Masterarbeit / Master Thesis

Title of the Master Thesis/ Titel der Masterarbeit

Rethinking the Role of Biofuels in Combating Climate Change: the European Union's Search for a Sustainable Biofuels Policy

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Angestrebter Akademischer Grad / Academic Degree Aspired

Master (MA)

Vienna, Mai 2011

Studienkennzahl: A 067 805
Studienrichtung: Individuelles Masterstudium: Global Studies: A European Perspective

Betreuer/Supervisor: Simron Jit Singh, Ph.D

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Acknowledgement

I extend deep and heartfelt thanks to some people who helped through the way of writing this paper. I am grateful to my supervisor Mr. Simron Jit Singh,PhD, who was always available to discuss the trajectory of the paper and provide valuable suggestions and contacts. He made writing this paper a very academically fulfilling experience. I would have to thank the Erasmus Mundus coordinator of University of Vienna, Leopold Koegler who was a cheerful motivator and guide with all the official paperwork. Were it not for Poldi, this process would have been much more overwhelming. I also extend my thanks to my classmates who always had the best suggestions - Deepti Kakkar, Fahad Mustafa, Tanya Podobinska, Joe Steff, and David Engelhardt to name just a few. I would have to thank the European Commission for the opportunity to study this fascinating programme of Global Studies at the University of Leipzig and University of Vienna and for making the world feel truly smaller with all the wonderful people I met. I am also grateful to have been selected for the traineeship at the European Commission in Brussels which allowed me access to relevant documents, a large library and to participate in conferences and workshops and to speak to important policymakers and academicians in the field of sustainable agriculture and biofuels.

Abstract

This paper looks at how biofuels have become an integral part of the energy policy in different parts of the world, largely driven by pro-biofuels government policies that have led to an uneasy supply-demand situation between developing and developed countries, food and fuel. The idea of biofuels as a renewable or 'green' energy has come under serious scrutiny following its impact on food prices in 2008. Also, recent scientific studies question its long-term contribution to greenhouse gas savings (owing to indirect effects from land-use change). This has raised questions on its contribution to mitigating climate change-it's primary rationale in industrialised countries. The last section of this paper focuses on the European Union, the largest consumer of biodiesel in the world. Being at the forefront to reduce greenhouse gas emissions to adhere to targets under the Kyoto Protocol and its own Renewable Energy Directive, the European Union is in search of a sustainable biofuels policy.

Diese Arbeit untersucht, wie Biokraftstoffe – meist stark gefördert von Regierungen durch Pro-Biokraftstoff-Maßnahmen, die zu einer beunruhigenden Angebots- und Nachfragesituation zwischen sich entwickelnden und entwickelten Staaten und zwischen Nahrungsmitteln und Treibstoff geführt hat – ein integraler Bestandteil der Energiepolitik in verschiedensten Teilen der Welt geworden sind. Die Vorstellung von Biokraftstoffen als erneuerbarer oder „grüner Energie" wurde durch die Auswirkungen auf die Lebensmittelpreise 2008 einer harten Prüfung unterzogen. Neueste wissenschaftliche Untersuchungen hinterfragen auch deren längerfristigen Beitrag zur Verringerung der Treibhausgase (infolge indirekter Effekte der Veränderung der Bodennutzung). Diese Ergebnisse haben den Beitrag der Biokraftstoffe zur Milderung des Klimawandels in Zweifel gezogen – den hauptsächlichen Beweggrund der industrialisierten Staaten. Der letzte Teil der Arbeit konzentriert sich auf die Europäische Union, den weltweit größten Konsumenten von Biodiesel. Als Vorreiter der Treibhausgasreduktion, um an den Zielen der Kyoto-Protokolle und der eigenen Renewable Energy Directive festzuhalten, ist die Europäische Union auf der Suche nach einer nachhaltigen Biokraftstoffpolitik.

List of tables, boxes, and graphs

1.0 Introduction

The use of biofuels as a source of energy is not a new phenomenon. For most part of human history, biomass has been the main source of energy and remains so particularly for the rural poor. Dried cow-dung cakes, stalks and husks of grains and pulses, inedible agricultural waste and firewood are the dominant source for cooking heating and lighting in many parts of the developing world where biomass forms an integral part of the rural economy. For example, biomass comprises 15 percent of Chinas energy consumption and 32 percent of India's energy consumption in absolute terms.[1]

Liquid biofuels or biodiesel also share a relatively long history. They were critical in the development of the early internal combustion engines and automobiles in the 19th century. The German inventor Rudolf Diesel published a paper on his revolutionary engine that would run on the principle of high pressure being converted to high temperature. His original design was made to run on peanut oil and the engine was demonstrated on August 10, 1893 at Augsburg in Germany[2]. Interestingly, Diesel said: "The use of vegetable oil for engine fuels may seem insignificant today but such oils may in the course of time become as important as petroleum and coal tar in the present time."[3] What is a recent phenomenon, however, is the

[1] Pachauri, Shonali and Jiang, Leiwan, *The Household Energy Transition in India and China*, Energy Policy 36 (2008), 4022-4035, pp 4024
[2] Demirbas, Ayhan, *2008, Biofuels: Securing the Planet's Future Energy Needs*, Springer-Verlag, pp 159
[3] Demirbas (2008) pp 160

production of biofuels on an industrial scale, backed by government subsidies and technological advancements. This scale of biofuels production has left a trail of questions about the future of food security, the impact on the environment, and the real benefits of this alternative energy as a way to reduce greenhouse gas emissions and mitigate climate change.

The debate is divided between those who are pro-biofuel and see it as a panacea to at least three pressing problems- lowering the dependence on crude oil and increasing energy security, replacing fossil fuels and reducing carbon emissions (and therefore mitigating climate change) and providing job opportunities in the agriculture sector. There is sufficient evidence however to question whether the pitfalls outweigh these benefits. There is a faction that vehemently opposes biofuels since their production from food crops such as maize and wheat directly competes with food production, and there is a high probability of land being diverted from other uses to 'grow fuel'. The highly substitutable nature of feedstock for food and feedstock for industrial use has been pointed as a specific drawback. This competition with food was at least partly responsible for a steep rise in global food prices between 2007and 2008 that manifested in riots in Mexico, Bangladesh and some other parts of Asia. The year 2008 in some ways has been the tipping point in the competition between scarce natural resources such as land and growing demand and consumption of food, partly attributed to increasing demand from China and India (see Figure 3 in Appendix). Biofuels have become part of a global agenda where the stakeholders in the debate include farmers, the energy industry, environmentalists, politicians and the science and technology experts. Lobbying is significantly tied in with the biofuels agenda given the government subsidies and trade incentives that the industry has attracted[4].

[4] Von Braun, Joachim, 2007, *When Food Makes Fuel: The Opportunities and Challenges of Biofuels,* International Food Policy Research Institute, Keynote Address at the Crawford Fund Annual Conference, Australia, (http://www.ifpri.org/sites/default/files/publications/2007jvbcrawfordkeynote.pdf)

The problems associated with biofuels bear global repercussions as it pits the developed and developing worlds against one another in terms of energy demand and consumption, availability of land and other resources and responsibilities to check global warming and reduce greenhouse gas emissions. The uncertainty of the economic, social and environmental impact of large-scale, government-subsidised biofuel policies has made biofuels one of the most controversial topics on the global agenda. The question of how to produce food for all, meet growing energy demands and reduce greenhouse gas emissions are some of the most fundamental questions facing modern society.

1.1 Terms and definitions

The study of biofuels throws up different terminology that has become an intrinsic part of the discourse on the topic. I would like to devote this section to defining some of terms that will be used in the course of this paper.

Biofuels are fuels of biological and renewable origin such as from fuelwood, charcoal, livestock manure, and agricultural waste and energy crops to name a few sources. Bioenergy can be defined as energy generated from biofuels[5]. Biofuels have also been defined simply as "combustible materials derived directly or indirectly from biomass plants or organic waste."[6] The term 'biofuel' tends to be used mainly for liquid fuels such as ethanol and biodiesel and the term 'biomass energy' for fuel derived from solid sources such as wood, coal, and dried dung. However, the term biofuels encompasses all types of fuel composed or produced from

[5] Hazel, P.B.R and Pachauri, R.K, 2006, *Bioenergy and Agriculture: Challenges and Promises,* International Food Policy research Institute (http://www.ifpri.org/sites/default/files/publications/focus14.pdf)

[6] R.W. Howarth and S. Bringezu (Ed.), 2009, *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

a biological raw material. Some of the literature distinguishes between biofuels and agrofules[7]. Biofuels are there described as local biomass that is used on a small-scale while agrofuels are food crops grown on an industrial scale for use as energy. This paper will largely (unless where mentioned) refer to biofuels with a reference to liquid biofuels that are industrially produced. This is because liquid biofuels such as ethanol and biodiesel form much of the focus and relevance in this particular paper.

Feedstock is defined in the literature as source material used for the production of biofuels, eg: sugarcane and maize that is processed for ethanol production or oil-producing plants eg: rapeseed that are converted to biodiesel. Feedstock could also be from agriculture waste or from algae.

Ethanol is produced from any feedstock that contains high amounts of starch such as maize, wheat, sugarcane or sugar beet by the fermentation of carbohydrates. Following the process of fermentation and distillation, ethanol can be used a blending agent for transport fuel, by mixing it with petroleum in varying proportions. Ethanol blending increases oxygen levels and reduces carbon monoxide emissions thus allowing petroleum to burn in a "cleaner" way.[8] In 2007, 62 million litres of ethanol was produced globally and of this 86 per cent was used as fuel[9]. Ninety percent of bio-ethanol was produced in Brazil and United States of America from sugarcane and maize respectively.

Biodiesel is produced from vegetable oils through a chemical process called transesterification. The primary feedstocks of biodiesel are plants that are rich in natural oil

[7] Friends of the Earth International Report , 2010, *Africa: Up for Grabs, Scale and Impact of Agrofuels* (http://www.foeeurope.org/agrofuels/FoEE_Africa_up_for_grabs_2010.pdf)

[8] Ethanol in the United States became the preferred blending and oxygenation agent in the United States after it displaced methyl tertiary butyl (MTB) which was a cheaper oxygentation additive to gasoline but was found to be highly toxic and seeping into water bodies. It was eventually banned and ethanol became the sole source of blending with petroleum (Hertel et al, 2008)

[9] Fischer et al, *Biofuels and Food Security*, IIASA Report, International Institute for Applied Systems Analysis (IIASA), 2009, Laxenburg, Austria

such as rapeseed, soybean, oil palm and jatropha. Biodiesel can be blended with diesel or used in its pure form. The mix of biodiesel to diesel is expressed in the percentage level as B20 (this means 20 percent biodiesel to 80 percent diesel). B100 (pure biodiesel) is also used in certain engines designed for this purpose. The European Union is the largest producer of biodiesel in the world. In 2006, 6.5 billion litres of biodiesel were produced globally, of which 75 percent was produced in the European Union.[10]

In the literature, biofuels have been further classified based on the feedstock and the technology used for conversion into **first generation biofuels and second generation biofuels**.

First generation biofuels are produced from starch-based feedstocks for ethanol and oil-based feedstocks for biodiesel.

Second generation biofuels are biofuels produced from non-food feedstock. These are seen as the answer to much of the criticism and concerns raised around the use of food crops as feedstock. However, there is still research into second generation biofuels and the need for technological advancements for them to become commercially viable and compete against first generation biofuels. The technologies to produce these biofuels differ radically from the transesterification process that is used in first generation biofuels. One involves the gasification of biomass and the further transformation of the gasto a liquid. Using this process, wood, straw or other biomass sources can be turned into a syngas before being converted into a liquid fuel by means of the "Fischer-Tropsch Process" (biomass-to-liquids or BTL).[11]

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[10] Ibid

[11] Doornbosch, Richard and Steenblik, Ronald, 2007, *Biofuels: Is the cure worse than the disease?*, Round Table on Sustainable Development, Organisation for Economic Co-operation and Development, Paris, 11-12 September 2007 (http://www.oecd.org/dataoecd/15/46/39348696.pdf)

1.2 Outline and Research Motivation

In the first half, the paper addresses the global expanse of the biofuels agenda and seeks to draw links between supply and demand - from developing to developed countries and the patterns of biofuel policies across the globe.

In the second part of this paper, I look at the specific link between climate change and the production of biofuels. The reason for this is that one of the main rationales behind the industrial scale production of biofuels is its alleged capacity to reduce or negate greenhouse gas emissions compared to fossil fuels. As such, it is an important element in the climate package of countries legally bound to reduce emissions under the Kyoto Protocol. This section dwells on the background of climate change legislation as a means to understand the role that biofuels play in them, particularly of the European Union which will come into greater focus on the third section. In this section, I also look closely at the literature that addresses the indirect effects from land use change from the cultivation of biofuels feedstocks. This has been a specific issue that has come up in quantifying the greenhouse gas savings from biofuels and one that is least addressed in current biofuels policy.

In the third section I analyse the renewable energy targets of the European Union and look at legislation and policy recommendations on biofuels within the European Union. I seek to ascertain whether the biofuel targets of the European Union, one of the world's largest consumer of biodiesel, can be met sustainably as projected under the Renewable Energy

Directive (RED), given that the use of first-generation biofuels from food crops have raised questions on the environmental credibility of biofuels and on food security in the long-term, not to mention the consequences beyond EU borders. The objective is to also analyse in the course of this thesis whether biofuels will be continued to be pursued as a source of alternative fuel particularly with the rationale that they mitigate climate change given that the indirect effects of biofuels from land-use change severely undermine this claim.

In summary, the research aim of this paper is to understand the motivations for the industrial-scale production of biofuels backed by government subsidies and pro-biofuel policies and understand the loopholes in the current biofuels policy of the European Union.

"*Industrial biofuels are not the fuels of the poor; they are the foods of the poor" - Vandana Shiva, 2007*

My interest in this topic was first sparked by news reports and academic articles about the rise in internationally traded food prices, which has been a trend since 2002, but peaked after 2006. Rise in food prises is not an uncommon phenomenon, but the price increase in 2007 and 2008 were particularly disruptive given the speed with which prices of basic cereals like wheat and maize rose. From 2000-2007, the prices of corn, rice and wheat rose by 85, 63 and 124 percent respectively. Corn and wheat particularly saw drastic rise between 2005 and 2007, between 66 and 67 percentage points respectively[12]. The socio-economic fallout of this price rise, particularly in poorer regions of Africa and Asia, manifested itself in food riots, widespread deprivation and export bans and tariffs on trading of food commodities leading prices to wildly fluctuate. Basic food commodities such as wheat and maize doubled in price

[12] Elliott, Kimberly Ann, 2008, *Biofuels and the Food Price Crisis: A Survey of the Issues, Centre for Global Development, Working Paper No. 151*. (Available at SSRN: http://ssrn.com/abstract=1221668)

in 2007 since the previous year, according to estimates by the United Nations.[13] The price rise in basic food cereals pushed nearly 100 million people back into poverty. While several factors were attributed to the rise in cereal prices, research has suggested that large-scale demand and production of first-generation biofuels in the United States and European Union was a key driver to the rise in prices of traded food commodities[14]. There are multiple dimensions to the food price increase, but the increasing trade off between food and fuel, that is, food crops being grown for the use of energy did add to the price increase. This is also complicated by the fact that there are government policies backing the use of biofuels which may distort the market.

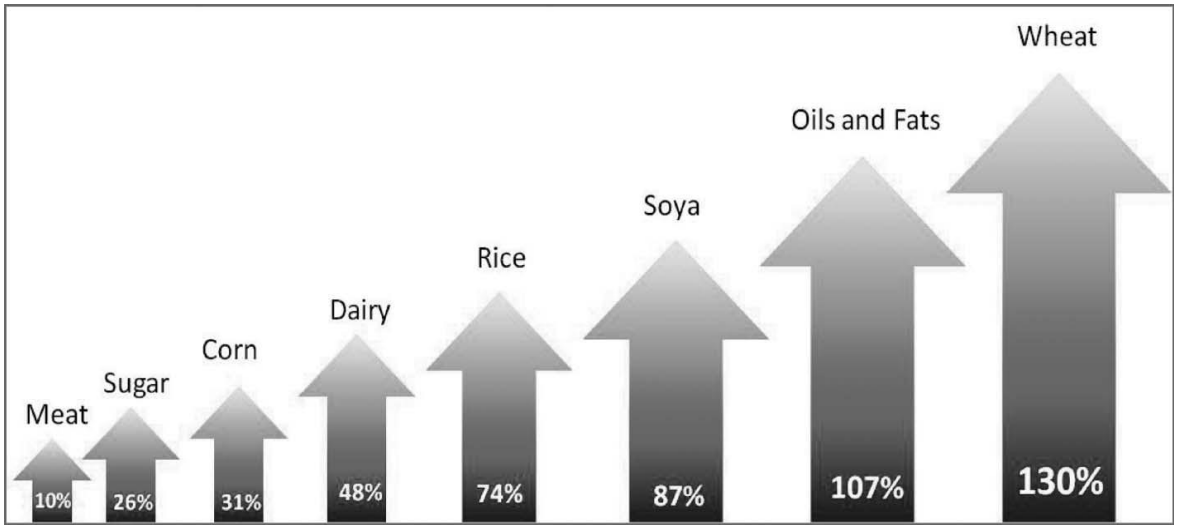

Figure1. Basic commodity price increases from March 2007 to March 2008 (Source: Conceição, Pedro and Mendoza, Ronald U. (2009) '*Anatomy of the Global Food Crisis*', Third World Quarterly, 30: 6, 1159 — 1182, pp 1160)

[13] *The Guardian* , 3 November 2007, "Global Food Crisis Looms as Climate and Fuel Shortage Bite", (http://www.guardian.co.uk/environment/2007/nov/03/food.climatechange)

[14] D. Mitchell,2008, *A Note On Rising Food Prices*, The World Bank, Development Prospects Group, (http://oldweb.econ.tu.ac.th/archan/RANGSUN/EC%20460/EC%20460%20Readings/Global%20Issues/Food%20Crisis/Food%20Price/A%20Note%20on%20Rising%20Food%20Price.pdf)

According to an estimate by the International Food Policy Research Institute (IFPRI), if major biofuels producing countries continue with the current biofuel production strategy, by 2020 world prices of basic food crops (or feedstock) will have increased substantially. Casava would increase by 11 percent, maize by 26 percent, oilseeds 18 percent, sugar by 12 percent and wheat by 8 percent. Maize could account for a 72 percent price rise if a more aggressive biofuel agenda is put into force.[15]

The debate over biofuels has since raised questions of long-term sustainability, solutions to climate change and energy security. The pro-biofuel policies of the United States and the European Union and the heavy subsidies provided to biofuel industries have to be analysed in terms of its impact on other economies, particularly poor and vulnerable parts of the world, where even slight fluctuations in food prices can have grave consequences since poor people spend nearly half their household income on food[16].

Food vulnerability of the poor also means a step back for the Millennium Development Goals (MDGs). The MDGs adopted at the Millennium Summit in September 2000, have set time bound targets to achieve eight primary goals to usher in development and alleviate poverty by 2015. The first of these goals is to reduce world hunger by half by 2015. By itself this goal is ambitious, given that the problem of world hunger and food security has been on the development agenda since decades. The practice of unsustainable agriculture and diversion of resources will only push back any progress in this sphere and the role of biofuels in this respect has to be analysed critically. Ironically, one of the arguments for championing biofuels has been to further rural development. It is clear therefore that the consequences of pursuing a blind biofuel policy give rise to several contradictory outcomes in this regard.

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[15] Conceição, Pedro and Mendoza, Ronald U., 2009, *Anatomy of the Global Food Crisis*, Third World Quarterly, 30: 6, pp 1172

[16] D.Mitchell (2008)

1.3 Methodology

This topic of biofuels straddles several academic discourses ranging from politics, economics, agricultural sciences, environmental studies, chemistry, energy security and science and technology. It is a budding and fast growing research area that lends itself to be analysed from many different perspectives. In this paper, I focus on the public policy and environmental perspective of biofuels. I aim to understand how biofuels are 'marketed' through public policy for the mitigation of climate change, particularly by the European Union, while at the same time locating this paper within the global studies discipline. Given the contemporary nature of the research and the ongoing developments on the biofuels debate, much of the data and literature is from online sources such as journals and scientific periodicals and official communication from international bodies such as the United Nations and the European Union. Information has also been cited from press releases and Directives (from the European Commission).

This paper primarily uses secondary sources of research that have been selected from objective sources with credible scientific citation in the literature. Biofuels being quite a divisive topic with a huge for and against lobby, care has been taken to desist from using facts from organisations or websites that are heavily tilted to one side of the debate for their own interests. I have also used primary sources in the form of official documents, Directives, Communications and press releases, particularly from the European Commission.

During my traineeship at the European Commission, I used my time to attend key conferences and events and speak to officials on the issue of renewable energy and climate change. I attended one high-level debate at the European Parliament that was specifically on the future of biofuels within the European Union. The outcome of the discussions was very indicative of the dilemmas that are facing the policymakers within the European Commission and the growing criticism towards policies that have failed to take into account long-term effects.

1.4 A global agenda

The biofuel agenda is a global one. Policies and practice are not limited to the borders of any particular country but have far reaching consequences beyond their geographical territories. There are strong interactions between the various biofuels polices simply because at the end, biofuels compete in the world market for feedstock and the scarce resource of land. Understanding a global scenario gives an idea of where demand and supply of biofuels originate and how global synergies can mitigate the problems arising from biofuels or exacerbate them. Global ethanol production tripled between 2000 and 2007 and biodiesel production in the same period grew six-fold[17]. In 2006, biofuels accounted for 0.9 per cent of the world's liquid fuel supply by volume and 0.6 per cent by transport distance travelled and ethanol accounts for 86 percent of total biofuel production[18]. The rising price of crude oil will only drive further production of biofuels.[19] To give a global overlook of the biofuel agenda and locate it within the discipline as a global issue, in this section I will briefly outline the

[17]Licht, F.O, 2008, World Ethanol & Biofuels Report, Agra Informa Ltd., Kent, UK http://www.agra-net.com/portal/ puboptions.jsp?Option=menu&pubId=ag072

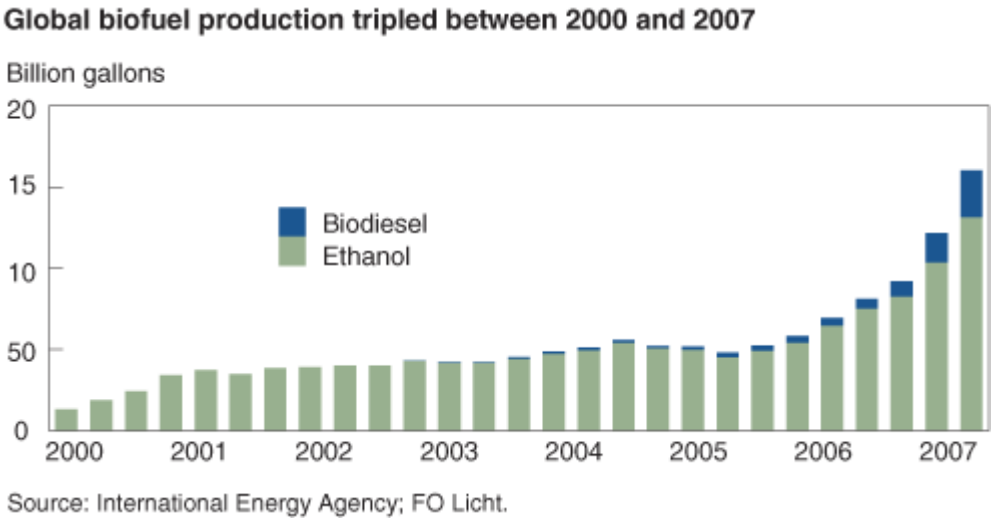
[18] Ibid

[19] In early 2004, petroleum prices per barrel was US$ 30 and went up to US$ 60 by the end of 2005 (Worldwatch Report, *Biofuels for Transportation: Global Potential and Implications for Sustainable Agriculture and Energy in the 21st Century*, 2006, http://www.worldwatch.org/system/files/EBF008_1.pdf)

status of biofuels and related policy in Brazil, the United States, India and China. The case of the European Union will be analysed later in this paper.

As the latter part of this paper focuses on the European Union's biofuel policy it is worth pointing out the connections between demand and supply of biofuels feedstock and consumption of the finished product. One report by the environmental organisation *Friends of the Earth International,* titled *Africa: up for grabs, the scale and impact of land grabbing for agrofuels* highlights the uncomfortable extent to which land has been leased or bought by biofuels companies based in Europe. As cited in the report, a third of land sold or acquired in the African continent has been for growing agrofuels, primarily for import to industrialised countries. This is roughly about 5 million hectares.[20] The stringent renewable energy targets set by the European Union to meet it's targets under the Kyoto Protocol may create a market wherein supply of feedstock will increasing be supplied from African countries or other developing countries. As the graph below shows, in just seven years, global biofuels production tripled, with biodiesel in particular gaining ground between 2005 and 2006.

Figure 2



[20] Africa: Up for Grabs, The Scale and Impact of Land Grabbing for Agrofuels, 2010, *Friends of the Earth International Report* , pp 4

1.4.1 Brazil

Brazil is one of the pioneer countries that has had a robust bioethanol policy since the 1970s. As a way to cope with the oil crisis in 1973, the government launched the National Ethanol Program (called ProAlcool) in 1975 which was aimed at ensuring energy independence and reducing oil imports. The Brazilian ethanol program is heavily linked to its status as a world leader in sugarcane production with sugarcane production increasing manifold due to the demand for feedstock from the ethanol program. The policy aimed to produce from sugarcane anhydrous ethanol that can be mixed with petrol to drive automobiles and hydrated ethanol that could be used to run vehicles. Subsidies, tax breaks and financial incentives were integrated in the program to make ethanol competitive in the domestic fuel market for transportation. In the mid 1980s the program suffered some glitches as oil prices continued to rise, making the dismantling of the ethanol subsidies problematic. The price of sugarcane also soared in 1989 resulting in scarcity of ethanol in some parts of the country. In 1993, mandatory blending of 22 percent anhydrous ethanol with petrol came into force in all petrol retail outlets. Since the year 2000, liberalisation of the ethanol industry in Brazil has driven up exports, particularly due to the high oil prices in the world market. While ethanol has a secure market in Brazil, biodiesel is still in the infant stages. Today nearly 45 percent of all energy consumed in Brazil comes from renewable sources[21]. The global demand for ethanol has resulted in over 7 million hectares of land under sugarcane cultivation with only a little of 3 million hectares of sugarcane being used to produce sugar for food consumption.

1.4.2 The United States of America

[21] Fischer et al, (2009) pp 46

Also looked towards alternative energy sources during the 1970s when crude oil prices in the world market rose following curtailment of supply by the OPEC. By 2006, the United States had displaced Brazil as the largest ethanol producer in the world. Ethanol production in the U.S has been largely maize based. Government subsidies to ethanol production began with the Energy Policy Act of 1978. While the justification of the subsidies was to boost agricultural potential and farm income it was also linked to the need to grow increasingly energy independent. Between 1983 and 2003, subsidies for ethanol were between 40 and 60 cents per gallon. In 2008, it was 51 cents per gallon.[22] It was only in 1990, that ethanol production was linked to environmental awareness. The Clean Air Act passed that year required a percentage of oxygen additive to gasoline (oxygen makes fuel burn cleaner). Ethanol was promoted in this respect since it contains a high percentage of oxygen by weight.[23] The Energy Policy Act of 2005 mandated that total consumption of biofuels in the US must include 7.5 billion gallons of biofuels and funding for US$ 500 to promote the use of biofuels. Further to this, the Energy Independence and Security Act of 2007 raised the targets and stipulated that total motor fuel consumption should include 9 billion gallons of biofuels, and increase this target to 36 billion gallons by 2022. The Farm Bill of 2007 also reduced tax credits for maize-based ethanol from 51 to 45 cents per gallon. The US has also imposed tariffs on imported ethanol so that domestic producers of ethanol have a competitive edge.

The picture of global energy in the future will be largely determined by the policies and practices of expanding economies such as India and China. China and India are expected to experience the fastest expansion in transportation sector energy use in the world.

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[22] Hertel et al, 2008, *Biofuels for All? Understanding the Global Impacts of Multinational Mandates*, Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Orlando, FL, July 27-29, 2008.

[23] During the 1990s methyl tertiary butyl ether (MTBE) was favored as an oxygenator since it was cheaper. However, it was banned following reports of its toxicity and seepage into water sources.

1.4.3 China

China's energy demand has increased exponentially and has been projected to grow from 1742 Mtoe in 2005 to 3819 in 2030, thereby accounting for 30 percent of the increase in global fossil fuel in this period. (Fischer et al, 2009). China's biofuel program was also initiated to foster greater energy security, lower pollution and encourage rural development. The ethanol program took off at the start of the decade but rising food prices in 2007 and 2008 alerted the government against promoting biofuels at the cost of land for food production or using food-grain as feedstock.

The government has a heavily regulated ethanol program wherein new feedstocks for ethanol production have to be approved by government authorities. In terms of targets, China has designated biomass energy as a priority under its renewable energy plans. It aims to produce ten million tons of "non-cereal" ethanol by 2020.

1.4.4 India

In India, the biofuel policy was conceived with the intention of sustainability with an emphasis that biofuels be produced from non-edible feedstocks that are derived from wasteland and therefore do not require the diversion of farm land for non-food production.
The Planning Commission in its "Vision 2020" report drafted in 2002 proposed the plantation of non-edible oil crops on "wasteland" or degraded land across the country.[24] The Indian Government decided to blend 5 per cent ethanol in petrol in some states and start a biodiesel purchase policy. As an emerging economy, India's demand for oil is expected to rise

[24] S.P. Gupta, 2004, *India Vision 2020: Report of the Committee on India Vision 2020, Planning Commission, Government of India plus background papers*, Academic Foundation

from 2.5 million barrels per day to 5.6 million barrels per day from 2002-2030.[25] There is also a correlation between GDP growth and oil demand, and as India's GDP grows between 6 to 8 percent in the coming years, demand for oil is expected to rise between 4 to 5 percent annually in the next decade.

According to the Vision 2020 report, India has 50 million hectares of degraded wasteland that are conducive for growing oil-producing plants. The report states "the greatest advantage of biomass and biofuels is that they can generate ten of thousands of rural jobs and stimulate enormous growth in rural incomes, especially among the weaker sections. Therefore, these strategies should not be regarded from the narrow perspective of energy alone but from the larger perspective of national development."[26] The report highlights the role of *Jatropha Curcas* that has the potential to produce 7.5 million tons of fuel if plated on 10 million hectares. It subsequently it will ensure employment to 5 million people. The National Mission on Biodiesel also promoted jatropha as the answer to rising fuel demands and to further rural development.[27] According to the Report of The Committee on the Development of Biofuel, the Indian Government plans to meet biofuels targets by growing jatropha on 13.4 million hectares of wasteland in the country.[28]

The Mission aimed at mixing 20 percent biodiesel in transport fuel by 2010-2011. However, commercial biodiesel production in India has not been as successful as anticipated. This has largely been attributed to resistance by farmers to growing jatropha on a large scale.[29] The lack

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[25] Kiesow and Norling, *The Rise of India: Problems and Opportunities,* Central-Asia Caucasus Institute and Silk Road Studies Program, 2007, pp 89

[26] S.P. Gupta, *India Vision 2020: Report of the Committee on India Vision 2020, Planning Commission, Government of India plus background papers*, Academic Foundation, 2004

[27] Report of the Committee on Development of Biofuel, Planning Commission of India, 2003 (http://planningcommission.gov.in/reports/genrep/cmtt_bio.pdf)

[28] As cited in: Montobbio and Lele, *Jatropha Plantations for Biodiesel in Tamil Nadu, India: Viability, Livelihoods, Trade-offs and Latent Conflict,* Ecological Economics (7), 189-195, 2010, pp 190

[29] Gonsalves, Joseph B., *An Assessment of the Biofuels Industry in India*, United Nations Conference on Trade and Development, 2006

of adequate information and confidence-building measures on the part of the government has led farmers to believe that jatropha cultivation is not viable. There has been no sustained programme on the part of the government to publicise the National Biodiesel Mission or provide subsidies for farmers to cultivate jatropha as has been the trend in other countries with a determined biofuel policy. The problem with the 'sustainable' approach to biofuel production in India is mainly to do with the approach to land. The idea of waste or degraded land is a highly complicated issue which policymakers appear to have ignored. Wasteland denotes land that was unoccupied, uncultivated or undeveloped. The idea of growing feedstock for biofuels on wasteland is problematic given that most of such land designated as 'waste' is often used by local communities to graze cattle or by children as a playground. Already studies have indicated that India has a very high level of Human Appropriation of Net Primary Production (HANPP)[30]. The global average of HANPP is 25 percent while India's HANPP is 73 percent indicating the huge pressure on land and eco-systems.

The Indian biofuel policy though will have to be clear about the land-use changes that will inevitably accompany its biofuels policy. In the last few years, the central government has taken a more cautious approach to biofuels but state governments have been more robust in earmarking land for jatropha cultivation and setting targets for biofuel production.

Montobbio and Lele show in their paper[31] how a mono-culture towards jatropha cultivation may lead to more harm than good in the long term. The results of their study, on private land cultivation of jatropha in Tamil Nadu, show that jatropha is not necessarily a pro-poor crop that is relatively less dependent on irrigation as it has been touted. They found that crop that

[30] Human Appropriation of Net Primary Production measures the aggregate effect of biomass harvest and land use intensity and denotes the amount of biomass appropriated by human beings relative to other species. See, Singh, Simron Jit et al., *India's Biophysical Economy, 1961-2008: Sustainability in a National and Global Context*, 2011 (Submitted to Regional Environmental Change Journal) , pp 27

[31] See Montobbio and Lele, 2010

was irrigated yielded more in comparison to crops that were rain-fed, thus requiring farmers to invest in additional irrigation for a better yield. Among other factors, the authors emphasise that jatropha crop show results not less than three years after a gestation period and often require farmers to take loans for the upkeep of cultivation.

1.4.5 African continent

The issue of biofuels in African countries is always bound to the issue of land. Biofuels have been identified as a key driver to land acquisition in different countries in Africa, according to a joint study by the Food and Agriculture Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD) and the International Institute for Environment and Development (IIED) [32]. The food crisis of 2008 resulted in greater interest in acquiring land in Africa as a means to ensure food security. However, one-third of land deals in Africa have been related to the cultivation of biofuels, particularly by companies based in China and the European Union. The Mozambique government attests that biofuels investors have applied for rights to use nearly 12 million acres of land in the country, equivalent to one-seventh of the total arable land there[33]. There is a perception of Africa being an untapped source for abundant fertile land for biofuels. Land in Africa is also seen as 'cheap' when compared to the international market prices. According to a Global Agro-

[32] Cotula, L., Vermeulen, S., Leonard, R. and Keeley, J., 2009, *Land Grab or Development Opportunity? Agricultural Investment and International Land Deals in Africa*, IIED/FAO/IFAD, London/Rome.
[33] *Africa: Up for Grabs, the scale and impact of agrofuels*, 2010, Friends of The Earth International Report, pp 10

ecological Assessment[34], nearly 80 percent of the world's reserve agricultural land is in and Africa and South America.

In the absence of land registration documents, land is often sold by the wrong parties. The situation becomes more complex as ownership of land is a contentious issue. The role of land in African communities is often complex involving mostly oral negotiations that have been in practice for centuries among local communities. Land is an integral part of cultural and social identity and form an organic bond with local customs and traditions. Land owned by a community is inaccurately classified as 'idle' or 'wasteland' since it does not have a single owner. The poor understanding of these complex social norms has lead to local farmers and agrarian communities being robbed off their land rights.

Governments have often directly leased land to foreign investors without consulting local communities. Some countries like Tanzania however are starting to regulate biofuels investments and insisting on provisions to involve small-scale local producers. Some African countries have designed their own biofuels policies with a view to tap local resources and reduce energy dependence. Senegal, for instance, has a National Biofuel Policy. The country's Jatropha Program (2007-2012) is part of this national scheme which aims to produce 1,190 million litres of crude jatropha oil that will fuel the transport sector as well as be used for power.[35] Nigeria has also set a national target to use up to 10 percent of home-grown biofuels in the transport sector by 2020. The 'Green OPEC' (fifteen countries in Africa signed a treaty in 2006 to create the Pan Africa Non-Petroleum Producers Association) aims to collaborate to promote biofuels and renewable energy in the African continent. However, the IIED-FAO

[34] Cotula, L., Vermeulen, S., Leonard, R. and Keeley, J., 2009, *Land Grab or Development Opportunity? Agricultural Investment and International Land Deals in Africa*, IIED/FAO/IFAD, London/Rome citing Fischer, G., van Velthuizen, H., Shah, M., and Nachtergaele, F., 2002, *Global Agro- Ecological Assessment for Agriculture in the 21st Century*, Rome, Food and Agriculture Organization of the United Nations (FAO), and Laxenburg, International Institute for Applied Systems Analysis (IIASA).

[35] *Biofuels in Senegal, Jatropha Programme 2007-2012*, Enda Energy, Environment, Development Programme, Ministry of Agriculture, New orientation for the Agriculture Sector Policy, REVA Plan, Special Biofuels Program, March 2007 (http://www.compete-bioafrica.net/policy/JATROPHA%20PROGRAM%20IN%20SENEGAL.pdf)

study shows that none of the land set aside for biofuels in Ethiopia, Ghana, Madagascar or Mal is intended for domestic production and consumption of biofuels.

The scale of overseas investment in Africa countries has raised important questions about the exploitation for natural resources in Africa and a new "scramble for Africa."

In Angola the government has set aside 500,000 hectares of land for the cultivation of biofuels. The Angolan state oil company has partnered with a Brazilian firm in 2009 to plant 30,000 hectares with sugarcane.

In the Congo, a Chinese firm has announced plans to plant palm oil on one million hectares of land.

In Ethiopia, the government has earmarked 300,000 hectares for energy crops primarily to grow sugarcane and jatropha. In Kenya, a Japanese company has announced plans in 2007 to grow jatropha on 100,000 hectares within the next 10 years. A Canadian company also secured 160,000 hectares for growing jatropha in the country. In Mozambique, nearly 5 million hectares of land has been acquired for growing biofuels by foreign investors. In Tanzania, 40 foreign-based companies acquired 8000 hectares of "degraded" forest for growing jatropha. These companies were working with aid agencies such as DFID and the EU Energy Initiative as part of a larger development programme in the country. However, following local protests, the Tanzanian government has suspended investments in biofuels.

Overseas biofuels investment in Africa is seen as a means to produce local jobs. Some governments in Africa have enthusiastically supported foreign biofuels investors in the hope and with the promise that it will lead to creation of more local jobs. However, according to the *Friends of the Earth International Report*, biofuels operations result in very few jobs since production is not particularly labour intensive. In the event that jobs are created, they are usually short-term contracts in time for the plantation and harvest of feedstock. The same

report, says that only one permanent job is created for every 100 hectares of biofuels planted. The jobs themselves are minimum wage and often do not result in a much higher standard of living for local people.

Von Braun (see annex- figure 4) in his paper includes a map outlining regions in the world most conducive for growing biofuels[36]. This map estimates the potential for land that can come under biofuel cultivation if biofuel targets of the United States and the European Union are to be met. The International Energy Agency estimates that nearly 43 percent of cropland will be needed to reach targets of even 15 percent biofuels in the transportation sector. The map takes into account three criteria in a country when gauging potential for biofuels cultivations- i) availability of arable land ii) availability of water and iii) food security in the region. By using this combination of criteria, we get a more comprehensive picture of land potential. It is interesting to note that in this analysis only one country in Africa can be termed as 'high potential' with many others being 'low potential'. Australia and parts of South America score as 'high potential'. From this map, it is clear that countries in Africa are least conducive for the cultivation of biofuels, despite land being 'abundant'. It is not the sole criteria and the continent is severely lacking in adequate water resources and food security.

1.5 Literature Review

A lot of the literature on biofuels is of relatively recent publication given that the study of the impact of industrially produced biofuels is for the most part from the last decade. The timeline of the literature for this paper is from 2003-2010. This reflects the contemporary nature of the problem as in many countries biofuel policies and targets have only been established less than a decade ago. The repercussions of these policies are being felt now and mistakes are being repaired based on credible studies. The contemporary nature of the

[36] Von Braun, Joachim, 2007, "When Food makes Fuel: The Promises and Challenges of Biofuels" Keynote address at Crawford Fund Annual Conference, Australia

literature is an advantage and disadvantage. There is a glut of information on the topic, which makes sifting the relevant and credible sources a challenge. At the same time, every study produced is prone to be disproven or its facts challenged in the next study since research on the topic is ongoing and dynamic in several aspects. The articles cited in the literature have been examined for the scientific credibility and objectivity.

The OFID study prepared by the International Institute for applied Systems Analysis (IIASA), Laxenburg, title **"Biofuels and the Food Crises"**, by Fischer et all (2008)[37] gives an account of the impact of biofuels on food security and the current status of biofuels policies. The study is an important contribution to the literature. To study the impact of biofuels on food security the study uses ecologic-economic modelling approach. It incorporates the FAO/IIASA Agro-ecological Zone model and the IIASA global food system model to quantify the impact of biofuels on food production. One of the main conclusions of the study is that first-generation biofuels, produced at the current pace or even greater, will ultimately be at the cost of availability of food for human consumption as it diverts scarce resources such as land, water away from the cultivation of crops. The study also brings to light the questionable "green" credentials of first generation biofuels.

The report "**Biofuels: Environmental Consequences and Interactions with Changing Land Use"**[38] from the proceedings of a Scientific Committee on Problems of the Environment (SCOPE) International Biofuels Project Rapid Assessment held between 22-25 September 2008 in Gummersbach, Germany is a comprehensive and objective , scientific analysis on the effects of biofuels on the environment. The report, consisting of 15 chapters and an executive summary, is edited by R.W. Howarth and S. Bringezu. It touches on various environmental and socio-economic aspects related to the production of biofuels.

[37] Fischer et al, 2009
[38] Howarth and Bringezu, 2008

Another report cited in this paper is the **Gallagher Review of the indirect Effects of Biofuels Production** by the Renewable Fuels Agency commissioned by the Secretary of State for Transport for the UK Government. It is a crucial study that delves into the indirect effects of biofuels production which is a sort of 'missing link' in biofuel policies. The main conclusion of the report calls for a more discerning biofuels policy, in the face of growing demand for transport fuel world-wide. The report says the indirect effects of biofuels have to be addressed in policy and by governments to avoid causing greater damage than the fossil fuels they replace.

For the section on the indirect effects from land use change from biofuels, Searchinger et al's paper: '**Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change'**[39] is heavily cited in the literature. The paper was among the preliminary studies on the effects from land use change in the cultivation of biofuels. The key finding of the study says that contrary to previous studies, corn-based ethanol instead of producing a 20 percent greenhouse gas savings, doubles greenhouse gas emissions over a period of 30 years and increases greenhouse gases for 167 years. This is because of farmers responding to high prices would convert grassland and forest land for the cultivation of food as more land originally for food is diverted for the cultivation of biofuels feedstock.
The paper by Curtzen et al, '**N2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels'**[40] is an important study on the climate implications of growing biofuels. The study takes into account the nitrous oxide emissions during the life cycle analysis of the biofuel production owing to the use of nitrogen fertilizers and demonstrates how this impacts global warming.

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[39] Searchinger et al, 2008, *Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change*, *Science* , Vol. 319 no. 5867 pp. 1238-1240

[40] Curtzen et al, 2007, *N2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels*, APCD, 7, 11191–11205

PART II

Biofuels in the climate change narrative

2.0 Introduction

In this section, I will look into how biofuels have been incorporated into the climate change narrative. As described previously, the rush to mitigate climate change and adhere to international climate treaties has coincided with the policy thrust to biofuels, particularly in the European Union, which is at the forefront to tackle climate change and also the largest consumer of biodiesel in the world. To understand the role of biofuels in mitigating climate change, it is imperative to understand the story of climate change.

I first look at an overview of how greenhouse gas emissions and global warming came under the academic and policymaking spotlight from the 1950s to the 1970s. I trace how legislation progressed from the United Nations Climate Change Convention to the Kyoto Protocol, which led to legally binding targets to reduce emissions among certain signatory countries.

By tracking the climate change agenda in the European Union, which is essentially a government policy at the European level, I describe how government driven policies have accelerated the rush to biofuels. Government policies do not act in a vacuum but bear deep

consequences on economic and social aspects. By essentially linking biofuels to the climate debate and to some extent the energy security policy, policies have legitimised the use of biofuels and created a market for them through the form of subsidies and tax breaks. The production and consumption of biofuels is justified politically as a means to lower carbon emissions but recent evidence may show otherwise as discussed in the subsequent section.

2.1 Overview of climate change conventions

In this chapter, I would like to focus on the issue of climate change, the conventions that are currently in place and the trend in the climate change debate. This will form the basis on the next section which looks at the rationale of biofuel policies by the European Union as a means to achieve its legally binding targets under the Kyoto Protocol.

The year 2009 was a watershed year in the climate debate. While not producing definitive targets or a legally binding text across the global political spectrum, the Copenhagen Summit has put into perspective the challenges, accomplishments and direction of efforts in climate change mitigation at the international level. While no new treaty was signed by consensus at Copenhagen,[41] there are hopes that the occasion would set the tone for discussion on a post-Kyoto climate change agenda. Climate change is a real problem that needs concrete solutions which means decisive actions on the parts of governments and individuals but this is easier said than done in the face of ground realties of politics, economic and national interests.

The United Nations Framework Convention on Climate Change defines climate change as:

[41] The United Nations Climate Change Conference -The Essentials in Copenhagen, 2009 http://en.cop15.dk/news/view+news?newsid=876

"*A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.*[42]"

Scientific evidence from the 1980s has been increasing to show that anthropogenic activities have resulted in an increasing concentration of greenhouse gases or GHGs which are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation in the atmosphere[43]. The evidence of the "greenhouse effect" was in fact described as long ago as 1827. The French scientist Fourier described how the earth's atmosphere warms the surface by letting through high-energy solar radiation but trapping part of the longer-wave heat radiation coming back from the surface largely due to the presence of carbon dioxide and water vapour in the atmosphere[44]. Swedish scientist Arhenius postulated at the end of the 19th century that one of the outcomes of the Industrial Revolution was the increased amounts of greenhouse gases in the earth's atmosphere that was warming up the earth's surface. The first global initiative about climate change can be traced to 1957 when the International Geophysical Year brought scientists together who monitored the impact of human activities on planetary processes.

Research on climate change and the effects of greenhouse gases started picking up in the subsequent years. Nearly a decade later, the Massachusetts Institute of Technology highlighted the concerns of climate change, and in 1970 the United Nations Security General spoke of a "catastrophic warming effect" of the earth in a report on the environment[45]. In 1979, the first World Climate Conference established the World Climate Research Programme that brought

[42] United Nations Framework Convention on Climate Change, 1992, pp 4
http://unfccc.int/resource/docs/convkp/conveng.pdf

[43] United Nations Framework Convention on Climate Change, 1992, pp 4

[44] Grubb, Michael et al , *The Kyoto Protocol: A Guide and Assessment,* Earthscan, 1999, pp 3

[45] Ibid

the issue into the limelight of international concern. In 1988 the Intergovernmental Panel on Climate Change (IPCC) was formed. This organisation was set up by the World Meteorological Organisation, Geneva and the United Nations Environmental Programme (UNEP). One of the rationales behind setting up the IPCC is that given the scientific complexity of climate change and the political sensitivity attached to the problem, there was a need for a neutral body that could be a source of bias-free and objective information.

Climate change awareness has been grouped under three stages: from the mid 1950s to the mid 1980s there was broad consensus on the scientific evidence that projected the reality of climate change. The second phase, from around 1985 to 1988, political and public interest in climate change grew, while from 1988, the third phase, post 1988 has seen the emergence for evolving an international policy response to climate change.[46]

2.1.1 The United Nations Framework Convention on Climate Change

In December 1990, the General Assembly of the United Nations passed a resolution allowing the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change (INC/FCC) to be set up. This committee had the task to draw up an effective framework convention on climate change. Between 1990 and 1992, the INC held five sessions. Participants from over 150 countries discussed the possibilities of binding commitments, the financial mechanism that would be needed to combat climate change and the differentiated but common efforts of developed and developing countries. Part of the challenge of the INC meetings was to draft a framework that would have popular consensus

[46] Mintzer, Leonard, Chadwick, 1995, *Negotiating Climate Change: The Inside Story of the Rio Convention*, pp 45

from the majority rather than focus on details that would deter support for the framework.[47] Climate change and measures to mitigate it are more deeply political issues than simply environmental ones. While most countries acknowledge the reality of climate change few are willing to bite the bullet and take actions that would sometimes be at the cost of national or popular interests. During the discussions there were disagreements between developed and developing countries. Developing countries were reluctant to agree to commitments that would hamper their economic growth. For these economies, reducing emissions would mean compromising on agricultural and industrial output that could possibly stagnate their economic growth. Many saw the climate change problem as a problem created by developed countries starting with the era of industrialisation from the 19^{h} century as witnessed in those economies with the rise of manufacturing and factories. Climate change is the legacy of the Northern countries economic progress during the past century. The burden therefore in reducing its impact should fall on them, rather on poor Southern countries who are only now charting their industrial growth. Developed economies, it was discussed, would also have to commit to funding measures to mitigate climate change in poorer countries who were already hard-pressed for resources. Another set of objections in these discussions leading to the ratification of the convention were expressed by the oil economies who were apprehensive about any measures that would demand a decrease in fossil fuel consumption and thereby threaten their prosperity and security. Given the complexities involved in the issue and the varying levels of commitment it was clear that while the convention would not be able to set any quantitative targets it would form a framework within which countries could establish their obligations with respect to climate change as a global phenomenon.

[47] *A Brief History on the Framework Convention of Climate Change:* Earth Negotiations Bulletin, Vol.12, No.12, March 1995 (International Institute of Sustainable Development)

On 9 May 1992, the United Nations Framework Convention on Climate Change was adopted. At the Rio Conference in 1992, the convention was endorsed by 155 signatories after which it came into force from March 1994. The convention covers those GHGs not covered by the Montreal Protocol[48]. The parties largely focus on their emissions of carbon dioxide, methane, nitrous oxide, perfluorinated hydrocarbons, hydroflourocarbons, and sulphur hexafluoride. It also created a method whereby emissions could be estimated in terms of carbon dioxide equivalents[49]. Once the convention came into force, negotiations continued to evolve through the Conference of Parties (COP). The COP is the main body that reviews the convention and makes decisions with the help of two subsidiary bodies that are largely engaged with the technical aspects of the convention. At the COP 1 in Berlin in March/April 1995 the negations moved towards strengthening the commitments of Annex 1 Parties.[50] Delegates were required, in what came to be called the Berlin Mandate, to set quantitative targets to reduce emissions. The negotiations continued to be highly politicised, with several countries such as the oil-exporting countries and powerful industry groups, many from the United States of America, reluctant to make new commitments or agree that the old commitments were inadequate.[51] Many from within the United States said any fresh commitments would have to be global, putting equal onus on the developed and developing countries alike. It was finally decided at Berlin that the current conventions commitments were inadequate and to "begin a process to enable it to take appropriate action for a period beyond 2000."[52] Industrialised countries were called upon to a) elaborate policies and measures and b) set

[48] The Montreal Protocol on Substances that Deplete the Ozone Layer is an international treaty signed by, to date, 196 countries to protect the ozone layer and phase out the production of substances that were resulting in ozone depletion. It entered into force in 1989.
[49] United Nations Framework on Climate Change: The First Ten Years, Climate Change Secretariat, 2004 http://unfccc.int/resource/docs/publications/first_ten_years_en.pdf (accessed April 21, 2009)
[50] These are mostly the developed countries, of which there are currently 41, including the European Community which is a Party in its own right. Annex I countries were aiming to return their emissions by 2000 to 1990 levels (See United Nations Framework on Climate Change: The First Ten Years, Climate Change Secretariat, 2004, UNFCC, http://unfccc.int/resource/docs/publications/first_ten_years_en.pdf
[51] Grubb, 1999, pp 46
[52] Grubb, 1999, pp 47

quantified limitation and reduction objectives within specified time-frames such as 2005, 2010, and 2020 for their anthropogenic emissions.

2.1.2 The Kyoto Protocol

Following the Berlin Mandate negotiations continued apace until the second Conference of Parties (COP) in Geneva in July 1996. This round of negotiations was held under the chairmanship of United States senator Tim Wirth. The Geneva round proved decisive in that it was there, with the initiative of the United States of America, that for the first time a need to have binding targets on emissions was emphasised. Representatives endorsed the IPCC Second Assessment Report that endorsed the Berlin Mandate with the words "legally binding." The high stakes involved on the table, the divergent opinions and the global agenda made the negotiations leading up to the Kyoto Protocol long and winding. Nearly 10,000 people attended the Kyoto Conference in December 1997. The negotiations culminating with the Kyoto Protocol took 30 months. While it is not in the scope of this paper to delve into the minute details that went into the negotiating process and legal and technical aspects of how the protocol evolved, it must be said that the negotiations were an international tug-o-war that saw countries change or emphasise their stance depending on national interests and political and economic limitations. The Kyoto Protocol is a watershed international agreement in environmental history and climate change since it successfully, though not easily, outlined commitments that were legally binding for Annex B countries[53] in reducing greenhouse gas emissions.

[53] Also called Annex I countries which are industrialised countries

The Kyoto Protocol has flexible mechanisms, in addition to their national measures, that will enable the countries legally bound to reduce their emissions and reach their targets. The Kyoto Mechanisms are: i) Emissions Trading ii) Clean Development Mechanism, and iii) Joint Implementation.

These mechanisms are based on the Coasian solution to the tragedy of commons, privatise the commons and trade the resulting property rights. The fundamental economic theory behind this is that well-informed trade between two consenting parties will provide benefits to both parties.[54] In principle, emissions reductions can be achieved at least cost in society through emissions trading. While the economics of this might sound straight forward, the "commodification" of the environment by creating a carbon market has raised ethical questions, some of which will be discussed below.

Emissions Trading enables countries to trade in carbon and has given rise to a 'carbon market'. Countries that are party to emission targets are entitled to a stipulated amount of emission (calculated in terms of 'assigned amount units') in the period from 2008-2012. Countries that have not used their emission allowance can trade these units with other countries that have exceeded their emission threshold, thereby setting up an exchange system of carbon units. The largest international implementation of an emissions trading system has been under the European Union Emissions Trading System (EU ETS).

The **Clean Development Mechanism** allows a country that is committed to reducing or limiting emissions through emission-reduction projects in a developing country thereby earning credit points that can be translated into tradeable carbon credits with one credit accounting for one tonne of carbon dioxide. These credits can be accounted within the Kyoto

[54] Hepburn, Cameron; *Carbon Trading: A Review of the Kyoto Mechanisms,* Annual Review of Environment and Resources Vol. 32: 375-393 (Volume publication date November 2007) pp 379

Protocol's emission targets. This mechanism is seen as a win-win situation wherein industrialised countries can reach their emission targets by initiating a development project aimed at reducing carbon emissions in a developing country, that may not be legally bound to reduce emissions.

According to the UNFCC website, *"The mechanism stimulates sustainable development and emission reductions, while giving industrialized countries some flexibility in how they meet their emission reduction or limitation targets."* [55]

The third and last mechanism offered by the Protocol is the **Joint Implementation** mechanism, whereby a country that has an emission reduction or limitation commitment can earn Emission Reduction Units (each equivalent to one tonne of carbon dioxide) from an emission reduction or emission removal project in another country that is also committed to reducing or limiting emissions. This "transfer" of emission targets allows countries more flexibility and cost-efficient means to reach their Kyoto targets.

While these mechanisms are in place, the protocol also has emission monitoring systems in place that ensure that accurate records of traded emissions are accounted for by the signatories. A reporting system is in place to keep record of annual emissions of countries and collect national reports that they are obliged to submit as party to the protocol. A compliance system also ensures that parties are meeting their targets and assists them in reaching their commitments should they face any problems. While the protocol is signed up till 2012 this does not imply that it will expire, rather a new international framework will have to be put in place by that time to carry forward the emission targets.

As mentioned below these mechanisms have not been without criticism. There has been considerable debate on whether the Kyoto Protocol has been an effective international tool in

[55] See UNFCC http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php

reducing emissions. In theory, Emissions Trading has been described as "an instrument for reaching maximum efficiency of abatement efforts."[56] Some scholars argue that the protocol was not visionary enough when setting emission targets of the Annex I countries to their 1990 levels. For example, emissions from some of the largest growing economies such as India and China were not taken into account. The system of trading carbon has also drawn criticism as a way of 'commodification of the environment' and making the emissions trading on the global market susceptible to manipulation. There is another ethical debate surrounding emissions trading. The concept of emissions trading has also left many uncomfortable as it legitimises pollution and allows richer countries to buy their way out as polluting agents. The idea of using an emissions trading system to reduce greenhouse gas emissions is also seen as complex. As put by Skjærseth and Wettestad: "Emissions trading cannot in itself reduce emissions or pollution; its effect depends upon how it is designed."[57] Carbon trading has also been described as a neoliberal 'accumulation of decarbonisation' and likened to the sale of indulgences in the Catholic Church in the early sixteenth century.[58] Emissions trading is based on the logic that an attractive monetary incentive attached to carbon emissions will encourage companies to lower their emissions and sell their credits to large polluters and profit. However, the enforcement of such a system at the international level with an effective authority to monitor trading is imperative in ensuring its success.

The other two flexibility mechanisms have also been contested and their suitability questioned. The Joint Initiative (JI) is mainly targeted at collaborations among industrialised countries. This mechanism also is theoretically designed to provide benefits to both countries involved as a means for one country to gain through investment and technology-sharing and

[56] Ott, Hermann E. and Wolfgang Sachs, 2000, *Ethical Aspects of Emissions Trading*, Wuppertal Institut für Klima, Umwelt, Energie, (http://www.wupperinst.org/uploads/tx_wibeitrag/WP110.pdf)
[57] Skjærseth and Wettestad, 2008, *EU Emissions Trading: Initiation, decision-making and implementation,* Ashgate, pp 2
[58] Hepburn (2007) pp 379

the other to gain carbon credits. However, this mechanism is also difficult to calculate given the 'environment additionality' of such projects is difficult to differentiate from normal projects. For example, drawing a common baseline against which we can measure this additionality is also mired in complications. As pointed out: "In the medium or long run, there is likely to be a plurality of baselines all of which have different implications in terms of climate policy. Countries are not likely to follow a pre-stabilised course, in which direction they move will depend on resource endowments, socio-economic conditions, relations of power and cultural outlooks."[59]

The Clean Development Mechanism (CDM) is a partnership between a developing country and an industrialised country. This mechanism was aimed at enabling non-Annex 1 countries under the Kyoto Protocol (developing countries) to ensure sustainable development while reducing their emissions.

Though again theoretically appealing with beneficial intentions to both parties, the CDM is also problematic in determining how these development projects aimed at reducing emissions can be conceived, implemented and evaluated accurately though there are elaborate measures and checkpoints in place to monitor such projects. The treaty outlines that certified emission reduction (CERs) are only created if all parties give their voluntary approval and if the emissions reductions are real, measurable, and additional[60]. The Project Design Document that has to be submitted for CDM projects is in itself high on transaction costs. Projects are evaluated against approved methodologies to determine the baseline on a case-by-case basis and it is determined if 'additionality' is achieved through the project. If a new untested methodology is used it has to be approved first by the CDM Executive Board. These obligations can lead to delays and further costs. Once the Project Design Document is

[59] Ott and Sachs, 2000, pp 20

[60] Hepburn(2007)

completed, it has to be submitted to a Designated Operational Entity that has the task to validate it, and check if all criteria have been adhered to by both parties. In particular there are evaluation procedures in place to check if 'additionality' is expected to be achieved through the project. The most obvious problematic aspect of CDM, apart from the technicalities of the mechanism, is how it is linked to sustainable development for developing countries. Development is a complicated issue that raises many questions about motives and results to beneficiaries. Debates on sustainable development often question the narrative of the conventional development trajectory. In terms of developing countries, the narrative of development has shifted to make sustainable development the mainstream path of development. In my interpretation, development in a contemporary understanding encompasses sustainability criteria and many developing countries, irrespective of Kyoto mechanisms, are choosing to embrace a more sustainable development path, either voluntarily or involuntary. To quote Ott and Sachs: "A country which for reasons of equity promotes biodiversity habitats, resource-light production, livelihood agriculture or the institution of community rights may already avoid a great deal of emissions , over and above any 'additionality'. Defining a baseline, all the more so in treaties with international partners, is therefore rather counterproductive for each country's search for sustainability; such a definition will most likely codify the dominating conventional view of development."[61]

Further in the same line of argument, Ott and Sachs question if CDM projects are really initiated in developing countries which do not have the infrastructure to support such projects, rather these projects are conceived for newly industrialised countries that have more promising prospects and are emerging markets. This trend could jeopardise countries that may be in dire need of environmentally sustainable projects but lack the institutional framework to support them.

[61] Ott and Sachs, 2000,pp 20

2.3 European Union under the Kyoto Protocol

The European Union ratified the Kyoto Protocol on May 3, 2002. In a press release issued by the European Commission the same day, the then Environment Commissioner Margot Wallstrom said: "*This is an historic moment for global efforts to combat climate change. Following today's ratification by the EU and its Member States, the countries responsible for an important share of the industrialised world's emissions in 1990 are legally committed to the global framework to address climate change. The scientific evidence on climate change is stronger than ever. We all know that even the targets in the Kyoto Protocol are only a first step if we want to prevent the severe consequences that climate change could have. All countries have to act, but the industrialised countries have to take the lead. Climate change can only be tackled effectively through a multilateral process. I urge our partners both in the developed and in the developing countries to also ratify the Kyoto Protocol soon*."[62]

The European Union has been at the forefront of international climate change policy since the early 1990s. The continent has set a precedent for the climate debate through the initiation of non-governmental organisations and policy endorsed by member states. Many environmental groups in the early 1990s made climate change a priority issue. The Climate Network Europe (CNE), a regional network of the Climate Action Network was set up in

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[62] Press Release from the European Commission , IP/02/794**,** 31 May 2002, Brussels (http://europa.eu/rapid/pressReleasesAction.do?reference=IP/02/794&format=HTML&aged=0&language=EN&guiLanguage=en)

1989. By 1998, CNE had 76 members in 19 European countries[63]. This civil society movement was running parallel to a political assertion of Green Parties that become an important voice in parliamentary politics in more than two-thirds of European Member States such as Germany, Austria, Sweden, Belgium, Finland, Italy, Ireland, France and the Netherlands. During that decade the European Union consisted of 15 Member States with the accession of Austria, Finland and Sweden in 1995. Even before Kyoto, the European Commission initiated proposals such as energy tax at the European level. But these did not gain favour among member states since they feared competitive disadvantages and resistance from industries. Many feel that these factors have made climate sceptics less influential in Europe than in the United States. While the Commission did not lead any international climate negotiations, member states agreed on common positions and put forward a joint strategy with the help of the Commission. By 1990 figures, the EU accounted for 24 per cent of Carbon dioxide emissions among industrialised countries.[64] This was roughly 15 per cent of global carbon dioxide emissions. During the Kyoto negotiations, there were North-South divides in the European Union's approach. The relatively poorer Southern states such as Portugal, Spain and Greece had demanded increases in emission allowances which could be offset by the Northern countries. The European Union's "green policy" has also been tied to its energy needs.

2.4 Tackling climate change in the EU

[63] Oberthür, Sebastian and Hermann Ott, 1999, The *Kyoto Protocol: international climate policy for the 21st century,* Springer-Verlag, Berlin, pp 14

[64] Ibid

Being at the forefront of an international movement to tackle climate change through a legally binding treaty, the European Union has been under enormous pressure to find ways to cut back on greenhouse gas emissions. The role of the European Union, from a developed economy perspective, is particularly crucial given that the United States has refused to sign the Kyoto Protocol. The EU has set up a complex regulatory framework to tackle climate change. The complexity of the challenge can be understood from viewing it through a three-tier perspective. Climate change is a global challenge, while the regulations are at the regional (EU level) and the local (member states level). The importance of legally binding frameworks through several regulatory instruments is necessary to keep carbon emissions low, since market forces by their current nature will not lead to a low carbon society. In this regard, the European Union has had to come up with public policies that will complement and direct economic and other instruments towards lowering greenhouse gas emissions.

The EU has developed a mix-bag of regulatory approaches to reach its Kyoto targets. However, given the structure of the Union and the difficult task of balance of power between European level and member states, much of the climate legislation is left to the discretion of member states. The shortcoming of not having a single EU-wide binding legislation is that assessing the impact of legislation by each of the 27 member states and then at the European level is a difficult task.[65]

In the short- term, the EU's challenge is to adhere to legally bound obligations to lower greenhouse gases by 2012 as per the Kyoto Protocol, the long-term strategy can be even more complex given that a post-Kyoto international climate agreement is still yet to be designed, taking into account the difficulties in reaching such a consensus at Copenhagen in 2009. The

[65] Peeters, Marjan and Deketelaere, 2006, *EU Climate Change Policy: The Challenge of New Regulatory Initiatives*, Edward Elgar Publishing, pp 4

EU however has been taking into account post-2012 scenarios. In 2005, the meeting of the council of the European Union indicated that the EU should not be taking the responsibility for climate change alone. It said developed countries should aim for a 15-30 percent emission reduction, compared to 1990 levels, by the year 2020. That same year, the Environmental Council said that developed countries must pursue an emission reduction target of 60 percent to 80 percent by 2050.

The approach towards climate change in the EU is largely based on a regulatory concept, which is rather a new are for the EU as it uses emission trading and taxation to lower greenhouse gas emissions.[66] The trajectory of the EU climate change policy has largely shadowed international treaties and legislation.

This timeline summarises the important landmarks in the European Union's climate policy since 1989[67]:

Table 1: European Union Climate Change Policy Timeline

Year	EC/EU climate-related action
1989	The European Union started the beginnings of its climate change policy in preparation for the Rio Summit.
October 1990	At a meeting, energy and environmental ministers concluded that if other countries committed to similar agreements, the whole of the European Community was willing to stabilise carbon dioxide levels to the 1990 levels.

[66] Peeters and Deketelears,2006, pp 5
[67] Information from Peeters and Deketelears,2006, pp 43

1993	The Directive 93/76/EEC (SAVE) required Member States to establish measures to limit their carbon dioxide emissions through improvements in energy efficiency, especially with regard to energy certification and thermal insulation of buildings. The Directive did not set any quantitative targets and left the definition of such at the discretion of Member States. The same year the Community adopted the Altener programme on renewable energy. A Community law came into effect, following a Decision from the European Community earlier this year, which established a monitoring mechanism of carbon dioxide and greenhouse gas emissions. Member States were required to inform the Commission about national measures that will limit carbon dioxide and greenhouse gas emissions. The Commission was required to evaluate whether the national programmes to reduce emissions would be sufficient for the Community as a whole to stabilise emissions to 1990 levels.
1994	The Community focuses on international negotiations surrounding the UNFCC.
1995	The first COP launched negotiations among industrialised countries on specific quantitative targets to cut carbon emissions.
March 1997	Community decided for the first time in a few months ahead of the finalisation of the Kyoto Protocol, the emission reduction and targets to be achieved by each Member State and a provisional outline of possible common and coordinated measures.
1997	The Kyoto Protocol negotiations determined a target for 8 percent emissions reduction of 1990 levels for industrialised countries.
June 1998	The Community faced political disagreements on the sharing of burden between Member States to reach the Kyoto targets. The Luxembourg 'burden sharing' agreement of June 1998 would only be reached four years later in 2002.

1998	The Council gave its consent to an agreement signed between the European Commission and the European association of car manufacturers which spelled out carbon dioxide reduction measures for cars in the European market. The agreement was formalised by a Commission recommendation in early 1999.
April 1999	The Commission amends Decision 93/389/EEC to make for better evaluation of monitoring mechanisms of greenhouse gas emissions and the exchange of information from national reduction programmes. Member States were obliged to offer more information on their emission reduction programmes which were foreseen to be taken into account for an annual evaluation by the Commission. However, the amendment however did not specify national targets for Member States despite the difficult burden sharing negotiations of 1998.
September 2001	On the eve of the Marrakesh COP7, Directive 2001/77/EC was issued which bound Member States to take measures to promote the use of electricity from renewable energy in accordance with national objectives.
2001	The year 2001 is in a sense a watershed year in climate policy in the European Union. Up until this year the Commission has not taken advantage of any legally binding acts to enforce climate-related agreements within the Community. Only after the Bonn and Marrakesh accords, and the process of ratification of the Kyoto Protocol did the European climate policy become more inward looking, seeking ways in which it could move beyond information sharing and incentive measures to actually defining how targets will be met by specific Member States.
October 2001	The Commission present to the Council a draft decision to ratify the Kyoto Protocol and formalise burden-sharing of emissions among Member States. It also submitted a draft Directive of greenhouse gas emission allowance trading system within the European Community. The Commission also submitted to the Council and European Parliament a Communication on the first phase of implementation of the European Climate Change Programme (ECCP). This programme was designed by several stake-holders such as member State

	experts, policy-makers and representatives of non-governmental organisations on common and coordinated measures to tackle climate change. The programme formed an important basis on which future proposals of the Commission were designed.
April 2002	The European Union ratifies the Kyoto Protocol. The Council and the Commission also seek to formalise several internal procedures that will work towards reaching the emission reduction targets.
2004	The Commission revises its greenhouse gas emissions monitoring mechanism set up in 1993 and first revised in 1999. The 2004 Decision included a mechanism that not only monitored greenhouse gas emissions in the Community but also implemented the Kyoto Protocol.
February 2005	Commission publishes its Communication titled "Winning the battle against climate change". This forward-looking Communication focused on climate change related action beyond 2012 and the need to bring more countries and sectors to commit to emission reductions and to promote low-carbon technologies and outlined how to adapt to the effects of climate change. The Communication also announced the launch of the ECCP II at the end of 2005. This was also the year that the Kyoto Protocol entered into force.
March 2007	European Union summit endorses a proposal to undertake a unilateral decision to reduce greenhouse gas emissions by 20 percent by 2020.
December 2009	Copenhagen Climate Summit- Failure to reach any international consensus on climate negotiations

The European Commission has further released many Directives related to climate change and the environment. The specific Directives related to Biofuels are discussed in the chapter on European Union's Biofuel Policy.

2.5 Government support measures for biofuels

Climate change policy is high on the EU agenda and incorporates policy that aims to reduce greenhouse gas emissions. Since the EU is treaty-bound to tackling climate change and taking concrete measurable steps in this regard, government intervention plays a key role in the production and consumption of biofuels in the European Union. An OECD Economics Assessment of Biofuel Support Policies found that biofuels are heavily dependent on public funding to be viable and compete with other fuel sources such as gasoline and diesel.[68] Government support for the supply and use of biofuels accounted US$ 11 billion in 2006 in the United States and the European Union, this figure is projected to increase to US$ 25 billion by 2015.[69] The support for biofuels is in many forms, through policies and legislation that is buffeted by tax concessions or financial support for biofuels producers and retailers. Mandates may be applied for a minimum percentage of blending biofuels in transportation fuel. Governments can also apply trade restrictions such as import tariffs to protect the domestic market and indirectly discourage alternative fuel suppliers.

Below is a brief description of how some governments can support measures to promote biofuels as outlined in the comprehensive study by Fischer et al (2008) :

i) Import tariffs

Import tariffs are applied to imported ethanol with a view to protect the domestic market. The United States, European Union, Canada, Switzerland and Australia are countries with the

[68] Fischer et al, 2008, pp 36
[69] Fischer et al, 2008, pp 36

highest import tariffs towards biofuels. Australia has one of the highest tariffs for imported ethanol.

ii) Tax exemptions

Among OECD countries, support for biofuels is usually complemented through reductions of exemptions from fuel excise tax. The United States was one of the first countries to apply exemptions to tax to biofuel suppliers. In the European Union, fuel excise tax is offered for ethanol by all countries except Czech Republic, Greece Finland, Italy and Luxembourg. Germany has excise concessions for E85. However, all the countries in the EU have fuel excise exemptions for biodiesel.

iii) Mandates

Many countries have introduced targets and mandates for the use of biofuels. Mandates make sure there is a permanent and assured market for biofuels, thereby creating incentives for producers and suppliers. Mandates may be voluntary or mandatory by law. In the case of the European Union this is discussed later in the paper.

The table below gives an outline of select countries and their respective mandates by target years:

Table 2: Mandates for transport fuel[70]

Country/region	Mandatory, voluntary or indicative targets
European Union	10 percent by 2020
Japan	Reduce fossil fuel dependence for transport from 98% to 80% by 2030
United States	20.5 billion gallons by 2015, 36 billion gallons by 2022 (16 billion from cellulosic ethanol)
Brazil	Mandatory 25% ethanol blend with gasoline
China	10 million tonnes of ethanol by 2020, 2 million tonnes of

[70] Countries selected from Fischer et al, 2008, pp 38

	biodiesel by 2020
India	20% ethanol blending in gasoline and 20% biodiesel blending by 2017
South Africa	2% of biofuels by 2013

iv) Direct subsidies for production

Governments in several OECD countries have initiated subsidies for biofuels based on volumetric production. For example, since 2004, the United States Federal Government provided an excise credit of $0.51 per gallon of ethanol to blenders. The government also provided a small tax credit to new biofuels or biodiesel factories on their first 15 ML of biofuels production. In April 2008, The Canadian government initiated a nine-year $ US 1.5 billion biofuel incentive programme- the eco-ENERGY for Biofuels programme- that would provide attractive incentives for the first three years to manufacturers who were producing "renewable alternatives to gasoline".

v) Incentives for investment

Biofuel producers in several countries benefit from direct investment incentives from several layers of government in the form of capital, government loans or government guaranteed loans. One study cited in Fischer et all (2008) gives the example of a biofuels plant in the US state of Ohio which benefited from direct investment incentive through 60 percent of its capital being directly from government intermediated credit. In the European Union, a report published in 2007 titled 'Biofuels at what cost?' cited that government support for ethanol and biodiel in OECD countries accounted for 60 percent of investment costs in some cases.

vi) Support for flex fuel automobiles

In many countries government support has extended to providing subsidies for the manufacturing of flex-fuel vehicles (FFVs). These vehicles are designed to run on a blend of ethanol. In Brazil tax exemptions are offered on vehicles that can run on a higher blend of ethanol. In Sweden, incentives have gone as far reducing registration charges and providing

free parking to FFVs. In the United States the motive behind supporting FFVs was seen as increasing these cars on the roads and forcing fuel providers to offer E85 pumps in fuel stations.

vii) Research and development

Promoting research and development on biofuels is key to ensuring that biofuels are produced sustainably. Current research on biofuels focuses on feedstock for second generation biofuels. It also means new technologies that can make ethanol from lignocellulosic material cost effective.

2.5.1 The economics behind policies that drive biofuel production

Government policies as described above through incentives and tax credits have pushed the production of biofuels artificially beyond the actions of market forces. They have been key drivers of biofuels and without the support of public funding, the production of biofuels may have not thrived or competed with other conventional sources of energy such as fossil fuels. Brazil was among the earliest countries to initiate a formal government support scheme for biofuels in the 1970s. Other countries such as the United States and the European followed suit. Support for biofuels is a through a combined approach of mandates, tax credits and incentives for constructing ethanol or biodiesel plants.

An OECD study in 2007, estimated, based on work by the Global Subsidies Initiative, those OECD subsidies for biofuels in 2006 was $ 11 billion.[71] Assuming the same levels of support and rate of production, subsidies are expected to reach $ 27 billion per year between 2013-17.[72] The OECD has estimated that elimination of biofuels subsidies would in fact reduce

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[71] T.D. Searchinger, 2008, *Government Policies and Drivers of World Biofuels, Sustainability Criteria, Certification Proposals and their Limitation*, from *Biofuels: Environmental Consequences and Interactions with Changing Land Use,* Howarth, R.W and S. Bringezu, 2008, pp 38

[72] Ibid

ethanol production in the United States by 20 percent on average compared to subsidised production between 2013 and 2017[73]. The same study says European and Canadian biofuels production, without subsidies, would reduce by 80 percent. The only exception would be Latin America where production costs are low, and where production would actually benefit and subsequently increase in the absence of subsidised competition from other regions and countries.

Government policies also influence the price of oil and as such make the production of ethanol sensitive to the price of oil. Birur et al (2007) cited in Seachinger (2008) calculated that US corn ethanol, receiving a tax credit of $0.13 per litre, was more economical than gasoline at $90 a barrel even though the price of corn was $ 5per bushel. The dependence of biofuels on oil prices is one of the aspects of most concern because if gasoline prices go up, the prices for feedstock increase until production of ethanol becomes economically unviable.

While high oil prices can independently drive biofuels production, the existence of government subsidies buffers the biofuels industry from the shocks of oil price fluctuations. As pointed out by Searchinger, *"When oil prices are high, demand for biofuels can help drive higher grain prices to a point at which produces can no longer make a profit. This phenomenon occurred in the summer of 2008 as extraordinarily high corn prices forced ethanol producers to cut back. On the other hand, US ethanol producers also lost money when ethanol production dropped in response to collapsing oil prices in the Fall of 2008 due to a global recession."*[74]

The production of biofuels in the future will be risky given these fluctuations. Government subsidies and guarantees reduce the market risk, as they assure producers of a guaranteed market through mandates and tax credits. Many countries, including developing counties, have followed the trend of mandates to ensure a reliable market for biofuels. Most countries

[73] Ibid

[74] T.D. Searchinger, 2008, *Government Policies and Drivers of World Biofuels, Sustainability Criteria, Certification Proposals and their Limitation,* pp 39

have adopted a 10 percent goal. For instance China has initiated a 10 percent blending requirement for biofuels, which is cushioned by sales tax exemptions and financial guaranties. Developing countries are emerging as key biofuels players in the global market since they are seen to have advantages in terms of producing feedstock, owing to tropical climes, and low production costs.

The trade of biofuels is also protected through import tariffs and preferential measures that are designed to discourage or eliminate international competition and promote domestic markets. Trade in biofuels will definitely be on a positive growth curve simply because given the targets set by countries, the will not be able to rely solely on domestic production. Trade in biofuels feedstock is a contentious global issue. In the absence of trade barriers, many developing or underdeveloped countries, with a tropical climate and low production costs, have a comparative advantage in feedstock production which will set a cycle of trade of raw material from poorer countries being exported to advanced industrial countries, who will produce the biofuels that will form an important component in their transport and automobile sector. According to Dornbush and Steenblick, 2007, when water is not a limitation, tropical countries have two to three times higher productivity of biofuels feedstock, such as sugarcane and palm oil, compared to temperate climatic zones. Part of the agenda of biofuels is to promote rural agriculture prospects. This is one of the reasons that the biofuels trade is protected. Countries and regions, such as the United States and European Union, would find it far more economically viable to import cheap feedstock, such as sugarcane and palm oil, which are perennial but choose to rely on domestically produced rapeseed and corn. By producing the feedstock domestically, they would also reduce their dependence on imported feedstock. Free international trade in feedstock, would make production of feedstock economically viable by pushing production to regions that own a comparative advantage in production and reducing prices.

Tariffs play a crucial role in protecting trade in biofuels. Many countries apply differential tariffs based on trade agreements with other countries. In OECD economies, ethanol tariffs range from 6 percent to 50 percent.[75]

Non-tariff barriers include regulatory measures that take into consideration safety and certification of imports. Biofuel feedstock are often subject to what is termed under WTO parlance as sanitary and phytosanitary (SPS) measures. These measures are intended to monitor and regulate feedstock because of their biological origin and test for pathogens and pesticide residue. Standardisation of such measures has proved a contentious issue, although the European Union has been among the first to promise to strive towards certification and standardisation of feedstock.

2.6 How green is 'green energy'

"The decision to produce biofuels is therefore a land use decision. The fundamental policy question is whether the benefits of devoting land to biofuels exceed those of leaving that land in its existing use, or potentially improving its existing use in other ways. Limiting the focus to climate change, the basic question is whether the use of biofuels, and thus the use of land for feedstock production, saves more GHG emissions by displacing fossil fuel than that saved by leaving land in its existing use even while continuing to use fossil fuels."[76]

The rush to biofuels seems to have overlooked considerations and growing evidence of their questionable environmental benefits. First generations biofuels compete with one of the scarcest resources on this planet-land. Perhaps this competition for land with cultivation of

[75] Dornbush and Steenblik, 2007

[76] T.D Searchinger, 2008, *Government Policies and Drivers of World Biofuels, Sustainability Criteria, Certification Proposals and their Limitation*

food, forests and wasteland could be argued better if biofuels were in fact a greener source of energy. As described above the motives behind biofuels in advanced industrial economies have been primarily to combat climate change and reverse the trend of wide-scale consumption and foreign reliance on fossil fuels that have high carbon emissions. However, there is increasing evidence to question the green-house gas savings from the cultivation of biofuel. The future of biofuels production, and policies supporting its production, will have to face the fact that biofuels come with serious trade-offs.

Box 1: Demand for land under current biofuel targets[77]

Demand for land under current biofuels targets

The demand for land will continue as long as biofuels targets exist. According to one estimate, biofuels account for 1 percent of the total 1500 million hectares under crop cultivation globally (Gallagher review 2006). According to the same review, if all countries were to meet their nationally set biofuels targets as per current estimate, this would result in between 55-160 million hectares of land under biofuels cultivation by 2020. Biofuels could account for an additional 83 percent of global land that will need to come agricultural use by 2020.

Specifically, the EU targets of 10 percent biofuels by 2020 could lead to additional land demand between 22 million hectares and 31.5 million hectares. The two extreme figures show a situation wherein second generation biofuels are taken into account and where they are not.

The definition of land that can be used for biofuels further complicates the issue. The interpretation of 'idle' or 'wasteland' to grow biofuels feedstock is highly subjective.

[77] Gallager Review, 2006

2.6.1 Estimating greenhouse gas emissions

More recent studies on the production of biofuels have drawn focus to trying to evaluate the greenhouse gas savings from biofuels[78].

One of the most widely cited papers in the literature, by T Searchinger et al, 2007[79] questioned the greenhouse gas savings from biofuels. According to the authors, most prior life-cycle studies on biofuels failed to take into account the greenhouse gas emissions from land use change that is land that is diverted to cultivating feedstock for biofuels.

According to the authors, "we use a worldwide agricultural model to estimate emissions from land use change and found that corn-based ethanol, instead of producing a 20 percent savings, nearly doubles greenhouse emissions over 30 years and increases greenhouse gasses for 167 years."[80]

At the core of this paper's argument is that existing land use has some carbon benefits. Grasslands, forests and even croplands sequester or store carbon as part of their life-cycle process. Now as the price of biofuels increase and farmers turn to more lucrative sources of livelihood like growing biofuels, they clear grasslands, forests or previous croplands and divert these lands to grow biofuels. During this process the stored carbon of these lands is released

[78] See Searchinger et al, 2008, Crutzen et al, 2007
[79] T.D Searchinger, 2007
[80] Searchinger et al, 2007

into the atmosphere. The authors argue that this is a significant loss and should be calculated when estimating the net carbon gain or loss from biofuels.

When compared to fossils fuels, biofuels save carbon through the same sequester process, wherein they store carbon and thus have a carbon credit. Fossil fuels on the other hand derive their carbon from the ground and do not sequester carbon in any way. From this perspective it is clear that biofuels are beneficial. However, since biofuels compete for scarce land it is crucial to take into account the land that is diverted for biofuels and as such the carbon losses or the carbon sacrifice that is entailed as a result of that. The net gains from biofuels can only be counted if the land diverted to biofuels increases the carbon benefit.

One of the reasons to fail to account for carbon losses through diversion of land is that it is difficult to quantify.

The paper makes a number of interesting points and presents key findings based on calculations:

"*An ethanol increase of 56 billion litres, diverting corn from 12.8 million hectares of U.S. cropland, would in turn bring 10.8 million hectares of additional land into cultivation. Locations would include 2.8 million hectares in Brazil, 2.3 million hectares in China and India, and 2.2 million hectares in the U.S.*"

While the authors took into account hat different types of forest land that have been diverted will account for different levels of greenhouse gas emissions, they conclude that,

"*Greenhouse gas savings from corn ethanol would equalize and therefore "pay-back" carbon emissions from land use change in 167 years, meaning greenhouse gasses increase until the end of that period. Over a 30-year period, counting land use change, GHG emissions from corn ethanol nearly double those from gasoline.*"

The analysis shows that in the United States corn ethanol production as projected for 2016 would need 43percent of the corn land harvested for grain in 2004, this would mean massive conversion of land under grain cultivation for food or livestock rearing.

Biofuels from waste definitely are a better alternative since they do not compete for land and give rise to emissions from land use change. Waste may include municipal waste, crop waste, grass harvest from reserve lands or even algae. However, it maybe not be viable economically to produce biofuels on a large scale from such waste or from reserve land that have little carbon benefit. The paper concludes that using good cropland to grow biofuels will aggravate. global warming but if farmers continue to grow food cereals on that good cropland, they in fact retain its carbon benefits.

These findings are further corroborated by Fargione et al 2008,[81] who calculate how large biofuels debts are and how long it will take for biofuels to repay the 'carbon debt' through conversion of land for six different native habitats that were converted- from Brazil Amazonian to grow soya to Malaysian tropical rainforest to grow palm and US grasslands to grow corn, among others. They estimate that land conversion leads to biofuel carbon debt by releasing 17 to 420 times more carbon dioxide than the annual greenhouse gas reductions that these biofuels were expected to provide by replacing fossil fuels. The authors conclude that a post Kyoto international negotiations on climate change would have to take into account the indirect emissions of greenhouse gases due to increase in demand for biofuels.

2.6.2 Critique of Searchinger's indirect effects of biofuels by land-use change

[81] Fargione et al 2008, *Land Clearing and the Biofuel Carbon Debt,* Sciencemag, http://climateknowledge.org/figures/Rood_Climate_Change_AOSS480_Documents/Fargione_Land_Clearing_Biofuels_Science_2008.pdf

Searchinger et al's 2008 paper became a contentious point in the debate on biofuels but set a foundation for the need for more work on quantifying greenhouse gas emissions from land-use conversion. There were several points that were seen a limitations in his study. Some of the critique to Searchinger's approach is outlined in the paper by Mathews and Tan, 2009.[82] This paper draws focus to what it explains as the flaws in Searchinger's assumption. According to them, the Searchinger paper depends largely on the assumption of the spike in 2016 United States ethanol production to draw its results. They argue that the conclusion that US increase in demand for ethanol will result in conversion of forest and grasslands in other parts of the world to grow corn for ethanol is inconclusive. Rather, farmers in Brazil would continue to grow sugarcane or in India jatropa, where they have a comparative advantage. They also say that an increase in US ethanol could be met with trade like imports which have been neglected by Searchinger. The Searchinger scenario has also been described as very US-centric- that it is not an argument that can be extended to other countries or regions such as the European Union. The role of biofuels in deforestation is also problematic, it is crucial to understand the interplay among diverse factors such as migration, timber collection and, urban expansion to state a few to understand or estimate the exact role of biofuels in converting forestlands to grow feedstock.

2.6.3 Nitrous oxide emissions from fertilizers

Further studies on the greenhouse gas credibility of biofuels have pointed to the nitrous oxide output as a result of fertilizers used for growing crop for biofuels. The paper most often cited

[82] Biofuels and indirect land use change effects: the debate continues, 2009 Society of Chemical Industry and John Wiley & Sons, Ltd | Biofuels, Bioprod. Bioref. (2009); DOI: 10.1002/bbb

in the literature by Curtzen et al, 2008[83] takes stock of the nitrous oxide (N20) that is emitted from producing biofuels. Nitrous oxide is a greenhouse gas with 300 times more potential to exacerbate global warming compared to carbon.[84] It is usually a by-product of nitrogen fertilizer that is used in agriculture.

They analyse the amount nitrous oxide flux in the atmosphere and determine the amount of nitrous oxide emitted as a result of agriculture cultivation , this is then compared to nitrogen fertilizer used in global cultivation to derive the relationship between nitrous oxide from soil cultivation nd the amount of fertilizer used. Curtzen et al state that the emission of nitrous oxide from nitrogen fertilizers in agriculture production is greater than previously estimated on the basis of figures of the Inter-Governmental Panel on Climate Change in 2006. This extends to the production of biofuels, particularly those that have a high requirement of nitrogen fertilizer for their cultivation. According to their argument, as the demand for biofuels increases, the use of nitrogen fertilizers in their production will also increase, thereby resulting in greater nitrous oxide in the atmosphere that will negate the carbon benefits of biofuels. For example, their study shows that rapeseed accounts for higher nitrous oxide emissions because it's cultivation is nitrogen fertilizer intensive. Rapeseed is the source of approximately 80 percent of biodiesel production in the European Union. They say: "*For bio-diesel derived from rapeseed, this analysis indicates that the global warming by N2O is on average about 1.0–1.7 times larger than the quasi-cooling effect due to 'saved fossil CO2' emissions."* [85]

The authors conclude that the displacement of fossil fuels by biofuels may not have the intended 'cooling effect' from a climate perspective since an important component of the biofuels life-cycle analysis- the emission of nitrous oxide- had been heavily underestimated or neglected in previous studies.

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[83] Curtzen et al, 2008, *N2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels*,

[84] Fischer et al (2008) pp 67

[85] Curtzen et al, 2008

The paper has been criticised for its methodology. The Gallagher Review states that "the paper applies an uncertain approach, questionable assumptions and inappropriate, selective comparisons to reach its conclusions."[86]

The paper by Mellilo et al, 2009[87] further elaborates on the role of nitrous oxide in a life-cycle analysis of biofuels, and its contribution to greenhouse gas emissions. According to the authors they use linked economic and terrestrial biogeochemistry models to examine direct and indirect effects of possible land-use changes from an expanded global cellulosic bioenergy program on greenhouse gas emissions over the 21st century and conclude than indirect effects of land-use conversion will have a far greater impact that direct effects. Also they argue that nitrous oxide will have a greater potential to exacerbate global warming in the future. Through simulations they calculate that over the next century nitrous oxide emissions will be much higher when converted to a carbon dioxide equivalent. They say that by 2100, biofuels production will account for nearly 60 percent of annual nitrous oxide from the use of nitrogen fertilizers.

2.7 Limitations of quantifying greenhouse gas emissions through land-use change

Although efforts to quantify greenhouse emissions from indirect effects of biofuels production are growing, there is a great deal of discrepancy and contradiction in the current literature on the topic. Life-cycle analyses is seen as an appropriate approach to deconstruct every component in the chain of biofuels production, including the emission of greenhouse gases which is crucial to ascertain it's implications if biofuels as currently produced will

[86] Galagher Review, 2006

[87] Mellilo et al, *Indirect Emissions from Biofuels: How Important?*, Science, 4 December 2009: Vol. 326 no. 5958 pp. 1397-1399

continue to be used on the climate change agenda as part of public policy. Fischer et al state that it is necessary to define a set of boundaries for a biofuels system as starting point to a more coherent system of evaluation so that it can be compared to the fossil fuel system.

The problematic areas of current and ongoing research, as crucial and well intentioned as they are, is that there are too many varied methods being employed for life-cycle analysis with too many variables in the parameters measures across different studies and the assumptions they use. The current literature on greenhouse gas balances differ greatly among crops, geographical locations, and technological factors, all of which drive results in a specific direction, making it difficult to compare across studies or reach a coherent conclusion.

The most significant aspect however is that greenhouse gas emissions from land-use change or the indirect effects of biofuels production has focused the debate on the 'green credentials' of biofuels and questioned this assumption. It has forced policymakers and governments particularly of advanced industrialised nations, to justify the massive subsidies and mandates that have been allocated to biofuels programmes in the name of mitigating climate change. The literature does not call for a sweeping ban on the production of biofuels but rather highlights the urgency of acknowledging the limitations of first-generation biofuels grown on converted land.

While the mandates have been designed to lower greenhouse gas emissions, ignoring the sustainability criteria in the production of biofuels will only mean two steps back for every intended move forward.

PART III

The European Union's policy on biofuels

3.0 Introduction

Biofuels as a source of renewable energy in the European Union has been gaining a lot of legitimacy since it was brought directly into policy in 2000 when the European Commission

released the paper 'Towards a European Strategy for the Security of Energy Supply'. In the European Union, the primary form of biofuels is as biodiesel which is mainly used in the transport sector. The transport sector is believed to produce 20 percent of the total anthropogenic greenhouse gas emissions in the EU.[88] Europe also accounts for some of the most elaborate liquid biofuels mandates in the world. Member states are required to ensure that 5.75 percent of their transportation is fueled by biofuels by 2010. There is a 10 percent binding minimum target for the share of biofuels in overall European Union transport petrol and diesel consumption by 2020. Biofuel consumption within the European Union, comes along with sustainability certifications, wherein the European Union monitors the type of feedstock entering the markets and checks if it adheres to sustainability criteria.

In terms of policy biofuels in the EU are meant to i) move away from dependency on oil imports, ii) reduce greenhouse gas emissions and iii) boost rural and agricultural jobs.

The Green Paper on Security of Energy Supply published on 29 November 2000 states that: "*The EU meets 50 percent of its energy needs through imports and, if no action is taken, this will increase to 70 percent by 2020 or 2030. This external dependence involves economic, social, ecological and physical risks for the EU. Energy imports account for 6 percent of total imports and, in geopolitical terms, 45 percent of oil imports come from the Middle East and 40 percent of natural gas imports come from Russia.*"[89] While this paper does not specifically mention biofuels, it highlights the dilemma of Europe in trying to find clean and non-dependent sources of energy to meet its growing demand.

As such, biodiesel came to be hailed as an alternative 'clean energy' as it was seen to reduce emissions and thereby mitigate climate change. Biofuels were part of the package to comply with Kyoto targets and lead to calculable reduction in greenhouse gas emissions. They were also seen as a way for the European Union to promote job opportunities in the agriculture

[88] Fischer et al 2008 pg 48

[89] Green paper on security of energy supply, European Commission , 2000 http://europa.eu/legislation_summaries/energy/external_dimension_enlargement/l27037_en.htm

sector. According to a European Commission communication in 2006: "*The EU is supporting biofuels with the objectives of reducing greenhouse gas emissions, boosting the decarbonisation of transport fuels, diversifying fuel supply sources and developing long-term replacements for fossil oil. The development of biofuel production is expected to offer new opportunities to diversify income and employment in rural areas.*"[90]

Biofuels are regulated and promoted at the European level and by Member States and the instruments and legislation are closely linked. The EU provides support for biofuels policies such as tax exemptions and subsidies while allowing member states to design their own policies to meet national targets.

As we have seen in the previous chapter, the net greenhouse gas benefits of biofuels are very much an ongoing debate with a diversity of literature. However, what is clear is that land-use conversion of all has huge impacts on the green credibility of biofuels. This concern has also influenced policymaking and brought the European Union's biofuels policy under great scrutiny.

In this chapter, I first look at the legislation that is in place at the European Union-level on biofuels. I then seek to ascertain whether the European Union can in fact produce biofuels sustainably. I analysis the limitations of certification schemes in place and then conclude with a report on a high-level panel on biofuels held at the European Parliament.

3.1 European Union's policies that promote biofuels

[90] Communication from the European Commission, *An EU Strategy for Biofuels*, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0034:FIN:EN:PDF

The first crucial piece of legislation linked directly to biofuels is the Directives 2003/30/EC[91], called more generally the Directive on the Promotion of the Use of Biofuels and other Renewable Fuels for Transport or just the Biofuel Directive, aimed at promoting the use of biofuels in the transport sector. According to the directive, which is dated 8 May 2003 "*...it aims at promoting the use of biofuels or other renewable fuels to replace diesel or petrol for transport purposes in each Member State, with a view to contributing to objectives such as meeting climate change commitments, environmentally friendly security of supply and promoting renewable energy sources."*[92]

In the first paragraph of this directive it clearly links biofuels to sustainable development by stating: "The European Council meeting at Gothenburg on 15 and 16 June 2001 agreed on a Community strategy for sustainable development consisting in a set of measures, which include the development of biofuels."[93] The directive sets a voluntary reference target of 2 percent biofuel consumption by 2005 and 5.75 percent by December 31, 2010. Member states are asked to set a parallel national directive that will take into account the reference target of 2 percent and achieve this based on a national strategy best suited to their demand and consumption. This first directive calls for an evaluation of the biofuel policy and the practice of such a policy in 2006. Among other factors, it takes into account the need to evaluate the sustainability of biofuel production within the European Union. It also looks to evaluate the life-cycle perspectives of biofuels with a view to adapt their promotion and calculate their impact on carbon dioxide emissions. The directive is also tied to the Kyoto Protocol and says: "*Greater use of biofuels for transport forms a part of the package of measures needed to comply with the*

[91] Directive 2003/30/EC of the European Parliament and of the European Council On the *Promotion of the use of biofuels or other renewable fuels for transport,* Official Journal of the European Union 17.5.2003, (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:123:0042:0046:EN:PDF)

[92] Ibid

[93] Directive 2003/30/EC of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport (OJ L 123, 17.5.2003).

Kyoto Protocol, and of any policy package to meet further commitments in this respect."[94] The directive also emphasises that biofuels can boost the rural job sector and turn 'problematical' waste production into biofuels.

A complementary directive is the Directive 2003/96/EC which deals with the taxation and subsidies of the production of biofuels. Taxation however is under the purview of Member States and as such it is also up to them to decide the tax incentives for biofuels and renewable energy in their respective territories. Incentives for biofuels were also included in the **Common Agricultural Policy (CAP),** which was reformed in 2003 to allow farmers an energy crop premium of 45 euros per hectare for a maximum of 2 million hectares, provided the feedstock was grown on land not meant for food crops. However, a revision of the CAP in 2008 called for an end to the bioenergy premium. Following fluctuations in the cereal market in 2008, it was decided by the European Commission that from 2009, compulsory set aside land for Bioenergy should be abolished.[95]

Another important piece of legislation that includes measures to support Bioenergy is the **EU Rural Development Policy**. The policy has grants and other support systems for setting up biomass production facilities. In January 2008, the Commission put out a proposal for a **Renewable Energy Directive**. The Directive set out targets for each Member State with the intention that the EU will together make up 20 percent of its energy use from renewable sources by 2020 and specifically achieve 10 percent of energy in the transport sector from renewable sources. The Directive includes legal and procedural guidelines in achieving these

[94] Ibid

[95] Fischer, 2009 quoting European Commission Press Release IP/08/1069 (http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/1069&type=HTML&aged=0&language=EN&guiLanguage=en)

targets so as to ensure that all sustainability criteria are adhered to in the production of biofuels. The Directive is to be implemented by Member States by December 2010[96].

This Directive is part of the more comprehensive Energy Policy Package that was presented in January 2008. The package calls for a 20-20-20 target, i.e it aims to have i) 20 percent improvement in energy efficiency ii) 20 percent reduction in greenhouse gas emissions and iii) 20 percent renewable energy by the year 2020. The Directive will apply a 'double credit' on second generation biofuels towards the 10 percent target of renewable energy for the transport sector with a view to emphasise sustainable biofuels rather than those that displace food crops. The legislation emphasises that biofuels must account for 35 percent of greenhouse gas emissions savings compared to fossil fuels and show a clear net savings greenhouse gas emissions. This percentage will rise to as high as 60 percent by 2017[97]. In light of studies, as demonstrated in the previous section, of greenhouse gas emissions from the indirect effects from land use change, the Commission will develop a methodology to measure greenhouse gas emissions from caused by indirect land-use change. The legislation calls for a review in 2014 on the progress of renewable energy towards the targets to be achieved by 2020.

3.2 Producing biofuels sustainably in the European Union

The European Union has incorporated sustainability criteria in the production of biofuels within the powerful Renewable Energy Directive[98]. The Directive explains the criteria against

[96] European Commission, Directorate General of Energy, http://ec.europa.eu/energy/renewables/index_en.htm

[97] Fischer et al, pp 50

[98] 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, Official Journal of the European Union, http://www.energy.eu/directives/pro-re.pdf

which Members States have to prove that their biofuels are sustainably produced, so that they can be counted as part of the EU's targets. It lays down the calculation for greenhouse gas savings from biofuels. The Directive also mentions that the Commission shall monitor and report the origin and impact of biofuels consumed within the EU based on reports from Member States. It will assess the environmental impacts of biofuels on a biannual basis and submit reports to the European parliament on the same. The Commission will also monitor commodity price changes related to the use of biofuels and the impact of biofuels on food prices.

A related Communication dated June 10, 2010 was issued by the European Commission and spells out that the commission has set up a system to ensure certification of sustainability criteria of biofuels that will count towards the 10 percent target in transport sector by 2020[99]. In the Communication, the Commission urges industry, government and non-governmental organisations to set up voluntary certification schemes for biofuels. The Commission will then assess the credibility of the schemes against criteria under the Renewable Energy Directive and determine if the biofuels will go towards the target of 10 percent in the transport sector. The Communication insists that only independent auditors are used to assess the certification compliance of biofuels right from the usage of land and type of feedstock to delivery in filling stations. It insists that protected land, rich in biodiversity or being used for food cultivation is not used for biofuels, and it insists that only biofuels with a substantial greenhouse gas savings of 35 percent and rising to 50 percent in 2017 with respect to fossil fuels be used by Member States towards their targets. It mentions how this can be calculated.

[99] Press Release from European Commission, (MEMO/10/247 of IP/10/711), '*Commission sets up system for certifying sustainable biofuels'*
http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/10/247&format=HTML&aged=0

As such, the Commission hopes to count only sustainably produced biofuels in its targets. The press release states that imported biofuels which do not meet the sustainability criteria will not be stopped, only that they will not count towards the EU targets, nor receive tax breaks or subsidies. As to how this will work in practice, the Communication cites this example:

A UK fuel supplier who is using ethanol from Brazil has to notify the quantities of biofuels to the UK authorities. To show that they are sustainable according to the Directive, he can join a voluntary scheme. The fuel supplier has to make sure that throughout the production chain all records are kept, by the trader he buys the biofuels from, by the ethanol plant the trader buys the ethanol from, and by the farmer who supplies the ethanol plant with sugar cane. This control is done before the company is joining the scheme and at least once a year thereafter. The auditing is done as in the financial sector: The auditor is checking all the paper and inspects a sample of the farmers, mills and traders. He will check whether the land where the feedstock for the ethanol is produced has been indeed farm land before and not a tropical forest.

The Commission describes its sustainability scheme as "the most comprehensive and advanced in the world with binding conditions"[100]. This is interesting given that a blanket ban on non-sustainable biofuels has not been proposed nor have the indirect land use effects of biofuels been adequately addressed apart from the fact that the Communication says the Commission will produce a report on the same by the end of 2010. It also gives rise to the question of how this will help deter non-sustainable biofuels from entering the European Union, given that tax breaks alone may not be an adequate incentive to promote only sustainable biofuels, particularly if these biofuels are being sourced from outside the European Union and tax breaks and targets have no bearing on the country of origin. This also invites

[100] Communication from the Commission on voluntary schemes and default values in the EU biofuels and bioliquids sustainability scheme (2010/C 160/01, European Commission http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:160:0001:0007:EN:PDF

criticism that the European Union would take steps to ensure sustainability within its borders but not take enough measures to prevent non-sustainable trade of biofuels from third countries where the impact may be felt the hardest.

A recent report published by the Institute for European Environmental Policy[101] analyses and estimates the anticipated consequences of Member States meeting their targets under the Renewable Energy Directive of the EU. The report takes note that the Renewable Energy Directive fails to account for the effects indirect land use change (ILUC) from biofuels, as such it aims to estimate the effects of ILUC. The report aims to "*ascertain the characteristics of the demand generated by the targets in one key area: the anticipated use of biofuels*". The report is aimed at anticipating the findings of the Commissions own report due out at the end of 2010. It uses the reports of 23

National Renewable Energy Action Plans to determine the direction of the EU biofuels policy with respect to ILUC. According to the report, "*the RED target, for 10% of transport fuel to be from renewable sources by 2020, is anticipated to stimulate a major increase in the use of conventional biofuels up to 2020, contributing up to 92% of total predicted biofuel use or 24.3 Mtoe in 2020. This would represent 8.8% of the total energy in transport by 2020; 72% of this demand is anticipated to be met through the use of biodiesel and 28% from bioethanol."*[102]

The main findings of the report shows that 23 Member States analysed will predominantly use conventional biofuels to meet their 2020 targets under the RED, that is, these biofuels will be from food crops or cereals. Under current conditions, this expanded increase in biofuels by 23 Member States, would result in change in land use that has been calculated to lead to between 44 and 73 million tonnes of carbon dioxide equivalent being released on a yearly basis. The report clearly indicates that the additional biofuels that will be produced in the EU will lead to

[101] *Anticipated Indirect Land Use Change Associated with Expanded Use of Biofuels and Bioliquids in the EU – An Analysis of the National Renewable Energy Action Plans,* November 2010, IEEP, (http://www.foeeurope.org/agrofuels/ILUC_report_November2010.pdf)

[102] Ibid, pp 2

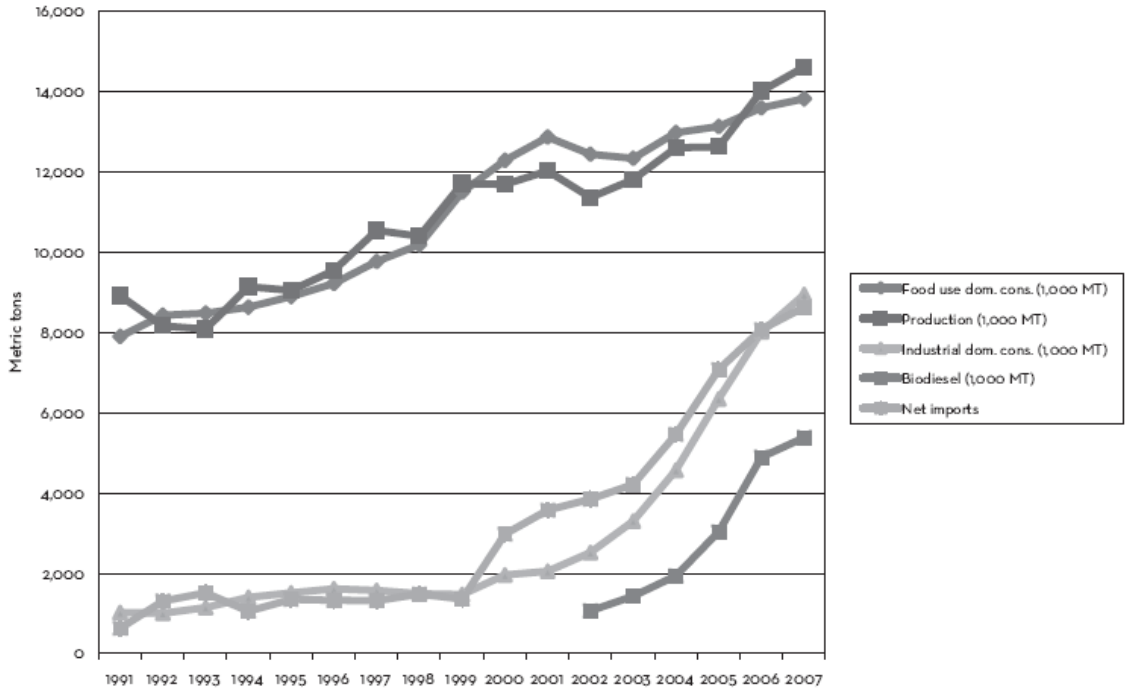
additional, substantial greenhouse gas emissions that will contradict the very idea of producing biofuels as part of the climate change package. The study reports that "the emissions are estimated to range from 27.3 to 56.4 MtCO2e on an annual basis up to 2020"[103]. Perhaps the most important aspect of this study is that though it acknowledges that the methodology and assumptions used will greatly influence the outcome of its conclusions, even when lower estimates of ILUC and greenhouse gas emissions are taken, a sensitivity analysis shows that the current biofuels programme of the European Union (and as it is anticipated to be carried forward in the absence of any fundamental changes) will fail to produce any greenhouse gas savings. In light of this it is crucial to address the effects of indirect land use change in the immediate future.

Furthermore, while analysing the sustainability criteria it seems that the European Union is keen to keep away unsustainable feedstock from its own markets. However, this noble intention does not solve the core problem of unsustainable feedstock being channelled to other countries which may not employ sustainable criteria. In other words, the European Union's actions might be laudable within its borders but that does not discourage the production of biofuels-sustainable or otherwise from being produced and having a damaging impact on the environment. In their study, Dittmer and Wassell Jr. Point out this contradiction: "*The EU increased edible oil imports from the United States—oil that was previously being exported to other countries. Consequently, China and India, as well as other states, increased their imports of palm oil. In this sense, EU biodiesel production is sustainable—it is made only from sustainable sources—yet biodiesel production has resulted in increased production of unsustainable palm oil."*[104]

[103] Ibid, pp 21

[104] Dittmer, T. and Wassell Jr., Charles, The Fallacy of Sustainable Production of Biofuel Feedstock *Challenge,* Vol. 51, no. 5, September/October 2008, pp. 20–39, pp 27

Figure 2: EU Edible Oil Use and Production



(From Dittmer and Wassell (2008:24) sourced from U.S. Department of Agriculture, Foreign Agricultural Service, Production, Supply and Distribution Online (PSD); biodiesel data from the European Biodiesel Board.)

Using the figure above, the authors show how industrial domestic consumption of oil seeds increases dramatically since 2001 (biodisel are part of this industrial consumption). Net imports of oil seeds also show a marked increase while food consumption increases but not as sharply. The European Union has increased net imports to replace oils seeds produced for food within its borders that has been diverted for industrial use. The imports in fact are not directly for industrial use, but largely used to stabilise food consumption of oil seeds.

The authors conclude that while the EU has increased its import of oilseeds from sustainable sources such as the United States and Canada, in the process other countries such as India and China have looked towards palm oil imports, say from Malaysia, which are unsustainable. In other words, in an highly integrated world market for feedstock, the demand for biofuels, even if accompanied with sustainability criteria, does give rise to production of unsustainable feedstock.

3.3 Limitations of certification schemes

While certification schemes are a step forward to ensuring sustainability. It is important to ask what are the ground realities of implementing and monitoring certification schemes? As put by Searchinger[105], "*Implementing certification systems presents great challenges. Most certification systems contemplate placing the point of regulation on the biofuel facility, which then becomes responsible for tracking and guaranteeing that its fuel sources meet land use criteria. Tracking each facility's production process should prove relatively easy, but tracking production of the feedstock is challenging.*"

Most biofuels certification schemes focus on environmental and socio- economic criteria such as greenhouse gas benefits and the use of non-biodiversity of food land. They may also look into factors such as the wages and working conditions of small farmers in developing countries. While the EU's certification scheme has been described as inadequate in addressing indirect land use change, Searchinger[106] points out that distinction between direct and indirect land use change from an economic perspective becomes complicated, since biofuels will create new demand for feedstock, the production of which will move to lands where it is more economically viable to produce. As such, some of these lands may include a mixture of lands- forest, cropland or biodiversity areas and wasteland. The use of land in a certification system is also difficult to enforce or monitor. A farmer may choose to use part of his food crop harvest in the production of biofuels. In that case how does one categorise the land and the sustainability of the biofuels produced. Fundamentally, all biofuels compete for land that is a scarce resource. Certification becomes increasingly complicated when the variables involved are many and diverse.

[105] T.D. Searchinger, 2008
[106] Ibid

The other limitation with certification schemes is the diversity of situations that arise. No one certification scheme can cater o all the possibilities- type of and, type of feedstock, method of cultivation, greenhouse gas benefits during the life cycle of a biofuels stock.. As the variables keep changing, a certification scheme has to be sensitive to the changes and adapt to produce accurate results. This might be an impractical and expensive task to accomplish in the long term. Some certification schemes are also too narrow in their focus and address solely one dimension, say for instance, greenhouse gas emissions. This creates the risk of ignoring other related environmental consequences such as loss of forest land or wildlife. The indirect effects of land use change become justified if the greenhouse gas savings from the production of biofuels are substantial enough under the certification scheme. Further, according to Searchinger, certification schemes that take into account indirect land use change, while noteworthy in their intention, may have to use models with large uncertainties that could lead to flawed results[107]. Incorporating indirect land use change within certification schemes however will reduce the greenhouse gas savings potential of biofuels thus raising important questions about the benefit of biofuels as part of government policy on climate change.[108]

3.4 Biofuels–the burning questions-the sustainability of European Bioenergy policy (High-level debate at the European Parliament, 11 November 2009)

As part of research for this paper, I attended a high-level panel discussion at the European Parliament in November 2009. The debate brought together important stakeholders from academics, policymakers and representatives of government. The event was hosted by MEPs Fiona Hall MEP (ALDE) and Sirpa Pietikainen MEP (EPP).

[107] T.D. Searchinger (2008)
[108] Ibid

The debate started with presentations by speakers on the topic: **"Bioenergy policies in a resource constrained world".**

The speakers included: **Jerry Melillo**, The Ecosystems Centre, Woods Hole, MA, USA, **Michael Obersteiner,** Head of Terrestrial Ecosystem Modelling Group, International Institute for Applied Systems Analysis, Austria, **Tony Grayling,** Head of Climate Change Department, UK Environment Agency and **Astrid Agostini,** Economist at Natural Resources, Environment, Climate Change and Bioenergy Division, UN Food and Agriculture Organization (FAO).

Melillo, who has been cited earlier in this paper, spoke about **Indirect land use change impacts – Options for an adequate policy response.** He spoke about how second generation biofuels, that were inherently less or not land intensive, would play an important part in the global energy mix. However, even they would pose serious environmental implications. For instance, if feedstock was grown on waste or idle land, it would need more nitrogen fertilizers and water for a viable harvest and this would have to be incorporated in the life cycle analysis. He used linked economic and terrestrial biochemistry models to gauge the implications of a direct and indirect land use of a cellulosic biofuels programme into the 21st century. According to his findings, indirect land use change will result in almost twice as much carbon loss than direct land use change. He also predicts that most feedstock in the future will be grown in tropical areas such as Africa and Latin America thus intensifying environmental consequences and threatening biodiversity hotspots. According to Melillo, the type of feedstock grown will determine the future environmental sustainability of biofuels.

Obersteiner's presentation was titled **"Tortilla versus Greenfuel: Trade Offs and Synergies in the Bioeconomy".** Obersteiner's stated that biofuels have come to be seen as a panacea for multiple problems. Using the analogy of a butler serving too many masters and their needs, he stressed that biofuels cater to too many needs- rural development, climate

protection, and energy protection. He said that it is necessary to realise the trade offs and understand that biofuels can only serve one "guest" properly. In his opinion, bioenergy is crucial to address the climate challenges we face and achieve the 2 degree Celsius target in reducing global warming. In view of this, it is imperative to ensure that Bioenergy results in negative emissions and make choices as to trade offs. In his view food prices should be linked to oil prices since there is a synergy and Bioenergy technology will be an important factor in expanding production of bioenergy and in policy measures

Agostini spoke on **"Social and Environmental Implications of Biofuels in the Developing World- Debunking a Few Myths and Identifying a Way Forward."** Addressing the socio-environmental aspects of the biofuels debate, Agostini started out by debunking a few myths about biofuels- i) that food prices have stabilised so therefore biofuels do not impact food prices adversely ii) that there is plenty of available land for the production of biofuels iii) that biofuels should not be produced in developing countries since sustainability risks cannot be controlled.

She stressed that while food prices had come down from 2008 levels, there were higher than 2005-2006 levels. On the question of availability of land for feedstock production, Agostini made the important point that 'waste' or 'idle' land is poorly defined and that no land was unused and freely available for biofuels production. By its nature land is scarce resource and the search for 'suitable' land is an abstract concept. She stated that while the gains from biofuels may seem many and important, it cannot be at the cost of displacing local communities and indigenous people. The rush to biofuels should not be without taking into account the livelihood rights of those whose lands may be taken up, particularly in countries where land rights are already contested and vulnerable groups have little recourse to law and justice. According to her, while articulating sustainability criteria is necessary, but it is crucial to see that this is done with the consultation of developing countries. Furthermore,

developing countries, from where feedstock originates, must have the capacity and infrastructure in place to ensure compliance with certification norms.

Grayling, who made the final presentation, on **"Biomass: Carbon Sink or Sinner"**, he used a Biomass Environmental Assessment Tool (BETA) for the life cycle analysis of biofuels. His main conclusions were that biofuels have a limited but important role to play in the energy mix. There is a lot of difference among different types of biofuels used and the greenhouse gas savings from each type. He also called for more standardisation within the EU that prevent use of unsustainable biofuels and maximise greenhouse gas savings.

The second part of the debate was a session titled: **"How to make the EU Bioenergy policy more sustainable".** The panellists for this session included: **Karl Falkenberg,** Director General of DG Environment, European Commission, **Timothy Searchinger,** GMF Fellow and Research Scholar at Princeton University, US, **Mark Avery,** Director of Conservation, RSPB, UK, **Íñigo Ascasíbar,** Environmental Advisor to the Spanish Permanent Representation to the EU, **Ian Backhouse,** Vice chairman of the Biofuel Committee, European Farm Association, (Copa-Cogeca).

Searchinger in his remarks stressed that the EU biofuels policy to be beneficial has to ensure that "additional carbon" in the environment is kicked off rather than see biofuels as carbon neutral and largely beneficial. There needs to be greater discerning in policies as to of which biofuels actually are carbon saving rather than lumping them all together. Avery from Birdlife, had a rather pessimistic view of the EU policy on biofuels as is stands today. In his opinion, the complications surrounding biofuels such as in direct effects of land use change, are beyond the scope of policymakers. He said the EU biofuels policy has too many foreseeable negative qualities that need urgent review. He ended by asking policymakers in the room to offer concrete solutions to fix the EU biofuels policy.

Backhouse who represented the EU Farmers' Association at the debate said that the association looked forward to a market-led way to ensure sustainable land use. He talked about the challenges in creating an economically viable and market-friendly policy that also safeguarded the interest of farmers who looked to biofuels as a promising source of business but at the same time incorporated sufficient sustainability criteria.

Falkenberg, Commissioner from DG Environment, agreed with Searchinger's point that biofuels should not be regarded as carbon neutral. He faced pointed questions from Avery who asked him if the "EU is willing to change its mind?" Falkenberg responded that sustainability criteria in EU policy was a huge challenge but worth the effort. He said biofuels are being used and there is a demand for them, so there was no way but to ensure that their use is sustainable. He said the European Commission could allow the status quo to continue and allow the market to take lead. However, policy was needed to intervene and limit the direction of biofuels.

In the session on questions and answers, a number of related points came up. A member of the audience questioned whether there was too much interference from the European Commission, giving Member States little autonomy in setting their own targets. Another member of the audience pointed out that although the European Commissioner spoke of allowing a free market in biofuels and policy only offering very limited direction, this has never been the case. The Commission has from the very start distorted the biofuels market through subsidies and tax breaks. There was also discussion about how the role of the EU in sustainable biofuels policy and was important on the global stage, but not enough to tackle such a huge issue internationally. Can and should Europe regulate for the world? What is its responsibility towards other countries that have not incorporated sustainability criteria as part of their own biofuels policies?

4.0 Conclusion

Second-generation biofuels have been hailed as the solution to all the detrimental aspects of first generation biofuels. Typically second generation are sourced from feedstock that is from non-food plant materials or agricultural residue or waste and are expected therefore not to have to compete for scarce land resources. As with conventional biofuels, there is government backing and research and development riding on the back of second generation biofuels to make these an economically viable alternative to first generation biofuels. The question remains how soon second- generation biofuels can be produced on a commercial scale. By some optimistic estimates[109] second generation biofuels will probably be fully commercially viable by 2012. However, a more complex estimate taking into account technological and economic hurdles puts the commercial viability of second generation biofuels around 2020.[110] While second generation biofuels promise to have a better record of greenhouse gas savings, it is too early for them to be fully incorporated into current policy.

What is clear is that there is no future for first generation biofuels from a sustainability point of view given the stress it puts on land and water resources. There is also concern that lignocellulosic could also harm the environment since removing crop residues from the field could affect soil carbon fertility.[111]

From this paper it can be concluded that policy on biofuels is short-sighted and inadequate. It has become difficult for governments to justify the scale of production backed by subsidies in the face of evidence showing that biofuels may not achieve the great promises of green energy by saving on greenhouse gas emissions and adhering to Kyoto Protocol targets. Rather than

[109] Fischer et all, 2008, pp 168
[110] Ibid, pp 169
[111] Haberl et al, *The Global Technical Potential of Bioenergy in 2050 Considering Sustainability Constraints*, Current Opinion in Environment Sustainability (Ed. Leemens and Patwardhan) , Volume 2, Issue 5-6, pp394-403 December 2010,

swing the other extreme of calling for a total boycott or ban on biofuels, what is needed is a nuanced policy that will take heed of specific sustainability criteria right from the sourcing of feedstock to the consumption. It is imperative that policy addresses the indirect effects of land use change and takes into account the means to the ends in achieving greenhouse gas emissions targets. The European Union's policy on biofuels has also largely been reactive rather than proactive in setting the tone for a sustainable biofuels policy.

On 22 December 2010, the European Commission issued a press release about a report that takes into account indirect land use change in the production of biofuels[112]. The report acknowledges that indirect land use change can reduce greenhouse gas savings from biofuels. The press release also points out that current models for assessing indirect land use change have shown certain limitations and the Commission will release an Assessment Report by July 2011 on the policy approaches to be taken with regard to indirect land use change. The assessment Report, it says, could lead to an amendment of the Renewable Energy Directive or result in new legislation. It is to be seen how future legislation on biofuels in the European Union will develop. Some of the policy options include taking no action while continuing to monitor the situation and attributing a quantity of greenhouse gas emissions to biofuels reflecting the estimated indirect land use change impact.

Reaching the target of 10 percent renewable energy in the transport sector and a six percent reduction in greenhouse gas emissions in the transport sector by 2020 will be no mean feat but it cannot be at the cost of long-term sustainability, particularly beyond the European Union's borders.

[112] European Commission, IP/10/1772, December 2010, Biofuels: Commission adopts report on indirect land use change
http://europa.eu/rapid/pressReleasesAction.do?reference=IP/10/1772&format=HTML&aged=0&language=EN&guiLanguage=en

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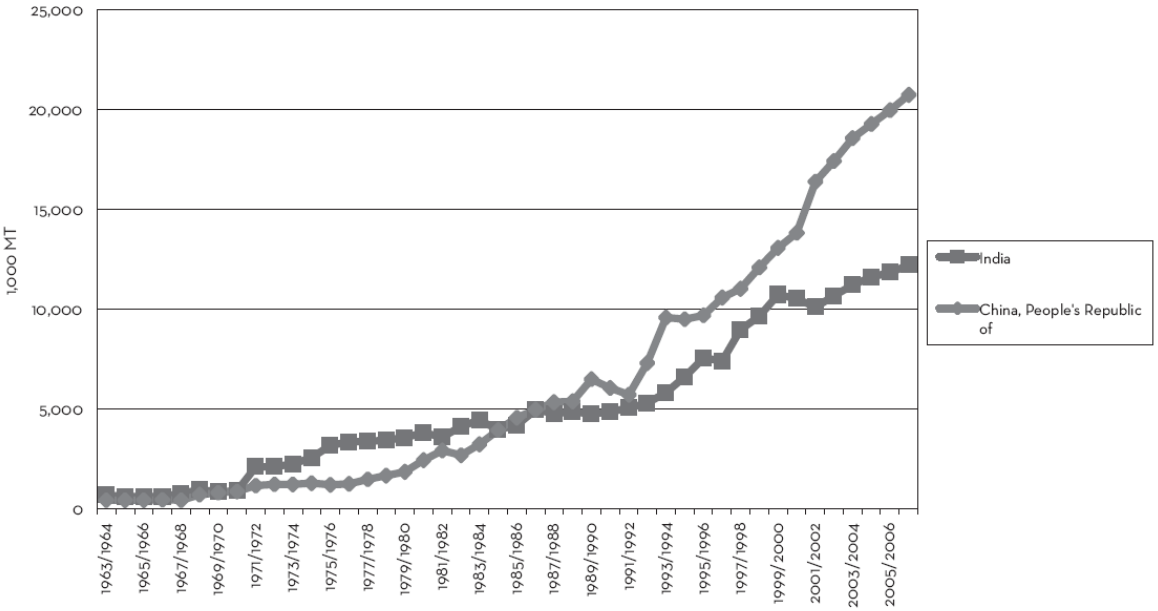
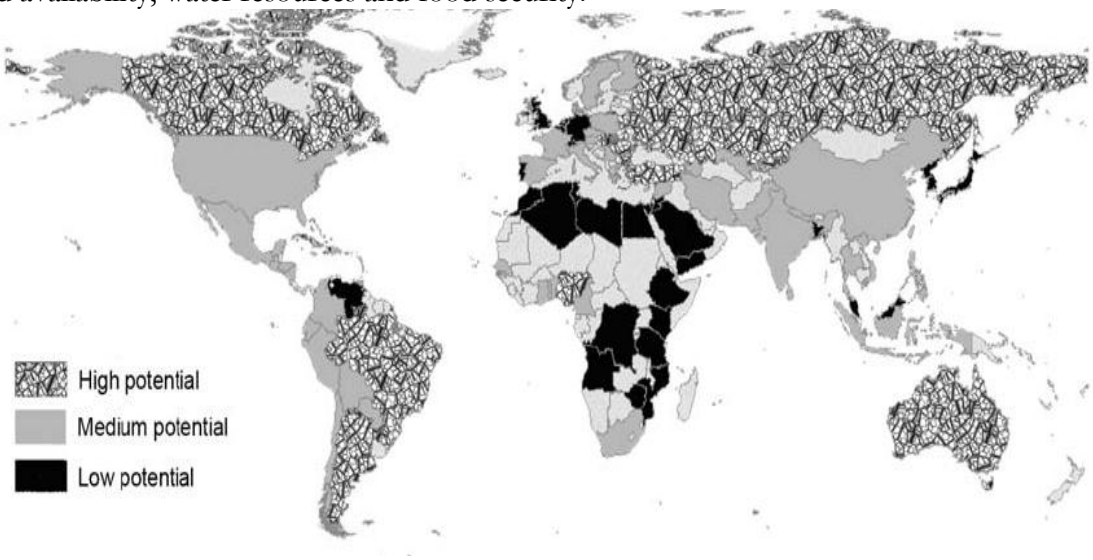
Appendix

Figure 4: China and India Food Consumption



(Source: Dittmer and Wassell (2008) from U.S. Department of Agriculture, Foreign Agricultural Service, Production, Supply, and Distribution Online (PSD).

Figure 5: Biofuel Potential in different parts of the world taking into account three variables- land availability, water resources and food security.



(Source: Von Braun, Joachim, "When Food makes Fuel: The promises ad Challenges of Biofuels", IFPRI, Keynote speech at Crawford Fund Annual Assembly, 2007)

Curriculum Vitae

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Date and Place of birth	15 May 1982, Mufulira, Zambia
Gender	Female

OCCUPATIONAL FIELD **Communications, International Relations**

WORK EXPERIENCE

Name of employer	**Food and Agriculture Organization, UN, New Delhi**
Type of business sector	Inter-governmental organisation
Duration of employment	March 2011- Present
Position held	**National Communications Associate**
Main responsibilities	Steering all communication activities from FAO, India

Name of employer	**Bruegel, Brussels, Belgium**
Type of business sector	Public policy research institute, think tank
Duration of employment	March 2010-November 2010
Position held	**Communications Assistant**
Main responsibilities	Web management, media outreach and communication planning, editing publications

Name of employer	**European Commission, Brussels, Belgium**
Type of sector	Public body/ International organisation
Duration of employment	October 2009-March 2010
Position held	**Communications and Media Trainee**
Main responsibilities	Assisted the Press Officer in drafting press releases, memos and editing the newsletter. Also edited content for the website.

Name of employer	**The Hindu, Bangalore, India**
Type of sector	Newspaper, Media
Duration of employment	June 2005 to June 2007
Position held	**Journalist (sub-editor)**
Main responsibilities	Monitored news from wire services, edited news stories and designed news pages.

EDUCATION

Name of institute(s)	University of Leipzig, University of Vienna
Title of Degree	Master in Global Studies (expected)
Duration	Classes 2007-2009 (Thesis- 2010)
Principal subjects	Global Studies, Global History, International

Relations, International Development

Name of institute	Asian College of Journalism
Title of Degree	Postgraduate diploma in Journalism
Duration	2004-2005
Principal subjects	Journalism

Name of institute	St Joseph's College Bangalore
Title of Degree	Bachelor of Arts
Duration	2000-2003
Principal subjects	History, Economics

LANGUAGES

Native-level fluency (English)
Mother tongue (Tamil)
Fluent- written and spoken (Hindi, Kannada)
Basic- read and speak (French, German)

ACHIEVEMENTS

Successfully applied for the competitive European Commission traineeship programme from a limited quota for Non-EU graduates
Erasmus Mundus scholarship for Global Studies
Mary Roy Prize for Best Student in Journalism, ACJ
First prize in English in ICSE (school-leaving exam)
Prize for high grades in History and Economics, B.A.