Policy Vacuum in LULUFC

The Erasmus University Rotterdam

Department of Regional,Port and Transport Economics

Name:Rashiq Muhaimen

Student Number:370526

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1 Introduction

Sustainable development is a term heard very often in news, social media and governmental policies. The term has been defined in many ways, but the most commonly used definition is from Our Common Future, also known as the Brundtland Report: Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The report was written in 1987 and placed environmental issues firmly on the political agenda; it aimed to discuss the environment and development as one single issue(UnitedNations, 1987). Since then the shift toward sustainability has gained a lot of momentum and much has been done. The main focus has been on the reduction of the emissions of green house gases (GHG). These gases include carbon dioxide, Methane, Nitrous oxide and Fluorinated gases. The main sources of these emissions are, the burning of fossil fuels (energy and industry), burning of fossil fuels in transportation, and land use and land use change and forestry(LULUCF).

This thesis will focus on the GHG emissions from LULUCF. In this thesis a historical overview will be provided regarding the policies that have already been undertaken to curb emissions in the all sectors. This will be done in order to demonstrate how these sectors are sometimes related and how policy in one sector can effect emissions in another. Once the overview has been provided and links between the sectors have been established an environmental analysis of the policies will be presented and the following research question will be answered:

How effectively do European policies reduce GHG emissions emitted from LULUCF?

The methodology used to answer the research question will be a literature review and the thesis will be structured in seven chapters, this being the first, the second chapter will explain the relevance and developments that have taken place in the realm of climate change, chapter three will shed light on global agreements that have been made to try and mitigate climate change.Next a section highlighting the existing remedies to mitigate climate change according to the scientific community will be presented. This will be followed by the existing policies employed by the EU, the following chapter will evaluate the effectiveness of the policies and make remarks if policies are contradictory or inefficient. The seventh and final chapter will answer the research question and be used for concluding remarks.

2 Setting the scene: The Green House Effect and Our Contributions to it

In this section the historical perspective on climate change will be provided followed by an account of activities pursued by man that contributes to the green house effect and the trends in those particular activities.

2.1 The Green House Effect, the Debate and the Principle

The earth's atmosphere contains GHG that trap heat from the sun. If the amount of GHG in the atmosphere increase, more heat is trapped within the earth's atmosphere which results in an increase in the average temperature of the earth. This is known as the green house effect or global warming.

This process of heat from the sun being trapped is a natural one. However the actions taken by mankind, already mentioned in the introduction increase the level of GHG in the atmosphere and has an impact on this natural process. This causes changes the climate of our planet which potentially has dire consequences. Nowadays this is an accepted point of view(However,special interest groups do still exist). Most people do believe that the excessive emission of anthropogenic GHG do pose a threat to the future of the planet. However, the road to this consensus was a long and hot debate. The debate was almost global and had two opposing sides.

The pro side argues rising levels of atmospheric greenhouse gases are a direct result of human activities such as burning fossil fuels, and that these increases are causing significant and increasingly severe climate changes including global warming, loss of sea ice, sea level rise, stronger storms, and more droughts. They contend that immediate international action to reduce greenhouse gas emissions is necessary to prevent catastrophic climate changes. The con side argues human-generated greenhouse gas emissions are too small to substantially change the earths climate and that the planet is capable of absorbing those increases. They contend that warming over the 20th century resulted primarily from natural processes such as fluctuations in the sun's heat and ocean currents. They say the theory of human-caused global climate change is based on questionable measurements, faulty climate models, and misleading science.(ProCon.org, 2015)

However, there was no debate about the heating potential of GHG. British physicist John Tyndall first began experiments leading to the discovery that CO_2 in the atmosphere absorbs the sun's heat as early as 1859. On Feb. 16, 1938 engineer Guy S. Callendar published an influential study suggesting increased atmospheric CO_2 from fossil fuel combustion was causing global warming(Callendar, 1938). Many scientists at that time were skeptical of Callendar's conclusion, arguing that that natural fluctuations and atmospheric circulation changes determined the climate, not CO_2 emissions(Hawkins and Jones, 2013). This counter claim is very difficult to disprove. This is due to the common difficulties that arise when trying to define causal relationships. Trying to find causality in something as complex as the environment of a whole planet

is not so easily done. Climate science is a system science. There are many systems working together, none of which we fully understand, none which we do not understand at all. So statistically speaking it is almost impossible to make a statement as strong as "Yes, anthropogenic emissions GHG can and are altering our climate". However, there is substantial evidence that there is has been a constant increase in the level of GHG compared to pre-industrial levels.

So why was it that there was so much debate? The reason being, most industrial and productive processes, energy is required and the production of this energy releases GHG into the atmosphere. If anthropogenic GHG were indeed a real issue and policy makers took action to reduce these emissions, the emitters of these gases would be at a loss. In economic terms, if producers lose the debate, GHG will be recognised as a negative externality. If policy makers regard it a negative externality and impose quotas and restrictions or any other form of limitation to production, the producers lose profits. So special interest groups used the fact that it is nearly impossible to prove causality between burning of fossil fuels and global warming to try and argue that production does not need to consider the volume of CO_2 emitted.

The debate still continues. In Nov. 2014 the Intergovernmental Panel on Climate Change(IPCC) stated in the summary of it's Fifth Assessment Report on global climate change that "Human influence on the climate system is clear," and that "recent climate changes have had widespread impacts on human and natural systems." It went on to say that continued emission of greenhouse gases "will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems"(IPCC, 2013). In its 2013 Nongovernmental International Panel on Climate Change (NIPCC) report The Heartland Institute argued against human-caused global warming which said that global warming since 1860 is the result of natural "cycles driven by ocean-atmosphere oscillations, or by solar variations (NIPCC, 2013).

However, On 2 February 2000, the European Commission issued a Communication on the precautionary principle. The precautionary principle enables rapid response in the face of a possible danger to human, animal or plant health, or to protect the environment. In particular, where scientific data do not permit a complete evaluation of the risk. The precautionary principle is detailed in Article 191 of the Treaty on the Functioning of the European Union (EU). It aims at ensuring a higher level of environmental protection through preventative decision-taking in the case of risk. The next section will address what these risks entail and which actions of man can increase these risks.

2.2 Our Contributions to the Green House Effect and the Risks

There are three primary activities of man that accelerate the green house effect by increasing the levels of GHG in the atmosphere. They are burning of fossil fuels (energy and industry), LULUCF, and transportation. This section will outline the evolution of these sectors over time.

2.2.1 Energy and Industry

Among the various human activities that produce greenhouse gases, the production and the use of energy represents the largest source of emissions(EPA, 2010). Within this sector the most dominant GHG is CO_2 resulting from the oxidation of carbon in fuels during the combustion process. CO_2 emitted from energy represents almost 70% of anthropogenic global emissions(IEA, 2014). Global total primary energy supply (TPES) more than doubled between 1971 and 2012, mainly relying on fossil fuels. Increasing demand for energy is due worldwide economic growth population growth and development. Despite the growth and innovation of non-fossil energy(wind, solar, nuclear etc...)the share world energy supply produced using fossil fuels remained relatively unchanged over the past 41 years. In 2012, fossil sources accounted for 82% of the global TPES.

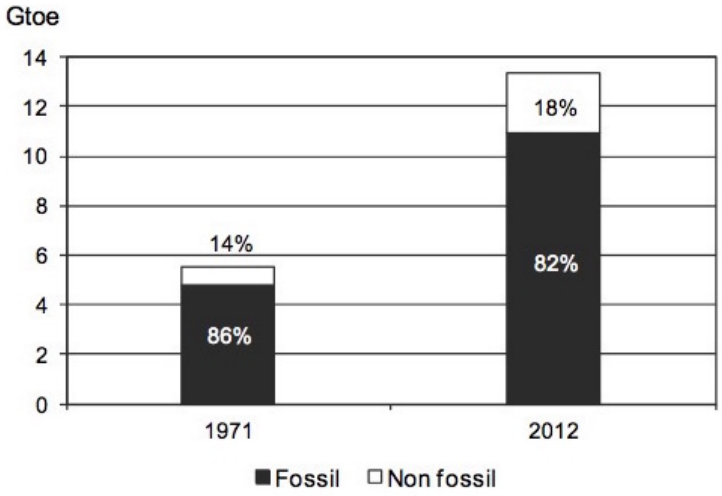


Figure 1: Renewable vs Non-Renewable sources of Energy

Since the Industrial Revolution, annual CO_2 emissions from fuel combustion dramatically increased from near zero to almost 32 giga tonnes of carbon dioxide(GtCO_2) in 2012. Growing world energy demand from fossil fuels plays a key role in the upward trend in CO_2 emissions.

2.2.2 Transportation

Transport is the second largest emitting sector of GHG and account for approximately a quarter of EU emissions(EuropeanComission, 2015c). The transport sector includes the movement of people and goods by all modes, cars, trucks, trains, ships, airplanes, and other vehicles. The majority of greenhouse gas emissions from transportation much like from energy are CO_2 emissions resulting from the combustion of petroleum-based products, in internal combustion engines. Road transport accounts for more than two-thirds of EU

transport-related greenhouse gas emissions and over one-fifth of the EU's total emissions ofCO_2. However, there are also significant emissions from the aviation and maritime sectors and these sectors are experiencing the fastest growth in emissions, meaning that policies to reduce greenhouse gas emissions are required for a range of transport modes(EuropeanComission, 2015c).

While emissions from other sectors are generally falling, those from transport have continued to increase until 2008. Greenhouse gas emissions in other sectors decreased 15% between 1990 and 2007 but emissions from transport increased 36% during the same period. This historical increase is largely due to increased demand for travel and the limited gains in fuel efficiency, which is more than off set by the growing demand(EuropeanComission, 2015c).

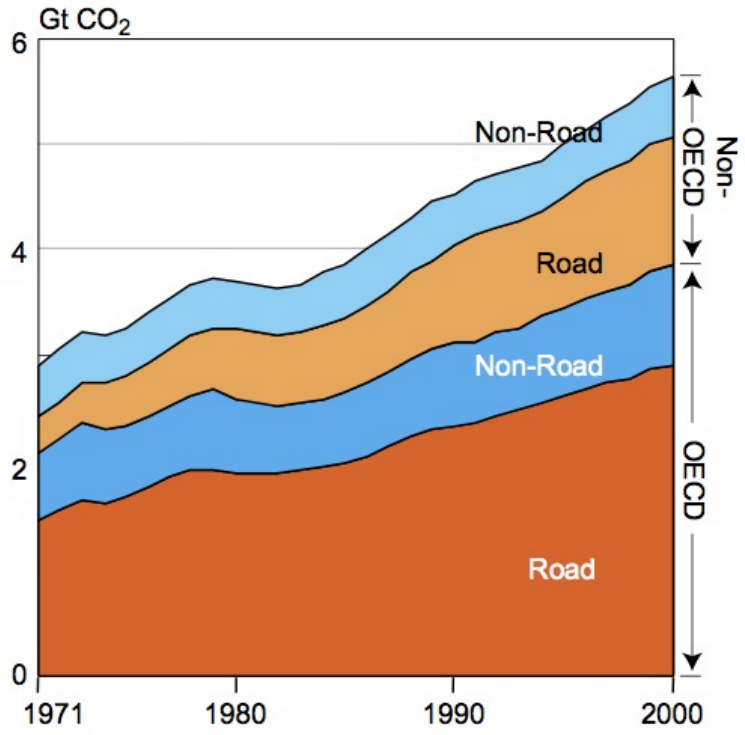


Figure 2: Emissions from Transport(IPCC 2007)

Since 2008 there has been a decrease in the emissions from transport in the EU. The decrease was due to rising oil prices in 2008 and the financial crisis. However, it is difficult to predict if this decrease will be sustained. However, one study has found demographical, economical and infrastructural factors are going to shape the future transport demand, with an expected increase of demand in the eastern part of Europe, due to the impacts of new infrastructures and the catching up trends with the other members GDP higher levels(Sessa and Enei, 2009).

The increasing political importance that is being attached to decarbonizing transport reflects the fact

that, of all the economys sectors, transport has proven to be one of the most problematic in terms of reducing its GHG emissions. Since 1990, GHG emissions from transport, of which 98% are CO_2, had the highest increase in percentage terms of all energy related sectors. Furthermore, transports GHG emissions are predicted to continue to increase, if there is no policy intervention, to over 2,000 mega tonnes of carbon dioxide(MtCO_2) by 2050(Sessa and Enei, 2009).

2.2.3 LULUCF

LULUCF is an inventory sector defined by the IPCC that covers anthropogenic emissions and removals of GHGs resulting from changes in terrestrial carbon stocks. It covers the carbon pools of living biomass (above and below ground), dead organic matter (dead wood and litter) and organic soil carbon for specified land categories (forest land, cropland, grassland, wetland, urban land and other land)(Kuikman et al., 2011). However, for the purposes of this thesis, the sector LULUCF will also include agriculture other than crops as well.

This sector is different from the two mentioned earlier. It is important to stress that both emissions and removals of carbon may occur in the LULUCF sector and that these removals and emissions can be caused by both natural and anthropogenic occurrences. Estimating these emissions and removals requires an understanding of how natural processes affecting greenhouse gas dynamics interact in response to the interventions of humans. Removals result from the capacity of plants and soils to 'suck in' and retain greenhouses gases from the atmosphere through the process of photosynthesis. Removals also take place when trees grow and organic material builds up in soils. Emissions take place for instance when plants die and decay or when soils are disturbed so that their capacity to store is decreased. This would be the case when trees or crops are harvested, if wetlands are drained or if grasslands are ploughed(EuropeanComission, 2011). High emissions from LUC mostly occur in the tropical regions, where forest carbon density is highest(A.Baccini, 2012). However, natural processes like earthquakes can also disturb the carbon sink and result in emissions. This is in sharp contrast to nearly all other sectors in GHG inventories, which are concerned with emissions directly and entirely caused by human activities(Kuikman et al., 2011). The other aspect how it is different is that the main emissions from LULUCF is not necessarily CO_2. Emissions from agriculture are mostly non-carbon GHGs(Not considering the carbon released from LUC). This will be discussed again in section 5.1.

In most industrialised nations, emissions of greenhouse gases mainly come from energy production and other man-made sources. In the EU, the forest and agriculture sectors counter some of these emissions by removing an amount of carbon from the atmosphere equal to about 9%.Although EU forest area keeps increasing, globally deforestation continues to be unabated, only shifting from Amazon to Indonesia, from Russia to Congo, etc. Estimates suggest LUC)was one of the largest individual sources, contributing ap-

proximately 15% between 1990-2010(Peters et al., 2012). Forest loss releases carbon stored in biomass and soil to the atmosphere, increasing radiative forcing and temperature changes on a global scale(G.Bala et al., 2007), and if this cleared land is used for energy intensive agricultural products such as rice and red meat it contributes further to global warming by adding to the total non-carbon emissions.

It must be recognised that the problem is global, and even if with in the EU LULUCF is a net sink the EU STILL contributes to land degradation in third countries (consider Brazil or Indonesia), as we are a net "importer" of land embedded into imported products(EuropeanComission, 2015b).

2.3 The Risks of Climate Change

According to Stephen H. Schneider(nobel peace prize winner 2007) the science of global warming is a complex system science, which consists elements that are well established, competing explanations to those and speculative components of those elements. Hence it is not possible to firmly quantify the risks associated with climate change. However, according to NASA the likely effects are:On average, Earth will become warmer. Some regions may welcome warmer temperatures, but others may not. Warmer conditions will probably lead to more evaporation and precipitation overall, but individual regions will vary, some becoming wetter and others dryer. A stronger greenhouse effect will warm the oceans and partially melt glaciers and other ice, increasing sea level. Ocean water also will expand if it warms, contributing further to sea level rise.Meanwhile, some crops and other plants may respond favourably to increased atmospheric CO_2 , growing more vigorously and using water more efficiently. At the same time, higher temperatures and shifting climate patterns may change the areas where crops grow best and affect the makeup of natural plant communities(NASA, 2015).

What the above is effectively trying to say is, some areas of earth will become barren waste lands and deserts while others flood due to sea level rise and completely alter the vegetation patters as we know them and potentially have adverse effects on the biodiversity of the planet. Climate change affects many sectors of the economy, and agriculture is one of the most susceptible as farming activities are highly dependent on weather. Access to natural resources (soil, air and water) is crucial to agricultural sustainability. Increased weather variability caused by climate change impacts crop yields and is a threat to food security.

The following section will discuss what policies have been adopted by the EU the try and establish clear objectives for reducing human-generated greenhouse gas emissions over time to keep the global average temperature rise below two degrees(UNFCCC, 2011) which was agreed upon in the The Cancun Agreements of the United Nations Climate Change Conference(UNCCC) 2010

3 Existing Remedies to Climate Change

There is a lot of literature available on methods that can be applied to tackle climate change, this section will describe what the scientific community believes to possible remedies to the problem. There are three general approaches to deal with GHG emissions, the hard measures which are technical mitigation and increasing productivity, and the soft measures of demand management/reduction. The first two have been more common in the past, but in recent times increasingly more body of research is being published on soft measures acknowledging their potential.

According to the IPCC fourth annual report, there are multiple options for lowering GHG emissions from the energy system while still satisfying the global demand for energy services. Some of these possible options, are, energy conservation and efficiency, fossil fuel switching, renewable energy(RE), nuclear and carbon capture and storage(Edenhofer et al., 2011). These are all examples of technical mitigation and increasing productivity.

However, research shows that gains in fuel efficiency are limited(EuropeanComission, 2015c). Hence there is very little reduction in GHG emissions possible from things such as cleaner and more fuel efficient vehicles. Research also shows that increase in productivity its also near its limit in the agricultural sector. For instance, in Brazil there was a dramatic increase in productivity since 1960 (155% for cattle and 300% for cropland), but the projections for the next decade show much lower expected gains (24% for cattle and 23% for cropland, from 2010 levels to 2021)(Karstensen et al., 2013).

The energy system is by far the largest contributor of GHG hence most gains can be made by mitigation of emissions in this sector, however, remedies exist outside of this sector that can also have significant impact and can slow down the global warming process, examples are, re-forestation, new and innovative agricultural methods, and soft measures to reduce general demand for products with large carbon foot prints, in particular meat and dairy products. According to research human consumption of meat and dairy products is a major driver of climate change.GHG emissions associated with their production are estimated to account for over 14.5 percent of the global total. This is more than the emissions produced from powering all the worlds road vehicles, trains, ships and aeroplanes combined(Bailey et al., 2014). So, other than the energy system, remedies exist in the agriculture and food production sector. Especially if one considers that agriculture and food products are often produced on de-forested lands which also contributes substantial amount of GHG.

The following section will describe what policies the EU have adopted to battle climate change and keep global temperature rise below 2 degrees celsius.

4 The Kyoto Protocol

UNCCC of 2010 is not the only one worth mentioning in the context of climate change. Perhaps even more important was the conference in 1997 which took place in Kyoto. In December 1997 over 161 nations met in Kyoto, Japan to negotiate a treaty to limit greenhouse gas emissions and work toward the objectives of the UNFCCC. The resulting Kyoto Protocol,entered into force on 16 February 2005. The Kyoto Protocol is an international agreement, which commits its parties by setting internationally binding emission reduction targets. The Kyoto protocol works in phases to try and ensure a smooth transition towards sustainability and it recognises that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity, the protocol places a heavier burden on developed nations under the principle of "common but differentiated responsibilities." 15 countries with in the EU are a part of the Kyoto protocol and the European Commission has set goals and designed policies to adhere to the Kyoto protocol. It must be mentioned here that the . The next section will outline some of the existing climate change mitigation methods

5 EU Policies following the Kyoto

Since the Kyoto agreement the EU has been thinking about ways to reduce GHG emissions and has set targets for its self. Under Kyoto's first commitment period, from 2008 to 2012, developed countries had to reduce their emissions by an average of 5% below 1990 levels by 2012. The 15 countries that were EU Member States at the time that Kyoto was agreed committed to an 8% cut a achieved this by a comfortable margin(EuropeanComission, 2015a). The second commitment period of the protocol runs from 2013-2020 and the EU has made ambitious commitments again.

To ensure that they are able to meet their goals the EU launched what is known as the "The 2020 climate and energy package". The package is a set of binding legislation which aims to ensure the European Union meets its ambitious climate and energy targets for 2020. These targets, known as the "20-20-20" targets, and set three key objectives for 2020:

1. A 20% reduction in EU greenhouse gas emissions from 1990 levels;
2. Raising the share of EU energy consumption produced from renewable resources to 20%
3. A 20% improvement in the EU's energy efficiency

To meet these objectives the EU has two broad programs. These are known as the The EU Emissions Trading System (EU ETS) and the Effort Sharing Decision(ESD). These two will be outlines in the following subsections.

5.1 EU ETS

The EU ETS launched in 2005 is the EUs corner stone policy to battle climate change and reduce GHG emissions cost effectively. It is worth noting that like the Kyoto protocol, the ETS also works in phases. The third and last phase in now ongoing and lasts through the period 2012-2020. However, this program does not include all emitting sectors. The system covers emissions of CO_2 from power plants, a wide range of energy-intensive industry sectors and commercial airlines. The EU ETS covers CO_2 emissions from flights within and between countries participating in the EU ETS, international flights to and from non-ETS countries are also covered. Furthermore it covers more than 11,000 power stations and industrial plants in 31 countries. This totals to about 45% of total greenhouse gas emissions from the 28 EU countries. In the third phase of the EU ETS a single, EU-wide cap on emissions applies in place of the previous system of national caps.

The EU ETS is a cap and trade program. A 'cap', or limit, is set on the total amount of certain greenhouse gases that can be emitted by the factories, power plants and other installations in the system. The cap is reduced over time so that total emissions fall. The emitters receive a certain amount of "allowance" and after each year a company must surrender enough allowances to cover all its emissions, otherwise heavy fines are imposed. If a company reduces its emissions enough to save some of their emitting rights, it can keep the spare allowances to cover its future needs or else sell them to another company that is short of allowances. The flexibility that trading brings ensures that emissions are cut where it costs least to do so. It is predicted that In 2020, emissions from sectors covered by the EU ETS will be 21% lower than in 2005.

5.2 ESD

From the section above it is obvious that the ETS, which proves to be very elegant and useful has some shortcomings. Namely, it only includes energy and industry. This left large emitting sectors such as transportation(except aviation and international maritime shipping) and LULUCF to be regulated only by the market. However, in 2013 the ESD was launched and it set binding annual greenhouse gas emission targets for Member States for the period 2013-2020. In contrast to the EU ETS, the ESD sets national emissions target in sectors not covered by EU ETS and are unanimously agreed upon. They have been set on the basis of Member States relative wealth (measured by Gross Domestic Product per capita). Less wealthy countries are allowed emission increases in these sectors because their relatively higher economic growth is likely to be accompanied by higher emissions.

Currently the ESD does not set a target for emission reductions in the LULUCF sector. Instead, progress is being made be on improving the accounting systems by member States. This is because there are a lot of methods out there used to quantify the level of CO_2 in the atmosphere and there is discrepancy about how to measure the emissions from the LULUCF sector. This problem is very closely related to the fact that this sector both emits and absorbs CO_2 . The Commission will consider whether to propose GHG

targets for agriculture and forestry sectors once the accounting systems have proven that they are robust and effective. This does not seem like such an issue given that with in the EU the LULUCF sector acts as a net sink. However, it must be kept in mind that the EU contributes to land degradation and emissions in third countries as we are a net "importer" of land embedded into imported products(EuropeanComission, 2015b).

5.3 REDD+

As mentioned in section 2.2.3 with in the EU the LULUCF sector is a net sink, however that is not the case every where. Global emissions from permeant change of forestry to other land uses such as crops, roads, settlements, mining or grazing land is approximately 12%. Deforestation is 70-80% driven by the conversion to agriculture in order to provide larger amounts of fuel, food and fibres to a bio-economy that is expanding even faster than global consumption.

The 'reducing emissions from deforestation and forest degradation' (REDD) initiative emerged from negotiations under the UNFCCC in 2005. REDD aims to create incentives for developing countries to reduce greenhouse gas emissions from forested lands. Following intensive discussions on the need for social and environmental safeguards, the concept was expanded to the REDD+ initiative which includes the goals of sustainably managing forests and conserving and enhancing forest carbon stocks.

6 Flaws in the Desgin of EU policies

The previous section provided a general overview of the broad policies the EU has in place to combat GHG. This section will take a deeper look at these policies and demonstrate how these policies are sometimes more interrelated than is immediately obvious. Furthermore it will become apparent that policies are very often misaligned which lead to sub optimum efficiency in reduction of GHG.

As mentioned previously, the EU does not have a target for GHG reductions in the LULUCF sector. Furthermore, EU imports lead to land degradation and deforestation in the third countries. Between 1970 and 2010, approximately 18% of the Brazilian Amazon was deforested(A.Baccini, 2012), the primary reasons being, demand for new land for the cultivation of soybeans and expansion of pasture (E.Barona et al., 2010).

The REDD+ initiative (Reducing Emissions from Deforestation and forest Degradation) is creating incentives for developing countries with large deforestation rates to reduce forest loss and encourage regrowth. However, as industrialised countries are paying to protect tropical forests through mechanisms such as REDD+, the same countries might also indirectly be driving deforestation via consumption of agricultural products from the very countries whose forests they aim to protect(Pacheco et al., 2010).

Furthermore, other than agricultural products GHG release from land use change (the so-called carbon

debt) has been identified as a potentially significant contributor to the environmental profile of biofuels(Kim et al., 2009). Some studies show along with the one just stated show that time required for biofuels to overcome this carbon debt due to land use change and begin providing cumulative greenhouse gas benefits is referred to as the payback period and has been estimated to be 100-1000 years depending on the specific ecosystem involved in the land use change event. Currently the EU promotes the use of biofuels(and other sources such as electric) with the goal of at least 10% percent renewable energy in transport by 2020.

The following subsections will attempt to quantify the impacts of these two misalignments, namely deforestation for the production of agricultural products and deforestation. The production and consumption of biofuels will not be discussed as there is still too much contradicting research. This discussion is much like the fuel-mix discussion of electric cars. The debate on whether meat and dairy production and consumption needs to be reduced is settled. There is scientific consensus that a reduction is of paramount importance in the battle against climate change.

6.1 Quantifying the Emissions from LUC for Agriculture

Worldwide, agricultural activity, especially livestock production, accounts for about a fifth of total greenhouse-gas emissions, thus contributing to climate change and its adverse health consequences, including the threat to food yields in many regions(McMichael et al., 2007). Studies by (A.Carlsson-Kanyama, 1998) and (Engström et al., 2007) have shown that choice of food and diet can influence the energy requirements for the provision of human nutrition and the associated GHG emissions. Anthropogenic warming in the agriculture sector is caused by the so called non-carbon GHG, namely methane and nitrous oxide.(Carlsson-Kanyama and González, 2009).

Methane is produced when organic materials decompose in oxygen-deprived conditions, notably from fermentative digestion by ruminant livestock, from stored manures, and from rice grown under flooded conditions. Emissions of this gas, therefore, can be tied to products such as meat, milk, and rice. Nitrous oxide is emitted with the production of fertilisers and is generated by the microbial transformation of nitrogen in soils and manures(Carlsson-Kanyama and González, 2009).These two gases are emitted in much less volumes than carbon dioxide. However the ability to trap heat within the atmosphere of the non-carbon gases are far superior to that of CO_2 . Methane is second to carbon dioxide when it comes to the overall contributions of radiative forcing(17%)(IPCC, 2013). However, methane is a lot more effective when it comes to trapping heat in the atmosphere. Up to four times as effective as CO_2.

Currently Brazil is the largest producer of beef and it is also the country where a lot of the rain forest is being cleared in order to produce more agricultural products. (Karstensen et al., 2013) has written a paper estimating the share of emissions from deforestation and beef production that can be allocated to different geographical location based on consumer demand. He concludes that the exported CO_2 emissions from all

Brazilian deforestation over 19902010 averaged 25%. For beef products the average exported was 15%, while for soybean products the average exported was 50%.

In the past western Europe and USA was one of the main importers of Brazilian beef,nowadays the emerging economies such as Russia and China are the largest consumers. However, the consumption of meat in Europe is still far too high for it to be sustainable.

A recent Food and Agriculture Organisation of the United Nation(FAO) report focuses specifically on the current and future effects of livestock production on the world's environment and climate. The report states that the world's livestock sector, which provides the livelihoods of about 1.3 billion people, is growing faster than other agricultural subsectors. Yearly worldwide meat production is projected (in the absence of policy induced changes of trend) to double from 229 million tonnes in 1999-2001 to 465 million tonnes in 2050, and milk output to almost double from 580 million tonnes to 1043 million tonnes. Most of this increase is projected to occur in countries with low or middle incomes. Livestock currently use almost a third of the world's entire land surface, mostly permanent pasture, but also including the third of the world's arable land that provides livestock feed. So it is not only that the livestock are emitting GHG on land that is emitting GHG, to produce food for this livestock, we are clearing more forest and emitting even more GHG due to LUC.

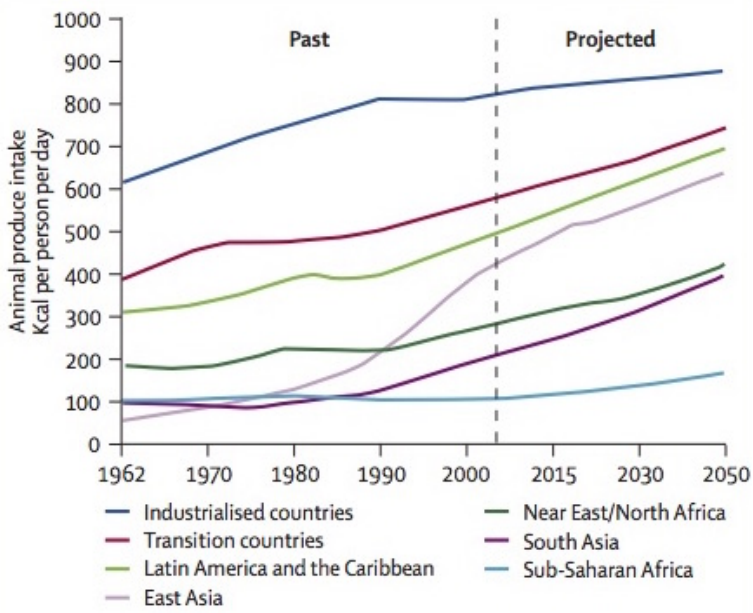


Figure 3: Trends in consumption of livestock products per person (milk, eggs, and dairy products, excluding butter)

If no action is taken to influence the projections in the graph above, emissions from LULUCF will reach unprecedented levels and no policy applied in any sector will be able to compensate the massive non-carbon

emissions arising from the production and consumption of agricultural products, namely meat and milk products. The next section will address some of the suggestions that have been made in the literature to try and tackle this growing problem.

6.2 How can the EU better Curb Emissions from LUC for Agriculture

From the section above it is clear that there is a gap between what the EU policies are regarding LULUCF and what they ought to be, more specifically, something needs to be done to curb the amount of agricultural products consumed(in the EU and else where) produced with very energy intensive methods.

Studies by the American Journal of Clinical Nutrition have shown that animal-based foods and rice, contribute significantly to the emission of noncarbon dioxide gases Plant foods based on vegetables, cereals, and legumes present the lowest GHG emissions with the exception of those transported by airplanes. Animal products, including dairy, are associated with higher GHG emissions than plant-based products, with the highest emissions occurring in meats from ruminants(Carlsson-Kanyama and González, 2009).

Furthermore, studies have shown that meals with similar caloric content may differ by a factor of 2 to 9 in GHG emissions(A.Carlsson-Kanyama, 1998). Thus, it can be concluded that such large levels of consumption of meat is not necessary for sustenance. So, if everyone eats less meat we solve a very large problem. However, practice is very different from theory. There are both cultural aspects to eating meat and strong consumer preferences(This is covered in more detail later). Still, some authors have suggested "that the unprecedented serious challenge posed by climate change necessitates radical responses"(McMichael et al., 2007).

In practice there are three ways (excluding policy to limit production) in which emissions from the agro-sector can be reduced: technical mitigation, increasing productivity, and demand management/reduction. Technical mitigation and increasing productivity usually involve hard measures and demand management/reduction is conducted using soft measures. According (McMichael et al., 2007) The main options for reducing greenhouse-gas emissions per unit of animal production include:

1. Sequestering carbon and mitigating carbon dioxide emissions by reduction and reversal of deforestation arising from agricultural intensification and by restoration of organic carbon to cultivated soils and degraded pastures

2. Reducing methane emissions from enteric fermentation (especially in ruminants such as cattle, sheep, and goats) through improved efficiency

3. Increasing the proportion of chickens, monogastric mammals, and vegetarian fish in the flow of animals grown for human consumption

4. Mitigating emissions of methane through improved management of manure and biogas

5. Mitigating emissions of nitrous oxide via more efficient use of nitrogenous fertilisers.

However, they also find that using the latest technology one can only reduce emissions per unit of animal product by only 20% at fairly low costs. Reductions below this level have very high costs and are not realistic. Furthermore, in its latest review of the scientific literature on mitigation in the agriculture sector, the IPCC found that the greatest potential for emissions reduction exists on the demand side. To make the case made by the IPCC stronger, the FAO stated in their 2013 report "even with a transformative step change in policies and implementation, supply-side mitigation alone would be unable to contain increasing livestock emissions. Estimates indicate that shifting all livestock farming to the least emissions-intensive production practices available within a particular region or agro-ecological zone could offer emissions reductions of 32 per cent at current output levels. This would be a remarkable achievement, but not enough to offset rising demand for meat and dairy products: livestock emissions would continue on an upward trajectory".

Hence, the most effective way to bring this upward trajectory to a halt is to control the rising demand. However, at the moment there is not a single instrument in place achieve this goal. Administrations the world over have implemented policies and launched communication campaigns to reduce energy demand among motorists, households and industry as part of climate policy-making. But efforts to moderate meat and dairy consumption are absent from mitigation strategies. To make matters worse, in many european countries meat and dairy products and heavily subsidised. In the EU, cattle subsidies alone exceeded $731 million, equivalent to $190 per cow(Bailey et al., 2014).There is consensus that very large reductions are possible in the agro-sector, but for some reason or the other most governments, if not all are reluctant to take action to curb consumption of meat and dairy.

A paper in the American journal of clinical Nutrition concludes that further research is needed to understand barriers and why changes in diets have not been a main issue on the climate agenda until now(Carlsson-Kanyama and González, 2009). However, a more recent study by the think tank Chatham House tries to answer this question. They find that there are five main reasons why governments seem reluctant to take policy action.

1. Fear of backlash.

2. Intrusion: Governments and non-governmental organisations (NGOs) may be concerned about public intolerance of any attempt to interfere in lifestyle decisions, inviting accusations of paternalism and preaching, and risking alienating voters or supporters. These concerns may be greatest in developed, market-based economies where notions of free choice and individual rights predominate.

3. Cultural significance: Promoting dietary change would necessarily challenge the cultural significance of meat in many societies around the world, and its aspirational status in many developing countries.

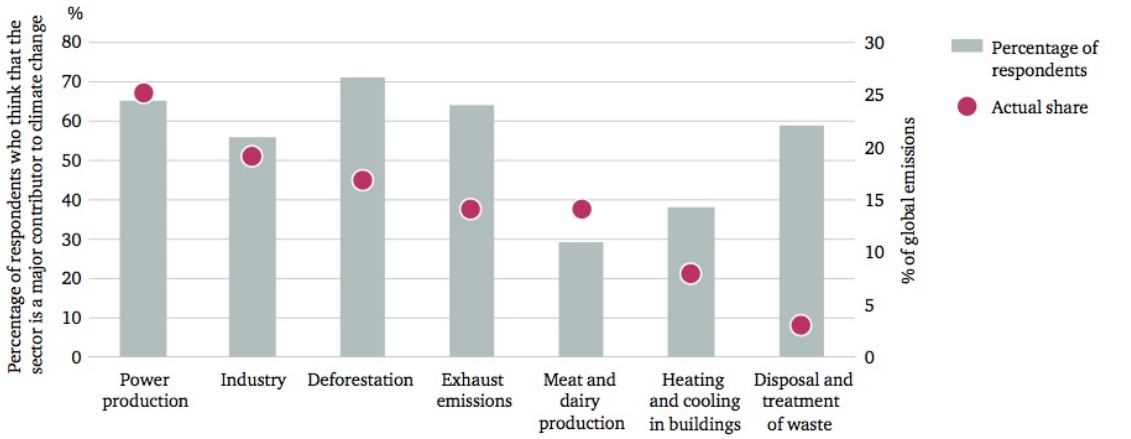
4. Private-sector resistance: Attempts to reduce meat and dairy consumption would be likely to mobilise resistance from powerful interest groups, including the livestock sector and feed-crop farmers, in much the same way as policies to promote clean energy have encountered resistance from some in the fossil fuel sector.

5. Public ambivalence regarding climate change: Surveys often demonstrate relatively high levels of public awareness and concern about climate change, yet public engagement remains comparatively low. A lack of belief that individual action will make a difference can translate to low levels of empowerment and minimal changes to individual behaviour. As a result, mitigation strategies focused on individual behaviour change have not been prioritised.

However, the authors of the report do acknowledge that there are multiple assumptions and generalisations in the conclusions drawn above. And they agree with the authors from the journal of clinical nutrition that in reality "there is minimal research on how dietary change might best be effected" This lack of research in this field is recurring, most governments believe that challenge of changing consumptions patters(in food behaviour) is insurmountable and this results in a policy vacuum. However, policy in this sector should not be any different than policy in the energy sector. Mitigation policies are very rarely easy options and most mitigation policies face familiar challenges of special interests, upfront costs, coordination failures, information gaps and capacity constraints. Changing food behaviour is not that different from changing patterns in energy consumption(Bailey et al., 2014). Yet the absence of effort directed to doing so indicates that many policy-makers and environmental campaigners believe it is.

The EU is in a unique position as its functioning is on some what different level than the national governments and politicians. The population does not attach "one face" to the EU as it does with presidents, majors and other officials. If the EU does take action it has to deal with some of the same problems as national governments but they are certainly in a better position to act than national governments. The EU needs needs to include a change in diet needs to be an important point on the climate change agenda. It should do so with haste.

The steps the EU can take to reduce consumption of meat and dairy do not require very large investments. Their main focus should be on closing the "awareness gap". As mentioned earlier in this thesis, there is public acceptance that particular human actions do cause climate change, however compared with other sectors, recognition of the livestock sector as a significant contributor to climate change is markedly low(Bailey et al., 2014). Consumer with higher levels of awareness are more willing to reduce consumption of meat and dairy products.



*Percentage of respondents who, when asked how big a part – if any – different activities play in the human contribution to climate change, stated 'a lot' for each activity.
Sources: Ipsos MORI/Chatham House (2014); IPCC (2007); IPCC (2014).

Figure 4: Percentage of actual and perceived contribution to climate change*

Source: Ipsos MORI/Chatham House (2014).

Figure 5: Comparison of the impact of awareness on willingness to take individual action on transport habits and on meat and dairy consumption

In order to close the awareness gap, information campaigns can play an important part. However, the campaigns must be designed in a smart manner. It is known that climate change and environmental concerns are not a primary consideration in choices, even less so when the choices involve food behaviour. Taste, price, health and food safety are the things people care about. Campaigns must be designed to target these areas. Health and food safety should be targeted first. If consumers learn about the benefits of consuming less meat they will have intrinsic motivation to change behaviour. But perhaps even more important is to convince the population first that there are no bad effects to eating less and only then convince them that there are even benefits. Many individuals in modern society have forgotten that for human beings, historically, as for the animal world at large, the fundamental point about food and energy has been that, to survive, an individual must acquire at least as much food energy as is expended in basal metabolism, reproducing, and acquiring food(McMichael et al., 2007). Some of the potential benefits that can be used to campaign include: reduction in colorectal cancer, limit cancer risk, fight diabetes, and help prevent obesity(Although this has more to do with the fat content in red meat and not caused by eating meat, the fat content in red meat is potentially modifiable with technology). Food safety and the conditions under which their meat is produced is also a concern that the general population should learn about. Industrial producers use large amounts of pharmaceuticals to prevent diseases from spreading like wildfire among animals on huge factory farms, and to promote faster growth. But this is dangerous: bacteria are developing resistance to drugs that are vital to treat diseases in humans.Although the European Union prohibited antibiotics to promote growth in 2006, this did not lead to a significant decrease in their use on farms. Systematic inquiries have recently revealed that 8,500 tonnes of antimicrobial ingredients were distributed in 25 European countries in 2011. Germany has the highest (overall) consumption at 1,600 tonnes a year. However Denmark, where veterinarians are subject to relatively tight controls, reports only a third of the German per animal head level.(Holden et al., 2014).

Once enough people are willing to change their eating patterns due to better understanding of the consequences of their food choices, policy(or there lack of) needs to limit consumption of food with high energy requirements and large GHG emissions with minimum backlash. An easy place to start are the subsidies, the EU can make regulations that prohibit subsidies to meat and milk products. The savings would be immense. National governments can then use this money to research and innovate, whether it be in the agro-sector or in renewable energy. The removal of subsidies will via increases in retail prices, help to reduce meat consumption. (McMichael et al., 2007) proposed a 10% reduction in the current global average meat consumption of 100 g per person per day as a working global target, the EU can advocate this and support this growing movement of less meat and more vegetarian diets.

As mentioned earlier nowadays the largest consumers of meat and dairy are developing nations like Russia and China and most gains in reductions can be made by changes in their behaviours. The EU

can indirectly influence this by limiting production and consumption of meat and dairy(Within the EU) using either hard measures, soft measures, or policy. If this is done perhaps contraction and convergence is possible. Contraction and convergence is an ambitious yet widely supported plan to harmonise global greenhouse gas emissions to a safe and sustainable level per person within the next few decades. Because rapid reductions in greenhouse-gas emissions per unit of livestock production would be technically difficult in the short term, the prime objective must be to reduce consumption of animal products in high-income countries, and thus lower the ceiling consumption level to which low-income and middle-income countries would then converge(McMichael et al., 2007).

7 Conclusion

Considering everything uncovered during my literature review, the research question is answered as follows: The EU policies to reduce GHG emissions emitted from the LULUCF sector are not any where near as efficient and effective as it should be. The sector is not included in the EU ETS program. It is included on the ESD BUT currently the ESD does not set a target for emission reductions in the LULUCF sector. Instead, progress is being made be on improving the accounting systems by member states. So, in reality there is no policy that is targeting reductions in this sector and it must be emphasised that this is no small sector when it comes to emissions. Furthermore, the EU is spending tax payer money to save the rain forest through mechanisms such as REDD+ the same countries might also indirectly be driving deforestation via consumption of agricultural products from the very countries whose forests they aim to protect. The EU needs to act and it needs to act fast to manage demand of meat and dairy products if global temperature rise is to remain below 2 degrees.

There are plenty of barriers that must be crossed before behaviour of the masses will change. However, the EU MUST start doing something to raise awareness. They have to start discussing a change in diet as a top priority on the climate change agenda. The belief that the barriers are too great to be overcome is a false choice. There are already plenty of individuals taking action to reduce consumption of meat and dairy and spreading awareness, the only issue is the lack of organisation. The EU can set an example and play a leading role by taking initiative and starting educational campaigns that promote greater synergy between environmental and health education to obtain agreement for a dietary change for the general public.

There are already movements in schools and universities of things such as "walk to school Wednesday" and "meat free Monday". These may seem trivial but it is a starting point. If everyone eats a little bit less, walks a little bit more, the gains in reduction will be quite large. Exactly how large is impossible to quantify, but the point remains, when it comes to GHG, less is more. A recent assessment of mitigation opportunities in agriculture estimated that shifting dietary trends so that average worldwide per capita meat consumption falls to 90g per day, as recommended in the Harvard healthy diet, could avoid 2.15Gt CO_2 of

emissions per year by 2030. We can all do a little to make a big change. Yes, it is a sacrifice. We all need to consume less and it goes against most economics. But if we do not manage our consumption we will not have much of a planet left. We need to get people engaged in this climate change phenomenon. It cannot just be in the news headlines and in the background. According to Stephen. H. Schneider "We are talking about the sustainability for their children, their grandchildren, and the rest of nature. Our behaviour in the next generation can precondition a sustainability issue for a millennium or ten, based upon the convenience of one species for one generation, I find that a morally daunting prospect".

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