportation, biofuel production, biofuel transportation and final use are required.[508] Therefore, LCA analyses require large amounts of information and considerable explanation and interpretation.[509] Moreover, the LCA approach is challenging also because its methods are still not standardized. It is often difficult and displays a large variation in results, owing to different methodologies, system boundaries and input/output assumptions.[510] It is also suffers from lack of full accounting of indirect land-use change.[511]

Though there is presently a lack of consistent methodologies for GHG emissions accounting, LCA still forms a good basis for comparing various biomass-biofuel systems. When measured over the entire production chain, it is found that the potential of GHG reduction varies according to different biofuel feedstocks. The production of sugarcane-based ethanol, for example, results in significant reductions in GHG

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507 Elbehri (n 501) 66.

508 Anoop Singh, Stig Olsen and Deepak Pank, 'Importance of Life Cycle Assessment of Renewable Energy Sources' in Anoop Singh, Deepak Pank, and Stig Olsen (eds), *Life Cycle Assessment of Renewable Energy Sources: Green Energy and Technology* (Springer Science and Business Media 2013) 3-5.

509 Ibid.

510 Edi Wiloso and Reinout Heijungs, 'Key Issues in Conducting Life Cycle Assessment of Bio-based Renewable Energy Sources' in Anoop Singh, Deepak Pank, and Stig Olsen (eds), *Life Cycle Assessment of Renewable Energy Sources: Green Energy and Technology* (Springer Science and Business Media 2013).

511 Ibid, 22. For information about iLUC, see also, Section 3.3.3.3.

emissions compared to corn-based ethanol.[512] And the production of second-generation biofuels such as corn stover and switchgrass generally can lead to more reductions in net carbon emissions than the first-generation biofuels.[513]

3.3.3.2 Deforestation

The potential of GHG reduction is significantly affected by agricultural practices, including fertilizer use, pesticides, harvesting, distribution process, and the final consumption.[514] Among them, the clearing of forests to grow biofuel crops has been a major concern as this practice can release large amounts of GHG emissions. Tropical forests store around 46% of the world's living terrestrial carbon, and 25% of total net global carbon emissions may stem from deforestation.[515] The numbers above make it obvious that tropical forests are imperative for climate change mitigation.

Biofuels are blamed for increasing deforestation because of a rapid expansion of the feedstock plantations. Several developing countries, such as Brazil, Malaysia and Indonesia, have been at the centre of the biofuel-deforestation debate.[516] In Malaysia and Indonesia, Oil palm plantations are often found in rainforest areas specifically

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512 Henry Lee, William Clark and Charan Devereaux, 'Biofuels and Sustainable Development' (An Executive Session on Grand Challenges of the Sustainability Transition, San Servolo Island, Venice, 2008).

513 Michael Wang and others, 'Wello-to-wheels Energy Use And Greenhouse Gas Emissions of Ethanol from Corn, Sugarcane and Celllulosic Biomass for US Use' (2012) 7(4) Environmental Research Letters <http://iopscience.iop.org/1748-9326/7/4/045905/pdf/1748-9326_7_4_045905.pdf> accessed 30 July 2015.

514 Keith Paustian and others, 'Agriculture's Role in Greenhouse Gas Mitigation' (Pew Center on Global Climate Change 2006) iii <http://www.c2es.org/docUploads/Agriculture's%20Role%20in%20GHG%20Mitigation.pdf> accessed 24 March 2012.

515 E Soepadmo, 'Tropical Rain Forests as Carbon Sinks' (1993) 27 Chemosphere 1025.

516 For discussion about deforestation in Brazil, see, Daniel C Nepstad and others, 'Interactions among Amazon Land Use, Forests and Climate: Prospects for a Near-term Forest Tipping Point' (2008) 363(1498) Biological Sciences 1737.

cleared for this purpose, or in areas that had been cleared earlier but planted with rubber or coconut.[517] Some reports argue that the expansion of palm oil plantations in Malaysia and Indonesia has indeed caused deforestation.[518] Oil-palm plantations in the two countries expanded in forest and in peatlands, resulting in an annual tropical forest loss of about 2 million ha and the oxidation of a large area of peat land.[519]

However, it is worth noting that evidence shows that the oil palm's expansion has reflected global demand for edible oil more than biofuels.[520] Therefore, it is not entirely correct to blame biofuels production for the oil-palm related deforestation. More balanced views have now emerged regarding the relationships between biofuel development, deforestation and forest degradation. Some studies realized that the relationship between biofuel development and deforestation is complex.[521] It is difficult to detect direct links and to quantify these at the global level, due to limited data availability. Combined, these difficulties make it impossible to quantify the relationship between biofuel production and deforestation and to map it at the global level.[522] Therefore, on the one hand, decision makers should note that biofuel projects

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[517] Mendelson Lima, Margaret Skutsch and Gerlane de Medeiros Costa, 'Deforestation and the Social Impacts of Soy for Biodiesel: Perspectives of Farmers in the South Brazilian Amazon' (2011) 16(4) Ecology and Society 4.

[518] Milieudefensie, Friends of the Earth and Sahabat Alam Malaysia, 'Malaysian Palm Oil: Green Gold or Green Wash? A Commentary on the Sustainability Claims of Malaysia's Palm Oil Lobby, With A Special Focus on the State of Sarawak' (Friends of the Earth International Issue 114, Friends of the Earth International 2008) <http://www.foei.org/wp-content/uploads/2014/08/04-foei-sarawak-full-report-lr.pdf> accessed 3 June 2012.

[519] Ibid.

[520] Yan Gao and others, 'A Global Analysis of Deforestation due to Biofuel Development' (2011) Center for International Forestry Research Working Paper 68, ix <http://www.cifor.org/library/3506/a-global-analysis-of-deforestation-due-to-biofuel-development/> accessed 4 July 2013.

[521] Yan Gao, Margaret Skutsch and Omar Masera, 'The Challenges of Estimating Tropical Deforestation due to Biofuel Expansion' in Alexandros Gasparatos and Per Stromberg (eds), *Socioeconomic and Environmental Impacts of Biofuels* (CUP 2012) 90.

[522] For discussion about the methodological difficulties in estimating the relationship between biofuel and deforestation, see Gao, 'A Global Analysis of Deforestation due to Biofuel Development' (n

may impose severe negative effects on tropical deforestation. While on the other hand, it is also worth noting that the relationship between biofuel development and deforestation is complex, and both the pros and cons of biofuel development for the forest are worth analysing.[523]

Lastly, most information about biofuels related to deforestation is based on investigation on first-generation biofuel production.[524] This is because not many second-generation biofuels have been produced on a commercial scale for many years. For Jatropha, a second-generation feedstock, although it has been planted in some Africa and Asian countries, its establishment is so recent that it is difficult to find evidence on this feedstock's impact on deforestation.[525] As a result, new research is urgently needed on the potential impact of second generation lignocellulosic biofuels on deforestation.

3.3.3.3 Land Use Change

Another critical and highly debated thorny question on biofuel sustainability is land-use change, and it is closely linked to the debate of GHG emissions. The total land area required for producing biofuels to meet a 10% global petroleum fuel substitution (118-508 Mha) scenario with first-generation biofuels would require 8-36% of current cropland, largely through conversion of pastureland.[526] Although total land area required for producing biofuels is relatively small, roughly 2-10% of the current global

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523 It is suggested that, within reasonable limits, expansion of biofuel feedstocks might be possible while protecting forest resources. See, Holly Gibbs and others, 'Carbon Payback Times for Crop-based Biofuel Expansion in the Tropics: The Effects of Changing Yield and Technology' (2008) 10 Environmental Research Letters 3 <http://iopscience.iop.org/1748-9326/3/3/034001/fulltext/> accessed 3 June 2012.

524 Gao, 'A Global Analysis of Deforestation due to Biofuel Development' (n 520) ix.

525 Ibid.

526 Bekunda (n 73) 253.

agricultural area (consisting primarily of cropped land and permanent pastures), regional and country levels in land availability for biofuels crops are largely different.[527]

Land-use change occurs when biomass ‘induces a relocation of food and fibre production, housing, and other uses to former grass- or woodlands’.[528] When forests and woodlands are converted into agricultural land to produce biofuels feedstock, the GHG reduction potential will be different than if the production is just started from traditional agricultural land. This is because forests and grasslands can sequester more carbon. When land conversion takes place, it releases much of the carbon stored in soils and organic matter, through either combustion or decomposition. This is a lengthy process stretching over decades.[529] This is particularly an issue for developing countries. For instance, in Malaysia, more than 50% (1 040 000- 1 109 000 ha) of the palm oil expansion between 1990 and 2005 took place on forest land.[530]

Biomass plantation can cause land-use patterns to change directly or indirectly. Direct land-use change (LUC) occurs when newly demanded biofuel feedstocks are grown on converted land such as forests and grasslands. In Brazil, vast areas of grasslands for grazing are being converted to soybean plantations for biodiesel production.[531] It is an example of direct land use change (LUC). Indirect land-use change (iLUC) refers to second, third and higher degrees of land substitutions. It occurs when the use of crops for biofuel production causes changes in land use elsewhere to replace those crops.[532] For instance, in the US, the expansion demand for ethanol may did not cause land conversion from grasslands or forests domestically (LUC). However, the increased demand on the US market would affect the quantity of exports corn to countries such

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527 Ibid.

528 Elbehri (n 501) 65.

529 Ibid.

530 Lian Koh and David Wilcove, ‘Is Oil Palm Agriculture Really Destroying Tropical Biodiversity?’ (2008) 1 Conservation Letters 60.

531 Lima (n 517)1.

532 Elbehri (n 501) 71.

as India and China. Consequently, these countries may cultivate more land, including forest and woodlands, for biofuels feedstock in order to replace the reduced imports of US corn. As a result, iLUC would occur outside the US due to the US biofuel production.[533]

Both LUC and iLUC have impacts on GHG emissions for biofuels, but there is a distinction between direct and indirect land-use change: the impacts of iLUC is more uncertain. The reason why raising questions over whether biofuels achieve GHG emissions savings compared with fossil fuel usage is mainly because the increased biofuel crop production may indirectly cause the release of carbon from newly cultivated land.[534] LUC typically included the carbon accounting procedure in most life cycle analyses, but assessing iLUC is more difficult and is to a large extent an uncertain process limited by current technology. Some research has indicated that iLUC emissions are potentially large compared to the direct global warming effects of processes in the biofuel supply chain, for any biofuel whose feedstock competes with food for land.[535] But none of the current standards or environmental impact assessment adequately address the issue of iLUC.[536] However, most research carried out recently suggests that concerns regarding iLUC have not been overstated, as iLUC can indeed increase the release of CO2 emissions during biofuel production. As a result, it is clear that further research is required, and the impacts of both LUC and iLUC should be assessed to get an adequate estimation of GHG emissions associated with biofuel

533 Timothy Searchinger and others, 'Use of U.S. Croplands for Biofuels Increases Greenhouse Gases through Emissions from Land-Use Change' (2008) 319 Science Magazine 1238.

534 Ibid.

535 Richard Plevin and others, 'Greenhouse Gas Emissions from Biofuels' Indirect Land Use Change Are Uncertain but May Be Much Greater than Previously Estimated' (2010) 44 Environmental Science and Technology 8015.

536 Emanuela Menichetti and Martina Otto, 'Energy Balance and Greenhouse Gas Emissions of Biofuels from a Life-cycle Perspective' in Robert W Howarth and Stefan Bringezu (eds), *Biofuels: Environmental Consequences and Interactions with Changing Land Use* 81-109 (Cornell University Press 2009).

production.[537]

3.3.3.4 Biodiversity

'Biodiversity', also known as 'Biological diversity', is essential for the performance of an eco-system. The term of 'biodiversity' is defined in the Convention on Biological Diversity (CBD) and, means 'the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'.[538] The reduction in global biodiversity has emerged as one of the greatest environmental threats since the last century.[539]

Biomass cultivation and biofuel production can have both positive and negative impacts on biodiversity. It depends upon many factors, such as variety of biofuel feedstocks, previous land use, and plantation methods. When well-managed biomass plantations are established in suitable areas, such as in the degraded land, and GHG emissions are reduced, then the diversity of species might be enhanced.[540] Studies suggest that oil palm growers in Southeast Asia could marginally increase the species richness of

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537 For example, the EC presented a legislative proposal to address the iLUC concerns in 2012, which is expected to go through a second reading in Parliament and the Council in 2015. For discussion about EU policies dealing with iLUC, see, Didier Bourguignon, 'EU Biofuels Policy: Dealing with Indirect Land Use Change' (European Parliament Briefing PE 545.726, European Parliamentary Research Service 2015) <http://www.europarl.europa.eu/RegData/etudes/BRIE/2015/545726/EPRS_BRI%282015%29545726_REV1_EN.pdf> accessed 30 July 2015.

538 Convention on Biological Diversity (29 December 1993) 1760 UNTS 79; 31 ILM 818 (1992) <https://www.cbd.int/convention/> accessed 14 March 2012.

539 Dennis Keeney and Claudia Nanninga, *Biofuel and Global Biodiversity* (IATP 2008) 5 <http://www.iatp.org/files/258_2_102584_0.pdf > accessed 12 July 2012.

540 Ed Gallagher, *The Gallagher Review of the Indirect Effects of Biofuels Production* (RFA 2008) 49 <https://www.unido.org/fileadmin/user_media/UNIDO_Header_Site/Subsites/Green_Industry_Asia_Conference__Maanila_/GC13/Gallagher_Report.pdf > accessed 12 July 2012.

butterflies and birds on their plantations by preserving remnant forest patches within their estates.[541] While, on the contrary, when inappropriate crops are planting in unsuitable areas, negative impacts would occur.[542] Extensive, low input farming is the most favourable system for wildlife.[543] However, biofuel production increases the pressure to convert such regions into intensive production of biofuels, with crops such as oilseed rape and beet which are particularly unfavourable to wildlife.[544]

Studies have shown that the cultivation of many of the biofuel crops have already negatively impacted biodiversity through direct conversion of natural ecosystems or indirect land conversion of non-degraded land.[545] The replacement of natural forests and grassland by large monocultures biomass crops can cause the expansion of invasive species, soil erosion and water runoff, as well as a loss of biodiversity.[546] In developing countries, ecosystems are destroyed by plant crops used for biofuels. Examples include sugarcane and soya in Brazil, Argentina, Paraguay and Bolivia.[547] In India and Africa, the planting of jatropha trees for biodiesel threaten the biodiversity and ecosystems in the remaining forests. Countries such as Indonesia, Malaysia, Colombia and Ecuador are experiencing accelerating biodiversity loss due to oil palm plantations.[548] There has been evidence that palm oil plantations can support just no more than 20% of the

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541 Lee, 'Biofuel Expansion in Southeast Asia: Biodiversity Impacts and Policy Guidelines' (n 135) 191.

542 Gallagher (n 540).

543 For discussion about low input farming and wildlife, see Katarzyna Biala and others, 'Low Input Farming Systems: an Opportunity to Develop Sustainable Agriculture' (Proceedings of the JRC Summer University, Ranco, 2-5 July 2007).

544 Biofuelwatch (n 255).

545 Alison Campbell and Nathalie Doswald, *The Impacts of Biofuels Prodcution on Biodiversity: A Review of the Current Literarture* (UNEP-WCMC 2009) 5 <https://www.cbd.int/agriculture/2011-121/UNEP-WCMC3-sep11-en.pdf> accessed 23 July 2012.

546 Jeffrey McNeely, 'Energy and Biodiversity: Understanding complex relationships' in Adrian Bradbrook and Richard Ottinger, (eds) *Energy Law and Sustainable Development* (IUCN Environmental Policy and Law Paper, IUCN 2003) 34 <http://cmsdata.iucn.org/downloads/eplp47en.pdf> accessed 12 July 2012.

547 Biofuelwatch (n 255) 6.

548 Ibid.

original rainforest diversity, and often less.[549]

Indeed, the impacts on forest biodiversity are extremely difficult to predict precisely because of the complexity and longevity of trees. According to the current literature available, most of the biofuel production scenarios suggested that biodiversity will continue to be negatively impacted.[550] The development of cellulosic biofuels may help reduce negative biodiversity impacts, as the feedstocks grown on marginal lands, as well as waste products from agriculture and forestry can be utilized. However, if the production on marginal lands had a significant impact on water reserves through increased irrigation, it may in turn generate a higher risk of biodiversity loss.[551]

3.3.3.5 Air Quality

Air pollution is another severe environmental issue related to GHG emissions. Studies tend to agree that, compared to fossil fuels, biodiesel and ethanol tend to release fewer pollutants, inlcuding PM, CO emissions and sulphate emissions.[552] For example, it is found that second-generation ethanol, cellulosic ethanol, can offer health benefits from PM2.5 reduction that are of comparable importance to its climate-change benefits from GHG reduction. A shift from gasoline to cellulosic ethanol has great advantages for air

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549 World Rainforest Movement, 'Oil Palm and Soy Bean: Two Paradigmatic Deforestation Cash Crops' (WRM Bulletin No. 85, WRM 2004) <http://wrm.org.uy/oldsite/bulletin/85/oilpalm.html> accessed 28 January 2015.

550 Ibid.

551 Petr Havlik and others, 'Global Land-use Implications of First and Second Generation Biofuel Targets' (2011) 39 Energy Policy 5690.

552 John Christensen and others, 'Renewable Energy in the Context of Sustainable Development' in Ottmar Edenhofer and others (eds), *Renewable Energy Sources and Climate Change Mitigation: Special Report of the Intergovernmental Panel on Climate Change* (CUP 2011) 739. However, there is no clear evidence of how it benefits to air quality through consumption of biofuels. See, Department for Environment, Food & Rural Affairs, *Road Transport Biofuels: Impact on UK Air Quality* (AQEG, Crown 2011) 26 <https://www.gov.uk/government/publications/road-transport-biofuels-impact-on-uk-air-quality> accessed 13 April 2014.

pollution and people health.[553] However, during biofuels consumption in transport, there is still a number of pollutants emitted, such as carbon dioxide (CO2), carbon monoxide (CO), nitrous oxide (N2O), particulate matter (PM), methane (CH4), total hydrocarbons (THC), and volatile organic compounds (VOC).[554] Such gases and particles are released when burning practices occur, and its localized effects contribute to deteriorating local and regional air quality, which could be dangerous for both the environment and human health.[555] In addition, it is also indicated that the so-called green hydrocarbons derived from lignocellulosic biomass have the potential to be produced with much greater efficiency than the first-generation biofuels, which may translate into a reduction of air pollutants across their entire life cycle.[556]

More severe air pollution is associated with biomass production, especially in the case of burning down forests for biofuel production. It is a common practice in developing countries, particularly in South Asia and South America. For example, farmers in Indonesia use fires to clean fields for the cultivation of palm oil plantations, which has resulted in considerable increases in air pollution.[557] Another example is farmers in Brazil usually burn sugarcane fields just prior harvest.[558] The state of São Paulo is the largest sugarcane producer in Brazil, with a cultivated area of about 5.4 Mha in 2011. Approximately 2 Mha were harvested annually from 2006 to 2011 with the pre-harvest

553 For more information, see, Jason Hill and others, 'Climate Change and Health Costs of Air Emissions from Biofuels and Gasoline' (2009) 106(6) National Academy of Sciences of the United States of America 2207.

554 Jeffrey Gaffney and Nancy Marley, 'The Impacts of Combustion Emissions on Air Quality and Climate: From Coal to Biofuels and Beyond' (2009) 43 Atmospheric Environment 23.

555 Elbehri (n 501) 65.

556 John Regalbuto, 'Cellulosic Biofuels – Got Gasoline?' (2009) 325 Science 822, 824.

557 The method of burning forests to clear land, also called 'slash and burn' method, is commonly used in Southeast Asia in history. See, Quirine M Ketterings and others, 'Farmers' Perspectives on Slash-and-burn as a Land Clearing Method for Small-sale Rubber Producers in Sepunggur, Jambi Province, Sumatra, Indonesia' (1999) 120 Forest Ecology and Management 157.

558 Leaves need to be first eliminated by burning to ease the harvest. See, Daniela Franca and others, 'Pre-Harvest Sugarcane Burning: Determination of Emission Factors through Laboratory Measurements' (2012) 3 (1) Atmosphere 164.

straw burning practice, which emits trace gases and particulate material to the atmosphere.[559] This practice emits particulate material, GHG and tropo-spheric ozone (O3) precursors to the atmosphere, causing severe air pollution and GHG emissions, and risks to human health in São Paulo.[560]

3.3.3.6 Water Use and Soil Quality

The rapid expansion of biofuel production could also severely impact on agricultural water consumption and soil quality. As nations need to balance the demands and availability of water resources to support growing agricultural, human health, energy, industrial, and ecological demands around the word, water can be an even more essential factor than carbon to consider in determining sustainability.[561] One important consideration in biomass development is the quantity of water used. The US National Research Council report calculated that the amount of water required in growing the corn for biofuels is about 200 times greater than the amount needed for processing each gallon of ethanol.[562] Water footprints for biofuels vary, depending on crop type applied, production location, and agricultural practice.[563]Both first-generation feedstocks such

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559 Daniela Franca and others, 'Pre-harvest Sugarcane Burning Emission Inventories Based on Remote Sensing Data in the State of São Paulo, Brazil' (2014) 99 Atmospheric Environment 446.

560 Ibid, 447; See also, Diarmid Campbell-Lendrum and Carlos Corvalan, 'Climate Change and Developing-Country Cities: Implications for Environmental Health and Equity' (2007) 84 Journal of Urban Health: Bulletin of the New York Academy of Medicine i109.

561 Michael Hightower, 'Reducing Energy's Water Footprint: Driving a Sustainable Energy Future' (2014) 2 (1) Cornerstone 4 <http://cornerstonemag.net/reducing-energys-water-footprint-driving-a-sustainable-energy-future/> accessed 7 January 2015.

562 Committee on Water Implications of Biofuels Production in the United States, National Research Council, *Water Implications of Biofuels Production in the United States* (National Academies Press 2008) 51 <http://books.nap.edu/openbook.php?record_id=12039&page=51> accessed 18 June 2014.

563 For further reading about water use and biofuels as well as other bioenergy, see, P Winnie Gerbens-Leenes, Arjen Y Hoekstra and Theo H van der Meer, 'Water for Bioenergy: A Global Analysis' in Alexandros Gasparatos and Per Stromberg (eds), *Socioeconomic and Environmental Impacts of Biofuels* (CUP 2012) 69.

as rapeseed and corn, and second-generation biofuel feedstocks such as jatropha, cassava and sorghum could cause water use issues.[564] It would be a major constraint on biofuel production in many countries where water is a scarce resource, such as China and India.[565]

In addition, water and soil quality can be affected by biofuels production. Biofuels expansion affects the quality of water and soil by many aspects such as fertiliser run-off, nutrient pollution, and pesticide use. Irrigation depletes lakes, rivers and aquifers, while fertilisers cause an increased burden of nitrates in water and soil, as they runoff into streams and rivers, and then contribute to eutrophication, which is a major threat to fish stocks.[566] Nutrient pollution could cause severe damage on the local ecosystem, as many forms of marine life cannot survive with low oxygen levels. It is noted that there is considerable potential for corn bioethanol production to increase the severity of nutrient pollution in waterways, because compared with many other feedstocks, corn is of the greatest application rates of fertilisers and pesticides per acre.[567] It is warned that projected future increases in use of corn for ethanol production do occur; the increase in harm to water quality could be considerable.[568] In addition, as second- and third-generation biofuel production is evolving to agro-industry system, it may generate a higher risk of soil erosion, as soil compaction from heavy machinery in an intensive large-scale production.[569]

564 Ibid.

565 Both of them launched several considerable biofuel production projects, but now they already face severe water limitations in agriculture production. See, Charlotte de Fraiture, Mark Giordano and Yongsong Liao, 'Biofuels and Implications for Agricultural Water Use: Blue Impacts of Green Energy' (2008) 10 (Supplement 1) Water Policy 67.

566 Andrew Sharpley and Helen Jarvie, 'Agricultural Management, Water Quality and Ecology: Putting Practice into Policy' [2012] Water Sustainability in Agriculture 87.

567 Committee on Water Implications of Biofuels Production in the United States, National Research Council (n 562) 27-31.

568 Ibid, 35.

569 Elbehri (n 501) 71.

Biofuels have the potential to contribute to climate change mitigation, natural resources preservation, and environment protection. It is one of the most important reasons why biofuel industry received so much support all over the world and developed so rapidly in the last few decades. However, this may need to be balanced against the negative impacts on the environment. It has been widely discussed that, without a careful design and assessment, biofuel industry might cause a variety of severe problems on the environment, including increased GHG emissions, impropriated land use and deforestation, air and water pollution, soil erosion and biodiversity loss. These issues are frequently occurring in many developing countries. For example, the clearance of Indonesia's peat forests to plant oil palm plantations has caused massive outputs of CO2. Once forest removal reaches a certain level, a process of self destruction may begin. The final impact remains much unknown. Therefore, a precautionary approach to developing biofuels is necessary. A comprehensive assessment of the environmental impacts of biofuel production and the identification of measures to reduce these impacts based on a local scale is required before any biofuel plant is being launched. However, the impacts on the environment are not always obvious, and many of the issues cannot be solved by an individual operator or local community, such as the iLUC, and the calculation of GHG emissions, instead, national and international efforts are needed. In order to help to reduce adverse impacts on the environment, to regulate biofuel industry developing in a sustainable manner, many countries, mainly from the Global North, have begun to incorporate sustainability requirements and standards into the national biofuel legal framework.

3.3.4 Legal Response and Initiatives on Biofuel Sustainability

3.3.4.1 Biofuel Sustainability Initiatives in the Netherlands

The Netherlands was among the first European countries to initiate national-level initiatives on biofuel sustainability. In 2006, the Cramer Committee for 'Sustainable Production of Biomass' was set up to develop a certification system and formulate sustainability criteria for the production and conversion of biomass.[570] In 2007, a report of 'Testing Framework for Sustainable Biomass' was issued by the Cramer Commission.[571] This report emphasized six themes of biomass sustainability, namely: (1) GHG emissions; (2) competition with food production; (3) biodiversity; (4) environmental effects on water, air and soil; (5) prosperity of the local economy; and (6) social well-being of the local population and employees.[572] The six guiding principles clearly addressed the requirements of biofuel sustainable development from the environmental, social and economic dimensions: principle (1), (3), and (4) concern environmental sustainability; the theme of (5) is for addressing economic sustainable development issues; (6) is clearly about social sustainable development requirements; and theme (2) is specifically about the biofuel related food issue, which is an economic issue but also is an social issue. The Cramer sustainability framework in the Netherlands clarified about the environmental, social and economic sustainable aspects of biofuels, and therefore formulated a good foundation for biofuels of receive wide social support.[573]

Moreover, following the EU RED which was published in 2009, the Cramer Committee set out a requirement of 35% GHG emission reduction for biofuels, to be increased to

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570 Jacqueline Cramer, 'Criteria for Sustainable Biomass Production' (Final report from the project group, Sustainable Production of Biomass 2006) <http://www.globalproblems-globalsolutions-files.org/unf_website/PDF/criteria_sustainable_biomass_prod.pdf> accessed 12 August 2012.

571 Ibid.

572 Ibid.

573 These principles should apply to biofuels in transportation, but also to the biomass used for heating, energy generation and biochemistry materials. See, Jacqueline Cramer, *Testing Framework for Sustainable Biomass: Final Report from the Project Group 'Sustainable Production of Biomass'* (Commissioned by the Dutch Energy Transition's Interdepartmental Programme Management 2007) <http://www.globalbioenergy.org/bioenergyinfo/sort-by-date/detail/fi/c/1202/> accessed 12 August 2012.

50% from 2012.[574] The Committee also proposed a methodology for calculating GHG emission. This calculating module covers the entire chain from production of raw materials through to end-use. There were other preconditions for the type of land on which biomass may be cultivated. However, the calculation only included LUC, but not the iLUC.[575] The macro-level issues, including deforestation, changes in land use, and availability of food, are required to be monitored and reported to the Cramer Commission.[576] The Cramer criteria cover both domestically-produced and imported biomass. For each theme it will be necessary to collect the relevant data in consultation with the parties involved in the producing countries.[577] It might be difficult for developing countries' producers to prove the compliance, or heavy burden caused, because in many developing countries, there is a lack of regional information on GHG lifecycles, land-use patterns and carbon stocks of arable land.[578]

3.3.4.2 Biofuel Sustainability Initiatives in the United Kingdom

In order to meet EU Biofuels Directive (2003/30/EC) and Kyoto Treaty obligations, the British Government has provided ambiguous signals on biofuels. The National Government places biofuels in the context of creating a low carbon economy.[579] Renewable Transport Fuels Obligation (RTFO), which was administered by the Renewable Fuels Agency (RFA) in April 2008, is the UK's main policy mechanism for biofuel sustainability.[580] The main purpose of the RTFO is to reduce its dependence on fossil fuels and GHG emissions from the road transport sector, as well as to increase

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574 Nicolae Scarlat and Jean-Francois Dallemand, 'Recent Developments of Biofuels/Bioenergy Sustainability Certification: A Global Overview' (2011) 39 Energy Policy 1630, 1634.

575 Ibid.

576 Ibid.

577 Cramer (n 570).

578 See also, Section 3.4.4.

579 Bomb (n 12) 2261.

580 The Renewable Transport Fuels Obligations Order 2007, SI 2007/3072.

the share of sustainable biofuels.[581]

According to the RTFO, certain road transport fuel suppliers will be legally obliged to include a proportion of fuels from renewable sources in their petroleum-based fuels.[582] The obligation has been set at 2.5% for 2009, 3.25% for 2009, 3.5% for 2010, 4% for 2011, 4.5% for 2012, and rising to 5% for 2013 and beyond.[583] The RTFO also required fuel suppliers to submit reports periodically to the RFA on the carbon savings and sustainability of biofuels.[584] As limited by land availability and producing cost, a significant proportion of biofuels in the UK need to be imported from developing countries to meet the RTFO targets. The reporting requirements are designed to ensure that biofuels used in the UK, including the imported biofuels, deliver carbon savings and meet UK 'minimum' sustainability standards. Therefore, UK suppliers need to report on the carbon emission savings of their fuels, using a carbon calculation methodology based on a well-to-wheels approach (another name for LCA), and on broader aspects of the sustainability of individual batches of biofuels supplied within the UK.[585]

The UK reporting schemes work together with a certification system. In order to meet the RTFO targets for the volumes of renewable fuels supplied, obligated companies are requested to accumulate renewable fuel certificates.[586] Only the certificated biofuels

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581 Ibid.

582 Ibid.

583 The targets were set at a higher level at 5% by 2010, but now UK government has reduced the targets at 5% by 2013. See, The Renewable Transport Fuel Obligations (Amendment) Order 2009, 2009, Draft SI 2009/000; Gallagher (n 540) 22-28.

584 RFA, *Carbon and Sustainability Reporting within the Renewable Transport Fuel Obligation: Technical Guidance Part 1, 2* (2009) [hereinafter Technical Guidance Part 1].

585 Fuel suppliers need to submit monthly reports and yearly reports. For required contents in the monthly and yearly reports, see, Technical Guidance Part 1, 2-4, 42-50, Annex E.

586 Department of Transport, *Consultation on the Draft Renewable Transport Fuel Obligations Order* (2007) 6-7.

could be measured as a percentage of fossil fuel sales reported to the RFA.[587] The RTFO's sustainability reporting framework was based upon a 'meta-standard' approach under which existing voluntary agro-environmental and social norm standards were benchmarked against a RTFO Sustainable Biofuel Meta-Standard to assess the extent to which the feedstock produced could be considered sustainable.[588] Benchmarking determines whether an obligated party can use part or all of the existing standards to meet the meta-standard.[589] If the existing standard meets all of the criteria, then it is considered as meeting the full RTFO meta-standard. If it meets most, but not all of the criteria, the existing standard is said to 'qualify' for the meta-standard. The sustainability reporting focuses on the farm or plantation level rather than the full production chain. Only biofuels derived from agricultural and forestry feedstocks are included as, fuels from residues are not included in the sustainability reporting obligation.[590] This limitation makes sense because sustainability standards for agricultural and forestry practices are better developed and adaptable to biofuel feedstock.

The RTFO Sustainable Biofuel Meta-Standard is defined by five environmental principles, two social principles, and a set of recommended criteria and indicators.[591] The environmental principles are: (1) biomass production will not destroy or damage large above or below ground carbon stocks; (2) biomass production will not lead to the destruction or damage to high biodiversity areas; (3) biomass production does not lead to soil degradation; (4) biomass production does not lead to the contamination or depletion of water sources; (5) biomass production does not lead to air pollution. These

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587 Ibid.

588 Timo Kaphengst, Mandy Ma and Stephanie Schlegel, 'At a Tipping Point? How the Debate on Biofuels Sustainability Standards Sparks Innovative Ideas for the General Future of Standardization and Certification Schemes' (2009) 17 Journal of Cleaner Production S99.

589 Technical Guidance Part 1, 8.

590 Ibid, 11, 33.

591 The criteria and indicators contained in an annex to the Technical Guidance. See Technical Guidance Part 1, 83-95.

five principles are quite similar to Cramer principles in the Netherlands, though expressed slightly differently. The social principles are: (1) biomass production does not adversely affect workers' rights and working relationships; (2) biomass production does not adversely affect existing land rights and community relations.[592] These social principles of RTFO are not exactly the same as the Netherlands principles, as food security is not included in RTFO requirements. Moreover, instead of a broad local economic and social-welfare concern in Cramer criteria, the RTFO highlighted workers' rights and land rights concerns.

Instead of requiring producers to get certification for the meta-standard directly, compliance with the meta-standard is achieved through existing standards. In order to do so, existing, voluntary agro-environmental and social certification schemes need to be benchmarked against the above principles, criteria and indicators. If a voluntary standard meets all of the RTFO sustainability criteria, it will be deemed a qualifying standard. By now, there are numbers of qualifying sustainability standards, such as Roundtable on Sustainable Palm Oil (RSPO), Sustainable Agriculture Network/Rainforest Alliance (SAN/RA), Forest Stewardship Council (FSC), and Assured Combinable Crops Scheme (ACCS). An economic operator that complies with and is certified by one of the above standards can use such certification to demonstrate compliance with the UK biofuel sustainability criteria.

The sustainability and carbon reporting requirements of the RTFO are original policy initiatives in the UK. It is an important step to assist the biofuels industry to demonstrate its environmental effects and justify the government's support received. The certification-based reporting scheme is relatively sophisticated in scope. It is significantly valuable as it provides a practical model for sustainable development in biofuels, although it has raised debates about whether it is fair for developing countries' producers to follow the UK 'minimum sustainability standards' under the WTO

[592] Ibid, 9.

framework.[593] A similar system has also been adopted by the EU Commission, and it has also been taken up by many sustainability initiatives for biofuels that were developed in other European countries.[594] Detailed technical guidance for sustainability reporting under the RTFO parallels that proposed by the Netherlands and Germany with the aim of harmonizing activities among the three countries.

3.3.4.3 Biofuel Sustainability Initiatives in the European Union

The EU has an important tracking history regarding the search for the preservation of environment and persists in strategies to effectively reach green economy and sustainable development. As early as the initial years of biofuels development, regulators in Europe have made the reduction of GHG emissions an important target in the biofuel development agenda, even when biofuel consumption in the EU was nearly zero.[595] It is believed that ensuring biofuels develop in a sustainable way is crucially important for the future of the new industry, especially when now it faces volatile and unfavourable market conditions. 2003 marked a critical year for the evaluation of the EU liquid biofuels policy as policy initiatives that had been extensively discussed on EU-level and within Member States by then were implemented into EU legislation.[596]

The Biofuels Directive

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[593] The issue of consistency of biofuel sustainable standard and WTO rules is discussed in Chapter Five.

[594] Bart Dehue, Sebastian Meyer and Carlo Hamelinck, 'Towards a Harmonized Sustainable Biomass Certification Scheme' (Ecofys 2007) <http://www.wsis.ethz.ch/wwfhsbs.pdf> accessed 27 September 2013.

[595] Marc Londo and Ewout Deurwaarder, 'Developments in EU Biofuels Policy Related to Sustainability Issues: An Overview and Outlook' (2007) 1 Biofuels, Bioproducts and Biorefining 292, 294.

[596] Lamers (n 2) 2657.

Directive 2003/30/EC is also known as the 'Biofuels Directive', as it is especially enacted for the promotion and use of biofuels for transportation.[597] In order to achieve 'climate change commitments, [and an] environmentally friendly security of supply and promoting renewable energy sources', the Biofuels Directive requires Member States to ensure that a minimum proportion - at 5.75% by 2010, and 10% by 2020 - of biofuels is put on the market for transport.[598] Moreover, the Biofuels Directive also requires that from 2006 the European Commission report every two years on the environmental impact of biofuels use, including, from a life-cycle perspective, crop sustainability and climate change effectiveness.[599] As a result, Member States need to take into consideration the 'overall climate and environmental balance' of different increasing biofuels and promote those with the 'most cost-effective environmental balance' preferentially.[600]

Biomass Action Plan

The Biomass Action Plan is important legislation regulating biofuels sustainability in Europe.[601] The Plan was issued by the European Commission to ensure the proper implementation of the Biofuels Directive. It outlines more than 20 actions to stimulate the development and diffusion of bioenergy in Europe. The Commission recommends in the Plan that only biofuels that comply with minimum sustainability standards, tracked through certifications, would count toward biofuel targets.[602] It provides a legal basis for promoting sustainable biofuels via the certification scheme. On the one hand,

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[597] Council Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport [2003] OJ L 123/44.

[598] Ibid, art 1.

[599] Ibid, art 4(2) (b)-(e).

[600] Ibid, article 3.

[601] Commission, 'Communication from the Commission: Biomass Action Plan' COM (2005) 628 final.

[602] Ibid, 9, Annex 4.

it still allows people to purchase non-sustainable biofuels on the market, while on the other hand enabling governments to provide price premiums for sustainable biofuels which count towards the targets. Finally, it can change the behaviour of market actors and promote biofuel industry to develop in a sustainable manner. Moreover, the Commission mentions the impact of biofuels on food security and the possibility to 'allow the sustainable use of low-value land' while improving food security globally.[603] Furthermore, the Commission also states that they will investigate whether increased biofuel mandates could reduce pollutant and GHG emissions.[604]

Revised Fuel Quality Directive (RFQD) and Directive for Renewable Energy (RED)

By now, EU biofuels policy has evolved over the years from modest support for ethanol production as an agricultural by-product to the legal mandates for renewable fuels.[605] The EU current approach for biofuel sustainability is reflected in the Revised Fuel Quality Directive 2009/30/EC (RFQD) and the Directive for Renewable Energy (RED).

In January 2007, the European Commission revised the 1998 Fuel Quality Directive.[606] This proposal includes some important new alternative fuels considerations.[607] There are two issues presented in the proposal: GHG reductions and preservation of high

603 Ibid, 41.

604 Ibid, 11.

605 Alan Swinbank, *EU Support for Biofuels and Bioenergy, Environmental Sustainability Criteria, and Trade Policy* (ICTSD 2009) <http://www.ictsd.org/downloads/2012/02/eu-support-for-biofuels-and-bioenergy-environmental-sustainability-criteria-and-trade-policy.pdf> accessed 15 August 2013.

606 The 1998 Fuel Quality Directive sets emission standards for fuels, but does not contain any emission standards for GHGs. See, Council Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC [1998] OJL 350/58; Commission, 'Proposal for a Directive of the European Parliament and of the Council Amending Directive 98/70/EC' COM (2007) 18 final.

607 Ibid.

conservation value areas.[608] The biggest achievement of this proposal is the reference to sustainability principles of GHG reduction.[609] RFQD was approved in December 2008 and adopted in April 2009. The RFQD includes sustainability criteria and a target of 6% reduction of lifecycle GHG emissions from production and consumption of transport fuels in the EU from 2011 to 2020.

On 23 April 2009, the EU adopted the Renewable Energy Directive 2009/28/EC (RED), which established an EU-wide mandatory target of a 10% of road transport fuels from renewable sources by 2020 along with an overall 20% of all energy from renewable energy.[610] The RED targets have been translated into individual targets for Member States. Many EU Members have legislation in place to achieve these targets, such as the RTFO in the UK. The RED also set forth the environmental sustainability criteria for biofuels consumed in the EU. Article 17 of the RED is the provision for the EU biofuels sustainability scheme. It sets out two parts of environmental sustainability principals: the achievement of GHG emission savings, and other agronomic and land-use issues. A minimum rate of GHG emission savings, rules for calculating GHG impact, and restrictions on land where biofuels may be grown are included under the RED. [611] More specifically, it requires that: firstly, on the life cycle basis, and excluding indirect land-use change effects, the eligible biofuels' use should result in a reduction of GHG emissions of at least 35% compared to fossil fuels. Secondly, feedstock cannot be grown on land with high biodiversity value such as primary forests and highly biodiversity grasslands, or land with high carbon stocks such as wetlands,

[608] Ibid.

[609] The proposal though did not contain any reference to sustainability principles other than GHGs reduction.

[610] Council Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC [2009] OJ L 140/5.

[611] Ibid, art 17(7). The calculation for the potential reduction of GHG brought by biofuels includes all the life cycle of the production, including emission related to its cultivation, production and transportation. Article 17 does not set social sustainability criteria for biofuels. However, the Commission are required to submit social sustainability reports every two years since 2012.

peatland or continuously forested areas. Moreover, feedstock has to be produced in compliance with certain other environmental criteria for soil, water, air quality, and social standards such as adherence to conventions of the International Labour Organization. In addition, renewable fuels derived from non-food cellulosic material, lingo-cellulosic materials, wastes, and residues are double counted for purposes of achieving this target.[612]

Both of the RFQD and the RED are formally adopted by the Commission in April 2009. The same sustainability criteria for biofuels are contained in the final versions of the two directives. Biofuels that do not meet the sustainability requirements will not count toward the RED's or RFQD's targets and requirements, or qualify for financial incentives. There is a co-decision procedure which requires that the European Parliament and the Council to agree on a final common version.[613] This coordinated approach ensures a coherence of energy and environmental policy, and in turn avoids duplication of legislation.

However, the methodology of how to account for iLUC is still a major question pending in Europe. The adoption of the EU RED and RFQD both include a requirement for the Commission to compile a report by 2010 reviewing the impact of iLUC on GHG emissions and seeking ways to minimize that impact.[614] The report was released in December 2010, in which it 'recognises that a number of deficiencies and uncertainties associated with the modelling, which is required to estimate the impacts, remain to be addressed, which could significantly impact on the results of the analytical work carried out to date'.[615] Uncertainties persist on both the methodology and the equivalent in GHG emission of the iLUC effect of EU biofuels, and these considerations are not

612 Ibid, art 13.

613 Treaty Establishing the European Community [1997] OJC 340/3, art 251.

614 Commission, 'Report from the Commission on indirect land-use change related to biofuels and bioliquids' COM (2010) 0811 final.

615 Ibid.

expected to have concrete impacts in EU biofuel sustainability policy until 2017.[616]

3.3.4.4 Biofuel Sustainability Initiatives in the United States

The US Government began considering biofuel sustainability in the mid-2000s.[617] In 2005, the Energy Policy Act (EPA) was passed which contained a national policy on low carbon fuels, Renewable Fuel Standard (RFS1), which set a floor on the quantity of biofuel produced of 7.5 billion gallons by 2012 in the US.[618] The EPA 2005 is an important step for renewable fuel development in the US, as it first established the renewable fuel volume mandate, and even added reference to sustainability objectives in biomass research programs. However, the EPA and RFS1 did not contain any sustainability requirements or GHG saving consideration.[619]

In December 2007, the Energy Independence and Security Act (EISA) amended the RFS1and made substantial changes to it when the Energy Independence and Security Act of 2007 was enacted.[620] The newly revised standard was referred to as the RFS2.[621] It required that some 36 billion gallons of biofuels to be produced in the US for road transportation by 2022, which was expected to account for one quarter of all road transport fuel sales by that year, with at least 16 billion gallons from cellulosic biofuels,

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616 David Blandford, Tim Josling and Jean-Christorphe Bureau, 'Farm Policy in the US and the EU: The Status of Reform and the Choices Ahead' (2011) International Food & Agricultural Trade Policy Council, 12 <http://www.agritrade.org/Publications/documents/Farm_Policy_Reform_US_EU.pdf accessed 06/03/2012> accessed 19 January 2013.

617 Jody Endres, 'Clearing the Air: the Meta-Standard Approach to Ensuring Biofuels Environmental and Social Sustainability' (2010) 28 Virginia Environmental Law Journal 74.

618 Energy Policy Act of 2005, Public Law 109-58, 2005.

619 Ibid.

620 Independence and Security Act of 2007, Public Law 110-40, 2010.

621 Renewable Fuel Standard (RFS2), US Code, S 7545(o).

and a cap of 15 billion gallons for corn-starch ethanol.[622] As production levels approach the cap on corn ethanol, most additional growth in mandated volumes will have to come from advanced biofuels under the RFS2.

In addition to the expanded volumes and extended date, RFS2 also required that the blending mandates of biofuels must achieve certain minimum levels of GHG reduction, compared with the gasoline and diesel fuels they displace. The target for 2020 is split into sub-targets for different categories of biofuels depending on the feedstocks that are produced from and their GHG saving range. Basically, it defined two categories of biofuels: conventional biofuels and advanced biofuels. Under RSF2, conventional biofuels mainly refer to cornstarch ethanol, which is required to have lifecycle GHG emissions at least 20% less than average emissions of fossil fuels sold in the US in 2005. Advanced biofuels, defined as 'renewable fuel, other than ethanol derived from cornstarch', have to meet 50% reduction standards compared to 2005 average emissions. Cellulosic biofuels, which are one kind of advanced biofuels and are defined as 'renewable fuel derived from any cellulose, hemi-cellulose, or lignin', must achieve at least a 60% GHG reduction.[623]

Moreover, in order to be counted towards compliance with volume standards under the RFS2, biofuel feedstock crops must be derived from land that complies with certain use restrictions. In order to guard against the loss of native forests and prairie, and protect endangered species, EISA requires that renewable biomass be 'harvested from agricultural land cleared or cultivated at any time prior to [December 2007] that is either

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622 Tim Josling, David Blandford and Jane Earley, 'Biofuel and Biomass Subsidies in the US, EU and Brazil: Towards a Transparent System of Notification' (IPC Position Paper, International Food & Agricultural Trade Policy Council 2010) <http://www.agritrade.org/documents/Biofuels_Subs_Web_Final.pdf> accessed 21 March 2013.

623 Clean Air Act Amendments of 1970, Public Law 91-604, § 211, 42 U.S.C. § 7545. See also, Timothy A Slating and Jay P Kesan, 'A Legal Analysis of the Effects of the Renewable Fuel Standard (RFS2) and Clean Air Act on the Commercialization of Biobutanol as a Transportation Fuel in the United States' (2012) 4 Global Change Biology Bioenergy 107, 109.

actively managed or fallow, and non-forested.'[624] The RFS2 also contains additional critical safeguards necessary to protect natural resources, such as conservation standards to preserve soil and water quality.[625] Therefore, unlike in 2005, when the US first established mandatory blending targets for biofuels, the 2007 renewable fuels mandates were accompanied by environmental sustainability standards. The imposition of sustainability criteria in the form of GHG savings and direct land use restrictions in RFS2 is a significant legal effort towards biofuel environmental sustainability.[626]

When comparing the EU and US biofuel sustainability frameworks, it can be found that both the EU RED and the US RFS2 covered considerations about the significant environmental issues, including GHG emissions, land use change, deforestation, biodiversity preservation, as well as air, water and soil protection. In that way, both EU and US environmental sustainability framework for bioenergy set good examples for other players to balance the relationship between biofuel development and environmental sustainability. Another common point of these two schemes is that both of them give priority to cellulosic and advanced biofuels, though with different approaches. Under the EU RED, advanced biofuels count more towards mandatory targets than do first-generation biofuels. Under the US RFS2, EISA set a mandate of 16 billion gallons of cellulosic ethanol to be blended annually by 2022, with a cap on corn ethanol.[627] These policies provide a direct legal basis to speed the transition from conventional biofuels to advanced biofuels. However, the insufficient cellulosic supplies made the US approach very problematic, as we discussed before, because there were no commercially viable plants to produce cellulosic ethanol in 2007. As a result, the inability to meet cellulosic mandates has made producers of advanced biofuels

[624] Renewable Fuel Standard (RFS2), US Code, S 201(o) (1) (I).

[625] Ibid.

[626] For further reading about the RFS, see, Randy Schnepf and Brent D Yacobucci, *Renewable Fuel Standard (RFS): Overview and Issues* (CRS Report for Congress R40155, Congressional Research Service 2013) <https://www.fas.org/sgp/crs/misc/R40155.pdf> accessed 5 May 2014.

[627] For discussion about environmental benefits of first- and second-generation biofuels, see Chapter Two.

‘openly dissatisfied with the current way RFS2 is designed’.[628]

Beside of the common characteristics of the EU and US initiatives of biofuel sustainability, there is at least a significant difference between the two legal frameworks worth mentioning. Firstly, regarding GHG thresholds, EISA directed the EPA to consider both ‘direct and significant indirect emissions such as significant emissions from land used changes’ in determining the GHG emissions. While the EU RED does not yet require GHG emissions owing to indirect land use changes to be calculated into total GHG emission savings. Again, that the US approach includes iLUC is very problematic owing to scientific controversy. As discussed before, issue of iLUC is inherently complex and uncertain as EISA does not specify the methodology for calculating lifecycle GHG emissions.

3.3.5 Conclusion

The relationship between biofuels and environmental sustainability is dynamic and completed. On the one hand, biofuels could be a solution to many environmental issues. It can help reduce GHG emissions, improve air quality in cities, contribute to mitigating climate change, and substitute part of the scarce fossil fuel resources. On the other hand, without proper management, biofuel production could generate severe undesirable environmental sustainability consequences, such as the expansion of the agricultural frontier, deforestation, monocropping and biodiversity loss, and air, water and soil pollution. In order to minimize these adverse impacts on the environment, to ensure the biofuel industry develops in a sustainable way, developed nations, particularly EU and the US, have incorporated sustainability requirements and criteria into their national

[628] Matthieu Mondou and Grace Skogstad, ‘The Regulation of Biofuels in the United States, European Union and Canada’ (CAIRN Report 2012) 12 <http://www.ag-innovation.usask.ca/Mondou%20&%20Skogstad-CAIRN%20report-30%20March.pdf> accessed 30 July 2015.

legal frameworks. In laws adopted during the last decade, different environmental, economic and social aspects were mandated into biofuels production and trade.[629] Environmental sustainability standards are highlighted in both the EU RED and US RFS; and linked with the EU and US biofuel consumption mandates as requirements, including GHG emission savings relative to fossil fuels, and restriction on the use of particular kinds of lands (including those with high carbon stocks and biodiversity). However, the iLUC remains a problem that cannot be calculated and addressed without a proper method in the EU and US biofuel sustainability policy. As regard to socio-economic sustainability standards, it focuses on the impact of the production of biofuels on the price and supply of food, as well as on labour force conditions, especially in developing countries. However, neither the US nor the EU has mandated those sustainability criteria of biofuels, as it is still difficult to find the indicators and methodologies to measure biofuels' social and economic effects.[630]

To a large extent, the EU and US biofuels policy and evaluations lead and shape international practice in the global biofuel field.[631] The implementation of mandatory blending targets and environmental sustainability standards for renewable fuels in the EU and the US directly affects developing countries' producers of biofuels and biofuel feedstocks. The blending targets open up new market opportunities, but seizing these opportunities requires compliance with the environmental sustainability requirements of the respective US and EU legislation. Despite the fact that both the EU and US biofuel mandates and environmental sustainability criteria are subject to continuing controversy, the EU and US biofuel sustainability frameworks are not completely incomparable when looking carefully at the overall structure, definitions used, sustainability requirements, reporting methodology, and the way GHG emissions and

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[629] UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 74.

[630] Mondou (n 628).

[631] Afionis (n 5).

iLUC are incorporated.[632] For example, a major source of contention is the appropriate model to estimate renewable fuels' GHG emissions over their lifecycle, including whether and how to estimate iLUC of biofuels.[633] It makes exporting biofuels or biomass to both EU and US markets difficult and costly.[634]

Despite the legal initiatives and sustainability standards in the EU and US jurisdictions, it is worth noting that a common definition of 'sustainable biofuels' does not exist. Internationally recognized principles and standards for 'sustainable biofuels' have not yet been enacted or implemented in national or regional legislation. Therefore, as a significant group of biofuel producer and exporter countries, developing countries have an opportunity to participate as a party to develop common methodologies and sustainable practices for biofuels, to create a level cross-jurisdictional playing field for producers of biofuels and the feedstocks. Bringing developing countries' public policies for biofuels into closer alignment with those in the EU and US would also serve to promote the global biofuel sustainability principles and standards, as well as the global biofuel market.

3.4 Biofuels Certification Schemes and Meta-Standard Approach

3.4.1 Introduction

The need to secure the sustainability of biofuel production and trade in a fast growing market is widely acknowledged. Various legal responses and initiatives have been

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632 NL Agency, 'Sustainability Requirements for Biofuels and Biomass for Energy in EU and US Regulatory Frameworks' (Ministry of Economic Affairs, Agriculture and Innovation 2011) 28 <http://english.rvo.nl/sites/default/files/2013/12/Report%20EU%20and%20US%20biomass%20legislation%20-%20Partners%20for%20Innovation.pdf> accessed 30 July 2015.

633 Mondou (n 628) 2.

634 Ibid.

established in developed countries to facilitate biofuel development in a sustainable manner. Establishing certification schemes is recognized as a possible strategy that helps ensure sustainable biomass and biofuel development. Certification is an attestation (issue of a statement) by a third-party that specifies that requirements related to products, processes, systems or persons have been fulfilled (ISO).[635] A certification body is a legal or administrative entity that has specific tasks and composition, with acknowledged authority for publishing standards.[636] Certification schemes are widely used in business because they have obvious positive impacts, which include improved efficiency within a supply chain, decreased risk, higher transparency and increased awareness about problems in the supply chain. In principle, certification schemes have an impact on supply chains and can critically re-orient decisions about the depth of corporate social responsibility.[637]

Biofuel certification schemes emerged in the European countries over the last few years. Starting from 2011, a number of feedstock-specific standards have started certifying and tracing biomass and biofuel production. They offer an opportunity for a global assessment with an aim to promote biofuel production and business practices via more responsible and environmentally-friendly sourcing, processing and manufacturing practices. In practice, using certification schemes to regulate biofuels sustainability is a significant initiative which may solve the complicated issues around biofuel production and sustainable development. As discussed in Section 3.2, the relationship between biofuels and sustainability is complex as the key sustainability dimensions are difficult to address in an integrated manner. Biomass could be multi-used for food, feed, fibre and fuels, making their relationship full of uncertainty. A biofuel certification system could be established on the basis of a single final use, which would make it possible to

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635 Adapted from ISO/IEC 17000, 2005, Definitions 5.2 and 5.5. Available at: <http://www.iso.org/sites/ConsumersStandards/en/5-glossary-terms.htm> accessed 21 December 2012.

636 Ibid.

637 Elbehri (n 501) 143.

understand and analyse the sustainability issues in the biofuel sector. However, certification schemes need to be operated with many other policy instruments and initiatives together, to ensure its effectiveness in securing sustainability, not resulting in indirect displacement effects.

In the EU and the US, biofuels certification schemes have worked as an important part in the whole renewable energy and sustainable development agendas. However, in developing countries, although sustainable development of biofuels is also an import issue realized by policy makers, certification schemes have not been commonly employed for promoting biofuel sustainability. This section firstly reviews the ongoing initiatives in the field of biomass and biofuel certification. Secondly, it indicates the strengths and limitations of these schemes by drawing upon experience. Lastly, recommendations on how to move forward to a harmonised, efficient system to guarantee the sustainability of biofuel production and trade are given, from the perspective of developing nations.

3.4.2 A Review of Biofuel Certification Schemes

Biomass can be produced in agriculture or in forestry. A number of different forest and agriculture certification schemes already exist and cover many aspects of sustainable production method.[638] The review below includes an analysis of existing certifications on forestry and agriculture. Sustainability principles and criteria developed by these systems could be adapted for biofuels certification, and provide a useful experience for the development of biofuel certification schemes, or for benchmarking.

[638] I Lewandowski and A P C Faaij, 'Steps towards the Development of a Certification System for Sustainable Bio-energy Trade' (2006) 30 Biomass and Bioenergy 83.

3.4.2.1 Forest Certification Schemes: FSC and PEFC

Forest Stewardship Council (FSC) is the most known forestry standards to be applied on a project level. It is a non-governmental and non-profit organization established in 1994 to promote responsible management of the world's forest, especially in response to concerns about deforestation and poor management of forest resources.[639] It provides standard setting, trademark assurance and accreditation services for companies and organizations that are interested in responsible production and consumption of forest products.[640] Based on information provided by the FSC, in the past 20 years, over 180 million hectares in more than 80 countries have been FSC certified.[641] The share of plantations of the total forest area certified by FSC in developing countries is about 40%. Many developing countries, such as Malaysia and Indonesia, have elaborated national initiatives aimed at FSC compatibility.[642] There are ten principles and the relevant criteria which cover social environmental and economic considerations form the basis for all FSC forest management standards. The key issues include tenure and use rights and responsibilities, indigenous people's rights; community relations and workers' rights; use of forest products and services, maintaining biodiversity and high conservation value forests; forestry planning, monitoring and assessment; and planning and management of plantations.[643] They must be applied in any forest management unit before it can receive FSC certification.[644] The FSC principles concern a wide range of forest sustainable

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639 J van Dam, M Junginger and A P C Faaij, 'From the Global Efforts on Certification of Bioenergy Towards an Integrated Approach Based on Sustainable Land Use Planning' (2010) 14 Renewable and Sustainable Energy Reviews 2445.

640 Graeme Auld, Lars Gulbrandsen, and Constance McDermott, 'Certification Schemes and the Impacts on Forests and Forestry' (2008) 33 Annual Review of Environment and Resources 187, 191.

641 Available at: <https://ic.fsc.org/20th-anniversary.756.htm> accessed 14 March 2015.

642 Ewald Rametsteinera and Markku Simula, 'Forest Certification—An Instrument to Promote Sustainable Forest Management?' (2003) 67 Journal of Environmental Management 87, 91-92.

643 Available at: <https://ic.fsc.org/the-10-principles.103.htm> accessed 14 March 2015.

644 Available at: <https://ic.fsc.org/principles-and-criteria.34.htm> accessed 14 March 2015.

development from economic, social and environmental dimensions. Many of the principles are also closely concerned with policy makers for biofuel sustainability design, such as local people's rights, worker's rights, and biodiversity maintenance.

The Programme for the Endorsement of Forest Certification schemes (PEFC) is another large forest certification system. PEFC was founded in 1999, as a non-profit international umbrella organization for the assessment of and mutual recognition of national forest certification schemes from around the world.[645] A wide range of products are included, both forest products, such as timber and paper, and non-wood forest products, such as agricultural fibre and berries. PEFC is the largest forest certification system in the world, which includes 35 independent national forest certification schemes. By the end of 2006 193.7 mln ha (65%) of forest of the world was certified by PEFC.[646] Some of the largest programmes endorsed in the PEFC programme are, the Australian Forestry Standard (AFS), the Brazilian Programme of Forest Certification (CERFLOR), Chile Forest Certification Corporation (Certfor), the Malaysian Timber Certification Council (MTCC), and the North American Sustainable Forest Initiative (SFI).[647] In contrast to FSC, PEFC does not develop any sustainable principles for forest management under the system itself. Instead, it relies on inter-governmental principles developed and adapted for different regions of the world.[648] Moreover, it does not have its own accreditation body but relies instead on national accreditation services. It is stated that this practice could lead to less control over the

[645] Jinke van Dama and others, 'Overview of Recent Developments in Sustainable Biomass Certification' (2008) 32 Biomass and Bioenergy 749, 751.

[646] 84.2 mln ha (29%) is certified by FSC and 17 mln ha (6%) is certified by other systems. See, Ir M W Vis, Ir J Vos and Ir D van den Berg, 'Sustainability Criteria & Certification Systems for Biomass Production' (Final report, Biomass Technology Group 2008).

[647] As of June 2012, 243 million ha of forest were certified within the programme, and around 8 500 companies and organizations have achieved PEFC Chain of Custody certification. See, van Dam, 'From the Global Efforts on Certification of Bioenergy Towards an Integrated Approach Based on Sustainable Land Use Planning' (n 639) 2451.

[648] Ibid.

certified companies and organizations.[649] For example, in some cases forests might be certified although there may be unsustainable logging practices in sensitive areas. Therefore, FSC and PEFC provide good examples for regulating and managing biofuel sustainable development via the certification scheme, as amount of biomass used for biofuel feedstocks come from forest system, thus many of sustainability principles and criteria could be learned directly from the FSC and PEFC. However, it might be noticed that, neither of FSC nor PEFC directly address the issue of GHG emissions, though forest management is closely linked to the topic.

3.4.2.2 Agricultural Certification Schemes: RSPO and RTRS

The Roundtable on Sustainable Palm Oil (RSPO) is a multi-stakeholder initiative established in 2004 with the objective of promoting the growth and use of sustainable palm oil products and for developing global standards for sustainable palm oil.[650] The RSPO developed principles and criteria to ensure that palm oil production is economically viable, environmentally appropriate and socially beneficial. The system of criteria and principles cover major economic, social and environmental aspects, including the establishment and management of plantations and processing: (1) commitment to transparency; (2) compliance with applicable laws and regulations; (3) to long-term economic and financial viability; (4) use of best practices by growers and millers; (5) environmental responsibility and conservation of natural resources and biodiversity; (6) responsible consideration of employees, individuals and communities; (7) responsible development of new plantings and (8) commitment to continuous

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[649] Peter Sprang, Gerhard Oesten and Errol Meidinger, *Aspects of Quality Assurance under the Certification Schemes FSC and PEFC* (University of Freiburg Institute for Forestry Economics 2001) 52-54 <http://www.rainforest-alliance.org/sites/default/files/publication/pdf/aspects.pdf> accessed 14 March 2013.

[650] Scarlat, 'Recent Developments of Biofuels/Bioenergy Sustainability Certification: A Global Overview' (n 574) 1633.

improvement in key areas.[651] The RSPO criteria are formulated in terms of process and management requirements, according to the best practice. They also concern the issues of land use and food security. However, issues of GHG emissions are not addressed. From 2009 to 2011, a framework and guidelines, as well as specific criteria and indicators for reducing GHG emissions were planned and developed by two successive science-based working groups (commissioned by the executive board of RSPO).[652] A GHG calculator, which is called PalmGHG, was developed by the GHG working group 2. It allows producers to calculate the GHG balances of oil palm products using the LCA approach.[653] A set of guidelines for national interpretation, which address key concerns at local or regional level, also has been provided.[654] Currently, the RSPO principles and criteria have been translated into national interpretations for many developing countries, such as Colombia, Ghana, Indonesia, Malaysia, Papua New Guinea Solomon Islands and Thailand.[655]

The Roundtable on Responsible Soy Production (RTRS) is a global platform with the common objective of promoting a set of voluntary sustainability principles and criteria for soy production. While the RTRS was established in 2006, its standards became fully operational in 2010.[656] Overall, RTRS standards are structured into 5 principles and 21 criteria, including relevant indicators. The main principles are: (1) legal compliance and good business practices; (2) responsible labour conditions; (3) responsible community

651 Available at: <http://www.rspo.org/about> accessed 1 March 2015.

652 Scarlat, 'Recent Developments of Biofuels/Bioenergy Sustainability Certification: A Global Overview' (n 574) 1633.

653 Available at: <http://www.rspo.org/certification/palm-ghg-calculator> accessed 1 March 2015. The calculator is flexible, allowing for different crop rotation lengths and use of alternative default values. Further reading about the RSPO GHG calculation structure and content, see, Cecile Bessou and others, 'Pilot Application of PalmGHG, the RSPO Greenhouse Gas Calculator for Oil Palm Products' (2014) 73 Journal of Cleaner Production 136.

654 Ibid.

655 Available at: <http://www.rspo.org/about> accessed 1 March 2015.

656 Available at: <http://www.responsiblesoy.org/en/quienes-somos/about-rtrs/> accessed 12 June 2012

relations; (4) environmental responsibility; and (5) good agricultural practice.[657] These principles are the basis of the norms to be used for economic, social and environmental responsibility for all kinds of soybean production, including conventional, organic and GM soybean production.[658] Similar to the RSPO, a set of guidelines for national interpretation, which addresses key concerns at local or regional level, also has been provided by the RTRS. It will develop national level macro-scale maps which will provide biodiversity information and a generic global methodology.[659] But unlike the RSPO standards, which focus primarily on production, the RTRS principles and criteria cover the production, transport, processing, trading and use of soybeans. [660] In addition, RTRS certification schemes are developed in compliance with the EU RED. Additional requirements specific to the EU RED include GHG reduction, land use and carbon savings. As of January 2012, there are ten certified producers and four certified chain of custody companies.[661]

The RSPO and RTRS schemes, as well as the FSC and PEFC are not certification schemes particularly designed for biofuels production. They were developed for a wide range of products as a result of various concerns. Forestry standards, such as FSC and PEFC, were set to ensure sustainable management of forests; while agricultural certification schemes, such as PRSP and RTRS, were primarily developed to ensure health and safety of given products or develop organic agriculture.[662] However, these

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[657] Ibid.

[658] Ibid.

[659] Scarlat, 'Recent Developments of Biofuels/Bioenergy Sustainability Certification: A Global Overview' (n 574) 1633.

[660] Available at: <http://www.responsiblesoy.org/en/quienes-somos/about-rtrs/> accessed 12 June 2012.

[661] Jinke van Dam, Sergio Ugarte and Sjors van Iersel, *Seclecting a Biomass Certification System-A Benchmark on Level of Assurance, Costs and Benefits* (Netherlands Agency Report 2012).

[662] Nicolae Scarlat and Jean-Francois Dallema, 'Status of the Implementation of Biofuels/Bioenergy Certification Systems – Major Implications, Reporting Constraints and Implementation Control' (JRC Scientific and Technical Reports, European Commission Joint Research Centre Institute for Energy 2011) 25 <http://bookshop.europa.eu/en/status-of-the-implementation-of-biofuels-and-bioenergy-certification-systems-

existing certification schemes are closely related to biofuels sustainability, as they cover one of the areas in biomass production. Therefore, the existing forest and agriculture schemes provide insight into the structures of certification systems, including design, implementation constraints, and cost-benefits, as well as operational experience and effectiveness.[663] In addition, the sustainability principles and criteria included in these schemes could be adapted for biofuels certification, and provide a useful experience for the development of a biofuels certification scheme, or for benchmarking. However, these forest and agricultural certifications were not driven much by climate change issues when they were formulated, in that carbon conservation aspects, GHG balance and land use competition are not usually included in the certification schemes for agriculture and forestry. (RSPO is an exception as it updated its standards later). Some socio-economic issues which related closely to biofuel products, such as food security problem, were usually not addressed in these certification schemes (with RSOP as an exception). Therefore, the sustainability principles and criteria in forest and agricultural standards were developed differently due to the difference in priority, and they cannot ensure the sustainability concerns specifically related to bioenergy/biofuel standards.

3.4.2.3 Biofuels Certification Schemes

3.4.2.3.1 Intergovernmental Schemes and Initiatives: RSB and ISCC

The Roundtable on Sustainable Biofuels (RSB) was established in 2006. It is a voluntary, international initiative bringing multiple stakeholders together concerned

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pbLBNA24650/?CatalogCategoryID=fMEKABst_fQAAAEj0pEY4e5L> accessed 9 October 2013.

663 Biomass Technology Group, 'Sustainability Criteria and Certification Systems for Biomass Production' (Report prepared for DG TREN – European Commission Project 1386, BTG 2008) <http://www.compete-bioafrica.net/sustainability/sustainability_criteria_and_certification_systems.pdf> accessed 30 July 2015; van Dam, 'Overview of Recent Developments in Sustainable Biomass Certification' (n 645) 749.

with achieving global consensus around a set of principles and criteria for sustainable biofuel production and processing. According to the RSB, the meta-standard is open for direct application by producers as well as for endorsement by established certification systems.[664] A set of required criteria was developed around five RSB principles, namely: (1) the GHG performance through the whole life cycle of biofuels; (2) biodiversity and ecosystem services; (3) soil, water and air quality; (4) local development and food security; and (5) land rights, water rights and stakeholder engagement. Accordingly, both environmental and social sustainability considerations are included, and a GHG emission reduction is required.[665] The RSB standard is applicable to any crop in any country. The principles and criteria, as well as the methodology of GHG emission calculation, under the RSB system are widely accepted and have been used by many other sustainable biofuel initiatives.[666]

The International Sustainability and Carbon Certification (ISCC) is supported by the German Federal Ministry of Food, Agriculture and Consumer Protection, and is operated by the Meo Company. It is a government-supported, private-run certification scheme. This international scheme was finalised in 2010, with the aim of ensuring sustainable production of biomass and bioenergy, covering all relevant raw materials from agriculture and forestry. This certification scheme applied to sustainable production of liquid biofuels in transportation and electricity sectors.[667] The ISCC standard encompasses the following sustainability principles and a number of criteria: (1) biomass shall not be produced on land with high biodiversity value or high carbon stock and not from peat land and high conservation value (HCV) areas; (2) biomass shall be produced in an environmentally responsible way, including protection of soil, water and air and application of Good Agricultural Practices; (3) safe working

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664 Available at: <http://rsb.org/about/what-is-rsb/> accessed 17 March 2013.

665 Ibid.

666 Endres (n 617).

667 Scarlat, 'Recent Developments of Biofuels/Bioenergy Sustainability Certification: A Global Overview' (n 574) 1635.

conditions shall be provided; (4) biomass production shall not violate human rights, labour rights or land rights; (5) biomass production shall take place in compliance with laws and relevant international treaties; (6) good management practices shall be implemented.[668] Accordingly, both the issues of reduction of GHG emissions and sustainable use of land are highlighted in the ISCC standard. In the same as RSB, the ISCC system also adopted meta-standard approach that relies on existing certification schemes and standards.[669]

3.4.2.3.2 National and Regional Schemes and Initiatives: CEN and CSBP

The European Committee for Standardisation (CEN) is a non-profit organization with the aim of providing a platform for harmonizing European standards with in various industrial sectors. The CEN Technical Committee 383 (CEN/TC 383) was created in 2008 in order to work on European standards dealing with sustainability principles, criteria and indicators including the verification and auditing schemes for biomass.[670] CEN/TC 383 addressed a large range of sustainability themes for biomass production, including GHG emission and fossil fuel balances, biodiversity, environmental, economic and social aspects and indirect effects within each of the aspects.[671] CEN/TC 383 also defines the reporting requirements and conditions for tackling indirect effects. Six working groups were established on terminology, GHG assessment, biodiversity and environmental impacts, economic and social aspects, verification and auditing, and indirect land use effects.[672] A whole energy supply chain shall be traced back to the origin. Suppliers have to state the origin by documentation and fuel properties by

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[668] Available at: <http://rsb.org/sustainability/rsb-sustainability-standards/> accessed 17 March 2013.

[669] Ibid.

[670] CEN/TC383 – Sustainably Produced Biomass for Energy Applications <http://www.cen.eu/cen/Sectors/Sectors/UtilitiesAndEnergy/Fuels/Pages/Sustainability.aspx> accessed 15 May 2012.

[671] Ibid.

[672] Ibid.

quality declaration.[673] The CEN/TC 383 standard applies to biomass for all energy sectors, including transport, heating, cooling and electricity.[674] Although it is not specific to biofuels in the transport sector, the introduction of CEN standards and criteria is expected to harmonize sustainability principles and criteria of biofuels in the EU and facilitate compliance with the EU sustainability regulatory requirements.

The Council on Sustainable Biomass Production (CSBP) is a multi-stakeholder organization that was established in 2007 in the US to develop a voluntary sustainability standard for biomass production and conversion and establish an independent third-party certification program.[675] CSBP standards aim to provide a rigorous threshold for the sustainable production of biomass and bioenergy, to 'maintain and enhance social, economic, and environmental well-being'.[676] CSBP formulated a wide range of comprehensive sustainability principles, criteria and indicators for the production of biomass. The key issues it addressed include: GHG emissions, biological diversity, soil quality, surface and ground water quality, and integrated resources management planning.[677] Among them, the GHG emissions are required to be calculated on the basis of the LCA approach. It needs to consider all emissions from production inputs and cultivation practices, land conversion, harvesting, collection, processing, storage and transportation of biomass.[678] Moreover, the CSBP Standard also addresses social sustainability issues, it requires a strict compliance with human rights and labour protection laws in the US.[679] Therefore, as the most significant national/regional

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673 van Dam, 'Overview of Recent Developments in Sustainable Biomass Certification' (n 645) 751.

674 Scarlat, 'Recent Developments of Biofuels/Bioenergy Sustainability Certification: A Global Overview' (n 574) 1635.

675 CSBP, 'Draft Provisional Standard for Sustainable Production of Agricultural Biomass' (Council on Sustainable Biomass Production 2010) <http://www.fao.org/bioenergy/28185-0c80b63a4db091a00b2e1cb187f714e73.pdf> accessed 15th May 2012.

676 Ibid.

677 Ibid. See also, Scarlat, 'Recent Developments of Biofuels/Bioenergy Sustainability Certification: A Global Overview' (n 574) 1637.

678 Ibid.

679 Thomas Redick, 'Chapter 3: Sustainability Standards' in David Songstad, Jerry Hatfield and

biofuel and biomass certification schemes in the EU and US respectively, both CEN and CSBP aim to ensure biomass and bioenergy production in a sustainable manner while maintaining and enhancing social, economic, and environmental well-being. Both of them have formulated a wide range of sustainability principles, criteria, and indicators applicable to biofuel production.

In contrast to forest and agricultural certifications, bioenergy and biomass certification and sustainability principles and criteria are developed with the requirement of energy security and climate change in mind. As a result, a larger scope of energy-related socio-economic issues is covered by the latter group. The issue of food security is pointed out by several of them such as RSB, ISCC and CEN. Moreover, it is generally the issues of carbon stock and GHG emissions that are highlighted in bioenergy certifications, as reducing GHG emissions is a prominent goal for biofuels development policies. The related land use change aspects started to be tackled in biofuels certification schemes, since these issues were not considered important in forest and agricultural certification. However, while LUC is part of the calculation, iLUC is not in most of the current schemes. It is mainly because a common, internationally accepted methodology as well as assumptions and default values are missing.[680] In addition, it is worth noting that many of these certification schemes adopted the meta-standard approach, such as RSB and ISCC, allowing use of existing sustainability principles and standards. The benefit of doing so will be discussed later in the chapter.

From the description of these initiatives above, it can be seen that, firstly, most of the initiatives originate from developed countries, mainly in the European region, and followed by the North American region. Conversely, only a few specific biofuel sustainability certification systems have been implemented in developing nations.

Dwight Tomes (eds), *Convergence of Food Security, Energy Security and Sustainable Agriculture* (Springer 2014) 37.

[680] See also, Scarlat, 'Status of the Implementation of Biofuels/Bioenergy Certification Systems – Major Implications, Reporting Constraints and Implementation Control' (n 574) 32.

Secondly, the majority of these certification schemes are voluntary, market-based, industry-led, multi-stakeholder schemes. A wide range of environmental and socio-economic principles and criteria are included. Some of them focus on environmental sustainability; some others include both environmental and socio-economic sustainable standards. Thirdly, as biofuel certification initiatives are newly developed, there is still some controversy about it, such as the methodology of calculating GHG emissions, iLUC effects, as well as some social issue implications. This development brings significant advantages for sustainable biofuels, but it also presents limitations and raises issues. The next section will examine the problems and limitations of the existing certification schemes and what lessons can be drawn for developing countries.

3.4.3 Proliferation of Existing Certification Schemes

The biofuel-related certification schemes and sustainability standards and criteria introduced in this section are emerging as a possible option to regulate biofuel development in a sustainable way. It can have some positive impacts on the biofuel industry, including improved efficiency within a supply chain, decreased risk, higher transparency and increased awareness about problems in the supply chain. Many important and fundamental sustainability principles and criteria related to biofuels can be found in a multiplicity of forms of certification schemes.[681] However, certifying the sustainability of biofuels is a complex and difficult process. The implementation of sustainability standards is complicated and entails number of difficulties.[682] One of the most significant issues is that there is increasing number of biofuel/bioenergy certifications in the markets. The proliferation of existing certification schemes could be very problematic.

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681 Such as the forms of roundtables, consortia, private labels, industry-wide certifications.

682 Scarlat, 'Status of the Implementation of Biofuels/Bioenergy Certification Systems – Major Implications, Reporting Constraints and Implementation Control' (n 574) 36.

These certification schemes cover all aspects of the biofuel industry, from feedstock cultivation, production, to distribution, and consumption. Numerous complex conversion options are involved in biofuels production using a wide range of biomass feedstocks, including agricultural crops, forestry residues, and organic waste. Moreover, they are formulated from a wide range of environmental and socio-economic sustainability principals and standards, including GHG deduction, air pollution, water management, biodiversity preservation, labour rights, and land rights. The majority of these certification schemes are market-based, industry-led, multi-stakeholder schemes, which means they apply to different stakeholders and represent different groups of interests. In addition, most of the certification schemes applied on a national/regional level, are rooted in different legal systems, designed with different policy objectives, and employ different or even competing social values, legal standards and criteria. Consequently, the growing range of certification and standard-setting schemes supported by different stakeholders globally has resulted in a significant degree of complexity that could limit the effectiveness of these schemes. It could be argued that it is essential for enabling biofuel certification schemes to develop and evolve. It can lead to a beneficial competition between different systems and standards, resulting in constant improvement in standard application.[683] However, what has happened with proliferation of certification schemes and standards is that there is, to some extent, a loss of control, and substantial confusion among various stakeholders as well biofuel markets. This chaotic situation confuses both applicants and consumers, making it difficult for industry, society and consumers to understand, follow, participate in and implement those different approaches. Moreover, the existence of a plethora of certification schemes allows some poor performers and unqualified producers to 'shop the standards', and hide their image by 'green washing'.[684]

[683] Kaphengst (n 588) S99.
[684] Ibid.

In addition, as there is a lack of coherence among so many different schemes and standards, they may be designed with different emphasis, or even worse, they may contain conflicting principles or criteria. Lack of coherence could put biofuel/biomass exporting countries (many of them are developing nations) in trouble. That is to say, in order to expand the international market, producers in developing countries may need to follow sustainability requirements of importing countries and get the associated certificates. These certificates could be a guarantee of market access, but on the other hand, it means more advance technologies and higher cost. Therefore, the proliferation of certifications means they need to follow different standards depending on different importing countries. Correspondingly, the producing cost will increase exponentially. It will be a heavy burden and obstacle for biofuel producers in developing countries to pursue foreign markets, and will have a negative impact on the global biofuel market access. Consequently, it is clearly that there is a need to end the proliferation of standards and to streamline the existing schemes.

In light of these concerns, academics and policy makers have begun to ask: whether it is possible to unify all these existing schemes, and design a globally uniform, multi-purpose biofuel certification system?[685] If we can apply a kind of one-size-fits-all approach, which could ensure the production and consumption of biofuels that will reduce GHG emissions, not pollute air or water resources, not increase deforestation or despoil environmentally valuable land, or not violate socio-economic norms such as child labour or competition with food and feed, then we could easily avert the current predicament. However, this option seems idealistic and not workable in reality.

Though biofuel sustainability concerns a variety of considerations from economic, environmental, and social aspects, it does not mean that a sound biofuel certification

[685] Henry Lee and Charan Devereaux, 'Biofuels and Certification: A Workshop at the Harvard Kennedy School of Government' (Discussion Paper 2009-07, Environment and Natural Resources Program, Center for International Development, Harvard University 2009), 12-14.

scheme has to cover all aspects of sustainability requirements, to solve all kinds of problems linked with biofuel industry. On the contrary, in order to assure its effectiveness and efficiency, it is generally believed that a biofuel certification scheme should be designed with specific policy goal(s). In many areas of regulation, certifiers may want to over-achieve, but a regulatory regime should only deal with what is the most necessary and basic.[686] This is especially relevant to biofuel policy makers in developing countries. For a majority of developing countries, biofuel certification schemes and standards are newly developed instruments that have a lack of both theoretical and empirical supports. A multi-target certification system without links to national/local considerations would be not easy to implement or manage, and would impose an unnecessary burden on local producers. Therefore, an effective and efficiency biofuel certification scheme should be based on specific national/regional considerations, with limit but clearly designed objectives.[687] It should be designed case by case.

However, many of the existing certification schemes, designed by stakeholders in developed countries, do not always tailor solutions to local conditions in developing nations.[688] Some criteria for producing a method may be appropriate in the UK, but quite inappropriate in Malaysia. Or some standards could be achieved only with particular process and production technologies which are unavailable or prohibitively expensive for poor farmers in developing countries. Therefore, if there is no 'one-size-fits-all' system, what principles and standard are the most essential that should be given the priority when designing a biofuel certification scheme in a developing country? Obviously, according to the discussion above, the answer shall be different case by case.

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686 Ibid.

687 For more discussion about the importance of a well-defined context for biofuel sustainability, see, Rebecca A Efroymson and others, 'Environmental Indicators of Biofuel Sustainability: What About Context?' (2013) 51 Environmental Management 291.

688 Simonetta Zarrilli, 'Making Certification Work for Sustainable Development: The Case of Biofuels' (2008) United Nations Conference on Trade and Development UNCTAD/DITC/TED/2008/1, 36 <http://unctad.org/en/Docs/ditcted20081_en.pdf> accessed 24 June 2013.

Nevertheless, some general recommendations could be given.

To begin with, the most imperative principle and standard in biofuel certification schemes should deal with the requirement for GHG reduction. This is because climate change mitigation and GHG emission reduction are the most imperative drivers for governments to support biofuels, and for consumers to choose biofuels. Especially, as there is increasing criticism and questioning about whether biofuels can reduce the GHG emissions or raise the emissions, it is essential there are principles, standards, and criteria dealing with the GHG reduction requirement included. On the one hand, it can help governments to ensure that biofuels reach targets needed, and indeed contribute to GHG emission reduction, such as in the UK and at EU level. On the other hand, it can give a clear clue to buyers or consumers that the certified biofuel products indeed reduce GHG emissions and contribute to climate change mitigation. Uncertainty about the calculation method of GHG emission cannot be an excuse for policy makers to avoid considering them. Again, as discussed, GHG emission reduction is the most important reason for being in favour of biofuels and it should be the central consideration of biofuel sustainability scheme in every country.

Moreover, many existing certification schemes include a variety of environmental and social sustainability principles and criteria. However, it may not suit all developing countries. Too broad of a range of standards could generate a heavy burden that could reduce the system's efficiency. Therefore, I recommend that developing countries could start with the emphasis on environmental sustainability only. The rationale behind this is that most of the social issues, such as labour structure, minimum wage and land ownership, are totally separate issues that are not generated by biofuels, and cannot be solved by biofuel development.[689] One example is that the 'minimum wages' indicator is required by some existing certification systems. However, compliance with this indicator would be difficult and prohibitively costly to assess in many developing

[689] However, the issue of 'food versus fuel' might be an exception with this argument.

countries, as informal employment is widely practised in the agricultural sector of rural areas in the Global South.[690] The social issues linked with existing social policies, initiatives and practice, therefore could be regulated by separate domestic legal and policy instruments or international agreements. Moreover, the social impacts of a biofuel project are highly location-specific, and remain poorly documented in developing countries. In addition, many of the socio-economic principles and criteria currently under discussion lack measurable indications. They all make it very difficult to design and implement with social standards. Although some existing schemes have considerable coverage of social sustainability concerns, it is found that, the lack of proper criteria and indicators, as well as the gaps in procedural rules, are likely to undermine the likelihood that social sustainability is achieved through these schemes.[691] Therefore, social sustainability concerns could be left out of a biofuel certification scheme at least at the current stage, and they still could be added in the future.

In addition, it is worth noting that the certification scheme is just *one* option of policy instruments to stimulate sustainable development of biofuels, but not the only one. Biofuel certification schemes should work with many other legal and political initiatives together in a national energy strategy to achieve the environmental, economic and social requirements of sustainability for biofuels development, but the biofuel certification scheme itself could focus more on the environmental sustainability instead of the socio-economic concerns, as the latter group of issues are more difficult to evaluate and implicate with proper criteria and methodologies at that moment.

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690 R Delzeit and K Holm-Müller, 'Steps to Discern Sustainability Criteria for a Certification Scheme of Bioethanol in Brazil: Approach and Difficulties' (2009) 34 Energy 662.

691 Further reading about the effectiveness of social sustainability requirements for biofuels in the current voluntary schemes, see, Laura German and George Schoneveld, 'A Review of Social Sustainability Considerations Among EU-approved Voluntary Schemes for Biofuels, with Implications for Rural Livelihoods' (2012) 51 Energy Policy 765.

Therefore, the all-in-one designed certification scheme is ideal, but may be too ambiguous to work effectively in reality. When designing a biofuel certification scheme for a developing country, it is recommended to begin with the environmental sustainability considerations, and include the most necessary sustainability principles only. Furthermore, the detailed minimum thresholds required under the stated principles and criteria should be left to local conditions and local stakeholders, resulting in a wide range of compliance and adherence possibilities. It is not an easy task for developing countries to develop sound biofuel certification schemes with suitable and specific criteria and indicators. The reason behind this is that there is a lack of capabilities at the national level for the evaluation of draft criteria and the formulation of positions in consultation with all interested parties.[692]

3.4.4 Meta-Standard Approach in Developing Countries

In order to tackle the problems of proliferation of existing certification schemes and transaction cost obstacles for small biofuel producers, 'meta-standard' approach could be an option. 'Meta-standard' is not a new concept for biofuel certifications, it has been used in some of the existing certification schemes, such as the PEFC, RSB and ISCC. Moreover, the concept of a 'meta-standard' is important to the European Commission's regulatory approach.[693] The UK RTFO contains a requirement for carbon intensity reduction and a meta-standard for other sustainability issues. A similar system has also been adapted by the EU Commission.

The UK RTFO Sustainable Biofuel Meta-Standard is defined by five environmental

[692] Zarrilli (n 688) 36.

[693] For the concept of 'meta-regulation', see, Christine Parker, *The Open Corporation* (CUP 2002), 245-91; Colin Scott, 'Speaking Softly without Big Sticks: Meta-regulation and the Public Audit' (2003) 25 Law and Policy 203; Neil Gunningham, 'Environmental Law, Regulation and Governance: Shifting Architectures' (2009) 21(2) Journal of Environmental Law 179.

principles, two social principles, and a set of recommended criteria and indicators.[694] Instead of establishing new biofuel certification schemes, existing agro-environmental and social certification schemes could be benchmarked against the RTFO sustainability principles. If a certification standard can meet all or most of the meta-standard criteria, then it would be a 'qualifying standard' under the RTFO. A biofuel producer that is certified by a 'qualifying standard' can use such certification directly to demonstrate compliance with UK biofuel sustainability criteria. The 'meta-standard' approach adopted in the RTFO is an innovation to the biofuel industry governance toolkit. It has been taken up by many sustainability initiatives for biofuels that were developed in the European countries.[695]

The rationale behind the meta-standard approach is given by the variety of already-existing schemes and standards for sustainably managing biomass resources.[696] These schemes aim at ensuring (specific types of) biomass resources produced sustainably, and contain many core principles and criteria for biomass and biofuel products already. Therefore, it is unnecessary or undesirable to develop totally new standard for which producers need to be certified.

The benefits and advantages of the meta-standard approach are fairly obvious. Firstly, meta-standard approach build upon existing schemes, which are already known among producers and the acceptance might be higher. Existing schemes, which have worked for a period within a country or region, are expected that have formulated with respect to the local context, and developed appropriate indicators of sustainability from more generic suites. Therefore, decision makers need to consider the context when ascribing meaning to indicators.[697] Secondly, this leads to saving time and costs. Developing a sustainability standard through a multi-stakeholder process can take several years and

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694 See, Section 3.3.4.2.

695 Dehue (n 594).

696 Kaphengst (n 588) S99.

697 Efroymson (n 687) 291.

is costly. The resort to a meta-standard approach avoids wasting resources on duplicative efforts. Existing sustainability standards already have producer acceptance, and the use of a meta-standard avoids the situation whereby producers have to be certified in accordance with multiple standards. It is a possible way to avoid redundant schemes and to reduce the costs of administration, and in turn to benefit smallholders in developing countries. In addition, voluntary certification in practice is not always consistent with international trade rules, as technical regulations included could be used as non-tariff trade barriers. Therefore, the use of a meta-standard approach for biofuels certification could reduce conflicts with the WTO rules.[698] There is a particular negative perception in developing countries that voluntary codes are a disguised form of trade discrimination.[699] Therefore, from a global governance perspective, the meta-standard approach for biofuel sustainability will aid the process of streamlining the proliferation of certification schemes and harmonizing sustainability standards. This will reduce transaction costs for biofuels producers and promote the growth of a sustainable biofuels industry in a large (regional or global) market.[700] This is what has happened in the EU. As a uniform global certification scheme for biofuels would not be developed in a short time, the meta-standard approach could be employed by developing countries' governments.

However, the limitations and challenges of implementation of the meta-standard approach in developing countries need to be known. It is not easy for the meta-standard approach to be effectively implemented in developing countries. The difficulties do not stem from a meta-standard approach *per se* but from a lack of existing certification systems in developing countries. As introduced, meta-standards build upon existing certification systems, but currently in most developing countries, there are no many

[698] Endres (n 617) 108-11.

[699] Further discussion on the relationship between the ultilateral biofuel sustainability requirements and the WTO rules can be found in Chapter Five. See also, Riva Krut and Harris Gleckman, *ISO14001: A Missed Opportunity for Sustainable Global Industrial Development* (Earthscan 1998).

[700] Dehue (n 594) 4.

such schemes or standards in use, and not even much experience of regulating sustainable development. Considering using existing certification schemes from other countries does not seem workable. As most existing certification schemes are provided by stakeholders in developed/importing countries, the design was not based on considerations of developing/exporting countries' conditions. Some standards might be too difficult for developing countries to achieve that viewed as disguised trade barriers.[701]

Pelsy draws on the experience of forest certification schemes to suggest that the inadequacies in private mechanisms are likely to happen in the biofuels context.[702] He argues that the difficulties of developing an effective chain of custody that checks products from the plants through to the finished product should not be underestimated.[703] For example, shipping documents can be forged easily.[704] Pelsy argues that the implementation and verification of biofuels sustainability standards could easily suffer from more loopholes than the forestry schemes since the production of biofuels is far more complex to assess.[705] Farmers could cultivate food crops on new land converted to cropland and use the old cropland for biofuel, complying with sustainability criteria for biofuels crop cultivation. In this way, conversion of land for food crop production could not be stopped. And a certification scheme established on the basis of the final use of a crop might be ineffective in securing certain sustainability concerns.[706] Therefore, he argues that addressing biofuel sustainability concerns through voluntary certification systems and a meta-standard approach is just an interim

701 This issue will be fully examined in Chapter Five.

702 Florent Pelsy, 'The European Commission 2008 Directive Proposal on Biofuels: A Critique' (2008) 4 Law, Environment and Development Journal 121,131.

703 Ibid.

704 Pelsy also mentioned that certification has also led to a segmentation of the forestry products market. The certified sustainable products comprise a small higher price segment, while the uncertified products supply the rest of the market.See, ibid, 132.

705 Ibid.

706 Scarlat, 'Status of the Implementation of Biofuels/Bioenergy Certification Systems – Major Implications, Reporting Constraints and Implementation Control' (n 574) 36.

measure.[707] More international efforts and further cooperation will be required in the long term to promote a multilateral agreement on mandatory sustainability standards for biofuels.

Internationally harmonized standards for sustainable biofuels could start from regional cooperation. For instance, in Europe, the current EU-wide biofuels directive is established on the basis of the domestic standard of the Netherlands, UK and Germany. A similar approach could be learned by developing countries. For instance, jatropha projects in China and India cooperate as they are neighbouring countries and share similar environmental conditions in the jatropha plantation areas. Similarly, Southeast Asia countries, South America countries, or Africa countries can also establish cooperative sustainable biofuel initiatives. In addition, cooperation between the North and South is also needed. The EU/US principles and standards of biofuel certification schemes could not be fully applicable to developing countries. A more friendly, coordinated position amongst importing countries on minimum standards is needed to ensure biofuel sustainability concerns do not become new barriers in international trade.

3.4.5 Conclusion

Certification schemes and the sustainable standards and criteria are emerging as a possible option to regulate biofuel development in a sustainable manner which is economically viable, environmentally appropriate and socially beneficial. Biofuels certifications could help to improve efficiency within a supply chain, decrease risk, higher transparency and increase awareness about sustainability problems in the supply chain. Biofuel certification systems have been widely used in developed nations, especially in the EU countries, and many important and fundamental sustainability principles and criteria related to biofuels have been developed in multiplicity of forms

[707] Pelsy (n 702) 132.

of certification schemes.

However, the growing number of certification and standard-setting schemes supported by different stakeholders which are mainly from developed nations result in a significant degree of complexity that could limit the effectiveness of these certification schemes. Moreover, many of the existing certification schemes, designed by stakeholders in industrialized economies, do not always tailor solutions to local conditions in developing nations. The need to prove adherence to a broad set of environmental and social standards will be considerably costly and a heavy burden for small-scale producers in developing countries.

Therefore, developing countries need to improve upon their own certifications, while keeping an eye on the international sustainable development forums. Instead of including all kinds of sustainable concerns within one certification, it is suggested in this section that the environmental sustainability standards, especially the GHG emission reduction standards, need to be addressed as they are more imperative than some others. Particularly, the UK meta-standard approach which builds upon existing schemes might be a possible solution for tackling the problems of proliferation of certification schemes and could be employed by developing countries. At least, it could be an interim measure for regulating biofuel sustainability. Having reviewed the biofuel certification schemes and assessed their effectiveness in terms of achieving sustainability criteria, it cannot be expected that biofuel certifications are the perfect instruments for achieving all requirements of sustainability, as ‘sustainability’ itself is a controversial concept.

3.5 Conclusion

Energy law and environmental law rarely merge or work together. However, as issues of sustainable development and climate change are deservedly receiving great attention globally, it inspires intensive discussion about rethinking the approaches of energy and environmental regulations. It is argued in this chapter that only when energy policy and environmental regulations are considered together within a sustainable development framework, that both energy issues and climate issues can be balanced and coped with at the same time. It is important for biofuel policy enactment.

The relationship between biofuels and environmental sustainability is dynamic and complicated. On the one hand, biofuels can help to tackle climate change and improve air quality, and offer opportunities to solve all sorts of other environmental problems. On the other hand, however, the cultivation of energy crops could cause or exacerbate environmental problems associated with biofuel production. Of these, the most significant potential impacts associated with biofuel production result from the expansion of the agricultural frontier and changes in land use, including natural habitat conversion and the impacts it may have on tropical forests, savannahs and biodiversity. Therefore, biofuels have the potential to positively or negatively affect the natural world and human health, depending upon factors such as feedstock selection and management practices used. Whether the impacts are largely positive or negative will be determined mostly by policy and regulations.

In order to promote the biofuels industry developing in a sustainable manner, governments have begun to enact legal and policy regulations for biofuel sustainability. The EU and the US has made great efforts in the enacting of biofuel sustainability regulations. These biofuel regulation initiatives are worth learning for policy makers in developing countries. This is because there have been various severe environmental issues associated with biofuel production occurring in developing countries. Decision makers and biofuel lawyers in these countries should prioritize the principle of environmental sustainability and adopt policies that compel the biofuel industry to maintain or improve current management practices of land, air, water, soil and other resources.

Among the different kinds of initiatives in the EU and US, the certification scheme is significant. Biofuel certification scheme could be a possible option for developing countries to learn about how to regulate their biofuel industry sustainably, as the national and international standards and certification schemes will be necessary to safeguard the resource base. One important recommendation for the decision-maker is that environmental sustainability principles and considerations should be given more priority than social concerns for new players (developing countries) in the biofuel markets. Standards and best management practice take time to develop properly, in that it is critical to initiate practical step-by-step processes that entail consistent progress towards increased sustainability. The UK meta-standard approach should be examined by policy makers in developing countries, as it offers a way to develop biofuel sustainability standards based on the local context and the existing certification schemes.

Last but not least, it is worth noting that the biofuel certification scheme is not the only policy instrument for achieving biofuel sustainability; and environmental sustainability is not the only dimension for achieving biofuel sustainable development. In order to achieve a sustainable future for biofuel development, maintaining a high-quality environment for the sake of future generations' needs is not enough. It is also necessary to reconcile the needs and aspirations of social and economic development. More complex and dynamic socio-economic issues related to biofuel sustainability should be also addressed properly but with a broad range of policy instruments, and wide cooperation with other sectors, such as the agricultural sector. These issues will be further discussed in the following chapter.

CHAPTER FOUR BIOFUELS, AGRICULTURAL MARKET AND RURAL DEVELOMENT

4.1 Introduction

Besides energy security and climate mitigation, agricultural and rural development is another main driver in promoting the biofuel industry. Initially, biofuel programmes were designed to support agricultural economies. Governments promoted the use of biofuels from agricultural and forest resources as a way of expanding traditional agricultural markets. Biofuel policies and instruments were set up in both developed and developing countries to help domestic agricultural producers and rural economies. The massive production of biofuels, from agricultural resources, has tightly linked energy markets and agricultural markets, which are historically separate. The whole picture of agricultural markets has changed with the developing progression of the increasing agricultural-energy industry. For the agricultural economy, significant benefits and huge opportunities have come together with the development of biofuel industry. It has helped with expanding markets and increasing demands for agricultural and forest products, boosting employment in agricultural communities, and using for essential local fuels and in turn changing people's lives in rural areas. For developing countries, rural development is the most directive and imperative motivation along with energy security.[708]

However, troubles and problems follow as well. To some extent, these agricultural economy-related socio-economic troubles are more complex and difficult to assess and manage than those environmental sustainability issues discussed in Chapter Three. Due

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[708] See also, Section 1.2.3.3 and 1.2.4.3.

to methodology limitation, it is hard to find proper and applicable socio-economic indicators of biofuel production.[709] Two selected controversies are illustrated and analysed in this chapter. One of the highly concerning issues is about the biofuel-related food security problem in developing countries. Biofuel's impact on global food prices and poverty reduction will be examined in this chapter. Moreover, as a heavily subsidized agricultural-energy industry, it will be determined whether biofuel domestic policies in developed nations are positive for the global biofuel trade development, as it has caused attention under the WTO framework. This issue comes from the trade perspective of biofuels.

4.2 New Opportunity of Agricultural Revitalization and Poverty Reduction

4.2.1 Introduction

Rural development is a critical issue for the whole world, because most of the world's poorest people live in rural farming regions. As discussed in Chapter One, supporting the development of rural areas is one of the imperative motivations for promoting biofuels industry all over the world, and has more significant meaning for developing countries. Many governments have promoted the use of biofuels from agricultural and forest sources as a way of expanding traditional agricultural markets and developing rural communities. Biofuel programmes are set up to help domestic agricultural producers and rural economies by linking energy and traditional agricultural markets,

[709] Rocio Diaz-Chavez, 'Indicators for Socio-Economic Sustainability Assessment' in Dominik Rutz and Rainer Janssen (eds), *Socio-Economic Impacts of Bioenergy Production* (Springer Science & Business Media 2014) 17.

increasing agricultural market demand, and boosting agricultural community employment in countries all over the world.

Despite a variety of debates about 'food-versus-fuel' or risky to traditional agriculture and rural community, this section examines how the biofuel industry could help governments to achieve the policy target of developing the agricultural sector and agricultural community. It explores this issue in three aspects: the potential for biofuels to increase market demand for agricultural products, as well their potential to increase agricultural employment and benefit rural life.

4.2.2 Expanding Markets and Higher Prices for Agricultural Products

Biomass resources come from agriculture and forest resources all over the world. Biofuel production and processing could benefit the lives of people living in agricultural communities in various aspects. One of the most significant is that the biofuel industry could link the energy market and traditional agricultural market, expand markets for agricultural products, higher agricultural commodity prices, and benefit the global agricultural economy as a whole.

Biofuels could have a great impact on global agricultural markets. The rapid increase in demand for the production of biofuels, particularly ethanol from maize and sugarcane, has had significant effects on the grain supply-and-demand system.[710] Compared with previous historical rates of growth, it is estimated that, during the 2000 to 2007, the increased biofuel demand was to have accounted for 30% of the increase in weighted average grain prices.[711] Recent dramatic increases in food prices are having severe

[710] Nuffield Council on Bioethics (n 1) 30.

[711] Mark W Rosegrant, *Biofuels and Grain Prices: Impacts and Policy Responses* (IFPRI 2008) 2; See also, Martin von Lampe, 'Agricultural Market Impacts of Future Growth in the Production of

consequences for developing countries and poor people, and biofuel production and policies is one of imperative triggers of the high food-prices.[712]

However, the role of biofuel production and policies in the food-price hikes is particularly controversial. Biofuel linked food-price increases could also be a benefit to the agricultural sector. It is because global prices of agricultural products at quite a low level for a very long time, sometimes it has been even lower than the costs of production. For a long period of time, world food prices have been constantly declining; during the period from the late 1970s to the early 1990s, the prices have gradually halved.[713] The long term trend in declining food prices has been the result of numerous factors, which include technology development, the Green Revolution, demographic changes and especially agricultural support policies.[714]

The long-term low prices of agricultural commodities have significant impacts on small-scale farmers living in rural communities of developing countries.[715] In developing countries, there are commonly no sufficient subsidies or strong government support for the agricultural sector, resulting in excess supply. It is claimed that the downward pressure on agricultural commodity prices has triggered a 'race to the bottom'

Biofuels' (AGR/CA/APM(2005)24/FINAL, OECD 2006) 6 <http://www.oecd.org/trade/agricultural-trade/36074135.pdf> accessed 12 February 2013.

712 This issue will be further discussed in the next section of this chapter.

713 Joachim von Braun and Getaw Tadesse, 'Global Food Price Volatility and Spikes: An Overview of Costs, Causes, and Solutions' (ZEF-Discussion Papers on Development Policy No.161,Center for Development Research 2012) <https://www.db.com/cr/en/docs/zef_dp_161.pdf> accessed 11 February 2013.

714 Siwa Msangi and Mark Rosegrant, 'World Agriculture in a Dynamically-changing Environment: IFPRI's Long-term Outlook for Food and Agriculture under Additional Demand and Constraints' (FAO Expert Meeting on How to Feed the World in 2050, Rome, 2009) <ftp://ftp.fao.org/docrep/fao/012/ak970e/ak970e00.pdf> accessed 11 February 2013.

715 Ian Gillson, Steve Wiggins and Nilah Pandian, 'Rethinking Tropical Agricultural Commodities' (UK Department for International Development and Overseas Development Institute working paper, 2004) <http://dfid-agriculture-consultation.nri.org/summaries/wp10.pdf> accessed 5 June 2012.

in wages and working conditions on plantations, including actualization of labour, the use of child labour, increased workloads, reduced benefits such as health provision, schooling and housing.[716]

Meanwhile, the expansion of the agricultural-based energy production could help to change the picture, by increasing market demand, absorbing excess supply and maintaining higher commodity prices. One outstanding example is the sugarcane ethanol production in Brazil. The rapid expansion of the sugarcane-based fuel industry expanded the demand market for Brazil sugarcane, contributed to a significant rise in the price of sugar. Consequently, biofuel programmes in Brazil bring new opportunities for traditional agricultural market, and is therefore promoted by the government to protect farmers from excessively low prices.[717]

Firstly, a wider range of crops could be used for biofuels, and the biofuel crop cultivation could become an important income support for farmers. It could further diversity the variety of agricultural products produced and open up new markets for these underutilized forms of feedstock.[718] As a result, the reformed agro-energy market could help lift prices of crops than traditional agricultural market, and in turn help to increase farmers' income. Moreover, farmers could receive great financial support from the government for the energy crop cultivation, such as tax exemptions, tex credits and insured loans. These subsidy instruments are necessary and essential at the initial stage of biofuel development in rural areas.[719] In addition, the biofuel industry could bring

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716 Ibid, 6.

717 Asbjørn Eide, *The Right to Food and the Impact of Liquid Biofuels (Agrofuels)* (FAO 2008) <http://publish.uwo.ca/~dgrafton/righttofood.pdf> accessed 12 February 2013.

718 Worldwatch Institute, *Biofuels for Transport: Global Potential and Implications for Sustainable Energy and Agriculture* (n 57) 123.

719 Some argue that, once the biofuel sector is no longer in its 'economic infancy', it will be no longer necessary for governments to provide biofuel subsidies. Biofuel subsidies in developed countries can impose significant costs on government budgets, and have a trade-distorting effect on the global biofuel market. See, Section 4.4.

more income to farmers by elevating prices of crops by way of adding value to biofuel feedstocks. This means that, farmers could not only profit from crop planting, but also from later stages of the value chain in the processing. Biofuel processing work could pay more than feedstock production. Refiners usually receive higher wages than traditional agricultural labourers. In Brazil, for example, technical workers are paid about 30% more than cane-harvesting labours.[720]

4.2.3 Creating Agricultural Employment

The biofuel industry can bring more income and benefits to agricultural communities not only by expanding agricultural markets and elevating prices of agricultural products, but also by providing additional jobs in rural areas. Compared with the fossil fuel industry, the biofuel industry is not concentrated, and it needs more employment. Therefore, it could absorb more agricultural labours, and in turn benefit the economic development in rural areas, especially for the developing countries which have an enormous agricultural population.

A UN Report in 2007 has examined the implications of biofuel development on agro-industry and job creation.[721] The report found that the development of bioenergy industries could bring significant potential job creation. It is '[b]ecause the vast majority of bioenergy employment occurs in farming, transportation and processing, most of these jobs would be created in rural communities where underemployment is a common problem'.[722] It is estimated that, in Tanzania, replacing imported fossil fuel with domestically-produced biofuels in the transport sector would generate 300,000 jobs,

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720 Masami Kojima and Todd Johnson, *Potential for Biofuels for Transport in Developing Countries* (World Bank 2005) 131.

721 UN-Energy, *Sustainable bioenergy: A Framework for Decision Makers* (UN-Energy 2007) <ftp://ftp.fao.org/docrep/fao/010/a1094e/a1094e00.pdf> accessed 12 February 2012.

722 Ibid.

and almost all of these jobs would be in rural areas.[723] In Brazil, biofuel industry is credited with employing half a million workers. In the US, the ethanol industry employs about 147,000 to 200,000 people.[724] And in the future, biofuel industry will contribute to even greater employment worldwide. It is estimated that in China, 9 million jobs will be created from the large-scale biofuel programmes.[725]

All of the construction required to build a new biofuel producing facility, such as a corn ethanol mill, which can bring a significant one-time boost to the local economy. About as many jobs are produced during the construction phase of an ethanol plant as during its operational phase, and the plant will also require routine maintenance.[726] Additionally, transporting feedstock to the facility and shipping fuels and co-products from the facility can generate extra business for local trucking or rail companies.

4.2.4 Using for Essential Local Fuels

While biofuel economy can bring many enormous benefits to rural communities, such as expanding agricultural market as a whole, or creating more working opportunities for agricultural communities, the most direct one is that biofuels can provide fuel itself as an alternative energy to remote rural communities which are short of refined petroleum fuels. Rural communities are typically short of fossil fuels for essential life, such as heating, cooking, and lighting; and need to depend upon imported energy for life. However, it is never easy to distribute fuels via truck, train or pipeline, as many

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[723] Leo Peskett and others, 'Biofuels, Agriculture and Poverty Reduction' (2007) Natural Resource Perspectives 107 6/2007, 4 <http://www.sarpn.org/documents/d0002598/Biofuels_Agric_ODI_Jun2007.pdf> accessed 14 January 2013.

[724] Ibid, 12.

[725] Worldwatch Institute, *Biofuels for Transport: Global Potential and Implications for Sustainable Energy and Agriculture* (n 57) 124.

[726] Ibid.

regions have little infrastructure, and the condition of maintained roads are very poor. Even if the imported fuels can be delivered to the remote villages, the prices might be at times higher than the prices in city areas. Therefore, liquid biofuels make particular sense as an alternative to petroleum fuels for these rural areas.

Cellulosic fuels can be co-harvested both for liquid transportation fuel and for local energy use. Jatropha tree could be a good example here. Jatropha bushes grow well on marginal lands, they can be harvested twice annually and remain productive for decades.[727] In Mali, just 1% of the rural population had access to electricity. To change it, the Mali-Folkecenter, which is a Malian NGO developing renewable energy, began to facilitate the planting of jatropha trees in villages to reduce the cost of importing expensive petroleum fuels.[728] Compared with diesel fuel, jatropha oil can save significant amounts of money on operating engines for these communities, and provide energy for many people who otherwise would not be able to access it.[729] Moreover, oilseed crop is also a possible alternative source to traditional fuels used in rural communities. For example, in some inland parts of Brazil, the roads are commonly of a low quality, in that transport of traditional liquid fuels is difficult and costly. Home-grown oil seeds fuels become an alternative that give the residents access to the essential energy.[730] And it is calculated that, in Argentina, locally-grown biodiesel costs half the pump price of fossil diesel.[731]

Although the section above is not about liquid biofuels used for the transportation sector, biofuels for local use has significant meaning for changing people's life in rural communities, as in these areas, people rely heavily on traditional uses of biomass that

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727 Richard Brittaine and NeBambi Lutaladio, *Jatropha: A Smallholder Bioenergy Crop: the Potential for Pro-poor Development* (FAO 2010) 463-65.

728 Ibid, 73

729 Ibid.

730 Worldwatch Institute, *Biofuels for Transport: Global Potential and Implications for Sustainable Energy and Agriculture* (n 57) 130.

731 Ibid.

are neither sustainable nor climate-smart. Therefore, policy makers should consider the energy access in rural area when investing in new biofuel programmes. It is not only about biofuels used for transportation, but about all sources of bioenergy used by rural communities. It is of great significant because it could be a way to change the whole picture of peoples' lives in poverty.

4.2.5 Conclusion

In conclusion, for agricultural economy, significant benefits and huge opportunities come together with the rise of biofuel industry. Biofuel policies and instruments are set to help domestic agricultural producers and rural economies. The production of biofuels has tightly linked the energy market and agricultural market. It helps with keeping the prices of agricultural products at a high level, expanding markets by increasing demands for these products; boosting employment in agricultural communities; and providing essential local fuels and in this way changing peoples' lives in rural areas for the better. Therefore, the development of the biofuel industry has offered a new opportunity for the traditional agricultural market to reform and revitalize.

After reviewing the potential of biofuels to benefit the agricultural sector, we get a really beautiful rosy picture of the future of agricultural development. However, in reality, there are significant controversies and debates about whether biofuels could really benefit agricultural markets and rural development. For example, it has been stated that increasingly expended biofuel production raises food prices and increases world poverty, or the heavy-subsidy policies for biofuels and biofuel feedstocks in developed countries are trade-distorting and inconsistent with WTO rules. These selected controversies will be analysed in the following sections of this chapter.

4.3 Impacts of Biofuel Economy on Agricultural Market and Food Security

4.3.1 Introduction

Despite their potential to contribute to expanding and revitalizing the agricultural market, creating and boosting agricultural employment, and facilitating energy access in rural areas, the evolution of knowledge and practice on biofuels in the last decade highlighted a number of the biofuels sustainability debate. One of the hottest topics about socio-economic concerns of biofuel sustainability is about the impacts of biofuels expansion on commodity food prices and affordability.[732] Since 2004 food prices rose, achieving a peak in 2008, and coinciding with the rapid increase of corn-based ethanol production from 15 to 50 billion litres between 2004 and 2010.[733] From that time, significant research has been carried out on the matter by 2015.[734] There is a considerable amount of accusations that more land, water, labour and other resources are devoted to biofuel crops, food production declined, food prices increases and food insecurity grew.[735] As food security *per se* is a major concern worldwide, especially in the net food-importing developing countries, it becomes an even more pressing challenge when we consider using food crops for biofuel production.[736] As a result, it

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[732] For discussion about the biofuel environmental sustainability, see, Chapter Three.

[733] Xiaoguang Chen and Madhu Khanna, 'Food vs. Fuel: The Effect of Biofuel Policies' (2013) 95(2) American Journal of Agricultural Economics 289.

[734] Per Stromberg and Alexandros Gasparatos, 'Biofuels at the Confluence of Energy Security, Rural Development, and Food Security: A Developing Country Perspective' in Alexandros Gasparatos and Per Stromberg (eds), *Socioeconomic and Environmental Impacts of Biofuels: Evidence from Developing Nations* (CUP 2012) 21.

[735] Ibid.

[736] UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 63.

leads to some inevitable questions: Does biofuel production increase world food prices, and dose it cause more hunger? What shall we do as a legal response to the 'food versus fuel' dilemma, shut down the industry or continually move forward?

In order to answer these answers, this section begins with an introduction to the issue of food security and its implications for poor people and poor countries. Second, it reviews the 2008 world food crisis and the role of biofuel production in this event. After that, it explores the relationship between biofuel production and world food prices, and the implications for poor people in developing countries.

4.3.2 Overview of Food Security

What is 'food security' and what cause food security issues? Food security is primarily a phenomenon relating to individuals, and is determined by three sets of factors concerned with supply, access and guarantees to food.[737] Food security is defined as 'access by all people at all time to sufficient, safe and nutritious food to maintain a healthy and active life'.[738] This definition was utilized by the World Bank in its 1986 report on world poverty and hunger. The World Bank acknowledged in this report:

> The world has ample food. The growth of global food production has been faster than the unprecedented population growth of the past forty years. Prices of cereals on world markets have been falling. Enough food is available so that countries that do not produce all the food they want can import it if they can afford to. Yet many poor countries and hundreds of millions of

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[737] Christopher Stevens and others, *The WTO Agreement on Agriculture and Food Security* (Commonwealth Secretariat 2000) 35.

[738] World Bank, *Poverty and Hunger: Issues and Options for Food Security in Developing Countries* (A World Bank Policy Study, World Bank 1986) 1 <http://wwwwds.worldbank.org/external/default/WDSContentServer/WDSP/IB/1999/09/17/000178830_98101901455676/Rendered/PDF/multi_page.pdf> accessed 12 February 2013.

poor people do not share in this abundance. They suffer from a lack of food security, caused mainly by a lack of purchasing power.[739]

This definition is also adopted at the 1996 World Food Summit in Rome.[740] This Summit discussed food security issues. The conference delegated the Rome Declaration on World Food Security, wherein they committed to 'implement policies aimed at eradicating poverty and inequality and improving physical and economic access by all, at all times, to sufficient, nutritionally adequate and safe food and its effective utilization'.[741]

Food security is a significant issue worldwide, especially in developing world. The United Nations Food and Agriculture Organization (FAO) estimates that there are 826 million people who do not receive adequate caloric intake for food health worldwide.[742] Approximately 80% of these undernourished people reside in seven developing countries: China, India, Bangladesh, Pakistan, Ethiopia, Indonesia and the Democratic Republic of Congo.[743] The FAO reports that a child dies every 6 second from undernourishment.[744]Adequate nutrition is the first step toward societal advancement in education and infrastructure development. There are more people that do not receive adequate protein, fat, important minerals and essential vitamins.[745] For instance, it is

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739 Ibid.

740 FAO, 'Rome Declaration on World Food Security and World Food Summit Plan of Action' (World Summit on Food Security, Roman, November 2009) <http://www.fao.org/docrep/003/w3613e/w3613e00.HTM> accessed 21 March 2013.

741 Ibid. For more discussion about the definition of 'food security', see D John Shaw, *World Food Security: A History since 1945* (Palgrave MacMillan 2007) 383-86.

742 FAO, *The State of Food Insecurity in the World 2010: Addressing Food Insecurity in Protracted Crises* (FAO 2010) 50 <http://www.fao.org/docrep/013/i1683e/i1683e.pdf> accessed 12 February 2013.

743 Ibid, 10.

744 Ibid, 33.

745 Gala Buchanan and Raymand Orbach, 'Creative and Innovative Research: Our Only Hope for Achieving Sustainable Food and Energy Security' in David Songstad, Jerry Hatfield and Dwight Tomes (eds), *Convergence of Food Security, Energy Security and Sustainable Agriculture* (Springer

estimated that several hundred thousand individuals lose their sight each year duo to vitamin A deficiency.[746] At the centre of these human tragedies is the issue of food security: the inability to access the safe an nutritious food necessary for a healthy and active life.[747]

4.3.3 Food Price Upsurges and 2008 Food Crisis

Since food prices decreased from the 70s to the 90s, there has been an upsurge in world prices of food products including grains, soya beans, wheat, and oil seeds from the beginning of 2002.[748] From 2002 to 2007, agricultural commodity prices have increased by some 140%.[749] More shocking is that between 2007 and 2008, global food prices rose at an unprecedented rate, increased by more than 60%.[750] Consequently, the world market price increase for food and feed cereals, oilseed and vegetable oils finally triggered a global food crisis in early 2008. In comparison with average food prices between 2002 and 2004, globally traded prices of cereals, oils and fats have averaged 2 times higher in 2008, and sugar prices have had averages of 80 % above their 2000-2004 prices.[751]

2014) 4.

746 Ingo Potrykus, 'Regulation must be Revolutionized' (2010) 466 Nature 561.

747 Shaw (n 741) x.

748 Further reading about a history of world food security, including the food price shocks of the early 1970s, see, Ibid.

749 Harry de Gorter, 'Explaining Agricultural Commodity Price Increases: The Role of Biofuel Policies' (Oregon State University conference on rising food and energy prices: US food policy at a crossroads, Corvallis, October 2008).

750 Nichodemus Rudaheranwa, 'Biofuel Subsidies and Food Prices in the Context of WTO Agreements' (Commonwealth Trade Hot Topics Issue 63, 2009) <http://www.thecommonwealth.org/files/214119/FileName/THT63BiofuelSubsidiesandFoodPrices.pdf> accessed 21 March 2013.

751 HLPE, *Biofuels and Food Security* (n 141) 55.

The 2008 food crisis caused high concerns relating to food prices and food security all over the world, but especially in net-food importing developing countries. Considering the food security sensitivity, the 2008 food crisis raised high tensions with 'food insecurity anxiety' or even food riots worldwide, especially in developing countries, such as Mexico, China, Thailand, Egypt, among many others.[752] Paul Krugman described the food crisis in the New York Times in the following:

> Over the past few years the prices of wheat, corn, rice and other basic foodstuff have doubled or tripled, with much of the increase taking place just in the last few months. High food prices dismay even relatively well-off Americans but they are truly devastating in poor countries, where food often accounts for more than half a family's spending. There have already been food riots around the world. Food-supplying countries, from Ukraine to Argentina, have been limiting exports in an attempt to protect domestic consumers, leading to angry protests from farmers- and making things even worse in countries that need to import food.[753]

Analyses has emphasised different explanations for the upsurge in world food prices and have identified a number of contributing factors.[754] These include the weak dollar, high oil prices, rising agricultural fuel and other input costs, underinvestment in agriculture, unfavourable weather events in major exporting countries, the financial crisis and economic recession.[755] Moreover, it also includes the global population growth, the rising food demand, and the changes in dietary habits, a relative increase in meat and dairy consumption, in large emerging developing economies.[756] All these

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[752] Rudaheranwa (n 750).

[753] Paul Krugman, 'Grains Gone Wild' *The New York Times* (New York, 7 April 2008) <http://www.nytimes.com/2008/04/07/opinion/07krugman.html?pagewanted=print&_r=0> accessed 21 March 2013.

[754] HLPE, *Price Volatility and Food Security* (A Report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, HLPE 2011) <http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE-price-volatility-and-food-security-report-July-2011.pdf> accessed 12 February 2013.

[755] Ibid.

[756] Ibid.

factors in combination contributed to the declining supply and rising demand for food staples and translated into rising food prices. However, it is worth noting that these factors are not exclusive, they are acknowledged in the literature, but assessment of their impacts on food prices and agricultural market is still preliminary. There is no consensus on the most significant contributing factor.

Among the variety of factors, the use of food crops for the production of first-generation biofuels is thought to have significantly contributed to the world food price upsurges.[757] As a new source of demand for food crops, land, and other resources, biofuel production (mainly the first-generation biofuel production) raises food security concerns globally. Firstly, it is quite straightforward that there is competition between biofuel and food industries for agricultural commodities. This is because major biofuel feedstock is composed of corn, sugarcane, soybean oil, palm oil, and other vegetable oils and their backward linkages to oilseeds. Although second-generation biofuel feedstocks which are from cellulosic materials create less competition with food production, the first-generation biofuels that are based on food crops are still the main commodities in the current biofuel market.

Secondly, the increasing global demand for both food and biofuels also raise new competition for land and the associated resources on the land, such as water resources.[758] Some studies have observed the implications of large-scale biofuel projects for land expansion.[759] An expansion of biofuels would result in land used

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757 HLPE, *Biofuels and Food Security* (n 141) 55; Zibin Zhang and others, 'Food versus Fuel: What Do Prices Tell Us?' (2010) 38(1) Energy Policy 445; Teresa Serra and others, 'Nonlinearities in the US Corn-Ethanol-Oil Price System' (2011) 42 (1) Agricultural Economics 35; Teresa Serra, David Zilberman and Jose M Gil, 'Price Volatility in Ethanol Markets' (2011) 38(2) European Review of Agricultural Economics 259; Zilberman (n 3).

758 For an assessment of the impact of biofuel targets on the land-use change and food supply in a multi-country, multi-sector global computable general equilibrium model, see, Govinda R Timilsina and others, 'The Impacts of Biofuels Targets on Land-Use Change and Food Supply: A Global CGE Assessment' (2012) 43 Agricultural Economics 315.

759 Roman Keeny and Thomas Hertel, 'The Indirect Land Use Impacts of US Biofuel Policies: The

change for other agricultural commodities toward production of biofuels feedstock. Grassland and forest land could be converted to agricultural land to produce biofuel feedstocks, or could be used to produce other food crops due to the expansion of biofuel feedstock plantation. They are referred to in the LUC and iLUC respectively.[760]

Therefore, it is believed that greater international demand for biofuels has many implications for the production, price and availability of staple commodities. Many studies analyse the aggregate economic effects of biofuels on food prices and food security.[761] Some studies indicate a strong relationship between food commodity prices and the share of biofuels in total transport fuels, although knowledge and assessment of the short-term and long-term impacts of biofuels on food prices still remains preliminary.[762] The controversy still persists on the extent of its impacts and its role in driving price volatility.[763]

It is projected that by 2020, the steeply rising demand for biofuels will push global prices of wheat by as much as 30%, corn by 41% and oilseeds by 76%.[764] And the prices of cassava, which is a staple in many of the poorest areas of sub-Saharan Africa, Asia, and Latin America, would increase by 135% by 2020.[765] There is a general

Importance of Acreage, Yield, and Bilateral Trade Responses' (2009) 91(4) American Journal of Agricultural Economics 895; Searchinger (n 533) 1238.

760 See, Section 3.3.3.3.

761 Zilberman (n 3); Eric Bahel, Walid Marrouch and Gerard Gaudet, 'The Economics of Oil, Biofuel and Food Commodities' (2013) 35 Resource and Energy Economics 599.

762 Günther Fischer and others, 'Biofuels and Food Security: Implications of an Accelerated Biofuels Production' (Summary of the OFID Study, IIASA 2009) <http://www.globalbioenergy.org/uploads/media/0903_OFID_-_BiofuelAndFoodSecurity.pdf> accessed 12 February 2013.

763 Philip Abbott, 'Biofuels, Binding Constraints and Agricultural Commodity Price Volatility' (NBER conference on 'Economics of Food Price Volatility', Seattle, August 2012).

764 von Braun, *The Promises and Challenges of Biofuels for the Poor in Developing Countries: IFPR 2005-2006 Annual Report Essay* (n 6) 9.

765 Cassava is generally referred to as the second-generation biofuel feedstock, but is also related to food security issue. Ibid.

consensus that the rapid increase in global biofuel production provoked a rise in food commodity prices. The production of food crop-based biofuels (first-generation biofuels) is an important factor leading to global food market imbalances, and pushing international food prices upwards.[766]

4.3.4 Implications for Developing Countries: A Factor in Rising Hunger?

The upward pressure on world agricultural commodity prices in the 2008 food crisis has never gone away. There is evidence that global food prices are still increasing since 2008.[767] As biofuels production is developing rapidly all over the world, there is a concern that crops that would otherwise become food and feed might instead become fuel, and therefore contribute to world hunger, especially for the poorest inhabitants living in rural areas of the developing world.

During the last few decades, the international community made great efforts to reduce world hunger in spite of countless food conferences and summits. However, 'hunger' is still a severe worldwide issue today. In 1970 about 900 million people in the developing world, a third of the total population, was chronically undernourished. Four decades later, in 2007, there were some 923 million undernourished people in the world. Even more shocking is that the food price crisis in 2008 pushed another 100 million poor people into the ranks of the world's hungry.[768]

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[766] HLPE, *Price Volatility and Food Security* (n 754).

[767] HLPE, *Biofuels and Food Security* (n 141) 55.

[768] Henrik Duer, Jeppe Lundbæk and Lillah Sørensen, 'Stakeholder Consultation Concerning Modelling of Impacts of EU Biofuels Policies: Early Findings and Call for Stakeholder Input to Further Analysis on Efficient and Low-disturbing Biofuels Policies – ELOBIO' (2nd ELOBIO stakeholder consultation, ELOBIO 2009) 24 <https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/2nd_elobio_stakeholder_workshop.pdf> accessed 12 February 2013.

The world's poorest people already spend 50% to 80% of their total household income on food.[769] The IFAD estimated that by 2011, some 1.4 billion people in the world were living on the equivalent of less than $1.25 a day. More than two thirds of them reside in rural areas and depend on farming. For them, even the slightest increases in the prices of staple grains could have devastating consequences.[770] Moreover, it is estimated that the number of food-insecure people in the world would rise by over 16 million for every percentage increase in the prices of staple food.[771] As pointed out by Runge and Senauer: '[L]arge increases in the prices of staple foods will mean malnutrition and hunger. Some of them will tumble over the edge of subsistence into outright starvation, and many more will die from a multitude of hunger-related diseases.'[772]

Since the 2008 food crisis, much of the literature on crop-based biofuel production focuses on the potential impacts on world food prices and food security. An internal report generated by the World Bank demonstrated the link between biofuels production and the food crisis as below:

> Biofuels have forced global food prices up by 75 per cent—far more than previously estimated—according to a confidential World Bank report obtained by The Guardian. The damning unpublished assessment is based on the most detailed analysis of the crisis so far, carried out by an internationally-respected economist at the global financial body. The figure emphatically contradicts the US government's claims that plant-derived fuels contribute less than 3 per cent to food-price rises. It will add to pressure to governments in Washington and across Europe, which have turned to plant-derived fuels to reduce emissions of GHGs and reduce their

[769] C Ford Runge and Benjamin Senauer 'How Biofuels Could Starve the Poor' (2014) 86(3) Foreign Affairs 41, 51.

[770] IFAD, *Rural Poverty Report 2011: New Realities, New Challenges: New Opportunities for Tomorrow's Generation* (IFAD 2011) 9 <http://www.ifad.org/rpr2011/report/e/rpr2011.pdf> accessed 12 January 2013; Regine Andersen, *Governing Agrobiodiversity: Plant Genetics and Developing Countries* (Andersen 2008) 4.

[771] Runge (n 769) 51.

[772] Ibid.

dependence on imported oil.[773]

So far, many studies have suggested that biofuel production and its supporting policy instruments indeed affected the global prices of certain crops.[774] And some of them indicated that increased biofuels production (and higher crude oil prices) has raised food prices and contributed to global poverty and chronic undernourishment.[775] For instance, as two of the most important exporters of the EU biofuel market, Malaysia and Indonesia, announced in 2006 that they had reached an agreement in which both countries committed to set aside nearly 40% of their crude palm oil output for biodiesel production.[776] Malaysia and Indonesia together account for about 90% of global palm oil production. Therefore, it is believed that the stronger pull on commodity markets of the biofuel industry compared to the food industry could lead to land being taken away from other uses, thus causing concern about negative impacts in the food market. Moreover, it is further indicated that food prices are expected to continue to rise in response to biofuel consumption targets adopted in the US and EU.[777] Corn-based ethanol production in the US has led to an increase in the price of global corn.[778] Biodiesel production in Europe has contributed to a rise in the global price of rapeseed

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[773] Aditya Chakrabortty, 'Secret Report: Biofuel Caused Food Crisis' *The Guardian* (London, Thursday 3 July 2008) <http://www.theguardian.com/environment/2008/jul/03/biofuels.renewableenergy> accessed 19 November 2013.

[774] Donald Mitchell, 'A Note on Rising Food Prices' (2008) The Word Bank Development Prospective Group Policy Research Working Paper 4682 6/2008, 4 <http://www.bio-based.eu/foodcrops/media/08-07ANoteonRisingFoodPrices.pdf> accessed 19 November 2013.

[775] Hang To and R Quentin Grafton, 'Oil Prices, Biofuels Production and Food Security: Past Trends and Future Challenges' (2015) 7 Food Security 323.

[776] Naveen Thukral, 'Malaysia – Indonesia Set Palm for Fuel, Market Soars' (*Reuters News Service*, 21th July 2006) <http://www.planetark.org/dailynewsstory.cfm/newsid/37356/story.htm> accessed 19 November 2013.

[777] Ewing (n 236) 520.

[778] Timothy Wise, 'The Cost to Mexico of U.S. Corn Ethanol Expansion' (2012) Global Development and Environment Institute Working Paper No. 12-01, 2 <http://www.ase.tufts.edu/gdae/Pubs/wp/12-01WiseBiofuels.pdf> accessed 21 March 2013.

oil.[779] Biofuel policies and instruments for promoting biofuel production and consumption used in developed countries could have indirect but significant effects on food prices and food security in developing countries.[780]

In the US, for example, enormous volume of corn is being used to feed the growth of ethanol production, which is sending shock waves through the food system. In March 2007, corn prices rose to over $4.38 a bushel, the highest level in ten years. Moreover, wheat and rice prices have also surged to a decade high.[781] This in turn caused an increasing demand on corn to outstrip supply, and made the related market very vulnerable.[782] Consequently, it not just affects the US domestic agricultural market, but the food market of its neighbour. Corn bioethanol production in the US was blamed for causing the 'tortilla riots' in Mexico during late 2006 and early 2007.[783] Tilman states: 'In recent months, soaring corn prices, sparked by demand from ethanol plants, have doubled the price of tortillas... Tens of thousands of Mexico City's poor recently protested this 'ethanol tax' in the streets.'[784] Tortilla is a staple food for the poor in Mexico made from corn. Because of the rapid development of corn ethanol industry, the US began to reduce the exported corn to Mexico, and thus the price of corn and tortilla soared.[785]

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779 Worldwatch Institute, *Biofuels for Transport: Global Potential and Implications for Sustainable Energy and Agriculture* (n 57)135.

780 Aaron Smith, 'Children of the Corn: The Renewable Fuels Disaster' (American Enterprise Institute, 4 January 2012) <http://www.aei.org/publication/children-of-the-corn-the-renewable-fuels-disaster/?searchterm=deficit> accessed 19 November 2013.

781 Runge (n 769) 51.

782 Nuffield Council on Bioethics (n 1) 30.

783 Ibid.

784 David Tilman and Jason Hill, 'Corn Can't Solve Our Problem' *The Washington Post* (Washington D C, 25 Mar 2007) <http://www.washingtonpost.com/wp-dyn/content/article/2007/03/23/AR2007032301625.html> accessed 19 November 2013.

785 Patrick Westhoff, *The Economics of Food: How Feeding and Fueling the Planet Affects Food Prices* (FT Press 2010) 17-19.

It is pointed out that rapidly expanding biofuel production and the ambiguous targets setting for biofuel use in transport and other various biofuel supporting policies in developed countries may have a significant impact on people at risk of hunger, particularly in rural areas of developing countries.[786] An international report of 2009 predicted that, 'for the range of simulated global shares of first-generation biofuels in total transport fuels … in 2020 and… 2030, the resulting impact on the expected number of undernourished people is substantial, up to about 200 million'.[787] Moreover, the study also shows that South Asia, with the greatest number of poor rural people, and sub-Saharan Africa, with the highest incidence of rural poverty, are two of the most affected regions.[788] Therefore, biofuels appear to be one contributing factor that has indeed raised world food prices, and could have a negative effect on vulnerable countries and populations.

However, it may be too simplistic to argue that the biofuel market demand higher food crop prices, and will in turn harm the poorest people. The reasons for destabilising food prices are complicated, so blaming food crisis spikes on biofuels production alone would appear to be one-sided. Moreover, higher crop prices will not necessarily harm the poorest people. For a long time, food prices have been at a very low level, even lower than the production cost. Biofuels production could be a new opportunity to reduce poverty by protecting farmers from excessively low prices. According to the World Bank report and the World Food Summit, poverty is a major cause of food security and the eradication of poverty is critical to improving access to food.[789] Therefore, in order to demonstrate the impacts of biofuel development on food security, at least two aspects need to be examined: the impacts on the agricultural market and food price; and the impacts on agricultural community and poverty reduction. Although

[786] Fischer (n 762) 19; Gallagher (n 540) 9.

[787] Ibid Fischer, 21.

[788] Ibid, 20.

[789] FAO, 'Rome Declaration on World Food Security and World Food Summit Plan of Action' (n 740).

many studies recognized that rapidly expanding biofuel production is a driver of higher food prices, it is still hard to get a clear conclusion about how the biofuel industry will affect an agricultural community. Biofuel programmes could benefit agricultural community by increasing farmers' income, creating employment, and changing traditional lifestyle for the poor.

In relation to the case of 'Mexico tortilla riots', some reports have accused biofuels production of driving up food prices or threatening food security by using the strongest language of human tragedy and misery.[790] However, there is little consensus as to the extent of its impact. The conclusions could be very different when different methodologies and modules are applied. For example, according to a World Bank report in 2008, from 2002 until 2008 'biofuels and the related consequences of low grain stocks, large land use shifts, speculative activity and export bans accounted for approximately 70%-75% of the increase in food prices'.[791] In this report, biofuel production in the US and EU was seen to be the most important factor contributing to the increase of food prices. However, another report in 2010, which was also conducted by the World Bank, indicated that the effect of biofuels on food prices was smaller than first believed. The 2008 spike was fuelled by numerous factors, including a weak dollar, fiscal expansion, lax monetary policy in many countries, and investment fund activity.[792] Other factors were more significant than biofuel development that may have been partly responsible for the 2008 food crisis, such as the use of commodities by financial investors (so-called 'financialization of commodities').[793]

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790 Action Aid, 'Meals Per Gallon: The Impact of Industrial Biofuels on People and Hunger' (Action Aid 2010) <https://www.actionaid.org.uk/sites/default/files/doc_lib/meals_per_gallon_final.pdf> accessed March 2013.

791 Mitchell, 'A Note on Rising Food Prices' (n 774) 16-17.

792 Further reading about causes of the global food crisis, see, John Baffes and Tassos Haniotis, 'Placing the 2006/08 Commodity Price Boom into Perspective' (2010) World Bank Policy Research Working Paper No. 5371 <http://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-5371> accessed 21 March 2013.

793 Some commentators have concluded that biofuel production has no significant impact on feedstock prices (by 2010). See, ibid, Baffes; see also , Amela Ajanovic, 'Biofuels versus Food Production:

4.3.5 Conclusion

At a number of international conferences, the international community has recognized the food security continues to be one of the most fundamental of human rights in the 21st century.[794] If there is concrete evidence that biofuel expansion can be a threat for our society to combat food insecurity and world hunger, it would be a convincing reason to suspend the current biofuel projects. However, the relationship between biofuels production and food security is still largely elusive and uncertain, although the debate on food-fuel competition has never stopped since the 2008 food crisis.

For the 2008 food crisis, although a range of other factors have been adduced in the enormous amount of studies, the steeply rising demand for the production of biofuels was identified as an important factor by many observers and a wide range of organizations. Many studies observed that biofuel expansion risks competing with food production directly by diverting food crops for biofuel production and indirectly through competition or land, agricultural labour, and other production inputs such as water. It would consequently exacerbate food insecurity in developing countries by increasing food prices and reducing food production, and in turn increasing undernourished people in the world.

Although much research has indicated that biofuel production is a relevant factor for the 2008 food price surging, it is difficult to draw a robust conclusion about to what extent they are related. The expert debates are largely blurred by the use of different economic models and competing forms of statistical analysis.[795] Biofuel production is

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Does Biofuels Production increase Food Prices?' (2011) 36 Energy 2070.

794 Shaw (n 741) 388.

795 HLPE, *Biofuels and Food Security* (n 141) 14.

merely one of variety of factors raising the global food prices; but sometimes, the impacts of biofuel production and market on food prices could be overemphasized. Some research suggests that the linkages between biofuel prices and food prices are rather weak.[796]

In addition, as discussed in section 4.2, the increased price of agricultural commodity will not harm farmers. Biofuel production could help to increase feedstock prices, which could increase farmers' income. Biofuel programmes could create new opportunities of employment, facilitate rural development, and change people's lifestyle in rural areas. In this way, biofuels production will help to address the root of hunger—poverty in the long term. Therefore, it is insufficient to simply argue that biofuels compete with food and contribute to world hunger. In other words, the 'food versus fuel' dilemma shall not be the reason for any decision-maker to prohibit the development of the biofuel industry.

On the contrary, the biofuel-related food security issue should be a motivation for decision-makers in developing countries to accelerate the development progress of biofuels, especially in relation to the science and technology aspect. As current first-generation biofuel production has encouraged a competition with food and feed over crops, land and other resources, it is important to make a fast transition to producing second-generation biofuels from lignocellulosic feedstocks.[797] In fact, inedible crops and a variety of perennial cellulosic crops are already being used or explored for their biofuel potential in the developing world, such as jatropha, several palms and indigenous Amazonian trees. The potential oil yields and quality of these crops under different agro-climate zones are beginning to be investigated.[798] However, simply switching to the second-generation biofuel production cannot totally solve the 'food

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[796] UNCTAD, *The State of the Biofuels Market: Regulatory, Trade and Development Perspectives* (n 1) 64.

[797] Zilberman, (n 3) 6.

[798] Bekunda (n 73) 252.

versus fuel' dilemma. Careful planning and comprehensive policies for biofuel programmes are required to facilitate the rural development and poverty reduction.

Therefore, a cautious approach for dedicated crops towards biofuel production and deployment in developing countries remains justified. Current mandates, targets, and substantial subsidies supporting biofuel production and consumption need to be reconsidered in the ethical and moral aspects regarding the direct and indirect impacts on food security and rural poverty. Food production should be always given a priority over biofuel production to meet national food security requirements in developing countries. Careful planning and comprehensive policies are required as these biomass feedstocks have tied fuel and food prices together, linked the energy and agricultural market together. It is necessary to view food security and energy security as interdependent and requiring integrated solutions since both are critical to human survival and well-being.

However, food security is not the only issue linked biofuels and agricultural sector. As a heavy agricultural subsidy-supported sector, the biofuel sector is inevitable related to many government support policies. These policies may have both positive and negative impacts on the biofuel markets, and need to be carefully analyse and design by biofuel lawyers and agricultural policy makers. These issues will be discussed in the following section.

4.4 Biofuels Agricultural Subsidy Policy and WTO Disciplines

4.4.1 Introduction

The treatment of subsidies in the WTO/GATT has a complex political and legal history. Agricultural subsidy issues have been problematic under the WTO regime for a long time, and are particularly contentious in international trade negotiations. The controversy stems from the trade-distorting impacts of government support policies designed to protect domestic agricultural markets and maintain farm incomes. The WTO disciplines on subsidies provide an important framework to constrain the proliferation of trade distorting subsidies that can lead to global inequities, particularly for developing countries and the LDCs.

With regard to biofuels, government subsidization policies have played a fundamental role in keeping the industry commercially viable. However, in the context of international trade, these heavy subsidies that aim to promote domestic biofuel industry could be problematic. Moreover, as the biofuel industry just began to develop from the recent few decades, and the current international trade of biofuels is extremely limited, biofuels subsidies are relatively new on the scene and their place in the WTO agreement remains uncertain. The main part of WTO provisions that deals with subsidies is the WTO Agreement on Subsidies and Countervailing Measures (SCM). For agricultural subsidies there is further guidance in the Agreement on Agriculture (AoA). These two agreements are certainly relevant to biofuel regulation and biofuel trade. Therefore, the biofuel subsidy policies need to be incompliance with both the SCM Agreement and the AoA in order to have coherence with the WTO rules.

This section aims to clarify the interaction between biofuels subsidy policy and the WTO disciplines. The first part identifies key policy measures used in major producing countries to support domestic biofuel development. The second part outlines the emerging discussion about the classification of biofuel products under WTO rules. The third part discusses how to WTO agreements and provisions deal with biofuel subsidies. The fourth part analyses the application of WTO subsidy disciplines to common biofuel measures and raises a number of questions of how those disciplines might affect national policies. Finally, it gets the conclusion of whether the current WTO agreements effectively regulate biofuel subsidies in the perspective of developing Member States.

4.4.2 Biofuels Subsidies Policies in Major Producing Countries

United States

In the US, there has been a mature domestic support system for biofuels. Federal policy that mandates the use of a minimum volume of biofuel in RFS2 creates a source of demand that is not based on price, but rather on government fiat. As long as the consumption of biofuels is less than the mandated volume, its use is obligatory.[799] As a result, there has been a relatively stable biofuel market in the US by reducing the risk of investing in biofuels by guaranteeing biofuel demand.[800] Despite the federal mandates for blending biofuels into vehicle fuels and import tariffs to limit import competition in the domestic fuel market, the federal government has provided a variety of subsidy programmes, such as tax exemption, tax credits, and insured loans to small producer of ethanol, as well as federal funding for R&D.

Federal government support for ethanol production date back some thirty years. It was established during the time of the 1970s oil crises, when energy security concerns were high. The Energy Policy Act of 1978 provides a subsidy of 4 cents per gallon of gasohol (E10), equivalent to 40 cents per gallon of pure ethanol through a partial exemption of the federal gasoline excise tax.[801] The level of this subsidy has varied over the years several times.[802] As of 2007, this had evolved into the Volumetric Ethanol Excise Tax Credit (VEETC), which provides a 51cent per gallon, and came into effect in 2009.[803] The VEETC provision provides the single largest subsidy to ethanol. It is the main

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799 Schnepf (n 626) 4.

800 For more discussion about the US mandates and the EPA 2005 and EISA 2007, see Section 3.3.4.4.

801 Josling, 'Biofuel and Biomass Subsidies in the US, EU and Brazil: Towards a Transparent System of Notification' (n 622).

802 It was 54 cents per gallon from 1990 to 2005, and was reduced to 51 cents. *See*, Ibid.

803 Ibid.

source of financial support for biofuels in the past few years in the US, and is also a major direct federal cost associated with the implementation of the RFS mandate.[804] It is estimated that tax losses from the VEETC would average $2,220 million per year for the 2006-2010 period.[805] In addition to the federal tax credit, tax exemptions and credits for the use of ethanol are also provided at the state level.[806]

Moreover, the 2002 US Farm bill introduced specific measures to support the reduction of biofuels based on agricultural materials. This programme provided a variety of subsidies to biofuel plants, such as grants, insured loans to small producers of ethanol, and loan guarantees for biofuel projects.[807] In addition, subsidy programs were established especially for promoting the development of second- and third-generation biofuels in the US. For example, the Federal Cellulosic Biofuel Producer Tax Credit established in 2009.[808] The program provides cellulosic biofuel producers a tax credit of up to $1.01 per gallon of cellulosic biofuel against the producers' federal income tax liability.[809]

The US ethanol industry has been one with substantial subsidies. The US mandates act RFS2 as well as various subsidy forms, driving up market clearing prices and setting the demand floor, thereby improving the competitiveness of otherwise unviable biofuel producers.[810] It is argued that, to a large extent, the combination of high oil prices and

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[804] Lynn J Cunningham and others, *Alternative Fuel and Advanced Vehicle Technology Incentives: A Summary of Federal Programs* (CRS Report for Congress R42566, Congressional Research Service 2013) <https://www.fas.org/sgp/crs/misc/R42566.pdf> accessed 12 May 2014.

[805] Jank, 'EU and US Policies on Biofuels: Potential Impacts on Developing Countries' (n 91) 23.

[806] Ibid, 24.

[807] Ibid. See also, The Farm Security and Rural Investment Act of 2002, Public Law 107- 171; 116 Stat. 284 (2002).

[808] Food, Conservation, and Energy Act of 2008, Public Law 110-234, U.S.C. §15321, 122 Stat. 923 (2008).

[809] Ibid.

[810] See also, Section 3.3.4.4.

a fixed subsidy has led to today's boom of the ethanol industry in the US.[811] It cannot be denied that the US mandates as well as strong subsidy support worked as powerful legal instruments for the expansion of biofuel production and consumption. However, there are also many criticisms towards the US biofuel subsidy policy. Critics of the US biofuels subsidy have taken issue about the current continued heavy federal subsidies for biofuels, especially corn-starch ethanol production, which is not economically sustainable for both the US domestic market and international biofuel market. For the domestic biofuel economy, taxpayers are being asked to finance continued biofuels subsidies in support of biofuels infrastructure that would be a heavy burden and economic inefficient.[812] For international biofuel trade and market, the strong subsidy supports provided by the US on domestic ethanol production limits the exporting opportunities for developing countries, and has negative impacts on international biofuel market.[813] Therefore, some argue that it is no longer necessary since the sector is no longer in its 'economic infancy' and would have been profitable in most months since 2006 without federal subsidies.[814]

European Union

Similarly with the US, the EU has also passed legislation that mandates the incorporation of biofuels into the transportations sector. It established indicative (voluntary) biofuels targets for member states in the Biofuel Directive 2003, which required that biofuels constitute 5.75% of all transport petrol and diesel by 2010 and

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811 Wallace E Tyner, 'The US Ethanol and Biofuels Boom: Its Origins, Current Status, and Future Prospects' (2008) 58(7) BioScience 646, 647.

812 Further reading, see Schnepf (n 626).

813 This issue will be continually discussed in the next section. There are some other criticisms about US biofuel policies such as its implications on agricultural market volatility. See, Bruce A Babcock, 'The Impact of US Biofuel Policies on Agricultural Price Levels and Volatility' (ICTSD Issue Paper 35, ICTSD 2011) <http://www.ictsd.org/sites/default/files/event/2013/09/the-impact-of-us-biofuel-policies-on-agricultural-price-levels-and-volatility.pdf> accessed 30 July 2015.

814 Schnepf (n 626).

10% by 2020. In the face of evidence that these non-binding targets would not be met, the EU RED was adopted in 2009 as a part of the EU 'Climate Change Package'. The EU RED established an EU-wide binding target of 10% of transport energy from renewable sources by 2020 along with a requirement that 20% of all energy come from renewable sources.[815] In order to achieve the targets, the EU provides two main types of subsidies to support biofuel production and consumption, which are tax exemptions on biofuels and direct subsidies to agricultural producers.[816]

To support the biofuels industry, the Energy Taxation Directive passed in 2003 allowed, for the first time, exemptions from or reductions on energy taxation for biofuels.[817] Since tax policy is not part of the sphere of action of the European Community, implementation is in the hands of each EU Member State, and in that varying levels of tax exemptions apply in each Member States.[818] For example, Spain and Sweden exclude biofuels from excise taxes by providing full tax exemption on ethanol and biodiesel. Some other EU countries, such as Germany, France, Ireland, Italy, and the Netherlands, grant tax relief for restricted quantities of biofuels.[819] In the UK, the RTFO is implemented; a lower road-fuel tax applies on biofuels, in that both users and taxpayers in effect support the uptake of biofuel. It is observed that all Member States who have succeeded in achieving high biofuel penetration rates have different tax schemes in place.[820]

Moreover, feedstocks for biofuel production also benefit from the substantial support

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815 For more information about the EU Biofuel Directive 2003 and EU RED 2009, See also, Section 3.3.4.3.

816 Jank, 'EU and US Policies on Biofuels: Potential Impacts on Developing Countries' (n 91) 22.

817 Council Directive 2003/96/EC of the European Parliament and of the Council of 27 October 2003 on restructuring the community framework for the taxation of energy products and electricity [2003] OJ L 283/51.

818 Jank, 'EU and US Policies on Biofuels: Potential Impacts on Developing Countries' (n 91) 22.

819 Ibid.

820 J M Amezaga, S L Boyes and J A Harrison, 'Biofuels Policy in the European Union' (7th International Biofuels Conference, New Deli, February 2010) 4.

through agricultural policies. In general, a number of the key feedstocks for biofuels, such as sugar beets and rapeseed oil receive significant levels of government support and benefit from general agricultural support policies.[821] It is common for EU countries to provide support for agriculture production by subsidizing indirect inputs such as fertilizer and seeds.[822] In addition, there are two instruments established within the Common Agricultural Policy (CAP) particularly for the domestic producers of biofuel feedstock.[823] Firstly, a specific 'Energy Crops Scheme' was introduced in 2003 that provided a direct per acre subsidy of up to 45 €/ha for farmers within the EU, although this was removed in 2010. Even traditional food crops receive support if the materials could be used for biofuel production. For example, oilseed producers and cereal producers used to receive per hectare compensatory payments.[824] Secondly, another instrument within the CAP is the so-called 'Set-Aside Scheme', although it was also abolished shortly after it came into force. Set-aside land accounted for 10% of a farmer's land and could not be used for production under EU agricultural law. Under the compulsory Set-Aside Scheme, energy crops could also be grown on Set-aside land: it allows the production of non-food crops on set-aside land without losing the subsidy.[825] As a result, by the end of 2010, there was no remaining mechanism to directly encourage the production of biofuel feedstocks from the EU agricultural law.

The promotion of biofuels in the EU has been implemented using various policy

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821 Masami Kojima, Donald Mitchell and William Ward, 'Considering Trade Policies for Liquid Biofuels' (World Bank 2007) <http://documents.worldbank.org/curated/en/2007/01/9795685/considering-trade-policies-liquid-biofuels> accessed 30 July 2015.

822 Toni Harmer, *Biofuels Subsidies and the Law of the WTO* (ICTSD Global Platform on Climate Change, Trade Policies and Sustainable Energy Issue Paper No. 20, ICTSD 2009) 18 <http://www.ictsd.org/downloads/2012/02/biofuels-subsidies-and-the-law-of-the-wto.pdf> accessed 21 March 2013.

823 Jank, 'EU and US Policies on Biofuels: Potential Impacts on Developing Countries' (n 91) 22.

824 Ibid.

825 J M Amezaga, S L Boyes and J A Harrison, 'Biofuels Policy in the European Union' (7th International Biofuels Conference, New Deli, February 2010) 4.

instruments. Several directives have dealt with differing aspects of the biofuel production chain. For example, the EU RED and RFQD allowed blending; the Energy Taxation Directive allowed Member States to exempt biofuels from being taxed; and the CAP supported the growth of energy crops.[826] On the one hand, EU biofuel policy is mandated at a continental level by the EU; on the other hand, it leaves large room for Member States freely to determine how best to implement the policy frameworks and meet the targets. The IEA estimated the value of biofuel subsidies in the EU in 2011 at €8.4 billion ($11 billion), with the bulk of these subsidies going to biodiesel.[827] It is showed that, without subsidy policy intervention to stimulate the use of biofuel crops, the EU targets of biofuel consumption and GHG emission reductions would not be met.[828] Whilst these biofuel policies have been successful in introducing and increasing the levels of biofuels in the EU markets, their application has resulted in much controversy and discussions at the same time. For instance, it has been argued that the tax exemption schemes resulted in significant revenue losses for governments that should be switched with other schemes, such as obligation schemes, for the future.[829] And also, the heavy domestic subsidy for biofuel feedstocks from agricultural law in the EU, as well as in the US, may have negative effects on exporter developing countries' biofuel development, and violate WTO rules.[830]

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826 Ibid, 1.

827 IEA, *World Energy Outlook 2012* (IEA 2012); Ivetta Gerasimchuk, 'Biofuels Polices and Feedstock in the EU' (Energy, Environment and Resources EER PP 2013/04, Chatham House 2013) 3 <http://www.chathamhouse.org/sites/files/chathamhouse/home/chatham/public_html/sites/default/files/Nov13Gerasimchuk.pdf> accessed 30 July 2013.

828 Martin Banse and others, 'Will EU Biofuel Policies Affect Global Agricultural Markets?' (2008) 35(2) European Review of Agricultural Economics 117.

829 Further reading about tax exemption schemes, see, Luc Pelkmans and Leen Govaerts, 'Biofuel policy measure in Europe and their impact on the market' (17th European Biomass Conference and Exhibition, Haumburg, 29th June - 3rd July 2009).

830 However, as recent changes to the EU agricultural policies have removed many energy crop subsidies, the 'heavy subsidy issue' may leave much pressure to the US. For the EU, instead, it may generate additional questions about the role domestic production will play in meeting increasing demand in the EU biofuel market. Concerns would also be raised over the likelihood that cheap and unsustainably produced biofuels may be imported from developing countries. Further discussion can be found in the next section and Chapter Five.

Brazil

Brazil, although a developing country, is the most viable and efficient ethanol producer globally. In certain respects, Brazil has been the pioneer of large-scale liquid biofuel production and use as a substitute for conventional fossil fuels.[831] The Brazilian government began to support its ethanol industry in the 1970s after the inception of the first oil crisis. At that time, facing rapidly escalating oil import bills, Brazil launched the Brazilian National Ethanol Program (Pro-Alcool program) to satisfy both the need to lower dependence on imported oil and to create a new market for the country's sugar crop.[832] Under the Pro-Alcool program, the Brazilian government stimulated ethanol industry through direct low-interest loans to sugar companies, a mandatory blend of 20% ethanol with all gasoline sold, and subsidies at the fuel pump to ensure that ethanol blended fuels could be competitive with pure gasoline.[833] So far, Brazil's early biofuel industry has enjoyed a range of direct subsidies and assistance from the government, but what is worth noting is that most of these subsidy instruments were deregulated in the 1990s. Compared with the US and EU, it is argued that the Brazilian ethanol industry is much less dependent on governmental subsidies and support.[834]

As the top world biofuel producers, the US, EU and Brazil have provided significant subsidises and domestic support to encourage a swift move away from conventional

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[831] For more discussion on biofuel production in Brazil, see Chapter One.

[832] Carlos R Soccol and others, 'Brazilian Biofuel Program: An Overview' (2005) 64 Journal of Scientific & Industrial Research 897.

[833] Jens Giersdorf, 'Politics and economics of ethanol and biodiesel production and consumption in Brazil' (DPhil thesis, Freie Universität Berlin 2012) <http://www.qucosa.de/fileadmin/data/qucosa/documents/13726/DBFZ_Report_15.pdf accessed 12> January 2015.

[834] Nancy I Potter, 'How Brazil Achieved Energy Independence and the Lessons the United States Should Learn from Brazil's Experience' (2008) 7 Washington University Global Studies Law Review 331. For information about the biofuel commercial farming in Brazil, see also, Section 1.2.4.2.

energy to biofuels. As demonstrated above, the rapid expansion of the biofuel industry seems to be policy-driven notably by mandates and subsidies. To trigger the growth of biofuel demand, the governments implement mandates and targets for the blending of biofuels with petrol or diesel. All sorts of subsidies, ranging from tax credits, tax exemption to small loans, loan guarantees as well as assistance for R&D, are common measures to support domestic biofuel industries in the main producing countries.[835]

It is hard to deny that these subsidies, which are provided through all sorts of programmes on different levels, have greatly promoted the production and consumption of biofuels. These subsidies enhance the market competitiveness of biofuel products, affect consumer choice, increase the confidence of investors, and ensure the market stability of the newly formulated market. It is predicted that the elimination of these subsidies would result in a reduction in world ethanol and biodiesel consumption of roughly 13 and 65% respectively (average for 2013-2017), and it would be a fatal blow for the new born biofuel industry.[836] In the early stage of biofuel development, government subsidies and support are imperative and indispensable, and have positive impact on rural development.

However, it also cannot be denied that the central objective of these biofuel subsidies is to stimulate domestic biofuel development instead of thinking about the global biofuel industry and market. From an international trade policy perspective, the heavily-subsidized biofuel policies issued in the three main producing countries are very problematic. With the increase in biofuel and their feedstock trade in the international market, problems have cropped up under the WTO regime.

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835 It is reported that biofuels are heavily subsidized by most developed countries. See, Peter Oosterveer and Arthur P J Mol, 'Biofuels, Trade and Sustainability: A Review of Perspectives for Developing Countries' (2009) 4 Biofuels, Bioproducts & Biorefining 66, 72.

836 OECD, *Biofuel Support Policies: An Economic Assessment* (OECD Publishing 2008) <http://www.oecd.org/tad/agricultural-trade/biofuelsupportpoliciesaneconomicassessment.htm> accessed 21 March 2013; See also, Section 4.2.2.

The current international trade in biofuels is still extremely limited, and biofuel producing countries appear to be relying primarily on domestically produced feedstock.[837] Some argue that when examining the patterns of trade in ethanol feedstocks such as corn and sugarcane, there is no evidence that biofuel production has any impact on world trade in either the corn or sugarcane market.[838] However, empirical evidence suggests that in theory the international trade flow of biofuels would scale up significantly in the coming years. This is because the supply and demand of biofuels do not originate from the same place.[839] As was previously stated, ambitious mandates and targets are engaged in developed countries toward the production and consumption of biofuels in transportation. However, these countries have fairly limited land areas for biofuel feedstock cultivation. This limited land availability restricts the potential increase of domestic feedstock for biofuel production in many developed nations. In order to meet the biofuel targets, imported biofuels or biofuel feedstocks are needed. Conversely, many developing countries, especially tropical and subtropical countries, have a real comparative advantage in the production of feedstock for biofuels. For example, Brazil is a main exporter of ethanol, it has the lowest ethanol production cost in the world today, at only US$ 35 per barrel.[840] Malaysia is a key exporter of biodiesel feedstocks. Between 1999 and 2005, EU imports of palm oil from Malaysia more than doubled, reaching 4.5 million tons, which accounted for 18% of world palm oil imports.[841] Therefore, it is expected that there should be room for significant increases in the flow of biofuels and their feedstocks.

In 2005, the world's most important exporters of ethanol were Brazil, EU, US, South

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[837] See also, Chapter One.

[838] Doaa Abdel Motaal, 'The Biofuels Landscape: Is There a Role for the WTO?' (2008) 42(1) Journal of Word Trade 61, 68.

[839] Jank, 'EU and US Policies on Biofuels: Potential Impacts on Developing Countries' (n 91).

[840] Motaal (n 838) 69.

[841] UNCTAD, *The Emerging Biofuels Market: Regulatory, Trade and Development Implications* (n 79) 12, 37.

Africa, China, Saudi Arabia, Costa Rica and Jamaica.[842] The world's most important importers were the EU, the US, Latin America, Japan, India, Korea and Nigeria.[843] From both the import and export lists of 2005, it can be found that many developing countries were involved in the international market of biofuels. A rapid increasing of international trade in biofuels would certainly benefit developing countries, especially those tropical exporting countries. However, national policies enacted by the major biofuels consumers in the developed world, particularly the US and the EU countries, might seriously reduce the export opportunities for developing countries. Consequently, the access to a larger biofuel market is an incentive for developing countries to challenge the biofuel supportive policies in the EU and US in international trade under the WTO legal framework.

It is reasonable to argue that a comprehensive examination of the measures, implementations and market impacts is needed to deal with biofuels on the international level. Specific national policies and measures shall be analysed in detail to draw conclusions about the WTO consistency. Biofuel supportive policies on domestic/regional levels contain a large range of forms, such as national mandates and targets, volume-related subsidies, loans guarantees and financing incentives, fuel-tax reductions, and financial support to research and development. Moreover, there are also many sub-national level supportive policies for biofuels within countries. For instance, in the US, many states have their own tax credits or exemptions for the use of ethanol. In the EU, implementation of the 20-20-20 target is in the hands of the Member States, and Member States provide their own biofuel support to achieve the EU levels. Therefore, it makes the problem more complicated. Especially, there is at present no comprehensive procedure that enables a cross-country comparison of biofuel policies under the WTO. Nor is there any coherent way in which subsidies for biofuels can be

842 Marcos Jank and Luiz do Amaral, 'Potential Supply and Demand for Biofuels in the Coming Decade: Towards a US-Brzil Partnership' (Woodrow Wilson International Centre for Scholars, Washing D. C., 20 February 2007).

843 Ibid.

assessed as to their impact on trade.[844] Consequently, the matching of subsidy policies for biofuels with the appropriate WTO disciplines is not easy.

4.4.3 Classification and Subsidization Application of Biofuels

It is not an easy task to analyse the application of WTO rules to individual biofuel subsidies, not only because there are various subsidies with different stages of biofuel production and use in both national and local levels, but also because the WTO currently has no specific regime to deal with biofuel products.[845] As mentioned above, specific national policies and measures shall be analysed in detail to draw conclusions about the WTO consistency. However, it is a too long story for this section, instead, this part provides a general consideration of the operation of the WTO subsidy disciplines in context of some key biofuel support measures, and furthermore, it discussed a number of possible questions about the application of those rules.

To begin with, in order to examine the issue of biofuel subsidy policies and WTO subsidy rules, the first step is to clarify the classification of each biofuel product under the WTO framework.[846] In fact, under the current WTO system there is no uniform classification for biofuel products. Instead, the two main products on the market, biodiesel and ethanol, belong to different categories respectively.

Biodiesel is an industrial good governed by the WTO Agreement on Subsidies and

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[844] Ibid.

[845] Trade in biofuel feedstocks is governed by the Agreement on Agriculture.

[846] The way in which a biofuel is classified is not only important as far as domestic subsidies are concerned, but importantly also determines which set of WTO disciplines on tariffs are applicable. See, Robert L Howse, Petrus van Bork and Charlotte Hebebrand, 'WTO Disciplines and Biofuels: Opportunities and Constraints in the Creation of a Global Marketplace' (IPC Discussion Paper, International Food and Agricultural Trade Policy Council 2006) <http://www.agritrade.org/Publications/wto_biofuels.html> accessed 21 March 2013.

Countervailing Measures (SCM). More clearly, biodiesel falls under Chapter 38 of the Harmonized Commodity Description and Coding System (HS), which covers chemicals not listed elsewhere:

> A… decision by the WTO's Harmonized System Committee (35th session, March 2005) confirmed that biodiesel should be classified under HS 3824.90, which refers to *chemical products* and preparations of the chemical or allied industries (including those consisting of mixtures of natural products), not elsewhere specified or included.[847]

Accordingly, biodiesel is an industrial good governed by the SCM. Ethanol is not referred to explicitly in the HS, but it is classified on the basis of its chemical composition as 'ethyl alcohol' in Chapter 22 of the HS. It is worth noting that this classification covers both undenatured (HS220710) and denatured (HS220720) ethanol, which means that it does not distinguish between the various uses for ethanol. There is no other separate classification or sub-classifications specific to biofuel ethanol as opposed to ethanol used for other purposes.

Moreover, the AoA applies to products covered by Chapters 1 - 24 of the HS and a range of other goods specified in Annex 1 of the AoA. Ethanol is a product in Chapter 22 of the HS. Therefore, ethanol is classified as an agricultural good, which is subject to both the SCM and to the specific provisions of WTO AoA.[848] Biodiesel is not covered by Chapters 1 - 24 and, is therefore not subject to the AoA. As a result, there would seem to be a prima facie case that ethanol would be a covered product under the AoA, whereas biodiesel would not, so it is possible that there could be subsidies for ethanol that are permissible under the AoA but not for biodiesel under the SCM

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847 Ronald Steenblik, 'Liberalisation of Trade in Renewable Energy and Associated Technologies: Biodiesel, Solar Thermal and Geothermal Energy' (2006) OECD trade and environment working paper 1/2006 [emphasis added] <http://www.oecd-ilibrary.org/docserver/download/5l9t0v83qc6c.pdf?expires=1431478372&id=id&accname=guest&checksum=AD8F6DBE6A0357C8D9BE519570B92012> accessed 21 March 2013.

848 Article 21 AoA provides that the SCM is subject to the specific provisions of the AoA.

provisions.

Therefore, the subsidy classifications applicable to biofuels have been based on conceptions of the substances in question as agricultural or chemical products, and are not specific to the use of the substances as fuels, though biodiesel is an exception as it has its own HS classification. As HS classifications are the basis for subsidy application in WTO Member's schedules, the fact that biofuel classifications are not consistently aligned with the actual consumer market in question, the biofuel market, makes it difficult to ascertain the actual trade flows of biofuels, and get precise biofuel trade statistics. Furthermore, as the classification issue is also a key for tariff bandings, it may lead to a number of problems with respect to consistency, certainty and non-discrimination in the application of existing WTO obligations.

As two of the main biofuel products, ethanol and biodiesel, belong to different categories, the status of biofuels in the WTO is still the subject of much discussion. Moreover, the status of biofuels in the WTO could also be affected by the current Doha Development Round negotiations on the status of so-called 'environmental goods'. The Doha Ministerial Declaration calls for the elimination or reduction of tariffs and non-tariff barriers to environmental goods and services.[849] But the controversy comes with what is an 'environmental good/service'. Discussions of a common definition have being conducted and focused on two classes of goods: those relating to established environmental technologies and 'environmentally preferable products'.[850] In 2007, Brazil and Peru proposed, at the Committee on Trade and Environment Special Session in the Doha Round, that ethanol and other biofuels should be considered as

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[849] WTO, *Ministerial Declaration* (20 November 2001) WT/MIN(01)/DEC/1 <https://www.wto.org/english/thewto_e/minist_e/min01_e/mindecl_e.htm> accessed 21 March 2012.

[850] Timothy Josling and David Blandford, 'Biofuels Subsidies and the Green Box' in Ricardo Melendez-Ortiz, Christophe Bellmann and Jonathan Hepburn (eds), *Agricultural Subsidies in the WTO Green Box* (CUP 2009) 542.

environmental goods and should therefore be subject to tariff cuts or elimination. This proposal was opposed by the EU and the US, but if it were to be accepted, there would be substantial and accelerated 'entry price' reductions that could constrain the ability of both the EU and the US to promote the production and consumption of domestically produced biofuels, which means it would be of benefit to biofuel export of developing countries.

In addition, the issue of biofuel subsidies under the WTO include not only the subsidies provided for biofuel products, but also the subsidies for biofuel feedstocks, as these subsidies may be passed on for the benefit of biofuel producers. As overwhelming majority of feedstocks used for the current production of biofuels are agricultural crops, such as corn and sugar, the classification of biofuel feedstocks is quite straightforward as agricultural goods.[851] However, the classifications of the second- and third-generation biofuel feedstocks are less clear. It is not readily apparent that these feedstocks, such as switchgrass and miscanthus, fall within the categories under the AoA.

In summary, the classification of biofuels under the current trading system is a key issue concerning the nature of biofuel subsidy, and would determine the relevant and applicable WTO trade rules.[852] However, there is no agreement among WTO Members on whether biofuels are defined as industrial, agricultural or even environmental goods. Ethanol and biodiesel are currently under separate classifications. Biodiesel is considered an industry product that is governed by provisions of the SCM Agreement; while ethanol is an agricultural product that is subject to the provisions of both the SCM Agreement and the AoA, which contains more specific regulations on subsidies. Although feedstocks for the first-generation biofuels fall within the catalogue of the agricultural goods, there is a lack of information on how some of the feedstocks for

[851] Harmer (n 822).

[852] Rudaheranwa (n 750) 4.

second- and third-generation biofuels would be treated. Therefore, there is no clear classification of biofuels under the current trading system, which means there is no specific place to discuss how to make progress on trade liberalisation for biofuels. As well as trade in biofuels and their feedstocks increases, such uncertain is probably going to be heated and disruptive for biofuel trade. International efforts are needed to clarify the classification of biofuels as agricultural, industrial or environmental goods.

4.4.4 WTO Agreements on Subsidy Policy: the SCM and AoA

Biofuel subsidies are relatively new on the scene and their place within the WTO framework is untested and subject to debate. According to Harmer (2009), there is little evidence that domestic policymakers consider the relationship between biofuel subsidies and the law of the WTO.[853] However, general subsidy issues or agricultural subsidy issues have been problematic under the WTO regime for a long time. The treatment of subsidies in the GATT has a complex political and legal history. There are a number of multilateral, plurilateral and unilateral trade agreements under the WTO regime which relating to issues raised by classification of biofuels, such as the GATT, the WTO Agreement on Subsidies and Countervailing Measures (SCM), and the Agreement on Agriculture (AoA). The first agreement covers the treatment of biomass and biofuels in general. Basic principles such as non-discrimination, national treatment and most favoured nation treatment are embedded in the fundamental articles of the GATT.[854] The last two are more specifically relevant to the issue of subsidies or agricultural subsidies. For all practical purposes, the provisions of the SCM Agreement and the Agreement on Agriculture comprise the current WTO law-governing subsidies.[855] Therefore, the biofuel and their feedstocks subsidy policies need to be

[853] Harmer (n 822).

[854] More detailed information about the GATT Agreements is discussed in Chapter Five.

[855] Mitsuo Matsushita, Thomas J Schoenbaum and Petros C Mavroidis, *The World Trade Organization: Law, Practice and Policy*, (OUP 2004) 263.

incompliance with both the SCM and the AoA in order to avoid challenges from other WTO Members.

4.4.4.1 The SCM Agreement and Biofuel Subsidies

4.4.4.1.1 Definition of Subsidy under the SCM Agreement

As the most significant subsidy agreement under the WTO, the SCM is relatively rigorous on applicable subsidies generally. The SCM Agreement regulates all subsidies in any economic sector.[856] A main objective of the SCM Agreement is to monitor the use of subsidies in order to reduce or eliminate their trade distorting effects.[857] According to Article 1 of the SCM Agreement, a subsidy is *a financial contribution* by a government or public body that confers a *benefit specific* to an enterprise, industry or region.[858]

There are still various controversies surrounding biofuel subsidies and the SCM Agreement regarding the conditions under which a measure equates to a subsidy. In order to consider these questions, the definition of a subsidy under the SCM Agreement needs to be specifically analysed. In the definition of 'subsidy' under the SCM Agreement, 'financial contribution' and 'benefit' are two separate essential legal elements; each of them must exist for a particular financial assistance to be a subsidy. This point has been made clear by the Appellate Body.[859]

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[856] Michael K Young, *United States Trade Law and Policy* (Carolina Academic Press, 2001) 68-70.

[857] WTO, *Agreement on Subsidies and Countervailing Measures* (15 April 1994) <http://www.wto.org/english/docs_e/legal_e/24-scm.pdf> accessed 21 March 2012.

[857] SCM Agreement, art 1.1. [emphasis added].

[858] SCM Agreement, art 1.1. [emphasis added].

[859] Harmer (n 822).

To begin with, one important issue arose from the element of ‘financial contribution’. According to the SCM Agreement, the term of ‘financial contribution’ explicitly refers to the situation of a transfer of funds or the provision of goods and services or revenue, which would otherwise be due to the government, but that has been forgone or not collected (but not includes direct cash payments).[860] A tax measure, which operates to reduce the amount of tax owed by a taxpayer, is clearly a form of the government forgoing revenue that was otherwise due. It is a common measure used by governments to support biofuel production, such as in the US the VEETC was used by the federal government.[861]

A potential controversy concerning biofuel tax exemption is whether it is a measure of subsidy, or in other words, whether a tax measure is a financial contribution. In order to determine whether there is a financial contribution conducted by a tax exemption, a benchmark is essential and imperative to be established to assess the measure. However, there is no uniform tax regulation within the current WTO regime. And according to the Appellate Body, a benchmark should be based on the tax rules of the WTO Member in question.[862] Therefore, the benchmark can only depend on the specific tax rules of the individual Member States. It obviously makes the assessment uncertainty. At present there is not yet got any general conclusion about what an appropriate benchmark would be for a tax credit or reduction relating to biofuels.[863]

Moreover, correctly identifying a ‘benefit’ and whether it exists is also a complex matter. This issue is related to financial assistance such as loans and loan guarantees, which are commonly used for biofuel production. According to the SCM Agreement, ‘benefit’

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[860] SCM Agreement, art 1.1 (a) (ii).

[861] Josling, ‘Biofuel and Biomass Subsidies in the US, EU and Brazil: Towards a Transparent System of Notification’ (N 622).

[862] Panel Report, *US - Tax Treatment for Foreign Sales Corporations—Report of the Appellate Body* (13 February 2006) WT/DS108/R, 90.

[863] Harmer (n 822).

means that the subsidy must confer a competitive advantage on the recipient. Article 14 of the SCM Agreement provides guidance on defining the term 'benefit' with a non-exhaustive list of 'market' benchmarks.[864] It is worth noting that a workable market benchmark is crucial for benefit analysis, as it is the key to 'isolate a given instance of financial support and determine whether a competitive benefit has been conferred'.[865]

In theory, the benefit analysis is straightforward. If the government is foregoing government revenue which the recipient should have paid under a normal condition, then it confers a benefit.[866] What is crucial is that in determining whether a benefit is conferred, the relevant analysis should not focus on whether the recipient is better off than its competitors in a marketplace. Rather, the question is whether a recipient is better off than it would otherwise have been absent the financial contribution.[867] Take biofuel loans as an example, in order to decide whether a group of biofuel producers received 'benefit' from a government loan, it needs to be determined whether they have received a contribution on terms more favourable than those available in the market.[868] If the amount that the producers pay on the loan is less than the amount that would have been paid on a comparable commercial loan, then the loan will have conferred a 'benefit'.[869] However, in litigation, the analysis of 'benefit' could be controversial. When the government is acting in the market, the determination of whether this conduct is conferring a benefit may not be easy.[870] This is because, as has been acknowledged

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864 SCM Agreement, art 14.

865 Howse, 'WTO Disciplines and Biofuels: Opportunities and Constraints in the Creation of a Global Marketplace' (n 846) 17.

866 Luca Rubini, 'Ain't Wastin' Time No More: Subsidies for Renewable Energy, the SCM Agreement, Policy Space, and Law Reform' (2012) 15(2) Journal of International Economic Law 525, 545.

867 M S Srikar, 'Renewable Energy Programmes in the European Union, Japan and the United States: Compatibility with WTO Law' (2012) Centre for WTO Studies Working Paper CWS/WP/200/4, 51-52 <http://wtocentre.iift.ac.in/workingpaper/Renewable%20Energy%20Programmes_WTO%20Compatibility.pdf> accessed 9 April 2013.

868 Harmer (n 822) 9.

869 SCM Agreement, art 14(b).

870 Rubini (n 866) 545.

by the Appellate Body, the benchmark of the determination is the 'marketplace', and a meaningful 'market' benchmark for benefit is elusive.[871] That is to say, whether there an advantage exists need to be decided by referring to the conditions the recipient would otherwise have had to face in a competitive marketplace, without any government intervention.[872]

As pointed out by Rubini: 'If the "market" is significantly distorted, the identification and determination of the actual benchmark to test the advantage allegedly conferred by a subsidy may thus be elusive.'[873] However, in reality, market conditions are pervasively influenced by government intervention. It is commonly agreed that energy markets have been heavily distorted by a variety of government policies and political factors.[874] This is a particular an issue with biofuels. Not only is the biofuels market just emerging and therefore lacking in reliable market signals as to what constitutes a subsidy, it is also a market that has been heavily intervened by government policies and instruments in all of the producer nations. This means that determination of the actual benchmark to test the allegedly subsidy may thus be elusive.

4.4.4.1.2 Prohibited Subsidy and Actionable Subsidy

According to the above, there is much controversial surrounding the issue of under what conditions a measure constitutes a subsidy. Furthermore, even it can be decided that a financial assistance is a subsidy, uncertainty still exists. To begin with, the SCM Agreement covers both industrial and agricultural subsidies, which is relevant to both

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[871] Ibid; see also, Appellate Body Report, *United States - Reviews of Countervailing Duty on Softwood Lumber from Canada* (12 October 2006) WT/DS257/AB/RW.

[872] Howse, 'WTO Disciplines and Biofuels: Opportunities and Constraints in the Creation of a Global Marketplace' (n 846).

[873] Rubini (n 866) 545.

[874] Ibid.

ethanol and biodiesel products. There are three categories of subsidies: prohibited, actionable and non-actionable subsidies. Non-actionable subsidies are not illegal under the WTO framework, in that most controversies are related to prohibited subsidies and actionable subsidies.

Prohibited subsidies refer to two kinds of subsidies: export subsidies[875] and local content (or import substitution) subsidies.[876] Export subsidy disciplines are not directly relevant to this topic because export subsidies are not widely being used in the biofuel industry.[877] Local content subsidies refer to the practice of having receipt of the subsidy contingent upon using domestic inputs over imports.[878] If a subsidy measure is found to be a prohibited subsidy, then the subsidizing member will be asked to withdraw the subsidy without delay, and a deadline for the withdrawal will be specified by the panel.[879]

The use of domestic support in the form of local content subsidies is a common practice, as many countries have sought to foster domestic production of biofuel and their feedstocks, raising the prospect of policies that favour domestically sourced biofuels. For example, the US Federal Cellulosic Biofuel Producer Tax Credit Program provides a tax credit to domestic cellulosic biofuel producers only.[880] These subsidies are prohibited explicitly by the SCM Agreement, because use of local content subsidies

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[875] SCM Agreement, art 3.1(a).

[876] Ibid, art 3.1(b).

[877] Laura J Loppacher and William A Kerr, 'Can Biofuels Become a Global Industry?: Government Policies and Trade Constraints' (2005) 5 Energy Politics 7.

[878] The issue in the biofuels area refers to providing subsidies for using locally produced feedstock crops.

[879] SCM Agreement, art 4.7. Art 4.7 also allows for an expedited remedy with respect to prohibited subsidies. For more information, see, Contrast Article 19.1 of WTO, *Understanding on Rules and Procedures Governing the Settlement of Disputes* (15 April 1994) WTO Doc TN/DS/W/32 <https://www.wto.org/english/docs_e/legal_e/28-dsu_e.htm> accessed 21 March 2012.

[880] Brent D Yacobucci, 'Biofuels Incentives: A Summary of Federal Programs' (Congressional Research Service Reports Paper 8, CRS 2010) <http://digitalcommons.unl.edu/crsdocs/8> accessed 21 March 2013.

could reduce expected market access, and nullify or impair benefits for foreign suppliers of competing inputs.[881] For this reason, biofuel subsidy policies that express a preference for domestic over foreign-sourced biofuels may present trade distortion problems as prohibited on local content subsidies, and is outright WTO illegal according to the SCM Agreement.

Actionable subsidies refer to subsidies which are 'actionable' or challengeable in the WTO. These subsidies are only outright illegal under the WTO if they are found to meet certain criteria and to cause certain kinds of 'adverse effects' to other countries.[882] Article 5 of the SCM Agreement provides several ways for aggrieved countries to prove the subsidy in question has certain adverse effects, specifically (1) injury to the domestic industry of another WTO Member; (2) serious prejudice to the interests of another WTO Member; or (3) the measure nullifies or impairs a benefit that a WTO Member expected from its WTO membership.[883] In practice, the most relevant one is showing 'serious prejudice'.[884] When a government confers a financial benefit to a specific producer, such benefit may constitute a subsidy measure that could be challenged by another WTO member if it is believed that the subsidy caused serious prejudice to its interests either in the form of price suppression or market share loss.[885] This analysis turns on three further factors: the magnitude of the subsidies, the price contingency nature of the subsidies, and the effect on limited production.[886]

For biofuels, certain programmes can result in 'adverse effects'. It would depend on the

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[881] Annie Dufey, *Biofuels Production, Trade and Sustainable Development: Emerging Issues* (n 119) 29.

[882] SCM Agreement, art 5.

[883] Ibid.

[884] Matthew C Porterfield, 'U.S. Farm Subsidies and the Expiration of the WTO's Peace Clause' (2006) 27 University of Pennsylvania Journal of International Economic Law 999.

[885] For the cases in which the 'serious prejudice' may arise, see SCM Agreement, art 5.

[886] Panel Report, *United States - Subsidies on Upland Cotton* (8 September 2004) WT/DS267/R [hereinafter *US - Upland Cotton*]; Phoenix X F Cai, 'Think Big and Ignore the Law: U.S. Corn and Ethanol Subsidies and WTO Law' (2009) 40 Georgetown Journal of International Law 865, 899.

circumstances of the particular biofuel support programme and the impact it has.[887] It could arise, for example, if a subsidy does not appear to specifically target a biofuel product but in fact has significant indirect effects on the expansion and growth of production and investment in it. This could enable producers to produce or export biofuels at a low cost, and cause injury to the domestic industry in the biofuel product of an exporting country.[888] For an actionable subsidy, a WTO Member can make a complaint against the subsidy measure in WTO dispute settlement, or it can address the subsidy issue pursuant to its domestic law through the imposition of unilateral countervailing duties.[889] However, it is worth noting that to meet the burden of proof with respect to establishing the 'serious prejudice' is not easy, as a holistic analysis of the net economic effect of the subsidies is needed, and the analysis would be a case-specific one, based on economic data on prices and market shares.[890] This is particularly true for the case of biofuel subsidy, as both the global food market (as the targeted impacted market) and the biofuel (or biofuel feedstock) market have been extremely volatile, such as the markets of 2008.

Furthermore, even if a measure qualifies as a subsidy under the SCM Agreement, it is not subject to the full disciplines of that agreement unless it is a 'specific' subsidy.[891] According to Article 2 of the SCM Agreement, a subsidy needs to be only available to a particular recipient. It requires government support programs to be specific to certain enterprise/industries or a limited class of producers. However, in practicea subsidy may be *de facto* specific even it does not single out specific industries or firms directly. The outcome of the analysis depends on a comprehensive examination of the factual scenario relating to the criteria of eligibility of the subsidy and its actual impact.[892]

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[887] Srikar (n 867) 75.

[888] Ibid; See also, Harmer (n 822) 9.

[889] Howse, 'WTO Disciplines and Biofuels: Opportunities and Constraints in the Creation of a Global Marketplace' (n 846) 17.

[890] Cai (n 886) 900.

[891] SCM Agreement, art 2.

[892] Rubini (n 866) 547.

Moreover, 'Specific' is a very objective expression, and there is no reference to the level or extent of the 'specific' in the provision. Rubini commented that: 'This provision encompasses multiple tests that can be used in a determination, in a way that is flexible, unclear and in the end expansionist.'[893] Therefore, it is very difficult to prove that a subsidy is not specific. The 'specific' discipline under the SCM Agreement cannot really work in disputes; or even worse, it can generate much uncertainty.

From the above analysis, it seems that it is difficult to examine the nature of a biofuel subsidy under the SCM Agreement. There are no clear-cut answers and all the elements/requirements are invariably subject to interpretation. Whether a subsidy is a financial contribution, whether it confers a benefit or whether it constitutes injury to domestic industry or a serious prejudice to the interests of another Member are complicated questions involving appreciation of legal jurisprudence as well as the interplay of intricate facts.[894] It involves detailed economic analysis of a targeted market as well as an understanding of legal nuances. In the context of biofuel support programmes such as tax incentives, direct subsidy to feedstock farmers, grants and loans, it would be necessary to examine, case by case, whether they fulfil the conditions of a prohibited or actionable subsidy. Usually, understanding the true nature of a support measure involves complex questions of law and fact.[895] Biofuel support programmes are no exception. Therefore, there are many hurdles that a complainant country must overcome to successfully challenge a biofuel subsidy according to the SCM regulations in WTO dispute settlement.

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[893] Ibid.

[894] Srikar (n 867) 61.

[895] Ibid.

4.4.4.2 The Agreement on Agriculture and Biofuel Subsidies

Compared with general subsidies or industrial subsidies, agricultural subsidies are more problematic in the trade liberalizing progress under the WTO.[896] Despite the SCM Agreements, the specific WTO rules governing agricultural subsidies are also in the AoA. The agreement divides agricultural support into three categories: export competition, market access and domestic support.[897] Each of these is subject to different disciplines. In the case of biofuel subsidies, the most relevant category is that of domestic support.

While the SCM Agreement takes a 'definition approach' to subsidies, distinguishes among prohibited subsidies, actionable subsidies and non-actionable subsidies; the AoA uses a different approach, which is an 'effect approach'. That is to say, according to different degrees of the total trade-distorting effect of a subsidy, domestic support is divided into three categories, or 'boxes': Amber Box (highly trade-distorting subsidies), Blue Box (minimally trade-distorting subsidies), and Green Box (non-trade-distorting subsidies). In order to decide if a Member's biofuel subsidy policies are compatible with the WTO regime, it needs to analyse under which box a specific biofuel measure is categorized and then decide if it needs to be eliminated or reduced according to the AoA. The Blue Box subsidies are linked to production and will be largely limited due to the agreements reached in the Doha Round.[898] Therefore, with regard to biofuel subsidies, the Green Box subsidies and Amber Box subsidies are the most relevant.[899]

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[896] Karen Halverson Cross, 'King Cotton, Developing Countries and the "Peace Clause": the WTO's US Cotton Subsidies Decision' (2006) 9(1) Journal of International Economic Law 149, 195-162.

[897] The issue of market access is relevant to Chapter Three.

[898] See, Jared Baragar, 'Who's to Blame? An Analysis of Agricultural Subsidies and Their Effects on Development' (2009) Independent Study Project Collection Paper 778 <http://digitalcollections.sit.edu/isp_collection/778/> accessed 21 March 2013.

[899] Harmer (n 822) 7.

4.4.4.2.1 Green Box

Subsidies placed in the Green Box are those that only have minimal trade-distorting effect, or have no effect at all, on the market.[900] These subsidies could refer to non-actionable subsidies in the SCM agreement. As Green Box subsidies, they have to completely decouple from the production of specific crops, and the current output or prices.[901] It has been agreed that these subsidies are allowed without caps or limits, therefore there is no requirement for Member States to limit or reduce such payments.

According to Annex 2 of the AoA, Green Box subsidies could apply to a variety of programmes which are not tied to the production of any specific crops, including general services and infrastructure, disaster relief, rural improvement projects, research and education, agricultural training and extension services, as well as environmental conservation and protection programmes.[902] Biofuel programmes were not explicitly included, however, some of the programmes are relevant. For example, the EU CAP required cereal and oilseed producers to set aside a portion of their land (which means not grow arable crops on the land) in order to receive payments. Moreover, farmers could also gain a further payment if they voluntarily set aside additional land for the growth of energy crops. When considering the objectives or outcomes of the support policy, these subsidies for biofuel crops that are grown on set aside land and benefit the GHG reduction could be notified under such provisions.[903] However, as mentioned, the Green Box provisions present a number of hurdles and, at least with respect to decoupling, are likely to be applied strictly.[904] In addition, according to the Annex 2,

900 AoA, Annex 2.

901 Annie Dufey, *Biofuels Production, Trade and Sustainable Development: Emerging Issues* (n 119).

902 AoA, Annex 2.

903 Howse, 'WTO Disciplines and Biofuels: Opportunities and Constraints in the Creation of a Global Marketplace' (n 846); Harmer (n 822) 19.

904 Harmer (n 822) 10.

the R&D subsidy which refers to 'general research, research in connection with environmental programmes and research relating to particular products' could be put into the Green Box. Therefore, R&D expenditures for biofuel technologies, especially for advanced biofuel technologies, or for the diffusion of these technologies to farmers could also be notified under the Green Box.[905] However, there is an implied limitation: direct payments to producers or processors are excluded from this category. That is to say, if an R&D subsidy programme were too specific in direct payments to particular producers or processors, then the subsidy may not be recognized as Green Box subsidy.[906]

However, in order to be categorized into the Green Box, a subsidy program must: (a) have no (or minimal) trade-distorting effects or effects on production; (b) be part of a publicly funded government programme; (c) not involve transfers from consumers; and (d) not have the effect of providing price support.[907] Accordingly, to qualify for Green Box treatment, 'the amount of the payment shall be limited to the extra coast or loss of income involved in complying with the government programme'.[908] These conditions clearly require that any support measure should be compensation equal to the income foregone or to the additional cost of switching from conventional fuels to biofuels.[909] Besides these four general criteria, a Green Box subsidy program has also to be subjected to more specific policy criteria which are contained in Annex 2.[910] If a subsidy programme does not meet the Green Box criteria, it must be reported to the

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905 David Blandford, 'Climate Change Policies for Agriculture and WTO Agreements' in Joseph A McMahon and Melaku Geboye Desta (eds), *Research Handbook on the WTO Agriculture Agreement: New and Emerging Issues in International Agricultural Trade Law* (Edward Elgar 2012) 240.

906 Harmer (n 822) 10.

907 Harmer (n 822).

908 Howse, 'WTO Disciplines and Biofuels: Opportunities and Constraints in the Creation of a Global Marketplace' (n 846).

909 Blandford, 'Climate Change Policies for Agriculture and WTO Agreements' (n 905) 240.

910 AoA, Annext 2.

WTO as Amber Box subsidy or Blue Box subsidy.[911] Consequently, as commended by Harmer, the Green Box provisions of the WTO Agreement on AoA do not provide a broad category sheltering measures on the basis that they offer some environmental benefits.[912]

4.4.4.2.2 Amber Box

Article 6 of the AoA defines Amber Box subsidies as all subsidies that do not fall into the Blue and Green Boxes. In general, the Amber Box covers subsidies that are the most distorting from a trade perspective. These subsidies include price support which are tied to the current market price of a product, and production subsidies that are 'coupled to' or directly linked to production quantities. In the biofuel market, for example, let us assume that the market price of corn is \$0.80/bushel, and the government guaranteed price is \$1.00/bushel. If a subsidy were calculated based on the difference between the guaranteed price and the market price, and conducted as a payment of \$0.20/bushel, the subsidy would fall in the Amber Box. For example, a guaranteed price system was included in the EU CAP before its reform. The CAP provided important indirect support to the EU biofuels industry early in its development, including support through minimum guaranteed prices and per hectare payment.[913] Moreover, it is not just subsidies for biofuel crops that should be regulated by the AoA, but also 'measures directed at agricultural processors…to the extent that such measures benefit the producers of the basic agricultural products'.[914] Accordingly, if subsidies extended to ethanol or biodiesel processors, but in fact designed to benefit the farmers of agricultural crops, then the subsidies could fall within the Amber Box.

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[911] Howse, 'WTO Disciplines and Biofuels: Opportunities and Constraints in the Creation of a Global Marketplace' (n 846).

[912] Harmer (n 822).

[913] Ibid,19.

[914] AoA, Annex 3, para 7.

Instead of stopping provision of all the trade-distorting support in Amber Box immediately, WTO Members have agreed to cap their annual total expenditure on this domestic support at a pre-agreed level, and reduce the use of these subsidies over time. According to the AoA, WTO Members should reduce their domestic subsidies based on an Aggregate Measure of Support (AMS).[915] The Base Total AMS for each WTO Member is a quantification of all domestic agricultural subsidies during the 1986-88 base period.[916] It requires developed countries to reduce their annual domestic support of their Total AMS by 20% over six years from 1995 to 2000. Developing countries are accordingly to reduce 13.3% in Base Total AMS over a ten year implementation period from 1995 to 2004. LDCs were exempt without any requirement.[917] If a WTO Member State exceeds its AMS ceiling in any year, the Member States will have breached its obligations under the AoA; and any Amber Box spending by the Member in excess of the ceiling is vulnerable to WTO challenge.[918]

Moreover, Amber Box subsidies are also subject to another important restriction under the AoA, which is the *de minimis* limitation. Under the *de minimis* limitation, Members are allowed to make *de minimis* payments at agreed upon levels: 5% of the value of production for developed countries, 10% for developing countries, and again no limitation for LDCs.[919] If domestic support falls below a *de minimis* level, then it does not have to be counted in an AMS.

As ethanol subsidies are counted as agricultural subsidies, a key issue would seem to be whether they should be notified as trade distorting under the Amber Box (that should

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915 AoA, art 6 (1).

916 Ibid, art 1(h)(i), Annex 3.

917 Ibid.

918 Harmer (n 822) 7.

919 Cai (n 886) 875.

be calculated into the AMS), or trade-neutral under the Green Box.[920] Some provisions of the AoA are very relevant to biofuel policies. Article 1(a) of the AoA indicates that:

> '[A]ll support provided for an agricultural product in favour of the producers of (a) basic agricultural product or non-product-specific support provided for agricultural producers in general, other than support provided under programs that qualify as exempt from reduction under Annex 2 (green box) should be included in a country's AMS.'[921]

Moreover, Article 1(b) states that, a 'basic agricultural product' in relation to domestic support commitments is defined as the product as close as practicable to the point of first sale as specified in a member's schedule and related supporting material.[922] Furthermore, according to Article 7:2(a):

> 'Any domestic support measure in favour of agricultural producers, including any modification to such measure, and any measure that is subsequently introduced that cannot be shown to (be exempt from reduction)… shall be included in the Member's calculation of its Current Total AMS.' [923]

From the above, it is clear that biofuel subsidy policies are not explicitly addressed in the AoA since they were not on the international agenda, but it is still possible to determine the category of a particular biofuel subsidy policy.[924] Some biofuel subsidies might be consistent with those classified as minimally trade-distorting; some others might be significant trade-distorting that should be put into the Amber Box. For example, if biofuel feedstocks come from cellulosic materials that are not 'marketable agricultural products' or from waste materials, then subsidies of those biofuels could fit within the Green Box.[925] But if biofuel/ethanol subsidies are considered as acting as a

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920 Blandford, 'Climate Change Policies for Agriculture and WTO Agreements' (n 905) 241.

921 AoA, art 1(a).

922 AoA, art 1(b).

923 AoA, art 7:2(a).

924 Josling, 'Biofuels Subsidies and the Green Box' (n 850) 540-41.

925 Blandford, 'Climate Change Policies for Agriculture and WTO Agreements' (n 905) 241.

form of price support policy which in favour of the producers of basic agricultural products, such as corn, sugarcane and oilseeds, and as such would be coupled to production (increase the domestic demand for ethanol feedstocks and hence their price), then it would seem that they should be treated as Amber Box subsidies and included in a country's estimate of its AMS.[926] One specific example is that the US provided $ 1.2 billion of Amber support to corn under the 1995-2000 reference period; it extended $ 2.2 billion during 1999-2001.[927] Moreover, the AMS calculation is not limited to payments made to producers of the basic agricultural product but extends to payments that 'in favour of producers of the basic agricultural crops' and also to 'measures directed at agricultural processors'.[928] That is to say, if there is a subsidy to an ethanol producer instead of farmers, but the subsidy has direct or indirect effect on the ethanol feedstock price (by increasing it), then the subsidy might need to be calculated towards the AMS.[929]

4.4.5 Biofuel Subsidies with WTO considerations

The previous analysis has shown that biofuel industry is heavily reliant on government subsidy support, and the variety of subsidy policies in the main producing countries could have significant effects on the international biofuel market. Moreover, the status of subsidies for biofuel under WTO subsidy disciplines can create significant legal uncertainty, and even conflicts between different legal requirements and policy prescriptions.

As the most important subsidy agreements under the WTO regime, both the SCM Agreement and the AoA put restrictions on the ability of policymakers to implement

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[926] Josling, 'Biofuels Subsidies and the Green Box' (n 850) 541.

[927] Canada, *Agriculture Domestic Support Simulation*, JOB(06)/186, 13 June 2006.

[928] Harmer (n 822) 10.

[929] Ibid.

trade-distorting measures. They also contain a number of provisions that provide flexibility and assistance to developing countries to implement their obligations. For example, according to Article 27.2 and 27.3 of the SCM Agreement, LDCs and the countries that do not meet a certain threshold level of Gross National Products are exempt from the prohibition on export subsidies.[930] The AoA also contains provisions aimed at favouring developing countries. As discussed, according to the AoA, developing countries have an extended time period (2000-2004) for implementation of their AMS reduction commitments of 13.3% of the AMS, instead of 20% for developed countries.[931] The level of *de minimis* limitations are different for developed countries and developing countries, which are 5% and 10% respectively.[932]

Moreover, there are also certain subsidies used by developing countries that are not counted towards the AMS.[933] Most of these subsidies are related to food security and rural development, such as income support to farmers decoupled from production, income safety-net programs, crop insurance programs and payments under the environmental program.[934] These subsidies and support measures are generally available to low-income and resource-poor farmers in developing countries, and have a significant impact on enhancing food security and alleviating world's poverty. In addition, the Green Box provisions of the AoA also provide developing countries with a wider range of options by taking advantage of special and differential treatment through the development programme box.[935] Therefore, both the SCM and the AoA contain a number of provisions to assist developing countries in implementing their obligations and to take account of their development needs.

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[930] SCM Agreement, art 27.

[931] AoA, art 15.2.

[932] AoA, art 6.4.

[933] AoA, art 6.2.

[934] Ibid, Annex 2.6, 2.7, 2.8, 2.12.

[935] AoA, art 6.2.

Ironically, it is commonly denounced by developing countries that current regulations of the AoA cannot really benefit developing countries in international trade. The Agreement left too much room for domestic policymakers to generate even greater gains for developed countries rather than for developing countries.[936] In the Uruguay Round negotiations, domestic subsidy particularly in the agricultural sector has been perceived by developing country WTO members as an unequal bargain.[937]

To begin with, it is argued that the AoA exempted many of the subsidies traditionally utilized by developed countries and thereby achieved minimal domestic subsidy reductions.[938] Since payments within the Green Box must not link to production, a large effort to decouple payments from production levels has resulted in a large amount of money being shifted toward these direct payments functioning under the project of decoupled income support.[939] These include direct payments to farmers, income safety net programs, and crop insurance programs.[940] In the US, decoupled income support was introduced as a replacement of Blue Box deficiency payments by the 1996 Farm Bill. From 1996 to 2005, the US decoupled subsidies amounted to about $5.5 billion, which corresponds to about 10% of the total Green Box expenditure and 8% of total domestic support.[941] The US claimed that these direct income payments were fully compatible with the Green Box exemptions, and should not be subject to the subsidy reduction obligations under the AMS.[942]

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936 Kym Anderson, 'The Challenge of Reducing Subsidies and Trade Barriers' (2004) World Bank Policy Research Working Paper No. 3415, Table 2 <http://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-3415> accessed 21 March 2013.

937 Cross (n 896) 195.

938 Carmen G Gonzalez, 'Institutionalizing Inequality: the WTO, Agriculture and Developing Countries' (2002) 27 Columbia Journal of Environmental Law 433.

939 Motaal (n 838) 68.

940 Andre Nassar and others, 'Agricultural Subsidies in the WTO Green Box: Opportunities and Challenges for Developing Countries' in Richardo Melendez-Oritz, Chirstophe Bellmann and Jonathan Hepburn (eds), *Agricultural Subsidies in the WTO Green Box: Ensuring Coherence with Sustainable Development Goals* (CUP 2009).

941 Ibid, 334.

942 Gonzalez (n 938) 433.

Furthermore, it is predicted that the US hopes to shift even more of its agricultural expenditures from the Blue and Amber Boxes into the Green Box: 'Presumably, this reflects their intention to continue and even expand decoupled income support, which is the most controversial element of Green Box spending allowed by WTO rules.'[943] While these programs are not directly linked to agricultural prices, they do provide farmers with additional revenue, thereby indirectly but significantly subsidizing agricultural production.[944] In this way, these Green Box decoupled subsidies could have similar distorting effects to the coupled subsidies.[945] Therefore, a number of subsidy measures, which are commonly used by developed countries, fall within the category of Green Box subsidy of the AoA. Excluding these measures from the AoA's subsidy reduction obligations will have a significant effect on agricultural production and trade.

Moreover, it is also contended that even if the AoA put a stricter reduction obligation on developed countries regarding Amber Box subsidies; it would not really make any difference. According to the AoA disciplines, WTO Members (except the LDCs) are obligated to reduce domestic subsidies based on the AMS, and the Base Total AMS is a quantification of domestic agricultural subsidies during the 1986-88 period. It is true that developing countries are offered an extended 5 years for implementation of their AMS reduction commitments of 13.3%, instead of 20% for developed countries. However, it is interesting to note that the Base Total AMS of the 1986-1988 period for developed countries was extremely high, and developed country Members did not need to make much of an effort to be compatible with the Agreement. Therefore, the AMS reduction commitment can hardly work effectively as a limitation for developed

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943 S Murphy, 'The United Sates WTO Agriculture Proposal of October 10, 2005' (Institute for Agriculture and Trade Policy, Minneapolis 2005) <http://www.tradeobservatory.org/library.cfm?refid=77195> accessed 28 March 2013.

944 Gonzalez (n 938) 433.

945 Nassar (n 940) 347-50.

countries' domestic subsidy. The gross amount of the total support provided by developed countries to their agricultural sector is kept on a high level. It is estimated that developed countries spend about $300 billion per year in agricultural subsidies.[946]

Indeed, the level of agricultural subsidies in OECD countries actually has increased from approximately $308 billion in 1986-88 to approximately $352 billion in 1998.[947] Under the current AoA obligations, developed countries, particularly the US, EU and Japan, still provide their agricultural producers nearly $1 billion per day in agricultural subsidies. [948] As Josling observed, ceilings on domestic support agreed to as part of the AoA do not function as a restraint on the largest subsidizing WTO members. In 1995 (the year the AoA went into effect), most of the heaviest subsidizing WTO members were far below their permitted AMS ceilings. The US was using only 26.9% of its permitted AMS, the EC 63.6%, Japan 73.1%, and Canada 15%.[949] This situation has not changed at all. Take the US as an example, the 2014 Agricultural Act was signed into law by President Obama on 7 February 2014, replacing some farm subsidy programmes with several major new subsidy initiatives.[950] It is predicted that the new programmes may well provide larger subsidies for farmers than those they received ever before, it could be more than double the average amounts paid out annually under the abandoned programmes.[951]

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946 James D Wolfensohn, 'A New Global Balance: The Challenge of Leadership' (Presidential speech, World Bank 2003) <http://documents.worldbank.org/curated/en/2003/09/6988183/new-global-balance-challenge-leadership> accessed 21 March 2013.

947 Gonzalez (n 938) 433.

948 The US, the EU, and Japan together account for close to 95% of agricultural domestic support that is reported to the WTO. See, Timothy A Wise, 'The Paradox of Agricultural Subsidies: Measurement Issues, Agricultural Dumping, and Policy Reform' (2004) Global Development and Environment Institute Working Paper No. 04-02 <http://www.ase.tufts.edu/gdae/pubs/wp/04-02agsubsidies.pdf > accessed 21 March 2013.

949 Tim Josling, 'Developing Countries and the New Round of Multilateral Trade Negotiations: Background Notes on Agriculture' (Workshop on Developing Countries and the New Round of Multilateral Trade Negotiations, Cambridge, Mass, 5-6 November 1999).

950 Agricultural Act of 2014, Public Law 113-79; H.R. 2642, 128 Stat. 649 (2014).

951 Vincent H Smith, 'The 2014 US Farm Bill: Implications for the WTO Doha Round in a Post-Bali

Moreover, through the 2014 Farm Bill, the US has shifted these agricultural subsidy programmes from Green and Blue boxes into Amber Box, with the potential for substantially increased total outlays on those programmes.[952] As a result, the expenditures on farm subsidies in any given year could be more than double their maximum levels over the period covered by the previous Farm Bill (2008-2013).[953] It is predicated that it is still very unlikely that the US would exceed its AMS cap under the AoA.[954] Therefore, it is clear that the AMS ceiling amount cannot functionally restrict the amount of US subsidy at the moment.[955]

For developing countries, although they seem to enjoy more flexible obligations, it needs to be pointed out that, the Base Total AMS of the 1986-1988 was generally very low for developing countries. Furthermore, even though the reduction commitment did not put too much pressure on developing countries, a problem is that in most developing countries there are no sufficient subsidies in the agricultural sector. For example, in Sub Saharan Africa, public spending on agriculture amounts to only 4 % of total government expenditure.[956] As one commentator Watkins observed: 'In the real world agricultural

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Context' in Ricardo Melendez-Ortiz, Chirstophe Bellmann and Jonathan Hepburn (eds), *Tackling Agriculture in the Post-Bali Context: A Collection of Short Essays* (ICTSD 2014) 153.

952 The original Direct Payments programme was a decoupled Green/Blue Box programme. It was a major source of crop subsidies for US farmers between 2008 and 2013, providing a subsidy of 4.9 billion dollars a year. See, Ibid.

953 Ibid.

954 Ibid.

955 Further reading about US subsidy under the 2014 Farm Bill, See also, Joseph W Glauber and Patrick Westhoff, '50 Shades of Amber: The 2014 Farm Bill and the WTO' (AAFA session The 2014 Farm Bill: An Economic Post Mortem, ASSA Annual Meetings, Boston, January 2015); Carl Zulauf and David Orden, 'The US Agricultural Act of 2014: Overview and Analysis' (2014) IFPRI Discussion Paper 01393 <http://cdm15738.contentdm.oclc.org/utils/getfile/collection/p15738coll2/id/128802/filename/129013.pdf> accessed 30 July 2015.

956 Agence France Presse, 'World Bank Says Agriculture Must Take Centre Stage in Development' (*Global Policy Forum*, 20 October 2007) <https://www.globalpolicy.org/component/content/article/220/47371.html> accessed 28 March

production and trade is determined not so much by comparative advantage but by comparative access to subsidies—an area in which food producers in the industrialized world enjoy an unrivalled advantage over those in developing countries.'[957] Therefore, it is contended that even with the ASM limitation, developed countries still keep a comparative advantage in relation to access to subsidies.[958] When the rich subsidies of developed countries and the domestic inadequacies of developing countries work together, it easily undermines developing countries' efforts to build up their agricultural economies and promote development.[959] The AoA thereby fails at achieving its stated objective of creating a 'fair and market-oriented trading system' by allowing developed countries to continually use sufficient trade-distorting domestic subsidies.[960] As Cho concluded, 'the balance sheet of the WTO enterprise has revealed only the "uneven distribution" of benefits among rich and poor members'.[961] Steinberg also comments that the GATT/WTO consensus decision-making process serves as an external display to legitimize power-based outcomes.[962] The widespread perception that the AoA advances the agenda of its most powerful members threatens to severely undermine the legitimacy of the institution.

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957 Kevin Watkins, 'Free Trade and Farm Fallacies: From the Uruguay Round to the World Food Summit' (1996) 26 The Ecologist, 244, 245.

958 David Adeyinka Coker, 'A Scoping Paper Concerning the Link between International Trade and Investment Agreements and Foreign Direct Investments in Agriculture in Developing Countries and Least Developed Countries' (FAO 2012) <http://www.fao.org/fileadmin/templates/tci/pdf/InternationalTradeAndAgreement/FAO_Scoping_Paper-May_14_2012.pdf> accessed 21 March 2013.

959 Baragar (n 898).

960 Jelena Birovljev and Biljana Ćetković, 'The Impact of the WTO Agreement on Agriculture on Food Security in Developing Countries' (135 EAAE Seminar Challenges for the Global Agricultural Trade Regime after Doha, Belgrade, 28-30 August 2013).

961 Sungjoon Cho, 'The WTO's Gemeinshaft' (2004) 56 Alabama Law Review 483, 488.

962 Richard Steinberg, 'In the Shadow of Law or Power?: Consensus-Based Bargaining and Outcomes in the GATT/WTO' (2002) 56 International Organization 339, 342.

4.4.6 Conclusion

The rapid development of biofuel industry is policy-driven notably by rich subsidies and government support. From the perspective of domestic markets, government subsidization has played a fundamental role in shaping domestic biofuel industries in the 'infant stage' in the main producer countries. However, from the perspective of the international biofuel market, biofuel subsidy polices designed in the main producing countries (mainly the developed countries, with the Brazil as an exception) may work as barriers, especially for developing countries which are potential biofuel feedstocks and products exports but have a lack of sufficient financial support. As a combined energy and agricultural industry, biofuels offer new export opportunities for developing countries, especially for those tropical countries that can produce biomass more efficiently. However, by now, the international biofuel market is still dominated by developed member producers, mainly the US and the EU countries. The comparative advantage of tropical developing country producer of ethanol has not been unleashed yet. International trade rules play an important role ensuring that national subsidy policies do not work as trade barriers that deprive exporter developing countries of opportunities to participate in the global biofuel market. Therefore, the issue of biofuel subsidy and WTO compatibility have been greatly considered by those exporter developing country members.

Because they are derived from agricultural feedstocks, biofuels and their feedstocks subsidies have to be compatible with the disciplines of WTO agreements, particularity the SCM Agreement and the AoA rules. However, as has been demonstrated in this section, the matching of subsidy policy with the appropriate WTO discipline is not always easy. This is because the WTO disciplines governing the production and trade in the biofuel sector are not clear yet and leave considerable ambiguity and uncertainty. Moreover, the SCM Agreement and the AoA under the WTO regime seek to strike a balance between giving policymakers flexibility to achieve domestic policy goals and not to generate new trade barriers. However, it seems that the existing disciplines under these WTO agreements provide too much flexibility or 'policy space' to national intervention. Heavy domestic subsidies in developed countries can greatly weaken the comparative advantage of tropical developing country producers of biofuels, and operate as barriers to a fair international market of biofuels.

Reducing agricultural subsidies was an area receiving particular attention when Doha was launched in 2001, because the Uruguay Round did not succeed in significantly constraining developed countries' ability to subsidize domestic agricultural production. Under the Doha Round agriculture negotiations, a broader shift was expected away from a trade system dominated by the US and EU toward a system that could be increasingly influenced by emerging market economies. However, unfortunately, with the outcome at the WTO Tenth Ministerial meeting in Nairobi, Kenya, the December of 2015 finally marked the moment of the end of 14 years long Doha Development Round when the developed and the developing world formally parted company over the Doha Agenda.[963] For issues of biofuel subsidies, developing countries tend to have a comparative advantage in biofuel production, and biofuel feedstocks and products could make up an added percentage of exports in many developing countries. Therefore, removing barriers to trade in biofuels should still be highlighted in the future multilateral negotiations beyond the Doha Round. However, with the ending of Doha Talks, it becomes more difficult to predict whether there would be some substantial

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963 For the past years of intensified engagement of the developed nations and emerging economies, see Josling, 'Developing Countries and the New Round of Multilateral Trade Negotiations: Background Notes on Agriculture' (n 949). For latest news about the outcome at the WTO Tenth Ministerial meeting in Nairobi and the official ending of Doha Development Round, see the WTO website, available at <https://www.wto.org/english/thewto_e/minist_e/mc10_e/mc10_e.htm> accessed 28 January 2016. See also, Michael Froman, 'We are at the End of the Line on the Doha Round of Trade Talks' *Financial Times* (London, 13 December 2015) <http://www.ft.com/cms/s/0/4ccf5356-9eaa-11e5-8ce1-f6219b685d74.html#axzz3z2M7H4qb> accessed 28 January 2016; Shawn Donnan, 'Trade Talks Lead to "Death of Doha and Birth of New WTO"' *Financial Times* (London, 20 December 2015) <http://www.ft.com/cms/s/0/97e8525e-a740-11e5-9700-2b669a5aeb83.html#axzz3z2M7H4qb> accessed 28 January 2016.

changes to new international trade rules that could have an influence on the treatment of ethanol and biodiesel.

4.5 Conclusion

Biofuel production is expanding rapidly all over the world, driven directly by rising crude oil prices, the desire of countries to be energy independent, reducing GHG emissions, and concerns about agricultural revival and rural development. Even though energy security is usually the overarching policy driver of biofuel expansion, depending on the local context, agricultural and rural development are becoming important shapers of biofuel policies, particularly in developing nations where the majority of the population lives in agricultural communities.[964] Biofuel and its feedstock production can help to re-integrate resources in energy-agricultural markets and stimulate market demand. It can also help to generate employment and income opportunities, as well as increase access to energy use in rural life. These positive effects are directly linked to rural development and therefore contribute significantly to rural poverty alleviation and human well-being.

However, when biofuel economy brings more opportunities to the agricultural sector, it also brings significant challenges and potential risks. The large and rapid expansion of food crop-based ethanol and biodiesel worldwide has affected virtually every aspect of food markets and prices in both national and international markets. It is argued that as more food grains will be used to produce biofuels, food grain carryover stocks will remain tight, and average grain prices will increase. Policy makers in developing countries need to think about how they should respond to biofuels development when food security is an issue, as a majority of people in the developing world are living in

[964] Stromberg (n 734) 3.

the agricultural sector, and food security is a particularly severe issue in many developing countries. However, although the ‘food versus fuel’ debate exists and food security should be given priority over alternative fuels exploration, this should not be a reason for developing countries to stop developing biofuels industry. With proper policy design and new generation biofuel technology development, biofuels development could help with agricultural and rural development by expanding traditional agricultural markets, increasing prices for agricultural crops, creating agricultural employment and increasing farmers’ income.

Moreover, this chapter explored another important issue of biofuels in agricultural regulation. It discussed the heavy subsidy for biofuel and its feedstock in developed countries, its implications for developing country exporters, as well as weather the subsidies are trade-distorting and violate WTO rules. Firstly, it argued that the heavy biofuel subsidies in developed countries subsidies can greatly weaken the comparative advantage of developing country exporters, as any government support in these countries is likely to be limited. Therefore, they are indeed have negative effects on the international biofuel market. Furthermore, after the examination of two of the most important agreements of the WTO, the AoA and the SCM, it argued that the existing disciplines under the WTO framework provide too much flexibility to the utilization of trade-distorting subsidies. In addition, from the negotiation history it can be argued that developing countries are not favored in the way that was expected. Therefore, more efforts are needed to address the agricultural policy support issue so it does not undermine opportunities for the poorest countries. Moreover, biofuel subsidy policy is just one of many issues associated with the biofuel market and the WTO rules, more controversies related to biofuel trade and market under the WTO framework will be discussed in the next chapter.

CHAPTER FIVE BIOFUELS AND THE WTO

5.1 Introduction

The gaps and conflicts between the trade regime and environmental regime has been the subject of intense debate for a long time at both national and international policy levels, but as the concept and requirements of 'sustainable development' are being fully explored in recent decades, the conception of the relationship between trade law and environmental law has developed. Although more and more studies explored the potential linkages between trade liberalization and environmental protection, the trade-environment debate is inextricably linked with the often vastly different perspectives of free traders and environmentalists, developed and developing countries. Since the 1980s, the resort to trade restrictions for the purposes of environmental policy has given rise to an increasing number of international dispute settlement proceedings on the worldwide level in the context of the GATT/WTO. This background against which the biofuels industry and trade began to develop should be kept in mind.

The biofuel industry, as an environmentally-friendly energy industry, carries significant meaning for sustainable development strategy in both the areas of international trade law and environmental law. When legislating for this new-born industry, the significant and divisive battles between trade rules and environmental policies need to be fully explored and understood. Policy makers need to carefully balance the interests of the associated environmental concerns and the free trade concerns. It is necessary and important to keep the current biofuel market prosperous, while maintaining a competitive advantage for the industry in the long term.[965] Imposing lofty

[965] This is because, as demonstrated in the above chapters, 'environmentally friendly/sustainability' is a very significant reason for why governments and customers choose biofuel products instead of conventional fuels.

environmental standards on the new-born industry could be a heavy burden on its initial development; while without environmental regulations or requirements, the ‘green industry’ may become a ‘grey industry’. From this viewpoint, it is important to find out how to regulate the biofuel industry on both the domestic and international level, to balance the interests, and to eliminate the conflicts of international trade and environmental aspects. It is not only important for the sustainability of biofuel development, but could also be important for clarifying the relationship between trade law and environmental law in the 21st century. It could also be informative for exporters in other environmental-linked industries/markets.

This chapter is divided into two sections. The first section analyses and compares the evaluation and interrelationships of international trade law and international environmental law in the context of the global sustainable development framework. The historical gaps and conflicts, as well as potential linkages of the two fields of law are discussed in this section, to illustrate the context in which biofuel production and trade is developing. Moreover, the perspective of developing countries to the trade-environment debate will also be discussed in the first section. It highlights the right to development and the resistance of the Global South to the sustainable version. The second section focuses on biofuel environmental sustainability regulations and the international biofuel market. It particularly explores the question of whether the unilateral biofuel sustainability standards can be compatible with the GATT/WTO regulations. Developments in the interpretation and application of exceptions in relevant articles of GATT, as well as the WTO cases are discussed in this section. As a sensitive industry which is closely linked with the trade-environment debate, the story of the biofuel industry could be viewed as an example to suggest if there is any reconciliation between trade and environmental imperatives.

5.2 WTO, International Environmental Law and Sustainable Development

5.2.1 Introduction

International trade is increasingly making human society more and more interdependent, not only economically, but also socially. In that the externalities of global trade expansion include the impact of trade on the economy, society, and environment. With an increasing economic and trade globalization and exploration, the linkages between trade, environment and societies' development become much more significant than ever before, and the relationship between economic and environmental issues has been a hot topic recently in the present context.[966] Although environmental protection is an explicit objective of the WTO, the conflicts and gaps of international trade law and environmental law remain significant, as they are traditionally separate branches of public international law. One of the most controversies over the relationship between free trade and environment protection has been mainly focused on the conflicts between the WTO rules and its environmental goals. On the one hand, implementation of WTO rules which aim to protect trade freedom can cause environmental hazards; on the other hand, environmental measures which are contained in WTO agreements can be used as non-tariff barriers to international free trade.

This section, firstly, discusses the gap and conflict between international trade law and international environmental law historically. Secondly, it demonstrates that, as the concept of 'sustainable development' become increasingly important, what is the effect on the relationship between international trade law and international environmental law?

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[966] The above chapters of this thesis focus on biofuel production and its related issues in the environmental, economic and social aspects. This chapter mainly explores the issues related to biofuel trade and the international market.

Lastly, it explores the position of developing countries in the trade-environmental debate in the context of the sustainable development. This section emphasises in the context of international trade law, it is imperative and necessary to consider the environmental values and interests. It is important to build a legal framework for biofuels industry to remove the conflicts between the interests of its trade aspect and environmental aspect. However, on the other hand, in the process of fostering global collaboration on environmental protection and sustainable development, more emphasis should be put on developing countries' concerns of access, trade barriers and sustainability in the WTO negotiations.

5.2.2 Potential Gaps and Conflicts between Trade and Environmental Regime

International trade law is mainly based on international agreements. Since 1947, word trade was governed by the General Agreement on Tariffs and Trade (GATT).[967] The main objective of the GATT was to raise the standard of living of the people of the world and to secure progressive development of the economies of countries.[968] The GATT has been revised from time to time to make it more responsive to the changing requirements of international trade and economic relations. The Uruguay Round of trade negotiations (1986-94) was aimed at trade liberalization through the removal of the remaining barriers to free and fair trade. It resulted in the creation of a powerful and effective international organization and a treaty structure namely the World Trade Organization (WTO) to carry on the work of the GATT. The principal objective of WTO is to 'develop an integrated, more viable and durable multilateral trading system encompassing the GATT as modified, all Agreements and Arrangements concluded under its auspices and the complete results of the Uruguay round multilateral trade

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[967] Anupam Goyal, *The WTO and International Environmental Law: Towards Conciliation* (OUP 2006) 16.

[968] Ibid.

negotiations'.[969] The WTO legal regime is the most effective multilateral enforcement mechanism that had ever existed in the international trade context. It 'limits the alternative trade policy instruments in accordance with economic theory and sets up a coherent institutional framework for the making, administration, adjudication and enforcement of trade rules and for the coordination of trade policies'.[970]

Environmental law aims to protect scarce resources at the production level and at the consumption level.[971] Compared with international trade law, international environmental law is a more recent and less developed field of international law. There is no general agreement on the protection of the environment, similar to the GATT in international trade law.[972] Moreover, there is no effective multilateral enforcement mechanism similar to the WTO. Until recent decades the issue of environmental protection has become an issue of great importance in the international legal context, and also within the WTO legal regime.[973] International trade law and international environmental law are different and separate branches of public international law. The main objective of international trade law is the development of the world economy, and promoting the free trade order; while the ultimate purpose of international environmental law is to protect the environment and the natural resources on the earth.[974] Therefore, it is reasonable to argue that there is no any inherent relationship between the two regimes.

With separate legal objectives and different emphasis in the two disciplines, gaps are

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969 General Agreement on Tariffs and Trade 1947 (adopted 30 October 1947, entered into force 1 January 1948) 55 UNTS 194 [hereinafter GATT 1947].

970 Ernst-Ulrich Petersmann, *International and European Trade and Environmental Law after the Uruguay Round* (Kluwer Law International 1995) 1.

971 For discussion on the overview of environmental law, see Section 3.2.3.

972 Petersmann (n 970) 2.

973 John H Barton and others, *The Evolution of the Trade Regime: Politics, Law, and Economics of the GATT and the WTO* (Princeton University Press 2008) 27-55.

974 See also, Section 3.2.3.

easily generated. Moreover, gaps are generated also because there has been a lack of cooperation between the two regimes for a long time. Among 180 multilateral environmental agreements (MEAs), merely about 20 of them include trade provisions on the restriction of imports and exports for environmental purposes.[975] Similarly, international trade agreements rarely contain provisions dealing with environmental protection or conservation.[976] For a long time, trade policy makers have not been concerned about issues in the environmental regime. They even intentionally have sought to limit efforts to link trade and environmental policy-making, and prohibit such efforts altogether.[977] As a result, MFAs and the GATT/WTO laws regulated issues in their own fields respectively.

Despite the gaps between the trade and environmental regimes, conflicts between the two regimes are also significant. Firstly, since the primary purpose of liberalizing trade is to increase economic growth, trade unavoidably affects the level of environmental protection. Trade rules increase domestic/global welfare by delivering the quantifiable benefits to consumers. In the process, the environment and scarce resources could be harmful at the production or consumption level. While environmental regulations increase domestic/global welfare by protecting the environment against improper human activities. In the process, the economic and trade interests could be limited.[978] Therefore, the trade and environmental regimes essentially reflect different interests

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975 The agreements which contain explicit trade-restrictive measures include the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora, the 1978 Montreal Protocol, the UNFCCC and the Kyoto Protocol. See, Petersmann (n 970) 41; Onno Kuik, Richard S J Tol and David J - E Grimeaud, 'Linkages Between the Climate Change Regime and the International Trade Regime' in Ekko C van Ierland, Joyeeta Gupta and Marcel T J Kok (eds), *Issues and the International Climate Policy: Theory and Policy* (Edward Elgar 2003) 201.

976 Even if there are provisions concerning the environment, it is commonly contended that those environmental provisions incorporated in trade agreements cannot work properly.

977 Daniel C Esty, 'Bridging the Trade-Environment Divide' (2001) 15 Journal of Economic Perspectives 113.

978 Andrew J Green and Tracey D Epps, 'The WTO, Science, and the Environment: Moving Towards Consistency' (2007) 10 Journal of International Economic Law 288.

and priorities.

Moreover, the WTO has a strong dispute settlement mechanism and has compulsory jurisdiction over Member States. In contrast, there is no effective dispute settlement mechanism in the international environmental law area. Therefore, environmental measures which have trade implications are very often to arise in disputes before the dispute settlement bodies under the WTO framework. The problem is, as the WTO is mainly a free-trade oriented regime, it is only has limited environmental concerns. Some argue that it is impossible for the WTO regime to widely accept multinational environmental regulations: '[A]n environmental measure taken in implementation of a multinational convention is unlikely to be challenged under the WTO, and if a challenge were brought, it would be likely to fail.'[979] As a result, they consider that the WTO Panel and Appellate Body often value free trade order over environmental protection.[980]

In addition, as mentioned above, trade policy makers intentionally keep the environmental issues out of the WTO. The reason behind this is firstly that environmental protection is not necessary to facilitate trade development directly. Moreover, economists and trade officials fear that considerations of environmental interests will generate an extra burden for the progress of trade liberalization. Particularly, trade officials in developing countries fear a situation that 'protectionist wolves find their way into the trading system in environmental sheep's clothing'.[981] They worry that developed countries will 'impose lofty environmental standards on low-income countries, depriving them of one aspect of their natural comparative advantage and subjecting them to trade barriers if they fail to perform up to developed

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979 Andreas E Lowenfeld, *International Economic Law* (OUP 2008) 314.

980 The GATT cases *Tuna-Dolphin* and *US-Shrimp* are famous cases which demonstrate the tension between international trade law and the environmental regulations, and they are important understanding the strain of WTO jurisprudence concerning environmental protection concern. The details of these two cases will be explored in Section 5.3.

981 Esty (n 977) 117.

country standards'.[982] It is hard to deny that these worries have some basis in reality. As demonstrated in Chapter Three, the proliferation of biofuel certification schemes is substantial confusion among stakeholders and consumers, and has an negative effect on the biofuel market.

However, the arguments for excluding environmental considerations from the trade regime do not provide a justification for complete separation of trade and environmental policies. With increasing trade globalization and exploration, it is impossible for economists or trade officials to kick 'environmental protection' out of the WTO platform. Moreover, enacting the UNFCCC, the Kyoto Protocol, and other MEAs concerning climate change, will undoubtedly bring about great economic and social changes. For example, compliance with the Kyoto Protocol obligation of reducing GHG emissions has called for fundamental alterations in national energy, industrial and transport policies.[983] It could show clearly how economically and socially sensitive the climate change issue is. In this regard, it can conclude that there is no real choice about whether to address trade and environment together. The two regimes have been largely linked together with the increasing conflicts. The linkage has been a matter of fact already. The real problem is how to address the systemic issues about the GATT/WTO and environmental protection. These arguments above illustrate the necessity for addressing trade and environmental issues together.

5.2.3Potential Linkages between International Trade and Environmental Law

Although the trade-environment debate is inextricably linked with the often vastly different perspectives of free traders and environmentalists, there are more and more

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[982] Ibid.

[983] Leonardo Massai, *The Kyoto Protocol in the EU: European Community and Member States under International and European Law* (Springer Science & Business Media 2011).

studies recognizing the vital links between environment and economic growth. There is an assumption in the trade community that there is no inherent conflict between economic growth and environmental protection. Economic development and environmental protection are both needed for improved human well-being. Trade liberalization can improve financial investment, technological innovation and eventually it improves the country's overall welfare, and in turn leads to a more efficient use of natural resources and improved standards for environmental protection and conservation.[984] Empirical research on the relationship between trade and the environment support this view and affirms that trade growth has the capacity to lower pollution.[985] Therefore, trade liberalization can help the environment and sustainable development, and the process of trade liberalization should be required to aid sustainable development. As illustrated in Chapter Three, both economic development and environmental protection (as well as social development) are requirements of the concept of 'sustainable development'.[986] In this regard, there are strong potential linkages between trade law and environmental law, and the trade-environment linkages must be addressed within the broader framework of sustainable development.[987]

Moreover, it is also pointed out that trade liberalization itself is not the ultimate goal of a process, even under the WTO framework.[988] The ultimate objective of international trade and global trade liberalization should be sustainable development.[989] The preamble to the WTO Agreement clearly reflects assumptions about the interrelationship between economic development and environmental quality. It is one

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[984] Nicola Borregaard and others, *Environmental Impacts of Trade Liberalization and Policies for the Sustainable Management of Natural Resources: A Case Study on Chile's Mining Sector* (UNEP 1999) 2.

[985] Shawkat Alam, *Sustainable Development and Free Trade: Institutional Approaches* (Routledge 2007) 207.

[986] See also, Section 3.2.4.1.

[987] Alam, *Sustainable Development and Free Trade: Institutional Approaches* (n 985) 205.

[988] Ibid, 1-4.

[989] Ibid.

of the WTO's objectives to protect and preserve the environment, which has been explicitly expressed in the WTO preamble.[990] The first paragraph of the preamble states that:

> The Parties to this Agreement,
>
> Recognizing that their relations in the field of trade and economic endeavor should be conducted with a view to raising standards of living, ensuring full employment and a large and steadily growing volume of real income and effective demand, and expanding the production of and trade in goods and services, while allowing for the optimal use of the world's resources in accordance with the objective of sustainable development, seeking both to protect and consistent with their respective needs and concerns at different levels of economic development,[991]

Accordingly, it recognizes the extent to which environmental factors are inextricably linked within the WTO structure. However, it should undertake more efforts to clarify specific WTO rules in relation to trade and environmental issues. Since a variety of environmental regulations can potentially be used as non-tariff barriers, they may shape trade flows to a significant extent. In that, when the WTO reviews environmental measures, it needs to ensure that such measures are not only designed to protect national or regional industry from international competition.[992] In addition, the new development of trade and environmental law is also reflected in the WTO case law. The WTO is predicated upon the 1947 GATT system, which almost entirely focused on trade in goods. However, more and more GATT/WTO cases increasingly go to the heart of the trade-environment debate in the context of the WTO.[993] It is contended by

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[990] Steve Charnovitz, 'The WTO's Environmental Progress' (2007) 10 Journal of International Economic Law 690.

[991] WTO, *Agreement Establishing the World Trade Organization* (15 April 1994) <http://docsonline.wto.org> accessed 12 August 2012.

[992] Green (n 978) 288.

[993] The relevant cases, such as *US – Shrimp* and *US – Tuna*, will be analyzed in the next section.

Professor Cottier, Director of the World Trade Institute, that attention should now move to the intersection of trade and human rights or justice, as 'the trade and environment debate and, in particular, the case law of the Appellate Body [has] gradually brought about a better balance' between trade and the environment.[994]

Furthermore, 'sustainable development' is an important concept when addressing the systemic issues surrounding the WTO and environmental protection. It provides for principals and regulations which connect economic development with the conservation of the environment. As discussed in Chapter Three, the concept of 'sustainable development' is the mainstay of environmental jurisprudence, as international environmental law itself has been developed on its basis. It is worth noting that, although sustainable development is a main pillar concept of international environmental jurisprudence, it is not an alternative name for environmental protection by implying limits to economic growth. In order to promote sustainable development, it is necessary to make trade liberalization and the environment mutually supportive with each other within a coherent framework.[995] Or it can be seen as a new concept of economic growth.[996] It is a development process, in which economic and social policies, trade and industry policies, energy and agricultural policies, all aim to induce development paths that are economically, socially, and environmentally sustainable.[997]

Sustainable development requires that the adverse impacts of economic growth and trade expansion on the ecosystem and natural elements, such as water, soil and air, should be minimized. The rate of depletion of natural resources should be taken into account, new technologies and financial support should be added for minimizing

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994 Thomas Cottier, 'Challenges Ahead in International Economic Law' (2009) 12 Journal of International Economic Law 3, 4; Isabelle Van Damme, 'Eighth Annual WTO Conference: An Overview' (2009) 12 Journal of International Economic Law 175, 180-82.

995 Alam, *Sustainable Development and Free Trade: Institutional Approaches* (n 985) 206.

996 Ibid.

997 Ibid.

depletion of critical natural resources and there should be improved likelihood of substitutes being available. In other words, sustainable development essentially requires that, the process of human development, policies of regulating trade expansion, resource exploration, financial investment, and new technology creation, operate in harmony with one another, and therefore meet human needs and aspirations in the long term.

As environmental sustainability has been a significant concern currently in the international legal context, many sustainable development principles carry implications for international trade. For example, Principle 8 of the Rio Declaration states: 'To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies.'[998] And also, the UNFCCC states: 'The ultimate objective [of stabilizing greenhouse gas concentrations in the atmosphere]… is to enable economic development to proceed in a sustainable manner.'[999] Therefore, there is plenty of evidence of a consensus that government legislation and policy should be guided by principles of sustainable development.

5.2.4 Trade-Environment Debate and Developing Countries

The issues surrounding economy development and environmental protection have significant concerns for developing country members of the WTO. The practice of using trade measures as environmental tools has created controversy among both trade supporters and developing countries who often condemn this measure as protectionist, eco-imperial and unilateral.[1000] Despite the progress that has arguably been made in the past fifteen years at numerous global forums focused on sustainable

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[998] Ibid, 15.

[999] UNFCCC, art 2.

[1000] Alam, *Sustainable Development and Free Trade: Institutional Approaches* (n 985) 15.

development,[1001] there remains a stark and significant disparity between the North and South as to what particular strategies should be adopted to achieve the objectives of sustainable development. The current treatment of trade-environment issues is inseparably entwined with the economic, social and political construction of the current dominant world system and consequently has resulted in major conflicts of interests between powerful developed countries and developing countries. The conflicts of North-South interests as manifested in global economic and environmental governance must be reconciled as a matter of urgency.[1002] Presenting the perspective of developing countries in the development of the trade and environment debate has been a primary objective of the international community.

For developing nations, economic growth is the prominent objective of national strategy. Developing countries will be able to take appropriate measures to deal with the proximate causes and effects of environmental degradation only through vastly increased economic development and capacity building measures.[1003] Therefore, they do not agree unrestricted utilization of trade measures to protect the environment. They fear that trade restrictions for environmental purposes have further opened the door to green protectionism. These measures could be a kind of disguised protectionist barrier, which would likely be used as an obstacle to gain access to the market of developed countries, and consequently offset the competitive ability of developing countries. As noted by Rauscher: 'Green argument can easily be abused to justify trade restrictions that are in reality only protectionist measures and it is often difficult to discriminate between true and pretended environmentalism.'[1004] Therefore, they hope that trade-environment issues could be addressed in a pragmatic manner by considering the economic and social problems and stages of development of the South on the basis of

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[1001] See also, Section 3.2.4

[1002] Alam, *Sustainable Development and Free Trade: Institutional Approaches* (n 985) 205.

[1003] Michael Rauscher, *International Trade, Factor Movements, and the Environment* (Clarendon Press 1997) 3.

[1004] Ibid.

the principle of common but differentiated responsibility. In other words, they seek a sustainable development framework to address the trade-environment linkages, a framework which, when properly applied, could protect free trade, while placing a primary emphasis on the developmental needs and priorities of developing countries.[1005]

However, on issues of environmental protection and trade development, it is not easy to reach a consensus between developed and developing countries. From the Uruguay Round to Doha Round, developing countries were pressing hard within the WTO negotiations for a substantial reduction and eventual end to agricultural subsidies, and for further liberalization of tariff peaks on third world exports. Unfortunately, it is undeniable that developing countries are still at a disadvantage as 'latecomers' in negotiating process due to historical and political disadvantages, and in many cases, due also to their inexperience in negotiations.[1006] These nations still often are restricted by all sorts of trade barriers, particularly non-tariff barriers in the international trade. The Doha talks have long been questioned whether it is likely to deliver the meaningful trade gains for developing countries that the WTO membership seeks.[1007] And unfortunately, the end of Doha Negotiations in December 2015 finally defined the failure of Doha architecture. As a result, new approaches need to be brought to the table to cope with the failure. It would require countries to explore emerging environmental-related trade issues, biofuel issues for instance, in a new form of multilateralism in the future. In terms of environmental protection and economic development, especially on the issue of how developing countries shall bear their responsibility in protecting the environment, there is big dispute and conflicts between developed and developing

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[1005] Ibid.

[1006] For detailed discussion on the history and evolution of the WTO, see Craig VanGrasstek, *The History and Future of the World Trade Organization* (WTO 2013).

[1007] Kyle Bagwell and Robert W Staiger, 'Can the Doha Round Be a Development Round? Setting a Place at the Table' in Robert C Feenstra and Alan M Taylor (eds), *Globalization in an Age of Crisis: Multilateral Economic Cooperation in the Twenty-First Century: National Bureau of Economic Research Conference Report* (University of Chicago Press 2014) 90.

countries.

On the issue of trade in biofuels, many of the biofuel policies and measures introduced by developed countries addressing non-trade concerns, including environmental protection, climate change, food security, economic prosperity and social welfare, have been met by developing countries in the international biofuel market with much suspicion and opposition.[1008] Developing countries often suspect that such measures are inspired by protectionist intentions, rather than genuine non-trade concerns.[1009] The EU biofuel certification scheme and environmentally sustainable standards provide a feasible method for biofuel sustainable development in Europe. However, it also may become an excuse to limit imports of biofuels or the feedstocks from other countries. It is important to think about how to ensure that international trade of biofuels is in a free and fair environment, while promoting biofuels development on a sustainable path. In order to address this issue, the perspective of developing countries should be taken into consideration.

5.2.5 Conclusion

In sum, the biofuels industry, as an allegedly environmentally-friendly energy industry, carries significant meaning for sustainable development strategy for the world. As an economically and environmentally sensitive energy sector, links between biofuels and sustainable development are varied and complex. Theoretically, it is believed that only when biofuel production achieves the three goals of environmental sustainability, social

[1008] Peter Van den Bossche, Nico Schrijver and Gerrit Faber, *Unilateral Measures Addressing Non-Trade Concerns: A Study on WTO Consistency Relevance of Other International Agreements, Economic Effectiveness and Impact on Developing Countries of Measures Concerning Non-Product-Related Processes and Production Methods* (Ministry of Foreign Affairs of The Netherlands 2007) XXIX .

[1009] Ibid. Issues associated with economic and social concerns have been discussed in Chapter Four, while environmental concern-related measures are targeted in this chapter.

sustainability and economically sustainability at the same time, can they be seen as 'sustainable biofuels' that contribute to both economic development (including trade prosperity) and environmental protection. These requirements make it necessary for policy makers to link trade and environmental concerns together when designing biofuel policies.

However, it is clearly not an easy task, especially when there is a lack of internationally-agreed criteria for sustainable biofuels, and the medley of different government measures aimed at sheltering domestic markets is holding back growth in the global biofuels trade. A lack of coherence and coordination between trade and environmental agendas could lead to biofuels providing a solution to one specific problem while simultaneously creating several others. Under current trading conditions, there are many environment-related policy problems existing as non-tariff barriers in the international biofuels market, that already prevent developing countries from reaping the benefits of the biofuels trade. It is therefore increasingly urgent to map a path for the global biofuels industry and markets to develop in a sustainable way under the current WTO framework. The next section will demonstrate the conflicts between trade and environmental concerns related to biofuel legislation and policies.

5.3 Biofuels Sustainability Standards and WTO Compatibility

5.3.1 Introduction

The above section explained the gaps, conflicts and linkages between international trade regime and environmental regime. It demonstrated that as the concept and requirements of 'sustainable development' were explored over recent decades, the relationship between trade law and environmental law also developed over time. This is the background against which the biofuels industry and trade began to develop and should be kept in mind.

It is worth noting that there are many issues associated with the biofuel trade and market under the WTO. This is because, on the one hand, the 'biofuel phenomenon' *per se* is a comprehensive topic. Biofuel industry closely links with the energy market, agricultural market, and involves intensive advanced biotechnologies and environmental and social considerations. On the other hand, there are a variety of agreements under the WTO framework relevant to biofuel legislation, such as the GATT, TRIPS, CBD, SCM Agreement, AoA, and Agreement on Technical Barriers to Trade (TBT).[1010] Instead of enumerating all these issues and agreements under the WTO framework, this research focuses on one of the most significant topics, which is the compatibility of unilateral domestic/regional biofuel standards/measures and the GATT disciplines.[1011] Relevant principles and rules, including Most-Favoured-Nation (MFN) Treatment, National Treatment and particularly Article XX of the GATT, as well as the WTO case law are under exploration to get the answer. Or it can be put in another way: are there any negative effects for the international biofuel market that follow from using biofuel sustainability standards and criteria? What are the impacts of the standards and requirements for biofuel development in the exporter developing countries? What is the attitude of the WTO towards unilateral sustainability standards in developed countries?

[1010] The TBT Agreements are not the subject matter of this thesis. For discussion about the TBT Agreements and biofuels certification, see Gabrielle Marceau and Joel P Trachtman, 'The Technical Barriers to Trade Agreement, the Sanitary and Phytosanitary Measures Agreement, and the General Agreement on Tariffs and Trade: A Map of the World Trade Organization Law of Domestic Regulation of Goods' (2002) 36(5) Journal of World Trade 811.

[1011] Under the WTO regime, the issue of unilateral biofuel sustainability standards fall within the scope of non-tariff barrier issues. Biofuels tariff policy would also have a significant impact on biofuel markets, but this issue is not the subject matter in this thesis. For more discussion about tariff negotiations under the WTO, see Anwarul Hoda, *Tariff Negotiations and Renegotiations under the GATT and the WTO: Procedures and Practices* (CUP 2001). For analysis about biofuel tariff policy and the implications on the markets, see, Robert Ackrill and Adrian Kay, *The Growth of Biofuels in the 21st Century: Policy Drivers and Market Challenges: Energy, Climate and the Environment* (Palgrave Macmillan 2014).

In order to answer the questions above, a working definition of 'sustainable biofuel' needs to be examined. The 'sustainable biofuels' initiatives discussed in Chapter Three provided a first step toward determining whether there can be a possible way to promote the sustainable development of biofuels, while enhancing free trade in the international arena.[1012] It is relevant when evaluating the conformity of an import ban for non-sustainable biofuels with the WTO rules. As was discussed in Chapter Three, there is no universal definition of 'sustainable biofuels' under the WTO regime or any other international legal framework. The contents and levels of 'sustainability' for biofuels are very dependent on various requirements in different countries or certification schemes. Some countries' standards for sustainable biofuels, such as the Netherlands and the UK, include requirements from a broad range of environmental, economic and social aspects. Some other standards focus on environmental sustainability only, such as the requirements on the EU level. The different references to 'sustainable biofuels' contained in individual national/regional legislation make the issue more complicated. These concerns will be of further relevance in Section 5.3, when discussing the WTO jurisprudence in regard to GATT Article XX.

5.3.2 Conflicts of Biofuels Sustainability Criteria and WTO Principals

5.3.2.1 Most-Favoured-Nation Treatment

In order to figure out what are the conflicts concerning the implementation of a ban on the importation of non-sustainable biofuels under the WTO regime, it is necessary to note that there are several sources of conflict that would arise between international trade and international environmental legal regimes. To begin with, as demonstrated in section 5.1, the obligations related to international trade, as set forth in the GATT,

[1012] See, Section 3.3.

usually take priority over the environmental rights and obligations embodied in multilateral treaties.[1013] This part will put more emphasis on other specific sources of conflict under Article I (the most-favoured-nation clause) and Article III (national treatment clause) of the GATT. Article I (1) of the GATT reads as follows:

> With respect to customs duties and charges of any kind imposed on or in connection with importation or exportation or imposed on the international transfer of payments for imports or exports, and with respect to the method of levying such duties and charges, and with respect to all rules and formalities in connection with importation and exportation, and with respect to all matters referred to in paragraphs 2 and 4 of Article III, any advantage, favour, privilege or immunity granted by any contracting party to any product originating in or destined for any other country *shall be accorded immediately and unconditionally to the like product originating in or destined for the territories of all other contracting parties*.[1014]

The above is the most-favoured-nation (MFN) clause, which is one of the so-called 'cornerstone[s] of the GATT' and 'covered agreements of the WTO'.[1015] The MFN is an imperative fundamental for relations between countries in the world trade order, as it demonstrates the principal of non-discrimination.[1016] As the Appellate Body noted in *US – Section 211 Appropriations Act*:

> For more than fifty years, the obligation to provide most-favoured-nation treatment in Article I

1013 Chris Downes, 'Must the Losers of Free Trade Go Hungry? Reconciling WTO Obligations and the Right to Food' (2007) 47 Virginia of International Law 619**;** Michael Hahn, 'A Clash of Cultures? The UNESCO Diversity Convention and International Trade Law' (2006) 9 Journal of International Economic Law 515.

1014 GATT, art I (1) [emphasis added].

1015 Appellate Body Report, *European Communities – Conditions for the Granting of Tariff Preferences to Developing Countries* (7 April 2004) WT/DS246/AB/R [hereinafter *EC – Tariff Preferences*] para 101.

1016 Ibid; See also, Appellate Body Report, *United States – Section 211 Omnibus Appropriations Act of 1998* (2 January 2002) WT/DS176/AB/R [hereinafter *US – Section 211 Appropriations Act*] para 297; Appellate Body Report, *Canada – Certain Measures Affecting the Automotive Industry* (31 May 2000) WT/DS139/AB/R [hereinafter *Canada – Autos*] para 69.

of the GATT 1994 has been both central and essential to assuring the success of a global rules-based system for trade in goods.[1017]

The MFN clause provides a formal equality of treatment between Member States of the GATT/WTO by mandating that any advantage or privilege extended to the product of one country must be extended 'immediately and unconditionally' to the goods of all other countries party.[1018] The principle purpose of the MFN treatment obligation of Article I (1) is to prohibit discrimination among like products originating in, or destined for, different WTO Members, and to ensure equality of opportunity to import from, or to export to, all Member States.[1019] With regard to the issue surrounding biofuels, the MFN clause directs how the importing governments must treat biofuel and biofuel feedstock products from Malaysia and Brazil, for example.[1020] This means that market access, taxes and other charges applied to imported biofuels must not confer an advantage to Malaysia over Brazil, and vice versa.

Conflicts arise due to the fact that 'sustainable standards and criteria' is for the process of biofuel production, while the MFN provision focuses on trade in 'like products' instead of the manner by which such products are produced. In other words, according to sustainable biofuels criteria, sustainable and non-sustainable biofuels would be subject to differentiated treatment. However, if sustainable biofuels and non-sustainable biofuels are 'like' products, then the sustainability standard policy would be a contravention of the application of the non-discrimination obligations of Article I. The further concern is of whether sustainable and non-sustainable biofuels are 'like' products according to different processes of biofuel production. The principle of 'product versus process' will be further discussed in Section 5.3.2.3.

1017 Appellate Body Report, *US – Section 211 Appropriations Act*, para 297.

1018 Appellate Body Report, *Canada – Autos* para 84; See also, Kuik (n 975) 203.

1019 Van den Bossche (n 1008) XXXI.

1020 Marsha A Echols, 'Biofuels Certification and the Law of the World Trade Organization' (ICTSD 2009) 9 <http://www.ictsd.org/downloads/2009/06/marsha-echols.pdf> accessed 30 July 2015.

5.3.2.2 National Treatment

The duty of non-discrimination is also found in GATT Article III which is so-called 'national treatment'. It prohibits WTO members from treating imported products less favourably than like domestic products by internal taxes or measures. Article III (1) states:

> The contracting parties recognize that internal taxes and other internal charges, and laws, regulations and requirements affecting the internal sale, offering for sale, purchase, transportation, distribution or use of products, and internal quantitative regulations requiring the mixture, processing or use of products in specified amounts or proportions, should not be applied to imported or domestic products so as to afford protection to domestic production.[1021]

The national treatment obligation is one of the most important and also one of the most contentious provisions of the WTO trading system. It has been the subject of a large number of cases in the GATT dispute resolution system.[1022] The purpose of the rule is to prevent domestic tax and regulatory policies from being used as protectionist measures and nullify the benefits of tariff concessions.[1023] For biofuels, both the internal tax and regulatory policies are relevant, but for biofuel sustainable standards, the more relevant is the latter one.[1024] Particularly for the internal regulation issues, Article III (4), which is called 'treatment not less favourable' clause, requires that imported products be treated no less favourably than like domestic products. Article III (4) of the GATT reads as follows:

[1021] GATT, art III.

[1022] John H Jackson, 'National Treatment Obligations and Non-tariff Barriers' (1989) 10 Michigan Journal of International Law 207, 208.

[1023] Ibid.

[1024] For internal tax provision, see GATT, art III (2).

> The products of the territory of any contracting party imported into the territory of any other contracting party shall be accorded treatment no less favorable than that accorded to like products of national origin in respect of all laws, regulations and requirements affecting their internal sale, offering for sale, purchase, transportation, distribution or use. The provisions of this paragraph shall not prevent the application of differential internal transportation charges which are based exclusively on the economic operation of the means of transport and not on the nationality of the product.[1025]

The purpose of this provision above is to ensure the internal measures will 'not be applied to imported or domestic products so as to afford protection to domestic production'.[1026] In essence, the 'national treatment' obligation provides for equality of treatment between imported and domestic 'like products'. According to the 'treatment not less favourable' clause, the formal difference in treatment between domestic and import 'like' products is not necessary or sufficient to be a violation of Article III. Instead, it should be decided by 'examining whether a measure modifies the *conditions of competition* in the relevant market to the detriment of imported products'.[1027] In *Alcoholic Beverages*, the Appellate Body states that the purpose of Article III is to 'provide equality of competitive conditions for imported products in relation to domestic products'.[1028] In the dispute of *EC-Asbestos*, the Appellate Body also clarifies that the objective of Article III is to 'prevent Members from applying internal taxes and regulations in a manner which affects the competitive relationship'.[1029] Moreover, the Appellate Body added an important clarification in *Dominican Republic Import and*

1025 GATT, art III (4).

1026 Appellate Body Report, *Japan - Taxes on Alcoholic Beverages* (4 October 1996) WT/DS8/AB/R, WT/DS10/AB/R, WT/DS11/AB/R [hereinafter *Japan - Alcoholic Beverages II*] 16.

1027 Appellate Body Report, *Korea - Measures Affecting Imports of Fresh, Chilled and Frozen Beef* (11 December 2000), WT/DS161/AB/R, WT/DS169/AB/R [hereinafter *Korea - Various Measures on Beef*] para 137.

1028 Appellate Body Report, *Japan – Taxes on Alcoholic Beverages II*, WT/DS8/AB/R, WT/DS10/AB/R, 16.

1029 Appellate Body Report, *European Communities - Measures Affecting Asbestos and Asbestos - Containing Products* (5 April 2001) WT/DS135/AB/R [hereinafter *EC - Asbestos*] para 98.

Sale of Cigarettes:

> '[T]he existence of a detrimental effect on a given imported product resulting from a measure does not necessarily imply that this measure accords less favorable treatment to imports if the detrimental effect is explained by factors or circumstances unrelated to the foreign origin of the product, such as the market share of the importer in this case.'[1030]

This interpretation is significant in the biofuels sustainability issue, because when enforcing sustainable standards and criteria in biofuel production, it is likely that the sustainability criteria will be a heavier burden for the exporting states, which are usually developing countries, compared for importing states.[1031] For example, according to the EU biofuel sustainability criteria in Article 17 of the RED, it is necessary to measure the entire life cycle of the biofuel. Exporting countries will face discriminatory treatment when compared to European countries,[1032] as biofuels extracted from raw material located on continental Europe will not have such an element on its energy efficiency calculation.[1033] In this regard, biofuels produced in developing countries will be at a disadvantage to competitors. Therefore, EU sustainable biofuel criteria may be *de facto* discriminatory against some biofuels from developing countries, and as a result of that, in violation of the non-discrimination principles according to the GATT Article III.

[1030] Appellate Body Report, *Dominican Republic - Import and Sale of Cigarettes* (25 April 2005) WT/DS302/AB/R, para 96.

[1031] Van den Bossche (n 1008) 71-72.

[1032] See, Section 3.3.4.3.

[1033] Vinicius Diniz Vizzotto, 'Sustainability Criteria for Biofuels in European Union (Directives 28/2009 and 30/2009): Incentive to Sustainable Development or Violation to WTO Agreements?' (Revista de Direito Empresarial Nº 39 –Secao Especial –Doutrina Estrangeira 2014) 221 <http://ssrn.com/abstract=2515320> accessed 11January 2015.

5.3.2.3 'Process versus Product' and 'Like Products'

As previously demonstrated, there is a significant controversy in the application of Article I and III of the GATT relating to the interpretation of 'like products'. According to the non-discrimination obligations in Articles I and III, 'like products' are not allowed to be treated differently. In other words, it is only between 'like products' that the MFN treatment and national treatment obligations apply. Products that are not 'like' may be treated differently. The concept of 'like products' plays a very important role in the GATT regulations. However, the concept of 'like products' is neither defined in the GATT 1994, nor has it been authoritatively interpreted by the WTO member countries. Instead, the Appellate Body indicated that the concept of 'like products' has different meanings in the different contexts in which it is used. Its meaning is being clarified and evolving through the practice of the Panels and of the Appellate Body. The scope of 'like products' could be different in the different contexts. The Appellate Body states in *Japan – Alcoholic Beverages II*:

> The accordion of 'likeness' stretches and squeezes in different places as different provisions of the WTO Agreement are applied. The width of the accordion in any one of those places must be determined by the particular provision in which the term 'like' is encountered as well as by the context and the circumstances that prevail in any given case to which that provision may apply.[1034]

There are a considerable number of GATT dispute settlement reports that shed light on the meaning of the concept of 'like products' in Article I and Article III. The meaning of 'like products' was addressed in *Spain-Tariff Treatment of Unroasted Coffee*.[1035] In this case, Spain had introduced different levels of tariff rates between different kinds of

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[1034] Appellate Body Report, *Japan - Alcoholic Beverages II*, 114.

[1035] *Spain - Tariff Treatment of Unroasted Coffee* (11 June 1981) GATT BISD L/5135 - 28S/102 [hereinafter *Spanish Coffee*].

unroasted, non-decaffeinated coffee beans. For ‘Colombia mild’ and ‘other mild’ coffee, Spain applied zero customs duties on them; while for ‘unwashed Arabica’, ‘Robusta’ and ‘other’ coffee, it imposed a 7% customs duty. Brazil, which exported mainly ‘unwashed Arabica’ to Spain, complained that Spain’s tariff policy violated Article I (1) by treating ‘like products’ differently.[1036] Spain argued that the application of various tariff rates on different coffee beans was not a violation of the MFN clause under Article I (1) since the different kinds of coffee beans were cultivated with different methods.[1037] It seems that Spain is trying to imply that if coffee beans were cultivated with different methods, then they are different coffee products. Therefore, in this case, the central dispute is: whether the various types of unroasted non-decaffeinated coffee were ‘like products’ to which the MFN treatment obligation applied.[1038] In other words, whether the processes or production methods (‘PPMs’) by which products are produced are relevant in determining whether those products are ‘like products’. After careful consideration of four criteria, the GATT Panel sided with Brazil, concluding that all six types of unroasted coffee beans were ‘like products’.

The four criteria in analysing ‘likeness’ are as following:

1. Sharing physical properties, nature or quality;
2. Serving the same or similar uses;
3. Whether consumers perceive or treat the products as serving the same or similar end uses;
4. Sharing the same international tariff classification.

These general criteria provide a framework for analysing the ‘likeness’ of particular products, although it is worth noting that, the criteria above are ‘simply tools to assist

[1036] Ibid.

[1037] Ibid, 3.6 - 3.7.

[1038] Ibid, 3.1 - 3.2.

in the task of sorting and examining the relevant evidence'. They are 'neither a treaty-mandated nor a closed list of criteria that will determine the legal characterization of products'.[1039] Among these 4 criteria, criteria 1, 2 and 4 are clearly satisfied, and it is the third criterion 'whether consumers perceive or treat the products as serving the same or similar end uses' which will form part of the central discussion. The Panel in the *Spain Coffee* case pointed out that, discrimination (differentiated tariff rates) based on production methods was unjustified because the variously produced coffee beans were blended together before being sold to end-users.[1040]

According to this decision, it seems that such non-product-related PPMs are not relevant to determining the 'likeness' of products, as they do not affect the physical characteristics of the products. In *US-Tuna I*, a similar conclusion could also be made. The Panel argued that like products should be defined only by the products themselves, not by PPMs. It is also argued that if PPM does not affect the physical characteristics, it is a 'non-product-related process and production method', in that the relevant products cannot be treated differently.[1041] Therefore, it seems that, according to both cases of *Spain Coffee* and *US-Tuna I*, nothing supports a definition of production likeness based on PPMs.

When we keep this conclusion in mind and come back to the case of biofuels, it is clear that the real issue is whether sustainable biofuels and non-sustainable biofuels are not 'like products' because of the different PPMs. More specifically, the issue is whether products are 'like' if the PPM does not affect the physical characteristics of the product.[1042] If the conclusion above can apply to the sustainable biofuels issue, then it

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[1039] Appellate Body Report, *EC - Asbestos*, 102.

[1040] *Spanish Coffee*, 4.6 - 4.7.

[1041] Panel Report, *United States - Restrictions on Imports of Tuna* (16 June 1994) WT/DS29/R [hereinafter *US - Tuna I*]; Robert Ackrill and Adrian Kay, 'EU Biofuels Sustainability Standards and Certification Systems – How to Seek WTO-Compatibility' (2011) 62(3) Journal of Agricultural Economics 551, 556.

[1042] Van den Bossche (n 1008) XXXII.

is likely to be concluded that to distinguish biofuels produced using sustainable and unsustainable methods is discriminatory and would violate the GATT. However, if we examine it more closely, the conclusion may be not so absolute. In some contexts, it would not be correct to come to the conclusion above.

To begin with, it is worth noting that an important reason given by the Panel against Spain is that the Panel believed production methods in the *Spain Coffee* case were largely irrelevant, because 'ultimately the coffee beans produced by different methods were blended and therefore consumers could not distinguish between the different types of coffee beans'.[1043] It means that, the Panel did not find that discrimination based on production method was *per se* in violation of the MFN clause. The key reason for the Panel reaching this decision was that the production methods were not relevant in customers' consumption decisions. In essence, if consumers found production methods to be irrelevant in their decisions, then countries were unjustified in basing discriminatory measures on production methods. Therefore, consumer choice is a key factor in determining whether the tariff schedule that treats those coffee products in a different way would be prohibited under the GATT. If production methods are relevant to consumer choice, then differentiation based on production method might be permitted.

The detailed examination of this issue has been discussed by the Appellate Body in *EC-Asbestos*. In this case, the four criteria (physical properties, end-uses, consumers' preferences and tariff classification) of determining 'likeness' of products were also identified, and the third 'likeness' criterion, consumer preferences, were particularly examined.[1044] The central issue was to examine the 'likeness' of chrysotile asbestos

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[1043] *Spanish Coffee*, 3.12.

[1044] Bradly J Condon, 'Climate Change and Unresolved Issues in WTO Law' (2009) 12 Journal of International Economic Law 895, 906; Stephanie Swizer, 'International Trade Law and the Environment: Designing a Legal Framework to Curtail the Import of Unsustainably Produced Biofuels' (2007) 6 Journal of International Trade Law and Policy 30, 36.

fibres and PCG fibres.[1045] The Appellate Body in EC – Asbestos disagreed with the manner in which the Panel had examined the 'likeness' of the two kinds of fibres. It also did not agree with the Panel's refusal to consider the health risks posed by asbestos in the determination of 'likeness' because 'this criterion would not provide clear results'. Instead, the Appellate Body believed that an overall determination of whether the products at issue could be characterized as 'like' required, thus, that the evidence relating to each of those four criteria, alone with any other relevant evidence, should be examined and weighed. It states as following:

> …neither the text of Article III (4) nor the practice of panels and the Appellate Body suggest that any evidence should be excluded a priori from a panel's examination of 'likeness'. Moreover, as we have said, in examining the 'likeness' of products, panels must evaluate all of the relevant evidence. We are very much of the view that evidence relating to the health risks associated with a product may be pertinent in an examination of 'likeness' under Article III:4 of the GATT 1994.[1046]

Accordingly, the Appellate Body believed that the toxic nature of chrysotile asbestos fibres constituted a defining aspect of the physical properties of those fibres and was relevant to the examination of 'likeness' under Article III (4). It was because the toxic nature of chrysotile asbestos fibres generated health risks for the public and is 'relating to consumers' tastes and habits' when choosing between different products at issue.[1047] The Appellate Body ruled that the determination of whether products are 'like products' is 'fundamentally, a determination about the nature and extent of a competitive relationship between and among products'.[1048] Thus, it noted that 'Panels must examine fully the physical properties of products. In particular, Panels must examine

[1045] PCG fibres are polyvinyl alcohol (PVA), cellulose and glass fibres. *See*, Appellate Body Report, *EC - Asbestos*, 109.
[1046] Appellate Body Report, *EC – Asbestos*, 113.
[1047] Ibid, 114.
[1048] Ibid.

those physical properties of products that are likely to influence the competitive relationship between products in the marketplace'.[1049] Evidence relating to health risks may thus be relevant in assessing the competitive relationship in the marketplace between those 'like' products.[1050] Therefore, the Appellate Body realized that the process in which products are made can have an impact on consumers' tastes and preferences, and affect the competitive relationship in the market, and is relevant to determining the 'likeness' of products.

Therefore, as reflected above, the question of whether non-product-related PPMs may be of relevance in the determination of 'likeness' now requires a nuanced analysis case by case. Although in both the cases of *Spanish Coffe*e and *US - Tuna I*, the results were that the product methods were irrelevant to examining 'likeness' of products, it is too simple to be the end of the story. It should be noted that non-product-related PPMs may have an impact on consumer preferences and tastes, and thus on the nature and the extent of the competitive relationship between products. In this situation, the non-product-related PPMs would be a relevant element in the determination of 'likeness'. Moreover, some others argue that, the application of *Spanish Coffee* to sustainable biofuels may be limited. This is because although both the cases are about discrimination based on production method, the issue of sustainable biofuels is also about sustainable development and environmental preservation, whereas *Spanish Coffee* largely does not address this issue.[1051] Some scholars have concluded that: 'No consideration shall be given to the fact that it might have been produced by using renewable energy sources, or conversely by fossil fuel burning units.'[1052] The following analysis has been formulated in relation to the impact of *Spanish Coffee* on sustainable methods of biofuel production:

[1049] Ibid.

[1050] Ibid, 115.

[1051] Appellate Body Report, *EC – Asbestos*, 673.

[1052] Kuik (n 975) 202.

> While the principles set forth in *Spanish Coffee* appear to suggest that discriminating between biofuels produced using sustainable and unsustainable methods is prohibited under the GATT, the Panel's decision left some room to argue otherwise … consumer choice seems to be a relevant factor in determining whether a tariff schedule that treats seemingly like products differently violates the GATT. If production methods are relevant to consumer choice, then discrimination based on production method might be acceptable. In the case of biofuels, it may be important to consumers that biofuels are produced in a sustainable manner.[1053]

Accordingly, is it important for consumers that biofuels are produced in a 'sustainable method'? The issue of how to examine the consumers' tastes and habits might be difficult. As biofuels programs are largely derived by governments, it is hard to say it certainly does matter to consumers that biofuels are produced in a sustainable way.[1054] It is likely that the Panels and the Appellate Body will make different decisions case by case. In *EC – Asbestos*, the Panel declined to examine this criterion because they believed that 'this criterion would not provide clear results'. However, the Appellate Body disagreed with this opinion. The Appellate Body itself examined the health risk of the products and its impacts on consumers' preferences; and stated that 'the evidence was certainly far from sufficient to satisfy the complainant's burden'.[1055] It could be argued that in the *EC – Asbestos* ruling, the Appellate Body made a significant findings concerning evidence relating to the health risks associated with a product. It states that, '[w]e are very much of the view that evidence relating to the health risks associated with a product may be pertinent in an examination of 'likeness' under article III:4 of the GATT 1994'.

Establishing links between the 'likeness' of products and their respective impact on

[1053] Enrique Rene De Vera, 'The WTO and Biofuels: the Possibilities of Unilateral Sustainability Requirements' (2008) 8 The Chicago Journal of International Law 661, 672.

[1054] Julia Ya Qin, 'Defining Nondisimination under the Law of the World Trade Organization' (2005) 23 Boston University International Law Journal 215.

[1055] Appellate Body Report, *EC – Asbestos*, 141.

health has important implications for biofuel sustainability, because environmental protection and climate change mitigation are closely linked to public health. However, it can be found that the health risk issue and biofuel sustainability issue is different. The later one is more controversial as no universal/global standards are formulated yet. It is reasonable to argue that the toxic nature of chrysotile asbestos fibres will definitely effect consumers' choice and then change the competition relationship between products. However, in the context of sustainable biofuels, more efforts are needed to examine consumers' tastes and habits. It should take into consideration the general consumer perception of sustainable biofuels, which is likely to vary from one country to another. The variance will follow the different levels of national economic development, customs and priorities with respect to the environment and public health. The Netherlands biofuel sustainability scheme contains a wide range of labour, societal and environmental sustainable development requirements.[1056] This could make the scheme difficult to clarify whether it has a significant impact on general consumer preferences and tests. Moreover, it is worth noting that the issue of trade and labour standards has been with WTO since its birth. At the first WTO Ministerial Conference in Singapore in 1996, it was agreed that market access should not be likened with labour standards.[1057] On the contrary, the EU biofuel sustainability scheme focused only on the GHG emissions and the environmental aspects. This scheme might be easily argued that it is relevant to the consumers' choice, as it to a large extent reflects more general common interests. Therefore, from the attitude of the Appellate Body in the *EC – Asbestos* case, requirements of environmental protection and climate change for biofuel production might be used as elements to be taken into account when assessing 'likeness' of products, but it remains more uncertain about other societal requirements.

It still remains debatable whether non-product-related PPMs are relevant in determining whether products are 'like' under the WTO law. To decide the 'likeness' of sustainable

[1056] See, Section 3.3.4.1.

[1057] Zarrilli (n 688) 36.

biofuels and unsustainable biofuels, it will depend on whether, in a specific market, the sustainability of the biofuel production process has a significant impact on consumer preferences and tastes, and thus on the nature and the extent of the competitive relationship between differently produced biofuels.[1058] Therefore, the levels of requirements and specific standards and criteria could lead to different results.

This section reviewed the relevant GATT provisions to reveal that implementation of biofuel sustainability standards to ban imports of non-sustainable biofuels may generate conflicts under the WTO regime. In particular, it could conflict with the MFN clause in Article I of the GATT. Moreover, the sustainable certification scheme for biofuel production can impose a heavier burden on biofuels imported from the exporting country than on biofuels produced by the importing country. According to the relevant WTO case law, there is no evidence to support the proposition that sustainable biofuels and non-sustainable biofuels can legally be treated differently. Therefore, when a nation imposes sustainability criteria to ban the importation of biofuel products from another country, Article I and III of the GATT could be used as a legal basis to challenge it. Therefore, there is the possibility that measures to implement an import ban on non-sustainable biofuels could be challenged by another WTO Member before the WTO Panel was explored.[1059] This being the case, the next step will be to analyze whether the general exceptions of Article XX of the GATT could under specific conditions - justify such measures.

5.3.3 Legal Exceptions under Article XX of the GATT

After examining the likely conflicts between sustainable biofuel policy and Article I

[1058] Ibid, 64.

[1059] Gary P Sampson, *The WTO and Sustainable Development* (United Nations University Press, 2005) 84-85.

and III of the GATT, this section moves on to the key issue in this Chapter: the general legal exceptions under Article XX of the GATT. As discussed in the last section, both of the MFN clause in Article I and the National Treatment clause in Article III of the GATT could be referred to as a legal basis to challenge a different treatment for normal/unsustainable biofuel products from certified sustainable biofuel products. But if the measure could be located in any of the exceptions under Article XX of GATT, it may be justified and not violate WTO rules, even if it is inconsistent with Article I or Article III of the GATT. Therefore, besides Article I and III, Article XX is also an imperative article in need of being examined when analysing the WTO/GATT-consistency of biofuels certification on the basis of sustainability. Considering this provision is complex itself, and the strain of WTO jurisprudence towards sustainable biofuels is not clear, Article XX and the associated GATT case law will be extensively analysed below.

5.3.3.1 Objective and General Interpretation of Article XX of the GATT

As discussed in Chapter Three, sustainability is not an unfamiliar concept under the WTO framework. It is often stated by WTO leaders or its adjudicative bodies that sustainable development is an explicit goal of the WTO.[1060] The Preamble of the GATT explicitly states that an objective of the WTO is to:

> expand […] the production of and trade in goods and services, while allowing for the optimal use of the world's resources in accordance with the objective of sustainable development, seeking both to protect and preserve the environment and to enhance the means for doing so in

[1060] Pascal Lamy, 'Globalization and the Environment in a Reformed UN: Charting a Sustainable Development Path' (24th Session of the Governing Council/Global Ministerial Environment Forum, Nairobi, 5 Feburary 2007) 8; WTO, *Decision on Trade and Environment* (15 April 1994) WTO Doc No LT/UR/D-6/2 <https://www.wto.org/english/tratop_e/envir_e/issu5_e.htm> accessed 21 March 2012.

a manner consistent with their respective needs and concerns at different levels of economic development.[1061]

Moreover, Article XX of the GATT provides the most obvious textual hook for advocates of sustainable development. Article XX states, in the relevant part:

> Subject to the requirement that such measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade, nothing in this Agreement shall be construed to prevent the adoption or enforcement by any contracting party of measures: ...
>
> (b) necessary to protect human, animal or plant life or health;...
>
> …
>
> (g) relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption.[1062]

Accordingly, Article XX of the GATT leaves room for WTO Member States to be exempted from general GATT disciplines, in order to employ national/regional policy to protect non-trade concerned values. The content of Article XX is a list of specific exceptions to general GATT rules from (a) to (j), which is considered to be an exhaustive list of limitations.[1063] Among them, paragraphs (b) and (g) are fundamentally important and particularly relevant to biofuel sustainability issues, as they are concerned with sustainable development and permit measures that depart from core GATT rules for environmental protection purposes. Namely, WTO Members can

[1061] General Agreement on Tariffs and Trade 1947 (adopted 30 October 1947, entered into force 1 January 1948) 55 UNTS 194 [hereinafter GATT 1947].

[1062] Ibid, art XX.

[1063] GATT Panel Report, *United States-Section 337 of the Tariff Act of 1930* (7 November1989) GATT BISD L/6439 - 36S/345, para 5.10.

adopt biofuels sustainability policy which is inconsistent with general GATT disciplines if they can prove that it is for the purpose described under paragraph (b) or (g) of Article XX.

However, the listed exceptions are not allowed to be misused or abused. In order to prevent abuse of Article XX exceptions, the chapeau of Article XX states that measures taken under Article XX should 'not be applied in a manner which would constitute a means of arbitrary discrimination between countries where the same conditions prevail, or a disguised restriction on international trade'. In essence, the introductory clause functioned as a standard of non-discrimination, which prevents two types of discrimination: discrimination between the domestic (importing) and exporting countries; and discrimination between exporting countries.[1064]

Furthermore, it can be understood that as there is a restrained relationship between the chapeau and the listed exceptions of Article XX. The restriction is necessary as it helps to balance the rights of importing states and exporting states. In *US-Gasoline*, the Appellate Body emphasised that 'a balance between trade liberalization and other social values is considered more fitting'.[1065] With respect to the object and purpose of the chapeau of Article XX, the Appellate Body ruled:

> The chapeau by its express terms addresses, not so much the questioned measure or its specific contents as such, but rather the manner in which that measure is applied. It is, accordingly, important to underscore that the purpose and object of the introductory clauses of Article XX is generally the prevention of 'abuse of the exceptions of [what was later to become] Article XX.[1066]

1064 Appellate Body Report, *United States - Import Prohibition of Certain Shrimp and Shrimp Products* (12 October 1998) WT/DS58/AB/R [hereinafter *US - Shrimp*] para 157; Appellate Body Report, *United States - Standards for Reformulated and Conventional Gasoline* (20 May 1996) WT/DS2/AB/R [hereinafter *US - Gasoline*] 23-24.

1065 Appellate Body Report, *US - Gasoline*, 22.

1066 Ibid.

In response to this interpretation, it has been commented that '[t]he Appellate Body grasped the internal logic of Article XX that had eluded several panels of putting the chapeau to work to catch illegitimate attempts to misuse an environmental exception'.[1067] In the *US – Shrimp* case, the Appellate Body tried to maintain a balance between the right of a country to invoke an exception under the GATT Article XX and the substantive right of the other State under the GATT.[1068] The basis to find the balance is whether the invoked national/regional policy was consistent with the WTO rules, instead of the legitimacy of the policy itself.[1069]

At first glance, according to the GATT Article XX, an importing country requires other Members to comply with certain standards for sustainable development, if the situation is a type of measures that the exception (b) or (g) justified. Policies for promoting biofuels sustainability may be justified within this article because of their environmental sustainability considerations in terms of GHG emission reduction as well as alternative of fossil fuel resources. However, the challenge regarding biofuel production and trade is that the goal of producing sustainable biofuels is to protect interests *outside* the territorial jurisdiction of the importing state. In order to examine this problem, the limitation on the application of Article XX will be discussed in the following section.

5.3.3.2 Jurisdictional Limitation on the Application of Article XX of the GATT

To begin with, the GATT text itself does not explicitly regulate whether measures for

[1067] Donald M McRae, 'GATT Article XX and the WTO Appellate Body', in Marco Bronckers and Reinhard Quick (eds), *New Directions in International Economic Law Essays in Honour of John H Jackson* (Kluwer Law International 2000) 228-36.

[1068] Appellate Body Report, *US - Shrimp*, para 156**;** See also, Van den Bossche (n 1008) 120.

[1069] Sampson (n 1059) 83.

protecting a societal value or interest outside the territory of an importing country can be justified under Article XX. Neither the chapeau of Article XX nor the listed exception (b) or (g) include an explicit jurisdictional limitation. Moreover, in WTO case law, the Appellate Body has not yet ruled on this issue, or made any explicit statements on it. Consequently, the remaining question is whether there is an *implied* jurisdictional limitation on the exceptions under Article XX, which cannot be invoked to protect societal values or interests outside the territorial jurisdiction of the Member concerned.[1070]

In *US - Tuna I,* the US issued an import ban of tuna from other countries caught with nets that also catch and kill dolphins, and invoked Article XX (b) and (g) to justify the prohibition.[1071] The Panel, however, excluded from the scope of application of Article XX(b) and (g) all measures protecting human, animal or plant life or health, or relating to the conservation of exhaustible natural resources *outside* the jurisdiction of the country enacting the measures concerned. The Panel argued that if Article XX (b) or XX (g) could justify trade-restrictive measures for the protection of life or health or the conservation of exhaustible natural resources outside the jurisdiction of the country enacting the measures, that country could unilaterally determine the public health and environmental policies of other countries.[1072] The Panel in *US - Tuna II* confirmed that Article XX (b) and (g) cannot justify measures that pursue the protection of public health and environmental policy objectives *outside* the jurisdiction of the Member enacting the measure.[1073] Countries should not be allowed under Article XX to take trade-restrictive measures that would force other countries to change their domestic environmental policies.[1074]

1070 Van den Bossche (n 1008) 94.

1071 Panel Report, *US - Tuna I*.

1072 Ibid, paras 5.27 and 5.32

1073 Panel Report, *United States - Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products* (15 September 2011) WT/DS381/R [hereinafter *US - Tuna II*] paras 5.15-17, 5.20 and 5.31-33.

1074 Ibid.

In *US - Shrimp*, the Appellate Body noted that sea turtles migrate to waters subject to the jurisdiction of the US, and stated as following:

> Neither the appellant nor any of the appellees claims any rights of exclusive ownership over the sea turtles, at least not while they are swimming freely in their natural habitat -- the oceans. We do not pass upon the question of whether there is an implied jurisdictional limitation in Article XX (g), and if so, the nature or extent of that limitation. We note only that *in the specific circumstances of the case before us, there is a sufficient nexus* between the migratory and endangered marine populations involved and the United States for *the purposes of Article XX (g)*.[1075]

Accordingly, the Appellate Body in *US - Shrimp* explicitly refused to pass upon the question of whether there is an implied jurisdictional limitation in Article XX. Instead, it merely noted that in the specific circumstances of this case, there was a sufficient nexus between the migratory and endangered sea turtles and the US for the purposes of Article XX (g). It suggests that a 'sufficient nexus' between the protected interests expressed in the national measure and the territoriality of the import country is a necessary condition to invoke Article XX of the GATT. Furthermore, from this position, it has also been suggested that such a nexus definitely exists if the measures are designed for global concerns.

In addition, the jurisdiction limitation of Article XX needs also to be considered from the chapeau of this article. The chapeau of Article XX requires that of any measure is applied in a manner that constitutes 'arbitrary or unjustifiable discrimination', then it cannot fall within the paragraphs of Article XX. As the Appellate Body ruled in *US – Shrimp*, when a measure is applied without any regard for the difference in conditions between countries and in a rigid and inflexible manner, the application of the measure

[1075] Appellate Body Report, *US – Shrimp*, para 134 [emphasis added].

may constitute ‘arbitrary discrimination’ within the meaning of the chapeau of Article XX. Similarly, when applying the EU sustainability standards and criteria for biofuels in international trade, it seems that specific national conditions in developing countries need to be considered.

Moreover, the Appellate Body in *US – Shrimp* also addressed the question of whether the application of the measure at issue in this case constituted an ‘unjustifiable discrimination’ within the meaning of the chapeau. The Appellate Body found that for the protection of sea turtles, the US negotiated with some Members under a multilateral agreement: the Inter-American Convention for the Protection and Conservation of Sea Turtles; but never pursued negotiations with the complainants. The Appellate Body believed that the US behaviour is discriminatory and unjustifiable. Accordingly, in order to meet the requirement of the chapeau of Article XX, a Member needs to make serious efforts to negotiate a multilateral solution before resorting to unilateral measures in good faith. Failure to do so may lead to the conclusion that the discrimination is ‘unjustifiable’. Therefore, it can be argued that the attitude of the Appellate Body on the use of Article XX of the GATT 1994 for the protection of societal values outside the territorial jurisdiction of the Member taking the otherwise GATT-inconsistent measure is not supportive, or at least, it is very critical and prudent.

The question here is whether the sustainability criteria for biofuels will fall outside of the scope of Article XX because of its jurisdictional limitation. From the case of *US – Shrimp*, a nexus seems to exist if biofuel standards and criteria are designed for global concerns, such as GHG emissions or climate change; or transboundary concerns, such as air or water pollution across national boundary. In this case, Article XX of the GATT may be applied. On the contrary, the nexus may not exist if the measures aim to protect purely national interests, such as national or local environmental protection, or local economic prosperity.[1076] Then the jurisdictional application of Article XX will

[1076] Peter Van den Bossche and Werner Zdouc, *The Law and Policy of the World Trade Organization* probably exclude the situation from its scope. Therefore, it seems that the sustainable criteria focus on global environmental interests, such as ensuring that biofuels contribute to GHG emission reduction, are likely to fall within the jurisdiction of Article XX. On the contrary, the standard system which contains not only environmental concerns but also a broad range of social and economic considerations might be challenged as inconsistent with the WTO regulations, as in most of cases, socio-economic issues need to be investigated and addressed carefully within the different contexts of local conditions. However, there is still large uncertainty remains on this issue. Some local-content based biofuel policies may be considered as having more broad implications which may have far reaching consequences outside of the particular jurisdiction. For example, the protection of certain endangered species which only live in a particular location are likely to be considered to have an effect on the global common good.[1077] It is hard to reach a conclusion on whether national measures aiming to protect local biodiversity have a substantial implication on the environment outside of the jurisdiction.

5.3.3.3 Application of Article XX of the GATT to a Measure Banning the Import of Non-sustainable Biofuels

5.3.3.3.1 Introduction to the 'two-tier test' of Article XX

When narrowing down to the issue of biofuels sustainability, the most relevant part of the GATT 1994 are the exceptions of Article XX(b) and (g) paragraphs. The Member who invokes these two exceptions need to prove that a national policy or measure involved is in the scope of Article XX. To determine whether such an otherwise GATT-

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(3rd edn, CUP 2013) 96.

[1077] Marie-Eve Rancourt, 'Promoting Sustainable Biofuels under the WTO Legal Regime' (2009) 5 McGill International Journal of Sustainable Development Law and Policy 98.

inconsistent policy or measure is justified, in *US-Gasoline*, the Appellate Body set out a 'two-tier test' in the following passage:

> In order that the justifying protection of Article XX may be extended to it, the measure at issue must not only come under one or another of the particular exceptions – paragraphs (a) to (j) – listed under Article XX; it must also satisfy the requirements imposed by the opening clauses of Article XX. The analysis is, in other words, two-tiered: first, provisional justification by reason of characterization of the measure under Article XX(g); second, further appraisal of the same measure under the introductory clauses of Article XX.[1078]

Accordingly, in order to be justified under Article XX, a GATT-inconsistent measure must meet two kinds of requirements: first, the requirements of one of the exceptions listed in paragraphs (a) to (j) of Article XX, and second, the requirements of the chapeau which is about prohibition of unjustifiable discrimination or a disguised restriction on international trade.[1079] The following paragraphs will therefore first discuss the specific exceptions (b) and (g) and their requirements provided for in Article XX before analysing the requirements of the chapeau of Article XX.

5.3.3.3.2 Application of Article XX (b) and Interpretation of 'Necessary'

Article XX (b) concerns exceptions that are 'necessary to protect human, animal or plant life or health'. In *US-Gasoline*, the Panel established two elements that need to be followed by the Member States if they invoke the exceptions under Article XX (b):
(1) that the policy in respect of the measures for which the provision was invoked fell within the range of policies designed to *protect human, animal or plant life or health*;
(2) that the inconsistent measures for which the exception was being invoked were

[1078] Appellate Body Report, *US - Gasoline*, 22.
[1079] Charnovitz (n 990) 696.

necessary to fulfill the policy objective.[1080]

To begin with, concerning the initial element, it is not difficult to satisfy and has not given rise to many interpretative problems. As Article XX (b) covers measures for the protection of 'human, animal or plant life or health', it covers public health policy measures as well as environmental policy measures. In *US-Gasoline,* the Panel recognized that 'air pollution, in particular ground-level ozone and toxic substances, presented the requisite health risks to humans, animals and plants'.[1081] Therefore, it can be argued that in environmental sustainability scheme of biofuel production covers environmental policy measures, which contribute to GHG emission reduction and climate change mitigation, and therefore contribute to reducing health risks to humans, animals and plants. Moreover, considering the affects of sustainable biofuel production on biodiversity of local society, it is consistent with the objective of animal and plant protection. In addition, concerning the societal sustainable criteria, sustainable biofuels need to pursue a balance between food and energy, which is also a protection of the human right. Therefore, sustainable biofuel measures certainly can be considered to be measures designed for the protection of 'human, animal or plant life or health', and come into the scope of policy aims described in Article XX(b)(1).

The second element, 'necessity', is central to the controversy of applying Article XX (b). In *US-Gasoline*, the Panel made an important clarification as to the requirement of 'necessity' under Article XX (b): it is not the necessity of the policy objective but the necessity of the disputed measure to achieve that objective which is at issue. The Panel stated:

> [I]t was not the necessity of the policy goal that was to be examined, but whether or not it was

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1080 Appellate Body Report, *US - Gasoline*, para 6.20 [emphasis added].

1081 Appellate Body Report, *EC-Asbestos,* para 172. The challenge of adjudicating disputes relating to Article XX(b) is not identifying measures that actually fit in the category, but showing that the contested measure qualifies as 'necessary', which is relevant to the second element.

> necessary that imported gasoline be effectively prevented from benefiting from as favorable sales conditions as were afforded by an individual baseline tied to the producer of a product. It was the task of the Panel to address whether these inconsistent measures were necessary to achieve the policy goal under Article XX (b). It was therefore not the task of the Panel to examine the necessity of the environmental objectives of the Gasoline Rule, or of parts of the Rule that the Panel did not specifically find to be inconsistent with the General Agreement.[1082]

Moreover, it also reviewed the part of *Thailand-Cigarette*: addressing whether Thailand's import prohibition on cigarettes (which was inconsistent with Article XI of the GATT 1947) was justified under Article XX (b). The Panel in *Thailand-Cigarette* ruled as follows:

> That this provision clearly allowed contracting parties to give priority to human health over trade liberalization; however, for a measure to be covered by Article XX (b) it had to be 'necessary'.
>
> The Panel concluded… that the import restrictions imposed by Thailand could be considered to be 'necessary' in terms of Article XX (b) only if there were no alternative measure consistent with the General Agreement, or less inconsistent with it, which Thailand could reasonably be expected to employ to achieve its health policy objectives.[1083]

The Panel came to the conclusion that there were in fact various measures consistent with the GATT which were reasonably available to Thailand to control the quality and quantity of cigarettes smoked and which, taken together, could achieve the health policy goals pursued by the Thai government.[1084] The import restrictions on cigarettes were therefore not 'necessary' within the meaning of Article XX (b). Accordingly, the Panel in *Thailand - Cigarette* held that a measure cannot be considered 'necessary' if an alternative measure which is not inconsistent with GATT provisions or is less

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[1082] Panel Report, *US - Gasoline*, para 6.22.

[1083] Panel Report, *Thailand - Restrictions on Importation of and Internal Taxes on Cigarettes* (5 October 1990) WTO Doc. BISD 37S/200 [hereinafter *Thailand – Cigarettes*] paras 73, 75.

[1084] Ibid, 81.

inconsistent with them is available and could reasonably be expected to be used.[1085]

Furthermore, the Appellate Body of *EC - Asbestos* clarified the meaning of 'necessary' formulated in *US - Gasoline* and *Thailand – Cigarette*. It framed the issue as 'whether there is an alternative measure that would achieve the same end and that is less restrictive of trade than a prohibition'.[1086] In particular, the Appellate Body indicated in *US - Gambling* that the 'necessary standard is to be judged in every case through a process of weighing and balancing a series of factors'.[1087] It stated that the factors are open-ended, but that they should include: (i) the relative importance of the common interests or value pursued by the measure; (ii) the contribution made by the measure to the realization of the ends pursued by it; and (iii) the restrictive impact of the measure on international commerce.[1088] Therefore, the defending State bears the heavy burden of putting forward evidence to show that the measure involved is necessary without any alternative, or even in light of an alternative, but the proposed alternative is not 'reasonably available'.[1089] The determination of whether it is 'reasonably available' depends on the alternative contributions to the realization of the end pursued.[1090]

For sustainable biofuels, as noted in *US-Gasoline,* the requirement of 'necessity' under Article XX(b) does not refer to the necessity of the policy objective， such as the reduction of GHG emissions, or the conservation of biodiversity, but to the necessity of using the disputed measure to achieve the objectives. In *EC-Asbestos,* this requirement has been translated into 'whether there is an alternative measure that would achieve the same end and that is less restrictive of trade than a prohibition'. In this regard, it can be argued by other Member States that the restriction measures of non-sustainable biofuels

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[1085] Ibid, 75, cited in *US - Gasoline*, para 6.24.

[1086] Appellate Body Report, *EC-Asbestos*, para 172.

[1087] Appellate Body Report, *United States - Measures Affecting the Cross-Border Supply of Gambling and Betting Services* (7 April 2005) WTO Doc. WT/DS285/AB/R, paras 306, 309, 310 and 323.

[1088] Ibid.

[1089] Ibid, para 311.

[1090] Appellate Body Report, *EC-Asbestos*, para. 172.

are not ‘necessary’, as there are other measures available which can achieve the same end and are less restrictive, such as preferential customs duties for products produced consistently with selected sustainability criteria, country-specific customs duties for imports from countries that have national legislation related to established sustainability criteria, or tax reductions. Indeed, it may argue that a ban on non-sustainable biofuels is probably the more trade-restrictive solution.

5.3.3.3.3 Application of Article XX (g) and the *US-Shrimp*

In *US-Shrimp*, India, Malaysia, Pakistan and Thailand jointly brought a case against the US concerning a ban on the importation of certain shrimp products where shrimps were not caught using specified fishing methods to avoid the killing of sea turtles. The US ban was adopted pursuant to Section 609 of Public Law 101-162 (Section 609).[1091] The US defended that the measures it took as consistent with both the MFN clause and the national treatment requirements of GATT, and could be justified under the exceptions of Article XX (b) and (g). Moreover, it added that the restrictions included in the importation ban were implementing the objectives of a MEA: the United Nations Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).[1092] The US gave more reasons to prove the importation ban should be justified. The US argued that Section 609 came within Article XX of the GATT, as it met all the requirements of the chapeau of Article XX and the paragraph (g) and (b). The US provided a detailed explanation of why Section 609 met every requirement in Article XX (g).

[1091] Endangered Species Act 609, Public Law 101-162; 16 U.S.C. §1537 (1989). This Act calls for negotiations for the development of bilateral or multilateral agreements for the protection and conservation of sea turtles, in particular with foreign governments engaged in commercial fishing operations likely to adversely affect sea turtles.

[1092] United Nations Convention on International Trade in Endangered Species of Wild Fauna and Flora (signed 3 March 1973) 993 UNTS 243.

Article XX (g) sets out a three-tier test requiring that:

(1) The policy objective pursued by the measures at issue be the *conservation of exhaustible natural resources*;
(2) The measures at issue *related to* the conservation of exhaustible natural resources; and
(3) The measures are *made effective in conjunction with restrictions on domestic production or consumption*.

In order to decide whether the measures employed in *US - Shrimp* came within the scope of the exception under the Article XX (g), the three requirements need to be examined one by one. With respect to the first element of the test, namely, the measure must related to the 'conservation of exhaustible natural resources', the US argued that sea turtles are exhaustible natural resources, because they are endangered species classified under CITES.[1093] While the complainants had taken the position that Article XX (g) was limited to the conservation of mineral or non-living natural resources. They argued that living natural resources are renewable and cannot be exhaustible natural resources. The Appellate Body stated:

> We do not believe that 'exhaustible' natural resources and 'renewable' natural resources are mutually exclusive…'renewable', are in certain circumstances indeed susceptible of depletion, exhaustion and extinction, frequently because of human activities. Living resources are just as 'finite' as petroleum, iron ore and other non-living resources.[1094]

The Appellate Body, in *US – Shrimp*, thus adopted a broad, 'evolutionary' interpretation of the concept of 'exhaustible natural resources'. It concluded that, 'measures to conserve exhaustible natural resources, whether living or non-living, may fall within

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1093 Ibid.

1094 Appellate Body Report, *US-Shrimp*, para 128.

Article XX (g)'.[1095] Accordingly, in *US – Shrimp*, sea turtles are 'exhaustible natural resources' and the first requirement is satisfied. When transposing the first requirement test to the core question of biofuels, the defending WTO Member could demonstrate that an import ban on non-sustainable biofuels as a measure is concerned with the 'conservation of exhaustible natural resources' within the meaning of Article XX (g). Considering the impacts of non-sustainable biofuels on the environment, the defending WTO Member could argue that the measure aims to achieve a reduction in GHG emissions to implement the objective of MEAs, such as the UNFCCC and the Kyoto Protocol. Moreover, it also can argue that the preservation of biodiversity is related to the goal of conserving exhaustible natural resources, enshrined in the CBD.

Secondly, with respect to the second element of the test under Article XX (g), namely, the measure must be a measure 'relating to' the conservation of exhaustible natural resources, the US argued that a 'substantial relationship' exists between Section 609 and the conservation of sea turtles, as it required other countries to use an effective tool, namely, the Turtle Excluder Devices, for the preservation of the sea turtle.[1096] When examining this requirement, it is important to understand the meaning of 'relating to'.

Article XX (g) does not state how the trade measures are to be related to the conservation of exhaustible natural resources. This raises the question of whether any relationship with conservation is sufficient for a trade measure to fall under Article XX (g) or a particular relationship is required.[1097] It is worth noting that some of the subparagraphs of Article XX, such as (a), (b), (d), (j), state that the measure must be 'necessary' or 'essential' to the achievement of the policy purpose set out in the provision, while Article XX (g) uses a different expression, it merely requires measures 'relating to' the conservation.[1098] In *Canada – Herring and Salmon*, the GATT Panel

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[1095] Ibid, para 131.

[1096] Ibid, *US - Shrimp*, paras 25-26.

[1097] GATT Panel Report, *Canada - Herring and Salmon*, paras 4.5-4.6.

[1098] Ibid.

observed that: 'Article XX (g) does not only cover measures that are necessary or essential for the conservation of exhaustible natural resources but a wider range of measures.' It concluded that: 'While a trade measure did not have to be necessary or essential to the conservation of exhaustible natural resources, it had to be primarily aimed at the conservation of an exhaustible natural resource to be considered as "relating to" conservation within the meaning of Article XX (g).'[1099] In *US – Gasoline*, the Appellate Body accepted this interpretation of 'relating to conservation' as meaning 'primarily aimed at conservation'. The Appellate Body stated that 'a measure must be 'primarily aimed at' the conservation of exhaustible natural resources in order to fall within the scope of Article XX (g)'.[1100]

In *US - Shrimp*, the Appellate Body further clarified its understanding of the concept of 'relating to' the conservation of exhaustible natural resources. It explained that '[i]n making this determination, the treaty interpreter essentially looks into the relationship between the measure at stake and the legitimate policy of conserving exhaustible natural resources.'[1101] The Appellate Body stated that: 'The means and ends relationship between Section 609 and the legitimate policy of conserving an exhaustible, and, in fact, endangered species, is observably a close and real one.'[1102] Therefore, Article XX (g) requires a 'close and real relationship' between the measure and the policy objective. The measures employed must thus be 'reasonably related' to the end pursued, which is the conservation of an exhaustible natural resource under Article XX (g). However, as regards the biofuels issue, it may be difficult to establish that a restrictive measure based on biofuel sustainability standards is a reasonable means to the end pursued, which is conservation of exhaustible natural resources. It is because there is too much uncertainty, for example, with regard to climate change, the reduction of GHG emissions will depend on the type of land converted to the production of non-

1099 Ibid.

1100 Appellate Body Report, *US - Gasoline*, 18-19.

1101 Appellate Body Report, *US - Shrimp*, paras 135 and 137.

1102 Ibid, para 141.

sustainable biofuels, and as discussed in Chapter Three, emissions from land use change are very difficult to quantify.[1103]

The third requirement under the Article XX (g), namely, 'made effective in conjunction with restrictions on domestic production or consumption', was interpreted by the Appellate Body in *US - Gasoline* as an 'even-handed measure'. Referring to *US - Gasoline,* the Appellate Body stated:

> [W]e believe that the clause 'if such measures are made effective in conjunction with restrictions on domestic product or consumption' is appropriately read as a requirement that the measures concerned impose restrictions, not just in respect of imported gasoline but also with respect to domestic gasoline. The clause is a requirement of even-handedness in the imposition of restrictions, in the name of conservation, upon the production or consumption of exhaustible natural resources.[1104]

Accordingly, Article XX (g) does not require imported and domestic products to be treated equally or identically, it merely requires that they are treated in an 'even-handed' manner. If the requirement of 'even-handedness' is not met, it is also doubtful whether the measure at issue meets the 'primarily aimed at…' requirement of the second element of the Article XX (g).[1105] In *US – Gasoline,* the Appellate Body stated:

> If no restrictions on domestically-produced like products are imposed at all, and all limitations are placed upon imported products alone, the measure cannot be accepted as primarily or even substantially designed for implementing conservationist goals. The measure would simply be naked discrimination for protecting locally-produced goods.

[1103] Searchinger (n 533) 5867.
[1104] Appellate Body Report, *US - Gasoline*, 20 -1.
[1105] GATT Panel Report, *Canada - Measures Affecting Exports of Unprocessed Herring and Salmon* (22 March 1988) GATT BISD L/6268 - 35S/98, para 4.7.

In *US – Shrimp*, the Appellate Body showed that the import ban at issue met the 'even-handedness' requirement of the third element of the Article XX (g) test, because these measures were also imposed restrictions on domestic production. From the Appellate Body's interpretations, it seems that the requirement of the third element under the Article XX (g) is not a challenge to be satisfied. In the case of biofuels, it should not be difficult to prove that both domestic and imported biofuel products have to be treated identically under a biofuel sustainability scheme. The only thing need to be proved might be that the implementation of biofuels sustainability criteria at the domestic level is fully effective.

Therefore, after examining the three requirements of Article XX (g), the Appellate Body found that the measures employed in *US-Shrimp* came within the scope of the exception under the Article XX(g). However, the next step according to the two-tier analysis is to examine whether it also met the requirements of the chapeau of Article XX. In order to do so, the Appellate Body first examined the ordinary meaning of the chapeau's words.[1106]

5.3.3.3.4 Application of the Chapeau of Article XX and the *US-Shrimp*

For a measure to be justified under Article XX, the application of the policy or measure at issue, pursuant to the chapeau of Article XX, should not constitute 'arbitrary or unjustifiable discrimination between countries where the same conditions prevail'. As discussed before, the requirements of the chapeau embody the non-discrimination principle in Article XX. It requires maintaining a balance between the rights and obligations among the Members. On the one hand, it delivers a right to invoke an exception of Article XX. On the other hand, it requires every Member to respect the

[1106] Appellate Body Report, *US-Shrimp*, paras 148-150.

substantive rights of the other Members.[1107] The Appellate Body in *US-Shrimp* recognizes that the exceptions under Article XX are limited and conditioned on the substantive obligations contained in other provisions of the GATT. It held that the chapeau contains two prohibitions: (1) an arbitrary or unjustifiable discrimination between countries where the same condition prevails; (2) a disguised restriction on international trade.

To begin with, in *US – Gasoline*, the Appellate Body addressed the meaning of the words 'discrimination between countries where the same conditions prevail'. The Appellate Body stated:

> The provisions of the chapeau cannot logically refer to the same standard(s) by which a violation of a substantive rule has been determined to have occurred. To proceed down that path would be both to empty the chapeau of its contents and to deprive the exceptions in paragraphs (a) to (j) of meaning. Such resource would also confuse the question of whether inconsistency with a substantive rule existed, with the further and separate question arising under the chapeau of Article XX as to whether that inconsistency was nevertheless justified.[1108]

Accordingly, the chapeau of Article XX does not prohibit discrimination *per se*, but rather, 'arbitrary and unjustifiable discrimination'. Moreover, the Appellate Body also stated that these words refer not only to discrimination between exporting countries where the same conditions prevail, but also to discrimination between an importing country and an exporting country where the same conditions prevail.[1109] Finally in this case, the Appellate Body found that the measure at issue, though provisionally justified, constituted 'unjustifiable discrimination' because the discrimination resulting from the measure at issue 'must have been foreseen', which means that, it was deliberate.[1110]

[1107] Ibid, 156.

[1108] Appellate Body Report, *US - Gasoline*, 23.

[1109] Ibid.

[1110] For reasons given by the Appellate Body in this case, see ibid, 28-29.

In *US-Shrimp*, when the Appellate Body examined if Section 609 was consistent with the chapeau, it recognized that:

> [I]t is not acceptable, in international trade relations, for one WTO Member to use an economic embargo to require other Members to adopt essentially the same comprehensive regulatory program, to achieve a certain policy goal, as that in force within the Member's territory, without taking into consideration different conditions which may occur in the territories of those other Members.
>
> We believe that discrimination results not only when countries in which the same conditions prevail are differently treated, but also when the application of the measure at issue does not allow for any inquiry into the appropriateness of the regulatory program for the conditions prevailing in those exporting countries.[1111]

Based on the opinions above, the Appellate Body believed that the certification based on Section 609 constituted a means of 'arbitrary discrimination' within the meaning of the chapeau, because the certification is applied without any regard for the difference in conditions between countries and this measure is applied in a rigid and inflexible manner.[1112] It did not provide opportunity for an applicant country to be heard before the decision to grant or deny certification was made. It also did not allow for review of a denial of application based on the principles of basic fairness and due process.[1113]

Moreover, the Appellate Body in *US – Shrimp* also recognized that '[e]nvironmental measures addressing trans-boundary or global environmental problems should, as far as possible, be based on an international consensus'. However, the US only negotiated with selective shrimp-exporting Members. Therefore, the Appellate Body believed

[1111] Ibid, 164-65.
[1112] Ibid, 164, 165 and 177.
[1113] Ibid, 177-80.

'[t]he effect is plainly discriminatory and, in our view, unjustifiable'. It criticized the US for not widely attempting to conclude a multilateral agreement with other shrimp-exporting countries prior to the enforcement of the importation ban. In this regard, it is reasonable to argue that a WTO panel would likely require an importing state to consult other countries before implementing trade restrictions on non-sustainable biofuels, and put it as a condition to invoke the exceptions of Article XX. The Appellate Body added that the unilateral application of the certification system under Section 609 'heightens the disruptive and discriminatory influence of the import prohibition and underscores its unjustifiability'.[1114]

Furthermore, in *US-Shrimp,* the Panel ruled that Article XX could not justify measures that 'undermine the WTO multilateral trading system'[1115], 'trade concerns must prevail over all other concerns in all situations arising under GATT rules. The very language of Article XX indicates that the state interests protected in that article are, in a sense, "pre-eminent" to the GATT's goals of promoting market access'.[1116] A measure that 'condition[ed] access to its market for a given product upon the adoption by the exporting Member of certain policies' would undermine the multilateral trading system.[1117] According to the Panel in *US - Shrimp*, pursuant to the chapeau of Article XX, Article XX could not justify measures that oblige exporting countries to change certain domestic policies and make them compliant with the policies of the importing country. Therefore, the Panel reported that the importation ban on shrimp and shrimp products applied by the US in Section 609 could not be justified under Article XX.[1118]

The US argued that there was not any precedent to interpret the chapeau of Article XX as it required an assessment of whether a measure constituted a threat to the multilateral

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[1114] Appellate Body Report, *US - Shrimp,* para 172.

[1115] Panel Report, *US - Shrimp*, 7.44.

[1116] Ibid, 16.

[1117] Ibid, 7.45.

[1118] Lowenfeld (n 979) 395.

trading system. Furthermore, the interpretation was not reasonable, because it 'would impermissibly diminish the rights that WTO Members reserved under Article XX'.[1119] The Joint Appellees argued against the view above, stating that: 'If every WTO Member were free to pursue its own trade policy solutions to what it perceives to be environmental concerns, the multilateral trade system would cease to exist.'[1120] Moreover, considering the purpose and goals of Article XX, the chapeau should be used to protect against threats to the multilateral trading system.[1121]

Regarding the sustainable biofuels case, if the sustainability criteria could be justified under the paragraph (g) of Article XX, then it would need to be examined under the requirements contained in the chapeau of Article XX. According to the interpretation of the chapeau given by the Appellate Body in *US-Shrimp*, biofuels sustainability criteria could constitute arbitrary discrimination if they posed an obstacle to market access for biofuels produced in other countries. Although the importing country can require other countries to adopt similar measures in terms of their effects on the environment, even outside of the importing country's jurisdiction, it does not mean that the measures taken by the exporting country need to be exactly the same. In other words, flexibility should exist, and various situations in different countries need to be considered when implementing the biofuels sustainability policy in practice. In order to not constitute arbitrary discrimination, the application of measures which give effect to the biofuels sustainability criteria need to be flexible enough to make the market accessible in the course of the certification procedure, and allow 'a program for sustainable production of biofuels comparable in effectiveness' adopted by the exporting country.[1122]

As suggested in *US-Shrimp,* unilateral sustainability requirements for biofuels would

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[1119] Panel Report, *US - Shrimp*, para 10-11.

[1120] Ibid, para 35.

[1121] Ibid.

[1122] Van den Bossche (n 1008)127.

likely constitute 'unjustifiable discrimination' under the interpretation of the chapeau of Article XX, if the application of these measures would make market access for biomass conditional upon the adoption by the exporting country of essentially the same sustainability criteria for the production of biomass; or if the importing country did not negotiate with the relevant Member States before the effective implementation of the sustainability criteria.

All in all, the Appellate Body in *US - Shrimp* held that the measures contained in Section 609 was a means of 'unjustifiable and arbitrary discrimination' the measure therefore lacked the justifying protection of Article XX.[1123] The Appellate Body believed that it was not necessary to examine whether the US measures were applied in a manner that constituted a 'disguised restriction' on international trade.[1124] However, aware of the impact of this result, the Appellate Body particularly clarified that the WTO system was not indifferent to environmental concerns, and emphasized that WTO Members were free to adopt their own policies aimed at protecting the environment as long as they fulfilled their obligations to respect the rights of other Members under the WTO Agreement.[1125]

Although the *US - Shrimp* case does not concern biofuels itself, at least the above review of the case could suggest that unilateral sustainability requirements for biofuels production may not be easy to implement in a way that could be justified under Article XX. In the *US - Shrimp*, the Appellate Body explicitly approves the use of unilateral trade restrictions, however, the conditions put on it were very strict, in that the circumstances in reality are quite limited.[1126] The Appellate Body required the WTO Member States to seek a multilateral negotiation among all the interested countries as

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[1123] Appellate Body Report, *US - Shrimp*, para 184.
[1124] Ibid.
[1125] Ibid, paras 185-86.
[1126] De Vera (n 1053) 674.

a precondition of any unilateral initiative.[1127] However, it must be determined to what extent a WTO Member must seek a multilateral solution to a problem before it can resort to unilateral measures. Unfortunately, the Appellate Body of *US - Shrimp* only simply stated the obligation as engaging with the exporting countries 'in serious, across-the-board negotiations with the objective of concluding bilateral or multilateral agreement'.[1128]

5.3.4 Conclusion

This part analysed whether unilateral measures/standards for biofuel sustainability can promote the sustainable development of the industry, while not conflicting with international trade regulations under the GATT/WTO legal regime, particularly, whether the measures could be justified under the general exceptions of Article XX of the GATT. At first glance, it may argue that the application of the Article XX's jurisdiction can be justified in relation to the biofuels issue. The defending WTO Member may be able to prove that the national enacted biofuel criteria and measures are consistent with the wording of Article XX (b) or (g). In other words, it is may not be difficult to demonstrate that these measures meet the legitimate policy of protecting human, animal or plant life or health, or conserving exhaustible natural resources, because biofuels can contribute to the net reduction of GHG emissions and can be used as alternatives to fossil fuels.

However, the chapeau of Article XX GATT was highlighted in the above analysis in order to demonstrate the limitation of misuse or abuse of Article XX. According to the ruling of the Appellate Body in *US-Shrimp*, WTO Members are free to adopt their own

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[1127] Geert van Calster, 'Faites vos jeux - Regulatory Autonomy and the World Trade Organisation after Brazil Tyres' 20 Journal of Environmental Law 132.

[1128] Appellate Body Report, *US - Shrimp*, para 166.

policies of environmental protection as long as they fulfill their obligations to respect the rights of other Members under the international trade regime contained in the WTO Agreement. The Appellate Body confirmed that, if one country uses strict national legislation or policy to prohibit the importation from other countries without any flexibility; or does not have any positive consultation in the trade process, or does not consider different circumstances in different countries; it is an inconsistency of the chapeau of Article XX of GATT. In fact, the Appellate Body made itself very clearly in this case. It states that if environmental measures are applied in trade practice in order to solve the problem of the environment internationally, then consideration should be given to international common interests to the greatest extent. Therefore, whether the Article XX could be invoked as a legal basis in the biofuel case depends on the measures themselves.

In conclusion, from the existing WTO cases, the Appellate Body clearly expressed its concerns about environmental protection. However, in most of the cases the Appellate Body did not show much preference to environmental protection when it conflicted with free trade interests. It seems not easy to properly implement the unilateral biofuel measures in respect of the chapeau of Article XX. Negotiations between importing and exporting countries should be conducted in good faith. Unfortunately, it may be difficult to conduct such negotiations in practice, because, as discussed in Chapter Three, there is a lack of globally accepted biofuel sustainability standards and criteria to guide them. Great uncertain remains in relation to science and technology in the biofuel field, such as the calculation of GHG emissions and the evolution of iLUC impacts, which leave room for debate between Members based on different scientific data or technology methodology.[1129] All in all, a unilateral import ban based on sustainability criteria for biofuels may be difficult, though still possible, to implement in a manner that can be justified under Article XX.

[1129] See, Section 3.3.3.

From the perspective of developing countries, especially those who aim to export their biofuel products to the EU and US markets, it is not bad news. As discussed in Chapter Three, the objectives of current biofuel sustainable schemes and other biofuel sustainability policies usually reflect developed nations' needs and preferences, and some of them may not be necessary or practicable for developing countries. The limitation imposed by the chapeau of Article XX may be invoked as a legal protection for developing countries arguing that, in some circumstances, these unilateral biofuel sustainable requirements represent non-trade barriers in the global biofuels market. However, what is worth keeping in mind is that there is no direct case law yet about biofuels related to this trade-environmental debate issue. To a large extent, the attitude of the WTO towards biofuel sustainability measures is uncertain.

Furthermore, this uncertainty means significant challenges and opportunities for developing country players in biofuels. Although the current robust EU and US biofuel policies may offer export opportunities for developing countries, particularly for the tropical countries who can produce biofuel products more efficiently, performance of developing countries in the international biofuel market to a great extent depends on the conditions that prevail on the major biofuel markets.[1130] This is largely because of the inherent inequities in the current international trading system and the inequitable power relationship between the North and South in virtually every geopolitical sphere. Concerns about the environmental impact of producing biofuels, and demands for securing food production all could be potential conditions of market protection preventing the world biofuels market from being on a level playing field. In addition, the current deadlocked situation of Doha Talks implicates the shape of world trade may change significantly to the future opportunity for developing countries' exporters of goods (and services). However, fortunately, these conditions for international trade are not yet fixed. As mentioned before, different approaches might be brought in a totally

[1130] See, Section 4.4.2.

new and unknown form of multilateralism after the end of Doha Round. Therefore, recognition of, and providing appropriate implementation strategies and instruments for, resolving the concerns of developing countries need to be highlighted in fostering global collaboration on biofuel sustainable development. Special emphasis should be put on issues of access, trade barriers and sustainability relevant for developing countries in the WTO negotiations.

5.4 Conclusion

In order to promote biofuel development in a sustainable manner, the historical gaps and conflicts between international trade and the environment has to be considered and integrated into a coherent sustainable development framework. However, understanding the impacts on sustainable development are complicated by the fact that many of the expected development gains associated with biofuels will depend on whether they can be traded internationally, as the most efficient producing countries are or will be developing countries, while the main international consumers are industrialised countries. Current trading conditions and the threat of protectionism could undermine developing countries' competitiveness, leading to inefficiency and negative outcomes of biofuel development in developing countries. Key issues to be addressed at the international level include tariff barriers, but especially the non-tariff barriers which are commonly represented as environmental and social standards, in many developed countries that block the way of developing countries for exporting.

Biofuel sustainability certification standards, which have been used widely in many EU countries, have significant meaning for biofuel production and development in a sustainable meaner. However, some of the proposed sustainability standards for biofuels are believed to be possibly used as barriers of free trade and violate WTO rules.[1131] Also, the EU talks about sustainable development with regard to itself,

[1131] van Dam, 'Overview of Recent Developments in Sustainable Biomass Certification' (n 645).

unlinking it from needs of developing countries as such and thus there are differing versions of what it means. As a major player in the WTO it is probably relevant to its interpretation and use. The sustainability standards from the developed world may not be suitable for developing countries.

From the GATT/WTO case law, it seems that overly stringent regulations are probably conflict with the WTO rules. However, as the development of international trade law and the principle of sustainable development, environmental concerns are becoming more and more important in the WTO framework. The Appellate Body also left room for domestic environmental regulations. Moreover, as there have not been any biofuel disputes under the WTO, the attitude of the WTO towards biofuel sustainability standards is fairly uncertain. From the negotiation history of the WTO, it seems that, though great efforts have been made, it has never really changed that developed countries hold the right to call. With this in mind, it seems that the unilateral EU sustainability standards for biofuels could, to some extent, be barriers to market access for developing country exporters.

Therefore, unilateral regulations on biofuel sustainability are likely to cause much conflict with the current WTO disciplines. It can argue that unilateral regulation on biofuels is a mere stop gap until international multilateral agreement is reached on the interaction between trade in biofuels and sustainable development. It is essential that developing countries participate actively and constructively in the negotiations related to biofuels for furthering their own interest. They cannot entirely rely on the best intentioned developed countries to do this for them, because developed countries will inevitably find themselves making compromises in favor of their own interests and in response to powerful pressures from their constituents. This research thus calls for more international efforts to build international legal structures and instruments to promote sustainable production of biofuels, while not conflicting with the WTO rules. For example, special and differential treatment provisions should be carefully considered as they have been at the forefront of the WTO's efforts to facilitate the integration of developing countries into the multilateral trading system.[1132]

Lastly, even if the above analysis in this chapter highlights any inconsistency of sustainability standards of biofuels and the WTO rules as the former contained discrimination measures, the EU sustainable biofuels scheme still has significant meaning for the development of biofuels production and trade, as addressed in Chapter Three. It could be expected that in the future, there will be an international organization to enact a general sustainable criteria scheme for biofuels development which could carefully consider the interests of developing countries, instead of different standards and principles according to different nations. Consequently, it would be much easier to attain consistency with the WTO legal regime.

[1132] One notable scheme might be relevant here is the generalized system of preferences (GSP), whereby donors will accept products originating in beneficiaries at a preferential tariff rate, in contravention of the non-discrimination principle. The GSP can be a workable framework that applied to sustainable biofuels production under the WTO regime: sustainably-produced biofuels would be subject to a GSP tariff reduction, while unsustainably-produced biofuels would attach to MFN tariff rate. At the same time, however, doubts are expressed as to the effectiveness of GSP in assisting developing countries to participate actively and derive benefits from global trade. For further reading, see Edwini Kessie, 'The Legal Status of Special and Differential Treatment Provisions under the WTO Agreements' in George A Bermann and Petros C Mavroidis (eds), *WTO Law and Developing Countries* (CUP 2007); Dionysia-Theodora Avgerinopoulou, 'Legislative Development: Implementation and Enforcement of Multilateral Environmental Agreements-The New EC Generalized System of Preferences Scheme' (2006) 12 Columbia Journal of European Law 827; Anastasios Tomazos, 'The GSP Fallacy: A Critique of the Appellate Body's Ruling in the GSP Case on Legal, Economic, and Political/Systemic Grounds' in George A Bermann and Petros C Mavroidis (eds), *WTO Law and Developing Countries* (CUP 2007) 307; UNCTAD, *Generalized System of Preferences: List of Beneficiaries* (UNCTAD 2001); UNCTAD, *Generalized System of Preferences: Handbook on the Scheme of the United States of America* (UNCTAD 2003).

CHAPTER SIX CONCLUSIONS AND RECOMMENDATIONS FOR DECISION-MAKERS IN DEVELOPING COUNTRIES

6.1 Introduction

There is a large global interest in finding alternatives to transportation fuels to substitute petroleum-based fuels. Biofuel is among those renewable energies that can be a substitute for fossil fuels. The production and consumption of biofuels have entered a new era of global growth, with both the scale of the industry and the number of countries involved reaching unprecedented levels. The initial surge of biofuels in the main producing countries was driven by energy security, climate change and rural development. In order to drive the process of biofuel development, a variety of heavy policy support was imperative, such as mandates, tax exemptions, subsidies, as well as financial support on R&D of new feedstocks and technologies. Therefore, the current biofuel development is a result of a variety of factors, including the development of more efficient conversion technologies and the introduction of strong new government policies and legislation.

However, the consequences and effectiveness of biofuel on sustainable development is the subject of serious debate. A massive scale-up in the production and use of biofuels, if miss managed, could increase the concentration of economic wealth, while speeding up deforestation and biodiversity loss, having a negative impact on climate change, and possibly accelerating food insecurity and global poverty. The path taken will depend primarily upon policies put in place by leaders at national and international levels. Sound legal and regulatory frameworks for biofuels are gaining increased importance as means to ensure that environmental and socio-economic sustainability considerations are taken into account in the production, promotion and consumption of biofuels, with a view to minimizing risks of negative impacts and maximizing benefits in the immediate and long term. These policies will constantly shape biofuel programs and the associated impacts on the environment and our society in the years and decades to come. In the course of the rise of biofuel economy, technology plays an equally important role as that of biofuel policy and regulation. Without high-tech rapid development, the potential for biofuels cannot be fully realised.

Developing countries have advantages over developed countries in biofuel production, as many of them have apparent relative availability of land and feedstocks, as well as good climate conditions in that biomass production potential is much higher and production costs can be lower. However, a biofuel expansion in these countries raises concerns about potential added environmental and social pressures. Possible impacts include environmental consequences resulting from GHG emissions, land-use change, and loss of biodiversity, as well as socio-economic consequences such as increases in food prices and reduced food security in low income societies. These impacts are poorly understood and regulated in developing countries. For the dozens of developing nations that are just beginning to develop biofuel industries, many decisions will have to be made, including how to promote the new industry and how to regulate the industry. Policies will need to be designed, appropriately based on domestic economic and resource circumstances, and with the rapid pace of biofuels development, they will need to be put in place soon. Decision-makers will also need to keep an eye on factoring in the impacts that the policies from other nations, such as the EU biofuel sustainability standards, the US domestic support and subsidy on biofuels and the feedstocks, and international trade policies, such as what impact the continuing trade liberalization negotiations will have on their own biofuel and biofuel feedstock markets. However, in most developing countries, the biofuel industry is still in its infancy stage. Biofuel policies and regulations, if there are any, are fragmented and cannot formulate a coherence system. Therefore, the vast array of issues involved, the lack of knowledge about many of these issues, together with the fairly limited and fragmented policy design associated with biofuels, mean that formulating a coherent and appropriate legal and policy framework that compasses all aspects of law areas, relationships, interests and stockholders for biofuel industry is a considerable challenge for most developing countries.

Therefore, the central aim of this thesis is to bring together in a single document the variety of guidance, legislation, policy and other information relevant to the regulation of biofuels in developing countries. It is hoped that this research can help to ensure a greater understanding of the measures required for a comprehensive and coherent biofuel policy and legislation. It provides suggestions for decision-makers in developing countries for taking a more comprehensive approach that encompasses the relevant areas of law, sectors and stakeholders, to ensure the biofuels industry develops in a sustainable manner, and benefits their societies and the whole world in the long term. Throughout this thesis, I have sought to provide an answer to the question of how to build up a coherent legislative and policy framework of biofuel sustainable development. Based on the most significant issues surrounding biofuels development, four of the most relevant areas of law, mainly intellectual property law, environmental law, agricultural-economic law and trade law, have been discussed and analysed. By way of conclusion, this chapter assesses whether this thesis has met its proposed aims and reviews its findings which should respond to the research questions listed at the start.

6.2. Technology Development and Legal Regulation: Two Wheels for Biofuel Sustainable Development

In order to promote the sustainable development of the biofuels industry, both technology development and legislation evolution are indispensable. The main objective of this research, as I explained, is to help biofuel decision-makers to figure out how to build up a legal framework to support and regulate biofuel sustainability, but before we concentrate too much on the legal issues and policy instruments, it is certainly essential to get to know more about the industry itself and its sophisticated technologies. As a high technology-intensive industry, the type and level of science and technology can greatly affect and shape the development of the biofuel industry and the evolution of biofuel policy.

Generally speaking, when a new industry and its technologies are in their infancy, there is likely to be a good deal of uncertainty about both the benefits and the harms. It could be a big challenge for decision-makers to deal with compared with traditional industries.[1133] In the focal region of technology and regulation, biofuel lawyers need to be sensitive to transitions of different types/generations of biofuel technology, and link them to a variety of regulatory actions that need to be taken, and relocate them within the available array of strategies. Consequently, biofuel regulation is inevitably affected by technology development.

Developing countries may possess significant advantages for biofuel production and trade, but need the appropriate technologies for the industry to develop. Hard science and technology development is particularly important for sustainable development of biofuels industry, because the characteristics of different generation biofuel technologies are very different. Generally, the advanced technology supported cellulosic biofuels and other advanced biofuels have better performance than conventional food crops-based biofuels in terms of their carbon footprint of GHG

[1133] For more discussion about the relationship between law, regulation and technology, see, Bert-Jaap Koops, 'Ten Dimensions of Technology Regulation' in Morag Goodwin, Bert-Jaap Koops and Ronald Leenes (eds), *Dimensions of Technology Regulation* (Wolf Legal Publishers 2010) 309.

reduction and other environmental and social sustainability aspects. As long as the advanced biofuel technology developed well, many of the current unsustainability problems would be tackled without many legal and regulatory efforts. Developing countries' biofuel production has received lots of critics, because it may have negative effects on the environment and society. Meanwhile, it is common for these countries to have limited financial support and research ability to develop advanced and more sustainable biofuels themselves. Consequently, how to gain access to those more sustainable biofuel technologies becomes a common aspiration of the Global South.

However, as biofuel technology IP applications are increasing, developed countries have strong IP protection systems. Patent thickets make it difficult for second- and third-generation biofuel technologies to be transferred to developing nations. There is a considerable gap between developed countries which have already been exporting biofuels for years and developing countries that have just started to produce biofuel products. Disparities exist both in terms of the development of their biofuel industries and the development level of the countries themselves. Since developing countries generally have limited capacity to develop biofuel technologies on their own, enhancement of their biofuel sectors is often contingent on the availability of these technologies from industrialized countries. It is reasonable for developing countries to ask, whether it is justifiable that developed countries, on the one hand, ask them to take more responsibility on global issues of GHG emissions and climate change, as well as other environmental and social problems; while, on the other hand, lock the door to access to advanced technologies which can help to promote biofuel production developing in a sustainable manner in developing world.

All in all, the role of IPRs in biofuels is fairly uncertain and dynamic, as the Global North and South seem to hold opposite opinions on this issue. From the perspective of developing countries, it is argued that the IP ownership, particularly the patent thickets, of advanced biofuel technologies represents potential constraints on advanced biofuel technology transfer to and development in developing countries. Not surprisingly, developing countries' opinion on the IPRs is hardly can be agreed by developed countries. Most of the advanced biotechnologies are held in the private sector of developed countries, where there are established strong IP protection systems. To resolve the tension, international communities have made significant efforts by the UNFCCC and the TRIPS Agreements. However, it is still difficult for developing countries to get access to the real cutting edge technologies in the biofuel sector and more efforts of negotiations are needed in the future. Lastly, if industrialized economies generally wish to mitigate climate change, alleviate global poverty, push for greater industrialization and the development of service-based industries in the developing world, and liberalize international trade, they need to seriously re-consider the possibility of developing nations having access to the required science and technology for transition from the first-generation biofuel economy to the next-generation biofuel economy under their strong IPRs protection. A balance between private interests and public benefits need to be properly achieved in biofuels. Therefore, two complementary principles are recommended here to decision-makers, biofuel lawyers and IP lawyers: **Principle 1**: Using IPRs protection encourages biofuel technology development and innovation. **Principle 2**: Increasing the flexibility of the current IP scheme to encourage more technology transfer in developing countries.

6.3 Biofuels Production and Environmental Sustainability

Despite technological development and breakthroughs, government support and regulation is particularly important for keeping the biofuel industry running in an sustainable way. One of the outstanding issues that should be included in policy makers' agenda is of the impacts of biofuels on global climate change and its close ties to environmental sustainability. Disruption of the global climate, driven by human activities, has emerged over the past few decades as a major issue of concern. It is now increasingly apparent that the impacts of a changing climate will be significant and widespread. Biofuels have the potential to help meet the challenges that the global community faces today: reducing the GHG emissions and the threat of climate change. Alternatively, biofuels also could speed up deforestation and biodiversity loss, harm the ecosystem and possibly accelerate global warming. The path taken will depend primarily upon policies put in place by leaders at national and international levels.

These biofuel-related environmental issues frequently occur in developing countries, such as the deforestation caused by palm oil plantation in Southeast Asia and air pollution issues caused by biofuel feedstock burning in Brazil. The impact on the environment is not easy to measure as much remains unknown about the specific effects that these circumstances have on the environment. However, what is known is that they impose huge risks on the environment, as well as the future of the biofuels industry. The clearance of Indonesia's peat forests to plant oil palm plantations would cause massive outputs of CO2. If biofuels were produced from palm oil, biofuels would lose their credibility as a 'green energy', 'climate friendly energy' or 'sustainable energy'. They would then easily lose the support of the public and the consumers.

Therefore, for policy makers in developing countries, a precautionary approach to developing biofuels is necessary. A comprehensive assessment of the environmental impacts of biofuel production and the identification of measures to reduce these impacts based on a local scale is required before any biofuel plant is being launched. Both energy and climate change remain pressing problems for developing countries. Meeting challenges simultaneously will indeed be a complex task and will require an integrated approach to energy policy where such approaches have not always been the norm. The enormous breadth of the energy sector has often led to a piecemeal approach that makes the integrative task the much more arduous. Decision-makers need to end by drawing particular attention to two sets of themes connecting and underlying these challenges.

Concerns about the possible achievements of biofuels for climate change mitigation and the negative impacts on the environment have led to demands for sustainable development of biofuels. The concept of sustainable development now dominates the natural resources, energy and environmental discourse with its accommodating notion of developing in the present while not compromising the future. The increasing debate over biofuel sustainability and the multiplicity of biofuel sustainability regulations emerged over the last few years, mainly the EU countries and the US. Among all the biofuel sustainability policy initiatives, biofuel certification schemes are driven as much by market access and trade considerations as by the need to provide sustainability assurances. The EU itself, the Netherlands and the UK are all developing biofuel certification schemes. Certification schemes offer an opportunity for an integrated assessment with particular policy emphasis and could be instructive for developing countries.

However, there are some challenged faced by developing countries. At the very least, the existence of diverging sustainability standards in different countries can pose significant fee/cost for producers of developing countries. A producer wishing to export to other markets will have to incur extra costs to have their biofuels tested according to the importer country's conditions. For producers wishing to enter multiple markets, each with different standards, these costs become very high. In addition, few of these schemes currently being developed have included Southern stakeholder groups. Some certification schemes include a wide range of social sustainability requirements. These social standards cannot reflect the real need of developing countries at their current stage, and may place too much of a burden on developing countries.

Suggestions for decision-makers of developing countries that firstly, sustainability certification schemes for biofuels are worth developing. The ambition is therefore to reward the more sustainable biofuels and punish the less sustainable biofuels. Secondly, biofuel certification schemes are not the only instruments for regulating biofuel sustainability. They need to work together with all other policy instruments. Environmental sustainability standards instead of a wide range of all aspects of considerations, especially the standards and criteria of GHG emissions, should be included with the consideration of national/local context. Biofuels should be recognized as environmentally sustainable under the condition of delivering reasonable reductions in GHG emissions and farming practices not resulting in environmental damage. Thirdly, the meta-standard approach is worth investigating, as it is based on the existing certification schemes that could work more effectively and efficiently based on the local context of environmental requirements. Meanwhile, it could be help to unify a common biofuel certification scheme in the long term. In this regard, another two principles could be considered by biofuel policy makers: **Principle 3**: Ensuring biofuel production is under the condition of delivering reasonable reductions of GHG emissions in a life-cycle and benefits climate change mitigation. **Principle 4**: Ensuring biofuel production and its feedstock farming practices are not resulting in environmental damage with considerations of local context.

6.4 Emerging Agro-Energy Market and Socio-Economic Sustainability

Environmental regulation is an important part in biofuel sustainability strategy, but it is not the only one. Biofuel development does not just link energy and environmental regulations closely; such development also alters the demand and supply of biomass sources, tightened energy markets and agricultural market linkages. Consequently, it could impose significant impacts on the global food market and rural community. As a heavily-subsidized industry, the agricultural policy relevant to biofuel feedstocks and products is also a significant focus of debate in relation to the international biofuel market. These chain reactions in the socio-economic terms of biofuel sustainability also need to be carefully considered by biofuel lawyers and decision-makers.

The global food crisis of 2008 and the increased competition over agricultural crops for biofuels purposes instead of food production has raised concerns about biofuels clashing with food security and the long-term sustainability of current biofuel systems. It is argued that greater international demand for biofuels has many implications for the production, price and availability of staple commodities, and these impacts need to be investigated. Developing countries should evaluate the relationship between food security and biofuels expansion. In developing countries, food production should be given a priority over biofuel production to meet national food security requirements. Moreover, policymakers must take care to ensure that biofuels development will not adversely affect the poor and net-food-purchasing households, which are vulnerable to rising food prices. It is argued that biofuels can affect the food market negatively, but biofuels also can drive the economy of the agricultural sector and communities. The expansion of biofuels production could contribute significantly to higher incomes for farmers through higher feedstock prices and new employment opportunities to the benefit of rural areas, an outcome that is quite desirable for developing countries that generally have large rural populations.

Therefore, instead of aggressively stopping biofuel research and production programmes to avoid their negative effect on the food market and other undesirable consequences, decision-makers in developing countries should and need to design agro-energy policy carefully, and put the biofuel industry in a right position in their entire economy map. Although the economics of production will be the determining driver is sorting out how resources (including land, crops, water and other resources) are likely to shift between food and energy, the market force alone is unlikely to be the sole drivers of the process. Therefore, appropriate legal and policy regulations are critical in guiding the outcomes. Policy makers should develop an analytical framework that takes into account the diversity of their situations and specific needs. In addition, biofuel policies enacted in developed countries, particularly the US and the EU, also need to be investigated, and international cooperation is needed to manage the global agro-energy market as a whole. It is because the US and the EU are setting ambiguous targets for biofuel consumption in transportation, but will not be able to produce the feedstock themselves. In the case of maize, this is due to increasing amounts of US corn being used for ethanol rather than food. As ever, it is the poor and marginalized who live in Latin America that suffer the worst impacts.

Moreover, R&D activities are needed to facilitate the shift from first-generation of biofuels to second-generation biofuels. Second-generation biofuels based on the feedstocks such as grasses, wood, crop and forest residues, and municipal wastes could reduce the demand for food and feed crops for the production of biofuels and mitigate the competition of food and energy. Government support of research on high-yield seeds of non-grain feedstocks, enzymes for ethanol production, storage technology for non-grain feedstocks, and investment in infrastructure and facilities in producing areas would seem essential. In fact, inedible crops and a variety of non-food crops are already being used or explored for their biofuel potential. However, there is little information about the second-generation sources on the systematic assessment and analysis of the yield potential under different agro-climate zones and soil types of the tropics in developing countries. Therefore, besides depending on their domestic only, introducing advanced technology from more advanced countries would also be necessary for developing countries to mitigate the competition of food and fuel. All in all, despite various versions of analysis and predictions about biofuel and food competition, one principle should be universally applied for biofuel development, which is **Principle 5**: Ensuring biofuels development will not compete with food resources, or adversely affect food prices and food security.

Moreover, another biofuel policy debate is about the issue of developed countries' domestic support and agricultural subsidies for production of biofuels and biofuel feedstocks and its implications for developing countries' biofuel industry, as well as the WTO's attitude for these subsidies. The agricultural sector in developing countries already faces huge challenges under the WTO framework. The use of domestic support in the form of subsidies is a common practice in biofuels. Almost every producing country, especially in the industrialised world, has some form of domestic support for biofuel production. Policy goals associated with biofuel production implies that countries have important incentives to protect local production from more efficient foreign production. Although these government supportive policies for biofuels can usually be justified to help the industry to develop in the early stages, there is a substantial body of literature dealing with the negative effects of agricultural subsidies on developing countries' competitiveness.[1134] The real challenge for developing countries is that some of these agriculture incentive programmes in wealthy countries support biofuel feedstock production in a way that harms competitors in developing countries.

The WTO's attitude towards the heavy subsidies in developed countries is imperative for developing country producers and exporters. However, the WTO currently has no specific regime to deal with biofuel products. There is still yet an agreement among WTO members on whether biofuels are defined as industrial, agricultural or even environmental goods. The multisided nature of biofuels, which can be considered more than only one good, and its strategic possibilities, which can be used for the implementation of an energetic matrix within the context of sustainability, make the issue fairly uncertain in future negotiations. Generally, biodiesel is viewed as an industrial good. Ethanol, as well as most of the current biofuel feedstock, is an agricultural good under the WTO. Two imperative WTO agreements are relevant: the SCM Agreement and the AoA. As there are not many disputes about biofuels raised

[1134] Oxfam International, 'Cultivating Poverty: The Impact of US Cotton Subsidies on Africa' (Oxfam Briefing Paper 30, Oxfam International 2002) <http://policy-practice.oxfam.org.uk/publications/cultivating-poverty-the-impact-of-us-cotton-subsidies-on-africa-114111> accessed 11 November 2014.

under the WTO, using the SCM Agreement to protect developing country stakeholders against the heavy biofuel (feedstock) subsidy in developed countries still remains uncertain. Even worse, the design of AoA provide too much flexibility to the domestic policy space of its powerful members. As a result, it cannot really help to reduce agricultural subsidies in biofuels as well as in other sectors.

Therefore, biofuel industry development in developing countries still faces great challenges and international efforts are continually needed to help with replacing highly subsidized and protected commodity food production in rich countries. Although these policies play a crucial role in the industry's development in the early stages, the level of support in developed countries can constitute very costly barriers to the biofuel trade, especially for those most efficient developing countries that have limited financial capacity to support their industry. Biofuels support strategies in the developed world must be planned with a gradual phase-out over time or other means of moving beyond the subsidies once they are no longer necessary. Therefore, another important recommended Principal for biofuel policy makers is, **Principle 6**: Ensuring biofuel subsidy and other public supportive policies will not have trade-distorting effects on the international biofuel market, and enabling biofuel to develop in an economically viable way.

6.5 Global Trade of Biofuels under the WTO: Prosperity and Sustainability

Domestic biofuel policies indubitably had a tremendous effect on global markets. In general, biofuels trade restrictions should be removed over time, respecting the fact that the countries with nascent industries will want to protect them. Despite the biofuel subsidy policy, which may restrict the development of international biofuel trade, biofuel sustainability policy could be another controversial policy which operates as a trade barrier in biofuel markets. The proliferation of different environmental and social standards with no mutual recognition between them may give rise to non-tariff barriers blocking developed countries' markets from developing country exporters. Therefore, when participating in the international trade of biofuels, policy makers should consider how to identify if the unilateral biofuel sustainability standards established are legitimate measures in respect of sustainability or can be identified as 'green protectionism', which is the use of legal and administrative regulation with an allegedly environmental focus for the implementation of measures that distort the flow of biofuel products in the global market. Particularly, it must be determined whether the unilateral sustainability standards of regulating biofuel sustainability in developed countries could be justified under the general exceptions of Article XX of the GATT.

Although there has not yet been any biofuel dispute brought to the WTO, the WTO already has analysed cases in which restrictions to trade were linked to environmental factors, such as *EC – Asbestos*, *US – Gasoline*, *US – Shrimp*, *US – Tuna I* and *II*. The cases can be used for examining the (non)adequacy of biofuel sustainability standard and criteria relating to the international trade commitments. However, the attitude of WTO to the issue of biofuel sustainability measures is yet clear. Although a unilateral import ban based on sustainability criteria for biofuels may be difficult to be justified under the chapeau of Article XX, it is not impossible. Therefore, biofuel sustainability standards and criteria in industrialized economies may work as barriers for developing countries to pursue a larger potential market.

Therefore, existing WTO provisions must be clarified in order to clearly categorise biofuels as a specific group of goods under the WTO, to accelerate reduction of domestic support in developed country members, and to eliminate trade barriers, especially non-tariff barriers, to biofuel products. For decision-makers, there are two principles that should be considered to achieve biofuel market prosperity and sustainable development: **Principle 7**: Ensuring equitable access to the international biofuel market; and **Principle 8**: Removing tariff and non-tariff trade barriers and increasing trade liberalization. Moreover, not only the WTO, but also other International Organisations play a central role in the emergence of international biofuels law. They represent a response to the globalisation of the biofuel regulatory challenges. When national regulations lose their grip under the context of global biofuel development, international agencies are needed to mirror the global scope of action of problems, such as the climate-friendly technology transfer and diffusion, trans-boundary environmental impacts, food-energy market balance, as well as the protectionism of international trade.[1135] More efforts are needed to help their member states to regulate better by providing model guidelines, collective and better regulatory intelligence, a forum of dialogues and collegiality between the Global North and South, and always keep an eye on the interests and perspectives of their developing county members. In this way, the rise of the biofuel economy can offer more opportunity to simultaneously achieve the goals of enhancing and diversifying developing countries' exports, improving the conditions for rural inhabitants and also achieving environmental sustainability.

6.6 Conclusion

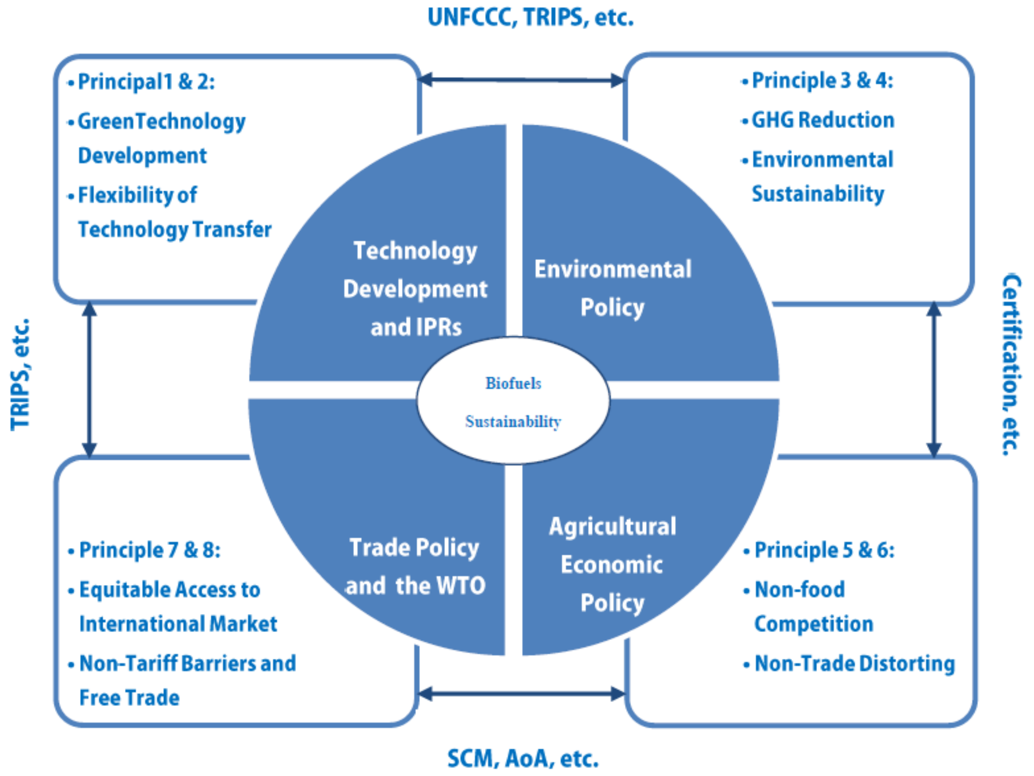
The production and trade of biofuels is increasing rapidly and affecting many sectors of the contemporary economy. The benefits and hopes brought with biofuels should not be underestimated, but at the same time, challenges remain. Along with the development of the biofuel sector, several important issues, including e global energy

[1135] Thomas W Walde, 'The Role of Selected International Agencies in the Formation of International Energy Law and Policy towards Sustainable Development' in Adrian J Bradbrook and Richard L Ottinger (eds), *Energy Law and Sustainable Development* (The World Conservation Union 2003) 171.

mix, the environment, the agricultural market and rural communities, as well as international trade, have been linked together unprecedentedly. A new intersection of energy and environmental issues is emerging; the energy market and agricultural market have been tightly linked; under the framework of the WTO, the inherent differences and contradictions on agricultural policy between developed countries and developing countries have become even more prominent; the relationship between environmental regulations and trade policies needs to be rethought and rebalanced. Consequently, as a new industry phenomenon, the rise of the biofuels industry has linked together many complicated social-legal relations which were seemingly separated before. Therefore, it is impossible to regulate the development of the biofuel industry within a single legal area or regime. On the contrary, in order to formulate a sound legal and regulatory framework for biofuels, it is necessary to consider and balance various values and interests from the aspects of technology development, the environment, agro-energy economy, and trade liberalization. In envisaging a biofuel legal and policy framework, at least four aspects need to be considered: science and technology, the environment, agricultural economy and trade liberalization.

Moreover, it is important to make it clear that the sustainable development benefits of biofuels are not straightforward. In order to identify and maximise upon the sustainable development opportunities associated with biofuels; and to identify and minimise upon the trade-offs and problems involved, the four areas of law should not be examined separately. Instead, the gaps, conflicts and linkages of their values and interests need to be taken into consideration and thought about in an integrated way. All concerns of technology and law, energy and environment, agricultural economy and trade liberalization should be considered and balanced within an appropriate sustainable development framework. It is exactly what I expected to get from this research. Following from the five Chapters of analysis, the suggested biofuels regulation framework is displayed as Figure 6 below.

Figure 6: Legal and Policy Framework and Regulation Principles of Biofuels Sustainable Development



By now, we have already developed a comprehensive and coherent strategic legal management model for biofuel sustainable development from perspectives of the developing world. Within the modelling of the law, we have concluded that both technological development and legal regulation are important and imperative to support biofuel development. In relation to science and technology, technological support and technology transfer, as well as the proper design and use of IP instruments (Principle 1 and 2), could ensure biofuels are produced in the most efficient and sustainable manner. In relation to law and regulation, environmental law and agro-economic policies are particularly relevant in ensuring that biofuel production is conducted under a coherent, sustainable development framework in terms of environment, society and economy (Principle 3, 4, 5 and 6). In addition, despite these production-concerned policy-design and legal principles, a biofuel trade policy and market-related instruments are also needed to build up a fair market for biofuels with free access and no barriers, and in turn to achieve for the industry prosperity and sustainability in the long term (Principle 7). In conclusion, according to this research and its recommended regulation modelling, the main legislation and policy considerations include at least biotechnology and IP law, environmental law and policy, agricultural-economic law and market regulations, as well as international trade law and the WTO rules. It is expected that with these legal regulations, considerations and principles working together within a coherent framework, the biofuels industry would not lead to a scenario in which it provided a solution to one specific problem/legal area, while creating many more in other legal areas.

Moreover, as regard to the interdisciplinary regulation framework for biofuels sustainability itself, it is worth noting that the regulation framework above is not a closed system, and the four areas of law mainly discussed within this thesis are not exclusive but fundamental. That is to say, this legislative and policy framework designed as a commonly accepted and basic model for any developing countries interested in biofuel sustainability regulations. Based on it, local contexts of particular countries or areas need to be considered and analyzed as well to develop a particular country-targeted biofuel legislation framework. In that, it is essential and necessary to keep the system to be open to any other legal area which is relevant to biofuels development when it is necessary. And it is worth noting that, when considering this legal framework suggested in Figure 6 together with different specific local context-based biofuel studies, the final framework for biofuel sustainable development could be and should be different for decision-makers from different countries. For example, biofuel stakeholders in Zambia may need to consider more about international investment law and the biofuel program-related indirect foreign investment instruments.[1136] Policy makers in Tanzania may be interested in researching further

[1136] Emmanuel Laryea, 'Evolution of International Investment Law and Implications for Africa' in Francis N Botchway (ed), *Natural Resource Investment and Africa's Development: New Horizons* about land law when launching new biofuel programmes.[1137]

In addition, as mentioned before, the rapid development of biofuel technology will greatly affect biofuel policy. The regulation map of biofuel development is a rapidly shifting scene and it is perfectly possible that, as the decades pass, our interests and concerns will be engaged by other technologies that emerge. This is another important reason why we need the biofuel regulation framework to be an open system. [1138]

In conclusion, I hope to have at least provided a defensible/adequate framework and developed appropriate principles and guidelines in this field. The issues occurring in daily life related to biofuel production, consumption and trade which inspired this thesis has never been more important. Indeed, it is not the aim of this thesis to cover all the possible impacts of biofuel expansion, or to providing a uniform, perfect and closed framework for biofuel industry for all the developing countries. Instead, the end result is a comprehensive study that attempts to integrate into a single research project the major issues and fundamental principles related to biofuels production and market sustainability. Based on the most significant issues surrounding biofuels in the current world, this work is formulated with four substantial chapters and concentrates on four areas of law: intellectual property law, environmental law, agricultural law and trade law. It believes that at least these four areas of law are closely relevant to biofuel legislation and policy making that should be closely examined within the suggested

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in Environmental and Energy Law (Edward Elgar Publishing 2011) 293.

[1137] Abdon Rwegasira, *Land as a Human Right: A History of Land Law and Practice in Tanzania* (African Books Collective 2012).

[1138] For examples, ethanol and biodiesel are generally referred to as biofuels *per se* in most producer nations' policy agenda, such as the US biofuel legal system. But as long as technology develops, it is found maybe some other new products are more effective biofuels, such as butanol. However, it is argued that the current US biofuel legislation is not open enough for the integration of butanol entering competitively into the existing infrastructure. For more discussion about butanol development and biofuels future, see Jack Rowbotham, Chris Greenwell and Mike Adcock, 'The Future of Alcohol-based Biofuels: Will We See the Death of Ethanol and Birth of Butanol?' (2014) 5(4) Biofuels 365.

interdisciplinary regulation framework (Figure 6) by decision-makers. Therefore, it is hoped that this research will help to provide a better understanding of the biofuel needs and aspirations of developing countries, viewed in a global context. Such a foundation is necessary for jointly solving the energy, environmental, socio-economic, and free trade challenges faced by the global community of nations in the twenty-first century.

6.7 Further Research

Based on the regulatory framework and legal guidance provided in this thesis, further research could be conducted focusing on particular developing countries. As mentioned above, biofuel legislation and policies need to be designed within specific national context. Therefore, it would suggest that 'country-based approach' research is needed, and work with this framework in Figure 6 as guidance for determining how to regulate the biofuel development of each particular developing country.

Moreover, this legislative and policy framework can also provide guidance and principles to further research on specific biofuel technology and feedstocks. The 'feedstock approach' research and studies are needed because benefits and costs of biofuels vary widely, according to the type of feedstock, cultivation method, conversion technology and geographical area. Energy crops differ in terms of their energy efficiency, their impacts on GHG emissions and other environmental effects, and their impacts on employment creation.

Lastly, it is important to recognise that the biofuels industry in the world is evolving rapidly, so it is challenging to present an up-to-date paper. Biotechnology and scientific developments, as well as the changes in the price of oil and biofuel feedstocks in global markets could change the picture of biofuel industry, and in turn directly affect legislative framework and policy strategy employed by policy makers. Therefore, further research could be conducted with this non-closed legislative and policy framework of biofuel sustainable development, and developed according to the latest information.

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