ISTANBUL BILGI UNIVERSITY
INSTITUTE OF SOCIAL SCIENCES
INTERNATIONAL POLITICAL ECONOMY MASTER’S DEGREE
PROGRAM

PUBLIC ACCEPTABILITY OF CARBON TAX

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ISTANBUL
2020

PUBLIC ACCEPTABILITY OF CARBON TAX

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Tezin Onaylandığı Tarih: 10.01.2020

Toplam Sayfa Sayısı: 102

Anahtar Kelimeler (Türkçe)	Anahtar Kelimeler (İngilizce)
1) Karbon Vergisi	1) Carbon Tax
2) Küresel İklim Değişikliği	2) Global Climate Change
3) Emisyon Ticaret Sistemi	3) Emission Trading System
4) Kabul Edilebilirlik	4) Public Acceptability

ACKNOWLEDGEMENTS

I would like to thank to my supervisor Associate Prof. Ayşe Uyduranoğlu for offering her support, assistance and encouragement. I express my sincere appreciation to my spouse Gökhan Dikmener for his great support and motivation.

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ABBREVIATIONS

ACX: Australian Climate Exchange

AMS: American Meteorological Association

BAAQMD: Bay Area Air Quality Management District

BAU: Business as Usual

CCX: Chicago Climate Exchange

CDM: Clean Development Mechanism

CEIT: Countries with Economies in Transition

CER: Certified Emission Reduction

CFC: Chlorofluorocarbon

CH_4: Methane

CO_2: Carbon Dioxide

COP: Conference of Parties

DEPA: Danish Environmental Protection Agency

EEA: European Environment Agency

EPA: United States Environmental Protection Agency

ERU: Earn Emission Reduction Units

ET: Emission Trading

ETS: Emission Trading System

EU ETS: The European Union Emissions Trading System

EU: European Union

GDP: Gross Domestic Product

GHG: Greenhouse Gas

IEA: International Energy Agency

INDC: Intended Nationally Determined Contributions

IPCC: The Intergovernmental Panel on Climate Change

ISO: The International Organization for Standardization

JI: Joint Implementation

JISC: Joint Implementation Supervisory Committee

NASA: National Aeronautics and Space Administration

NGO: Non-Governmental Organisation

NLG: Netherlands Guilder

OECD: The Organisation for Economic Co-operation and Development

R&D: Research and Development

REC: Renewable Energy Credits

TRCS: Tradable Renewable Certificates

UK: United Kingdom

UN: United Nations

UNDP: United Nations Development Program

UNEP: United Nations Environment Program

UNFCC: United Nations Convention on Climate Change

USA: United States of America

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ABSTRACT

The main objective of this thesis is to identify factors affecting the public acceptability of carbon tax, which is one of the financial instruments used for emission reduction. In this study, the factors that cause climate change, international efforts, carbon pricing mechanisms and carbon tax best practices on country basis are discussed. The factors such as impact of carbon tax on competitiveness, distributional concerns, public distrust and perception of the carbon tax that negatively affect the acceptability of carbon tax by the public are examined. The effect of carbon tax on competition is insignificant because tax effect on final price is minor. Similarly, the impact of carbon tax on income distribution is found not influential on public acceptability since tax revenues can be used to reduce the rates of existing taxes and tax exemptions can be defined for low-income households. However, public distrust and tax perception are the more important determinants of public acceptability. Public skepticism on government intention, the perceived corruption and inefficiency leading to decrease in political legitimacy are main drivers for public distrust. Also, the perception of carbon tax is concluded to be 'inefficient in terms of changing behavior', 'a type of penalty', 'a decrease in consumption and purchasing power', 'a restriction on the freedom of choice'. The conclusion section provides recommendations to increase public acceptability such as earmarking tax revenues, using revenues for limiting its negative impact on income distribution and applying tax at municipal level.

Key Words: Carbon Tax, Global Climate Change, Emission Trading System, Public Acceptability

ÖZET

Bu tez çalışmasının temel amacı; karbon salınımının azaltılmasında kullanılan mali araçlardan biri olan karbon vergisinin toplum tarafından kabul edilebilirliğini etkileyen etmenleri ortaya koymaktır. Bu çalışmada iklim değişikliğine neden olan etkenler, uluslararası girişimler, karbon fiyatlama mekanizmaları ve ülke bazında karbon vergisi uygulamalarının üzerinde durulmuş, karbon vergisinin toplum tarafından kabul edilebilirliğini olumsuz yönde etkileyen rekabet ve gelir dağılımı üzerindeki etkisi, kamuoyu güvensizliği ve vergi algısı gibi etmenler incelenmiştir. Tez çalışmasının sonucunda, karbon vergisinin rekabet üzerindeki etkisinin sınırlı olduğu görülmüş, bunun sebebi verginin nihai fiyat üzerindeki etkisinin düşük olması ile açıklanmıştır. Benzer şekilde, karbon vergisi geliri mevcut vergi oranlarını düşürmek için kullanılabileceğinden ve düşük gelirliler için karbon vergisi muafiyetleri tanımlanabileceğinden, karbon vergisinin gelir dağılımı üzerindeki etkisi toplumda kabul edilebilirliği açısından çok etkili olmadığı kanaatine varılmıştır. Ancak, kamu güvensizliği ve vergi algısı, verginin toplumda kabul edilebilirliği açısından daha önemli belirleyicilerdir. Toplumun devletin niyetine olan şüphesi, siyasi meşruiyetin azalmasına neden olan yolsuzluk ve verimsizlik algısı, toplum güvensizliğinin temel nedenleridir. Ayrıca, karbon vergisi algısının ‘davranış değişikliği açısından verimsiz', 'bir tür ceza', 'tüketim ve satın alma gücünde azalma', 'seçim özgürlüğünde kısıtlama' olduğu sonucuna varılmıştır. Sonuç bölümü, vergi gelirlerini tahsis etmek, verginin gelir dağılımı üzerindeki olumsuz etkisini sınırlamak için vergi gelirlerini kullanmak ve karbon vergisini belediye seviyesinde uygulamak gibi karbon vergisinin toplumda kabul edilebilirliğini artırmak için öneriler sunmaktadır.

Anahtar Kelimeler: Karbon Vergisi, Küresel İklim Değişikliği, Emisyon Ticaret Sistemi, Kabul Edilebilirlik

INTRODUCTION

The climate change is a global concern, affecting all and causes ecological, sociological and economic burden. Increasing use of hydrocarbons with the industrialization, the deforestation for agriculture, industry, housing needs, increasing population, industrialization, misimplementations in agriculture and waste management, and the destruction of areas such as lakes, streams and forests that absorb greenhouse gases, has increased the greenhouse gases in the atmosphere. Increasing greenhouse gas emissions due to human activities are the main causes of global climate change.

Greenhouse gas emissions can be evaluated within the scope of negative externalities and are the biggest market failures encountered on a global scale. Global warming is a concrete example of market failure. In this context, global cooperation is essential for the solution of the global climate change problem. Since the environment is a global public good, the solution of environmental problems requires global cooperation and joint action of all countries. It is inevitable that all countries in the world should take precautions together because without any cooperation the market cannot find a solution for the increasing global warming caused by greenhouse gas accumulation in the atmosphere starting with the industrial revolution.

In order to limit the cause and impacts of climate change within the free market system, the pricing of carbon and similar gases causing climate change is mandatory. In this context, economic units will have to review their carbon intensive production or consumption.

There are two important financial instruments for government intervention, the most effective ones are; carbon tax and emission trading systems. Carbon taxes are probably the simplest, most effective idea in which fossil fuels are taxed based on their carbon content. The emission trading system allows carbon emissions and allow the price of the allowances to occur in free markets. Both systems ultimately apply a price on emissions and support emission reductions.

In terms of the public acceptability of both tools, it is seen that although carbon tax idea is older than emission trading system, the level of public acceptability of carbon tax is lower. This thesis will examine the reason for low public acceptability and the factors affecting acceptability will be discussed.

The thesis consists of four chapters with introduction and conclusion parts. The first chapter will initially give general explanatory information about the definition and the reasons of climate change, human factor in climate change and greenhouse gas trend. Furthermore, how this issue was evaluated in terms of United Nations Framework Convention on Climate Change (UNFCCC) and other international efforts focusing on Kyoto Protocol and Paris Agreement will be explained.

In the second chapter the carbon pricing mechanism and environmental taxes, the theory and approaches, the structure of carbon tax in terms of its subject, base, rate, income usage will be explained and the other market-based mechanism –Emission Trading System- will be examined.

The third chapter is the core part in which the main idea of this thesis is discussed. In this chapter, main factors affecting public acceptability of carbon tax will be examined. Implications of carbon tax on income distribution and competition will be discussed and the importance of perception of tax, and public distrust will be examined.

The last chapter will explain the general characteristics of the carbon taxes imposed by Denmark, Finland, Norway, the Netherlands and Sweden, which are the five countries that impose the carbon tax, and a review of the carbon taxes imposed by the five countries since the 1990s.

In the light of all the investigations and evaluations, the factors affecting the acceptability of carbon tax by the society will be discussed and conclusions and recommendations will be presented.

CHAPTER 1

1.1 GLOBAL CLIMATE CHANGE

The average state of all weather conditions experienced or observed in any given area over a given period of time defines the climate. The World Meteorological Organization has determined this period to be 30 years. The formation process of climate systems consists of the heating process with short wave radiation from the sun and the cooling process with long wave infrared radiation from space (IPCC Synthesis Report, 2015).

The use of fossil fuels, deforestation, and industrialization are human activities, which make greenhouse gas accumulation in the atmosphere resulting in greenhouse effect. Greenhouse affect acts like a shield all around the Earth and make Earth temperature increase. This rapid increase in average temperature results in change in climate globally.

The Intergovernmental Panel on Climate Change (IPCC) gives a broader framework on climate change. According to IPCC 2007, “Climate change in IPCC usage refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity” (IPCC, 2007).

United Nations Convention on Climate Change (UNFCC) Article 1 defines climate change as the “…means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods” (United Nations Framework Convention on Climate Change, 1992).

IPCC, a United Nations body, conducts the most detailed analyzes of climate change, including its socioeconomic and environmental impacts. The evaluation reports produced by the IPCC are gathering the global studies on climate change. The relevant reports are therefore considered to be the most basic data source on climate change. IPCC published its final evaluation report in 2014. The 5th Assessment Report, published by the IPCC, explaining climate change and its impacts in the light of scientific data, includes data on climate change. According to this report: “The period from 1983 to 2012 was likely the warmest 30-year period of the last 1400 years in the Northern Hemisphere. The globally averaged combined land and ocean surface temperature data as calculated by a linear trend show a warming of 0.85 [0.65 to 1.06] °C over the period 1880 to 2012, when multiple independently produced datasets exist” (IPCC Synthesis Report, 2015).

1.2 WHY DOES HUMAN-CLIMATE OCCUR?

High levels of greenhouse gas emissions is a major cause of global climate change and can be mainly attributed to human activities. Human-induced activities are the main cause of climate change and anthropogenic greenhouse gas emissions cause an unnatural increase in greenhouse gas concentrations, particularly CO_2 and CH_4. With the introduction of fossil fuels with the industrial revolution, the amount of greenhouse gases in the atmosphere begins to increase. This carbon, created by human activities, is called anthropogenic carbon. As Etheridge et al. have shown, CO_2 and CH_4 emissions in the atmosphere have been steadily increasing since the Industrial Revolution (Etheridge et al., 1999).

The main cause of emissions to the atmosphere is the use of hydrocarbons. According to the 5th Assessment Report published by the IPCC, global greenhouse gas emissions increased by 2 percent in the 1970s, 1.4 percent in the 1980s, 0.6 percent in the 1990s, and 2.2 percent between 2000 and 2010 (IPCC Synthesis Report, 2015).

According to the IPCC data, the increase in the concentration of CO_2, methane, nitrous oxide and chlorofluorocarbon gases in the atmosphere is a consequence of the human impact, and this has been going on since 1750, with the main reason for the increase in fossil fuel consumption. Human-induced greenhouse gas emissions predates the industrial revolution due to both the presence of economic factors and the increase in population rates.

These gases absorb radiation and disrupt the world's current energy circulation and affect the climate. The IPCC reports state that at the end of the 20th century there will be an increase in the temperature of the earth's surface by 0.6 degrees, and with this increase there will be some deterioration and changes in the climate elements. Various distortion to environment such as; average increase in the sea level 0.1-0.2 m, decrease in snow-covered areas, El Niño and La Niña climatic changes, increasing droughts in Asia and Africa continents can be observed (Betsill and Bulkeley, 2003).

Figure 1: Total annual human induced greenhouse gas emissions between 1970 and 2010

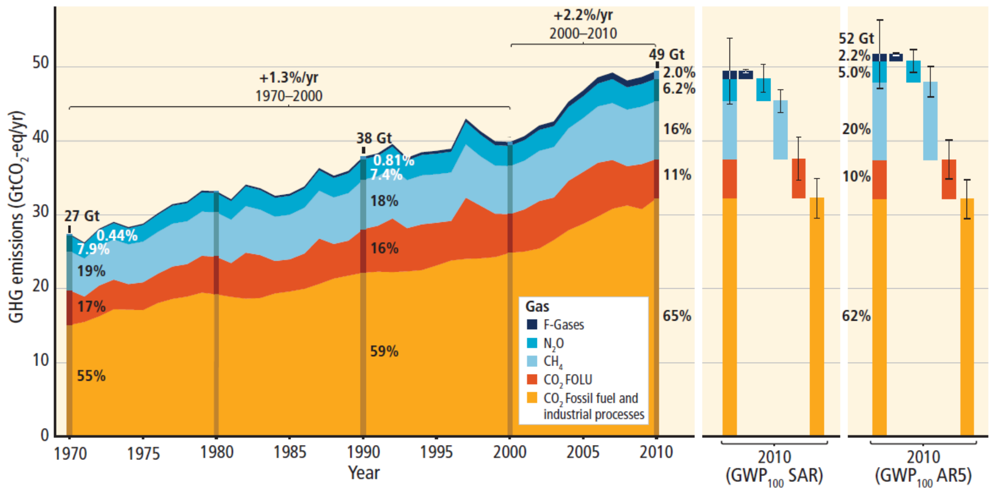


Figure 1.6 | Total annual anthropogenic greenhouse gas (GHG) emissions (gigatonne of CO_2-equivalent per year, $GtCO_2$-eq/yr) for the period 1970 to 2010, by gases: CO_2 from fossil fuel combustion and industrial processes; CO_2 from Forestry and Other Land Use (FOLU); methane (CH_4); nitrous oxide (N_2O); fluorinated gases covered under the Kyoto Protocol (F-gases). Right hand side shows 2010 emissions, using alternatively CO_2-equivalent emission weightings based on IPCC Second Assessment Report (SAR) and AR5 values. Unless otherwise stated, CO_2-equivalent emissions in this report include the basket of Kyoto gases (CO_2, CH_4, N_2O as well as F-gases) calculated based on 100-year Global Warming Potential (GWP_{100}) values from the SAR (see Glossary). Using the most recent GWP_{100} values from the AR5 (right-hand bars) would result in higher total annual GHG emissions (52 $GtCO_2$-eq/yr) from an increased contribution of methane, but does not change the long-term trend significantly. Other metric choices would change the contributions of different gases (see Box 3.2). The 2010 values are shown again broken down into their components with the associated uncertainties (90% confidence interval) indicated by the error bars. Global CO_2 emissions from fossil fuel combustion are known with an 8% uncertainty margin (90% confidence interval). There are very large uncertainties (of the order of ±50%) attached to the CO_2 emissions from FOLU. Uncertainty about the global emissions of CH_4, N_2O and the F-gases has been estimated at 20%, 60% and 20%, respectively. 2010 was the most recent year for which emission statistics on all gases as well as assessments of uncertainties were essentially complete at the time of data cut off for this report. The uncertainty estimates only account for uncertainty in emissions, not in the GWPs (as given in WGI 8.7). *{WGIII Figure SPM.1}*

Of all these gas concentrations, water vapor accounts for 60% of greenhouse gas, CO_2 accounts for 26% and other gases account for 14%. Calculations in climate forecasting models have shown that if the increase in CO_2 and other greenhouse gases continue, as it is now, the temperature measured on the earth's surface will increase by 3 °C at the end of the 21^{st} century (Ahrens, 2009).

As stated by the IPCC, “most of the observed increase in globally averaged temperatures since mid-20^{th} century is very likely (90% of possibility) due to the observed increase in anthropogenic greenhouse gas concentrations” (IPCC, 2007). Human activities change the dynamics of the climate system. According to the American Meteorological Association (AMS), “the climate is always changing. However, many of the changes observed are beyond what can be explained by the natural change of climate. Based on extensive scientific evidence, it is clear that climate change observed in the past century is due to greenhouse gas emissions from human-induced activities” (AMS, 2012).

The research titled “Contributions of Anthropogenic and Natural Forcing to Recent Research on Tropopause Height Change” reveals that due to greenhouse gas emissions, it thickens tropopause, a layer of solar radiation (Santer et al., 2003). The study shows that there is an increase in the height of tropopause after the second half of the 20th century and that this increase is predominantly caused by human activities (Santer et al., 2003). In fact, human activities have more impact on climate change than natural processes.

1.3 GREENHOUSE GAS TREND

Temperature on the Earth's surface is set by the balance between solar energy and disappearance of this energy in the space cavity after reflection. Certain gases in the atmosphere play a role in setting this balance. These gases are called greenhouse gases. The sunrays coming to the surface have ultraviolet radiation and have a short wavelength. 1/3 of these rays are reflected from the surface of the earth into space. The remainder is held by the soil and ocean surface. As the earth warms, it emits a long wave of infrared radiation. Greenhouse gases keep this long wavelength radiation and provide heating in the atmosphere. This situation is explained as a blanket effect, and the world temperature heats up to about 35 °C (Maslin, 2009).

Scientific and academic studies show that there have been significant changes in greenhouse gas concentrations since the pre-industrial period. The highest greenhouse gas emissions were measured between 2000 and 2010. The most important of these gases is CO_2, which is produced by burning of fossil fuels. Although CO_2 is not the only gas that causes climate change, CO_2 is the most important one, and the presence of methane, nitrous oxide and fluorine-containing gases has a significant impact on global climate change (Remuzgo and Trueba, 2017).

CO_2 is also described by NASA as the most important cause of climate change. A small but important part of the atmosphere, CO_2 emerges through natural processes such as breathing and volcanic activities, or human activities such as deforestation, land use and the use of fossil fuels. People have increased the CO_2 concentration in the atmosphere by a third since the industrial revolution. CO_2 is the longest and most important cause of climate change (NASA, 2019). In addition, according to EPA the majority of the greenhouse gases emitted by human activities is CO_2 (EPA, 2019). The latest report of the IPCC, states that CO_2 produces the biggest radiative greenhouse effect between 1750 and 2011 (IPCC, 2014).

1.4 WHY THIS IS A PROBLEM?

United Nations Framework Convention on Climate Change (Rio 1992)

UNFCCC is a milestone in the international climate change cooperation and it is an outcome of all the efforts towards combating climate change in the second half of the 20th century. In addition, it establishes the principles and general framework for the future cooperation actions against climate change. The main purpose of the Convention is; to achieve a level that prevents greenhouse gas accumulations in the atmosphere at a level that avoids the dangerous human-induced impact on the climate system. Such a level should be achieved by adapting to the ecosystem's climate change in a natural way, without harming food production and allowing sustainable economic development.

The principle of “common but differentiated responsibilities” has been adopted because some countries emit more greenhouse gases that cause climate change to the atmosphere after the industrial revolution. This principle was developed on the grounds that countries that emit more greenhouse gases to the atmosphere take more responsibility. In line with this principle, the contract has divided the countries into three groups with respect to designation of different commitments to the parties. These groups are “Annex I and Annex II and non-Annex countries” (Hayrullahoğlu and Hayrullahoğlu, 2012).

Annex-I Countries are grouped into two. The first one includes industrialized members of the OECD as of the year 1992; the second group includes economies in transition (CEITs) such as the Russian Federation, the Baltic States and several other Central and Eastern European countries. Turkey is a member of the OECD in that period included in the first group. Annex I countries are obliged to limit greenhouse gas emissions, to develop and protect greenhouse gas sinks, to report the policies and take the measures to prevent climate change, and to record and transmit data on existing greenhouse gas emissions. This group includes the EU and 42 countries (MFA, 2019).

Annex II Countries include only OECD members of Annex-1 and exclude the countries with economies in transition. In addition to the obligations that these countries undertake to comply with as Annex I; they are responsible for “promoting, facilitating and financing the transfer of environmentally sound technologies and know-how” to CEITs and developing parties in order to enable them to implement the provisions of the UNFCCC (Binboğa, 2014).

Developing countries are Non-Annex Countries and recognized as the countries vulnerable to the effects of climate change and to the impacts of the implementation of climate change measures. These countries have not yet taken any obligation and they are encouraged to protect greenhouse gas sinks, to reduce greenhouse gas emissions, and to cooperate on technology and research (MFA, 2019).

Conference of Parties (COP), the subsidiary bodies and the secretariat established by the UNFCCC have played a vital role in the development of the climate change regime. COP is an indispensable body in terms of its lawmaking power as well as its role in promoting the cooperation by means of adopting new protocols and making amendments. COP, as the supreme decision making body of the UNFCCC, is mainly responsible for ensuring the proper implementation of the UNFCCC. It reviews and promotes the implementation of objectives and the compliance with the commitments within the scope of the UNFCCC. It also makes decisions on the issues related to the rules and procedures for negotiations of new commitments under the UNFCCC. COP meets every year regularly, unless the parties decide otherwise.

Following the ratification and enforcement of the Rio convention in 1994, the COP-1 Berlin Summit in Germany was signed in 1995 and the COP-2 Geneva convention was signed in Switzerland in 1996. As a more comprehensive international agreement, UNFCCC has paved the way for a united operation. As a result, in 1997 Kyoto protocol was issued.

1.5 INTERNATIONAL EFFORTS

French scientist- Jean Baptiste Joseph Fourier who argued that the gases in the atmosphere could have a warming effect, was one of the first to put forward the greenhouse effect occurred in the atmosphere in 1827 (Alfsen and Skodvin, 1998). Around the 1860s, the British scientist John Tyndall suggested that concentration of some gases in the atmosphere, mainly CO_2, block the infrared radiation and thus lead to climate change (Weart, 2008). The Swedish scientist Svante Arrhenius took a further concrete step with regard to climate change science in 1896 with his study aiming at measuring the effects of increasing concentration of greenhouse gases. He predicted that a doubling of the CO_2 concentration in the atmosphere compared to the pre-industrial levels could result in a rise of global temperature by 5ºC to 6ºC, a very close estimate to the current scientific findings (Houghton, 2004). Then, the English scientist Guy Stewart Callendar contributed to this scientific progress made in the field of climate change through his studies shedding light on the link between global warming and increased concentration of CO_2. He discovered that CO_2 levels had increased about 10% in the 19th century (Sample, 2005).

The global environmental policy, which can be described as the first at the international level, came to the agenda with UNEP (United Nations Environment Program), which came into force after the meeting in Stockholm in 1972, covering countries around the world. It is accepted that international environmental law is born with Stockholm Conference which was the first international UN conference on the environment (Sürer, 2011).

For the first time in 1976, UNEP's management council discussed the importance of ozone depletion. In 1977, in cooperation with the World Meteorological Organization, an Ozone Layer Coordination Committee was established within UNEP.

In 1979 World Meteorological Organization led the second international step with the First World Climate Conference. It was emphasized that if the use of fossil fuels continues at the same rate and the destruction of forests continues, the amount of CO_2 in the atmosphere will rise to dangerous levels (Arı, 2010).

In 1981, the first intergovernmental efforts to reduce ozone depleting chemicals began. Because of this initiative, the "Vienna Convention for the Protection of the Ozone Layer" was adopted in 1985. The Convention encouraged intergovernmental cooperation in monitoring and sharing information on chlorofluorocarbon (CFC) production, systematic monitoring of the ozone layer and research.

Following the Vienna Convention, the Montreal Protocol was signed in 1987, which included studies on ozone depleting substances. It focuses on controlling the use and production of ozone depleting substances. The Montreal Protocol is widely recognized as a highly successful multi-directional agreement in terms of its high level of participation, its effectiveness, and its verified development and institutional structure for correcting ozone depletion (Birdal, 2015).

As an international target at the Toronto Conference (1988), it has been agreed to reduce CO_2 emissions by 20% globally by 2005. At the same time, it was decided to prepare an environmental climate convention to be developed by protocols.

After the Toronto Conference, it was understood that CO_2 gas was the most important factor in greenhouse gases in the early 1990s, and therefore the formation of climate change and global warming led to the discussion of carbon taxes (Aktan et al., 2006). The first application was in Finland in the 1990s. After Finland, carbon taxes have been introduced in Sweden and Norway since 1991 (Hotunluoğlu and Tekeli, 2007).

Kyoto Protocol (1997)

Following the UNFCCC, the formation of climate change regime continued with the Kyoto Protocol and several other decisions made during the COP sessions throughout the negotiations on climate change. According to Article 25 para. 1 of the Protocol, "ratification of 55 parties to the UNFCCC, which accounted in total for at least 55% of the total CO_2 emissions for 1990 of the parties included Annex-1 is required for the Protocol to be entered into force". The protocol has not been effective for a long period of time, particularly since the United States, which has largely caused greenhouse gas emissions, is not a party in the Protocol. Later, when this rate reached 42%, Russia, another major greenhouse gas emitter, was included in the protocol on 18 November 2004, reaching 55% of the 1990's carbon emissions. 90 days after Russia's accession, on 16.02.2005, the protocol was formally put into effect (Binboğa, 2014).

This meeting, also called the COP-3, was given great importance throughout the world. The Montreal agreement and the UNFCCC meeting were important pillars of the Kyoto protocol. The overall objective of the Protocol is to ensure that sustainable development and related environmental measures are taken (Aktan, Dileyici and Vural, 2006). As a result of the studies carried out in the Kyoto Protocol, it was decided in Article 3 that the developed countries would reduce their human-induced CO_2 equivalent greenhouse gas emissions by at least 5% below 1990 levels in the commitment period 2008 to 2012 (Turgut, 2014). The parties committed to reduce the greenhouse gas emission reduction to 18% below the 1990 level in the second period between 2013-2020 (Doha Amendment to the Kyoto Protocol, 2012).

Article 28 of the Protocol has two annexes, Annex A and Annex B. Annex A shows the greenhouse gases, sectors and resource categories subject to the protocol, and Annex B shows the parties' numeric target commitments for emission limitation or reduction. After the Kyoto protocol, the COP-4 conferences were held in Buenos Aires in 1998, the COP-5 in Bonn, Germany in 1999 and the COP-6 conferences in Hague, Netherlands (United Nations, 2016).

The 7th COP was held in 2001 in Marrakech, Morocco. The aim of the meeting was to agree on a legal text on the key technical aspects of the agreement on how to implement the Kyoto Protocol in Bonn in July 2001 (Shah, 2001). When the UNFCCC came into force in 1992, Turkey was in Annex I and Annex II List of the contract. Since it was a developing country, Turkey has endeavored to get out of the annexes of UNFCCC from COP I in 1995 to COP 6 in 2000. In Hague Conference, convened in 2000, Turkey proposed to limit her responsibility with reducing greenhouse gas emissions and be removed from the Annex II countries and this proposal was decided on (Dağdemir, 2005). After the decision of the COP-7, Turkey's position in the Annex 1 list accepted as different from other countries. Turkey has been removed from Appendix II list of the UNFCCC, there is no change in its position in the Annex I list. The meeting in Marrakech was unsuccessful. After the conference, in March 2001, US President George W. Bush announced that they had opposed the Kyoto Protocol decisions (Boyd, 2002). Between 2002 and 2008, the meetings were held in New Delhi, Milan, Buenos Aires, Montreal, Nairobi, Bali and Poland, respectively.

In 2009 during COP-15, The Copenhagen Accord was designed by America, China, India, Brazil and South Africa, and the provisions of the agreement were prepared by the United States. The memorandum adopted on 19 December 2009 is a political statement that outlines the UNFCC (UNFCC, 2009). Due to the limited number of countries preparing the agreement at the COP and not considering the other countries during the preparation of the agreement, countries opposing the global system such as Sudan, Venezuela and Bolivia rejected the adoption of a conference decision. Thus, the memorandum remained as a “consensus” for annex of the decision of the COP. After the Copenhagen Accord, meetings were held in Cancun, Durban, Doha, Warsaw and Lima respectively until 2015 within the UNFCCC.

Paris Agreement (2015)

In 2014, the climate march of more than four hundred thousand people in New York took place. Seven weeks after the march, world's two major climate change powers, the American and Chinese presidents, came together, and the two countries agreed on greenhouse gas reduction and the development of clean energy. The joint action of China and the USA in 2014 and their constructive attitude was one of the important factors in the realization of the Paris Agreement (Karakaya, 2016). The protocol ended on 12 December 2015 with the announcement of the Paris Agreement. Approximately 40 thousand delegates from 195 countries participated and the protocol was unanimously adopted by all countries. All parties are obliged to take responsibility for emission reduction; developing countries are given targets to reduce according to their current capacities. Developed countries have been asked to take more mitigation commitments and make absolute mitigations and to become “carbon neutral” after 2050 (Karakaya, 2016).

Many world countries have called for limiting global warming to 1.5 degrees, but this view generally represented developing countries in Africa, South America and Asia. The major powers, the USA, China and the European Union, have agreed to limit global warming to 2 degrees. An important issue that attracted attention at the Paris Conference was that, unlike the Copenhagen Accord, all countries around the world agreed to reduce emissions. If the emission reduction target agreed at the meeting was not successful, it was calculated by experts that global warming would be 2.7 degrees by the end of the current century. This will be a political and economic failure to prevent global warming. Therefore, to maintain the mechanisms agreed in the Paris Agreement on the 2 degree limit, meetings will be held and strengthened every five years in order to sustain the developments (Hertsgaard, 2015). The first reporting will be made in 2020, and the first evaluation meeting will be held in 2023. Developed countries will give developing countries a grant or loan of $ 100 billion every 5 years to achieve their emission reduction targets (Paris Agreement, 2015).

Turkey, - before "Paris Climate Summit"- within the scope of the fight against climate change, has submitted the INDC to UN Climate Secretariat voluntarily in 2015. Turkey's INDC, aims at reducing greenhouse gas emissions up to 21 percent from the BAU level by 2030.

For the ratification of the Paris Agreement covering the above-mentioned principles, at least 55 countries had to ratify and the ratifying countries had to account for 55% of the total greenhouse gas emissions. The agreement entered into force on 04 November 2016 with the fulfillment of the requirements (Rumney, 2016).

US President Trump, after coming to power in 2017, on 1 July 2017, arguing that the Paris Agreement imposes very heavy rules on the economy and has a negative impact on employment, announced that the United States would exit the agreement (McBride, 2017).

The 24th COP of the UNFCCC was held between 02 and 15 December 2018 in Katowice, Poland. In a report released by the United Nations, it was stated that the emission reduction plans of the countries in Paris were insufficient. In this case, the world's average temperature would increase by at least 1.5 °C until 2030 and if it was not taken more strict measures, the increase would reach 3 °C.

Climate change contribution financing to help developing countries was discussed and it was decided to provide $ 100 billion loan from 2020 onwards. Such loans may also be used if the carbon is trapped in the sinks, forest, ocean and soil. It was also decided to apply standards appropriate to the situation of the countries and to add items that would make it difficult to give up the commitments (Harvey, 2018).

CHAPTER 2

2.1 CLIMATE CHANGE AS A MARKET FAILURE

As a result of increasing greenhouse gas emissions, climate change is the most significant result of global warming. Climate change is one of the 21^{st} century's biggest challenges to humanity. Climate change has serious socio-economic consequences and pose a threat to human health, ecosystems, and even the survival of the human race. It is at the top of the international agenda, especially in recent years.

Climate change has been the biggest market failure created by economic agents all around the world and has been one of the most concrete examples of market failure in environmental issues. It is inevitable that all countries in the world will take precautions together because the market cannot find a solution to the global warming caused by greenhouse gas. In this context, the Kyoto Protocol should be described as the first important step towards the solution of this global problem (Akkaya, 2017).

All researches on climate change's economic and humanitarian aspect have a common feature underlining that if the planet is subjected to a temperature rise above the 2 °C, large-scale decreases in the world economy and, more significantly, human development would halt irreversibly. This critical temperature increase will be much higher if the new industrialization and associated energy policies are not under control. The density of carbon emissions in air must be maintained at 450 particles per million in order to maintain the temperature rise at 2°C. Otherwise, the carbon density in the atmosphere will increase to 750 particles by 2050. The world's cumulative carbon emissions must be decreased to a minimum of 4 gigaton levels in order to reach 450 particle levels in terms of CO_2 density. This means that the current CO_2 emissions will be reduced by 80% by 2050 (UNDP, 2007).

2.2 CARBON PRICING

Greenhouse gas management is an important international issue. Efforts have been made in many parts of the world since the 1970s in order to reduce greenhouse gas emissions. Three mechanisms are addressed to reduce greenhouse gas emissions. The first is to give instructions to companies and individuals to change their behavior with regard to technology choices that result in pollution, the second is to subsidize businesses and individuals to invest in innovation and promote the use of cleaner goods and services. The third is setting a price on greenhouse gas to internalize externality costs (Zubair, 2013).

Carbon pricing -a market-based tool - can certainly affect behavior via market alerts and dispose the need for compulsory behavior- objectives setting a charge on carbon emission, in order that the expenses of climate affects and the opportunities for low-carbon energy options are higher pondered in our production and consumption choices. Putting a price on each unit of CO_2 generated provides a strong incentive for innovations to create new, cheaper and safer solutions. It also allows the government to generate revenue.

Carbon pricing can be provided directly by “carbon tax” or indirectly by “emission trading”. Both means lead producers and consumers to a low-carbon economic system by making fossil fuels with carbon content expensive (Anderson and Ekins, 2009).

Whether it is through carbon tax or emissions trading, setting a price on carbon will be an important signal for businesses and could shape their production processes accordingly. After carbon price implementation, those who are responsible for pollution can stop the activity. They may cut down completely or have to pay a certain price for the emissions they cause as long as the pollution continues. In this way, greenhouse gas reduction could be achieved with a flexible approach at a low cost. The price of carbon can also become a tool for low-carbon economic growth by triggering the transition to clean technologies and innovation (Anderson and Ekins, 2009).

Although it is accepted that putting a price on carbon will provide an effective and low cost way of greenhouse gas reduction, the practice of carbon tax and emission trade may have different consequences in practice. In carbon tax practice, while the cost of pollutants can be known, it is not known how much emission reduction could be achieved. In the emission trading practice, it is clearly known how much the amount of the emission will be limited, while the emission price will not be known as a result of this limitation.

2.3 ENVIRONMENTAL TAXES

One of the most important public instruments used to prevent environmental problems or internalize negative externalities is environmental taxes. In other words, environmental taxes eliminate the difference between private and social costs and add the cost of environmental damage to the cost of the polluter or the price of the product. According to the definition made by the working group formed by the European Commission, environmental taxes are defined as "*a tax whose tax base is a physical unit (or a proxy of it) of something that has a proven, specific negative impact on the environment*". According to this definition, possible targets of environmental tax include toxic gas and water emissions, energy products (used in transportation and other forms), transport (mileage, annual tax and sales taxes), waste water, agricultural inputs (fertilizer, pesticides), waste (general waste collection services and personal products such as batteries, tires, packaging materials), ozone-depleting products (CFC) and pollution (Ferhatoğlu, 2003).

Environmental taxes are defined by OECD as a tax imposed on the physical unit of scientifically proven production that has a negative impact on the environment (EU, 2013). Based on the definition of environmental taxes, in 1997 Eurostat, the European Commission's Directorate-General for Environment and the Directorate-General for Taxation and Customs Union, OECD and the International Energy

Agency (IEA) agreed on a list of environmental taxes. The tax base is determined in four main categories (Energy, Transportation, Pollution and Resources). The purpose of this list is to provide a framework on which taxes should be included in the category of environmental taxes (EU, 2013).

Energy taxes are taxes on all forms of energy, from electricity to nuclear energy, especially fossil fuels in almost all countries. Renewable energy sources are generally exempted (Jamali, 2007). Energy products for which tax is imposed are; "energy products for transportation, unleaded gasoline, leaded gasoline, diesel, other energy products for transportation (LPG, natural gas, kerosene or fuel oil), energy products used for fixed purposes, light fuel oil, heavy fuel oil, natural gas, biofuels, electricity consumption and production, district heat consumption and production, other energy products used for fixed consumption, greenhouse gases, carbon content of fuels greenhouse gas emissions (including revenues from emission permits recorded as taxes)" (EU, 2013).

Environmental taxes are the first application tool of the "polluter pays" principle (Çelikkaya, 2011). The objective of environmental taxes is to stop or reduce the use of hazardous substances and practices or to prevent the destruction of natural resources. If the tax-setting goal is well established, the tax adds a cost to the subject of payment. If a cost is added to a production within the boundaries of a country or state, it will have an impact on the competitive environment if such a cost is not added to the production in other countries or states in which the economic relationship exists. As a result, in countries or geographies where environmental standards are high environmental taxes can reduce pollution, however in geographies that are less concerned about environmental standards pollution may increase due to the competition (Sollund, 2007).

The use of energy taxes for environmental protection was first introduced in Northern European countries such as Denmark, Finland, Sweden and Norway. Thus, the pioneers of carbon taxes were Scandinavian countries. These countries introduced carbon taxes in the early 1990s (Ptak, 2010). By the year 2000, Finland's carbon emissions are 2-3% below the level required and 3-4% below Sweden, Norway and Iceland. During the 1990s, however, overall emission rates have risen. Even Denmark had a decline in absolute emissions relative to the 1990s among the Scandinavian countries. The reason of this is that the tax revenues in Denmark has been used for environmental and energy-saving programs (Soares, 2011).

Not all energy taxes are introduced for environmental purposes, but the main motivation for the introduction of some traditional energy taxes has been increasing tax revenue (Akkaya, 2004). Although such taxes arise as a result of the taxation of a number of polluting outputs after production such as some energy inputs, their main purpose is to generate income. These taxes, which aim to generate income, also have positive effects on the prevention of environmental pollution. Therefore, such taxes can be called secondary environmental taxes. Taxes aimed directly at preventing environmental pollution are called primary environmental taxes (Üstün, 2012). They can be shaped as taxes on goods rather than pollution taxes in order to provide ease of application (Akkaya, 2004).

2.4 CARBON TAX

2.4.1 Carbon Tax Approach And Hypothesis

Many approaches and hypotheses have been developed regarding environmental taxes. Pigovian Approach, Coase Theorem, Double Divident Hypothesis can be listed as the most important ones:

2.4.1.1 The Pigovian Approach

In 1920, Pigou argued that if the polluters pay an amount equal to the marginal social costs caused by pollutants, the externalities can be internalized by the markets (Nimubona and Desgagne, 2005). The impact of the Pigovian policy is to impose taxes on carbon emissions. This encourages individuals and companies to internalize carbon externalities when they decide how long to drive, how much electricity they will use, and the technologies of the power plants they will establish

(Mankiw, 2009). Theoretically, a Pigovian carbon tax is that the marginal damage caused by the emission generated at a level equivalent to one ton of CO_2 (Hsu, 2011).

In other words, the tax will increase or decrease in proportion to the marginal damage caused by each ton of CO_2 (Hayrullahoğlu, 2012). According to this approach, a company's marginal special costs can be reduced to a social bearable level by raising the taxes to be incurred by the marginal cost of society's loss. As long as taxes increase the cost of the production of pollutants to compensate social costs, companies will try to maximize their profits by reducing their activities to a social optimum level.

Pigovian taxation was started to be used as a tool in environmental policies around 1970s. According to this view; to prevent negative externalities, additional tax should be established for each unit of goods produced by the firm, which produces more than necessary and wastes economic resources (Bilgin and Orkunoğlu, 2010). Therefore, increasing tax increases the operating costs of the firm and leads to a decrease in negative externalities. In fact, it is not possible for the firm that cause negative externalities to sustain its activities without environmental tax (Milne and Andersen, 2009).

Carbon taxes are inspired by Pigovian taxes but they are not a perfect example of Pigovian taxes. Both Pigovian Taxes and carbon taxes aim to lead to behavioral change in favor of the environment and thus to internalize the negative externalities associated with the use of fossil fuels. However, there is a difference between these taxes. In theory, the optimal rate of the Pigovian tax equals to the marginal external cost, whilst carbon taxes do not cover all the external costs because of both associated estimation difficulties and public acceptability. Although the main intention of carbon taxes is to reduce greenhouse gas emissions by placing a price on carbon emission, current carbon taxes implemented in various countries are far from the required level in order to achieve the target set by the Paris Agreement owing to public acceptability. Half of the emissions priced at less than

US$10/tCO2e which is far below the required level (US$40-80/tCO2 by 2020) by the Paris Agreement (World Bank and Ecofys, 2018; Stern and Stiglitz, 2017).

2.4.1.2 Coase Theorem

Coase approached the problem of externality from a different perspective. If the property rights are full and the parties can negotiate without cost, then the parties can always find an effective solution for externalities. If there is no activity between the parties while distributing property rights, the parties will agree to redistribute the rights in order to ensure efficiency (Baştürk, 2014). The law may determine who will pay this cost, but the result will not change. Coase assumes that the conditions for the formation of competitive markets are met (Autor, 2004). According to Coase, the problems caused by externalities can be solved through the market. Coase argues that the problem of externality may arise from ordinary economic activities among market actors, and the negotiation method can be used to solve the problems and in finding the most effective solution (Baştürk, 2014).

Hurwicz, in a study conducted in 1995, showed that an additional assumption of “zero income effect” was required to obtain Coase's result. After this assumption of Hurwicz, we can express the Coase Theorem as follows: “Imagine an economy in which there is a commodity that creates externality. If transaction costs are negligibly low (zero) in this economy and there is no income effect, bargaining between the parties is provided if the property rights through an effective solution. This result is independent of how property rights are distributed.” (Hurwicz, 1995).

2.4.1.3 Double-Divident Hypothesis

The double- dividend hypothesis claims that social welfare improves more than competitiveness when environmental tax is applied. A second benefit of environmental taxes in addition to protecting the environment is that tax revenues are capable of compensating for the increase in the income due to other taxes paid by the obliged party. When governments use their pollution tax revenue to reduce other distortionary taxes, environmental taxes may result in a double dividend (Mireille and Mouez, 2002).

The claim of double-dividend was further extended by Bovenberg and De Mooij. From the public finance view, they pointed to the existence of a "tax interaction effect that could offset the income recycling effect of environmental taxes". The mechanism of tax interaction is that environmental taxation leads to an increase in commodity prices and a decrease in the real value of post-tax income. Since the income tax reduction provided by environmental taxes is too low to offset price increases, the net impact of environmental taxes is often claimed to be negative due to labor supply flexibility. According to the hypothesis of double-dividend, environmental taxes both reduce the tax burden on labor and cause a decrease in employers' social security shares and contribute to the decrease in unemployment in general. In addition, reducing the carbon emissions caused by global warming and climate change provides an important application advantage for countries (De Mooij and Bovenberg, 1998).

There are three types of hypothesis with weak, moderate and strong effects. Weak effective type of hypothesis; cost savings can be made if revenues from environmental taxes are used to reduce the marginal tax rate of a distorting tax. For example, lowering taxes on labor or social insurance premium costs. Moderately effective type; it is possible to neutralize the income of a carbon tax and the effects of a deflecting tax on income. For example, not to cause any loss of welfare through taxation (Alagandram, 2011). A strong form of the double dividend hypothesis is green tax reform. The Green Tax Reform will not only improve the environment, but can also be used as a tool to reduce the overall tax burden on the tax system, reduce poverty, and support employment and technological innovation (Schob, 2003). If consumers can choose between dirty and clean goods, if the environmental quality is very good and the labor market is open, i.e. there is no unemployment situation, the double dividend hypothesis may not work, but firms can choose between dirty and clean production factors, and if there is unemployment, the environment for the dual benefit effect is ready (Koskela et al., 1998).

2.4.2 Carbon Tax Definition

One of the basic policies that the government can use to reduce the emission volumes is taxation. While the main objective of environmental taxes is to protect nature or reduce pollution, the main objective of some environmental taxes is to generate income. Carbon taxes were initially designed without environmental intent but then had an impact on protecting the environment. There are two ways to directly implement a carbon tax. These are; environmental taxes where a part or all of their income is used for environmental purposes; and taxes that affect climate change targets in various aspects.

Carbon taxes are applied to fossil fuels to reduce greenhouse gas emissions including CO_2. Carbon taxes could be charged as sales and/or emission taxes, to reduce CO_2 emissions depending on the carbon content of the fossil fuel consumed. In the case of a carbon tax, the tax-generating event is triggered by activities exceeding the CO_2 ceiling limit set by the provisions of the relevant law. Carbon taxes price CO_2 and other greenhouse gas emissions and thus internalize some of the costs associated with their environmental impact. While all carbon taxes naturally fulfill this function, policy objectives may change. While carbon taxes primarily serve to reduce greenhouse gas emissions by putting costs on emissions, they can increase revenues or generate market signals to raise funds for carbon reduction programs. Issues to be considered in the policy design for the implementation of carbon taxes include determining the tax base, which sectors will be taxed, how the tax rate is determined, how tax revenues will be used, how the impact on consumers will be assessed, and how the tax achieves emission reduction targets (Summer et al., 2009).

A carbon tax to be applied should be directed towards reducing emissions during production rather than reducing output due to tax. A method to solve this problem is; rather than taxing the outputs, choosing a Pigovian style taxation method for each emission that occurs (Rosen and Gayer, 2008). A Pigovian type tax is applied on the producer's initial input cost. After tax, the cost of production increases and this increase puts pressure on the producer to reduce negative externalities. The purpose of a carbon tax is to internalize externalities. It implies that the final price of the commodity includes not only the initial price, but also the cost due to externalities. This is similar to the polluter pays principle. This principle gained an international character at the 1992 Rio summit. Those who simply cause environmental costs pay all the social costs incurred by their actions (Rosen and Gayer, 2008).

Carbon taxes can benefit beyond reducing greenhouse gas emissions. Even where the elasticities are low and the effects are relatively small, carbon taxes can bring other benefits. Such as, they internalize the social cost of emissions and increase revenue. In fact, where flexibility is low, more revenue is likely to be generated, as emissions levels remain fairly constant. This income can be used to reduce other taxes or to finance social and environmental programs. It also applies “the polluter pays” principle and can increase the efficiency of the tax system (Worldbank, 2017).

For the preparation of carbon tax laws, politicians must focus on a number of criteria. These criteria are;

- Deciding the tax subject and its bases,
- Which sectors will be taxed,
- At which level the tax rate will be established,
- How to use the revenues,
- Evaluating the consumer effect,
- How tax will ensure emission reduction objectives,
- What can be done about concerns about competitiveness and distributional effects,
- How to negotiate, conclude and record carbon tax agreements at the international level (Keen, De Mooij and Parry, 2012)

2.4.2.1 Subject and Base of Carbon Taxes

In order to apply carbon taxes, governments should decide which fuels or resources are taxed. Often, carbon taxes are imposed on gasoline, coal and natural gas. However, some governments exempt certain industries from carbon taxes or allow them to pay lower tax rates. Governments should also determine the upper and lower limits of taxes and decide whether they should be levied on carbon resources. Taxation of fuel resources can provide an administratively efficient tax collection method, while taxation of resources such as taxing consumer electricity from the lower limit can provide a more direct signal to consumers (Summer, Bird and Smith, 2009).

Tax base; is the economic value, physical measure or technical amount of the tax subject dealt with in order to calculate the tax liability.

According to the US Department of Finance's Tax Analysis Office report No. 115 published in 2017, the potential environmental tax base is divided into three categories;

- Fossil fuel emissions,
- Non-fuel emissions, (emissions from industrial production and product use, fluorinated gas emissions and other non-fuel emissions)
- Biomass fuels, such as ethanol (Horowitz, 2017)

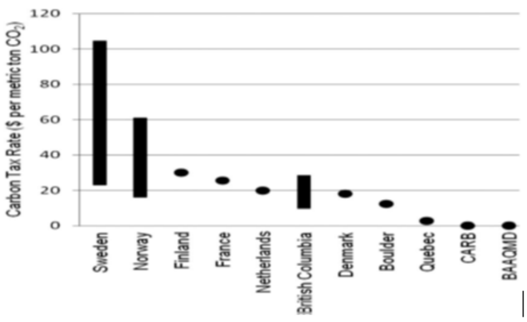
The tax base should be adjusted according to the amount of CO_2 contained in all greenhouse gases. As environmental hazards are due to the amount of carbon rather than the value of the burning fossil fuel, carbon taxes should be designed as specific taxes, not ad valorem taxes.[1]

[1] If the tax base is a physical measure or a technical amount, then the tax is called specific tax, if the tax base is determined on an economic value, then the ad valorem is a tax.

2.4.2.2 Tax Rates

The basic principles for determining the correct level of tax rates have been proposed by Pigou. The tax rate for any given emission level should be equal to the social marginal loss caused by the production of an additional unit of emission, or likewise to the marginal social benefit of one unit of carbon reduction.

Figure 2: Carbon Tax Rates



Source: Jenny Sumner, Lori Bird ve Hillary Smith, Carbon Taxes: A Review of Experience and Policy Design Considerations, Technical Report NREL/TP-6A2-47312December 2009, p.926

Carbon tax rates vary in their application ranges depending on their capacities. Higher carbon tax rates deliver buyers a stronger signal to alter behavior, whereas lower rates may not do much to alter buyer behavior, but they can subsidize carbon lessening programs. High carbon tax rates are observed in Europe. Standard tax rate in Sweden is equal to \$ 105 per ton of CO_2 where for industry, the rate is less than \$ 23 per ton of CO_2. Gasoline tax in Norway is \$ 62 and Finland's tax is \$ 30 per ton of CO_2. France's proposed tax rate is modeled after the cost pertinent to CO_2 allowances within the European Union's tax framework and is set at a value of around \$ 25 per ton of CO_2 (Summer, Bird and Smith, 2009).

Low-rate practice is seen in California. BAAQMD (Bay Area Air Quality Management District) has a tax rate of \$ 0.045 per ton of CO_2, it has explicitly designed taxes to increase revenue to support local greenhouse gas reduction programs, rather than encouraging behavior change. The proposed carbon tax rate is relatively low at $ 0.155 per metric ton of CO_2 and is designed to generate funds for greenhouse gas reduction programs (Summer, Bird and Smith, 2009).

2.4.2.3 Income Usage

The income from carbon taxes are managed in different ways; specifically managed in the form of carbon emission reduction programs, as deductions in income taxes for individuals, to be added to the State budget. The preference for income distribution provides political sustainability of the tax (Summer, Bird and Smith, 2009).

One of the important benefits of carbon taxes is the strong fiscal policy. If carbon taxes or regulatory restrictions raise the prices of goods, some problems arise due to pre-existing taxes on the same goods (Nordhaus, 2007**.** To solve these problems, it is the simplest method to use carbon tax revenues in order to reduce other taxes which have a disruptive effect on the economy. Income, salary and general consumption taxes reduce the participation of labor power. It also directs production towards the informal sector. Similarly, taxes on profits tend to economically reduce capital accumulation below the productive level (Keen, De Mooij and Parry, 2012). The rationale for this is the existing taxes or regulatory restrictions raise the prices of goods. The addition of new taxes or regulatory systems on existing taxes may lead to inefficiency or social losses. This double tax burden should be considered as a cost-effective aspect of global warming policy (Nordhaus, 2007). Using carbon tax revenues to prevent large-scale damages due to these costs benefits producers by providing incentives to increase working capital and accumulation (Keen, De Mooij and Parry, 2012).

In the event of a loss of income due to economic crises, carbon tax revenues will allow governments to put an end to the implementation of carbon tax and raise other taxes without the reaction of the society (Keen, De Mooij and Parry, 2012**.**

2.5 EMISSION TRADING SYSTEM

One of the legal tools available for policy makers to reduce greenhouse gas emissions is the emission trading system (ETS). It is based on the payment of greenhouse gas emissions to pollutants through the market mechanism.

This market-based approach allows regulators to reduce or control carbon. The ETS functions by limiting the total amount of carbon that can be released by the energy sector, by issuing allowances (certificates, permits representing a certain amount of carbon emission right), and allowing organizations to buy and sell these allowances. Allowances are created and allocated by a regulatory system and generally by Cap and Trade Regime.

Emission trading practice is based on the cap-and-trade system. The operation of the emission trading system can be explained in general terms as follows; the competent authority sets a reduction target for the emission amount and asks each enterprise in the selected sector to achieve the specified reduction by the end of the period by limiting the amount of greenhouse gas emitted by the selected sector. To this end, the regulator issues the right to pollute (emission permits) for the limited amount of emissions of each entity. Pollution rights form the basis of emissions trading. Each emission permits gives the plant the right to pollute a certain amount (a perm = 1 ton CO_2 emission permit). The relevant governmental organization distributes the exported emission permits (allowances) to the related entity at the beginning of the period by the total amount of emissions limited based on the unit account of 1 ton CO_2. Emission permits can be distributed free of charge to enterprises and each ton of permits can be given for a certain price. At the end of one year, the enterprises must deliver the emission permits with the maximum pollutant rights assigned to them. In summary, for every 1 ton of CO_2 emissions they emit into the atmosphere, they must deliver the permit corresponding to that amount to the relevant government agency.

However, the most important feature of this system is that companies have the right to buy and sell the emission permits distributed to them in the designated market. Enterprises that reduce emissions below the reduction target will be able to sell these pollution rights to enterprises that have exhausted their pollution rights. In terms of its features and functioning, emissions trading system can be seen as a policy tool strengthened by the market mechanism. This is because it is desirable to reduce emissions to a certain extent, such as performance-based standards. Achieving the determined reduction target is a necessity for businesses. However, in cases that it fails to meet its target, it achieves this reduction target by purchasing certified reduction units from those who achieve the target (Anderson and Ekins, 2009).

Carbon markets are formed by two different methods. The first method is programs that require compliance with mandatory rules. The second method is voluntary programs. Mandatory rules are created and regulated by national, regional and international systems. Programs that require complying with mandatory rules are generally Emission Trading (ET), Joint Implementation (JI), and Clean Development Mechanism (CDM) developed by the Kyoto protocol.

Emission trading transactions can be grouped under two main categories; emission allowances trade and project-based transactions. Project based processes are applied in the form of Carbon Offsets.

2.5.1 Transferable Emission Certificates

In this model, the pollution prevention method is considered to allow the use of pollutants in the specified amount. A certificate fee is charged to the total amount of emissions that occur, not to the amount of each emitted unit. These certificates can be purchased and sold. Since the total number of certificates can be controlled, pollutants and the resulting contamination can be controlled. In the implementation of emission permits, the responsible public authority sets a pollution limit and puts it on the market through these certificates, which entitles the right to pollute equal and divided shares to this level. These permits are distributed to companies in a way that corresponds to a certain amount of pollution. Requests for commercial permits are made according to the costs incurred by firms to improve the amount of pollution (Çiçek and Çiçek, 2012). If a firm's pollution reduction cost is less than or equal to the price of a commercial permit, it may prefer to bear the said improvement costs instead of obtaining a commercial permit. If the cost of pollution reduction remains more expensive than the emission certificates, then the firm is going to purchase the emission certificates (Jamali, 2007). In this context, the mechanism defined in the Kyoto Protocol as Cap and Trade Program.

2.5.1.1 Cap and Trade Program

This program uses market-based mechanisms to achieve greenhouse gas reduction. The Program set a limit on aggregated emissions and provide a limited number of allowences. The emission limit can be divided into emission allowences. Typically, an emission allowance represents one (metric) ton of CO_2 equivalent right. The institutions are obliged to receive allowance for each unit emission they generate, while at the same time they can trade the allowances among themselves. The system is implemented through stock exchange allowances to minimize the cost of affected resources. In the system, allowances or credits are given to companies showing how much pollution is allowed (Hoffman J., Hoffman M., 2008). Emission rights are shared between the institutions participating in the system. Sharing may be done free of charge, in which case rights may be assigned to institutions by the authority. Auctions can also be held for all or a certain percentage of rights. In this case, auction revenues are generally used in Research & Development or policy development financing to develop climate change adaptation or low carbon technology. In the following process, emission right holders monitor, verify and report their emissions (Atilla, 2013). If these companies use renewable resources, try to limit energy consumption and cause less pollution than the specified amount, credit surpluses will arise for this amount. These loans can be sold or deposited in banks. However, if a company exceeds the limit given to it, it must buy credit (Hoffman J., Hoffman M., 2008). If a company decreases its carbon emissions very costly, if another firm costs it less, the cheaper company can sell the permits to the other company for profit.

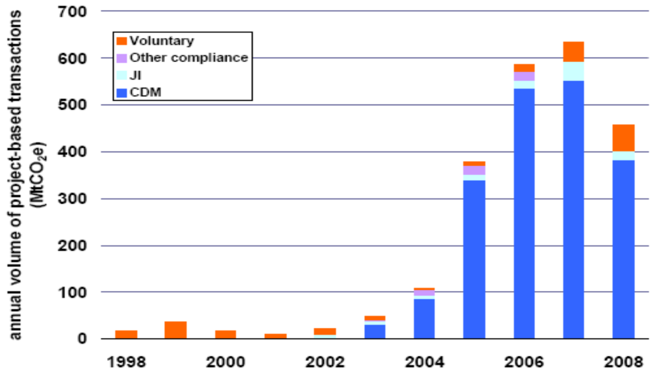
2.5.1.2 Renewable Energy Credits

Renewable energy certificates are named in many different ways such as Renewable Energy Credits (REC), Tradable Renewable Certificates (TRCS) and Green Tags. Traditional carbon emission trading programs develop low carbon consuming technologies by increasing the cost of carbon emitted, while the Renewable Energy Certificate (RECs) promotes carbonless renewable energy by providing production subsidies. 1 REC does not represent 1 ton of CO_2 like other credits. Instead, it is a unit that shows how much CO_2 is saved with a renewable energy technology developed. The REC represents 1 megawatt of electricity generated by renewable energy sources. RECs apply financial incentives to the energy sector to make renewable energy projects applicable worldwide.

2.5.2 Project Based Mechanisms

Kyoto Protocol defines the Project Based mechanisms as Joint Implementation (JI) and the Clean Development Mechanism (CDM). In the case of project-based transactions, the buyer supports the financing of a project and receives emission credits in return to ensure the reduction of greenhouse gas equal to the amount of excess emissions elsewhere, due to the excessive emissions it generates (Lecocq, 2005). There is no need to have a regulator in this system at all times, sometimes the buyer, the seller and a contract between them is sufficient.

Figure 3: Project-Based Emission Reductions Transactions (Annual Volumes of $MtCO_2e$)



Source: Capoor and Ambrosi (2009), p. 32, fig. 2

As it is supposed, it is a mechanism that can provide cheap, rapid carbon reduction. It is also ethical because they are applied according to the purchasing power of pollutants. Carbon offset programs, unlike the "Cap and Trade" system allocated by the government, can be bought and sold by auction, supports special projects developed for emission reduction, especially in forest areas (Newell, Boykoff and Boyd, 2012).

A carbon offset is a way to offset the emissions by supporting a CO_2 saving counterpart elsewhere (Carbon Footprint, 2019). Carbon offsetting programs are an application that collects voluntary donations from individuals or organizations engaged in carbon-producing activities and uses these donations to reduce the impact of carbon. Offsetting is the neutralization of greenhouse gas emitted in one place by preventing the same amount of greenhouse gas elsewhere, or by swallowing / trapping the same amount of greenhouse gas in the atmosphere (Öztürk, 2012).

2.5.2.1 Clean Development Mechanism

"The Clean Development Mechanism (CDM), defined in Article 12 of the Kyoto Protocol, allows a country with an emission-reduction or emission-limitation commitment to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one ton of CO_2, which can be counted towards meeting Kyoto targets" (UN, 2019). Since the beginning of 2006, for 2008-2012, the first commitment of the Kyoto Protocol, the mechanism has developed more than 1650 projects and has achieved a carbon emission reduction of more than 2.9 billion tons (UN, 2019).

The CDM is operating under the authority and guidance of the CMP[2] as well as the supervision of an executive board of the CDM (Article 12, para. 4, Kyoto Protocol). The CDM projects should be developed on the basis of voluntary participation of the parties involved; real, measurable and long-term benefits as for mitigation of climate change and additional emission reductions (Article 12, para. 5, Kyoto Protocol).

The CDM projects are mostly implemented in the sectors such as renewable energy, energy efficiency, methane reduction, coal mine/bed and fuel switch (Kamel, 2007). The CDM projects also provide finance for adaptation activities in the developing countries (Article 12, para. 8, Kyoto Protocol). In this respect, a levy, which amounts to 2% of the CERs issued from the CDM projects, is allocated to resources under the Adaptation Fund within the framework of the Kyoto Protocol in order to finance adaptation activities.

2.5.2.2 Joint Implementation

"The mechanism known as "joint implementation", defined in Article 6 of the Kyoto Protocol, allows a country with an emission reduction or limitation commitment under the Kyoto Protocol (Annex B Party) to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party, each equivalent to one ton of CO_2, which can be counted towards meeting its Kyoto target" (UNFCCC, 2019). The difference between the JI and the CDM is that it can only be implemented in Annex-B countries. A country in need

[2] Conference of Parties serving as the Meeting of Parties to the Kyoto Protocol

of emission credits supports emission reduction projects in another country. The host country earns a loan in proportion to the emission it reduces, and can sell this credit to the investor country. Each ERU is equal to one ton of CO_2 and can be exchanged or sold. The mechanism promotes sustainable growth and emission reduction by allowing developed countries the flexibility to set limits for emission reduction targets.

The Joint Implementation has two procedures for verification of the ERUs according to the eligibility requirements of the host country. According to the first procedure, “Track 1”, if a host party fulfills all eligibility requirements, it can test the JI projects and issuance of ERUs. According to the second one, “Track 2”, if a host party does not meet all eligibility requirements, its JI project has to be verified by the Joint Implementation Supervisory Committee (JISC) established during COP-11/CMP-1 in 2005 (UNFCCC, 2007). In 2005, parties agreed on the necessary requirements, only the projects starting as of 2000 may be eligible as JI projects and these projects may only generate ERUs after the beginning of the year 2008 (UNFCCC, 2007).

The JI projects have mostly concentrated in the CEITs, notably Russia, Bulgaria and Ukraine, owing to the lower investments costs in these countries to achieve emission targets. However, the JI has received much less attention than the other project-based mechanism, the CDM, partly because of its later crediting date and national institutional constraints (Karousakis, 2006).

2.5.2.3 Voluntary Carbon Markets

In order to minimize and offset the greenhouse emissions as a result of human activities, Voluntary Carbon Markets are designed for individuals, companies and NGOs on a voluntary basis. The systems in these markets are very close to those in the flexibility frameworks of the Kyoto Protocol. The main differences between the voluntary carbon markets and the implementation mechanisms of the Kyoto Protocol are that emission reductions are negotiated on a voluntary basis outside the framework of national commitments, independent of government policies and goals. There are no participation limits. Today, voluntary carbon trading is applicable in non-Kyoto countries and industries (Climate Volunteers, 2019).

Opened in 2003, the Chicago Climate Exchange (CCX) is the first global and comprehensive voluntary carbon trading market. It is possible to make carbon trading based on allocation and project, similarly, the Australian Climate Exchange (ACX) was opened in 2007 (Leonard, 2009).

2.5.3 The European Union Emissions Trading System

EU ETS is the first internationally applied emission trading system. All EU countries must comply with the rules set by the EU within the system. The Emissions Trading Program in the EU started in 2005 with Directive 2003/87 / EC. This Directive was amended in 2009 with Directive 2009/29 / EC.

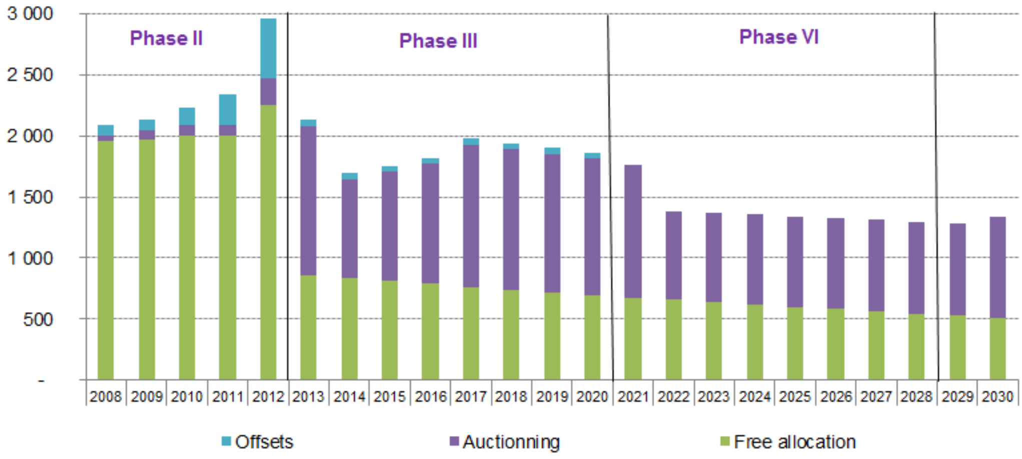
The primary objectives of EU ETS are reducing greenhouse gas emissions efficiently and efficiently in the balance of negotiated costs and environmental gains, and promoting cost-effectiveness of low-carbon corporate investments by creating a price signal that increases the economic value of energy efficiency, renewable energy and other low-carbon energy resources. Secondary objectives of the EU ETS are contributing to the EU's international commitments to support developing countries (e.g. implementation of the Clean Development Mechanism), and increasing the revenue that can provide support to low carbon technologies and energy efficiency programs with a part of it (Grubb, Hourcade and Neuhoff, 2014).

Since the EU ETS was introduced in 2005, three trading phases have been implemented. Throughout the initial phase, 2005 - 2007 period-, infrastructure practices have been the primary objective to carry out reliable surveillance, reporting and emission data verification activities. Therefore, there is no expectation of significant emission reductions in this period (Schade, 2014). However, in the first stage, in 2007, due to the over-allocation of free allowances, allocation prices fell to zero.

In the second trading phase (2008-2012) several changes were made to the community program to solve the initial problems and to provide a more effective ETS against climate change. Within this scope, allowance rules were changed, geographical coverage was expanded and Kyoto mechanisms were connected to the community program (Schade, 2014).

In the third trading period (2013-2020) the European Commission has decided to implement a harmonized distribution plan at EU level to increase transparency and reduce the complexity of many autonomous national distribution plans. EU allowances have been distributed centrally since 2013, applying a common maximum emission limit across the community. Moreover, the third period is the experience of shifting from free distribution to distribution of allowances by auction method. In this respect, it is recommended that at least 50% of the EU allowances be distributed by auction method (Schade, 2014). The third phase will end in 2020 and the fourth phase will continue until 2030. The EU ETS legislative framework for its next trading cycle (phase 4) was revised in early 2018 to allow it to meet the EU's emission reduction targets of 2030 in line with the climate and energy policy framework of 2030 and as part of the EU's commitment to the Paris Agreement of 2015 (EU Emissions Trading System, 2019).

Figure 4: EU ETS emissions cap and allocation by 2030



Source: CDC Climate Research, 2015. Based on the European Commission's 2030 proposals

The EU ETS has been introduced in 31 countries, in 28 EU member states as well as in Norway, Liechtenstein and Iceland (Schade, 2014). The EU-ETS covers 50% of CO_2 emissions and 45% of greenhouse gas emissions from more than 11,500 enterprises in the EU. Since 2013, in addition to CO_2 gas, Nitrous oxide (N_2O) and Perfluorocarbons have also been included (IETA, 2015). The amended EU ETS directive has expanded the scope of the sectors covered by oil refineries, steel works, iron production, aluminum, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acid and bulk organic chemicals. In the EU, Energy producing sectors are under the spotlight as they emit most (Holwerda, Woerdman and Roggenkamp, 2015). Since 2012, the aviation sector has been included. Energy plants with a capacity of more than 20 megawatts are included in the system (Nagy and Varga, 2009). Marine transport, land transport and household people are not included in the EU ETS. Instead, sanctions such as emission standards, direct regulations, taxation and labeling are applied to these sectors. Approximately half of the emissions emitted within the EU have been the subject of the EU ETS. This has made the EU ETS the largest multinational emissions trading system against climate change (Schade, 2014). Article 25 of the EU ETS clearly states that the program is open to other compulsory emission trading programs that are compliant (Schade, 2014). Final target to create a global carbon market by encouraging other major emission emitting countries, particularly the USA and China (Skjærseth and Eikeland, 2013).

Both a carbon tax and emission trading system are ultimately based on increasing the price for fossil fuels consumers - especially households - and reducing the amount of carbon emitted into the atmosphere. From these measures, we can group the market-based tools applied to reduce greenhouse gas into quantity-based and price-based mechanisms. Carbon taxes and emission trading system are totally both effective policies. Carbon taxes are "price based"; however emission trading system is “quantity-based” policy instruments. Taxes aim to achieve a balance by taxing the marginal external cost of emissions, while commercial permits (pollution certificates) aim to balance by reducing the total amount of carbon emissions. The main difference between emission trading system and taxes is that taxes impose a price on pollution; emission trading system tries to keep the amount of pollution under control. In the emissions trading system, the government determines the amount of emissions and allows the market to set the price. There is a price uncertainty. Potential price fluctuations are based on initial allowance or the amount of eligible allowances. In carbon tax, price is defined at the beginning, price with is fixed for a certain time. However, in carbon tax the amount of emission reduction is uncertain. In emission trading system the emission amount is limited and the total amount of emissions to be reduced is constant. While carbon tax aims to achieve a balance by taxing the marginal cost created by emissions, emission trading system aims to achieve balance by reducing the total amount of carbon emissions.

CHAPTER 3

Carbon pricing has faced with strong public opposition although it is a key element of climate policy and considered by many countries. The possible contributions of carbon taxes such as “clarity of the price signal, the ease of implementation and the generation and use of revenues for distributional purposes” (Baranzini et al., 2000) are straightforward. However, carbon taxes are not always welcomed by the public due to several reasons such as doubts about their effectiveness, public perceptions on the fairness of carbon pricing, their impact on competitiveness and distributional effect.

3.1 IMPACT ON COMPETITIVENESS

Competitiveness of a national economy, or a sector or a firm affects their marketing power and sales in national and international markets. In fact, competition can be traced more precisely at the firm level. Competitiveness in national and international markets depends on the cost structure of their products and their market share. Therefore, when examining the effects on competition, it is also necessary to examine the structure of firms. Competitiveness at firm level is influenced by numerous micro factors such as cost, quality, differentiation, punctuality in service, innovation and inventions, and many macro factors such as exchange rate, trade regime, public policies, economic and political stability.

A carbon tax directly affects the cost structure, which is one of the micro determinants of competition. This change in the cost structure can have an impact on the competitiveness of the firm. This effect may occur if competing firms are faced with different cost levels due to the application of carbon taxes. Firms react differently when there is an increase in costs due to a tax. Some firms may reflect the increased costs to consumers through the price mechanism if the market structure is favorable; or if they have the possibility of substitution, they may substitute inputs with other inputs with low carbon content or avoid taxation by shifting production to other countries that implement “social dumping” i.e., pollution havens (Zhang and Baranzini, 2004). A carbon tax that can significantly increase production costs can encourage companies wishing to avoid these costs with new technologies and production methods that reduce CO_2 emissions. Some companies may gain competitive advantage due to the carbon tax, while others loosing. These competition losses are more explicit in the short run. However, competitive advantage could be regained by replacing capital in to carbon efficient production factors in the long term and lowering the costs.

It is clear from the above description that a carbon tax will bring a cost increase. However, the researchers found the effect of carbon tax on competition is very small. Moreover, Grossman and Krueger (1994) concluded that the loss of competitiveness caused by a carbon tax was insignificant. The findings of a study on energy consumption in 1997 show that the potential for such results to increase dynamic efficiency is weak; roughly, the cost of a $ 100 carbon tax per ton of carbon in energy-intensive sectors is only 2% of the total production costs. Even if such an additional cost arising from a carbon tax does not increase dynamic efficiency, it can be effective for energy-intensive (oil refining, aluminum, cement, etc.) national-multinational companies to shift their investment and production activities to pollution havens. Due to the high share of general economic conditions and environmental costs in new investment costs, companies whose competitiveness decreases either continue their activities with a low capacity or transfer their investments abroad. Furthermore, according to the survey conducted by Baranzini and Carattini, individuals may not be worried about the issues of competition, customers having different preferences than companies; individuals may not anticipate the effects of competitiveness to be sufficiently large to become a real problem that makes sense in the light of Sceia's et al. [3] modeling (2012).

The fact that carbon taxes become the most important instrument in fulfilling the emission obligations of the Kyoto Protocol, the pressure on countries applying social dumping to reduce emission levels in the fight against global climate change

3 Rather minimal impacts on Switzerland in terms of trade while simulating the influence of unilateral changes towards stricter climate policy.

and homogeneous investment conditions at global level will increase the potential effects of carbon taxes on competitiveness.

In addition, in recent years, countries have begun to discuss carbon tax more frequently and even some countries apply this tax, which may lead to carbon tariffs to protect competition. Countries that are not implementing carbon tax will not be able to benefit from the environment friendly investments that are induced by carbon taxes. In addition, their exports will face additional tariffs in the countries that are implementing carbon taxes. Consequently, they will lose their superiority in competition in the medium and long term.

3.2 DISTRIBUTIONAL CONCERN

The introduction of a new tax increases the overall tax burden on the economy. However, if the revenues of the new tax can be used to reduce other taxes, this will result in a redistribution of the tax burden. If the revenue of a new tax is used to reduce the tax on the production factor which was previously over-taxed, this change will reduce the negative impact of the tax system on efficiency (De Mooij and Bovenberg, 1998).

The idea that the cost of a carbon tax will be on low-income families is the justification for opposing carbon taxes in most developing countries. The share of expenditure on fuel decreases with income. Therefore, it is stated that carbon tax will adversely affect income distribution. Low-income families in the UK spend 13.2% of their income, whereas the high income families spend 3.5% of their income on fuel (Poterba, 1993). Proops et al. (2001) found that as a result of their study in England, France, Italy and Spain; a carbon tax of 0.1 Euro per kilogram of carbon emissions had a damaging effect on income distribution in France and Spain. However, Creedy and Sleeman (2005) found that carbon tax did not create a negative effect on income distribution and thus welfare. According to Zhang and Baranzini (2004), this distributional effect of carbon tax is quite weak. The main reasons are the number of sectors and products affected by carbon taxes is not many, these taxes do not have a significant share in environmental taxes and the main share belongs to the fuel taxes (gasoline, diesel etc.) in tax revenues received from energy. According to the survey done by Baranzini and Carattini in 2016, only a minority (25%) was worried about the distributional effects of the carbon tax on rural households, due to the limited scope for substitution between private and public transport in rural areas. (Baranzini and Carattini, 2016).

However, although the direct impact of carbon tax on income distribution is considered to be negative, the indirect effects should be taken into account. Because, taxes directly increases energy prices and it also indirectly increases the prices of other goods depending on the share of energy in costs in areas where taxed energy is used as input. This mitigates the carbon taxes' disruptive effect on income distribution. In addition, evaluating the impact of carbon taxes in terms of continuous income rather than current income will ensure healthier results. In fact, assuming that energy tax is completely transferred to consumers, it is seen in a study conducted for the USA that when the indirect effect of the tax is taken into consideration with continuous income, the regressive effect of an energy tax such as carbon tax is reduced and even the tax is neutral in terms of income distribution (Sterner, 2012).

Even if environmental taxes have a disruptive effect on income distribution, it is possible to mitigate this negative effect with measures to be taken. In Netherlands, there is no tax on 800 cubic meters of natural gas consumption and 800 kW of electricity consumption per year. Due to the fact that this exception amount is not set too high, it is seen that the tax imposed to reduce energy consumption does not move away from the efficiency target (Speck and Ekins, 2000).

Income distribution will also be affected by the use of revenue generated by carbon taxes. This revenue can be used to reduce the rates of existing taxes, as well as to finance transfer expenditures for low income. If tax rates are considered to be reduced, which tax or tax rates will be reduced will be important for income distribution. Naturally, the revenue of carbon taxes can be directly assessed in reducing other taxes, aiming to alleviate or eliminate the negative impact of these taxes on income distribution.

It can be said that the inclusion of carbon taxes in the tax system mainly affects low income households. Therefore, the revenue provided by carbon taxes can be used for the purpose of partially or completely offset the negative impact of these taxes on income distribution. In this case, it may be conceivable to increase the transfer expenditures primarily for low income households. The second option is tax cuts that will favor especially low-income households.

There is no doubt that the policy of increasing transfer expenditures towards low income households will have a positive regressive effect. However, the short-term impact of environmental tax-based tax reforms on income distribution, which does not alter the total tax revenue, including tax reductions in existing taxes or taxes, is positive. In addition, it should be noted that there is the possibility of an additional positive impact on real wages and employment in the long run (Ian, Heine and Norregaard, 2012).

In addition to the fact that a carbon tax, which is an environmental tax, imposes a heavier tax on households, which are composed of a large number of individuals and have low income and consequently low expenditures. It can be said that households with limited or no access to public transport face a horizontal justice problem. In this context, the question of whether the status of the households affected by the environmental tax can be compensated with the changes in taxes on other goods in a way that does not change the total tax revenue in case of increasing the rate of existing environmental taxes or introducing a new environmental tax, is important in terms of environmental policy and social welfare.

Concerning this issue, the results of the study of the impact of increasing the rates of CO_2 tax applied in Sweden on the social welfare of a tax reform package including changes for other indirect taxes in a way that does not change the total tax revenue should be examined. In this study, the value added tax rates on foodstuffs and the tax on electricity consumption were reduced. On the other hand, by increasing the value-added tax rates on goods and services other than foodstuffs, it was concluded that increasing the carbon tax would compensate for the negative impact on income distribution and increase social welfare (Akkaya, 2017).

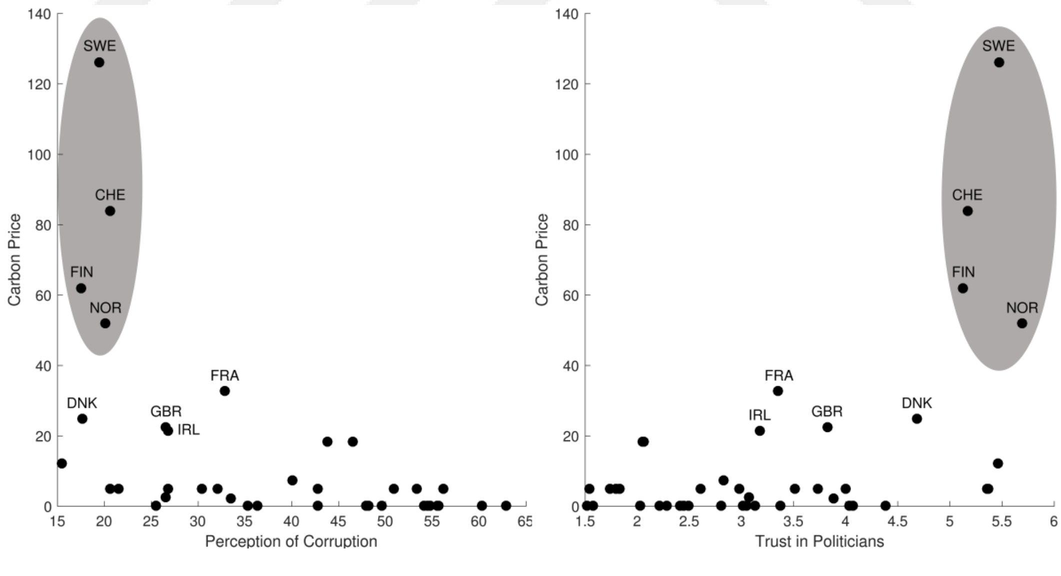
The negative effects of carbon taxes on income distribution lead to a decrease in the public support needed for the implementation of these taxes. If carbon taxes for the prevention of climate change and sustainable development are to be used effectively in the future, it is necessary to reduce the effects of the taxes on income distribution against the poor during the design of these taxes. Two different methods can be applied to achieve this goal (Zhang and Baranzini, 2004). The first method is to exclude the energy required to meet basic needs (heating, enlightenment, cooking) and to increase the taxation of energy consumption above this level. The second method is the redistribution of the obtained carbon tax revenues in a way that the poor will benefit the most. However, the introduction of this method conflicts with the aim of increasing the efficiency of the tax system by substituting the carbon tax for high deflective taxes and may have negative effects on macro-economic variables such as inflation and employment.

3.3 PUBLIC DISTRUST

Climate policies have been undermined by lack of public trust to politicians and percevied corruption (Hammar et al., 2006), (Baranzini, et al., 2014), (Rafaty, 2017). As shown in Figure 5, relatively high-trust and low-corruption are the only countries with a carbon price over \$40/tCO_2. Due to the lack of confidence in politicians and fiscal authorities, people are often skeptical of government intentions. The public believes the prime motivation for a carbon tax is to increase government revenues rather than reducing greenhouse gases (Klok et al., 2006).

A Clinch and Dunne (2006) analysis on Ireland revealed a lack of confidence in the government's ability to implement an environmental tax reform. However, the lack of information on carbon pricing received by the government motivated the distrust of German respondents. Nine reports, referring to the lack of confidence to government in terms of use of carbon pricing revenues, revealed a lack of confidence that the government would keep its commitments about use of tax revenues (e.g. reduction of labor taxes) or guarantee income neutrality. (see e.g. Beuermann and Santarius, 2006; (Hsu, Walters and Purgas, 2008). This is a matter of trust at its core. Trust issues often affect the specific environmental tax proposal being discussed, but they may also be wider, linked to people's general view of tax policy or even faith in the government itself ((Baranzini and Carattini, 2017); (Beuermann and Santarius, 2006); (Dietz, Dan and Shwom, 2007); (Hammar and Jagers, 2006). Empirical studies indicate that, if the use of revenue is specifically defined, public acceptance of a carbon tax increases. The public has no trust in politicians to make good use of revenue, if not explicitly allocated or redirected back to the population.

Figure 5: Carbon prices, corruption and trust (2012)

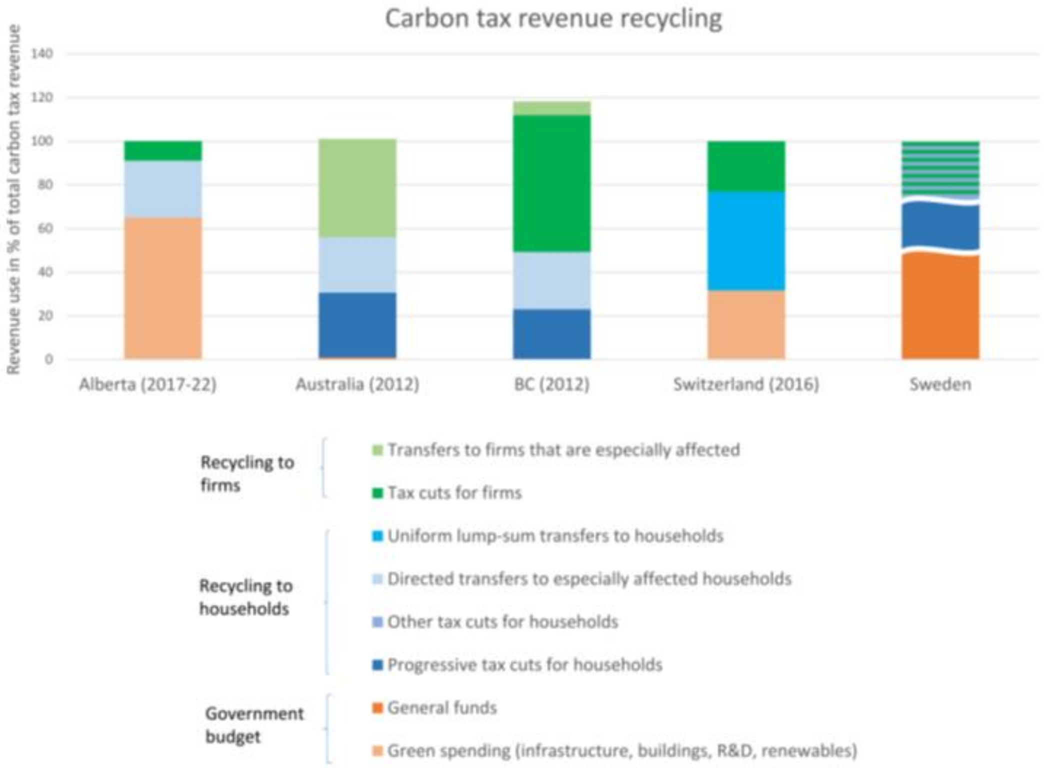


Source: Carbon price data from OECD (2016), corruption perception data from Standaert (2015), and trust data from Schwab (2012).

In the above graph, carbon prices were plotted against public perceptions of corruption and levels of government trust in selected countries. (Bilgin and Orkunoğlu, 2010). Based on OECD (2016) carbon price data, Standaert (2015) perception of corruption and Schwab confidence data (2012). Countries illustrated in grey surpass $40/tCO2 in energy prices.

The revenues from carbon taxes are managed in different ways: managed in the form of carbon reduction programs, managed as deductions in other taxes for revenue-neutral outcome, managed as redistribution to achieve a fairer (less fiscally regressive) outcome. Figure 6 demonstrates how in selected real-world schemes carbon revenues are recycled. All the recycling schemes studied return a share of income to both households and businesses, either in the form of dividends or tax cuts, or as a combination of both. In addition, some areas use green spending on carbon revenues - including green technology R&D, renewable energy grants, or public spending on building energy efficiency upgrades.

Figure 6: Real world revenue recycling



Source: AB (2016), BC (2016), Beck et al. (2015), Carl and Fedor (2016), FOEN (2017), Jotzo (2012).

Figure 6 shows the comparison of the five carbon tax schemes revenue-recycling choices. Remember that British Columbia has committed extra spending, irrespective of the revenue that has been received. Therefore the spending exceeds 100 %. Sweden recycles about half of its revenue by tax cuts on labor income and other tax cuts; the other half is allocated to the general budget. Nevertheless, there is no direct link between tax cuts and income streams, so the revenue shares shown are only a rough approximation (Carl and Fedor, 2016).

Selecting the allocation of taxes guarantees the political sustainability of taxes. Among these three recycling methods for revenue; the most favoured was to distribute energy tax revenue to support more emissions cuts, followed by social cushioning initiatives. The least preferred alternative for recycling tax revenue was revenue-neutral methods of redistribution. Income from carbon pricing should be distributed to mitigate more grounds for political distrust, and preferably to strengthen government confidence. In countries with low levels of political faith, a carbon tax may be more acceptable if the majority or all of the taxes is distributed to people as standardized lump-sum payments. Such a strategy would be particularly prominent for the average household and could strengthen policy responsiveness expectations.

In order to mitigate the negative distributional effects of carbon tax, many approaches have been put forward. Firstly, compensation by lump-sum payments is incremental, since fixed compensation sums account for a larger proportion of low-income household income. Since the share of energy is higher in the budgets of low-income households, the overall effect of carbon taxes with lump-sum transfers is progressive. In other words, government compensation can surpass the cost increase. A carbon tax with lump-sum transfers can achieve a revenue-neutral form if all the revenues are returned back.

Second, social cushioning is meant to be egalitarian by offering a higher amount of tax revenue for lower-income households, for example through a particularly generous income tax refund or targeted lump sum transfers. Table 1 demonstrates additional ways of constructing carbon taxes to make the results inclusive and hence more socially acceptable.

Thirdly, cutting other taxes and securing full or partial revenue neutrality in this way. However, this strategy is the least popular one and public have a resistance toward this strategy because generally speaking, the public is disconcerted by the prospect of using environmental tax revenue for something detrimental to the environment.

Table 1: Progressive Carbon Tax Design Modalities

Differentiated tax rates	• Threshold taxes: Consumption of carbon below a certain level is exempt from a carbon tax, which, in practice, is equivalent to redistributing part of the revenues through lump-sum transfers (e.g., if the threshold is 4 tons of CO_2 and the price is \$40/tCO_2, \$160 would be redistributed to make the first 4 tons "free")
Revenue recycling	• Lump-sum transfers, distributed across households in equal shares (per capita) • Lump-sum transfers, distributed across eligible households, with eligibility depending on, for example, household income (e.g., Alberta, Canada, provides lump-sum transfers only to households below a given income threshold) • Lump-sum transfers whose amount is defined based on equivalence scales (e.g., Alberta gives less weight to children or the second adult when redistributing revenues across eligible households) • Subsidies/grants for low-carbon technologies, with eligibility restricted to low-income households • Subsidies for low-carbon options that low-income households are more likely to use (e.g., public transport)
Other social cushioning measures	• Subsidies to compensate low-income households (paid through general budget), not necessarily tied to low-carbon consumption (e.g., food stamps)

3.4 PERCEPTION

Perceptions on environmental inefficiency has been the key bottleneck for the public acceptability of carbon taxes. Not only does the expectation of major environmental impacts influence acceptance, but also understanding of future co-benefits affects. Carbon taxes are not seen as an efficient way of discouraging high-carbon behavior by public. People are skeptical that taxation on its own will greatly change behavior. Such skepticism can underlie the conclusion that people believe that tax revenues should be used to improve emission reductions by allocating it to specific environmental projects. (Baranzini, Caliskan and Carattini, 2014). When funds are used for anything other than environmental reasons, the government will lose its legitimacy with regard to how urgent addressing climate change is.

Dresner et al. (2006) first raised the issue of perceived environmental inefficiency on the basis of qualitative assessments: Public opinion undermines the incentive impact of carbon taxes and therefore expect the use of tax revenues for environmental purposes. Otherwise, most feel that carbon taxes are simply for raising tax revenue. If tax revenue is earmarked for other reasons, the general public is usually disconcerted about the prospect of using environmental tax revenue for non-environmental purposes. This problem is defined by Sælen and Kallbekken (2011) as ‘‘issue-linkage’’. The use of tax revenue to offset excess emission reassures voters that the tax will be successful and that the environmental target will be achieved ((Baranzini and Carattini, 2017); (Kallbekken, Kroll and Cherry, 2011); (Sælen and Kallbekken, 2011)).

There is a public perception that the personal cost of a tax would be too high. People has a tendency to overestimate the cost of an environment tax, and underestimate the benefits. They are also likely to ignore the indirect costs of subsidies that are most likely to be funded either through higher income taxes or higher electricity bills (Jagers and Hammar, 2009); (Kallbekken and Aasen, 2010). The social psychology literature also suggests that people favor subsidies because they are considered to be less coercive than taxes. Taxes are "pushed" onto polluters, which imposes compulsory costs, while subsidies are seen as "pull" steps that are meant to encourage climate sensitive behavior. (de Groot and Schuitema, 2012); (Rosentrater et al., 2012); (Steg et al., 2006).

Environmental taxes are perceived as "penalties" or coercive measures that enforce behavioral change by the most (Steg et al., 2006). A hypothetical carbon tax was introduced in the survey (Baranzini and Carattini, 2017) at a cost of 120 CHF per ton of CO2, suggesting a price increase of about 15% of gasoline and about 30 % of heating fuel. Although the majority of respondents anticipate that the tax will reduce their energy consumption, considerable number of them (37 %) stated that this will not change their consumption behavior. Even a minor group of respondents (7 %) expects an increase in their consumption. (Baranzini and Carattini, 2016). The questionnaire extends the scope in the same survey and asks whether people expect the tax to be successful, i.e. if it would lead to a reduction in Switzerland's energy consumption and greenhouse gas emissions. A small majority (52%) believe that the tax will not be effective. Pigovian taxes are therefore viewed as oppressive and inefficient at the same time (Steg et al. 2006). This may lead to Pigovian taxes becoming more common if not classified as such: a “fee” is preferred to an equivalent instrument called “tax” in the laboratory experiment of Kallbekken et al. (2011).

With choice experiments, the effect of tax levels on acceptability can be calculated fairly accurately. For example, with a survey of 2,400 Swedish people, Brännlund and Persson (2012) studied the acceptability of carbon taxes. Gevrek and Uyduranoğlu (2015) surveyed 1,252 people from 16 Turkish cities on their carbon tax attitude. All of these studies found that a tax proposal's acceptability declines with the personal costs that it would place on respondents in the study.

Another tax proposal which is rejected by 92% of voters in 2015 was reviewed by Carattini et al. (2017). The proposal included a tax exchange in which a new energy tax on non-renewable energy would have created the same revenue as value-added tax that would have completely disappeared. The complete replacement of the value-added tax and the requirement to keep taxes stable over time would have meant a high and rising rate of taxation. This issue, and its consequences for the effects of distribution and competition, contributed to the major rejection in the vote, along with other factors addressed in the paper. Carattini et al. (2017)

conducted a second survey, a choice experiment with a representative sample of 1,200 Swiss citizens, to examine how alternative tax designs could have done in a ballot. The researchers found that the tax's acceptability decreases almost linearly as tax rates increase. Researchers also found that people with low levels of concern about climate change had a higher sensitivity to tax rates, while those with more concern about climate change paid less attention to price levels.

As people become more familiar with the measure and are better able to see its costs and benefits, public opposition to high tax rates can be changed. Hensher and Li (2013) conducted a survey in London, several cities in Norway, and Sweden on the acceptability of congestion charges. Citizens voted in a referendum in Sweden after they try a charge of congestion. The study shows that the congestion charge would have been opposed by a large proportion of survey participants in these cities prior to its implementation. Many of them, however, changed their minds once they saw the tax's efficacy in reducing road use and felt the value of reduced congestion (see also Börjesson et al., (2012); Eliasson and Jonsson, (2011); Odeck and Bråthen, (2002); Schuitema et al., (2010); Winslott-Hiselius et al., (2009)). Participants have discovered that the perceived charging costs were lower than expected and not higher than the personal and social benefits (Schuitema et al., 2010).

Carbon pricing's most discussed personal effect is that it may mean higher energy costs and less purchasing power. In 13 studies, this effect has been identified. For example, Carattini et al. (2017) found that a commonly used claim by Switzerland's carbon tax opponents was that higher carbon tax rates would increase the consumer price of energy. Kaplowitz and McCright (2015) respondents pointed to socioeconomic limitations faced by people, such as the lack of alternatives to driving as one reason against a gasoline tax that would produce unreasonable additional spending. Six of these studies highlighted purchasing power reduction. For example, many Swiss respondents (67 percent of a survey of 338 people) in Baranzini and Carattini (2017) were worried about a decrease in consumption and purchasing power due to a carbon tax being introduced. Five reports have listed the loss of jobs as a potential impact of carbon pricing. Irish and UK people participating in focus groups conducted by Clinch et al. (2006) claimed that implementing an environmental tax reform could result in job losses in their country. As a consequence of carbon pricing instruments, four studies identified a concern for less comfort and well-being. Beuermann and Santarius (2006) indicated that German respondents were concerned about the impact of an environmental tax reform on their daily lives, particularly in terms of preserving their living standards as a result of higher fuel prices. Four studies show that carbon pricing restricts “freedom of choice”. For example, Owen et al., (2008) found that some UK participants in focus groups were very reluctant to impose limits on individual carbon emissions.

Government influence on the people’s lifestyle and consumption has been a public concern. The idea of “voluntary behavior punished rather than appreciated” is mentioned in these studies. This result is due to “motivational crowding out” which implies the weakening of the inherent motivations of people with carbon pricing and limiting their voluntary efforts to reduce carbon emissions. (Frey and Jegen, 2001). This impact is related to expectations of justice in the way that some people feel they are disproportionately “punished” by a carbon tax because they have already undertook voluntary “climate action” (e.g. Baranzini, et al., 2014). That is, they would have to incur additional costs due to the tax, irrespective of whether voluntary climate action has already been taken.

CHAPTER 4

Many energy and carbon taxes have been applied in Denmark, Netherlands, Norway, Finland and Sweden as means of reducing carbon emissions. The general characteristics of carbon tax applications in these countries can be summarized as follows (Baron, 1997).

- No policy encompasses all carbon emissions in a completely homogeneous way.
- Exemptions have been granted to energy intensive industries or to sectors that are sensitive to international competition.
- Carbon / energy taxes have sometimes been replaced by other taxes on energy to minimize fiscal pressure while providing a correct signal in reducing carbon emissions.
- Differences between energy users are not taken into account in achieving emission targets in homogeneous taxes. However, countries rely on carbon taxes as a policy because the differences between users are taken into consideration in carbon tax.
- Carbon taxes are often used as a part of general fiscal reforms used to solve structural financial problems such as employment and distortionary taxes on capital.
- These taxes are often applied gradually to save time for adaptation and to avoid negative effects such as price shocks. It is regulated according to inflation in order to keep tax rates constant.

The difficulty that each country faces due to the tax package makes it difficult to compare it with one another. The countries are economically different from each other in terms of production and consumption, therefore each country has to design this tax in a different way. In this context, the common features of the carbon tax imposed by Denmark, Finland, Norway, the Netherlands and Sweden are summarized above. The specific properties of these carbon taxes are discussed in more detail below.

4.1 DENMARK

In the late 1980s, the Danish Environment Agency pursued environmental taxation while unemployment was high. In order to reduce unemployment, the government reached a consensus on increasing environmental taxes on household energy consumption, increasing income and reducing other taxes. Thus, the carbon tax on coal, oil, natural gas and electricity was introduced as 13.48 euros per carbon ton (Clinch and Gooch, 2006). In this context, the introduction of the carbon tax in Denmark for the first time was not a result of environmental purposes but a result of other socioeconomic problems.

The tax was imposed first on household consumption in June 1992 and a year later, in June 1993 tax was imposed on companies. 50% of the tax imposed on companies has been refunded. In addition, additional tax reductions have been made in companies with high energy sensitivity (DEPA, 1999).

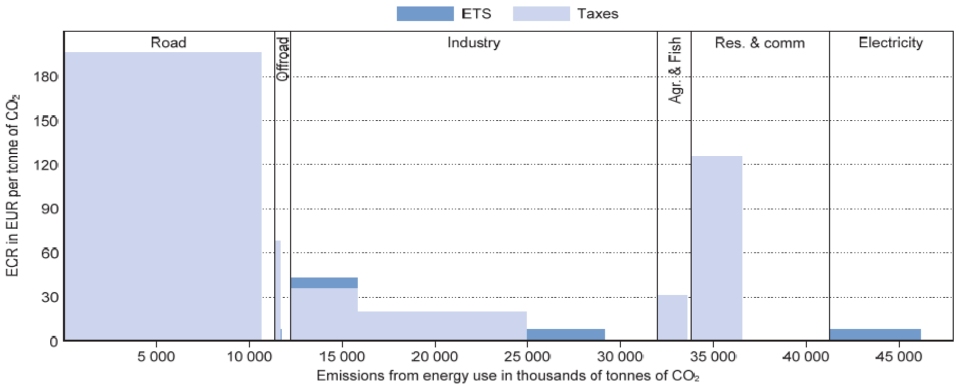
Although the carbon tax was first introduced due to high unemployment, its main objectives were to reduce carbon emissions until 2005 by 20% compared to 1988 levels, and to reduce carbon emissions from 61.1 million tons to 48.9 million tons. This tax leads to a decrease in energy-intensive production and is seen as an incentive tax due to the development of clean and renewable energy resources (DEPA, 1999). While the tax revenue is intended to be used separately from other tax items and to be returned to the taxpayers, this income was used in the general budget (Clinch and Gooch, 2006).

In 1995, the tax was adopted fully on household consumption and energy use in the industrial sector. The tax on the industrial sector was increased and extended to cover other users. Since 1995, only the changes that do not affect the costs have been applied and all revenues have been returned to the trade and industrial sector. In addition, exemptions are granted to fuels used in air and sea transport and in the production of electricity and gas (DEPA, 1999).

Instead of the carbon tax on fossil fuels used in electricity generation, the tax on electricity output was introduced in KWh to maintain competitiveness in Denmark. Moreover, the tax imposed on the output was beneficial for the re-funding of exports. The rates adopted were applied at the same rate in order to maintain the tax competition on electricity generated by liquid fossil fuels and the tax on electricity generated by using coal. In this context, while designing the carbon tax, Denmark has taken into consideration the possible negative effects on competition. No tax was imposed on electricity generation based on natural gas and renewable energy sources, and these were funded in a combined way with the carbon tax obtained (DEPA, 1999).

Tax rates were differentiated according to industry and trade sectors. Carbon tax was differentiated according to the use for heating purposes or the use of fossil fuels in intensive or light production processes (DEPA, 1999). This differentiation is shown in Figure 7. Accordingly, the highest tax per ton between 1995 and 2000 was derived from the use of fossil fuels in heating. The main reason for this is that when the taxes in the industrial sector were raised, the sector would lose its competitive advantage and the competitiveness in the international markets would be weakened. For these reasons, the carbon tax was basically differentiated in 3 parts. The first was the higher taxation of the use of fossil fuels for heating in homes and workplaces. Secondly and thirdly, it was formed by separating the production processes as "light" and "intensive" processes. The production stage, which was described as an "intensive" process, describes the stage in which fossil fuels were used intensively as in the heavy metal industry. The stage, which was described as a "light" process, was the process in which fossil fuels were used less during production.

Figure 7: Denmark effective carbon rate averages by sector and component (2015)



Source: OECD, Supplement to Effective Carbon Rates 2018

Companies were required to have the necessary equipment to monitor their energy use in three categories (heating, intensive process and light process). In order to accomplish this, the incentives they need before the rise of taxes had been provided to them.

Carbon agreements were one part of the carbon emission measures. Voluntary firms had an agreement with the Energy Agency for energy saving. Under this agreement, companies can obtain subsidies from the Agency as a result of the measures they will take. Consequently, the level of carbon tax was lower (DEPA, 1999). For competition, some countries combined taxes or pricing with agreements. The sector may agree with the government that it would voluntarily take the necessary measures to reduce carbon, so that it could be tax exempt or pay reduced tax.

As a result of these initiatives, it was determined that the carbon emission calculated in 1997 was 6% lower than the 1988 level. Although a reduction was achieved, further reduction of the carbon emissions envisaged. Although the carbon tax was 100 Danish krone per ton, the Danish Environmental Protection Agency has stated that a higher tax was required for effective carbon taxation (DEPA 1999).

Table 2: CO_2 Emission Tax & ETS, Denmark

	CO_2 emissions by sector (in t CO_2)	Tax		ETS		Overlap of tax and ETS[5]	Emissions not priced by tax or ETS
		Average price (in EUR/tCO_2)	Share of emissions priced	Average price (in EUR/tCO_2)	Share of emissions priced		
Agriculture & Fishing	2 121	128.7	71%	7.2	2%	2%	28%
Electricity	6 697	104.6	100%	7.2	77%	77%	0%
Industry	20 707	50.4	18%	7.2	40%	8%	51%
Offroad transport	917	162.6	85%	7.2	10%	8%	14%
Residential & Commercial	7 375	153.8	43%	7.2	0%	0%	57%
Road transport	11 136	202.4	94%	0.0	0%	0%	6%
Total[4]	**48 952**	**77.9**	**54%**	**2.0**	**28%**	**14%**	**33%**

Source: OECD, Effective Carbon Rates (2016)

Environment related tax revenues of Netherlands in its GDP is the highest among the OECD and partner countries. It was around 3.97% of GDP in 2014, where OECD average was 2.0% (OECD, 2015).

4.2 FINLAND

The carbon tax was first introduced in 1990 to slow down the increase in energy consumption and reduce its harmful effects. Although Finland was responsible for 0.3% of world emissions, it was the first country to apply the carbon tax. These taxes included fuels such as gasoline and diesel and other energy sources (oil, coal, natural gas and electricity, etc.) used in transportation. In 2001, 55% of Finland's total environmental tax revenues came from this tax (Hiltunen, 2004).

In the first year of the carbon tax, 7 marks (1.2 €) were introduced per ton of carbon. In 1993, this tax was raised to 14 marks (€ 2.4) and applied to 15 marks per megawatt of electricity per hour (Chinch and Gooch, 2006). The structure of taxation had been changed since the beginning of 1995 and the tax had been started by being charged according to energy content and also differentiated for fossil fuels according to their carbon content. In the same period, 40% of the taxes collected according to energy and carbon content were collected from energy, and the

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[4] Tax and ETS can apply to the same emissions base. The overlap describes the percentage of emissions in a sector that is priced by both tax and ETS.
[5] Total average prices are weighted by the share of emissions in each sector that is priced in the country.

remaining 60% were collected from fossil fuels because of the CO_2 content (Hiltunen, 2004).

In 1997, the carbon tax was replaced by a general tax on electricity consumption. One reason for this change in the tax structure was the opening of the Scandinavian electricity market and the development of the electricity stock exchange. Before 1997, Finnish energy taxes were targeting energy production by comparing them with production targets in other Scandinavian countries. This situation weakened Finland's competitiveness in electricity production and this tax structure was perceived as an attack on EU regulations (Hiltunen, 2004).

This tax applied by Finland to electricity in energy production had different levels for industry and households. This tax also was applied to fossil fuel use. In this context, a tax was levied on the usage of fuels in heating by differentiating it according to carbon contents. This tax was introduced to compensate for the loss of efficiency in environmental policy due to the tax exemption in electricity generation (Hiltunen, 2004)

Scandinavian countries had granted various privileges to the manufacturing industry since carbon tax was brought to fossil fuels, which would increase the costs of the industry and reduce its competitiveness. Although it was originally in other Scandinavian countries, Finland had not provided a separation or privilege in the application of carbon tax to the industrial sector. However, the system was changed in 1997 due to differences with the European Union. The main reason for this is that a Finnish mining company importing electricity from Sweden has applied to the European Parliament. The mining company was exempted from the import tax by a decision of the European Court. Against this decision, the Finnish Government has raised the import tax to a higher level than the national electricity tax and reduced taxes on some national electricity generation (EEA, 2000). In addition, coal and natural gas used as raw materials and intermediate goods in the manufacturing industry were exempted from this tax.

The increase in energy consumption in the Scandinavian countries in 2003 and the limited hydro energy generation increased electricity production demand. More oil and coal were used for this production. Due to this increase in fossil fuel use in 2003, greenhouse gas emissions were 85.6 million tons of CO_2. This amount was 15 million tons more than the amount specified by Finland in the Kyoto Protocol (Statistics Finland and Ministry of the Environment, 2005).

According to the survey conducted by the Finnish Prime Ministry, it was stated that if tax instruments were not used to reduce carbon emissions in 1998, the emission would have been 7% higher (Clinch and Gooch, 2006). Hilden et al. (2002) stated that taxes do not have a direct impact on the environmental purpose, rather they are aimed at generating income with indirect purpose. However, the main reasons why carbon tax cannot directly fulfill its environmental purpose are the exemptions and low tax rate in the industrial sector (Clinch and Gooch, 2006).

Environment related tax revenues of Netherlands in its GDP is 7th highest among the OECD and partner countries. It was around 2.85% of GDP in 2014, where OECD average was 2.0% (OECD, 2015).

Table 3: CO_2 Emission Tax & ETS, Finland

	CO_2 emissions by sector (in t CO_2)	Tax		ETS		Overlap of tax and ETS[5]	Emissions not priced by tax or ETS
		Average price (in EUR/tCO_2)	Share of emissions priced	Average price (in EUR/tCO_2)	Share of emissions priced		
Agriculture & Fishing	2 234	19.2	69%	7.2	1%	1%	31%
Electricity	12 320	37.6	100%	7.2	66%	66%	0%
Industry	52 741	63.8	27%	7.2	35%	13%	51%
Offroad transport	814	237.6	40%	7.2	24%	10%	46%
Residential & Commercial	10 170	59.2	30%	7.2	0%	0%	70%
Road transport	11 749	216.1	100%	0.0	0%	0%	0%
Total[4]	**90 027**	**46.7**	**48%**	**2.1**	**30%**	**17%**	**39%**

Source: OECD, Effective Carbon Rates (2016)

4.3 SWEDEN

CO_2 gas accounts for approximately 80% of Swedish greenhouse gas emissions. In this context, the Swedish energy tax system was reformed in 1991. According to this reform, carbon and energy taxes were imposed on fuel. However, these taxes were not applied according to the carbon content of fuels. In other words, the carbon tax introduced in the first stage was not expected to have an impact on CO_2 emissions.

Existing energy taxes had been reduced by 50 % after the introduction of carbon tax. With this new system, the industrial sector was exempted from energy taxes and 50 % exempted from the newly introduced carbon tax. In 1993, the 50 % exemption applied to the industrial sector was increased to 75 %, in other words, the 50 % rate in which the industrial sector is responsible for carbon tax has been reduced to 25 %. However, in 1997, this rate was raised back to 50 % (Clinch and Gooch, 2006).

Sweden's main objective in introducing this tax was to reduce CO_2 emissions. In addition, to bring this tax to the industrial sector to encourage new investments. This tax was imposed on petroleum, coal and natural gas as specific tax. With this tax introduced in 1993, the industrial sector load was kept low. At the same time, general energy taxes were abolished with the introduction of this tax. However, this tax had been increased in other sectors (EEA, 2000).

The carbon tax introduced in 1991 was applied at 250 Sweden Krona/ ton CO_2 in the first stage for the industrial sector and other sectors. However, a transition period was envisioned for energy-based industries until 1995. The industrial sector paid less carbon tax, as the government reduced tax to 80 Swedish Krona per ton for the industrial sector. However, after the end of this transition period in 1996, the carbon tax per ton was raised to 160 Swedish Krona. In mid-1997, this rate was low, resulting in a significant increase in energy consumption. Due to this increase in energy consumption, the carbon tax on the industrial sector was increased by 50 %.

In 1995, 11 billion Swedish kroner income was obtained from the carbon tax and in 1994, 5 million tons of CO_2 emission was reduced. In addition, in 1994, the Swedish Ministry of Environment and Natural Resources shifted from fossil fuel consumption to plant-based fuels as a result of the carbon tax (EEA, 1996). According to a study conducted by the Ministry of Environment, CO_2 emissions would have been 15 % higher in 1995 if there was no carbon tax, and in 2000, in the absence of tax, the emission amount would have been 20-25 % higher (Johansson, 2000).

According to Johansson (2000), the most important progress is the development in the production and market of biofuels. The main reason for this is the increase in the costs of the companies due to the carbon tax introduced and as a result they started to look for cleaner energy sources. Firms have directed to vegetable-containing fuels (bio fuels), which are less pollutant when burned. The increase in demand for biofuels and innovations in biofuel production have improved the production methods and market of biofuels. At the same time, despite the development of this market, there has been no increase in the prices of bio fuels.

Table 4: CO_2 Emission Tax & ETS, Sweden

	CO_2 emissions by sector (in t CO_2)	Tax		ETS		Overlap of tax and ETS[5]	Emissions not priced by tax or ETS
		Average price (in EUR/tCO_2)	Share of emissions priced	Average price (in EUR/tCO_2)	Share of emissions priced		
Agriculture & Fishing	1 501	77.4	33%	0.0	0%	0%	67%
Electricity	5 246	193.1	100%	7.2	24%	24%	0%
Industry	60 176	62.2	24%	7.2	23%	14%	67%
Offroad transport	719	112.4	10%	7.2	68%	7%	29%
Residential & Commercial	7 484	159.4	21%	7.2	0%	0%	79%
Road transport	21 241	226.6	91%	0.0	0%	0%	9%
Total[4]	**96 367**	**68.3**	**42%**	**1.2**	**16%**	**10%**	**51%**

Source: OECD, Effective Carbon Rates (2016)

Environment related tax revenues of Sweden in its GDP is 16^{th} highest among the OECD and partner countries. It was around 2.2 of GDP in 2014, where OECD average was 2.0 % (OECD, 2015).

4.4 NORWAY

The carbon tax was introduced in Norway in early 1991 to reduce CO_2 emissions. First, this tax was imposed on gasoline at $ 40.1 per ton of CO_2 emissions. 65 % of Norwegian CO_2 emissions were subject to this tax (Hoerner and Bosquet, 2001). Although this tax was imposed on gasoline at first, the same tax was imposed on petroleum products, coal and natural gas.

However, some sectors have been exempted from this tax on the grounds that it will create cost increases in some sectors affected by international competition and thus loss of power in international trade. The most important of these sectors are international freight transport, international shipping and fishing sectors in the North Sea. In addition, some sectors such as national air transport, paper and pulp, shore transportation and trade in the continent have benefited from this exemption. In 1999, the highest tax was imposed on gasoline. It is predicted that in order to be effective, a gradually increasing tax according to the carbon content should be applied and in this way, efficiency can be achieved and CO_2 emissions can be reduced. However, the carbon tax amounts in the Table 5 indicate that the tax is not intended to reduce emissions, but rather is intended to generate significant income from the most consumed product.

Table 5: CO_2 Tax Rates in Norway (in NOK, as of January 1999)

	Tax per metric ton CO_2
Gasoline	397
Petroleum products	
-Light oil	174
-Heavy oil	148
-North Sea supply fleet	100
-Coastal goods transport	100
-Pulp and paper industry	87/74
-Fish meal industry	87/74
Coal	189
Coke	144
Oil burned on continental shelf	336
Gas burned on continental shelf	381

Source: Hoerner, 2001

Despite Norway's implementation of the carbon tax, the environmental tax reform undertaken in 1992 has not been implemented as intended. They achieved to implement this reform in the 1998-1999 period. Basically, as the core of the reform that, the Norwegian government wanted to implement a revenue neutral environmental tax. In other words, it was aimed to reduce the income tax collected from persons with the income obtained from environmental taxes. In this context, in 1999, income tax revenue reduced 790 million (€ 89 million) Norwegian Kroner and it was covered with the revenue from environmental taxes. Thus, the carbon tax did not create an income effect, but was transferred only on the activities that create negative externalities. With this application, the use of carbon tax has been expanded (Hoerner, 2001). In addition, the impact of this tax on household energy consumption was very small. Because less than 10 % of fossil fuels are used in household consumption of gas and oil (EEA, 1996).

In the early 1990s, when the Norwegian government introduced a carbon tax, it reduced CO_2 emissions. However, as a result of the pressures of large industrial lobbies, the level of this tax had been kept low on sectors that use large amounts of fossil fuels. Therefore, the decrease in total CO_2 emissions was prevented in 1998 due to the increase in the carbon emissions of transportation and metal industry. From 1990 to 1999, there was an 18 % increase in CO_2 emissions due to these exemptions (Statistics Norway, 1999).

In 2002, 2.5 % reduction in greenhouse gas emissions was achieved. However, despite this decrease, the amount of greenhouse gas emissions remained 6 % above the 1990 level of the Kyoto protocol (Statistics Norway, 2004). In addition, it is committed that there will be no more than 1 % greenhouse gas increase between 2008 and 2012 (Statistics Norway, 2004).

Table 6: CO_2 Emission Tax & ETS, Norway

	CO_2 emissions by sector (in t CO_2)	Tax		ETS		Overlap of tax and ETS[5]	Emissions not priced by tax or ETS
		Average price (in EUR/tCO_2)	Share of emissions priced	Average price (in EUR/tCO_2)	Share of emissions priced		
Agriculture & Fishing	2 043	78.4	98%	0.0	0%	0%	2%
Electricity	332	1344.4	100%	7.2	58%	58%	0%
Industry	21 116	53.7	54%	7.2	83%	54%	16%
Offroad transport	3 865	20.7	69%	7.2	30%	21%	22%
Residential & Commercial	4 508	77.5	23%	7.2	0%	0%	77%
Road transport	9 912	240.3	100%	0.0	0%	0%	0%
Total[4]	**41 776**	**89.2**	**65%**	**3.3**	**45%**	**30%**	**19%**

Source: OECD, Effective Carbon Rates (2016)

Environment related tax revenues of Norway in its GDP is 19th highest among the OECD and partner countries. It was around 2.06 % of GDP in 2014, where OECD average was 2.0 % (OECD, 2015).

4.5 NETHERLANDS

In the Dutch tax system, there are four types of taxes on energy and carbon. These are; general fuel pricing, energy regulatory tax, excise tax and strategic oil storage tax (Hoerner and Bosquet, 2001). Of these taxes, the general fuel pricing system was first introduced in 1988. This application was introduced as part of the financing system of environmental policy expenditures. Therefore, the revenues obtained from this instrument are allocated by the Ministry of Environment for environmental expenditures. The application introduced in 1992 as a pricing system has been transformed into a tax and its field of application has been expanded. At the same time, with this transformation, the revenues obtained were transferred to the general tax revenues rather than to the Ministry of Environment. Thus, the control of this tax has been transferred from the Ministry of Environment to the Ministry of Finance.

The subject of general fuel tax was all fossil fuels. However, fossil fuels used as raw materials were exempted from this tax. Tax rates are applied to 50/50 carbon and energy content. Electricity was not taxed under general fuel tax. However, fuels used in electricity generation were taxed. The right to choose between these ratios was recognized for energy intensive industrial sectors. These sectors have chosen the most suitable and least costly ones. This practice continued until January 1997 (Dutch Ministry of Housing, 2007). In January 1997, the benefit was revoked. In addition, nuclear power has been taxed at the rate of NLG 31.95 per gram of uranium-235 under the general fuel tax since 1997.

The administrative tax on energy was the first tax that did not increase total budget revenue in the Netherlands. The project was designed as revenue-neutral, with tax funds recycled in several forms for businesses and households. Corporate recycling occurred by reducing the rate of social security contributions from workers by 0.19 percent, increasing the tax allowance for self-employed by NLG 1,300, and lowering the corporate profit tax rate by 3 percent on the first NLG 100,000 of earnings.

Household recycling has been achieved by decreasing the personal income tax rate by 0.6 %, increasing the regular income tax-free allowance and increasing the tax-free allowance for older citizens (Vermeend and Vaart, 1998).

Table 7: CO_2 Emission Tax & ETS, Netherlands

	CO_2 emissions by sector (in t CO_2)	Tax		ETS		Overlap of tax and ETS[5]	Emissions not priced by tax or ETS
		Average price (in EUR/tCO_2)	Share of emissions priced	Average price (in EUR/tCO_2)	Share of emissions priced		
Agriculture & Fishing	6 907	33.7	97%	7.2	17%	17%	3%
Electricity	37 085	91.3	100%	7.2	91%	91%	0%
Industry	59 632	44.2	46%	7.2	53%	22%	23%
Offroad transport	748	99.5	85%	7.2	16%	14%	13%
Residential & Commercial	31 003	68.6	95%	7.2	1%	1%	5%
Road transport	33 015	225.1	100%	0.0	0%	0%	0%
Total[4]	**168 392**	**85.1**	**80%**	**2.9**	**40%**	**29%**	**9%**

Source: OECD, Effective Carbon Rates (2016)

Environment related tax revenues of Netherlands in its GDP is 11th highest among the OECD and partner countries. It was around 2.37 % of GDP in 2014, where OECD average was 2.0 %. (OECD, 2015).

CONCLUSION

Global warming and climate change are undeniable facts. Their harm to human life is one of the greatest dangers in the world. The largest share of greenhouse gases that cause global warming belongs to CO_2, and it constitutes 80% of total greenhouse gases.

The level of CO_2 in the Earth's atmosphere increases daily, threatens the ecosystems to which all living things depend and climate change. Therefore, rapid decreases in CO_2 emissions are required all around the world to prevent extreme climate change, the occurrence of severe weather events, the emergence of drought in some regions, the inundation of coastal areas, the emergence and spread of many diseases, forced migration, political upheavals and international conflict.

To date, various measures have been considered to protect the environment, but none has been effective fully in protecting the environment. Therefore, environmental taxes, which are one of the most effective ways to protect and improve the environment, to prevent the destruction of natural resources and to reduce environmental pollution, have been utilized. Emission taxes have a higher share in environmental taxes and could be easily applied to discourage use of pollutants such as greenhouse gases, solid and hazardous wastes. One of the most effective economic instruments is carbon taxes, which are included in the emission taxes and are used to reduce the CO_2 emission intensity in the atmosphere.

The most important reason for using and recommending a carbon tax is that it is a market-based tax. In other words, a carbon tax affects prices and increases the costs of using fossil fuels that cause CO_2 emission through price mechanism, so encourages individuals to use less fossil fuels and find new energy sources. Therefore, it ensures the internalization of negative externalities emitted by the CO_2 emission generated by the use of fossil fuels.

However, in addition to the advantages of the carbon tax system being economically efficient, easily applicable, simple, clear and transparent, there are also some criticisms about public applicability due it is new, unjust and regressive tax. However, it is known that these disadvantages of carbon tax do not affect the applicability of such a tax, and that it can be turned into an advantage with effective policies and methods put by countries. Carbon taxation is effective in reducing greenhouse gas emissions. Thus improving the public acceptance of environmental taxes is important.

The major cause of social resistance to carbon tax is “public perception”. These taxes also constitute a significant percentage of the price reflected to the final consumer. However, carbon taxes lead to the belief that governments use climate change as an excuse in order to collect more taxes. In fact, taxes against climate change are not financial taxes, but they aim to reflect external costs into the price mechanism. Carbon taxes are excise taxes and have a regressive nature, as they do not fully reflect the taxpayers' solvency. In other words, low-income taxpayers feel the tax burden more. The regressive structure of tax could be addressed through design. Different tariffs can be created for different income groups to protect low-income groups from the regressive structure of the tax. It is important to remember that climate change will affect low-income people more. The important thing is how to use the income from the tax. As long as tax revenues provide funds for projects to protect the environment, low-income people will be indirectly affected by the tax application.

In general, the public discussions tend to concentrate on the negative impacts of a carbon tax on competition and distribution. However, individuals are also concerned about the environmental effectiveness of a carbon tax. Consequently, public perceptions on the environmental impact of a tax and expectation of local co-benefits are key to acceptance. Public opinion almost ignores the impacts on competition and tend to concern for the distributional issues predominantly, surprisingly with little impact on the acceptability.

Earmarking is effective on environmental purposes and could increase acceptability. When allocation is not specified, peoples distrust to government tend to decrease the approvals to carbon taxes. Since most people perceives environmental taxes as a means for government to raise more money, they may only give away some of their income if the use of tax revenues is clearly defined. Since the tax is viewed as environmentally ineffective, the only way to affect the environment is by allocating the tax revenue to the environment.

Therefore, earmarking of carbon tax revenues for environmental purposes increases the public acceptability of a carbon tax. For instance when the revenues are used to improve public transit, the acceptability of congestion charges and fuel taxes will increase.

Tax resistance could decrease when it is constructed in alignment with the preferences of the society. Results that are much more effective could be achieved if certain targets for environmental quality are set and the tax rate (optimal tax) is based on these objectives. The contribution of this tax to the low income and the economy would increase in the medium and long term. The duty of the government is to remove asymmetric information between society and the government. If tax revenue provides resources for environmental projects, society's tax support may increase.

To improve acceptability, communicating the primary and side benefits of carbon taxes appears to be necessary. It, in addition to earmarking, could be very effective in minimizing objections related to government distrust. In this context, one of the ways to recycle tax revenue to increase the acceptability is to prioritize environmental expenditures. In the same way, tagging as “climate contribution” rather than “carbon tax” may be beneficial in terms of public acceptability.

In the recent decades, the overall public concerns about the corruption and efficiency of the public system tend to increase more. The decreasing engagement and increasing mistrust in political mechanisms are more observed at the nation level. One of the factors affecting public acceptability of a carbon tax would be the overall trust in the political system, which is also a sign of the overall legitimacy.

Given the concerns about the corruption, efficiency and the mistrust to and decreasing legitimacy of the political systems carbon tax might function better at environments where the taxpayers can have grater benefit and influence, such as local investment programs or municipal taxes.

In order to increase public acceptability of a carbon tax, it can be recommended that:

- Revenues from carbon taxes may be applied in the form of reductions in personal income taxes. Thus, justice could be improved in income distribution and the regressive effect of carbon taxes could be eliminated.
- A number of exemptions may initially be introduced to encourage manufacturers to use fuels that contain little or no carbon. However, these should only be for the purpose of adaptation and promotion and should be applied for a certain period of time.
- Carbon tax returns can be used to support investments to clean technologies to compensate the damage of environmental pollutants. Thus, renewable energy sources can gain great importance and environmental innovations can be given priority. When applied in these ways, consumers' perception of carbon tax may be more optimistic.
- The first time a carbon tax is introduced, low rates should be applied, allowing time for the tax to be accepted.
- High-income families consume more than low-income families and are therefore responsible for more greenhouse gas emissions. However, low-income families have less to save and therefore have to spend most of their income on energy and fossil fuels. Therefore, low-income families are more likely to be affected by a carbon tax than high-income families. Carbon tax revenues can be used to support low-income families and offset the tax. Thus, the regressive property of the carbon tax may be eliminated.

- Carbon taxes could be implemented at the municipal level, which could increase the public acceptability because the taxpayers may directly benefit more from the expenditures financed by the carbon tax.

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