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Hybrid Model for Regulating Carbon

Master Dissertation

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Annotation

The objective of this dissertation is to review the instruments used to reduce carbon emissions, discuss the emission trading introduced by the European Emission Trading System and tentatively suggest further improvements. We shall look at carbon emissions as a negative externality and explore the theoretical foundations of carbon taxation and cap-and-trade systems as well as their possible interactions, conflicts and synergies. We shall also look at the risks associated with using carbon regulation in the EU, mainly carbon leakage and lack of international compliance with regulatory mechanisms, especially in the developing countries. On a practical side, we shall focus on the structure and performance of the carbon reduction policies during the three phases - NAP1, NAP2 and NAP3, paying close attention to free allocation and auctioning. Finally we shall discuss risk-reduction methods, focusing on a potential hybrid model combining both cap-and-trade and taxation with a percentage of the revenues redistributed to the developing world to stimulate climate change agenda.

Keywords

carbon emissions trading, carbon taxation, cap-and-trade, EU ETS, Kyoto Protocol, carbon leakage, hybrid model

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Statement:

1. This statement is to confirm that this paper is a product of my own work and also to confirm that I used the listed sources in producing it.

2. I agree that the paper can be checked for research and studying purposes.

Prague, 21 May 2010 Ksenia Ashrafullina

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I would like to express my gratitude to a number of people for their support during my work on this Master dissertation. First, I would like to thank my supervisor Zdeněk Hrubý for sparking my interest in industry regulation and putting me on track during my research. Second, I would like to thank Tomáš Havránek and David Boucher for their academic guidance, advice and valuable critique of ideas. Finally, I owe special thanks to Matteo Moriotti for providing me with industry insights, exciting reading materials and support throughout the time of writing.

Table of Contents

List of Abbreviations

AAU Assigned Amount Unit
APA American Power Act
BAT Best Available Technology
BAU Business as Usual
BSA Burden Sharing Agreement
CER Certified Emission Reduction
CCX Chicago Climate Exchange
CDM Clean Development Mechanism
CITL Community Independent Transaction Log
ERU Emission Reduction Unit
EUA European Union Allowances
ERU Emission Reduction Unit
EU ETS European Union Emission Trading Scheme
GHG Greenhouse Gas
IEA International Energy Agency
JI Joint Implementation
MtCO2e Millions of Tonnes of Carbon Dioxide Equivalent
MWh Megawatt Hour
NER New Entrant Reserve
OECD Organization for Economic Cooperation and Development
OTC Over-the-counter
SO2 – sulphur dioxide
tCO2e Tonne of Carbon Dioxide Equivalent
UNFCCC United Nation Convention on Climate Change
VER Verified (or Voluntary) Emission Reduction

Master Thesis Proposal
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Topic characteristics

Environmental economics tools have been widely employed to design policies targeted at reducing carbon emissions. The most comprehensive example of using a market-based approach for environmental regulation is EU ETS, that has become the first and the only such scheme in the world. During the five years of its functioning it has demonstrated both strengths and weaknesses. One of the most problematic issues of EU ETS is price volatility of emission permits that is influencing decision making of all the actors involved. In my thesis I would like to research the ways which could help reduce the volatility by using regulatory instruments.

Hypotheses

There are a number of ways in which the EU ETS can develop in the future. There is a chance that a hybrid model combing both cap-and-trade and a floor tax will be implemented. In my thesis I would like to investigate this scenario and see its potential implications for the effectiveness of the climate change policies.

Methodology

In order to analyze the potential hybrid model for regulating carbon I would like to use the latest research in the field available dealing with the outcomes of different carbon regulating schemes. Using Ekins' idea of floor tax, I would like to build up a discussion on how, by combining cap-and-trade and taxation systems, the EU can achieve stable emission permit price.

Short outline of the thesis

Chapter 1. Economics of Climate Change

Introduction to the problem of climate change and its economic effects. Overlook of scientific evidence and costs associated with both action and inaction. Discussion of the double dividend concept.

Chapter 2. Responding to Climate Change

Review of the ways in which climate change can be addressed: technology and market-based instruments. Introduction to the idea of carbon as a negative externality and discussion of both pigovian tax and Coase's environmental endowments. Linking theory to practical implementation, embodied in carbon tax, cap-and-trade and voluntary carbon market.

Chapter 3. International regimes regulating global warming

Discussing the role of the Kyoto Protocol and its major instruments: CDM and JI. Overview of the Copenhagen Conference and its results. Introduction to the EU ETS.

Chapter 4. The EU carbon policy

Detailed discussion of the EU ETS, its origins and development during NAP1, NAP2, NAP3. Analysis of allocation methods: free distribution, benchmarking and auctioning. Introduction to the problem of permit price volatility.

Chapter 5. Hybrid model

Defining the risks that the EU faces and ways to resolve them: import tax option and floor price introduction to balance the volatile permit price under cap-and-trade.

Chapter 6. EU competitiveness and carbon leakage

Discussing the way developing nations and technology choices influence the EU competitiveness, with a specific focus on carbon leakage and its threats. Suggesting the use of part of the floor tax revenue for investment in joint carbon reduction projects in the developing world in order to put climate change of the global agenda.

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In Prague, 2010

Author Supervisor

Introduction

Global warming has recently evolved from a purely environmental issue into a political and economic one. Climate change debate is now more often referred to as climate crisis debate, where the focus is not on whether facts regarding the warming of the planet are scientifically justifiable, but on how humanity can prevent the planet's ecosystem from falling into a total collapse. Moreover, the 'debate', albeit still fueled by some global warming skeptics, is no longer a debate at all: several governments around the world have initiated legislation curbing CO2 emissions, economists are looking at various carbon market regulation opportunities, and investors are searching for a formula that can help them forecast carbon price trend, making carbon the focus of attention for researchers from all walks of science.

This work will consider the latest developments in the economics of climate change and, assuming that the European Union Emission Trading Scheme is the most functional result that could have been achieved given all kinds of political, economic and social conflicts that surrounded its implementation, look at how it can protect its competitive advantage vis-à-vis risks emanating from developing nations that do not have a similar environmental regulation in place. The work will consider regulatory alternatives and discuss the potential for a hybrid system of carbon taxation and cap-and-trade that, if implemented, may alleviate the problem of carbon price volatility and lead to increased revenues for the EU member states. Some part of these revenues, as it will be seen, could be used to invest into joint carbon reduction projects that address carbon reduction in the developing nations that are hit most both by the changing climate and carbon leakage. Establishing closer cooperation with developing countries has the potential to improve compliance with regulatory standards across the world.

In the ***first chapter*** we shall discuss why carbon matters and why it became the focus of environmental regulation. We shall look at scientific evidence and the implications of it for the policy-makers. We shall also consider the findings provided by global warming skeptics in order to have a more balanced look at the subject in question. The cost of both action and inaction will be presented, followed by an introduction of a double dividend concept, which suggests that climate regulation not only helps towards reducing carbon footprint, but also increases competitiveness and efficiency. This background knowledge will serve as an introduction to the regulation theory discussed in the following chapter.

The ***second chapter*** will commence by discussing the potential of technology in resolving the issue of climate change and continue with an introduction to the environmental regulation theory based on the concept of carbon as a negative externality that can be resolved via introduction of either a pigovian tax or by distributing Coase's environmental endowments. These tools - evolved into a carbon tax, cap-and-trade system and voluntary market - will be discussed in detail. We shall conclude by making a comparison of the available options.

In the ***third chapter*** we shall look at the possibilities of international cooperation for stopping the climate change, discussing all-inclusive and club approaches together with their positive and negative sides. Most of the chapter will be devoted to the Kyoto Protocol, its origins, framework agreements, tools, achievements and failures. We shall also talk about the aspirations and resutls of the Copenhagen Summit and its inplications for the future of the global carbon regulation, setting a proper framework for a more focused discussion of carbon emissions trading in the EU in the chapters to follow.

All of the ***fourth chapter*** will be devoted to the first carbon emission scheme that exists in the world – the European Union Emission Trading System (EU ETS). A historical overview of how the scheme came about will be provided in order to understand underlying intentions, contradictions, theoretical foundations and aspirations. We shall look at how the powers in the EU are distributed between the Commission and the member states, resulting in a peculiar interaction and outcomes. Special attention will be given to the EU ETS allocation methods, namely, free distribution, benchmarking and auctioning. We shall see whether a choice of any particular method affects the price of the permits and whether the past allocation experience together with aspirations for a future change can resolve the problem of price volatility of emission credits. After revising the theoretical assumptions of allocation we shall discuss national allocation plans – the first two phases currently implemented that can be analyzed to draw conclusions, as well as the third phase, that has been designed but is yet to take effect. Finally we shall discuss the reasons for both criticism and praise that the system has received. In the following chapter this will allow us to discuss risks that the EU may potentially face.

The ***fifth chapter*** will be focused on the risks that the EU ETS is facing, developing a number of ideas about how to counterbalance them. Specifically, we shall look at an import tax option and its practical viability within the framework of WTO and free trade agreements. Carbon taxation will be given a scrutiny and suggestions about how it can be used to lower the price volatility will be offered. The chapter will end with a tentative suggestion of a hybrid climate control scheme, wedding both the carbon tax and the cap-and-trade already in place.

The ***sixth chapter*** will look at how imbalances created by the EU ETS can be faced. It will be argued that developing nations are presenting the major threat to the competitiveness of the EU products that are constrained by environmental regulation. At the same time we shall see that the developing world has become prey of carbon leakage from the developed world, posing a threat to a sustainable development of the world's climate. We shall revisit the EU flagship role in driving the psychological and institutional change in the realm of environmental policy and consider the options of risk reduction based on implementing a hybrid model, allowing some percentage of tax revenues to be used for sponsoring carbon reduction projects in the developing world. The chapter will conclude by assessing the means the EU has in order to put climate change on the developing world agenda.

In summary, this thesis will depart from a rather vast notion of climate change and its economic consequences. Through a series of close-ups it will work its way towards environmental regulation with a focus on the EU ETS, potential change to it in a form of additional taxation and creation of a hybrid model. The risks to competition will be discussed, suggesting investing resources from a complimentary carbon tax to the developing world in order to bolster compliance with environmental regulation and to prevent further carbon leakage from the developed world. The work will move from theoretical grounds to practical examples, ending in a suggestion of a new model for bringing more compliance to the international environment regulation practice.

Chapter 1. Economics of Climate Change

In this chapter we shall look at the scientific evidence of global warming and the research findings available today. We shall also look at the cost of both action and inaction in response to climate change, finishing by the double dividend theory that suggests positive outcomes of regulatory actions.

1 Why carbon matters

We believe it is important to give a short overview of how carbon affects the atmosphere of the planet to set the discourse about why carbon reductions are necessary. As noticed by the recipient of the 2008 Nobel Prize in Economics Paul Krugman, there are three reasons why climate change has to be addressed.

First, global warming exists, as is proven by the fact that since 1970 every successive decade was warmer than the previous one. CO2 is a long-lived gas that accumulates in the atmosphere, staying there for centuries[1]. This is aggravated by the loss of natural carbon sinks on land and in the ocean that trap CO2 from the atmosphere, meaning that the temperatures are bound to grow further[2].

Second, climate models used 20 years ago to predict climate change compared against real life facts have proven to be correct, giving credit to modeling techniques used today[3].

Third, there is a non-negligible probability of an utter disaster which should dominate climate policy.Small changes in the earth's atmosphere in a non-linear

1 Krugman,P., 'Building a Green Economy', *The New York Times*, 4.5, 2010 <http://www.nytimes.com/2010/04/11/magazine/11Economy-t.html?pagewanted=all> [accessed 30 April 2010] (para. 22 of 81).

2 *Bayon, R.; Hawn, A.; Hamilton, K., Voluntary Carbon Markets: An International Business Guide to What They Are and How They Work (Environmental Market Insights)*, UK and US: Earthscan 2009, p.2.

3 Paul Krugman, 'Building a Green Economy', (para. 23 of 81).

manner may lead to 'abrupt climate changes[4]. Scientist believe that a global temperature exceeding the present one by 2 degrees (a number chosen to be the ceiling for carbon increase) already happened in the Eem period, around 125,000 years ago, providing evidence of abrupt and uncontrolled climatic events happening as a result[5].

.......................1.1 Historical overview

Let us begin with a brief outline of the developments in the environmental science. The first studies of the atmosphere and its potential to trap heat were made as early as in the nineteenth century by the French mathematician Joseph Fourier, who suggested that the atmosphere keeps the earth's surface warm both by letting solar heat in and by trapping some of the longer-wave radiation that bounces back from its surface. Based on observing the effects of the Industrial Revolution, a Swedish scientist Svante Arrhenius came to a conclusion that the earth's surface could be warming due to the burning of fossil fuels in factories. David Keeling, whose studies laid the foundations of Al Gore's political agenda centred around climate change, established daily observations in Hawaii and in 1957 which confirmed that human activity amplified the natural 'greenhouse effect', causing temperature increase of 0.6°C during the twentieth century. Based on Keeling's conclusions the United States National Academy of Sciences warned in 1979 that by 2015 the warming could produce 6°C temperature increase and change the world climate[6].

It has been recently calculated that fifty per cent increase in emissions occurred from 1974 to 2004[7], the summer of 2005 being the hottest ever observed in the Northern Hemisphere[8]. Today atmospheric CO2 levels are at its highest in the last 650,000 years. As for the concentration of CO2 in the atmosphere, due to the use of fossil fuels in transportation, agriculture, energy generation and industrial production its

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4 Weitzman,M. L., 'The Extreme Uncertainty of Extreme Climate Change: An Overview and Some Implications', preliminary article, Harvard University, 2009 <http://www.economics.harvard.edu/faculty/weitzman/files/ExtremeUncertaintyCliCh.pdf>.

5 Andersen, M.S.; Ekins, P., *Carbon Energy Taxation. Lessons from Europe,* Oxford: Oxford University Press 2009, p. 258.

6 Labatt, S.; White,R.R., *Carbon Finance. The Financial Implications of Climate Change,* Hoboken, NJ: Wiley&Sons, Inc. 2007, pp.5-7.

7 Baumert, K.; Herzog, T.; Pershing, J., 'Navigating the Numbers: Greenhouse Gas Data and International Climate Policy', World Resource Institute, 2005, www.wri.org.

8 Silvern, N.; Dlugolecki, A.,'The Day Before Tomorrow', *Environmental Finance* 7(4), 2006, pp.28-29.

levels have risen from 280 parts per million (ppm) in the 18th and 19th centuries to today's 387 ppm. According to IPCC, with the world population reaching 9 billion and with the business-as-usual (BAU) development of the world economy, by 2030 the concentration of gas is expected to reach 500ppm, whereas in another 20 years, around 2050, the temperature has been projected to increase by 2.3°C[9]. This is more than scientists believe safe: to keep the planet under the 2-degree warming ceiling agreed internationally, the concentration will have to be stabilized at 450 ppm, 30-40% below 1990 levels, the year that was chosen by the Kyoto Protocol[10].

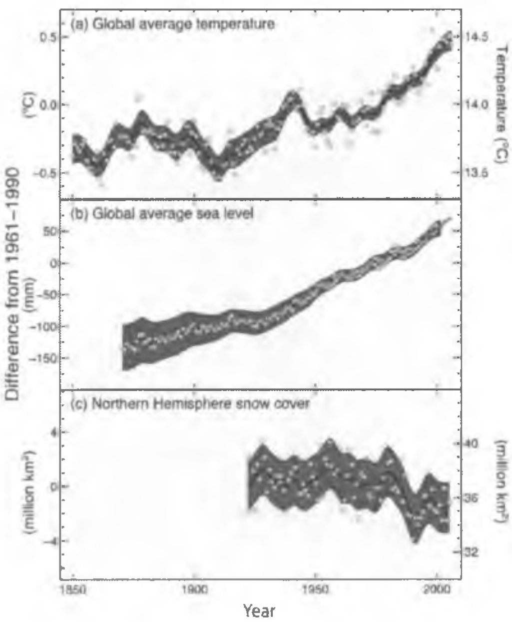

Chart 1: The Physical Science Basis of Climate Change: Latest Findings to be Assessed by WGI in AR5, IPCC http://www.ipcc.ch/pdf/presentations/COP15-presentations/stocker09unfcccCopenhagen_delegate_new.pdf

Chart 1 created by the IPCC summarizes the concerns about increasing global average temperatures, increasing see level and melting snow. Recent findings suggest that even these predictions are underestimated, making previously worst-case scenarios base-line projections. The figures mentioned so far might actually double[11].

......................1.2 Economic costs

The changes that occurred over the last two centuries of intensive fossil fuels

9 Labatt, S., *Carbon Finance,* pp.5-7.
10 Stern, N., 'The Stern Review: The Economics of Climate Change', www.sternreview.org.uk.
11 Krugman,P., 'Building a Green Economy', (para. 26 of 81).

use pose a threat of a catastrophe[12]. It will manifest itself in mutilated precipitation patterns, resulting in some regions being a lot wetter while other regions getting drier, causing storms, increased sea level and coastal flooding. These events pose a danger of the world economic decline, comprehensively explained in the Stern Review on the Economics of Climate Change, conducted by Sir Nicholas Stern on the request of the British government with the objective of identifying economic challenges related to climate change. The review predicts a 5-10 per cent loss in global GDP if the warming reaches 5-6°C, arguing that global climate change can cost world economies as much as $7 trillion in lost output, creating 200 million environmental refugees[13].

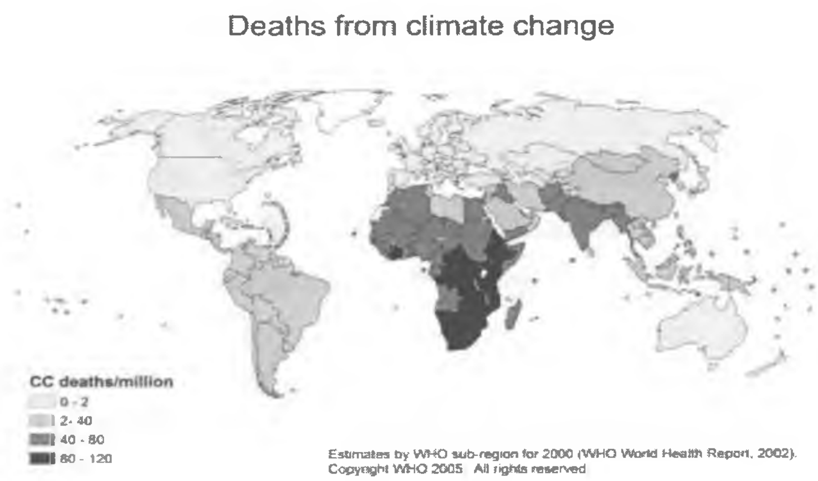

Illustration 1: WHO estimates of extra deaths (per million people) from climate change in 2000http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/d/Part_II_Introduction_group.pdf

Excess carbon has serious non-market consequences as well, such as inferior well-being, poorer health - especially in tropical countries, increased mortality rate and 30 per cent drop in income[14]. Illustration 1 shows deaths from climate change.

Examples of climate change consequences are readily available. The research findings presented by the MIT atmospheric science professor Kerry Emanuel repeatedly demonstrated both in 2005 and 2008 that Hurricane Katrina, which saw 1 million people displaced, 1836 dead and causing $89.6 billion of damage[15], is linked to

12 Weitzman,M. L., 'The Extreme Uncertainty of Extreme Climate Change'.
13 Stern, N., 'The Stern Review'.
14 Nordhaus, W. D.; Boyer, J., *Warming the World: Economic Models of Global Warming,* Cambridge, Mass: MIT Press 2000, pp 69-71.
15 Knabb, R.D.; Rhome, J.R.; Brown, D.P., 'Tropical Cyclone Report: Hurricane Katrina: 23–30 August 2005', National Hurricane Center, 10.8, 2006 <http://www.nhc.noaa.gov/pdf/TCR-AL122005_Katrina.pdf> [accesses 1 May 2010].

global warming[16].

Businesses – the main drivers of any economy – run physical risks associated with climate change. Industries dependent on climate conditions such as agriculture, fisheries, forestry, health care, tourism, water, real estate and insurance will feel the impacts of severe weather conditions. Electric power, oil and gas producers are also dependent on climate, thus storms, floods, droughts and rising sea levels have an impact on them, too[17].

......................1.3 Criticism of Climate Change

Despite a wide support for the case of climate change, there are some research findings that are skeptical about it. First of all, these skeptics, such as Patrick J. Michaels and Paul C. Knappenberger, denounce the publication bias, saying that IPCC, whose results are used by policymakers, tried to demonstrate that there is a link between climate change and negative effects, even though the opposite can be scientifically worthy. It is argued that results illustrating that there is no danger in global warming do not get published, resulting in overestimation of threats and underestimation of immunity to climate change[18].

There are a number of issues that the skeptics have come forward with. First, they believe that warming due to greenhouse gases is overestimated and that there are mistakes in data analysis and thus in temperature records presented by the Climate Research Unit at the University of East Anglia, which has been providing IPCC with data. Second, it is questioned whether the change rate of sea level is rising, as there are studies – not included by IPCC in its documents - that suggest the observed rise is a short-term variation. Third, climate models to predict future changes are under attack, as such models are claimed to fail on what they predict. Graph 1 represents the findings of climate change skeptics that suggest model incapacity to predict the real trend.

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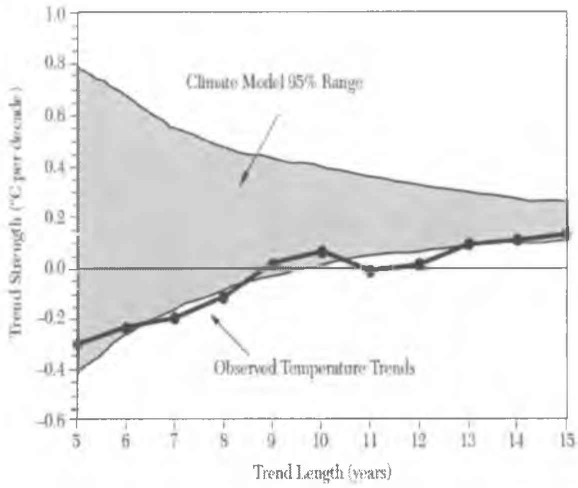
16 Emanuel, K., 'Increasing Destructiveness of tropical cyclones over the past 30 years', *Nature* 436(7051), 2005.

17 Labatt, S., *Carbon Finance,* pp.11-15.

18 Michaels, P. J.; Knappenberger, P.C., 'Scientific Shortcomings in the EPA's Endangerment Finding from Greenhouse Gases', *Cato Journal* Fall, 2009, <http://www.cato.org/pubs/journal/cj29n3/cj29n3-8.pdf>.



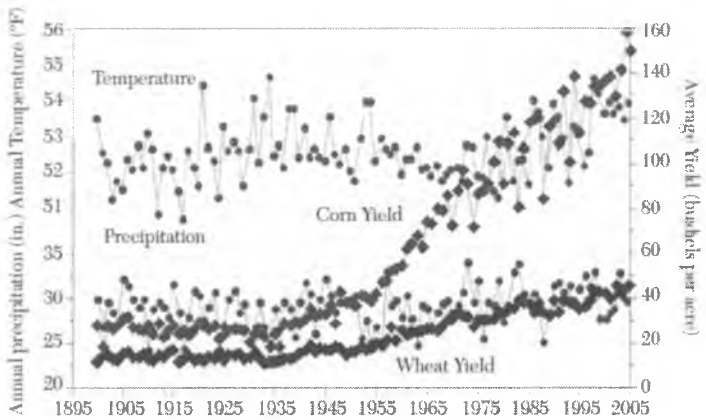
SOURCE: Michaels (2009).

Graph 1: The 95% Confidence Range of the Trends in Global Temperatures Projected by a Collection of Climate Models, along with Observations of the Same Quantity

Fourth, a series of papers suggested that people can adjust to changes and become less sensitive: once heat becomes more often, there are fewer victims, therefore with further increases of temperature the number of deaths will decline. Also, cities and their micro-climates are claimed responsible for big temperature changes, not the global warming per se. Fifth, global warming critics do not believe that agricultural production will suffer from changing climate, as both people and farmers will adjust to the new environment by responding with technologically advanced methods. Sixth, CO2 should not be grouped with other greenhouse gases as its impact on agricultural plants and thus general public welfare is positive. Graph 2 shows US annual crop yields from 1895 to 2005. The above mentioned facts represent in the opinion of global warming critics a clear case of publication bias and skewed representation of scientific information. Such misleading and not fully presented information, as they believe, become the basis of political decisions that, in turn, can be disproportionate and fall short of the intended outcomes[19].

The findings of the climate change skeptics are a valuable contribution to the scientific search for truth. We shall, however, fall in line with the international

19 Michaels, P. J., 'Scientific Shortcomings in the EPA's Endangerment Finding from Greenhouse Gases'.



Graph 2: Historical U.S. Annual Average Yields of Comand Wheat, along with U.S. Annual Average Temperature and Precipitation

agreement on dangers of climate change, and continue our discussion keeping in mind the potential risks presented by global warming to societies may be too great for inaction.

......................1.4 Global response

The ongoing debate about the earth's atmosphere has led to a number of responses. One the one hand, a big shift in social awareness of climate change is under way, most notably expressed in Al Gore's idea of the moral obligation to protect the planet from further severe changes. In 'An Inconvenient Truth' he has popularized the idea of common responsibility for climate change[20]. Al Gore's vivid description of the future based on current carbon emissions patterns has become part of the political, economic and personal agenda, despite criticism and astroturfing.

On the other hand, scientific findings have influenced policy-makers. Establishing a carbon price through tax, trading or other type of regulation has been proclaimed as an essential foundation for climate change policy. Creating a broadly similar carbon price signal around the world, and using carbon finance to accelerate action in developing countries have become urgent priorities for international cooperation[21].

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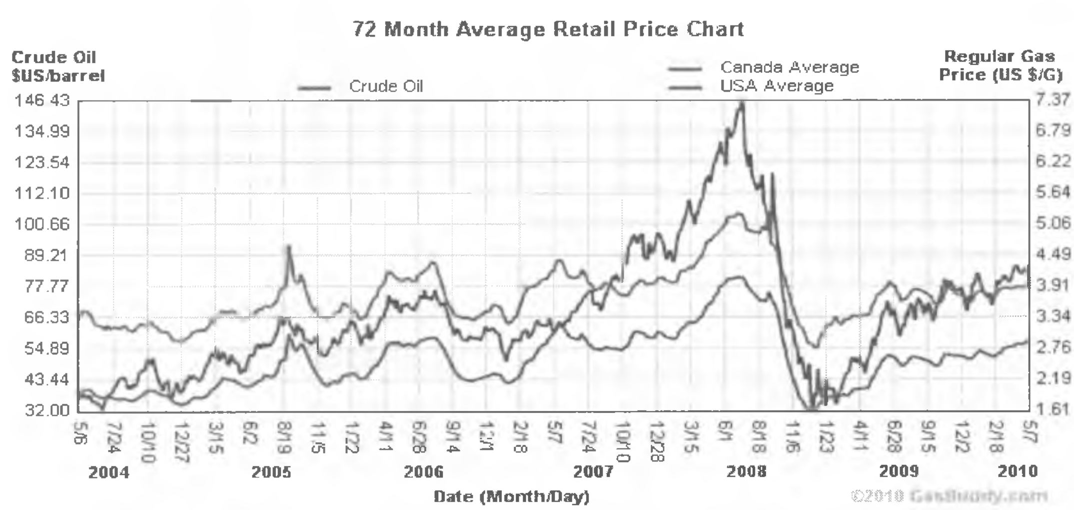
20 Gore, A., *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It*, USA: Rodale 2006.

21 Stern, N., 'The Stern Review'.

2 Energy constrained future: fossil fuels as major producers of CO2

The world is dependent on energy in order to grow and develop. The demand for energy is bound to increase as developing countries such as China, India and Brazil are bound to require more energy to fuel their economies. In the developed world energy consumption is already high and in the foreseen future is not expected to drop drastically[22].

The major sources of energy today and in the middle-term perspective are fossil fuels, primarily oil and gas. These sources, however, have capacity limits and thus put a challenge of where to obtain energy from in the long-term perspective. World oil production has peaked, whereas natural gas is viewed as a transition fuel of choice that can provide the world with energy only for the next 60 years given the known world supplies[23]. The producers of both oil and gas are prone to result in supply instability due to cartelized nature of their existence (OPEC, 'Gas OPEC'), political instability (rebel activities in Nigeria, Russia-Ukraine contradictions), natural disasters (Hurricane Katrina) and operational risks (BP platform destruction in April 2010). Such instability of supply is reflected in oil and gas high and volatile prices. Graphs 3 and 4 illustrate the volatility of both fuels.



Graph 3: Oil historical prices Source: www.pointcarbon.com

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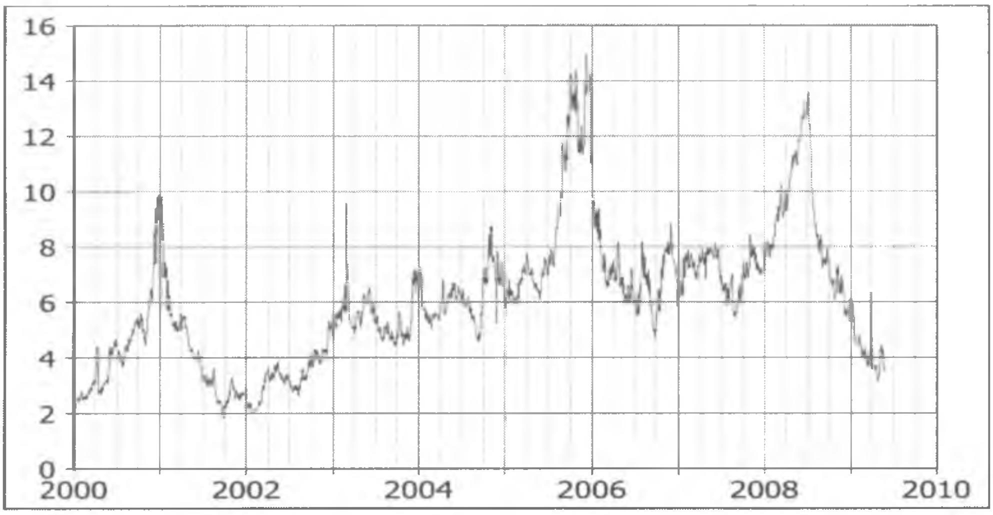
22 Griffin, J.M., *A Smart Energy Policy: An Economist's Rx for Balancing Cheap, Clean, and Secure Energy*, New Haven, CT: Yale University Press 2009.

23 Ibid.



Graph 4: Natural gas historical prices

Source: www.pointcarbon.com

So how will the energy be produced during the next stage of human development? There are essentially four ways.

The first is, quite paradoxically, to go on using fossil fuels from sources that before were not economically sensible. Due to oil demand being inelastic, oil prices are likely to be quite high in the near future, making it reasonable to invest in complex technologies that would, for instance, allow to obtain oil from Canadian or Venezuelan oil sands. Recovery methods have seen great technological advances, making used oil sites available for continued exploration and oil extraction. These extraction methods are energy intensive and produce more CO2 than conventional methods, promising to compromise carbon reduction attempts[24].

It is also possible to go back, where circumstances allow, to the fossil fuel that made the modern industrial society possible – coal. It is cheap, and there is enough coal to provide the world with energy for the next 200 years. Yet coal also poses a big threat to the carbon-free future, as despite considerable improvements in treating coal before combustion as to minimize smog and acidification, it is still the biggest greenhouse gas (GHG) emitter among other fuels[25].

24 Griffin, J.M., *A Smart Energy Policy.*
25 Ibid.

The second solution to providing the world with energy is expanding nuclear and hydro energy. There are a number of problems with both. Nuclear energy has high costs associated with capital investment and refurbishment, although recurrent costs are lower in comparison to other sources. Disposal of spent fuel is a problem, as it remains radioactive for hundreds of thousands of years. Operational safety is a danger: although accidents are rare, their aftermath is deadly, causing leukaemia and birth defects. Being central to global security, nuclear power is dangerous in a sense that obtaining nuclear energy may lead to nuclear weapon programs or terrorist groups producing nuclear bombs. As for hydro power, small hydro powers are considered a good option, whereas big hydro plants destroy the ecology of the site and often require displacement of many people[26].

As a preliminary conclusion we can say that the first way of providing the world with energy that relies on the use of fossil fuels will result in increased CO2 emissions and incur all the dangers currently associated with climate change. The second solution – nuclear and hydro – produces less carbon, but the cement used for building nuclear plants and the deforestation caused by large hydro plants do have an impact on carbon. Moreover, there are other environmental dangers associated with the two methods that increase their cost to the society.

The third way is to use renewables. In an energy constrained world, having renewable sources such as biomass, wind, solar, tidal, wave and geothermal energy seem very appetizing. Yet they have two major drawbacks: they are either non-reliable, or extremely costly[27].

The fourth way, as research findings predict, is moving by the middle of the twenty first century into a hydrogen economy based on generating hydrogen from a range of energy sources, predominantly fossil fuels, with capture and sequestration of CO2 produced as a result of the conversion processes[28].

Quite logically, it seems that moving towards renewables and hydrogen is the

26 Labatt, S., *Carbon Finance,* pp.39-41.
27 Ibid.
28 Ibid.

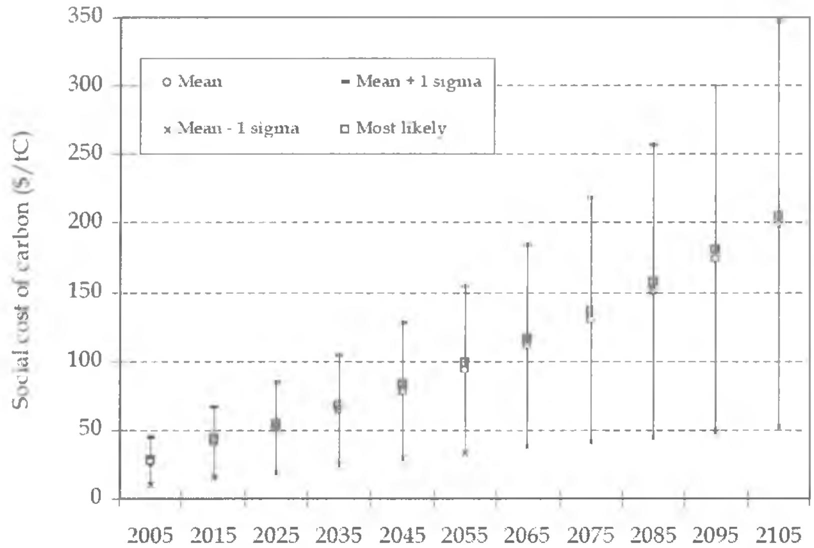
most obvious choice. Yet there is also a price issue: making renewables and hydrogen technologies competitive requires them to become cheaper, otherwise it would be difficult to fight, say, cheap energy produced from coal. What is clear is that something has to be done to make these burgeoning technologies mainstream. An important insight from the energy sources discussion is that the world needs more energy, and it has to be cheap. Since major sources of energy used today are finite, a move towards using cheaper, but more polluting technologies is viable. This puts the issue of climate change in the spotlight again, requiring further insights into how prices for energy sources should be formed and what kind of regulation is needed to make the unavoidable transition into a new era of energy generation possible. Throughout the rest of the work, as we discuss ways to regulate carbon, we should not lose sight of the underlying issue behind the challenge: the energy hungry world that is bound to increase its energy consumption. Therefore, in the next section we shall concentrate specifically on how prices are and should be formed and how regulation can help achieve lower levels of carbon.

3 The cost of action to address climate change: the double dividend discourse

It has been widely agreed that in order to tackle climate change the world needs to introduce regulatory measures. Using integrated assessment modeling that projects trends in consistent manner and assesses costs and benefits of climate policies, Nordhaus developed the DICE (Dynamic Integrated Model of Climate and the Economy) model, that stipulates that emissions depend of the economy, which, in turn, depends on the emissions. The costs of a very strong climate policy has been estimated to be between 1 and 3 per cent of gross world product, confronted with 5 to 10 per cent loss in gross world product in the case of inaction. Nordhaus also presents the price of carbon to the society, illustrated in graph 5[29].

The calculations are based on current prices of available energy sources, which might mean that in the future these numbers can be even lower due to a more wide use of some burgeoning technologies. This view is supported by the experience

29 Nordhaus,W.D., 'Economic Issues in a Designing a Global Agreement on Global Warming' (Address forClimate Change: Global Risks, Challenges, and Decisions,Copenhagen, Denmark, 2009) <http://nordhaus.econ.yale.edu/documents/Copenhagen_052909.pdf>.



Graph 5: Central case and uncertainty bands for social cost of carbon
http://nordhaus.econ.yale.edu/documents/Copenhagen_052909.pdf

with the US cap-and-trade program for acid rain which resulted in cost below the initial predictions[30].

Apart from addressing the problem of climate change at a lower cost than doing nothing, regulatory measures appear to have a 'second dividend'. Harvard economist Michael Porter suggested that environmental regulation can have a positive effect of generating more innovation and improved competitiveness[31]. The 'Porter hypothesis' argues that once businesses are under severe pressure from regulators, they shall 'ruthlessly' pursue improvements, increasing competitiveness. Moreover, having strong domestic competitors businesses will become stronger on the world market as well. Porter makes a number of recommendations on how to achieve this additional benefit. In his view, promoting predetermined technologies typical of command-and-control methods is a dead-end method, whereas giving market incentives is highly beneficial. The more watered down version of the 'Porter hypothesis' is the notion of double dividend, which substitutes competitiveness with a general notion of social welfare, which is still a valid argument for the use of climate change policies[32]. The Stern Report supports this view by claiming that a low-carbon

30 Krugman,P., 'Building a Green Economy', (para. 36 of 81).
31 Porter, M., *The Competitive Advantage of Nations*, New York: The Free Press1998.
32 van der Linde, C.,'The micro-economic implications of environmental regulation: a preliminary framework', in OECD, *Environmental Policies and Industrial Competitiveness,* Paris: OECD, 1993, pp.69-77.

economy will bring opportunities for growth[33].

In the first chapter we have seen that according to a number of prominent scientific studies climate change is threatening the earth's atmosphere and promises to make world economy shrink. That made us arrive at the conclusion that the use of regulatory measures in order to reduce carbon is projected to require less economic loss than not taking any action. Further we have looked at the double dividend argument suggesting that competitiveness and increased social welfare are the probable companions of regulatory action.

33 Stern, N., 'The Stern Review'.

Chapter 2. Responding to Climate Change

In this chapter we shall look at the existing options for reducing carbon footprint. First, we'll discuss possible technological changes together with implications and limitations they may have on combating climate change. Second, we shall discuss the theory behind market-based approach for carbon reductions and take a detailed look at the concepts of negative externalities, carbon taxation, cap-and-trade and voluntary markets.

1 Technological progress

A question often asked by economists and policymakers alike is 'What happens if technological change is more rapid then we are used to believe?' It is a valid question, yet it is rather rhetorical and in order for the science to make a great leap into the green future it needs to have the right incentives to do so.

In the first chapter we have already looked at the issue of pursuing alternative methods of energy generation. Indeed, there is a number of emerging and very promising technologies that have proven to be very efficient. Such emerging technologies include the use of LNG, ethanol, hybrid gasoline-electric vehicles, hydrogen-powered vehicles, carbon fibers that reduce vehicle weight associated with gasoline consumption, biomass fuels based on ethanol produced from wheat and rice straw, photovoltaic and solar cells and carbon sequestration to name just the major ones. They all have been proven to reduce GHGs, but at the same time they have all proven to be a lot more expensive than traditional fossil fuels that, as estimates suggest, are still in abundance due to new technologies capable of extracting more energy per a unit of most fuels. When oil prices peaked in the period from 2004 to 2008 - oil being the fuel of choice in the biggest economy of the world, the US - alternative sources of energy became more feasible due to a diminishing cost gap. Yet the history of oil is all about its volatility, making it impossible to secure profitability of new technologies without further support[34].

34 Griffin, J.M., *A Smart Energy Policy.*

Under technology incentives some researchers see subsidies that are referred to as 'beauty pageants' that end up in preferential treatment of some technologies and oblivion of others. If a new disruptive technology appears it might have to fight against existing subsidies[35]. For example, solar panels have received vast support due to government incentives in California, Germany and Spain[36], yet they might not represent the ultimate solution.

This leads us to the discussion of how to provide the needed incentives and the needed support to make emerging technologies affordable.

2 *Carbon as a negative externality: theoretical grounds for carbon markets.*

The environmental cost of using certain types of fuels, such as, for instance, coal, has not been included in the price that the consumer pays. The market price for a unit of coal, one of the worst polluters from the menu of fossil fuels available today, is less than that of a unit of natural gas, which, when used in a new natural-gas-fired power plants emits one-third of the carbon dioxide. This is a classical example of a negative externality, where there is a high societal cost related to the use of certain types of fossil fuels. Dirty air and water, deteriorated health and worsened well-being is the price the society must pay for not considering the cost of carbon[37].

Ideas about how to intervene and how to make human activities cleaner have developed over the last few decades. One of the suggestions has been to use command-and-control methods, such as prohibition or setting standards. This was successfully done in the US in the 90s when factories were required to dump less hazardous substances into the water and cars were required to meet emission standards[38].

35 Griffin, J.M., *A Smart Energy Policy.*
36 'The rise of Big Solar', *The Economist*,15.04, 2010 <http://www.economist.com/business-finance/displaystory.cfm?story_id=15911021> [accessed 1 May 2010].
37 Griffin, J.M., *A Smart Energy Policy.*
38 Krugman,P., 'Building a Green Economy', (para. 9 of 81).

However, standards and prohibition practices do not work everywhere. When it comes to carbon that can be produced in a variety of ways, prohibiting it or trying to introduce a standard becomes challenging. The alternative came in a form of a market-based solution suggesting creation of a price for carbon. Those who emit more get punished monetarily, whereas those who manage to emit less receive monetary gains. This paves the way to carbon-low technologies that can thrive given their ability to spend less on carbon despite the initial investment into it[39].

3 Market instruments: carbon taxation and cap-and-trade

There are a number of ways in which carbon can receive its price: governments can either introduce a tax on GHG emissions, or they can make carbon a unit of property that can be exchanged. Here the two alternatives – carbon taxation and cap-and-trade systems - are looked at in more detail.

.......................3.1 Carbon taxation

The father of environmental economics Arthur Cecil Pigou discussed the issue of negative externalities in 'The Economics of Welfare' published in 1920. He suggested that economic activities should not always be banned, but discouraged by setting a price, so that people who produce negative externalities pay for them in proportion to the damage. This type of payment is known as pigovian tax and is credited with laying the foundations of market-based environmental economics[40].

The idea of introducing taxation is much favoured by the economists, who talk a lot about making it a steadily rising carbon tax. A steadily rising carbon tax is a gradually increasing price that a governing authority sets on the GHG emitted from using fossil fuels. It has a number of benefits that help effectively incorporate the environmental cost paid by the society into the price of fossil fuels[41].

39 Krugman,P., 'Building a Green Economy', (para. 10 of 81).
40 Ibid. para.11.
41 Griffin, J.M., *A Smart Energy Policy.*

First, such carbon tax creates transparency by treating all GHG emitters equally. What you emit is what you pay for. Any new disruptive technology that appears on the market can enter the playing ground and pay for its emissions on the same terms as all others[42].

Second, carbon taxes are traceable and predictable. One can compare the taxes paid in the past and can make pretty straightforward conclusions about the future carbon expenditures. It also means that taxes resolve the issue of carbon tax volatility typical of cap-and-trade system. Once the tax growth is established, businesses know exactly how much they will pay and hence can plan well in advance. This allows investors to feel more secure about the future of their projects and to choose greener options with more confidence[43].

Third, introducing a tax is a relatively cheap option. Political and industrial tensions apart, introducing a tax doesn't require as many institutions and regulatory bodies, consultations, allocation plan approvals or worries about future uncertainties. Many countries, including developing nations such as China and India, can embrace it quickly and effectively without spending millions on figuring out how to set up a cap-and-trade[44].

Fourth, it is the market that tells the winning technology, not officials who might be interested in promoting or subsidizing a technology of their choice, as the case has been with 'beauty pageants' characterized by pouring lots of money in a certain technology. Such spending might reflect interests of lobby groups and not the interest of effectively curbing carbon emissions. Taxes can open up the way to technologies that might otherwise be doomed to a failure due to a much bigger financial support of their rivals[45].

Fifth, governments can receive an additional source of income that can be channelled towards other means.[46]

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42 Griffin, J.M., *A Smart Energy Policy.*
43 Ibid.
44 Ibid.
45 Ibid.
46 Ibid.

Sixth, government authorities can have a firmer grip on the total level of emissions by regulating the price, in this way achieving their international commitments of reducing carbon.

Seventh, carbon tax embraces all the carbon produced in the economy, not just some sectors as it is the case with the cap-and-trade[47].

However, taxes set taxpayers' alarms ringing as well as cause industrial lobby groups to oppose them. The solution offered to counterbalance this negative perception of a tax is to offer a revenue-neutral scheme which would reduce other taxes, such as income and payroll taxes and in this way re-establish the lost welfare[48].

Despite the scarcity of examples of carbon tax implementation, there is evidence from a number of EU countries – Denmark, Sweden, Germany, The Netherlands and the UK - that have introduced a tax on carbon. The outcomes of the Energy-Environment-Economy model for Europe, E3ME, that analyzed carbon taxation regimes in these countries has shown that GHG were reduced by 4-6 per cent from mid-1990s to 2004 in comparison to what would have happened without the tax under the BAU conditions[49].

47 Griffin, J.M., *A Smart Energy Policy,* p.50
48 Ibid.
49 Barker, T.; Junankar, S.; Pollitt, H.; Summerton, P., *The Effects of Environmental Tax Reform on International Competitiveness in the European Union: Modelling with E3ME, Carbon-Energy Taxation. Lessons from Europe,* Oxford: Oxford University Press 2009, pp.147-236

.......................3.2 Cap-and-trade

Another way of limiting the behaviour of parties that create negative externalities is, again, giving them a right to pollute, but under a certain limit. Licenses to pollute are distributed among participants along with a total cap set on how much they can pollute collectively. This approach is called cap-and-trade. Business that produce more carbon than allowed can buy additional license on the market, whereas those who have more licenses than needed can sell them at profit. It gives everyone an incentive to pollute less and look for the most efficient way of reducing emissions: buyers would need to cut back in order to spend less, whereas sellers would cut back in order to sell more[50].

The foundation for this approach was provided by the argument that Coase made in his famous article 'The problem of social cost', where he states that assignment of property rights would allow the trade of environmental endowments in order to achieve an economically efficient outcome[51]. Market failure would be corrected without the use of cost-internalizing pigovian taxes and everyone would have an incentive to emit less[52].

The US in 1990 was the first to test the Coase's idea in the environmental sphere by initiating the Acid Rain Program under the Clean Air Act that introduced a cap-and-trade system in which power plants could trade the right to emit sulphur dioxide under a limit. The program successfully reduced sulphur dioxide emissions by power stations at a cost inferior to that expected or offered by alternatives policies. Instead of rising, electricity prices fell down[53].

Once a market for carbon is created, carbon exchanges can take place in the most efficient way, achieving equilibrium. The bigger the market, the more matches are found, increasing the efficiency of emission cuts. The market aggregates the

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50 Krugman,P., 'Building a Green Economy', (para. 27 of 81).

51 Coase, R., 'The Problem of Social Cost', *Journal of Law and Economics* 3 (1), 1960, pp.1-44.

52 Ellerman, A. D.; Convery, F. J.; de Perthuis, C., *Pricing Carbon. The European Union Emissions Trading Scheme,* Cambridge: Cambridge University Press 2009.p.13.

53 Ellerman, A.D.; Joskow, P.L.; Schmalensee, R.; Montero, J.-P.; Bailey, E.M., *Markets for clean air: The US Acid Rain Program*, Cambridge: Cambridge University Press 2000.

information about carbon price and signals it to those who have to make a decision on how much to pollute[54].

In practice, breathing life into a carbon market means creating emission permits, or credits, that can be bought and sold. These carbon credits represent a reduction of GHG equal to one metric tonne of carbon dioxide equivalent, tCO2e, that can actually consist of different proportions of carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons, and perfuorocarbons[55].

Cap-and-trade has a number of benefits. First, credits, unless they are auctioned, constitute a compensation that industries receive for participating in the scheme: freely distributed property rights have a monetary equivalent that is captured by the business. Consequently, it is not the government that just gets the cash, but businesses that get rewarded[56].

Second, the market created through cap-and-trade also allows to overcome geographical and temporal boundaries, making it possible for carbon property exchanges between nations (if such system is set)[57].

Third, a cap-and-trade carbon market allows participation of a broader number of players, giving arbitrage opportunities to speculators and environmental groups who might want to try to drive the cost up[58].

Fourth, cap-and-trade is a politically more digestible solution, as it has proven to be difficult to introduce carbon taxation into legislation. Both the EU and the United States were in favor of introducing a tax: both of them had to go for the cap-and-trade option instead. The EU has the system in place, whereas the US senate is only preparing for the cap-and-trade to be introduced in 2013 as foreseen in the Kerry-Lieberman bill.

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54 Bayon, R.; Hawn, A.; Hamilton, K., *Voluntary Carbon Markets: An International Business Guide to What They Are and How They Work (Environmental Market Insights)*, UK and US: Earthscan 2009, p.25.
55 Ibid.
56 Krugman,P., 'Building a Green Economy', (para. 30 of 81).
57 Bayon, R.,*Voluntary Carbon Markets'.* p.26.
58 Ibid.

........................3.2.1 *Distribution of emission credits*

Emission credits can be distributed in a number of ways. They can be distributed for free by a regulator in a form of allowances on the basis of either ***grandfathering*** or ***benchmarking***. They can also be ***auctioned***, generating revenues for the government.

Grandfathering means granting some quantity of free allowances to installations on the basis of their historical emissions. Installations get the right to emit because they used to emit before. To some, this argument does not pass the moral test, yet it is completely in line with the logic of mitigating the negative externalities problem – letting installations continue with their practices, yet giving them an incentive to do it less[59].

Benchmarking means, again, granting some quantity of free allowances to installations, but using a specific efficiency criteria, rewarding those that are energy-efficient and penalizing those who are not. The decision is still made based on historical emissions, yet the 'best' emitters are used as benchmark setters. It is also argued that finding the right benchmark is very costly due to the heterogeneous nature of products. Practical benchmarking would mean coming up with hundreds of benchmarks for a wide variety of products. This last point is open to debate as, for instance, the US in 1990 introduced a clear SO2 benchmarking that gave positive results[60].

Auctioning is another way to distribute credits, which allows to form the price through trading the necessary amount of permits. It is argued that auctioning acts in the same act as taxes, bringing revenues to the issuing authorities[61].

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59 Bayon, R.,*Voluntary Carbon Markets'.* p.50.
60 Ellerman, Pricing Carbon, p.64-67.
61 Ekins, P.; Barker, T., 'Carbon taxes and carbon emission trading', *Journal of Economic Surveys*, 15/3, 2001, p.76.

.......................3.3 Tax and cap-and-trade: similarities and differences

The incentives that a cap-and-trade system produces have the same economic result as the pigovian tax, with the price of licenses effectively serving as a tax on pollution. However the two systems address two different uncertainties: the tax regulates the price, and not the quantity, whereas the cap-and-trade system regulates the quantity, and not the price[62].

As argued by Ekins, attempts to fix both the price and the quantity will fail in any market. The abatement adjusts to either of the parameters. It is a function of either the price or the quantity[63].

As for choosing one type or another, Weitzman suggests two scenarios. First, if the abatement is going to happen to such an extent that emissions are reduced to a level greater than optimal, it is advised to use tax. Second, if the damage caused is projected to be greater than the optimal level, i.e. exceeds the 'tipping point', than a cap-and-trade system should be used[64].

4 Voluntary carbon market

.......................4.1 The concept

Whereas taxing carbon and creating a cap-and-trade systems are compliance measures aimed at reducing CO2 levels in the atmosphere, voluntary carbon market is something that is more closely related to taking the moral duty of reducing carbon. Individuals and organizations voluntary buy emission reduction credits to reduce their net carbon emissions. This transactions take place either informally, or via a formal exchange[65].

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62 Krugman,P., 'Building a Green Economy', (para. 22 of 81).

63 Ekins,P.,'Carbon Taxes and Emissions Trading:Issues and Interactions' in Carbon-Energy Taxation. Lessons from Europe, Oxford: Oxford University Press, 2009, p. 248.

64 Weitzman, M.L., 'Prices vs.Quantities', *Review of Econmic Studies*, 41, 1974, p.91.

65 Bayon, R.,*Voluntary Carbon Markets'.*

The idea behind voluntary carbon market is pretty straightforward. Nature conservation and carbon reduction projects have good ideas that can help reduce carbon, but they do not have the resources to sponsor them. Consequently, these projects can calculate how much CO_2 they are likely to take away from the atmosphere and sell it to an entity that would like to offset its own emissions. A carbon-neutral deal is stricken, where the emitter pays the project money to carry out the idea[66].

The mechanism described is not a novelty, it already exists under the Kyoto Protocol and is known as Clean Development Programme (CDM), that will be discussed in more detail in the next chapter. In fact, voluntary carbon market is a parallel world of the United Nations Clean Development Programme. Voluntary market allows highly innovative, flexible and less expensive projects to happen at a lower transaction cost. While the nature of projects is the same – neutralizing carbon footprint, they do not carry the cost associated with the bureaucracy of being accepted by the UN CDM Executive Board, which increases the upfront costs of carbon reduction projects by 12-22 per cent. Emitters who would like to neutralize their emissions but are not regulated to do so can opt for voluntary carbon market projects to reduce costs. Virtually anyone can contribute to the reduction of carbon and benefit from it – corporations, governments and individuals[67].

We believe that this new development in the world of carbon can definitely be considered as yet another regulation tool. Although the initiative does not come from an established institution or government, it allows to mitigate the effects of climate change, thus making it a valid instrument. No doubt that it is not only the morals that drive this segment of the carbon market. As it develops, voluntary carbon attracts investors, insurers and speculators, creating sophisticated financial vehicles aimed at creating value. This grass root happening that with time acquired all the elements and incentives of business is a method in itself, complementing the compliance taxation and cap-and-trade.

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66 Bayon, R.,*Voluntary Carbon Markets'.*
67 Ibid. pp.15-16.

.......................4.2 Historical development

The origin of the voluntary approach is in the United States that for a long time was promoting emission trading, but then refused to ratify the Kyoto Protocol. Given the fact that the country was ready to go for a market for emissions but lacked political impulse to make it compulsory, voluntary measures emerged[68]. The EU, despite compulsory carbon regulation system in place, accounts for 47 per cent of buyer transactions in the voluntary markets[69].

Voluntary market is maturing quickly, with transactions reaching 2 per cent of the volume of the Kyoto markets in 2007, when 42.1 million tonnes of carbon dioxide equivalent (MtCO2e) were traded on the OTC market coupled with further 22.9 MtCO2e transacted on the Chicago Climate Exchange (CCX). The total volume of the voluntary carbon market reached 65 MtCO2e[70].

.......................4.3 Reasons for businesses to be interested

Businesses have quite a number of opportunities for improved performance in case they neutralize their emissions, making participation in the voluntary carbon market advantageous.

First, by buying offsets on the voluntary markets corporations can reach their corporate responsibility targets and increase their public image. Since the costs of such offsets are significantly lower than those acquired through the UN CDM, corporations can achieve savings while bolstering their image.

Second, by acquiring emission credits companies can improve their branding by claiming their products to be green. They can therefore enjoy increased sales by targeting green-minded individuals.

Third, investors can buy offsets on the voluntary market for a relatively small

68 Ellerman, A. D., *Pricing Carbon.* p.14.
69 Bayon, R.,*Voluntary Carbon Markets'.* p.50.
70 Hamilton, K.; Sjardin, M.; Marcello, T.; Xu, G., 'Forging a Frontier: State of the Voluntary Carbon Markets 2008', *Ecosystem Marketplace & New Carbon Finance,* 2008.

price with the intention of selling them for a higher price in the future.

Fourth, voluntary market is an exercise ground for future compliance legislation – companies can test their readiness for the new environmental demands if the latter are not yet in place[71].

.......................4.4 Proof of the second dividend argument

The voluntary nature of neutralizing emissions and an existing demand for it empirically supports the 'second dividend' argument as it effectively creates such benefits to the actors that are not only related to stopping climate change, but also create other benefits such as increased competitiveness of the businesses who employ them and making economy grow through creating a new sector and jobs.

.......................4.5 Functionality

Most voluntary carbon market operations go through four stages. First, the product is created or an idea generated. This can be done by virtually any person or any organization that can prove that their project will result in biodiversity, local community development or GHG reductions[72].

Second, the product should be verified. As there are CERs (Certified Emission Reduction) in compliance markets, there are VERs (Voluntary Emission Reduction) on the voluntary market[73].

There are many companies that have seized the opportunity of the voluntary market and they have developed trading and verification tools that allow them to manage VERs and related transaction. Examples of the most successful players are CarbonNeutral company, MyClimate, Gold Standard, Voluntary Carbon Standard etc[74].

During the third stage the product is distributed. It can be done either through retailers or wholesalers, or on an exchange. Retailers target individual byers, very often via Internet shops. As of today, there are about 200 suppliers of projects on the

71 Hamilton, 'Forging a Frontier'.
72 Bayon, R., *Voluntary Carbon Markets'.* p.50.
73 Ibid. p.56.
74 Ibid. p.57.

market. Wholesalers and brokers, who don't own credits, trade non-standardized products. Exchanges, such CCX, Asia Carbon Exchange, Green Exchange and Climex, sell both compliance market products and VERs[75].

During the fourth stage the product is consumed by individuals, institutions or other ecology-driven entities. For instance, the pioneer of voluntary carbon reduction AES Corp, an American electricity company, invested in 1989 in an agroforestry project in Guatemala. HSBC bought 170,000 tons of carbon in 2005 to make its operations carbon-neutral[76].

Criteria for validating voluntary projects:

- *Additionality – the project must create reductions over and beyond a business-as-usual scenario, and there must be some assurance that the project would not occur without the funding provided by carbon credits*
- *Permanence – the project must guarantee GHG mitigation over the stated time period. For instance, a proof that fire will not destroy forests or carbon stored underground will not be released in the atmosphere*
- *Leakage – the project must not transfer emissions to another location outside the project area*
- *Double counting of emissions should be excluded*

Source: Hamilton,Forging a Frontier

Voluntary carbon market has its downsides, too. Since there is no legal obligation to offset emissions, there is lack of uniformity, questionable transparency and volatility of demand. The market share is very small, thus it only contributes, not resolves the problem of climate change.

In chapter three we discussed the potential that emerging technologies have to contribute towards mitigating climate change. We have seen that these new

75 Bayon, R.,*Voluntary Carbon Markets'*, pp.19-35.
76 Ibid.

technologies need the right incentives and support in order to be implemented, which lead us to the discussion of ways carbon can be regulated. Thus, we looked at carbon as a classical example of a negative externality that can be tackled in a number of ways – through command-and control methods or through market-based approach. We concentrated out attention on the latter, discussing carbon taxation and cap-and-trade systems. We saw that although they regulate two different uncertainties – carbon price and carbon quantity - they both can achieve the same economic outcome. The two systems have their positive and negative sides, and have examples of successful implementation across the world. We have also noticed that cap-and-trade system can have different schemes of permit allocation, allowing grandfathering, benchmarking and auctioning (in the case of which the revenues can be considered as a tax). The part about voluntary carbon market was discussed in order to see alternative, non-compliance type developments in the world of carbon, giving an insight into how reducing carbon can actually benefit businesses, finding empirical support for the 'second dividend' argument.

An important insight has been that of political feasibility of carbon taxation. Since converting the taxation idea into legislation has proven to be a challenge, we shall assume in the next chapters that cap-and-trade is the most functional option at this stage of the carbon regulation development.

Chapter 3. International regimes regulating global warming

This chapter will discuss the need for international response to global warming and look at the existing international regimes, such Kyoto Protocol and its provisions, as well as an introductory overlook of the block-lead EU ETS. We shall discuss the Copenhagen Summit results and potential threats to global climate change cooperation.

1 The need for international response

The moral obligation to save the planet coupled with predictions of huge economic costs related to global warming have entered into the political agenda and made the advances in environmental legislation on the global level feasible. However, reaching a consensus on the distant future with high expenditures upfront is a titanic task as policymakers do not view future gains as much as the present ones[77]. Moreover, there is a risk of free-riding for participants of all-inclusive approaches, non-participation being a rational choice if countries are to follow their self-interest[78].

In order for any international accord to function there must be a monitoring institution enforcing it, as was the case with the successfully implemented SOx cap-and-trade experiment in the US. Binding emission targets and strict compliance timetables have to be introduced and enforced. Another prerequisite is to provide financial help and incentives to those less able to cooperate, i.e. developing nations lacking resources to initiate a major program addressing global warming[79].

Theoretically, there are a number of approaches available as a basis for an international regime. The first is to commit all nations to participate and share the burden. We shall see that this was the foundation for the Kyoto Protocol that tried to bring most nations to signing it. However, as we already said all-inclusive systems stimulate free-riding, making it necessary to add more 'carrots' for everyone to

77 Griffin, J.M., *A Smart Energy Policy, p.50*
78 Ibid, p.50.
79 Ibid. p.60.

contribute – compensating those who oppose it for joining in[80].

Another method is a so-called 'club approach' that would include only a number of countries that commit themselves to binding targets. Signs of the practical realization of these ideas are already there. The EU has agreed to reduce its carbon footprint by introducing the EU ETS regime that effectively puts limits on a 'club' of nations[81].

2 Kyoto Protocol

The first international effort to understand climate change was made in 1988 when the ***United Nations Environment Programme (UNEP)*** and the ***World Meteorological Organization (WMO)*** established the ***Intergovernmental Panel of Climate Change (IPCC)***. IPCC reviews the most recent scientific data provided by the scientist who contribute on a voluntary basis and makes predictions about the future trends in climate change. IPCC made it first assessment in 1990, and the latest available report, Climate Change 2007, estimates that at a 1 to 2°C increase in global mean temperature above 1990 levels (about 1.5 to 2.5°C above pre-industrial levels) there is an increased risk to unique and threatened systems such as polar and high mountain communities and ecosystems, risk of extreme weather events, unequal distribution of impacts and vulnerabilities between regions and increasing sea level[82].

Having chosen an increase in temperature of 2°C as the maximum 'safe' level, 189 countries met in 1992 at the 'Earth Summit 'in Rio de Janeiro, making voluntary commitments to address climate change by agreeing on the Framework Convention on Climate Change (UNFCCC). Although mitigation policies as well as adaptation measures were discussed, the Convention did little to establish firm governmental targets[83].

The next step came during the third UNFCCC Conference in Kyoto, when in 1997 the ***Kyoto Protocol*** was signed, committing 'Annex 1' countries that include 37 industrialized nations, to carry out mandatory reductions of GHG emissions of 5.2 per

80 Griffin, J.M., *A Smart Energy Policy,* p.65.
81 Ibid., p.150.
82 IPCC: <http://www.ipcc.ch/organization/organization.htm>.
83 Allianz AG and WWF International, 'Climate Change and the Financial Sector: An Agenda for Action', Gland: Allianz AG Munich and WWF International, 2005.

cent from 1990 level by the end of 2012. Other countries, such as India and China, joined the protocol without binding targets.

The protocol had to be ratified by at least 55 countries to be legally binding. The ratification happened in 2005, when Russia finally joined in, amid continuing opposition to it from the US and Australia (which ratified it in 2007).

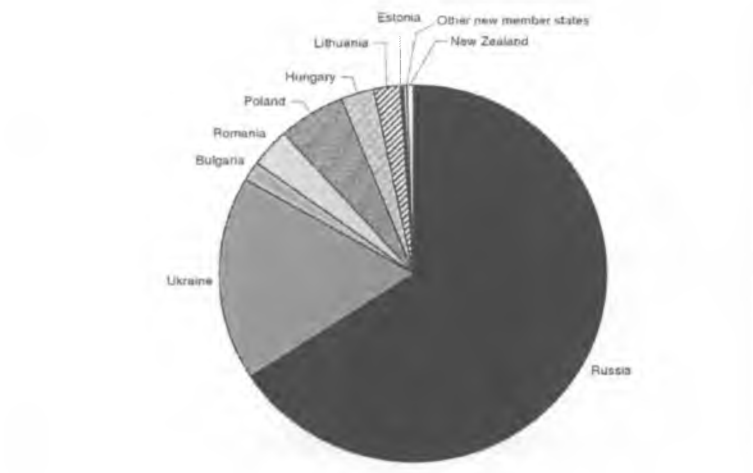
The Kyoto Protocol established the First Commitment Period from 2008 to 2012. The provisions of the protocol do not say how emission reductions should be made. Yet it offers three mechanisms for the Annex 1 countries to choose from: emission trading schemes (ETS), Joint Implementation (JI), and the Clean Development Mechanism (CDM)[84].

The first element of the system, *emissions trading*, is the cap-and-trade system we discussed in the previous chapter. It gives GHG caps to participating countries, which then distribute it among businesses within their respective jurisdictions. The desired result is to trade carbon credits, called assigned amount units (AAUs) between each other in order to meet Kyoto commitments.

The additional mechanisms are *Joint Implementation(JI)* and *Clean Development Mechanism(CDM).* Both are project-based transaction systems, but participants differ.

Under a JI project developed countries can purchase carbon credits, called Emission Reduction Units (ERUs), from GHG reduction projects implemented in another developed of transition country (specifically the former Soviet Union). The market for JI is worth US$499 million and trades about 41 million tonnes (Mt) of carbon as of 2008[85]. ERUs can be issued for emission reductions occurring in 2008 or later[86].

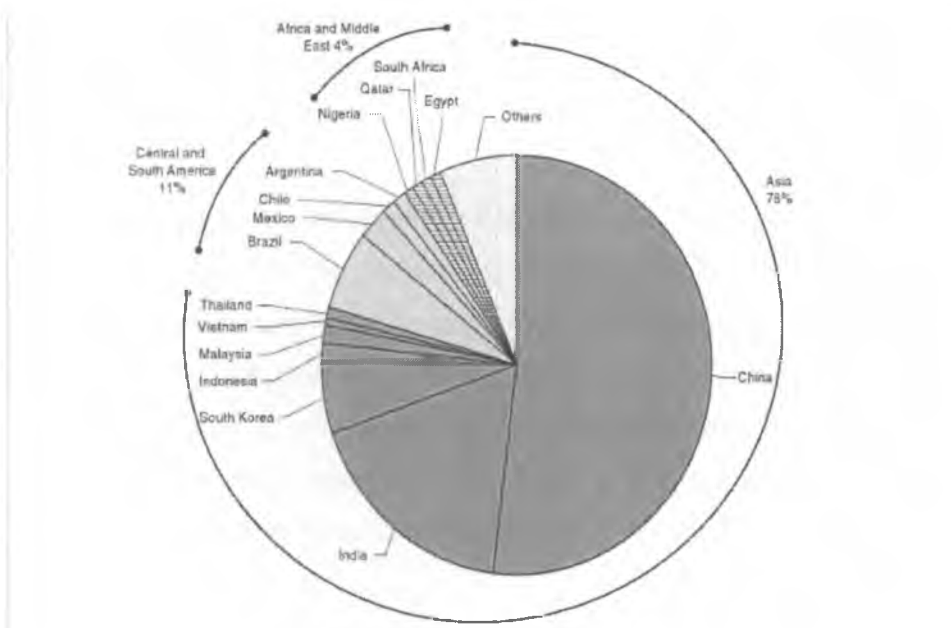
84 UNFCCC:<http://unfccc.int/kyoto_protocol/items/2830.php>.
85 Capoor, K.; Ambrosi, P., 'State and Trends of the Carbon Market', Wahington, DC: World Bank, 2008.
86 Ellerman, A. D., *Pricing Carbon,* p.13.



Graph 6: Potential ERU supply by country until 2012

Source: Ellerman, Pricing Carbon, p.284.

Graph 6 illustrates the potential ERU supply by country until 2012, explicitly showing that transition countries, such as Russia and Ukraine, are net contributers.



Graph 7: Estimated CER supply by country until 2012

Source: Ellerman, Pricing Carbon, p.281.

Under CDM, developed countries can finance carbon reductions in developing countries and receive carbon offsets called Certified Emissions Reductions (CERs). The market for CDM as of 2007 was estimated at over US$12 billion and trades 551 Mt of CO_2e[87]. CERs can be derived from emission reductions occurring from as early as 2000. Graph 7 shows which countries produce CERs.

As we saw earlier, voluntary market transactions with VERs happen the same way as at CERs, neutralizing carbon emissions through offsets.

3 Challenges to international cooperation

Kyoto Protocol provides decent guidance on how to address climate change, yet as we shall see it is only the EU that actually contributing largely to the set targets, being the only block of countries that embraced the cap-and-trade mechanism and made it obligatory. Some countries are benefiting from the CDM and JI projects, yet the future of international cooperation is at risk. The most recent example proving the weakness of international negotiations is the 2009 Copenhagen Summit that failed to design the future of the post Kyoto world, undermining all the achievements that have been made in the last 13 years.

First, it failed to secure the future of carbon trading, with EU ETS being a role model. What was hoped by the participants of the Copenhagen Summit is that carbon trading would receive support and be accepted as a scheme to stop climate change for the rest of the world, effectively creating a world carbon market. Instead, the summit made carbon trade lose its momentum as the US, Japan and Australia are still not part of the scheme. The market created by the EU ETS is already quite mature and needs growth from expansion into other continents[88].

Second, it made the existing carbon market shrink. CDM projects that form part of the carbon trading scheme are on the brink of extinction as their future is not clear after 2012. Investors, such as environmental financial companies, raise money

87 Ellerman, A. D., *Pricing Carbon,* p.284.
88 Gardiner, B., 'Lack of Direction on Climate Change Hobbles Carbon Trading', The New York Times, 15.02, 2010 <http://www.nytimes.com/2010/02/15/business/energy-environment/15rentrade.html> [accessed 30 April 2010] (para. 5 of 24).

through public offering or from pension funds in order to invest in CDMs and then sell the offsets produced for profit in Europe. Since CDM projects may last for a number of years, not knowing what will happen with the whole scheme after 2012 makes investors in CDMs abandon their projects. As a result, new investments fell by 30 to 40 per cent in 2009, whereas 2010 has seen another 40-50 per cent shrink[89].

Third, the summit failed to secure future reductions of carbon. Although it recognized the scientific case for keeping temperature rises to no more than 2°C, the final document did not contain commitments to emissions reductions to achieve that objective. The goal of reducing global CO2 emissions by 80% by 2050 was dropped[90].

Fourth, developing nations were not made to commit to the climate change agenda. The Copenhagen Summit agreed to provide $30bn a year for poor countries to adapt to climate change from 2010 to 2012, and $100bn a year by 2020. However developing nations are no obliged to make any cuts in their emissions[91].

As we have seen, there are numerous challenges that the world community is faced with. Kyoto Protocol has not become the beacon of change, Copenhagen negotiations did not bring the aspired results, and the whole CDM and JI projects are at risk. However, the EU ETS system is at place and it promises to contribute a lot to the development of carbon regulation, which will be discussed in the next chapter.

In this chapter we have looked at the possible options of international cooperation and discussed in detail the coming of age of the Kyoto Protocol and its provisions. We have also identified challenges to further cooperation and the risks they present. We believe that this has set the right preparatory framework for discussing the EU ETS, its functionality and challenges in the following chapters.

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89 Gardiner, B., 'Lack of Direction',(para. 14 of 24).

90 Vidal, J.;Stratton, A.; Goldenberg, S., 'Low Targets, Goals Dropped: Copenhagen Ends in Failure', *The Guardian* (London) 19.12, 2009 <http://www.guardian.co.uk/environment/2009/dec/18/copenhagen-dealRetrieved> [accessed 22 April 2010] (para. 2 of18).

91 Vidal, J., 'Low Targets, Goals Dropped', (para. 8 of 18).

Chapter 4. The EU carbon policy

In this chapter we shall concentrate entirely on the EU ETS scheme, its coming to life, its major phases and provisions for future improvements. We shall discuss how allocation methods influence the outcomes and how auctioning can correct present failures. We shall see how the EU ETS is connected to the Kyoto Protocol through CDMs and JIs. We shall then conclude by looking both at criticism and praise of the system.

1 EU flagship role in implementing market-based regulation

The EU has been the first to grasp the need for major change in carbon legislation. Even before the Kyoto Protocol was ratified in 2005, the EU already agreed on meeting the emission target of 8 per cent reduction below 1990 levels in the period from 2008-2012. The EU ETS has become the first and the largest international emissions trading scheme in the world. The official policy of the EU is to stabilize the global temperature increase at 2 degrees, which is considered a realistic number to bid for[92]. As it becomes clear from table 2, most of the carbon trading is happening in the EU, and most of it is due to emissions trading, CDMs constituting a small part of the overall trade.

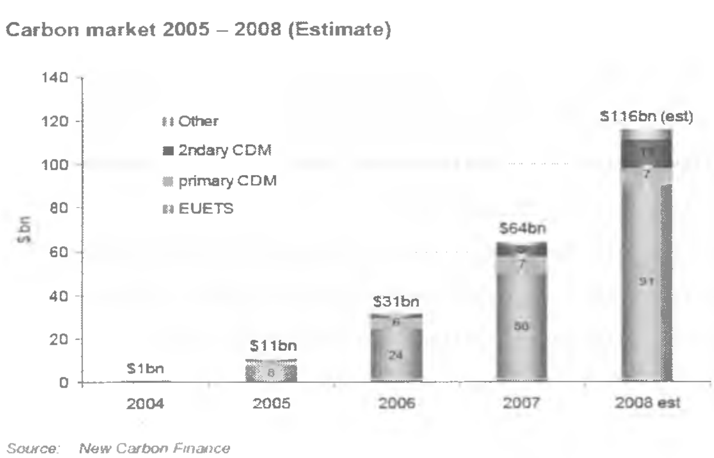


Table 2: http://www.wto.org/english/tratop_e/envir_e/wksp_goods_sept09_e/mani_e.pdf

92 Andersen, M.S., *Carbon Energy Taxation*, p. 6.

EU ETS covers 40 per cent of all European greenhouse gas emissions, covering electricity producing facilities and energy-intensive manufactures. The system is also supported by product efficiency measures that stimulate producers towards lower-carbon future. Initially EU ETS covered 11 per cent of emission from developing nations and 4 per cent worldwide[93].

.......................1.1 Carbon taxes vs. cap-and-trade

Cap-and-trade mechanism chosen by the EU is considered the result of two failures: a failure to introduce carbon taxation first on the EU, and then on the international level during the Kyoto negotiations. Indeed, the first policy of choice for the EU was introducing an EU-wide carbon tax in 1992[94]. This met with two kinds of obstacles - the fiscal autonomy of states vis-a-vis the Commission, and industrial lobby opposition within the member states. The EU members didn't want to cease tax-raising, although of only one environmentally-friendly type, to the Commission. Since fiscal matters are decided unanimously, there was no hope for a carbon tax legislation to pass on the EU level. The second reason why introducing a carbon tax was not plausible was because of the opposition from industry lobbies that feared increasing production costs and demanding new rules. As a result of these factors the idea to have a tax on carbon was scraped in 1997[95].

This gave way to theories suggesting the use of cap-and-trade. The idea to employ emission trading to help the EU towards climate change was first voiced by Klaassen (1997) and later developed by Sorrell and Skea (1999). As a result of the intellectual developments in this field, in 1998 the Burden Sharing Agreement (BSA) came to life, setting the target of 8 per cent below 1990 by 2008-2012 period, corresponding to the Kyoto requirements. Although for a long time, including during the Kyoto negotiations, the EU opposed emissions trading, it eventually accepted this path as a means of regulating carbon. This happened due to the fact that Kyoto Protocol did not provide any legal sanctions for non-compliance of its participants, and thus the EU opted for a 'domestic' scheme underpinned by the European Court of Justice[96].

93 Ellerman, A. D., *Pricing Carbon*, p.260.
94 European Commission. Proposal for a Council Directive Introducing a Tax on Carbon Dioxide Emissions and Energy, COM(92) 226 final. Brussels: European Commission, 1992.
95 Ellerman, A. D., *Pricing Carbon*, p.16.
96 Ibid.

The EU could rely on the experience of its member states that already had emission trading schemes in place. The UK introduced both a cap-and-trade system and sector-based intensity targets in 2002 that was voluntary and included £30 million as incentive payments for installations. Denmark from 2001 had an emission cap system in place for its electricity sector. Starting from the year 2000 The Netherlands, Sweden, Germany and France discussed the introduction of emission trading schemes. Such enthusiasm for emission trading came from the industries that tried to avoid taxes at any cost. These developments, promising to create a patchwork of local regulations across Europe prompted a wide support for market instruments for the whole EU[97].

2 *EU ETS goes into life*

In 2003 the Emission Trading Directive was issued, and on 1 January 2005 the trading commenced. The first 'pilot' period lasted from 2005 to 2007 and focused on power generation and industries, accounting for 40 per cent of total GHG emissions. Using carbon sinks such as forestry projects was not allowed. Member states had to come up with a national allocation plan (NAP) and through this in a decentralized manner they were assigned European Union Allowances (EUAs) based on historical emissions. The Commission had to approve the decisions of national states and also register all the transactions via the Community Independent Transaction Log (CITL). Emitters who exceeded their allowances had to automatically pay a penalty worth €40 per EUA for non-compliance. The EU later linked its ETS programme with Kyoto targets by issuing in 2004 the Linking Directive which allowed the use of certified emission reductions (CERs) deriving from the Clean Development Mechanism from 2005 and Joint Implementation credits from 2008. In 2010 the EU ETS accounted for almost 20 per cent of total GHG emissions, thus making the scheme even more important[98].

........................2.1 Allocation of allowances

97 Ellerman, A. D., *Pricing Carbon,* p.19-21.
98 Ibid., p.24.

One of the major criticism of the EU ETS comes from its decentralized nature of allocating allowances, as it has the drawback of offering different allocation of allowances depending on the state, thus making competition potentially unjust. Unlike the US Acid Rain Program for trading SO2 permits where allowances were decided on a federal level, the EU represents a mixture of procedures and outcomes that depend on member states. So far allowances have been granted to CO2 emitters for free. Emission trading sceptics believe that it means that carbon-intensive industries are actually the winners. They are historical emitters, and for what they already emit they receive property rights - paying nothing. New entrants who don't have historical emissions have to buy credits, which renders them less competitive[99].

However, in the following analysis of the three phases we shall see why free allocation of allowances was chosen and how it has set the ground for the future development of the system towards auctioning.

.......................2.2 NAP 1 (2005-7)

The first reduction period lasted from 2005 to 2007. It was not linked to Kyoto and it had a number of challenging problems to resolve. First, the data, especially from the Eastern European States, was poor and the whole scheme was based on very approximate business-as-usual emissions scenario. Second, member states had very close deadlines for submitting the data making the process rather patchy and not as accurate as wanted. However, in a timely manner the Commission assumed a facilitating and educational role that helped regulatory authorities of the member-states overcome their inexperience of allowance distribution. Close cooperation with all the involved stockholders and the distribution of non-official papers made the preparation and the realization of the first period possible[100].

.......................2.2.1 Allowance volumes and prices

The total allowances proposed by the member states accumulated to 2298.5

99 Ellerman, A. D., *Pricing Carbon,* 32-85.
100 Ibid., pp.32-85.

millions of EUAs, yet 2122.16 millions were allowed by the Commission, achieving a reduction of 4.3%[101].

As for the price of each EUA, the volatility and a zero price at the end of the period were actually a predictable result. In the first-period allowances were not permitted to be used in the following period and the business-as-usual estimations were the core of the calculations. It was not necessary to make cuts as the historical emissions were taken as a base and saved emissions could not be banked for the next stage – the two factors that eventually drove the price of the permits to zero by the year 2007. The ex-post analysis revealed that this was actually built into the whole scheme. The main idea was to introduce an initial cap, distribute the rights and by doing so create a market. Once emissions were calculated, the price emerged, giving an indication for future regulation.

.......................2.2.2 *Opt-in and opt-out provisions*

During the first phase member states could expand the EU ETS scheme to sectors that are regulated by the ETS, but are below the defined capacity limits. Only Austria, Finland, Latvia, Slovenia and Sweden added combustion installations with capacity below 20 MW, accounting for 5 per cent of all installations covered by the scheme[102].

The first phase also allowed some countries to apply temporary exclusion of certain installations if they were subject to emissions constraints. This was supposed to help smooth the transition to full trading. Belgium, the Netherlands and the UK chose to exclude 570 installation accountable for 38 Mt CO2 during the first phase[103].

.......................2.2.3 *Provisions for Auctioning*

As mentioned earlier, free allocation of permits is blamed for unambitious results. As we have seen, during the first NAP the ambition was actually to have the system running, thus the Commission tried to make the conditions less burdensome

101 Ellerman, A. D., *Pricing Carbon,* pp.32-85.
102 Ibid, pp.32-85.
103 Ibid, pp.32-85.

possible. Moreover, the idea to auction some of the EUAs never left the negotiations table of the Commission. In the first period 5 per cent of the total EUAs volume could be auctioned. Yet since the introduction of emission trading had a high political charge in the member states, most governments stayed away from auctioning, the only exception being Denmark, Hungary, Lithuania and Ireland. Among these countries only Denmark used the whole amount foreseen by the Commission. Thus auctioning was incorporated into the scheme from the very beginning, only being limited by political feasibility[104].

......................2.2.4 *Kyoto credits*

During the first phase installations could use as many CERs as they wanted, yet few were actually used due to the higher expected price in the following period as well as lack of the accounting link – the International Transaction Log - between EU ETS and CDM registry, that appeared only in 2008[105].

......................2.3 NAP 2 (2008-12)

The second period of emission trading was set to last from 2008-2012. It was a follow-up from the first stage but could rely on a number of major improvements made during the trial period. First of all, the problem of poor date was resolved. Now that the initial emission data was known coupled with robust numbers from trading throughout the period, the Commission could plan further reductions in a more informed manner and with more ambition. Second, the deadlines were not as pressing as before. The system was up and running, allowing for advanced target setting and doable deadlines. Third, the price mechanism was set to be completely different: banking second period allowances was permitted, excluding the possibility of a zero price at the end of the period. Fourth, the scheme got linked to the Kyoto Protocol. Being a cap within a cap system, this posed a coordination challenge for the Commission, which addressed it by including JI and CDM projects as additional instruments of offsetting carbon emissions. EUAs were tied to AAUs established by the Kyoto Protocol, thus bringing all member states in compliance with their obligations under the Kyoto targets. What remained the same was the decentralized manner in which member states could

104 Ellerman, A. D., *Pricing Carbon,* pp.32-85.
105 Ibid., pp.32-85.

allocate emission permits[106].

.......................2.3.1 *Allowance volumes and prices*

The allowed total of EUAs was established at 2082.68 million, a decrease from the NAP1 2122.16 million EUAs, although additional installations were calculated to make emissions grow by 2.5 per cent[107].

The Linking Directive generated a cost reducing effect. The price of abatement projects turned out to be lower than that of EUAs: involving them in the trade could make the final price of EUAs slightly less expensive. CER swaps emerged, that allowed installations to sell their EUAs and with the obtained money invest in JI/CDMs, extracting a margin. Such practices had a limited scope, however. Member states had to specify what percentage of NAP's total they wished to have for JIs and CDMs. This percentage was calculated as half of the gap between the Kyoto/BSA target and either 1990 historical or 2010 projected emissions. In practice this was in a range of 7-20 per cent of the NAP 2 total[108].

One of the features of the NAP 2 was a requirement for higher reductions from the 12 new member states, which initiated charges from Estonia and Poland against the Commission for inappropriate assumptions in rejecting NAPs. After reciprocal appeals to the Court of First Instance and final European Court of Justice ruling, a NAP for Poland was accepted, while Estonia is on it way to having its NAP accepted[109].

.......................2.3.2 *Opt-in provisions*

Whereas during the first period only the sectors under the EU ETS were allowed to be added to the scheme, the second phase saw member states adding sectors that were not covered the ETS. Only the Netherlands chose to participate, adding 6 Mt CO2 per year. In this way the EU ETS was enlarged by 0.26 per cent, which is a small number showing that the opt-in provision did no take up much. Mostly it was too costly to monitor smaller installations, and thus it was seen as an

106 Ellerman, A. D., *Pricing Carbon,* pp.32-85.
107 Ibid.
108 Ibid.
109 Ibid.

unnecessary effort that would not yield. No opt-outs were allowed[110].

Once the system is established and full auctioning is in place, some governments might find it useful to include further installations by using the opt-in option, either for fiscal or 'first mover' advantage reasons.

.......................2.3.3 *Auctioning*

As opposed to grandfathering allowances, which was highly supported by industries, there was a growing demand for a more transparent and less historically-dominated approach to emission distribution. During the second period the Commission allowed 10 per cent of the total EUAs volume to be auctioned. This time Germany, the UK, The Netherlands and Austria grasped the opportunity, yet the maximum used by Germany only accounted for 8.8 per cent. The auctioning failed to be used by member states again: in the first period the total of 0.13 per cent was auctioned, in the second period – 3 per cent, far below the respective 5 and 10 per cent limits. The fact that member states refused to fully implement the auctioning option suggests that finding political consensus with industries is a tough challenge, making cap-and-trade quite a useful instrument in mitigating regulatory changes[111].

.......................2.3.4 *Kyoto credits*

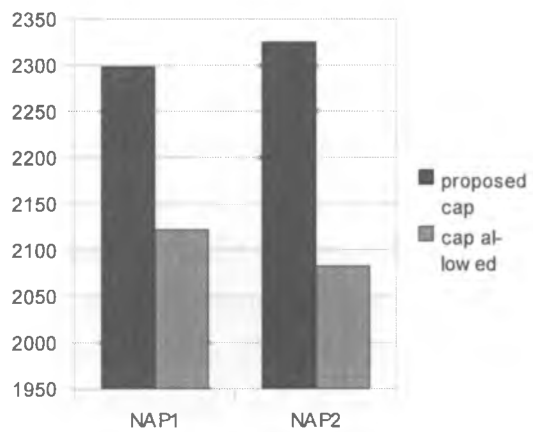
CERs and ERUs are used in accordance with state limits expressed as a percentage of the total allocation, accounting for about 13.4 per cent of the EUAs issued[112].

.......................2.4 NAP 1 and NAP 2 results

The first two periods, although the second one is still not finished, by preliminary forecasts have fulfilled the task the Commission had envisioned – allowing a decentralized allocation of rights under an established cap with a creation of market and price for carbon. The debate about the EU being unambitious about its reduction targets and the tools is well grounded and the evidence shows that the measures

110 Ellerman, A. D., *Pricing Carbon,* pp.32-85.
111 Ibid.
112 Ibid.

introduced did not have much effect on the GHG reductions. Yet the objective was not to exercise cuts from day one, rather, to set the institutions that are capable of yielding GHG emissions in a much longer perspective[113]. The reductions set by the Commission for both NAP1 and NAP2 in comparison to proposed caps can be seen in graph .



Graph 8: Proposed cap vs. allowed cap (in million tonnes of CO2)

http://europa.eu/rapid/pressReleasesAction.do?reference=IP/07/1869

A number of conclusions were made. First, during the first stages it turned impossible to use benchmarking tools for energy efficiency. Poor data, non-homogeneous nature of products and lack of standards for CO2 emissions made it difficult to establish an appropriate benchmark. Best available technology (BAT) tools were used instead.

Second, it became clear that different sectors of the economy benefit differently from the scheme. The electric power sector is not subject to non-EU competition and thus the price for electricity does not compete on the world market. Electricity producers have proven that they can pass the extra costs to their customers, being affected little by the new regulations. On the other hand, many industries have their prices set outside the EU on the world market. The new scheme is considered to potentially make them lose their market share.

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113 Ellerman, A. D., *Pricing Carbon*, pp.32-85.

Third, emission permit prices were proved to be volatile, which made investors nervous over the choice of future projects.

......................2.5 NAP 3

......................2.5.1 *The new cap*

For the third period the EU established an annual reduction factor of 1.74 per cent that will help reach the 21 per cent reduction below 2005 verified emissions by 2020. While the first NAP was only a rehearsal, it provided the grounds for setting up institutions, markets and prices. The second NAP was the first real try after somewhat chaotic preparation. It demonstrated the strength of the EU in the area of policy setting in yet unknown field of climate change regulation. Having become the centrepiece of the Kyoto Protocol scheme, the EU proved its leadership in policy making and advanced thinking. The third NAP, yet to be implemented, will see radical changes. Distribution of permits will become centralized and taken out of the control of member state jurisdictions. Agreed formulas will be used to calculate all the indicators related to permit distribution and proceeds from auctions. Aviation sector will fall under carbon regulation as well[114].

......................2.5.2 *Breaking away from NAP1 and NAP2*

The provisions for the post-2012 period were introduced by amendments to the ETS Directive on 23 January 2008 and approved in December 2008. First and foremost, the issue of unequal distribution of benefits from the scheme was addressed. Since the major novelty was to introduce auctioning, it was necessary to understand how it could affect the three groups of actors: the power sector, the non-power sector, and energy intensive sector with significant risks.

- The proposal was to allow no free allocation of emission permits to the *power sector*, except for heat delivered to district heating and industrial uses.
- The *non-power sector* was to receive up to 86% of permits for free in 2013, reducing this number by 10 percentage points each year, reaching 2020 with a scheme void of any free allocation.
- The *energy intensive sector* with significant risks could receive all of the

114 Ellerman, A. D., *Pricing Carbon,* pp.32-85.

allocations for free to counter competitors from other countries who have no CO_2 regulation measures in place. Alternatively, the Commission looked at establishing a 'carbon equalization scheme' or a border tax to protect domestic industries[115].

The agreed changes were slightly different from the ones proposed.

– The *electricity sector* could apply for a temporary derogation from auctioning with 70 per cent of the average 2005-7 verified emissions distributed freely in 2013, phasing it down to zero by 2020 with a possibility of extension.

– The *non-power market* was agreed to be able to delay the phase-out scheme till 2027, marking a 30 per cent free allocation baseline in 2020.

– The *energy intensive sector* could have 100 per cent of its permits for free[116].

.......................2.5.3 Auctioning revenues

The auctioning revenues use was also addressed by the Commission. At least 20% of the auctioning revenues that member state governments would receive will have to be spent on climate change purposes and reported to the Commission, giving states another climate-related obligation. In this way the bulk of the revenues is used by the state, keeping the spending of the revenues a national priority[117].

.......................2.5.4 Kyoto credits

It is expected that project based credits will be used less in the third phase. However, installations can carry over the unused second period offsets to the subsequent period[118].

Apart from confirming the primacy of member states in budgetary issues, the new auctioning schemes also gives a response to two other pressing problems – the need for *harmonization* and a much requested shift from free allocation to a *new type of incentive* setting.

115 Ellerman, A. D., *Pricing Carbon*, pp.32-85.
116 Ibid.
117 Ibid.
118 Ibid.

........................2.5.5 *Harmonization*

During the first two phases it was to member states' discretion how they wanted to allocate allowances. Due to political pressure and a concern for 'community-wide and fully harmonized implementing measures', during the third phase the EU will take care of harmonizing transitional free allocation to industries within sectors. The EU will also supervise the new entrant reserve (NER), established at 5 per cent for the industrial sector[119].

There are concerns whether the centralized approach to the allocation practices will have the aspired effect and be executable, yet harmonization is the first step towards a more balanced and just way of regulation emissions.

........................2.5.6 *'Windfall profits' or newly shaped incentives*

Moving from free allocation to auctioning is viewed by some as an opportunity for member states to get 'windfall profits' from selling permits. While mostly true, auctioning provides equal grounds for all the participants, eliminates the profits from holding permits for historical emissions and makes agents take into account the cost of carbon during their decision making process. Having an auction can also mean having a more tax-like scheme for participants, which was initially preferred by the EU[120].

........................2.6 Including the Aviation sector

The biggest change starting from 2012 will be to include aviation into the EU ETS. All airlines flying in and out of the EU will be constrained by the Aviation Trading Scheme (ATS), expanding the scheme by 15 per cent. The aviation sector will be able to buy allowances from the ETS, but it will not be able to sell aviation allowances (AAs), though. The cap will be 3 per cent below the average emissions in 2004-2006, and 5 per cent below the same average for 2015. This new legislation will mean that non-EU airlines will have to pay a sort of a border tax, giving the EU leadership role in setting up new rules for CO2 emissions across the world.

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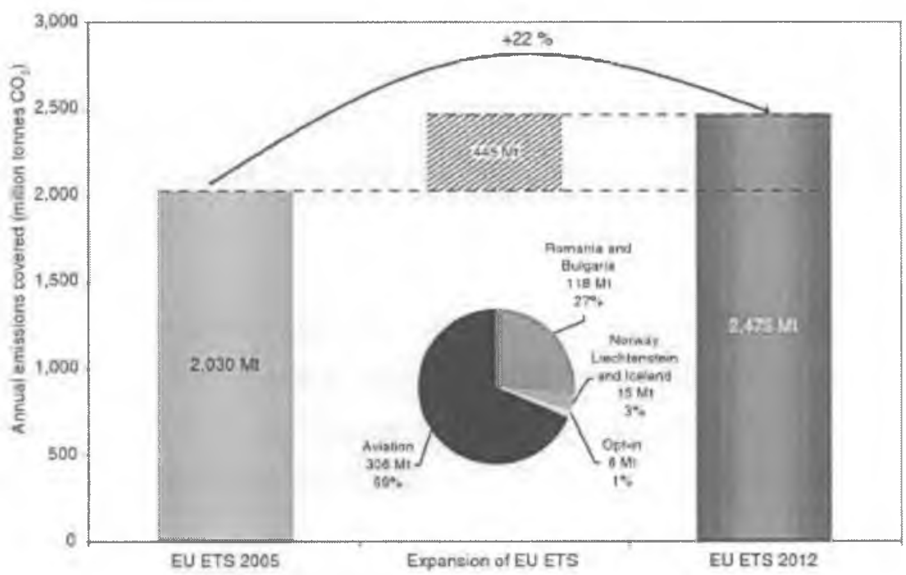
119 Ellerman, A. D., *Pricing Carbon*, pp.32-85.

120 Convery, F., 'Origins and Development of the EU ETS', *Environmental and Resource Economics* 43 (3), 2009, pp.391-412.

The EU decided against including road transport into the scheme as many countries already have fuel taxation regimes and receive important fiscal income from it. Moreover, car manufacturing lobby, especially form Germany, turned out to be stronger than the aviation one. The same scheme as for aviation is probably awaiting the maritime sector.

.......................2.7 EU ETS expansion

By 2012 the EU ETS will be expanded by 22 per cent, mostly due to the inclusion of the aviation sector, but also due opt-in installations and non EU member states – Norway, Liechtenstein and Iceland – joining in. Also, in comparison to 2005 there are two new member states that have joined the EU ETS – Romania and Bulgaria. Graph 5 illustrates the expected growth of the carbon market by 2012.



Graph 9: Expansion of EU ETS coverage (Carbon Finance 2009)

Source:Ellerman, Pricing Carbon, p.270.

.......................2.8 Kyoto Link

The EU ETS system is connected to the Kyoto Protocol by a Linking Directive, that allows EU installations use offset credits generated by Clean Development Mechanism and Joint Implementation program, discussed in the previous chapter[121].

3 Results of the EU ETS

Despite all the achievements, there is strong criticism against the chosen model. As argued by the Yale professor William D. Nordhaus, quantity-type systems with international trading tend to present more opportunities for corruption. Domestic governments have an incentive to collude with polluters in order to underestimate domestic emissions and hide from international monitors. The results of the third EU ETS phase are hoped to correct the potential for collusion through the harmonized nature of emission permit distribution[122].

Nordhaus also believes that the CDM element that became part of the EU ETS has been the major source of 'accounting emissions' with questionable additionality. The EU-ETS had little internal emissions reductions – 130 million tons, compared to 280 million tons obtained in the form of offsets offered by the Clean Development Mechanism. He compares the CDM to credit default swaps, a notoriously defective financial instrument[123].

EU ETS produced a volatile price for carbon that makes industries unwilling to participate in low-carbon projects due to uncertainty of future carbon price. This has undermined the effort of the EU to step into a low-carbon future as for now the introduced incentives are not doing their job.

The free allocation of allowance under the EU ETS has also generated 'windfall profits' for those sectors – especially electricity - that have been able to pass on the price of carbon allowances to their customers. This has made customers worse off with little effect on climate change.

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121 Ellerman, A. D., *Pricing Carbon,* pp.260-287.
122 Nordhaus,W.D., 'Economic Perspectives on Climate Change' (Lecture for the Yale Climate Institute, Yale University, 15.01, 2010) <http://nordhaus.econ.yale.edu/>.
123 Ibid.

Despite all setbacks, the idea of creating a constrained access to a resource that once used to be free has been proven doable by the EU. It did previously happen with other non-regulated sectors such as fisheries, yet carbon is much bigger and diverse 'product', making the EU experience a ground-breaking one. Being the first one to attempt such regulation, the EU has acquired a moral and know-how lead on the international level. In order to achieve bigger efficiencies the EU has already proposed to introduce auctioning in the third phase, moving the system from 2013 towards a more tax-like one. The EU ETS, despite much criticism and demands for a tax based system that was considered in the Commission in the 1990s but was rejected by member states, is, therefore, a system to stay. Further improvement to make it work are possible: for instance, by introducing a complementary floor tax on carbon or creating a window of volatility. These will be discussed in the next chapter.

In this chapter we carefully looked at the setup of the EU ETS scheme and discussed the major phases of it, including its link with the Kyoto. We have seen the shift from free allocations to auctioning and looked at both praise and criticism of the system. This will let us move forward towards the issue we declared the core of our research – creating a hybrid system combining both cap-and-trade ans tax so as to stimulate competitiveness of the EU carbon regulated industries.

Chapter 5. Hybrid model

In this chapter we shall critically look at the EU ETS and discuss its failures. Then we shall look at how these failures can be avoided by introducing taxation element to the system. Floor and ceiling prices meant to curb emission permit price volatility will be discussed, as well as their potential influence on the system. The chapter will conclude with the summary of methods available and their probability of being implemented.

EU ETS has become a reality, and will continue to regulate carbon trading till at least 2020, when the third phase of trading is supposed to finish. Previously we discussed two alternative ways of addressing climate change: cap-and-trade and carbon taxation. We have looked at the two schemes conceptually and discussed the running of the EU ETS. We saw that the only alternative to cap-and-trade system – the taxation model – is very difficult to achieve politically despite all its benefits and scientific support. It leaves us with the conclusion that the most probable scenario for the EU is to make improvements to the existing EU ETS model. The goal of the Commission will be to make the system work, making permits an efficient instrument of climate change regulation. In this chapter we shall look more closely at why cap-and-trade system should be modified and how the necessary changes can be achieved.

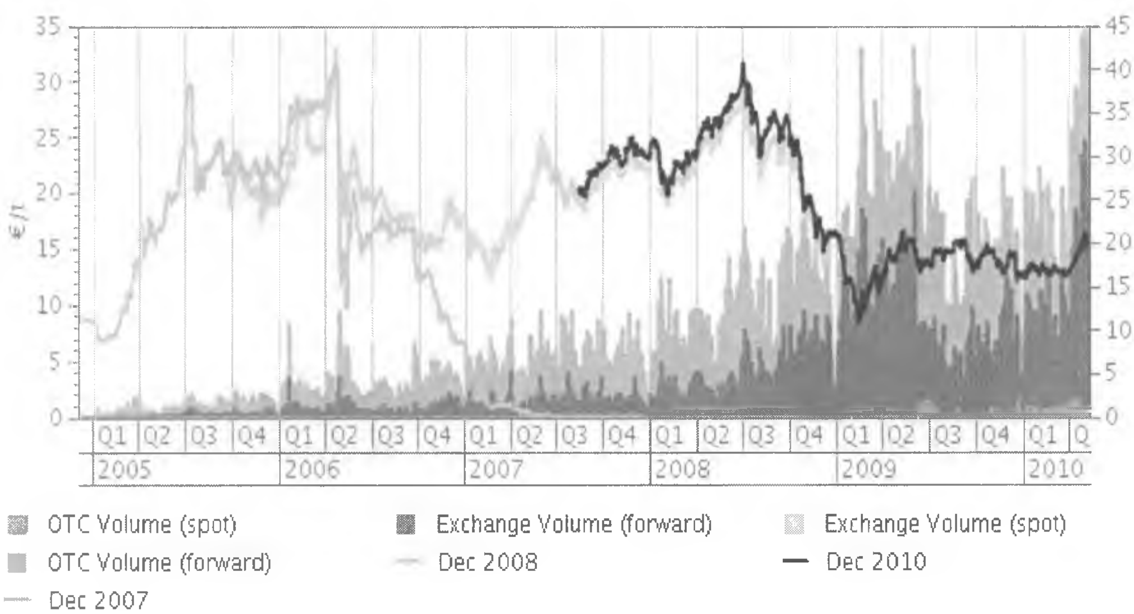
1 Reasons for a change

The reality of the EU ETS has been proven to be driven by special interests and industry giveaways, achieving results that are less than what could have been expected[124]. This makes policymakers think of how further incentives can be introduced in order to correct the failures of the system.

Price volatility of the EU ETS is a big concern. We have already discussed this issue when talking about the EU ETS in detail in chapter four. As seen from graph 10,

124 Gardiner, B., 'Lack of Direction', (para. 14 of 24).

the price of carbon has seen drastic changes over the life of the EU ETS. During the first period, from 2005 to 2007, it saw a big drop in April 2006 when it was announced that actual emissions were lower than expected. Coupled with no possibility to bank allowances, it drove the price to zero by the end of the 2007. As we already know the provisions of the first period were different from what was followed afterwards, as the first NAP was only a trial, thus it would be unwise to extrapolate the characteristics of the first phase on the consequent ones. We can see that in 2008, when the second phase started, the price ranged between €12 to €25/tonne. The crisis further brought the price down to €8 a tonne in February 2009. Ever since then the price stabilized at around €14, reaching €15 in April 2010 as firms started to buy permits to meet their end of year obligations and to secure a lower price for allowance banking due to foreseen cut in cap by 3 per cent in June 2010.



Graph 10: The line charts show the development of Point Carbon's bid-offer closing price for EU allowances (EUA 2005, EUA 2006, EUA 2007, EUA 2008 and EUA 2009)

http://www.pointcarbon.com/news/cme/

.......................1.1 Reasons for volatility

The observed volatility is what troubles the market players. The crises-related volatility reflects a drop in the energy production and does not tell much about the way carbon market behaves. What makes price volatile – given the fact that continuous cap cuts are part of the system – is how quickly businesses can adjust to new demands and reduce their emissions. Thus volatility, in some part, indicates the demand for carbon and the EU economy's response to the new carbon constraints. Some market participants attribute volatility to the uncertainty related to political decisions in the EU. Very often the market reacts to comments from officials in the Commission or member states. For instance, when in May 2010 Connie Hedegaard, the European commission climate chief, said it was possible for the carbon price to reach €30, the prices grew almost immediately. Events outside the EU influence the price as well. Foreseen introduction of a cap-and-trade in the US announced by Kerry-Lieberman 'American Power Act' and possible emission trading schemes in Australia and Japan in the future will have an effect on the EU allowances price as this would mean market expansion. Hence there are many factors that make prices fluctuate, volatility being the major concern of the whole EU ETS[125].

Another observation regarding volatility of the price comes from the fact, that the Commission establishes a cap, and thus the total amount of emissions does not change. What changes is the way businesses adapt to reduced emission targets and hence the price. It would be erroneous to expect a quick and drastic change in technology in the short-term, thus a major drop in price can occur only if the cap is not tight enough. Due to political uncertainty around the future of the world carbon trading as a result of the inconclusive negotiations during the Copenhagen Summit, the EU might continue with the special treatment practice for certain industries, making cap-and-trade requirements less stringent. The way incentives are given by the EU will continue to make carbon prices volatile. This in turn will affect the way businesses behave and whether they will deliver the expected CO2 reduction.

......................1.2 Importance of stable prices

At stake is the future efficiency of the EU economy. Stable prices give

125 McGarrity, J., 'Caution Urged on Carbon Price Floors', *Point Carbon,* 13.05, 2010 <http://www.pointcarbon.com/news/1.1444086> [accessed 13 May 2010].

confidence to investors about which projects to choose. Given an expectation of certain price, investors can opt for advanced technologies increasing efficiencies and emitting less CO2. However, if prices are volatile investors have less incentive to go for costly and thus riskier projects that promise greater reductions. Instead, it might be more cost effective for them to pay for extra amount of CO2 emitted or to shift the production abroad, where there is no future risk related to carbon emissions.

To give an example of how carbon price affects business choices we can look at coal, the dirtiest energy source of today. It has been estimated that in order to use less coal and switch to gas or other alternative fuels, the price of carbon has to go up from the current €15 to €25 or even €60, as believed by some industry experts, to make it possible[126]. How can industries be sure that carbon doesn't become prohibitively cheap? Clearly, something has to be changed in the way the system operates. In the next section we shall see how a tax mechanism can be introduced at the EU level to complement the cap-and-trade.

2 *Mixing carbon taxation with existing EU ETS*

There are a number of ways in which the current trading scheme can be improved. First, some sort of regulation can be imposed on sectors that are currently not under the EU ETS, thus complementing the scheme by expanding coverage to the rest of the economy. Second, the issue of volatility can be addressed by limiting it in a number of ways: governments may trade permits so as to keep prices withing the volatility window, or taxes can be added to the existing cap-and-trade scheme so as to set the floor for the carbon price.

As we have seen, the third period will bring the aviation sector under the cap, which will make the system more fare by expanding it beyond the current 45 per cent of European carbon coverage. However, expansion does not necessarily improve volatility, as the current sector under the EU ETS is broad enough to make the conclusion that the price has to be stabilized in some way. Next we shall look at how the price can be limited via an introduction of a tax.

126 McGarrity, J., 'Caution Urged on Carbon Price Floors'.

.......................2.1 Non-EU ETS regulating tax

Before we proceed to the discussion of a tax within the EU ETS, it is viewed important to see how carbon taxes work in general. For that we shall consider the developments in the non-EU ETS sector for examples.

.......................2.1.1 *Environmental tax in the EU countries*

During the 1990s a number of EU countries introduced environmental taxes in order to regulate energy consumption and CO2 emissions, while at the same time cutting income taxes and social security contributions and in that way producing a revenue neutral tax shift. Denmark, Finland, Germany, the Netherlands and the UK were the first to introduce such taxes[127].

The taxes included duties on energy products such as oil, coal, and electricity consumption, as well as CO2. The taxes targeted both households and industries, providing favorable conditions or giving exemptions to the former or to the latter depending on the country. The objective was twofold: environmental support as well as employment benefits through lowering the cost of labor. As a result an impulse to more efficiency and less consumption was given, lowering labor costs[128].

As the initial idea of the Commission was to install a taxation system rather than cap-and-trade in order to regulate climate change, there are existing provisions for taxation in the current legislation. The Energy Tax Directive, which was enacted in 2003, among other requirements sets minimum rates of duty on motor fuels, heating oils and electricity[129].

The rates set by the Energy Tax Directive are very low and new EU member states received reduced rates and various exemptions. It is largely in the discretion of member states whether to introduce a higher than minimum energy tax or not. France

127Speck, S.;Jilkova,J. 'Design of Environmental Tax Reform in Europe' in *Carbon Energy Taxation Lessons from Europe, Oxford:* Oxford University Press 2009, pp. 24-54.
128 Ibid, pp.24-54.
129'EU Carbon Tax on New Commission's Agenda Early Next Year', Euractive, 04.11,2009 <http://www.euractiv.com/en/climate-change/eu-carbon-tax-new-commission-agenda-early-year/article-187029> [accessed 13 May 2010] (para. 2 of16).

has considered introducing a tax aimed at the sectors outside the EU ETS, but in march 2010 the Conseil d'Etat ruled such tax to be unconstitutional, as it exempted 93 per cent of industrial emissions from it[130].

Unlike the environmental legislation of the 1990s implemented in some of the member states, the Directive does not include provisions for taxing carbon, as this idea was unpopular and the cap-and-trade system was going to be established. Thus, the Energy Tax Directive covers the non-EU ETS sectors such as transportation and households. However, Energy Tax Directive received criticism as it is believed that it creates double regulation of the industry: indeed, once electricity producers have been able to shift their emission permits expenses on users, the latter have to pay both for the EU ETS induced increase in price and the additional tax on electricity use[131].

Regulating the non-EU ETS sectors is a valid contribution to the climate change legislation agenda, and it has the potential to stimulate more efficiency and less consumption where implemented. Next we shall, however, concentrate exclusively on the sectors under the EU ETS to try to address the volatility problem.

......................2.2 Volatility curbing tax to complement the EU ETS

The core idea of curbing volatility is to set limits on how low or how high the price can go. Creating such window of volatility is believed to guarantee a minimum and a maximum price of carbon and encourage investors to take up low carbon projects.

There are two ways of setting the volatility window. The first is for the government to guarantee a minimum price and buy any permits offered for sale at this price, as well as guaranteeing a maximum price, at which the government would sell an unlimited number of permits or allow the participants to pay a penalty for any

130 Hall, B., 'Paris Scraps Carbon Tax Plan', FT (Paris) 23.04, 2010 <http://www.ft.com/cms/s/0/1b000010-3686-11df-8151-00144feabdc0.html)> [accessed 13 May 2010] (para. 12 of15).

131 Speck, S., Design of Environmental Tax Reform in Europe', pp. 24-54.

emission for which they had no allowances[132]. American Power Act falls under this policy option, as it suggests introducing a price window – from $12 to 25[133]. If the price is limited from both ends, including floor and ceiling as it is suggested in the Kerry Lieberman bill, it may dissuade financial institutions from trading carbon.

The second way to achieve less volatility is to introduce a carbon tax that would establish a floor price. It means breaking what used to be the price of a permit into two parts: carbon tax plus the price of a permit. Naturally, this will reduce the price of a permit, as now it is only a fraction of what it used to be, whereas the total paid for a unit of emissions remains the same. The tax is fixed, meaning that in any circumstances emitters would pay some minimum price. The variable – the permit price – will still be volatile and depend on efficiencies reached by the carbon market, but the total price for emissions will be a lot less volatile as a result. Providing a stable floor price for carbon would introduce more predictability into the market, providing low-carbon investors with the knowledge of the minimal price[134]. This approach is seen as the optimal one as investors, especially utilities, would support it, because they will know that there is a minimum they can expect and the maximum can be as high as the market allows. For example, EDF, who is planing to build nuclear plants in the UK, has already welcomed the decision made by the UK coalition government to introduce a floor levy.

The tax could be set to change gradually over time, giving the investors an instrument of calculating the minimum expected price of carbon in the future. It also gives the collecting authority a steady income, unlike auctioning that can not produce any predictable revenue.

As argued by Paul Ekins, such carbon tax would work only if it is introduced at an EU level or in a significant number of countries to have an impact on the whole EU. Otherwise it might have a negative effect on the industries as they might receive a stimulus to look for carbon leakage opportunities. The issue of introducing a complementary floor tax is thus a political one. Taxation is viewed as a strictly domestic

132 Ekins,P., 'Carbon Taxes and Emissions Trading:Issues and Interactions' in Carbon-Energy Taxation. Lessons from Europe,Oxford: Oxford University Press, 2009, p. 258.
133 McGarrity, J., 'Caution Urged on Carbon Price Floors'.
134 Ekins,P.,'Carbon Taxes and Emissions', p. 258.

matter, thus governments oppose to the introduction of a EU-wide tax in fear of seeing EU gradually steal certain functions from member states[135].

The UK has been the major opponent to the introduction of any EU tax; the newly elected coalition government of conservatives and liberal democrats have announced, however, that they are determined to set a floor price for EU allowances for electricity producers in the UK. If Germany, the biggest EU emitter, agrees to a floor price, it might positively affect the situation around the introduction of a carbon tax on the European level. The unanimity of member states is required for a decision on taxation matters – if that happens, a floor price for carbon may become a European reality, requiring a levy from carbon-intensive industries if the price falls below some chosen level[136].

To avoid double regulation, the 2007 Green Paper that proposes a revision of the Energy Tax Directive suggests to split the tax into energy and carbon components, making the EU ETS sectors exempt from the carbon component, while still keeping the energy one. This can set a minimum price on energy for all sectors, lowering volatility of the permit prices[137].

Yet even if there is a unanimous agreement on this proposal, it is unlikely that the minimum price will be high enough. The Commission estimates that €39 per tonne of CO2, more than twice of the today's price, is the necessary price if EU is to achieve its 2020 reduction target[138].

Given the peculiarities of the system already on place, introducing a floor tax and creating a hybrid model for carbon regulation would be a viable way to reduce volatility and provide a stable price for investors to have as a reference point.

3 *Potential complications*

If the cap-and-trade system is to take up across the world, and if volatility

135 Ekins,P.,'Carbon Taxes and Emissions', p. 258.
136 Ibid.
137 Ibid.
138 Ibid.

window in some of its form is introduced, there can be potential clashes between systems. Different approaches to carbon tax in the EU and in the US may lead to making carbon trade between these countries difficult. If the US decides to have a ceiling price amidst a higher than ceiling price for carbon expected in the EU, the prices will go up in the US as well, making the upper limit lose sense. If no linking between the two markets is provided it might hamper the international carbon market. All of this is yet to be determined, and as of now introducing a floor tax is a promising and probable option.

Introducing a hybrid model has the potential of curbing volatility, providing stable income to the governments, and giving investors a clear indication of the minimum carbon price while creating a level playing field for new technologies[139].

In this chapter we looked at how a hybrid model that adds a taxation element to the EU ETS can work for the cap-and-trade scheme. We discussed the options considered both in the US and in the EU and how they may potentially interact. We concluded by saying that having a floor price on carbon will be beneficial for the EU as it will bring stable income to the governments as well as predictability to investors. In the next chapter we shall complement our discussion by looking at the competition that EU industries may face due to a tightened cap and a hybrid model, as well as the effect such developments can have on climate change.

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139 McGarrity, J., 'Caution Urged on Carbon Price Floors'.

Chapter 6. EU competitiveness and carbon leakage

In this chapter we shall look at the major challenges that the EU ETS puts forward for EU industries. We shall see that relationship with the developing world and the choice of technologies have the biggest effect on the success of the EU emission trading scheme. Major attention will be given to carbon leakage and nuclear energy production. The chapter will conclude with some suggestions about how the EU can attain its low-carbon goals by cooperating with the developing world.

1 EU leadership in cutting carbon

The EU ETS has changed the way energy is consumed withing the union. Although the price of permit, now being approximately €15, is still lower than € 30, the price most researchers claim necessary in order to attain required GHG emission cuts, it has brought significant changes: the EU market is reaching maturity, carbon emissions and carbon offsets are regularly traded and affect the way businesses make their plans[140]. Having established the world's largest carbon market that trades EUAs and having widely used international carbon instruments such as CERs and EURs, the EU has set the price for the world carbon. The EU ETS signals the price of carbon to the rest of the world, leading to the development of offset projects in the countries and sectors not included into the EU ETS, mobilizing the rest of the world to participate in carbon trading.

The possibility for other countries to get linked to the EU ETS, as it has been done by Norway, Liechtenstein and Iceland, allows for possible further linkage from the US, Japan, Australia and Canada, setting a platform for a truly global carbon trading. The US and Japan are on their way to setting caps. The Kerry-Lieberman bill is seeking to introduce a cap-and-trade scheme in 2013 and to cut US GHG emissions 17 per cent below 2005 levels by 2020[141]. Japan, one of the world's biggest economies

140 McGarrity, J., 'Caution Urged on Carbon Price Floors'.
141 Carroll, R., 'Analysis Sees Strong Consumer Protection in Climate Bill', Point Carbon (London) 14.05, 2010 <http://www.pointcarbon.com/news/1.1444315> [accessed 14 May 2010].

and a major polluter has announced its determination to set absolute volume caps on emissions, yet the date is not clear yet[142]. These developments will definitely affect the carbon market, yet for now the EU is the only one that has introduced a carbon price. This can mean some competitiveness challenges as the firms within the EU have to compete with the firms that bare zero carbon restrictions, which may lead to carbon leakage.

2 Major challenges

The major challenges that lie in front of the EU are varied. We shall concentrate on what we believe to be the most pressing ones: the risks emanating from the developing world and the technological response options currently considered by the EU.

.......................2.1 Developing world

The major challenges come from the developing world and are threefold: ***first***, developing world nations are the ones that are likely to be worse off from climate change; ***second***, they are the biggest consumers of the future; ***third***, they do not have carbon regulation in place, making way for carbon leakage from the developed world. In the following sections we shall look at these issues in more detail.

.......................2.1.1 Climate change effects on the developing world

As argued by Stern, the impacts of climate change are not evenly distributed — the poorest countries and people will suffer earliest and most. The developing world will be unable to continue with its poverty reduction policies, getting mired in health, education and wealth gaps. Developing countries are at a geographical disadvantage, being already warmer and suffering from rainfall variability, meaning that the temperatures will continue rising and available water will become even more scarce. Being dependent on agriculture, the most climate-sensitive sector, there will be fewer

142 Masaki, H., 'Japanese Parliamentary Panel Passes Climate Bill', Point Carbon (Tokyo) 14.05, 2010 <http://www.pointcarbon.com/news/1.1444250> [accessed 14 May 2010].

revenues to keep up with health provision and to improve public services. Investment opportunities will be small, leading to more deaths, increased over the border migration and violent conflicts over land[143].

The first challenge related to the developing world is, thus, their susceptibility to major suffering from climate change, which will require international effort to resolve.

........................2.1.2 *Carbon emitters of the future*

Another important observation is that fossil fuels, which account for 87 per cent of world energy consumption and responsible for almost all current CO2 emissions, remain the fuel of choice due to their abundance as a result of improved efficiency. The largest energy consumers are the US, China, Russia, Japan, India, Canada, Germany, France, South Korea and Brazil, among which are the largest consumers of tomorrow – the developing countries. It has been demonstrated that GDP growth and energy use are highly correlated, meaning that India and China are the biggest polluters of the future[144]. During the UN climate summit in Copenhagen it became evident that the whole multinational debate narrowed down to the commitments the US and China could agree on[145]. Whereas the Kerry-Lieberman bill is establishing a cap-and-trade system in 2013, Chinese government is far from any major action to reduce carbon. The Chinese government has enacted administrative measures to achieve energy efficiency goals, but the incentive to lower energy consumption by 20 per cent per a unit of GDP by 2010 has not included a total cap on emissions, making China the biggest emitter of green house gases, leaving behind even the US. As the country is still in the process of urbanization and industrialization, GHG are bound to grow[146].

The discussed gap between developed and developing world brings us to the definition of the second risk – increasing emission from developing countries, that will

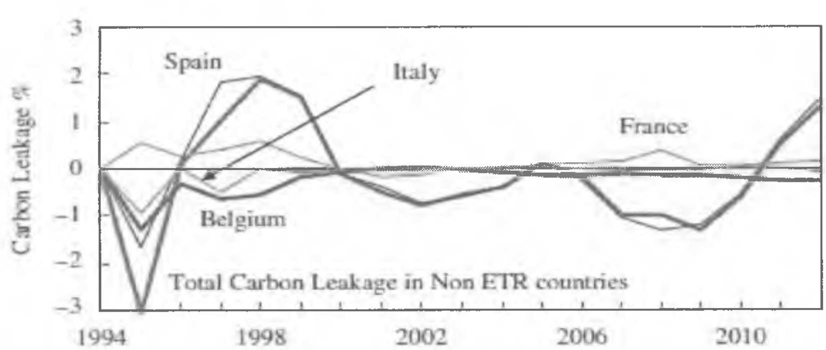
143 Stern, N., 'The Stern Review'.
144 Griffin, J.M., A Smart Energy Policy, p.60.
145 Vidal, J.;Stratton, A.; Goldenberg, S., 'Low Targets, Goals Dropped: Copenhagen Ends in Failure', The Guardian (London) 19.12, 2009 <http://www.guardian.co.uk/environment/2009/dec/18/copenhagen-dealRetrieved> [accessed 22 April 2010] (para. 2 of18).
146 Pan, J., 'Addressing Climate Change Through Sustainable Development' in Climate Change Perspectives, eJournal USA, 2009, <http://www.america.gov/publications/ejournalusa.html>.

continue to grow and thus continue to require more energy, with a high probability of choosing wealth over climate concerns.

.......................2.1.3 *Carbon leakage*

Once EU the regulation becomes more stringent, businesses will have to look for opportunities to cut costs even further. Most of the world's production is already placed outside the EU and this process might accelerate. Since there is no system of carbon control in place in the developing world, European businesses might be inclined to relocate where possible.

Indeed, the EU has taken a unilateral action to curb its carbon emissions. The effectiveness of such a policy is measured by carbon leakage, expressed as the increase in CO2 outside the area with carbon regulation in place divided by the reduction in the emissions within the regulated area. There are concerns that having emission reduction targets in one region might not be effective, as carbon-intensive production will move outside[147].



Graph 11: Evidence for carbon leakage in exports and imports in the UK and Germany.
Note(s): % difference represents the difference between the Baseline case and the Reference case.
Source(s): Cambridge Econometrics.

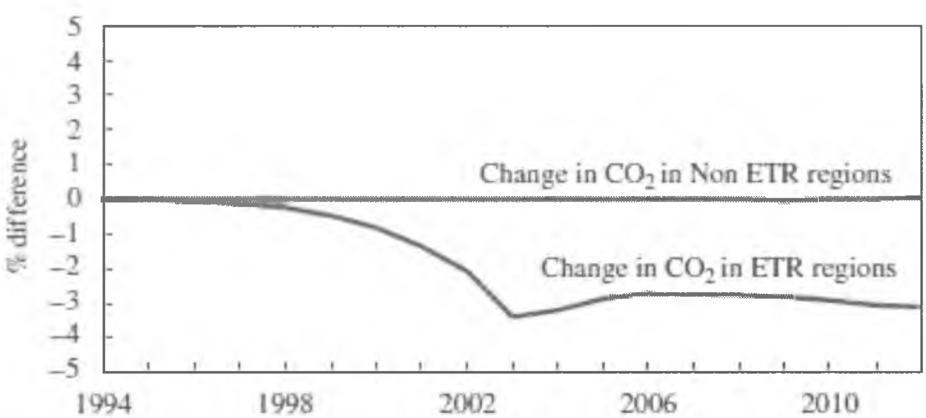
www.elsevier.com/locate/enpol Energy Policy 35 (2007) 6281–6292

There have been concerns regarding carbon leakage with the EU. Based on the Cambridge Econmetrics' E3 model for Europe, Terry Barker et al. looked at carbon

147 Barker, T.; Junankar, S.; Pollitt, H.; Summerton, P. 'Carbon Leakage from Unilateral Environmental Tax Reforms in Europe, 1995-2005' in Carbon-Energy Taxation. Lessons from Europe, Oxford: Oxford University Press 2009, pp.215-236.

leakage within the EU in 1995-2005, comparing countries with existing environmental tax reform (ETS) – Denmark, Germany, Finland, The Netherlands, Sweden and the UK - and those those that did not have any carbon regulation. The study concluded that in the non-regulated countries carbon leakage is very small, being negative in some years. This is shown in graph 11, composed by the authors of the study[148].

Another finding of this research is that emissions fall when there is some form of carbon regulation, yet that does not have any effect on other countries in the EU. This is shown in graph 12, where environmental tax reform countries reduce their emissions by 3-4 per cent, while non-ETR countries have the same level of emissions as before. The authors conclude that environmental tax reform in six EU countries from 1995 to 2005 suggests that there is no carbon leakage going on, output not being relocated away from carbon regulated countries. It is believed that this is due to the fact the taxes were very small and could not have a considerable impact to justify the relocation[149].



Gr aph 12: Changes in CO emissions in ETR and non-ETR regions. Note(s):% difference represents the difference between the Baseline case and the Reference case. Source(s): Cambridge Econometrics. www.elsevier.com/locate/enpol *Energy Policy 35 (2007) 6281–6292*

However, carbon leakage or its absence withing the EU does not tell much about carbon leakage outside the union. European industrial associations for a long time have been talking about the risk of de-industrialisation in Europe and moving production elsewhere if the EU is to continue with its carbon policy. The industries that

148 Barker, T., 'Carbon Leakage from Unilateral Environmental Tax Reforms', pp.215-236.
149 Ibid., pp.215-236.

are believed to suffer the most are those that consume the most energy: alloys, cement, ceramics, chloralkali, glass, iron and steel, lime, non-ferrous metals and paper industries. They are the once that may want to seek arbitrage opportunities outside the EU[150].

The EU has responded by coming up with a list of exemptions offered to the 10 per cent of the most efficient factories in accordance with a performance benchmark. Some studies, such as those conducted by the International Energy Agency (IEA) and The Organisation for Economic Cooperation and Development (OECD) conclude that such fears are overstated. According to the calculations of Claude Turmes, a Green member of the European Parliament, the exposure of the EU industries to non-EU competition is less than 2 per cent for the EU's lime and cement industry, around 5 per cent for EU refineries, and less than 20 per cent for the steel sector[151].

However, it is also argued that carbon leakage is a matter of time, and more of it will be occurring in the future as the cap-and-trade system develops. Eurogypsum President Jean-Pierre Clavel suggests that geographic proximity is a good opportunity for the EU industries. Moving factories to neighboring countries such as Ukraine, which, for example, is close to the gypsum source in Poland, is viable[152].

Russian gas supplies offers an interesting insight. Russia provides the EU with more than 40 per cent of its gas imports[153], and plans to provide China, which is moving its economy from coal to gas-based one, with gas starting from 2015[154]. As in 2010 the production of gas was scheduled to be 643 billion cubic meters and exports were estimated to be 168 billion, adding China alone would mean sourcing out approximately another 68 billion cubic meters of gas annually in exports[155]. Despite

150 "EU Industry and The 'Carbon Leakage' Threat", Euroactive, 27.01, 2009, updated 09.03, 2010 <http://www.euractiv.com/en/climate-change/carbon-leakage-challenge-eu-industry/article-176591> [accessed 16 May 2010].

151 Ibid.

152 Ibid.

153 Boulden, J.; Miller, A.; Warrington Taylor, P.;Boltman. T.; Sefanov, M., 'Gas Row Flares as Supplies to Europe Cut', CNN (London) 06.01, 2009 <http://edition.cnn.com/2009/WORLD/europe/01/06/ukraine.russia.gas/index.html> [accessed 14 May 2010].

154 Topalov, A., «Газпром» торопится в Китай (Gazprom Is Rushing to China), Gazeta (Moscow) 29.03, 2010 <http://www.gazeta.ru/business/2010/03/29/3344507.shtml> [accessed 14 May 2010].

155 'Россия вдвое увеличила экспорт газа' (Russia Has Doubled Gas Exports), Novaya Politika (Moscow) 04.05, 2010, <http://www.cbr.ru/statistics/credit_statistics/print.asp?file=gas.htm>

continuing exploration projects, Russia might have difficulties meeting both its growing domestic and foreign demands for gas. As energy efficiency remains low and has little prospects of being corrected in the near future, Russia will have to cover its domestic consumption by employing other energy sources as it depends on its long-term foreign gas exports contracts for revenues. Russia has already started to further develop coal-based electricity production[156], thus increasing its carbon emissions into the atmosphere. As demand for gas will grow, it is quite possible that Russia's reliance of coal for domestic needs will continue[157].

We can conclude that carbon leakage is a very probable scenario related to the development of the EU ETS that has to be considered as a major risk.

By looking at the three major challenges in the context of the EU vs. developing world countries we see that EU ETS with its current volatile prices is facing:

- increased demand for help from the poorest countries to alleviate climate change related problems of deteriorated health, development and wealth,
- continued climate change across the world due to increasing energy consumption in the developing world,
- carbon leakage from within the EU to the developing world, thus minimizing the positive effect from the carbon legislation.

This puts the issue of developing world on the EU agenda, as the EU ETS is linked to it in a numerous ways, as we have just seen.

......................2.2 Technological response

By passing the EU directive on renewable energies, the block agreed in 2008 to a binding target of increasing the share of renewable energy to 20 per cent by 2020. Today the share of renewables is 8.5 per cent, thus the challenge is quite demanding[158].

[accessed 15 May 2010].

156Trifonov, E., 'Город-ад'(Hell City), Gazeta (Moscow) 26.03, 2010 <http://www.gazeta.ru/comments/2010/03/26_a_3343366.shtml> [accessed 15 May 2010].

157 Ibid.

158 'EU Renewable Energy Policy', Euroactive, 02.08, 2007, updated 15.02, 2010

As the remaining 80 per cent of energy is still to be covered by conventional means, there is a strong move for nuclear energy in the EU, with many countries proposing to build new reactors[159]. Today nuclear power provides 15 per cent of the EU energy consumption with 163 nuclear installations around the EU[160], posing the question of where to keep radioactive waste[161]. Some considerations on nuclear energy are presented in the box.

We can conclude that the major challenges facing the EU today emanate from its relationship with the developing world and from its choice of technology for energy production. Developing world will require more help due to negative effects of global warming. It will also continue emitting more CO2 as its major economies grow. Developing countries are likely to become hosts to carbon leakage resulting from EU firms relocating its production in fear of losing competitiveness. The choice of technology for energy generation will also continue to be a major challenge as choosing certain types of energy sources may have a adverse effect on climate change despite the effort made by the EU.

<http://www.euractiv.com/en/energy/eu-renewable-energy-policy/article-117536> [accessed 16 May 2010].

159 'Non-renewables, Reactors Under Construction/Planned/Proposed', 01.07, 2009 <http://www.energy.eu/#depletion> [accessed 16 May 2010].

160 'Nuclear power plants in Europe, European Nuclear Society', 21.03, 2010 <http://www.euronuclear.org/info/maps.htm>[accessed 15 May 2010].

161 'Nuclear Waste Storage' <http://www.energy.eu/focus/NuclearWasteStorage.php> [accessed 16 May 2010].

Nuclear Energy

Many steps of the nuclear cycle have been proved dangerous. Birth defects, leukemia and cancer noticed in Niger, the world's fourth poorest country, are claimed to be linked to the uranium mining by French giant AREVA, which gets half of its uranium from this country. Revived interest in nuclear power in the EU due to the climate change issue has spurred the company to develop its third mine in 2013-2014, jeopardizing the lives of the country's population, unaware of the dangers associated with uranium mining.

Disposing of radioactive waste poses a similar threat to the populations who live in the areas where it us stored. Since 1993 Russia has been importing uranium hexafluoride for enrichment and storage. German company Urenco, owned by the UK and Dutch governments as well as by E.On and RWE AG, was shipping radioactive waste to Russia from 1996 to 2009 from a factory in Gronau. The total amount of waste is estimated to be 100 thousand tonnes French company AREVA is still exporting its nuclear waste into the country, contributing to about 125 thousand tonnes of uranium hexafluoride already stored. There is evidence that the waste is not properly protected and very often neglected, breaking security standards. Russia has announced that from 2010 it will stop importing uranium hexafluoride from EU countries, yet the tonnes already kept in the Russian sole are to remain their indefinitely.

Technological change that is required by the EU ETS, as we have seen, may have adverse effects on the populations and ecology of other nations. The good-intended incentives have the potential of turning into environmental collapse in the future.

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3 Available responses to challenges

Responding to the identified challenges is not an easy matter. One of the possible responses can be introducing a carbon import tax, that will reflect the price of carbon in the price of imported goods. In this way the EU can level the playing field for all the producers, no matter whether they act under carbon regulation scheme or not. This approach has its critics and proponents. Critics believe that introducing an import tax is difficult due to a varied nature of products imported, also they believe that this could damage the free trade due to its protectionist nature. The proponents, on the other hand, point out to the fact that WTO has indicated that levying such a tax would not contradict the free trade rules[162]. The issue of introducing such a tax is out of the scope of this work, thus we shall concentrate on what we have discussed intensively in the previous chapters – introducing a hybrid model, that would help to resolve the problem of carbon price volatility and thus create a clear indication for investors in renewable projects. Once the EU industries are more or less aware of the carbon cost, they can rely less on plans of carbon relocation and more on green investment. Member states would receive stable income from floor taxes, being able to reinvest it in research and development as well as other sustainable energy development programs.

4 Putting climate change on the developing world agenda

We believe that the EU ETS, although introduced unilaterally, has a truly global scope. We have seen at the way it is linked to the developing world, and thus we would like to tentatively suggest that part of the potential floor tax as part of the hybrid carbon regulation model be invested in joint renewable energy and carbon reducing projects in the developing world. CDM and JI schemes under Kyoto Protocol are promoting conservation and carbon cut projects, yet they do not always have the scope of magnitude necessary for a major breakthrough. Allowing a certain percentage of the taxes to be used by EU industries in the developing world could set the ground for a more sustainable energy production in the world and work towards meeting the EU goal of cutting carbon emissions. This proposal requires further investigation to see whether it could be politically, economically and technologically viable.

In this chapter we have looked at how the EU has taken a leading role in carbon trading and setting the carbon price. We identified major challenges: those

162 Krugman,P., 'Building a Green Economy', (para. 51 of 81).

coming from the developing world and from the choice of technologies. We saw that the EU has to cooperate closer with developing economies as in the contrary case EU carbon reduction efforts can be negligible. We also took a look at nuclear energy production and its disturbing consequences for livelihood, making a case for a rethinking of where the EU gets its energy from. We concluded with a discussion of how a hybrid model with a floor tax can decrease carbon price volatility and benefit both investors and member state government, suggesting the use of some proportion of the revenues for joint carbon reducing projects in the developing world.

Conclusion

In this work we analyzed the EU ETS by looking at its development, functioning and future prospects, coming to a conclusion that the existing carbon regulation can be improved by introducing to the present scheme a floor tax in order to stabilize the prices of emission permits. We came to such a conclusions by going through a number of steps. First, we made an attempt to define the problem of climate change based on the existing scientific evidence and debate around the issue of global warming. Taking into consideration the major works on climate change, we assumed that preventive measures should be taken to avert possible risks and thus developed our discussion on how economics can intervene in order to create market-driven incentives for cutting carbon. By looking at the double dividend theory that assumes that regulating carbon can improve welfare, we addressed the possible regulatory options, namely pigovian tax and Coase's environmental endowments, that allowed us to arrive at a deeper understanding of the way carbon taxation and cap-and-trade mechanisms operate. To complete the theoretical discussion, we also reflected upon voluntary carbon market, coming to a conclusion that its existence is a factual proof that double dividend theory stands. Having reviewed the theory, we turned to the practical example of the EU ETS - its theoretical origins, development, functioning and regulatory mechanisms. We concentrated on NAP1, NAP2 and NAP3 provisions, and specifically on the emission distribution methods in the present and in the future. This set a proper framework for the investigation of the core issue of the work – the emission permit volatility price and options for its stabilization. We looked at the possibility of an import tax, noting that WTO has suggested it is not against its free trade rules, and setting up of a volatility window for carbon prices. Using Ekins' proposal of a floor tax, we concluded that splitting the price of carbon into two components – tax and the price itself, can guarantee a minimum price for a unit of carbon and thus contribute to its stabilization. We discussed the positive effects of having a floor price: providing investors with a secure minimum carbon price to account for in their calculations, leaving governments with stable revenues and giving further incentives for the use of renewable energy. These insights, however, led us to the consideration of negative results of increased carbon regulation, the major concern being carbon leakage to the developing world as businesses try to keep up with their competitiveness. We arrived at the conclusion that shifting carbon-intensive industries could be a possible scenario, thus we suggested that the EU pay more attention to its cooperation with the developing world in order to avert any negative climate developments in there. We then tentatively suggested spending some part of the floor tax revenues on joint carbon reducing projects in the developing world, yet this idea is to be developed further and studied in more detail.

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