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Climate Change Training Module Series 9

MACROECONOMIC APPROACH TO CLIMATE CRISIS

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MACROECONOMIC APPROACH TO CLIMATE CRISIS

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MACROECONOMIC APPROACH TO CLIMATE CRISIS

CONTENT

ABBREVIATIONS

EU	European Union
USA	United States of America
ADB	Asian Development Bank
AIIB	Asian Infrastructure Investment Bank
R&D	Research and Development
UNFCCC	United Nations Framework Convention on Climate Change
CaT	Cap and Trade
CCR	Cost Containment Reserve
CDM	Clean Development Mechanism
CH_4	Methane
CIF	Climate Investments Fund
CO_2	Carbondioxide
CO_2e	Carbondioxide equivalent
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
EBRD	European Bank for Reconstruction and Development
EDAM	Economy and Foreign Policy Research Center
EEA	European Economic Area
EFTA	European Free Trade Association
EPA	Environmental Protection Agency
GCF	Green Climate Fund
GEF	Global Environment Facility
ETS	Emission Trading System
GO	Guarantees of Origin
GDP	Gross Domestic Product
HFC	Hydrofluorocarbon
I-REC	International Renewable Energy Certificate
ICAO	International Civil Aviation Organization
ICAP	International Carbon Action Partnership
IETA	International Emission Trade Association
ILO	International Labor Organization
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change

IsDB	Islamic Development Bank
MRV	Monitoring, Reporting, Verification
MRVA	Monitoring, Reporting, Verification, Accreditation
ITMO	Internationally Transferred Mitigation Outcomes
JI	Joint Implementation
LDCF	Least Developed Countries Fund
MW	Megawatt
NAPA	National Adaptation Programmes of Action
N_2O	Nitrous oxide
NO_3	Nitrate
NZ	New Zealand
OECD	Organisation for Economic Co-operation and Development
PFC	Perfluorocarbon
PMR	Partnership for Market Readiness
REC	Renewable Energy Certificate
RGGI	Regional Greenhouse Gas Initiative
SCCF	Special Climate Change Fund
SCF	Standing Finance Committee
SF_6	Sulfur hexafluoride
SGER	Specified Gas Emitters Regulation
TARSİM	Agricultural Insurances Pool
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Credits
VER	Verified Emission Reduction

EXECUTIVE SUMMARY

Intergovernmental Panel on Climate Change (IPCC), in its *1.5 Degrees, Climate Change, Land, Ocean and Cryosphere Special Reports* published in 2018 and 1029, indicated that the effects of climate change are increasing faster than usual. It is observed that almost every effect examined in these reports creates an intense stress on global economy. So much so that sophisticated economic modeling studies show that in case required steps are not taken in combating climate change, a decrease of 11% may be seen in global gross domestic product at the end of the 21st century.

Natural disasters such as hurricanes, drought, floods and overflows caused by climate change whose numbers increase every year, cost billions of dollars of economic loss in global extent. While problems encountered in sectors such as health, agriculture and energy sectors that are affected most by this loss prevent access to basic vital necessities in many developing countries, they cause interruptions in daily services in some developing countries, that are perceived as routine. All these economic impacts that have accelerated in recent years show that there is no winner of climate change and economies at all levels of development will be affected form the devastating effects of the climate crisis in the short or long term.

One of the ways to effectively combat the climate crisis that has devastating effects on global economy is to develop rational, innovative and solution-oriented economic strategies, policies and various economic instruments. Different macroeconomic approaches are being developed in this field aimed at the solution of the climate crisis at intergovernmental and supragovernmental levels and with the participation of the private sector.
The said macroeconomic approaches are divided in two groups as;

I. Results-based finance, and
II. Market-based options.

Considering that the economic cost of achieving the goals set forth in Paris Climate Agreement would reach 16.5 billion dollars in the next 15 years, it is clear that the results-based finance options in combating climate crisis must be exercised very carefully. So much so that only 463 billion dollars of the global gross domestic product being mobilized for global climate finance as of 2015 shows that results-based options need to be developed for combating climate change at macroeconomic level. In this context, financial combating resources founded by United Nations and Multi-lateral Development Banks to provide this development such as Green Climate Fund, Least Developed Countries Fund, Adaptation Fund and Climate Investments Fund are increasing their capacities every passing day.

Market-based options, which are powerful instruments of combating climate change, draw attention with the radical results they promise about carbon emission reduction and cash flow they provide for global climate finance. Carbon pricing instruments, whose first practices were applied in Scandinavian countries, are seen as one of the most powerful tools of the global climate change combat that facilitate transition of communities to low carbon life styles, whose numbers area ever increasing every day.

So much so that developments such as emphasizing by authorities such as International Monetary Fund (IMF), IPCC and Organization for Economic Co-operation and Development (OECD) that carbon pricing practices must be strengthened and

extended and that Nobel Economy Prize being rewarded to the climate change and macroeconomy relation are of the nature that reminds how important are carbon pricing mechanisms in present day climate change policies.

Considering target groups, institutional requirements and desired radical climate outcomes the strategies, methods and tools used in combating climate crisis must be designed and applied very carefully. In this context, economy models were developed that aim at executing sustainable development programs such as Green Economy and Low Carbon Economy, that have the feature of providing a framework for coordination of combating climate crisis. These models are important regarding the drawing of general outlines of the activities that will be conducted with tools such as results-based finance and market-based options.

Within the framework of the assessments given above, the global climate finance elements are compiled in this training model together with country policies in this field including Turkey; works of Asst. Prof. Dr. *Sevil Acar Aytekin, Ramazan Oğuz Tosun* and *Dr. Nuran Talu* were utilized in reporting the issues related with economic cost and macroeconomic reflections of climate change, economic models and market-based options.

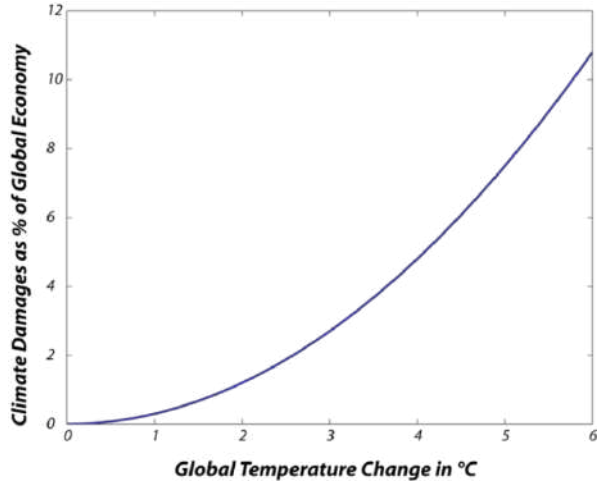

ONE DOLLAR
UNITED STATES OF AMERICA
In God We Trust
LIBERTY
1899
E PLURIBUS UNUM
ONE DOLLAR
ONE CENT
UNITED STATES OF AMERICA

1. ECONOMIC COST AND MACROECONOMIC REFLECTIONS OF CLIMATE CRISIS

Combating climate crisis has been included in global and national policies and action plans as an executive power up to now, mainly due to the environmental damages it causes. However, sophisticated economic models made throughout the years showed that the climate change is one of the biggest threats of the age for global economy with the stress it creates on different sectors and with the devastating effects of the disasters it causes. So much so that scientific studies foresee that as a result of increasing temperatures the Arctic Ocean in 2030 will melt completely and this may lead to significant change of the trade routes in the world.[1]

Economic aspects of the climate crisis were discussed comprehensively for the first time in the Second Assessment Report published by Intergovernmental Panel on Climate Change (IPCC) in 1995. In this report, which drew attention to the fact that climate crisis causes cumulative net losses for the global economy, underlined that approximately 30% of the greenhouse gas emissions of the period could be reduced with negative or zero cost. However, failing to implement the desired global and national climate policies in time increased the economic cost of the climate crisis and the cost of greenhouse gas emissions needed to mitigate this loss significantly. For example, 2018 Nobel Economy Prize winner William Nordhaus indicated that an increase of 4 degrees to be observed in global temperatures would cause a loss of approximately 4% in global gross domestic product (GDP); increase of 6 degrees would cause a loss of approximately 11%. Effects of global temperatures rise on GDP are shown in Figure 1. Sometime before Nordhaus published his studies, British economist Nicholas Stern had said in his book published in 2007 titled Climate Changer Economy that annual cost of preventing the worst effect of inaction scenario against climate change would constitute 1% of global GDP and this has been an indication how big a threat is global temperature rise for global economy.

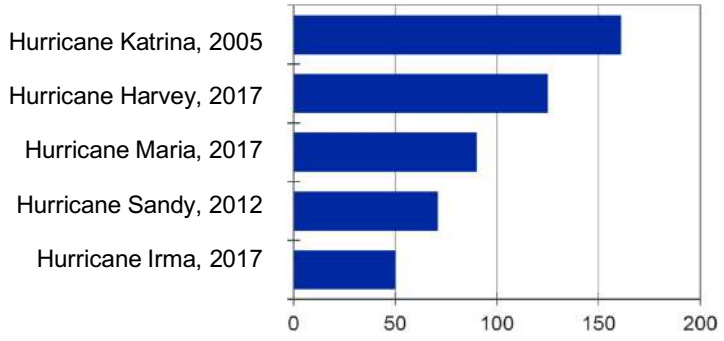
Figure 1: *Damages caused by climate change as a function of temperature change. Source: William Nordhaus*



[1]Climate News, August 2019 (https://www.iklimhaber.org/)

In the report titled Economic Effects of Climate Change published by Moody's Analytics in June 2019 the cost of hurricanes caused by climate crisis in 2017 to the economy of United States of America, which is responsible for approximately 14% of the global greenhouse gas emissions, has been 300 billion US dollars. Cost of the strongest hurricanes observed in years to USA economy is shown in Figure 2. In addition to this, the cost of extreme climate events caused by the climate crisis since 1980 increasingly in global scale has been recorded as 1.6 trillion US dollars. According to the records of Münich Re, which is one of the biggest insurance companies of the world, economic cost of the forest fires in California has been declared to be 24 billion US dollars. On the other hand, in the report titled The Effects of Climate Change on GDP by Country and the Global Economic Gains from Complying with the Paris Climate Accord published by Earth's Future in 2018 it has been indicated that in case the Australian Government fails to comply with the Paris Climate Accord, the cost of climate crisis to the Australian economy in the long term would be 126 billion US dollars. In the same report, it has been said that in the scenario of not complying with the Paris Accord, the global economic cost in the long term would be 23 trillion US dollars.

Figure 2: *Weather events that caused most damage ($) in USA history. Source: NOAA & Moody's Analytics*



Under the light of recent findings and economic modelings, macroeconomic analyses and approaches are of paramount importance among the fields of action to be developed for combating climate change. In this context assessing the market costs caused by climate crisis on sectoral basis and analyzing the observed macroeconomic reflections aimed at eliminating these costs have a critical position.

1.1. Economic Impacts of Climate Change in Different Sectors

It is important to assess the effects of the climate change on the sectors successfully in order to analyze the market cost of climate change effects. Even though the economic sectors themselves are sources of global greenhouse gas emission, they are among the components where economic effects of current climate crisis scenario are observed the most. In this context, the economic effects of the climate change on Agriculture, Food, Tourism, Energy and Health sectors are examined in this section.

Food & Agriculture Sector

Climate crisis has significant effects on food production on global scale. Factors such as thermal stress, flood and overflow events lower the productivity of agriculture, animal husbandry and fishing significantly and this situation creates a danger against food safety on global scale. According to 2012 data, fishing sector, which contributes more than 1.5 billion US dollars to the economy of the United States of America annually, incurs millions of dollars of loss every ear due to permanent changes observed in sea temperatures, diseases caused by temperature change and acidification of the ocean. It can be deduced that a similar economic scenario is observed in animal husbandry sector, which is one of the most effected subsectors of the food sector from the climate crisis. For example, in USA more than 36 million metric tons of red and white meat is consumed per year. Considering that contribution of this consumption to the federal economy is 100 billion US dollars per year, it is presumed that significant rise in veterinary prices triggered by heat waves and droughts and in repetition frequencies of parasite-borne animal diseases will cost billions of dollars of loss in the federal economy in the shırt term.

Agriculture sector draws attention as one of the most affected sectors by climate crisis. For example, 80% of the farmers who responded to the survey titled Heartbeat of the Farmer, conducted by Doktar[2] in Turkey in 2019, said that they feel the effects of the climate crisis. Agriculture Insurances Pool (TARSİM) reminding the extreme climate events expected to be experienced in the near future and emphasizing that the farmers in Turkey need to renew their insurances is of the nature that proves how much the agriculture sector in Turkey is affected by the climate crisis. On the other hand, effects of climate crisis on agriculture are being felt differently at different latitudes of the world. For example, in regions between the middle and high latitudes small increases are observed in agricultural production based on the local warming rates, in lower latitudes, in dry and tropical regions such as Africa, wheat agriculture production is expected to drop 35% by year 2050. In the report published by Moody's Analytics in August 2019, it is presented that while almost all of the world is affected negatively by the climate crisis concerning agricultural production, agricultural productions of United States of America and Russia are affected positive by the climate crisis. However, the cost of diseases caused by the climate crisis observed in these two developed countries is expected to be much higher than the gain brought about by the increase in agricultural production.

Tourism Sector

Direct and indirect effects such as extreme weather events, increasing insurance costs and safety concerns, water shortage, loss of biodiversity, and damages observed in cultural and natural heritage are most important evidences of the economic loss that climate crisis inflicts on the tourism sector. For example, the winter tourism in Central Europe where winter sports are the leading events is being foreseen as one of the sectors that may experience economic hardships in the future because of the fact that sufficient snow does not fall at the mountain slopes due to rising global temperatures in recent years. In addition to this, Southern Europe, North America and Australia have already begun to experience significant economic difficulties in the tourism sector due to drought and forest fires; Sub-Saharan Africa is having the same difficulties due to the danger of extinction of endemic species in nature parks (Source: European Climate Foundation

[2] DOKTAR: Agriculture and Stockbreeding Information Systems Research and Development Industry and Trade Inc.

& Cambridge University). In this context, it seems safe to say that tourism will be one of the most affected sectors by the economic effects of climate crisis in the short term. So much so that the surveys made by World Tourism Organization in 2016 showed that approximately 40% of the Nationally Determined Contributions (NDC's) consider tourism sector as country priority as a part of their mitigation and adaptation strategies or as a sector vulnerable to climate change.

Energy Sector

Energy sector has one of the largest shares in global greenhouse gas emissions and it is one of the sectors which are affected the most by the climate crisis. Considering that the investment cost of a small scale power plant is in the order of millions of dollars, it can be deduced that the energy sector may be one of the most vulnerable sectors against the effects of the climate crisis.

As discussed in the study titled Vulnerability of Energy Sector against Climate Change[3] published in 2012, the effects of climate change in energy sector are observed on energy resources, energy supply, energy transmission and transfer and energy infrastructure components.

Climate crisis imposes stress on both the renewable energy resources (hydro, wind, bio, solar, wave and others) and fossil energy resources (petroleum, natural gas and coal). These effects observed on energy resources directly affect the efficiency of energy supply. For example, hydroelectric energy generation is directly dependent on availability of water resources and therefore on hydraulic cycle. Considering the fresh water resources being extinct or going through substantial volume loss due to climate crisis in different regions of the world, especially tropical and dry regions, hydroelectric power plants are among the energy facilities that are likely to be affected from the climate crisis. It has been recorded that global warming also has significant effects on the blowing direction of the wind as well as its blowing strength.

In this context, the wind power plants that have the largest share in renewable energy generation on the global scale draw attention as one of the facilities that experience economic effects of the climate crisis. In a manner similar to the situation observed in wind power plants, the efficiency of wave energy is also dependent directly on the blowing strength and direction of the wind. Wave energy is presently at R&D stage; as an important energy subsectors of the future for meeting the global energy demand, it is considered that wave energy sector will also incur a significant economic cost due to the effects of the climate crisis. Liquid bio-fuels are another energy resources which is directly affected by the climate crisis. For example, growing of raw materials (sugar cane, corn cob, etc.) used for producing bio-fuels is adversely affected by the changing climate conditions. Also, rising global temperatures make it difficult to combat the parasites that cause harm to these plants that are used as raw materials for bio-fuels. Climate crisis affects the atmospheric water vapor concentration, cloudiness and cloud properties; therefore it affects the atmospheric light permeability. Solar power plants, whose efficiency depends on the atmospheric light permeability, are affected from climate crisis because of this reason. Electric generation efficiency of thermal power plants and therefore meeting the energy requirement (demand) through fossil resources drops because of the effects of the climate crisis. For example, the efficiency of two basic cycles known as Rankine and Brayton required for generating electricity in thermal power plants are dropping due to the effects of the rising global temperatures (on air humidity and fresh water resources). Factors such

[3] Energy Sector Vulnerability to Climate Change (2012).

as these that affect the design properties of thermal power plants cost high amounts of economic loss to the operation. In addition to this, interruptions are experienced in petroleum and natural gas supply operations conducted at open sea or plants at locations lower than the shore due to hurricanes caused by the climate crisis or economic damages are observed at the plants conducting the operations. For example, the hurricanes observed at Gulf of Mexico in 2004 and 2005 destroyed 52 plants and 115 platforms that were erected to extract petroleum and natural gas at open sea.

Transmission and transfer of energy require thousands of kilometers of infrastructure and such an infrastructure is being affected periodically by a series of weather conditions and climate events. Many of the weather events such as extreme winds and ice loads, wind loads on ice, lightning strikes, conductor vibrations and avalanches, landslides and floods that may cause damage at the power transmission lines are being triggered by the climate crisis, which increases it strength every passing day. Such extreme weather events cause millions of dollars of loss during energy transmission and transfer. In addition to this, in the studies conducted at California State University, it was foreseen that rising global temperatures may decrease the transmission capacities of fully loaded electric transmission lines.

Global climate crisis will bring about a new set of physical conditions that will make infrastructures of many sectors fragile, including energy sector. These new conditions will not only endanger energy supply but also will change the future energy infrastructure costs significantly. For example, Alaska Government indicated that in order to make the public energy infrastructures resistant against climate, there could be a cost of 3 to 6.1 billion US dollars until 2030 and 5.6 to 7.6 billion US dollars until 2080.

Health Sector

Even though global warming brings about some local benefits such as drops in winter deaths observed in temperate climates and increasing food production in some regions, the general health effects of the climate crisis to be caused by global warming will be very adverse. Because, climate change affects social and environmental determinants of health such as clean air, safe drinking water and safe shelter. Effects of climate change in health sector are measured parameters such as extreme temperatures, natural disasters and variable precipitation modes and infection paths. These parameters have been examined under the light of the data obtained from the World Health Organization.

Extreme air temperatures increase deaths caused by cardiovascular and respiratory diseases, especially among elderly people. For example, in Europe in the heat wave of 2003 summer, more than 70,000 unexpected deaths were reported. High temperatures also raise the level of ozone and other pollutants in the air, which worsen cardiovascular and respiratory diseases. Levels of pollen and other aeroallergens are higher in extreme heat. It is foreseen in the present scenario that these conditions may trigger asthma that ails approximately 300 million people. It is expected that continuing heat increases will raise this load.

On the global scale, number of natural disasters that are known to be caused by weather has increased more than three times since the 1960's. Every year these disasters cause more than 60,000 deaths, especially in developing countries. Rising sea water levels and extreme weather events destroy houses, medical facilities and other facilities that provide basic services.

It is possible for the extremely variable precipitation regimes caused by climate crisis to affect the fresh water resources. In this context, the lack of safe water causes hygienic problems and may increase the risk of diarrhea disease that kills 500,000 children under the age of 5 every year. Floods increase every passing day and it is expected that the frequency and severity of extreme precipitation to increase during the 21st century. Overflows pollute fresh water resources and increase the risk of water-borne diseases. As this situation provides breeding grounds for disease carrying insects such as mosquitos, the risk of having malaria increases, which is the most deadly disease of the world. Also, extreme precipitations and overflows cause drowning and physical injuries, damage local facilities and disrupt the provision of medical services.

In line with the parameters and data discussed above, it is seen that climate crisis has significant economic effects in the health sector. So much so that, according to the data of World Bank, it is estimated that the direct cost of the damage climate crisis inflicts on the health sector on global scale (excluding the costs in agriculture, water, cleaning and similar sectors that affect the health sector) is between 2 and 4 billion US dollars per year. In addition, economic costs of diseases caused by air pollution have been calculated as 1.7 trillion US dollars in OECD countries annually, 1.4 trillion US dollars in China and 500 billion US dollars in India. Also, according to the World Bank data, it has been calculated that workforce productivity loss in regions that are likely to be hot such as Asia and Caribbean may be 11-20% by year 2080.

1.2. Role of Climate Change Struggle in Employment Policies

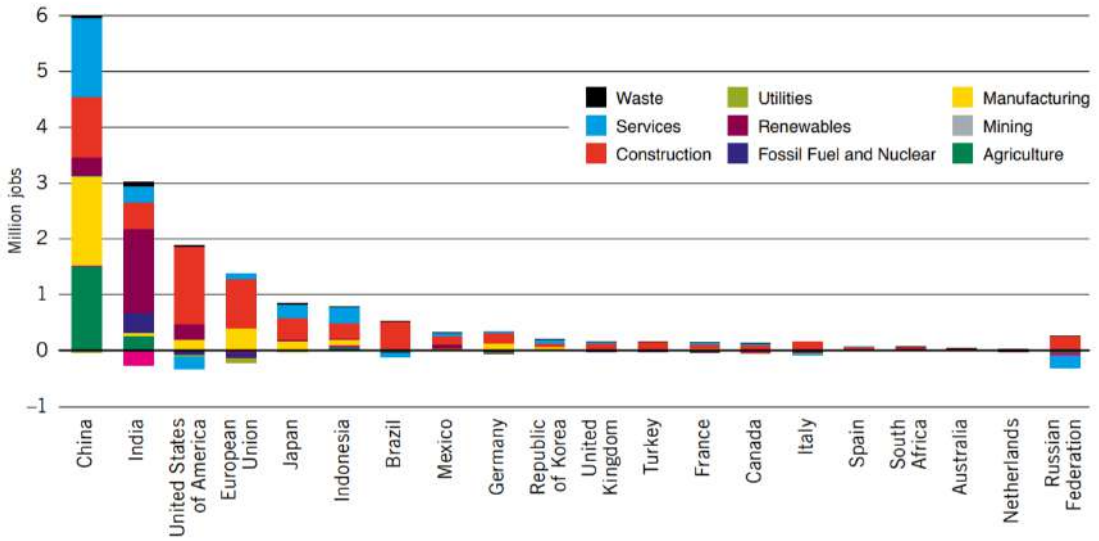
Economic crises caused by the climate crisis on the global scale affect the employment component negatively, which is one of the basic driving powers of the global economy, as much as they affect the sectors. So much so that 40% of the jobs in the sectors active in global markets are directly or indirectly affected by economic impacts of climate change (ILO, 2018). In such a scenario, including climate action plans in employment policies or designing climate change combat as a field of employment would be very important reaction for equalizing global economic effects of climate change. Starting from this point, the relation between employment policies and the climate crisis has been assessed in line with the report titled Effect of Adaptation to Climate Change on Employment, published by International Labor Organization in 2018.

In 2014, 1.2 billion jobs of the total 3.2 billion jobs in the world were carried out within the sectors that are directly or heavily dependent on ecosystem services. These sectors include agriculture, forestry, fishing, food, beverage and tobacco, wood and paper, bio-fuel and renewable energy resources, medicine and chemical industry and environmental tourism. The share of the employment based on ecosystem services exhibit large differences in G20 countries. India, China and Indonesia have the largest shares with 52, 50 and 41 percent respectively. While in England and Germany 5% to 6% of the total employment is dependent directly on ecosystem services, this ratio is 16% in European Union (EU) as a whole. In this context, the losses to be incurred in ecosystem services due to climate crisis will cause the activities in the said sectors to slow down considerably and will lead to clogging at the point of these sectors feeding the subsectors. This, in turn, means more job (employment) loss indirectly.

Development of employment policies in a manner that is sensitive to climate is important for mitigating the economic depressions that climate crisis will cause. So that, it is predicted that the steps taken

towards to goal of limiting the global warming in energy, transportation and construction sectors at or below 2 °C as of year 2100 will have positive effects on employment on global scale. For example, making the energy sector become more sustainable in this context will generate 18 million more jobs as of year 2030, compared to no-action scenario against climate crisis. Distribution of these new employment fields is shown in Figure 3. According to this figure, China, India and USA will be the most profiting economies with 6, 2.8 and 1.6 million new jobs respectively from such an energy transformation.

Figure 3: *The effect of achieving sustainable energy with year 2030 on employment in G20 countries (million jobs). Source: ILO, 2018*



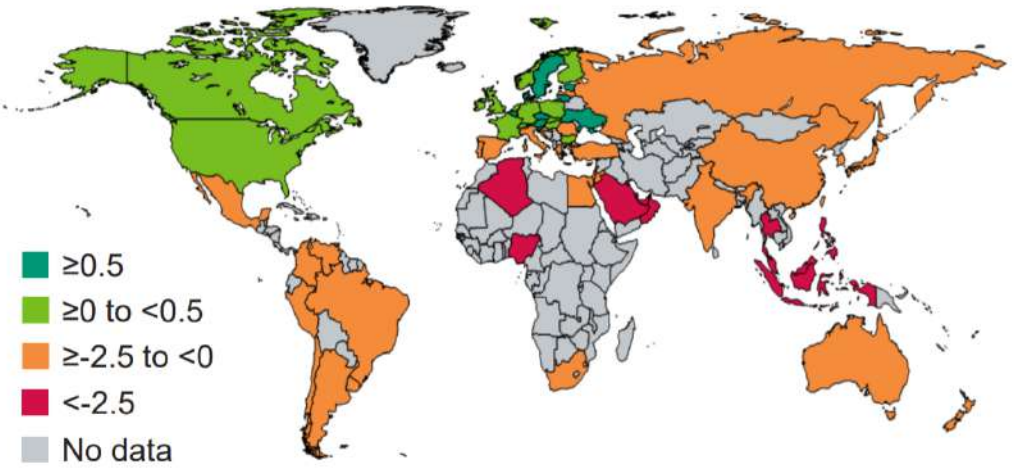
According to data obtained from International Labor Organization (ILO), in combating the economic impacts of global scale of climate crisis, besides the reflections of mitigation policies, the reflections of adaptation policies have a very significant share. So that, European Commission says that adaptation policies developed against climate crisis has a very large capacity in creating new job opportunities. For example, it indicates that even the reference adaptation scenarios that are not considered adequate against climate crisis have a capacity of creating half a million new employment opportunities within the borders of EU. Such an employment rate corresponds to 0.2% of the presently working population of EU. Furthermore, 136 thousand present jobs are saved from getting lost due to the current adaptation policies. In addition to these, ambitious adaptation policies that would have a budget that would correspond to 51% of the global GDP would provide 1 million new jobs by 2050 and 330 thousand present jobs at risk would be saved.

1.3. Reflections of Climate Crisis in Turkey's Economy

Even though the effects of the climate crisis, whose intensity increase every day, are felt at global level, some defenseless (climate-sensitive) countries and regions feel these devastating effects through much more severe ways. In this context, an important assessment in Moody's Analytics' report draws attention. According to this assessment, some

countries are classified by the deviations in their GDP's caused by the effects of climate effects. According to this classification, countries are assessed as the winners and relative losers of climate crisis. According to the analysis, in the scenario of an increase of 4 degrees to be experienced as of year 2100, the country that most loss will be observed will be India with 2.45% economic contraction it will go through by year 2048. Relative winners of the analysis are Canada, England, Germany, France and USA, which will be able to take very small steps to raise their GDP's (Gross Domestic Products) in the worst case scenario. In Figure 4, which is taken directly from the report, Turkey is shown s one of the loser countries of this scenario of climate crisis.

***Figure 4**: Deviations to be observed in GDP's of countries according to 4°C temperature rise and 2048 reference scenario (%). Source: Moody's Analytics*



As one of the countries where the economic effects of the climate will be felt the most, preparation of a working national climate change action plan/plans is very important for Turkey. In this context, Republic of Turkey has explained the first steps aimed at combating climate crisis in the Eighth Five-Year Development Plan prepared by State Planning Organization in year 2000. In the other development plans prepared after this one the measures to be taken (mitigation and adaptation) by the Republic of Turkey in combating climate crisis were clarified a little more; and recently in 11th Development Plan (July 2019) effects of the climate crisis on the country's economy were mentioned under a few headings (see 11th Development Plan paragraphs 79, 80, 102 and 664). For example, in 11th Development Plan it was mentioned that the climate crisis has important economic effects in Turkey on sectors such as tourism and food and strategic steps were listed to mitigate the economic and other effects of the climate change.

The documents that officially determine the policies and actions in combating climate change in Turkey are; *National Climate Change Strategy (2010-2023), National Climate Change Action Plan (2011-2023) and* National Climate Change Adaptation Strategy and Action Plan (2011-2023); it is indicated in these documents that necessary mitigation and adaptation measures will be taken to mitigate the economic effects in agriculture and forestry, industry, energy and transportation sectors in Turkey.

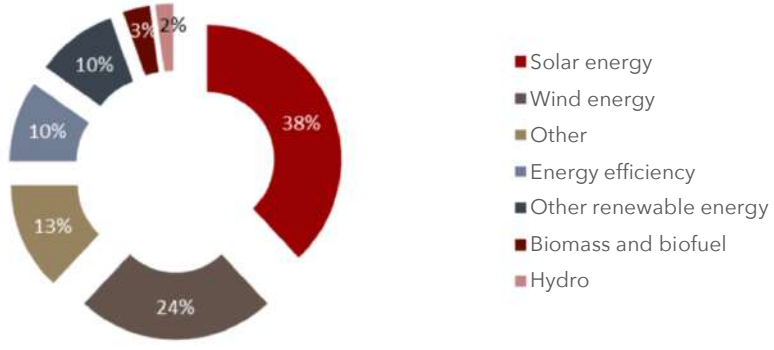
2. RESULTS-BASED OPTIONS IN TACKLING CLIMATE CRISIS: GLOBAL CLIMATE FINANCE

United Nations Framework Convention on Climate Change (UNFCCC) defines climate finance as the local, national or international finance obtained from public, private and alternative finance resources aimed at supporting mitigation and adaptation activities. UNFCCC emphasizes that economic cost of emission reductions and adaptation to effects of the climate crisis is quite high and makes a call for help Kyoto Protocol and Paris Accord from developed countries with high financial capacity to climate-sensitive countries to improve their mitigation and adaptation policies. Climate finance in the context of Paris Climate Accord has been founded on two basic elements; namely mandatory responsibilities of developed countries and incentivization of other stakeholders (such as private sector). In this context, climate finance is defined as; determining the priorities of developing countries in their combat against climate crisis and facilitating the financial mobilization of developed countries as their basic responsibility in line with these priorities.

2.1. Recent Situation in Global Climate Finance

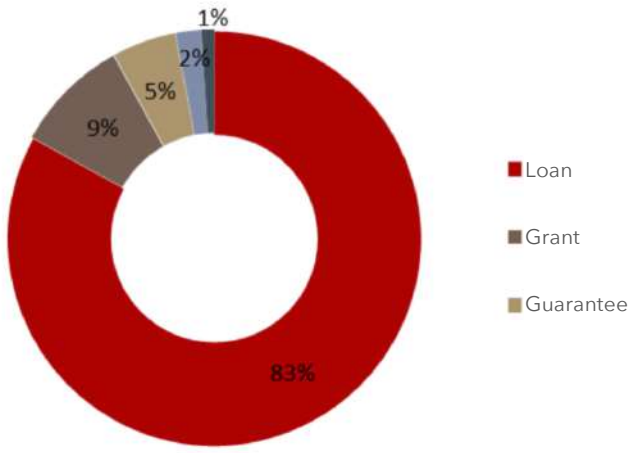
In the report titled Climate Finance, published by Escarus in 2016, it is mentioned that a budget of 700 billion to 1 trillion US dollars is needed to finance the low carbon development, which is one of the most significant driving forces of combating climate crisis and, in this context, to finance the renewable energy investments. In this context, it must be reminded that the financing climate actions undertaken in national contribution documents of Paris Accord may amount to more than 16.5 trillion dollars in the next 15 years. However, as of 2015, the amount spent for global climate finance (directly or indirectly) has been recorded as 463 billion US dollars (Climate Landscape, 2017). In addition to this, the data obtained from UNFCCC underlines that 175 billion dollars of climate change support was provided by developed countries to developing countries between the years 2010-2012. World Bank data shows that 58% of the global climate finance is provided by private sector and 92% of it is used for mitigation (renewable energy) projects. Distribution of renewable energy projects benefiting from global climate finance is shown in Figure 5.

Figure 5: *Distribution of renewable energy projects benefiting from global climate finance by project types. Source: Escarus, 2014*



A significant part of the global climate finance is provided by multi-lateral development banks. According to the Common Climate finance report published in 2014, of the climate finance provided by multi-lateral development banks 83% was loan, 9% grant, 5% guarantee, 2% equity and 1% by other mechanisms. Also, 67% of the financing provided by the said development banks was provided by public sector and 33% by private sector.

Figure 6: *Distribution of climate finance by mechanisms. Source: Escarus, 2016*



2.2. Role of United Nations in Global Climate Finance

In 16th Conference of Parties held in Cancun city of Mexico in 2010, the parties established *Standing Finance Committee (SCF)* to coordinate the financial affairs of UNFCCC

SCF has four basic functions: these functions are;

I. To provide consultancy to COP on a consistent climate finance;
II. To assist COP to rationalize UNFCCC's financial mechanism;
III. To provide guidance to COP to facilitate mobilization of financial resources for provision of global climate finance;
IV. To support COP for measuring, reporting and verifying the support provided to developing countries

Duties of the *Standing Finance Committee* also included organizing a forum once a year on climate finance, providing expert input for periodic reviewing UNFCCC financial mechanism and presenting assessment reports provided with the contributions of these experts every two years. It was decided in 21st Conference of Parties held in Paris in 2015 that SCF will serve the goals of the Paris Agreement.

UNFCCC coordinates the programs it manages for climate finance under Long Term Finance Process. Long Term Finance was designed to make use of various resources such as public/private or bi-lateral/multi-lateral resources to increase and mobilize climate finance. In this context, annual finance workshops will be organized by Conferences of Parties. Further, governments (ministries) of Developing Countries are expected to submit bi-annual finance reports to UNFCCC secretariat where 2020 climate goals are described.

2.3. Programs Providing Climate Finance

In order to make climate crisis combat more effective and sustainable United Nations have established a series of financial programs at public and private sector level. Of these programs those that provide finance at the largest scale and capacity can be listed as *Global environment facility, Green Climate Fund, Special Climate Change Fund, Least Developed Countries Fund, Adaptation Fund, Climate Investments Fund and Green Bonds*.

2.3.1 Global Environment Facility

Global environment facility (GEF) has been founded just before the 1992 Rio Summit to help deal with the most devastating and urgent environmental problems. Since that time, GEF has provided over 18.1 billion US dollars of grants to its beneficiaries and provided 94.2 billion US dollars of support by providing co-finance to more than 4500 projects in 170 countries. Today GEF has an international partnership structure in 183 countries consisting of international institutions, non-government organizations and private sector dealing with global environmental issues.

Since UNFCCC became effective in 1994 GEF has provided service as an important climate finance provider. Up until today, GEF has provided support to 940 climate mitigation projects, facilitating greenhouse gas emission reduction of 8.4 million tons CO_2e. GEF's annual support to climate projects in the current scenario is 910 million US dollars.

2.3.2. Green Climate Fund

Green Climate Fund (GCF) has been founded in Cancun in 2010 at 16th Conference of Parties with the approval of 194 countries as a part of UNFCCC's financial mechanism. The fund is steered by the principles and terms of UNFCCC; it aims to provide equal amount of finance to mitigation and adaptation.

This new global fund, which was founded to support the actions that the developing countries are conducting in combating climate crisis, helps the developing countries limit/mitigate their greenhouse gas emissions and adapt to climate change through results-based finance.

Paris Agreement does not include any provision about the amount of long term finance, because of the objections of developed countries, especially USA. For this reason, details related with Green Climate Fund, which is the target of the financing and its main distribution channel, have been designated by resolution 1/CP.21 by parties to UNFCCC. Green Climate Fund became the primary institutional flow mechanism with resolution 1/CP.21 and Special Climate Change Fund and Least Developed Countries Fund under UNFCCC were developed to serve Paris Agreement. Nevertheless, the common target to mobilize the annual 100 billion dollars that the developed countries have undertaken by 2020 in Cancun has been extended to 2025. Within the framework of the resolution that takes 100 billion dollars as minimum, parties to Paris Agreement will set a new collective finance amount target before 2025 (S. Cerit Mazlum, 2019).

GCF has started its first financial mobilization in 2014 and obtained a commitment of a significant climate resource in the amount of 10.3 billion US dollars from developed countries, some developing countries/regions and Paris Municipality in a short period of time. In the current scenario, 5.2 billion dollars of this amount has been collected. GCF has spent 2.4 billion dollars to support the projects that began operation by now. GCF's total financial portfolio becomes 18.7 billion dollars, including co-finance resources.

GCF's activities are compliant with the priorities of developing countries in line with the Country Property Principle. By means of the direct access granted to the party countries within the scope of GCF, beneficiary countries can easily access the financial support without being dependent on international mediators.

2.3.3. Special Climate Change Fund

Special Climate Change Fund (SCCF) was founded under the guidance of Conference of Parties in Marrakesh in 2001 (COP7); SCCF and Least Developed Countries Fund (LDCF) work to complement each other. Contrary to LDCF, SCCF is open to all developing countries that are defenseless against the effects of climate change and finances activities in a broader range of activities related with climate change. 77 of SCCF's projects in 79 countries were supported with voluntary contributions as of 2017, and it has a total portfolio of 350 million US dollars.

In SCCF portfolio, adaptation projects have the highest priority. SCCF also provides financing for projects of technology transfer and mitigation projects in fields such as energy, transportation, industry, agriculture, forestry, waste management and economic diversification.

2.3.4. Least Developed Countries Fund

Definition of Least Developed Countries is made for countries that are the most defenseless countries against climate change and that can adapt the least to the climate change. In most cases, these countries do not have the technical, financial and institutional capacity to determine the best methods for improving their resistance against climate crisis. For this reason, parties to UNFCCC decided to establish Least Developed Countries Fund (LDCF) in 2001. This fund is managed by GEF and it supports financially the adaptation action plans that the most climate-sensitive countries will develop against the effects of climate crisis.

LDCF was designed within the scope of UNFCCC to provide for the financial requirements of climate action specific to Least Developed Countries. LDCF also helps countries to prepare and implement their National Adaptation Programs (NAPA). NAPA's are country-specific strategies that determine the most urgent requirements of LDC's for adaptation to climate change.

Target sectors and thematic fields are designated within the scope of NAPA as water, agriculture and food safety, health, disaster risk management and prevention, infrastructure and fragile ecosystems. LDCF focuses financing of on-site adaptation activities that produce concrete results for mitigation of fragility of the key sectors designated with NAPA process and supporting defenseless communities.

Considering the voluntary contributions, LDCF's financial portfolio is 1.3 billion dollars. This financial resource is considered as the largest financial portfolio allocated for Least Developed Countries.

2.3.5. Adaptation Fund

Adaptation Fund finances the projects and programs that help climate-sensitive communities in developing countries to adapt to the effects of climate crisis. Enterprises that are found eligible for financing within the scope of the fund are selected according to country requirements, opinions and priorities. Adaptation Fund was founded within the scope of Kyoto Protocol, which is the implementation tool of United Nations Framework Convention on Climate Change. The fund has allocated 564 million US dollars to climate adaptation activities and activities of being resistant against climate crisis, including 84 supported concrete adaptation projects since 2010.

The fund is being partially financed by government and private sector donators and also by two percent share of Certified Emission Reduction (CER) program, which is published within the scope of Clean Development Mechanism projects of the Protocol.

2.3.6. Climate Investments Fund

Climate Investments Fund (CIF) is conducting activities since 2008 to strengthen the energy transformation, climate resistance, transformations in transportation and forestry sectors. CIF privileged financing is conducting different financing programs to test new business models and approaches, to generate economic performance records in unproven markets and to open supplementary financing for investors from other resources, especially private sector and multi-lateral development banks implementing CIF fund.

Climate Investments Fund (CIF) has a financial portfolio of 8.3 billion dollars and it provides climate finance in 72 developing and medium-income countries to manage sustainable adaptation action plans and reduce greenhouse gas emissions.

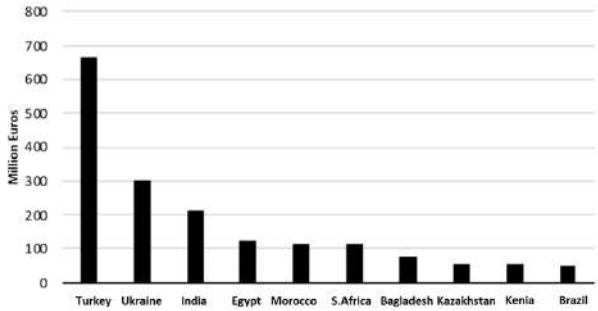
In case the donation commitments made to CIF are fulfilled and planned co-finance are provided, it is expected that the portfolio of CIF, which is currently 8.3 billion dollars, will rise to a portfolio of 58 billion dollars that will have the capacity to implement more than 300 projects.

2.4. Climate Finance in Turkey

According to the Global Climate Risk Index data published by German Watch in 2019, the effects of climate crisis cost 1.9 billion dollars to Turkey economy between the years 1998-2017. As a developing country, it is important to benefit from the global climate finance in combating climate crisis which causes such a loss in its economy. In this context Turkey is one of the beneficiary countries of the climate finance opportunities provided by institutions such as GEF Multi-Partner Banks (European Bank for Reconstruction and Development, EBRD), International Finance Corporation (IFC), World Bank and European Union.

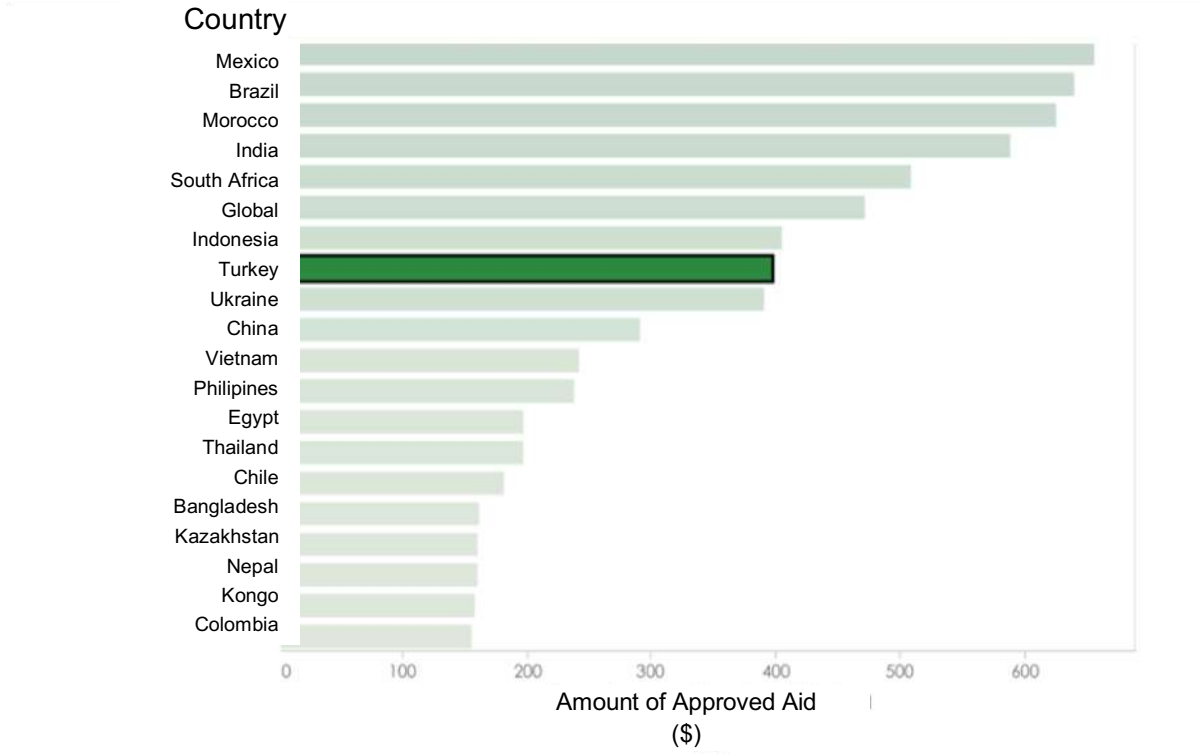
Turkey has benefited from a finance amounting to 332.4 million dollars up to now for 60 projects it implements within the scope of GEF and, with the co-finance it obtained in addition to this; it reached 1.7 billion dollars of financing in total. Turkey has become the country that has benefited most from EU climate opportunities between years 2013-2016. The countries that have benefited from EU climate finance aids, with Turkey in the lead, are shown in Figure 7.

Figure 7: *10 countries that have benefited from EU climate finance aids between 2013-2016. Source: ACT Alliance & İklim Haber, 2018*



In addition to this data, when the countries that have benefited from climate finance from a wider perspective, it is seen that Turkey is one of the 20 countries that have benefited most from multi-lateral climate finance opportunities. The countries that have benefited most from multi-lateral climate finance opportunities are shown in Figure 8, where Turkey is in the 7th position.

Figure 8: *20 countries that have benefited most from multi-lateral climate finance opportunities. Source: CFU, 2018*



Among the current climate finance opportunities, considering that it designed its entire portfolio to finance climate projects, Green Climate Fund draws attention as the finance resource with the largest capacity. In this context, Turkey focuses on the fact that Green Climate Fund is one of the important financial opportunities since the 22nd Conference of Parties organized in Marrakesh and repeats from time to time its motivation to make use of this fund. However, it does not seem possible for Turkey to make use of the Green Climate Fund. Starting from this point, it is important for Turkey to extend the existing climate finance options that it benefited/is benefitting from at this stage.

There are different ways to extend climate finance for a country like Turkey that has financial capacity above those of most developing countries. These ways can be listed as conducting R&D activities, establishing international networks, involvement and similar activities. National climate action plans and other policy documents will show that Turkey has a clear route in combating climate crisis and at what points Turkey needs climate finance on this route. This situation may carry Turkey to a capacity that will enable it to utilize opportunities provided by multi-lateral development banks at a higher level. R&D studies aimed at reduction and adaptation actions with the existing capacity may present the

opportunity to demonstrate to the international community how determined Turkey is in combating climate crisis and that existing climate finance flow is directed to Turkey's combat with climate crisis.

Another factor that will enable Turkey to benefit more from global climate finance opportunities is to increase Turkey's visibility on global partnership grounds. Effective representations at activities aimed at combating climate crisis organized at international level will facilitate better recognition at global level of Turkey's motivation to combat climate crisis. Considering all these factors, in case improved climate action policies and plans are implemented together with rational climate diplomacy, Turkey is at the position of an indispensible country having capacity to provide more climate finance in addition to the existing financial flow.

So much so that 9 financial institutions including Asian Development Bank (ADB), African Development Bank, Asia Infrastructure Investment Bank (AIIB), European Bank of Reconstruction and Development (EBRD), Islam Development Bank (IDB), International Finance Corporation and New Development Bank have declared at UN Climate Summit organized in New York in September 2019 that they have plans to provide a contribution of 175 billion dollars to global climate finance (EBRD, 2019). In this context, it may be assessed that Turkey's rational and multi-stakeholder national climate policy together with increased international visibility may facilitate its benefitting from new finance opportunities such as the above.

3. MARKET-BASED OPTIONS IN CLIMATE CHANGE STRUGGLE: CARBON PRICING INSTRUMENTS

In the post-millennium era when the effects of climate change began to rise rapidly almost all scientific authorities indicate that governments should make transition to low carbon development methods without including the use of fossil fuels in their development plans any more. Governments have different policy options to facilitate this transition. These options can be listed as; increasing incentives for renewable energy and carbon capture technologies, stopping fossil fuel subsidies, subjecting carbon emission sources to legal arrangements, implementing strict energy efficiency standards and increasing the society's climate change literacy. However, as indicated in the report titled "World Economic Situation and Prospects as of Middle of 2019" published by the United Nations, unless supported with carbon pricing practices, all these climate action policies will be inadequate to achieve the desired greenhouse gas emission reduction. In this context, according to World Bank 2018 data, carbon pricing practices draw attention as an important tool of global combat against climate change with its power to influence 20 percent of global greenhouse gas emissions. That economist William Nordhaus from USA has been awarded 2018 Nobel Economy Prize for integrating climate change to long term macroeconomic analysis is of the nature that proves how important the carbon pricing mechanisms for preparing contemporary climate action plans.

As of year 2018 when global greenhouse gas emissions due to use of fossil fuels reached a high level of *37.1 billion tons CO_2e /year,* governments should include carbon pricing practices in their national climate plans within the framework of reduction measures as an indispensible driving force. Considering the very critical engineering approaches and precise economic parameter it includes, the said climate change mitigation tool must be designed and implemented very carefully. Otherwise, these macroeconomic tools to be designed with a radical climate change mitigation goal will also be inadequate to stop the global carbon emissions that reached a peak value in 2018 after the past seven years. Starting from this point, it is quite important to analyze the historical backgrounds of macroeconomic tools in the context of their relations with Paris Climate Agreement that began to play quite an important role in combating climate change.

3.1. Historical Background of Carbon Price

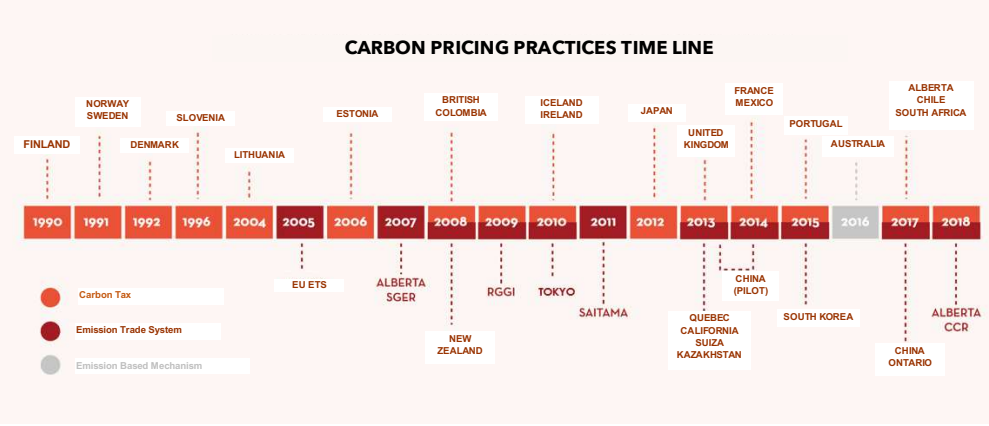
Use of market-based instruments and command and control practices as a mitigation practice in the solution of environmental problems is not a very new discussion. So much so that Canadian economist John H. Dales has been the first person who defined market-based emission upper limit and emission Allowance concepts in his book titled Pollution, Property and Prices published in 1968. The idea of solving environmental problems by way of taxation (command and control) began to be discussed at a much earlier date. British economist Arthur Piou discussed the idea of eliminating the suffering of affected groups due to environmental problems by taxation of pollutants with the concept of *economic externality* that he introduced at the beginning of 20th century. This idea was later recorded in the literature as Piou tax. The first market-based mechanism, on the other hand, aimed at solving the environmental problems implemented for the first time in history is the Acid Rain Program developed by United States Environmental Protection Agency (US EPA). This program has the characteristic of being the first emission upper limit and trading program in history is examined in Box 1 in detail (Climate Reality Project, 2017).

Box 1: EPA Acid Rain Program. Source: Climate Reality Project

Acid Rain Program is the first emission upper limit and trading system that was made effective in 1982 in United States of America for the purpose of reducing the use of leaded gasoline. Within the scope of the program, leaded gasoline producers were given emission allowances based on their historical production levels. These distribution allowances can be sold and bought between leaded gasoline producers. In later stages of the program, a new emission market was founded that covered sulfur dioxide emissions from thermal power plants. EPA Acid Rain Program was recorded as a successfully implemented program in the history of environmental management. Acid rain events observed within the borders of USA between years 1994-2000 decreased 36% by means of this program; industrial adaptation (participation ratio of the program is 100%.

The first carbon pricing mechanisms aimed at reduction of greenhouse gas emissions were developed in Scandinavia as carbon tax. Carbon tax practice was put into effect in Finland in 1990, in 1991 in Sweden and Norway and in 1992 in Denmark. The first mandatory Emission Trading Systems of history targeting greenhouse gas emissions were put in effect in Norway as European Union ETS in 2005. Right after these ETS's the first mandatory Emission Trading System of USA Regional Greenhouse Gas Initiative (RGGI) was put in effect as an interstate memorandum of understanding. When California, the 6th largest economy of the world founded its own Cap and Trade System in 2006, it aimed at reducing the greenhouse gas emissions by this macroeconomic instrument by 15% by year 2020. Carbon pricing mechanisms implemented in various countries/regions of the world can be examined with the use of Figure 9 below, which was published by Chile Carbon Pricing Project.

Figure 9: *Timeline for Carbon Pricing Practices . Source: Chile Carbon Pricing Project*



In the adaptation process to Kyoto Protocol, many countries /regions began the effort to include a macroeconomic mitigation tool in their climate change action plans. Even though it is not one of the requirements of Kyoto Protocol (carbon tax is a mitigation measure included in this protocol), many of these countries/regions preferred to establish their own carbon markets. While some countries established mandatory carbon markets required by the Protocol some other countries founded voluntary carbon markets or joined international voluntary carbon markets. Mandatory and voluntary carbon markets are examined in Carbon Pricing Instruments section in detail.

3.2. Paris Climate Agreement and Market-Based Instruments

Contrary to Kyoto Protocol, Paris Climate Agreement does not require the parties to use a macroeconomic instrument to meet the climate change commitments but grants the right to buy emission allowances to all party countries. This is one of the basic factors that differentiates Paris Climate Agreement from Kyoto Protocol, which is almost founded on national and international carbon markets and grants the right to sell emission Allowance to developing countries only

Paris Agreement includes two political mechanisms that encourage the parties to establish international carbon pricing practices and markets. The first of these is defined in article 6 paragraph 2 of the Agreement as internationally transferred mitigation outcomes (ITMO). As indicated in the report titled Introduction to Carbon Markets published by Carbon Market Watch in 2019; ITMO foresees buying and selling of emissions of party countries within an international carbon market.

The use of ITMO has the potential of facilitating the countries/regions reaching climate change commitments ((intended) nationally determined contributions). The system is based on selling the extra emission mitigations of countries/regions. For example, let us assume one party committed to reduce its greenhouse gas emissions by 1000 tons CO_2e but exhibited a performance of 1100 tons CO_2e. this country/region may sell this extra 100 tons CO_2e emission to another country/region that has difficulty reaching its climate change commitments.

The second political mechanism is defined in article 6 paragraph 4 of the Paris Agreement and it is described as Sustainable Development Mechanism in some platforms. Considering the economic parameters, even though it resembles *Joint Implementation* mechanism of Kyoto Protocol, it has a different mode of operation regarding the target group. Within the scope of the Sustainable Development Mechanism project owners who achieved emission reduction in party countries/regions may sell their emission reduction credits to other party countries or bodies/persons in party countries regardless of the development levels of the countries.

Starting from this analysis made on the mechanisms included in article 6 paragraphs 2 and 4 of Paris Agreement, it can be easily understood that it is not made mandatory for party countries/regions to implement market-based macroeconomic practices to achieve their commitments regarding climate change combat.

However, especially Sustainable Development Mechanism defined at paragraph 4 of article 6 encourages a global carbon price application in the long term. That is, even though Paris Agreement does not include provisions for establishing carbon markets and operating them, it is expected that a global carbon price practice will become operational in the future and only the party countries/regions that have carbon market

experience at the present will be successful components of this market.

Climate Reality Project/Carbon Pricing Tools Handbook contains a survey conducted by International Emission Trade Association (IETA) in 2016. According to this survey, whose target group includes organizations representing the government and the private sector, it is foreseen that the presently operational carbon markets will expand by 82% with Paris Agreement.

Starting from this point, it is required for the countries/ regions that are planning their own climate mitigation practices at macroeconomic scale or that are aiming to improve the operational economic instruments to be in control of the macroeconomic options implemented up to now. These instruments are discussed in detail in Carbon Pricing Instruments section.

3.3. Carbon Pricing Instruments

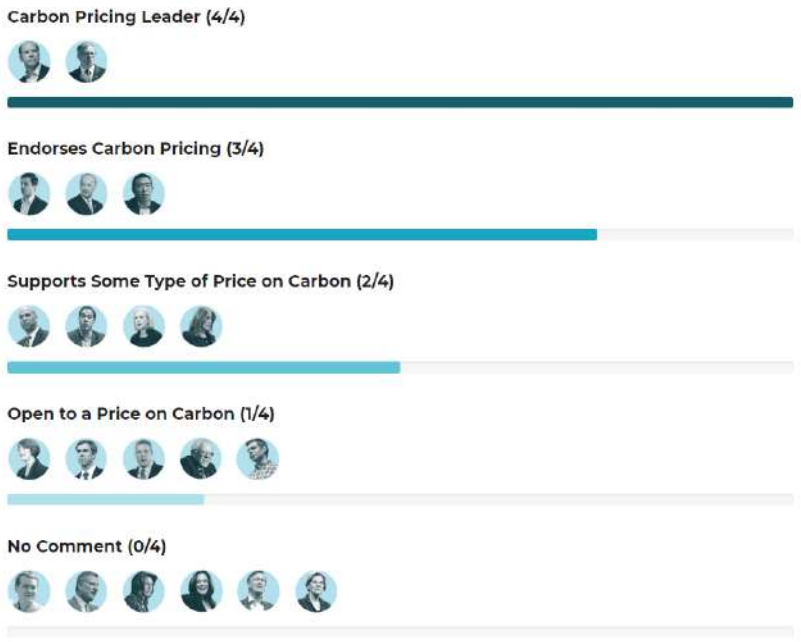
Intergovernmental Panel on Climate Change (IPCC) warns countries and international organizations in its report titled 1.5 Degrees Report published in September 2018 that there is only 12 years left to combat climate change effectively. In this critical juncture that contains such a time limitation in combating climate change, carbon pricing instruments are gaining increasingly growing political prestige and market support with the powerful environmental outcomes they promise. For example, in political campaigns for 2020 USA Presidential Elections, implementing carbon pricing practices draws attention as a common promise in the campaign programs of many of the Democratic Party presumptive nominees, at the Democratic Party front. Promises of challenging candidates in USA Presidential Elections related with carbon pricing are examined in Box 2 in line with the article published by Climate-XChange.

Box 2:

The survey conducted by Climate-XChange assesses Democratic Party presumptive candidates in 2020 USA Presidential Elections in four categories over 4 points by considering their carbon pricing promises. These categories are as follows: Carbon Pricing Leader (4/4), Endorses Carbon Pricing Practices (3/4), Supports Some Type of Price on Carbon (2/4), Open to a Carbon Price on Carbon (1/4), No Comment (0/4).

John Delaney and Jay Inslee (Washington State Governor), who got 4 points in the assessment, promise that if they are elected to the White House they will implement a federal carbon pricing program. So much so that they included even the design details in their campaigns such as scope of a possible carbon pricing practice and its unit price. Among the candidates who received 3 points in the assessment the former USA Vice President Joe Biden is one of the candidates who support federal carbon price that he calls carbon tariffs and he indicates that carbon pricing will become a significant source of income for the federal government. Only 6 of the 20 Democratic Party candidates nominated for USA Presidential candidacy have no promise for carbon pricing. Points of all the candidates and contents of their promises may be accessed from Figure 10 and from the article containing the details of the survey.

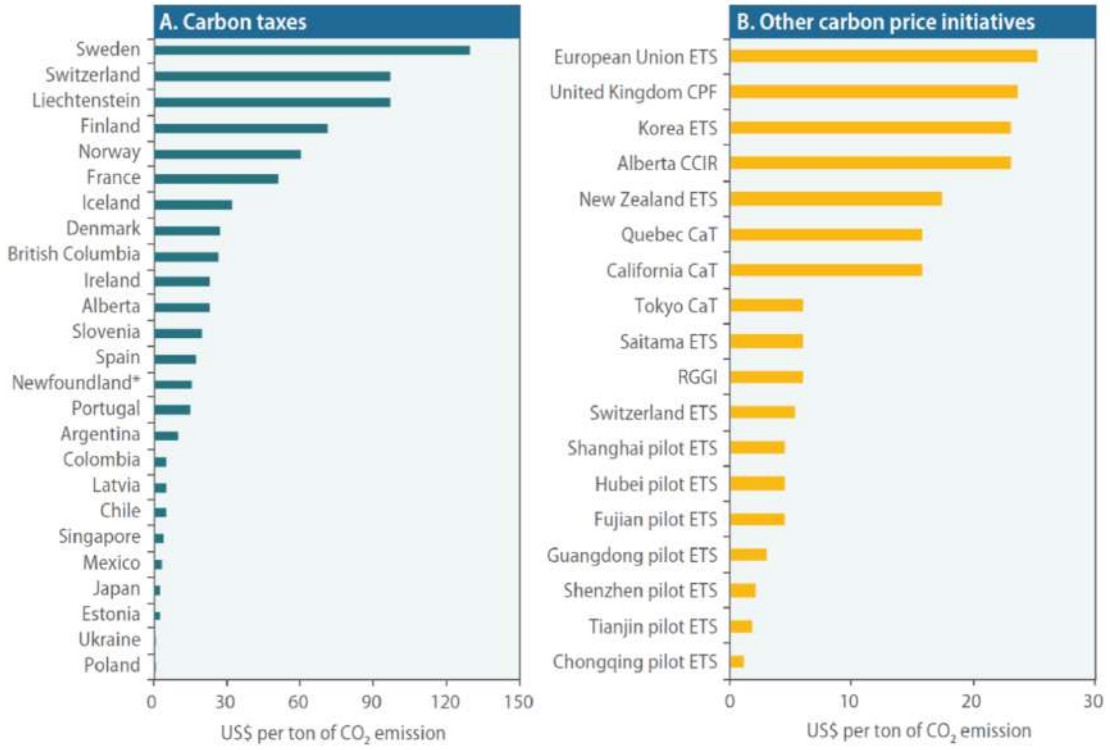
Figure 10: *Assessment of Carbon Pricing Promises of Democratic Party Presumptive Candidates in USA 2020 Presidential Elections. Source: Climate-Xchange, 2019*



In addition to the increasing political support for carbon pricing instruments, market support also triggers the governments to include in their climate action plans the said macroeconomic solution practices at a significant scale. Especially years 2017, 2018 and 2019 have been recorded as the years when carbon pricing initiative began to rise all over the world.

2019 data of State and Trends of Carbon Pricing Report published annually by the World Bank says there are 57 carbon pricing initiatives in the world. Also, in the Road Map Report for Establishing a Greenhouse Gas *Emission Trading System in Turkey,* prepared by Life Enerji, Ecofys and Future Camp in 2016 in line with the request of the Ministry of Environment and Urbanisation, it has been indicated that the emissions covered by carbon pricing initiatives in the world have increased three times in the last ten years. Carbon price per unit ton in these initiatives vary between 1 US dollar and 127 US dollars; unit price is over 10 US dollars in 51% of the initiatives. Current unit prices of all present carbon pricing initiatives (as of 2019) can be accessed through Figure 11, taken from the report titled "World Economic Situation and Prospects as of Middle of 2019".

Figure 11: Unit prices of carbon pricing initiatives implemented in various countries/regions of the world as of 2019. Source: United Nations, 2019



Carbon pricing instruments that were used up until now, that are being used and that are planned to be used are called market based mechanisms in the literature. These macroeconomic climate change mitigation options that have design and operational differences can be listed as Emission Trading System, carbon tax, voluntary carbon markets and CORSIA. Even the number of said market-based climate change mitigation options increase (such as results-based finance, energy efficiency trade system, etc.), pricing options mentioned in the literature as main stream until now are examined in this study.

3.3.1. Carbon Tax

Carbon tax is a macroeconomic policy instrument developed to price greenhouse gas emissions. In carbon tax practice, government directly determines the price amount that must be paid for each ton of greenhouse gas emission. Carbon tax differs with this property from emission trade, which is another carbon pricing instrument with operational and design feature.

As discussed in the Road Map Report for Establishing a Greenhouse Gas *Emission Trading System in Turkey,* the basic logic underlying the design of the said macroeconomic mitigation instrument is based on an economy theory with command and control axis. This theory says that all measures having less mitigation cost than tax will be taken. This way, it is intended to discourage polluting bodies from activities causing carbon emission with a marginal carbon price.

The entities that are in the target group of carbon tax have certain options to lower their tax obligation levels. These options may be listed as buying Carbon Offset certificates, donations made to financing of low carbon technologies and activities aimed at the reduction of emissions caused by deforestation.

As discussed in the first section, the first carbon tax practices were implemented by Scandinavian countries in the first quarter of 1990's. Even though the political and economic demand for carbon tax began to decrease in the adaptation process to Kyoto Protocol, it came again to the focus of the governments' climate change mitigation policies at the end of 2000's.

Carbon tax implemented by Switzerland in 2008 was followed by many EU countries, and some developed countries such as Australia and Japan and after a shırt while they began to implement their own carbon taxes.

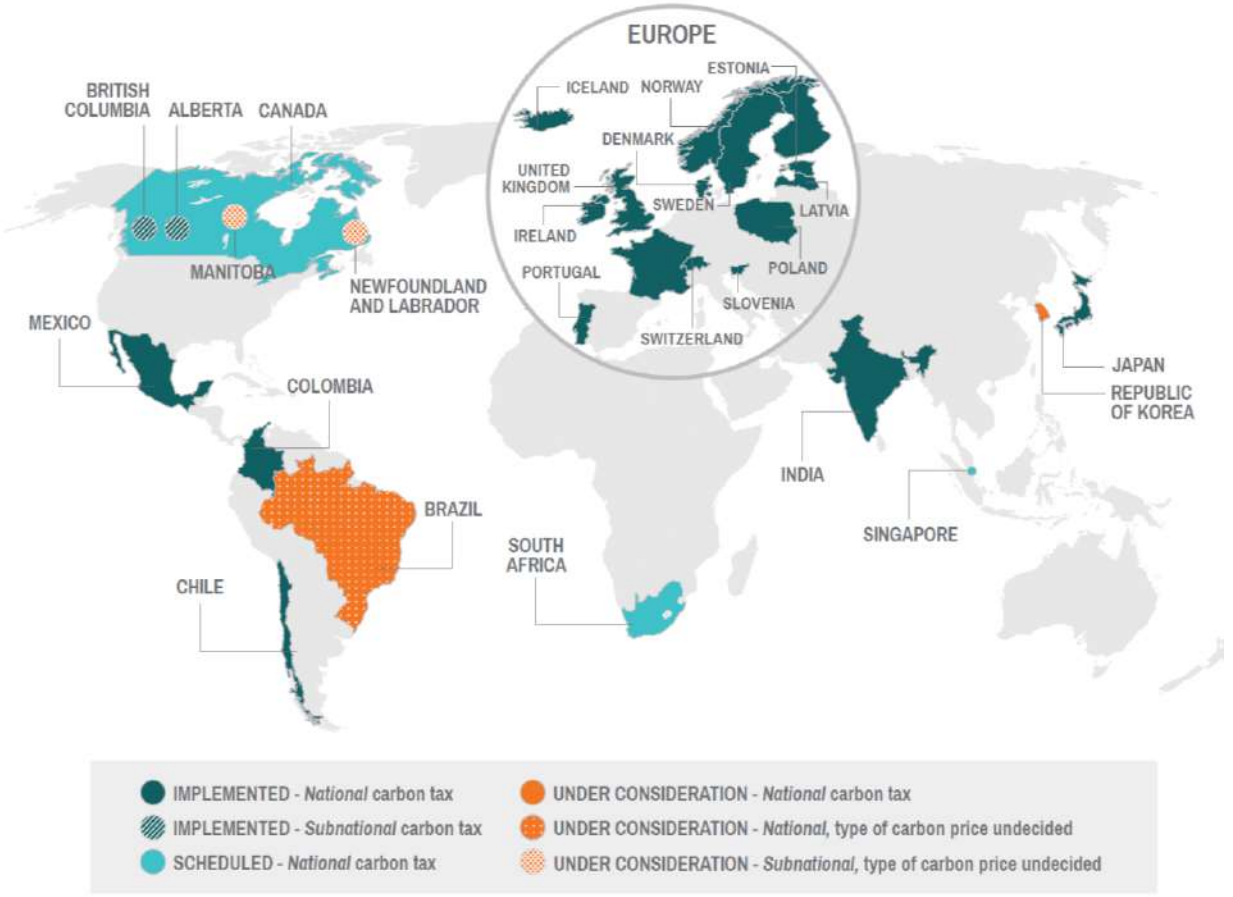
At the beginning of 2010's the first carbon tax practices in developing countries began in countries such as South Africa, Mexico and Chile. In addition to these practices some other developing countries like India are preparing to implement their own carbon taxes (at national level).

The countries that are implementing or preparing to implement carbon tax over the world can be observed with the help of Figure 12 below, which was taken from Carbon *Tax Guide: handbook for Policymakers* report prepared by Climate Focus, Gnarly Tree Sustainability Institute & Indiana University.

Box 3: Carbon Tax & ETS

It is possible to say carbon tax has some advantages and some disadvantages, especially compared to emission trade. The most distinct one of these advantages is that carbon tax provides a price certainty. Because, in this carbon pricing instrument, there is almost only one driving force that can directly affect the price. Thus, it is relatively easier to raise the carbon price to desired more competitive levels or, in case of a possible economic depression, to lower it to more cost-effective levels. On the other hand, the most characteristic disadvantage that it brings about is that it does not provide any guarantee for environmental results. Because, in carbon tax, contrary to emission trade system, an emission cap cannot be set. That is, a net emission reduction amount cannot be planned for a certain time period.

Figure 12: *Global Situation of Carbon Tax as of 2017. Source: Climate Focus, Gnarly Tree Sustainability Institute & Indiana University*

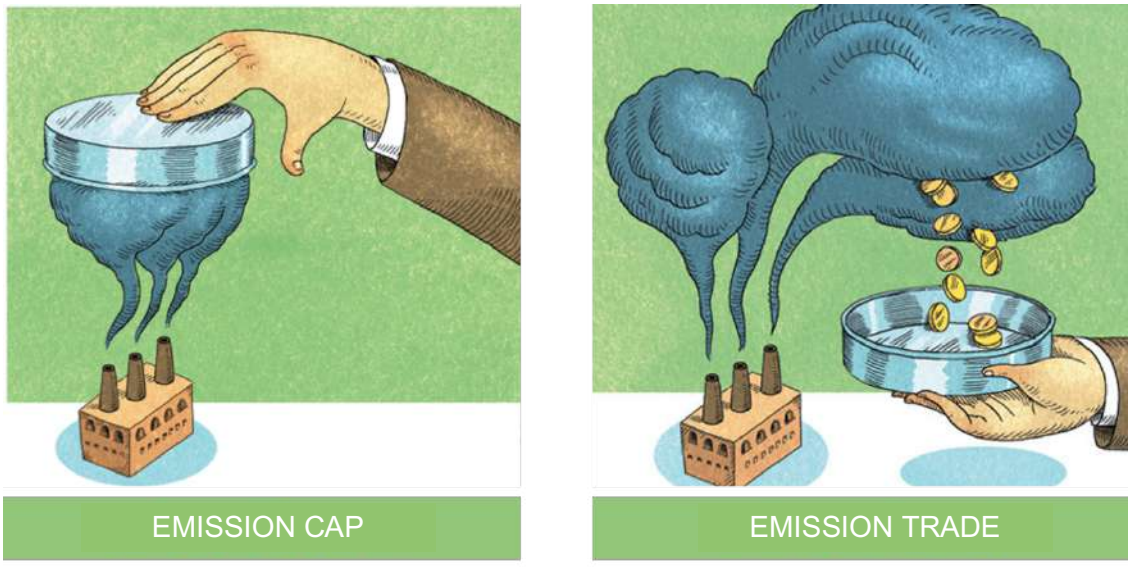


3.3.2. Emission Trading System

Emissions trade is one of the macroeconomic emission reduction options developed by *Joint Implementation and Clean Development Mechanism (CDM)* together within the scope of Kyoto Protocol. As Kyoto Protocol will end at the end of 2020, most of the countries that are subject to these mechanisms founded their own Emission Trading Systems.

Emission Trading System (ETS), which is called *Cap and Trade Program* in some practices is a carbon pricing instrument based on establishing a market where greenhouse gas emission allowances are traded and establishing an emission cap to cover these allowances. A greenhouse gas emission reduction is foreseen to be made by lowering this determined emission cap in line with greenhouse gas emission reduction targets of the related ETS in each adaptation period. Allowance means each ton of CO_2e greenhouse gas emission right given/sold to the entities that are subject to regulation within the scope of ETS. Operating mechanism of ETS is represented in Figure 13, drawn by *Wesley Bedrosian*.

Figure 13: *Emission Trading System. Source: Wesley Bedrosian*



The entities comprising the ETS target group have to document their emission allowances to correspond to the total greenhouse gas emission. These allowances are distributed to the entities in the target group free of charge or within the scope of an auction, depending on the design of the ETS. Emission cap is designed to create scarcity for allowances and to generate an incentive for carbon price. According to the Road Map Report for Establishing a Greenhouse Gas *Emission Trading System in Turkey,* prepared by Life Enerji, Ecofys and Future Camp a successful design to determine the emission cap makes the number of allowances less than the required allowances in a scenario without greenhouse gas reduction and a demand is created for the allowances in the market.

This situation prepares suitable conditions for determining a unit price for allowances and generates a net incentive for greenhouse gas reduction. From this point of view, Emission Trading System is considered as the most cost-effective carbon pricing instrument that facilitates greenhouse gas reductions of the entities in the target group. Also, politically it is a more successful regulation instrument compared to a traditional command and control application. Because Emission Trading System is a macroeconomic climate change mitigation instrument where interventions by governments on the market are minimized and polluters are given the chance to design their own greenhouse gas reduction strategies.

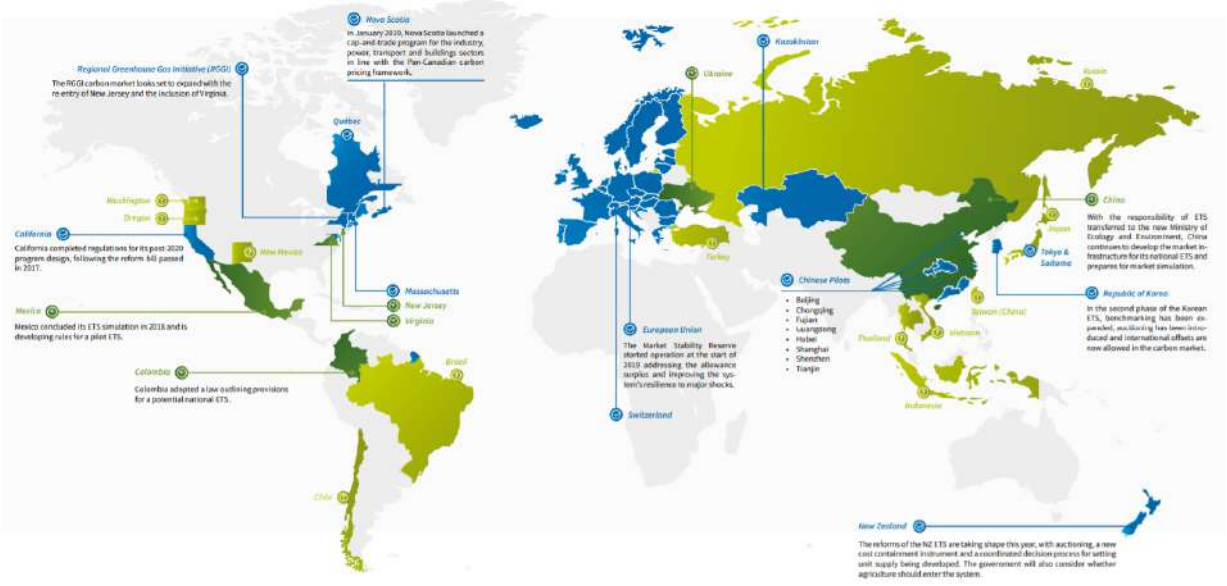
After the Kyoto Protocol was made effective, two different ETS practices were began to be experienced in the world; namely voluntary and mandatory practices. According to the data obtained from the guide titled Emission Trade in Practice: A Handbook for Design and Commissioning prepared by Partnership for Market Readiness (PMR) and International Carbon Action Partnership (ICAP) the first ETS of the history designed to limit the greenhouse gas emissions was began to be implemented in United Kingdom and Japan in 2002 as a voluntary mechanism.

After European Union implemented its (mandatory) ETS in 2005 many countries/regions began to implement their own emission trade practices. All

ETS practices that are operational and planned to be implemented can be accessed through Figure 14, which is taken from *"Trends in Emissiton Trading System Report 2019"* published by ICAP.

Some practices among the ETS's implemented up until now were applied by harmonizing them with carbon tax design elements. The said carbon pricing practice known as Hybrid Pricing in literature is discussed in Box 4.

Figure 14: *Global Situation of Emission Trading System as of 2019. Source: ICAP, 2019*



Box 4: Hybrid Pricing

As discussed in Climate Reality Project Handbook on Carbon Pricing Instruments, hybrid pricing is a carbon pricing tools which is getting more and more popular. This pricing practice, which was developed by blending some design elements of carbon tax and ETS (for example price setting and emission amount) can optimize environmental outcomes and changes observed in the price. Most of the ETS's in operation are designed as hybrid pricing practices. For example, Australian ETS was atypical hybrid mechanism before it was abolished. Government was able to influence the price directly to facilitate price certainty in this ETS system. This feature was intended to prevent potential price fluctuations that may be observed in Australian carbon market. Australia established the emission trade system in 2010 and abolished it in 2014.

3.3.3. Voluntary Carbon Market

Voluntary Carbon Market, known also as Carbon Offset Market is a carbon pricing practice that was developed pursuant to Kyoto Protocol, designed as in addition to mandatory Carbon markets and that covers Clean Development Mechanism, Emission Trade and *Joint Implementation* mechanisms. In this carbon pricing practice, participation aimed at greenhouse gas emission reduction is based on voluntariness and potential participants consist of business world components, government agencies, civil community, even individuals.

Compared to mandatory carbon markets, voluntary carbon markets are a very small emission trade market. This means that demand for the emission reduction certificates used in voluntary carbon market is low and that these certificates are sold at a very low price. For example, while as of April 2019 EU ETS unit carbon price (EUA) is approximately 24 Euros, VER credits, which are voluntary carbon market unit price, vary in the range of 40-60 Euro cents.

In voluntary carbon markets, emission reduction certificates are generated on project basis. According to the data in the report titled "Voluntary Carbon Market Analyses: General Outlook to 2018 and First Quarter Trends" published by Ecosystem Marketplace, the categories where projects are certified are listed as follows:

- Agriculture
- Chemical process/industrial production
- Energy efficiency/fuel switch
- Forestration and land use
- Household devices
- Renewable energy
- Transportation
- Waste disposal

Projects that make reduction of different greenhouse gas types (such as CO_2, CH_4, N_20) receive an emission reduction certificate for each ton of emission CO_2e that they reduced after passing certain stages in accordance with Clean Development Mechanism Methodology (such as registration, listing, verification, 3rd party verification/independent verification). These certificates are known in the literature as Verified Emission Reduction Unit (VER). Definition of the greenhouse gas emission reduction represented by these certificates, which are also known as Carbon Offset units, are made by making reference to an activity of equivalent capacity that makes greenhouse gas emission. Emission reduction certification procedure used in voluntary carbon market is described in Box 5.

Box 5: Emission Reduction Certification Procedure in Voluntary Carbon Market

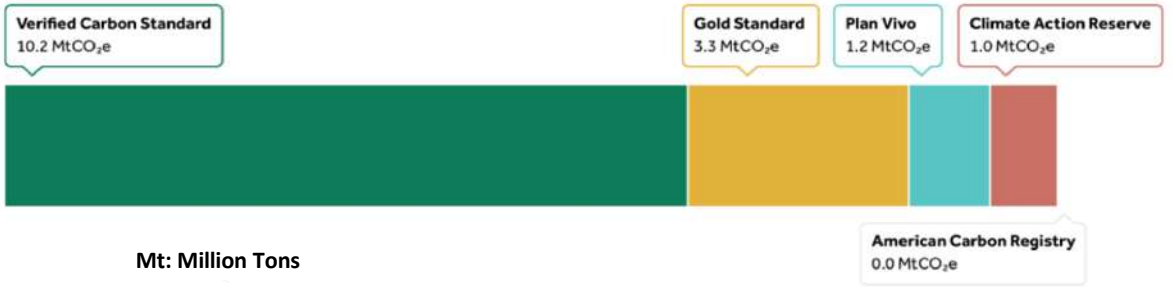
Emission reduction certification in voluntary carbon market can be described with an example. Let us assume that a wind power plant generates electricity with 60 MW capacity. If the same capacity of electricity (60 MW) were generated with a fossil fuel power plant project, there would be a greenhouse gas emission of 170,000 tons CO_2e in a certain period of time from this generation activity. This 170,000 tons of greenhouse gas emission that the wind power plant did not make in the determined period of time is expressed as negative emission amount of this project in accordance with Clean Development Mechanism Methodology and certification is made for each negative ton of emission. That is, the wind power plant can earn 170,000 counts of VER certificates (The numerical values in this example were taken from the data of an existing wind power plant project that is conducting activity in Turkey in voluntary carbon market).

The entities that make greenhouse gas emission may buy credits in voluntary carbon markets from entities that own VER credits (certificates). This way, carbon emissions are offsetted. Entities that buy carbon credits to cover their total greenhouse gas emissions will become carbon neutral. Estimated number of Carbon Offset projects made since 2005 until now in the world can be accessed through Figure 15, which was taken from the report *Carbon Market Analyses: General Outlook to 2018 and First Quarter Trends*.

Figure 15: *Estimated Number of Offset Projects by Country/ (2005-2018). Source: Ecosystem Marketplace*

Countries in the voluntary carbon markets are subject to certain certificate provider standards such as American *Carbon Registry*, *Climate Action Reserve*, *Gold Standard*, *Verified Carbon Standard (VCS)* and *Plan Vivo*. Emission reduction amount certified by these standards as of 2018 can be accessed through Figure 16, which is taken from Voluntary Carbon Market Analyses: General Outlook to 2018 and First Quarter Trends report. In Turkey, VER certificates are generated by Gold Standard and VCS.

Figure 16: *Certified Emission Reduction Amounts between 2018 January and March (according to standards). Source: Ecosystem Marketplace*

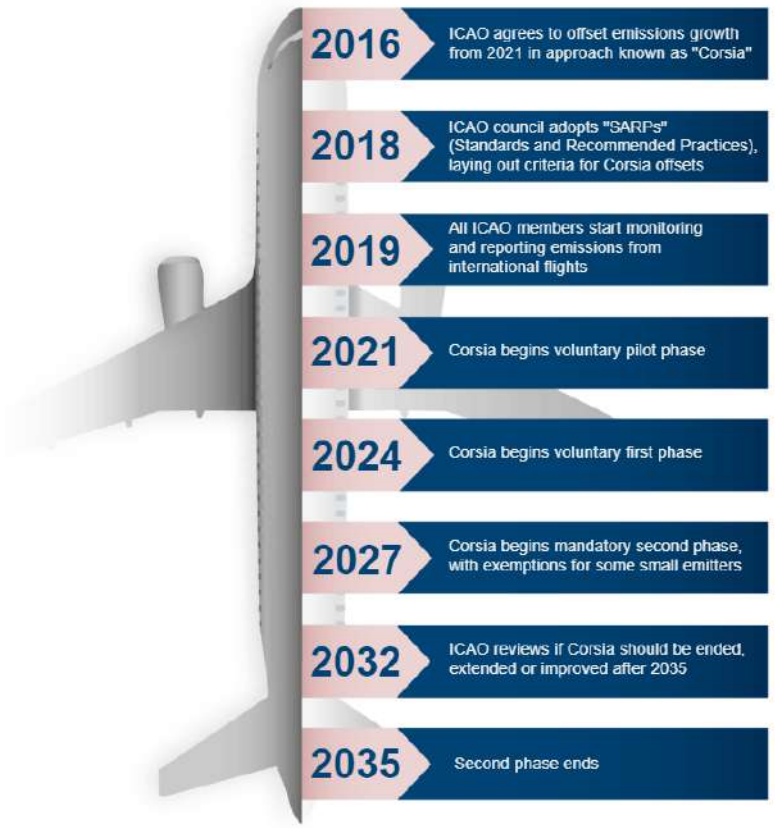


Participation of Turkey in Voluntary Carbon Markets is assessed in the section titled Present Situation of Carbon Pricing in Turkey.

3.3.4. CORSIA

Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is a market-based carbon pricing instrument developed by International Civil Aviation Organization (ICAO) for the reduction of greenhouse gas emissions caused by international aviation activities. This mechanism was accepted by 192 ICAO member states including Turkey in 2016 and this mechanism is expected to take effect until 2021. In the first phase of CORSIA that will begin in 2021 participation will be voluntary; with the second phase starting in 2027 participation will be mandatory. Phases of CORSIA are described in Figure 17, taken from the article titled "CORSIA: UN's Plan to Equalize the Growth in Aviation Emissions after 2020" published by Carbon Brief.

Figure 17: *CORSIA Time Tunnel. Source: Carbon Brief.*



Considering the other macroeconomic instruments analyzed up to now, it cannot be said that CORSIA is a typical carbon pricing tool that was designed from scratch. Because, aviation sector is presently subject to greenhouse gas reduction regulations under some carbon pricing mechanisms (such as EU ETS) and the Offset under CORSIA is foreseen to be made with some emission reduction certificates like voluntary carbon market credits VER. Even though developing a carbon pricing initiative aimed only at aviation activities seems like a marginal idea in the operational sense, considering the share of aviation sector in the global greenhouse gas emissions, it is understood how critically important CORSIA is.

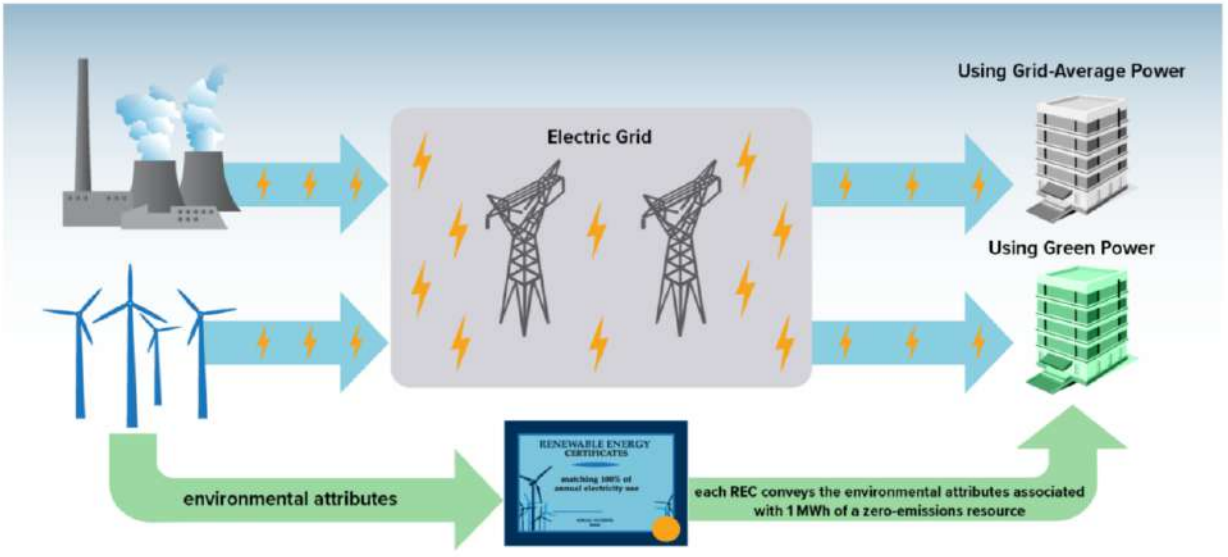
Data taken from Carbon Brief says that, if considered as a country, civil aviation sector would rank 6th between Japan and Germany in global greenhouse

gas emission ranking. This means that civil aviation sector (including domestic and international flights) produces 2.4% of global greenhouse gas emissions with annual 895 million CO_2e tons. However, since CORSIA will only price international flights with annual greenhouse gas emission of 10000 tons CO_2e, it is expected that CORSIA's expanding its pricing scope will be one of the issues that will be negotiated most in the future stages.

3.3.5. Renewable Energy Certificate Trade

Renewable Energy Certificates (REC) are credits invented for electricity generators or electricity consumers to declare that the source of electricity they generate or consume is renewable energy. That is entities or individuals may prove each 1 Megawatt hour energy they generate or consume with 1 REC they will obtain. Entities that make greenhouse gas emitting activities can show that the electricity they use in their operations is generated by renewable means with the REC's they will buy. Right of use of REC's belong to only one entity (as consumer or generator) its trade can be made only once. Once a REC is sold by the electricity generator to the user side its life is over. Making and trading of Renewable Energy Certificates are shown schematically in Figure 18, taken from the article titled "Differences between Offset Units and REC's", published by USA Environmental Protection Agency and Green Power Partnership.

Figure 18: *Trade Flow of Renewable Energy Certificates. Source: USA Environmental Protection Agency & Green Power Partnership*



Renewable Energy Certificate Trade is not a typical carbon pricing practice. Even though carbon content or carbon emission is not directly priced in this system, it makes contribution to greenhouse gas emission reduction through encouraging renewable energy use. It can be assessed within the scope of carbon pricing with this feature.

REC Trade is not a mandatory greenhouse gas emission reduction market. However, some regulations in force concerning the use of renewable electricity (such as quota application imposed on the use of electricity generated with fossil fuel) facilitate the use of REC's in these mandatory greenhouse gas reduction practices. Even though it is different from voluntary carbon market (Carbon Offset) regarding the pricing content, REC trade has similarities with voluntary carbon market on issues such as market volume and unit credit prices. Comparison of Carbon Offset units and REC's is made in Box 6.

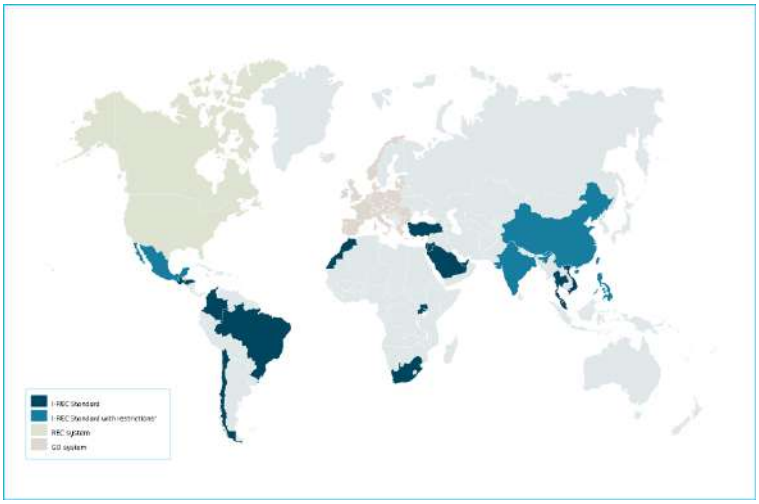
Box 6: Carbon Offset Units & Renewable Energy Certificates

Even though both market-based instruments give the entities the chance to reduce/equalize their greenhouse gas emissions, in theory Carbon Offset and renewable energy certificate trading are climate change mitigation practices used for different purposes. Basic differences between Carbon Offset and renewable energy certificate trading are explained below.

- **Unit of Measurement:** While the unit of measurement in Carbon Offset is one ton of CO_2 eq greenhouse gas emission, REC's are issued for 1 MW-hour of renewable electricity.
- **Purpose of Use:** Equalization units are issued to support greenhouse gas emission reduction directly. But, REC's rather reflect the service choice of the electricity consumer (in the context of being renewable or not). Also, another characteristic feature of REC's is that they support development of renewable energy sector directly.
- **Source:** Equalization units are issued to notify emission reductions recorded from many sources, from renewable energy generation to waste disposal. However, REC's are issued only to notify the electricity generated in renewable energy generation projects such as wind power plants, solar power plants.

Countries applying different programs in Renewable Energy Certificate Market certify the electricity they generate subject to different standards. North American countries are generally subject to Renewable Energy Certificate bearing the same name, European countries *Guarantees of Origin (GO),* all countries on continents besides these continents are subject to International Renewable Energy Certificate (*I-REC*) standard. Countries and the standards they are subject to are shown in Figure 19 taken from the official site of I-REC Standard. Countries can obtain their certificates after passing through a series of stages (registration, listing, verification, 3rd party verification) designated by these standards.

Figure 19: *Standards in Renewable Energy Certificate Market and Program Countries They Cover. Source: I-REC Standard*



3.4. Carbon Pricing Instruments Design Elements

Design and implementation of carbon pricing instruments require the integration of certain critical economic parameters and advanced engineering approaches in harmony with each other. Such that, inadequate analysis of these elements at the design stage may cause the related carbon pricing practice to become an unsuccessful macroeconomic practice. In a carbon pricing system whose basic design elements are not analyzed carefully, even increases may be observed in greenhouse gas emissions of the target group. Under the light of this information, design stage of a carbon pricing instrument that will be implemented as one of the climate change mitigation tools in a certain country/region is the most important driving force that will ensure the success of the pricing practice.

Box 7: Why are the carbon pricing design elements important?

Determining design elements successfully and analyzing them at macroeconomic level help finding answer to the question of ETS or Carbon Tax, which is one of the most discussed issues in carbon pricing literature and help program designers. For example, *as discussed in the analysis made in Carbon Pricing Instruments Handbook* published by Climate Reality Project, one of the most impoftant reasons for European Uninon to choose ETS as a carbon pricing instrument is that Europen Uninon has designed its legal farmework in a manner so that it cannot interfere with the financial policies (such as tax) of member states directly. Some critical issue such as this were used in the design elements analysis of EU ETS. Detailed discussions related with this subject are present in the report titled Emission Trade in Practice: A Handbook for Design and Commissioning prepared by Partnership for Market Readiness (PMR) and International Carbon Action Partnership (ICAP).

Carbon pricing practices other than Emission Trading System and Carbon Tax are not analyzed in the context of design elements because they cover relatively less greenhouse gas emission volume and cover less number of stakeholders and, more importantly because these instruments are not mandatory carbon pricing practices. Starting from this point, design elements of carbon tax and ETS are discussed in this part of the study.

3.4.1. Carbon Tax Design Elements

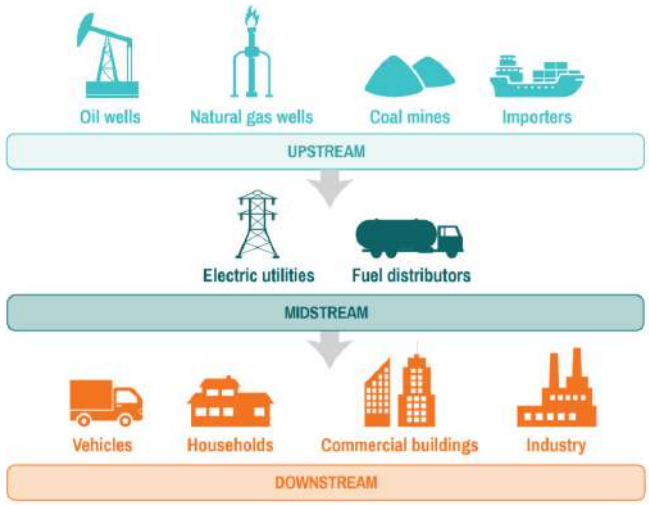
Countries/regions considering implementing carbon tax should determine the goals of the carbon pricing mechanism when designing the carbon tax and apply a marginal prioritization procedure among these goals. In this context, the design elements listed under the following headings summarize the issues that must be taken into consideration by countries/regions that plan to implement carbon tax in accordance with the *Carbon Tax Guide: handbook for Policymakers* report prepared jointly by Climate Focus and Gnarly Tree Sustainability Institute & Indiana University.

3.4.1.1. Scope of Pricing

One of the most critical points in the design of a carbon tax is to determine the pricing scope for determining *which greenhouse gases, which economic sectors* and *which activities* will be subjected to regulation. Determining these parameters correctly is important for minimizing the problems that the carbon tax practice may encounter in the future on issues such as management responsibility and political acceptance.

When determining the pricing scope, the first issue to take into consideration is to decide the regulation point that questions which activities that cause greenhouse gas emission will be subjected to regulation. Regulation points are divided into three as the source side (place where fuels enter the market), consumption side (place where emissions are made) and intermediate regulation point. Regulation points are schematized in Figure 20.

Figure 20: *Classification of Potential Regulation Points in Carbon Tax Practices. Source: Climate Focus, Gnarly Tree Sustainability Institute & Indiana University.*



In upstream regulation, carbon tax is applied on the products that cause greenhouse gas emissions at the places where they enter the economy subject to regulation. In the scenario where these products are fossil fuels regulation points may be coal mines, natural gas wells, oil wells or ports where imported fuels subject to regulation enter the country/region. In the scenario where products causing emission are agricultural or regular storage area regulations points may be farms and disposal sites of the wastes. Parallel to determining the source side regulation points, it is required to determine which fuel types will be subjected to regulation. For example, while British Columbia subjects to carbon tax 23 different fossil fuel types including petrol, natural gas and coal, Mexico carbon tax covers coal and petrol, India carbon tax covers only coal.

In downstream regulation, carbon tax is applied at the place where products causing the greenhouse gas emissions are consumed. The target groups of this regulation in general are energy using industries (for example, cement factory), transportation companies using fossil fuel and red meat processing companies. Parallel to determining the consumption side regulation points, it is required to determine which operations will be subjected to regulation. For example, while Chile applies carbon tax to high capacity steam boilers and turbines, South Africa applies carbon tax only to leakage greenhouse gas emissions.

In midstream regulation, carbon tax is applied at a point between the place where products causing greenhouse gas emission enter the economy subject to regulation and the place where these products are consumed in the economy. The target groups of this regulation in general are petrol and natural gas refineries, electricity generators and fossil fuel distributors

The second issue to be decided when determining the pricing scope is which greenhouse gases are to be subjected to pricing. In the carbon tax practices in effect in the world different greenhouse gases (CO_2, CH_4, N_2O, HFC, etc.) are subjected to regulation

The last issue to be decided in determining the pricing scope is the threshold values. In a carbon tax practice where regulation point and the greenhouse gases to be subjected to regulation are determined, lastly it is required to decide what scale of greenhouse gas emissions will be subjected to regulation. For example, in Chile carbon tax practice, electricity generators that conduct activity with a capacity over 50 MW are subjected to taxing scheme at the intermediate regulation point.

3.4.1.2. Pricing Amount and Increase Rate

Determining the unit pricing amount of the carbon tax, applied for limiting greenhouse gas emissions, is one of the most important design elements. As listed in Figure 11, price of the carbon tax implemented in different countries/regions of the world varies between 1 US dollar (Poland) and 137 US dollars (Japan). There are four different approaches to determine these pricing amounts. These approaches are described below.

1. **Social Cost of Carbon Approach:** This is an approach that foresees that the carbon tax amount to be determined such that the amount to be obtained from reduction measures be equal to the total cost of carbon emissions to be calculated. While it is one of the most effective approaches economically, it is not considered applicable due to the difficult requirements such as making scientific assumptions on greenhouse emissions and carbon dioxide accumulation in the atmosphere, determining the amount and type of losses caused by climate change and estimating values for these losses.

2. **Reduction Target Approach:** This is an approach that foresees determining the carbon tax amount in line with a predetermined greenhouse reduction goal similar to the approach applied in Emission Trading System. As a definite reduction level is promised in this approach without ambiguities, its chance of political acceptance seems higher.
3. **Revenue Target Approach:** This is an approach to determine carbon tax amount developed to establish a revenue mechanism through carbon tax. It is used especially by governments that need new public fund options.
4. **Comparison Approach:** This is an approach that requires determining of carbon tax amount by taking the practices in other carbon pricing initiatives as basis. In general, comparison criteria are the carbon tax practices used in the countries/regions that are competitors of the country/region where carbon tax will be imposed, their neighbors and trade partners.

After the amount of carbon tax is determined, it needs to be decided at which rate carbon price will be increased through the years. There are six methods developed to determine the increase rate: these methods are described below.

1. **Fixed Increase Rate:** Carbon tax remains fixed in time. Tax amount may be tied to inflation or not.
2. **Progressive Increase Rate:** It is used in a carbon tax practice that begins with generally a low carbon tax amount and increases steadily in time.
3. **Increase Rate Compatible with Social Cost:** It is used for determining a carbon tax amount in line with the changes observed in social cost of carbon.
4. **Formula-Based Increase Rate:** It is used in a carbon tax practice where policy makers determine the tax increase rate periodically.
5. **Periodic-Review Based Increase Rate:** This is the increase rate which is determined by reviewing of the taxation process by government officials and other market or economy stakeholders and presenting proposals based on these reviews.
6. **Unplanned Increase Rate:** Tax increase rates are decided by law makers or policy makers from time to time or periodically.

3.4.1.3. Risk Mitigation Policies

One of the elements that must be taken into consideration in designing the carbon tax is determining the undesired side effects within the risk mitigation policies to be developed. In this context, it is important to understand carbon leak risk and negative distributional effects.

Carbon leak means the situation of greenhouse gas emissions in the target group of the related country/region moving to another country/region where there is not an equivalent pricing policy as a side effect of the carbon pricing practice implemented in the said country/region. This risk has the potential to weaken the competitiveness of the countries/regions where carbon tax is to be implemented and mitigation policies against this risk must be developed carefully at the design phase of the carbon tax.

Negative distributional effects bring about the outcome of imposing the responsibility of paying carbon tax on certain groups (especially low income families, retirees, other disadvantaged groups and similar sensitive groups) disproportionately. These possible effects affect the social acceptance of carbon pricing mechanisms negatively. Starting from this point, when designing carbon tax, social

elements, especially demographic structure, of the country/region must be taken into consideration.

3.4.1.4. Use of Revenue

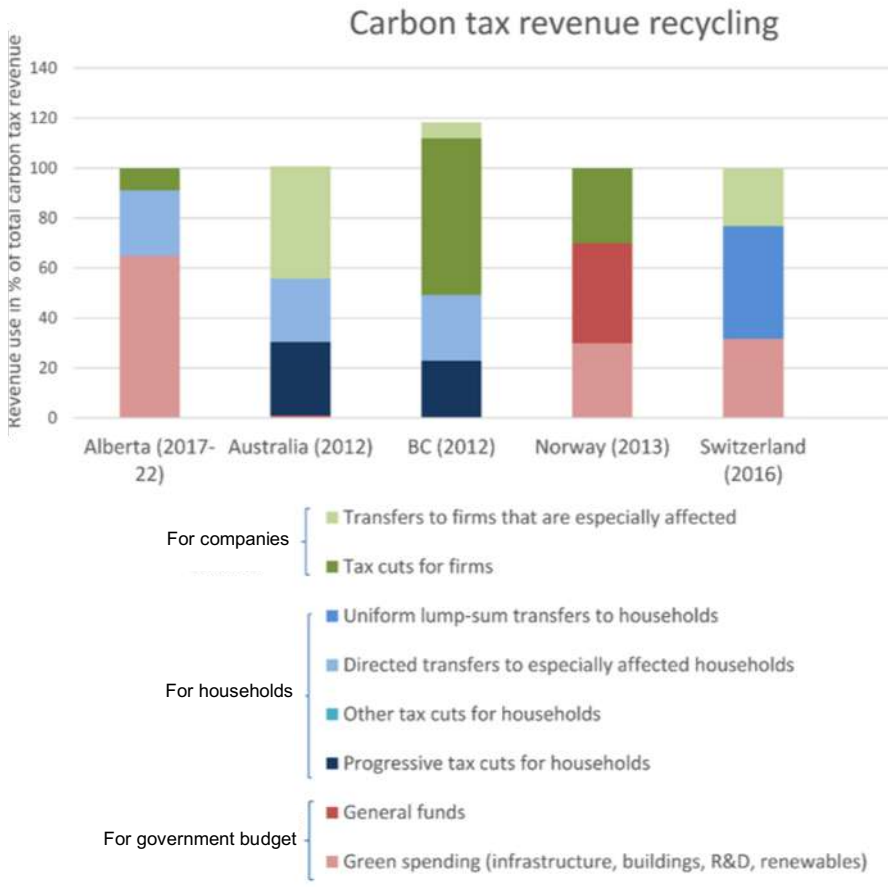
Re-use of carbon tax revenue is among the major design elements. Because, governments can obtain significant amounts of revenues through carbon pricing. Such that, carbon pricing practices experienced up to now show that even a modest carbon tax applying 30 US dollars per one ton of CO_2e emission may reach revenue of up to 1-2 percent of Gross Domestic Product (GDP). Starting from this point, it is important at the design phase of the carbon tax for the policy makers to decide how this revenue will be spent. Because, all decisions to be taken in this framework will have direct impacts on general economy, effectiveness of taxation and public welfare.

Two strategies have been developed for coordinating the use of carbon tax revenue, namely impartial use of the revenue and expenditure increase.

Impartial use of the revenue strategy is based on the principle of the government using the collected revenue to lessen other tax practices. For example, tax reductions applied for households and business world components are one of the most preferred practices among the re-use of the revenue options. Lightening the tax burden of low-income families is mentioned in the literature as the most typical and transparent form of the reuse of carbon price revenues.

Expenditure increase strategy is based on the principle of using the collected revenue for strengthening and maintaining the government incentives and policies that are in place in the current scenario. These measures generally focus on climate change policies (for example increasing the incentives for renewable energy projects) may be taken for supporting education policies, social programs or investment incentives in some carbon tax practices. Examples concerning the reuse of carbon revenue as practiced by different countries are shown in Figure 21.

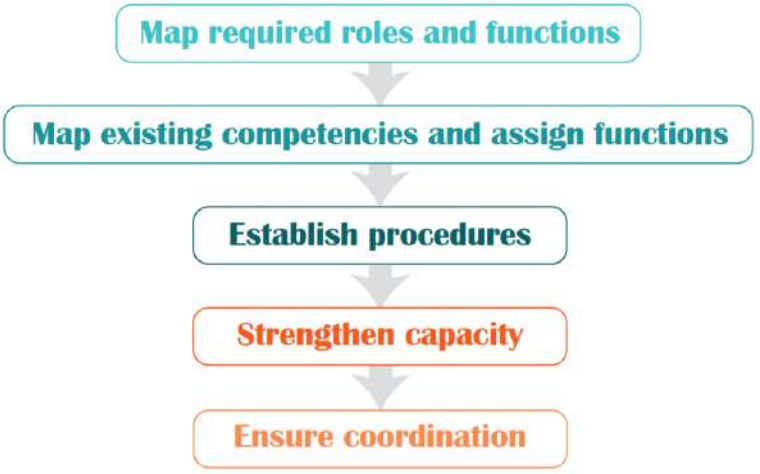
Figure 21: *Re-Use of the Revenue Obtained from Carbon Tax. Source: Our World in Data*



3.4.1.5. Compliance with Law and Supervision

One of the design elements that affect the success of the carbon tax to be applied is the mechanism of compliance with law and supervision. In this context M*onitoring, Reporting and Verification (MRV)* system and sanctions to be applied in case of violation of the law function as facilitating tools for the plants in the target group to comply with the law to be passed for carbon tax. Governments' establishing a strict supervision network forms the guarantee for this function. Establishing of such a framework covering critical arrangements such as these can be accomplished in five steps. These steps are listed in Figure 22.

Figure 22: *Stages of Institutional Arrangements to be made for the Implementation of Carbon Tax. Source: Climate Focus, Gnarly Tree Sustainability Institute & Indiana University.*



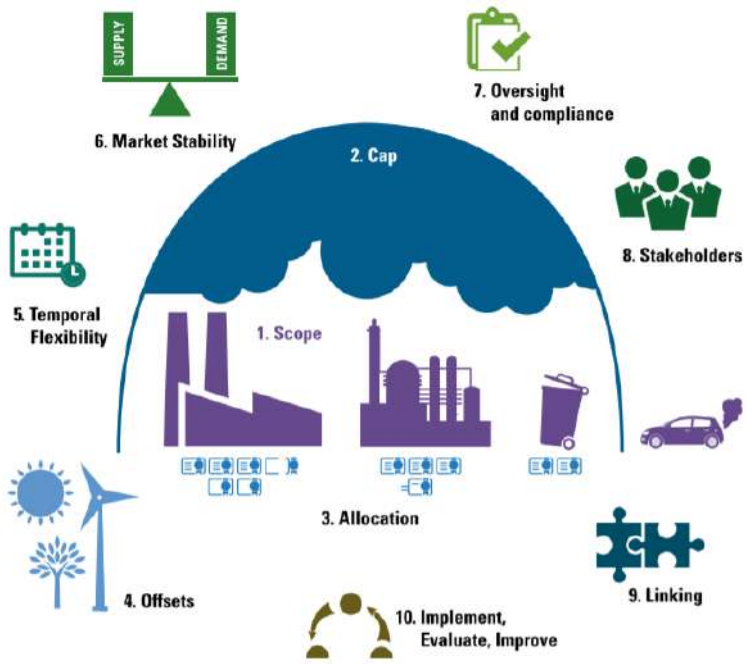
1. **Map required roles and functions:** This is the step of drawing the schematic for the coordination of basic requirements such as determining tax obligation, supervising tax management and putting the tax in force. In addition to three basic requirements here, each government may discuss new requirements according to the characteristic of its own carbon tax implementation.
2. **Map existing competencies and assign funcitons**: This is the step of deciding which entities will be charged with predetermined functions and in which entities new institutional structuring will be made.
3. **Establish procedures:** This is the step of drawing up certain procedures for MRV of emissions, tax evaluation, supervision of tax reports and determining eligibility for returns and related exemptions. These procedures may follow existing rules or may require new or adapted rules.
4. **Strengthen capacity:** This is the step strengthening the institutional capacities of the governments applying carbon tax, of the plants in the target group of the carbon tax and 3rd party verifiers included in the taxation scheme under the light of global practices.
5. **Ensure coordination:** As carbon tax is a financial measure, a series of policy interactions may be used covering different government entities. For this reason, necessary political measures should be taken to provide for relations among these entities in the design of carbon tax.

3.4.2. Emission Trading System Design Elements

Countries/regions considering toestablish Emission Trading System must determine the goals of this carbon pricing mechanism when designing the carbon tax and must apply a marginal prioritization procedure among these goals. Emission Trading System is a macroeconomic instrument that requires more careful analyses in its design compared to carbon tax because of the market dynamics it contains. In this context, the design elements lasted under the following headings, the points that the

countries/regions considering to establish Emission Trading System must take into consideration are described in accordance with Road Map Report for Establishing a Greenhouse Gas *Emission Trading System in Turkey,* prepared by Life Enerji, Ecofys and Future Camp. ETS design elements are shown in graphic from in Figure 23, which was taken from the same study.

Figure 23: *ETS Design Elements. Source: Life Enerji, Ecofys & Future Camp*



3.4.2.1. Pricing Scope

Determining pricing scope determines the interaction level of climate change mitigation policy that will be exercised with the application of emission trade practice in the context of geographical area, emission sources and greenhouse gas types. In addition, another function of the pricing scope to be determined is to shed light to governments on which geographical areas, emission sources and greenhouse gas types must be taken into consideration when making the allowances.

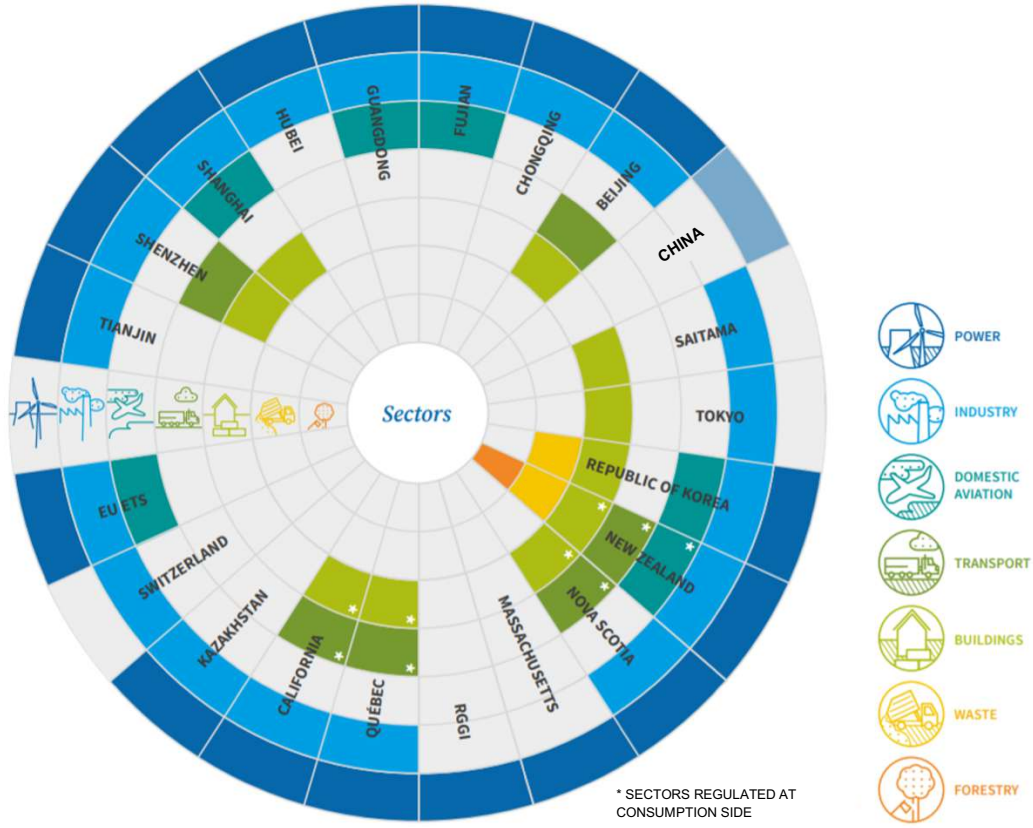
When determining the pricing scope in an ETS design, three basic decisions must be made. These decisions are described below.

1. Determining the sectors to be covered
2. Determining the gases to be covered
3. Determining regulation points.

Determining which sectors will be covered in pricing scope in an ETS determines the size of the ETS and the targeted greenhouse gas mitigation activity. Especially in industrialized countries these sectors are typically electricity generators and industries. Another point to be careful about is whether small polluters will be covered in the regulation or not. Considering the operation costs and administrative burden of ETS, covering high number of small emission plants (for example transportation sector) will not be cost effective, firstly for these polluters, secondly for ETS itself. Further, excluding sectors

which are difficult to monitor (for example agriculture sector) will increase the cost effectiveness of ETS. Sectors covered in pricing scope in different ETS practices are shown in Figure 24 in graphic form, which was taken from *Trends in Emissiton Trading System Report 2019* published by International Carbon Action Partnership (ICAP).

Figure 24: *Sectors taken into pricing scope in different ETS practices. Source: ICAP*



Determining which greenhouse gas types will be subjected to regulation within the scope of ETS is another decision that must be made under the heading of pricing scope. As discussed in sectoral coverage section, choice of gases to be subjected to regulation should be made in such a manner that will maximize the coverage but at the same time consider the administrative costs to increase the cost effective mitigation opportunities. In this context, carbon dioxide was included in the pricing scope in all ETS practices. In practices that subject gases other than carbon dioxide, emission amounts should be expressed in carbon dioxide equivalent *(CO_2e).*

Similar to the practice implemented within the scope of carbon tax, there are two regulation points in ETS where greenhouse gas emissions are subjected to regulation. They are *source side regulation point and consumption side regulation point*. Source side regulation points consist of places where greenhouse gas sources enter the country/region market such as fossil fuel extraction plants, refineries or fossil fuel importers/distributors.

Consumption side regulation points consist of the places where fuels causing greenhouse gas emissions are used in the country/region market. Administrative costs of source side regulation are lower than administrative costs of consumption side. For this reason, consumption side regulation is preferred in ETS's of countries/regions where sufficient data flow is provided in the current scenario and where there are established MRV systems.

3.4.2.2. Setting Emission Cap

Emission cap is the maximum amount of allowance that is given to the emission trade market by the government in a defined period of time. Emission cap limits the global greenhouse gas contributions made by the plants subject to regulation.

As explained in the earlier sections of the study, allowance is the right granted to polluters subject to regulation in Emission Trading System to make *1 ton CO_2e greenhouse gas* emission and it is known as carbon price in literature. Emission cap is one of the most powerful design elements that can affect the allowance prices. If the emission cap is strict (with high goal), number of allowances given to the market is minimized. In such a situation, there is allowance scarcity in the market and, in a reference scenario where other parameters do not change, allowance prices are high.

In an ETS design, when determining the emission cap, four basic decisions must be made. These decisions are described below.

1. Target level of emission cap
2. Approach to determine emission cap
3. Data to be used when determining emission cap
4. Period of emission cap.

Certain parameters affect determination of target level of emission cap. They can be listed as; whether environmental or system cost based approach will be used in determining the cap, discussion of whether the emission cap will serve a mitigation policy at national economy level, if mitigation policy is to cover certain sectors determining which sectors will be subject to regulation and deciding for how much of the emissions made at this cap will offset be used.

There are two approaches to determine the emission cap, namely absolute emission cap and intensity-based emission cap. Absolute emission cap is expressed in terms of absolute emission development in the period of time that emission cap will be applied. In other words, total emission amount to be made in that period of time is taken into consideration. In the intensity-based emission cap approach (Gross Domestic Product intensity) greenhouse gas emission per unit of production is focused on.

In determining the emission cap, there are various sets of data that can help policy makers. Contents of this these data sets may affect the success of ETS directly. Two of these data sets that are used most often are historical emission data and reference scenario data sets. Historical emission data is the type of data that is obtained from the emission inventory records of the country/region where ETS will be applied or from present statistics. Reference scenario data is the type of data that contains estimates based on emissions under a defined reference scenario. This is important to understand how greenhouse gas emissions will progress in a scenario without ETS system.

Emission cap period is defined as the number of years where emission cap is kept fixed under certain variables. The length of this period should meet three basic conditions. These conditions can be listed as follows:

I. Political foreseeability must be ensured,
II. Investor confidence must be ensured
III. Temporal flexibility must be ensured required for the policy makers to implement possible system variabilities.

3.4.2.3. Distribution of Allowances

Distribution of allowances defines the methods of distributing the allowances comprising the emission cap to the market at the beginning of a certain adaptation period. This design element also determines how the ETS costs will be distributed among the entities in the target group in the future. Such that, scarcity situation of the allowances in the market creates certain costs on ETS participants. One of the design elements that determine how these costs will be distributed among the participants is the method used in the distribution of the allowances at the beginning. These methods also affect the efficiency of ETS. For example, choice of these methods shapes the ETS design concerning issues such as understanding of ETS participants' production volumes, determining new investment locations and determining cost reflection scheme to consumers. There are two methods used in the distribution of allowances, namely free Allowance and auction.

In the free allowance method, allowances comprising the emission cap are distributed to the ETS participants free of charge at the beginning of the adaptation period in three different ways. The first of these ways is allowance according to historical emissions. In this allowance method, the entities in the target group of ETS receive allowances according to the historical emissions they made in the certain reference period of time. In the progressing stages of ETS, this reference scenario is either moved up or down or determine a more marginal reduction goal or to meet the expected economic growth. The second free allowance method is fixed sectoral comparison method. The basic logic behind distributing allowances with this method is determining a certain emission intensity reference criterion and historical activity level. Allowances are distributed among participant entities of ETS by referencing this criterion. The last free allowance method is production-based allowance method. This practice has similarities with fixed sectoral comparison method; the difference is that allowance amount is given not referencing the historical production level but current production level.

The second method used in the distribution of allowances is making auctions. This method, where allowances are determined jointly with ETS participants, is relatively simple and transparent. In this method, a good carbon price is determined in line with the nature of auction and entities in the target group need to make payment. It promises a powerful emission reduction with this feature.

3.4.2.4. Use of Offsets

Use of carbon offset certificates within the scope of ETS facilitates entities subject to regulation to make their reduction goals sustainable and finance them through more cost effective methods. Most carbon offset units, especially the carbon reduction units certified in developing countries, find buyers at a much lower unit price than ETS carbon units.

Limitations are being imposed related with the use of carbon offset certificates in mandatory carbon markets regarding project type or offset usage share. For example, carbon credits certified from forestation projects are not used in any ETS scheme except for California Emission Cap and Trade Program. In addition to this, there is a limit imposed on the percentage of carbon offset credits that are to be used in ensuring compliance with the law in almost all ETS initiatives. For example, in Quebec Emission Cap and Trade Program, polluters can

make maximum 80% of their reduction with offset credits; this ratio is 50% in EU ETS.

3.4.2.5. Temporal Flexibilities

Temporal flexibility is defined as the flexibility that the ETS participants will be granted on the time period in which greenhouse gas emission reduction will be made. There are two basic reasons for applying temporal flexibilities. The first reason is that temporal flexibilities give the ETS participants to lower their expenses. Because, by means of temporal flexibilities, entities subject to regulation within the scope of ETS can optimize the timing of their investments that they will make to perform their reduction activities. The second reason is the capacity of temporal flexibility to reduce price fluctuations. Because, temporal flexibilities may contain measures that foresee banking of the allowances or borrowing them. For example, by means of temporal flexibilities ETS participants have the possibility to buy or retain when allowance prices are low to be used at a time when allowance prices may be higher.

These flexibilities known as banking and borrowing in literature are an important driving force of a successful ETS practice. Because, while banking gives the entities in the target group of ETS the possibility to create a buffer against high prices in the future, borrowing feature takes part in a scenario where allowance scarcity and high prices are observed and provides contribution to market liquidity.

3.4.2.6. Market and Price Stability

Protection of market and price stability in Emission Trading System is important regarding the operational and environmental sustainability of ETS. For providing this stability, measures are taken aimed at price predictability and cost protection. These measures are taken under different conditions to keep the carbon prices under control directly or through indirect interventions.

In fact, price formation and price fluctuation is one of the reasons for ETS's being preferred as a macroeconomic mitigation tool. With this feature, ETS can determine the reduction with lowest cost possible in the market. However, external crises, regulator uncertainty, market irregularities and similar uncontrollable parameters ay cause price variations at undesired levels. These parameters are explained below.

External crises mean important changes in economic activities regulated by ETS and, in parallel to this, in observed emission levels.

Regulator uncertainty means compulsory or optional changes made in the design of ETS by policy makers.

Market irregularities mean the deficiencies that emerge when the market does not operate within the logic established on the evaluation of incentives provided within the scope of ETS. For example, when allowance prices fall below the desired levels in an ETS where banking is allowed, participants are expected to buy allowances to sell at a higher price later. This is seen as a guarantee for Allowance prices to remain at a normal level. However, when the participants are not able to utilize this opportunity due to regulator uncertainty or lack of technical information, market irregularities are observed.

In order to provide market and price stability in an ETS it is possible to intervene with these parameters through ways such as using an auction reserve price, known as market stability measure in literature, determining base price or ceiling price. With base price, governments buy some amount of allowances from the market to prevent carbon price from falling below a certain level. In price ceiling, governments

supply some amount of allowances to market to prevent carbon price from rising above a certain level. However, in a scenario where the amount of this allowance is not determined in a logical way, environmental outcomes of ETS will be jeopardized.

3.4.2.7. Compliance with Law and Supervision

Operability of a carbon market is dependent on the compliance of ETS components with the law (legislation). This law is a legal framework which covers the periods of adaptation to the law, definitions and responsibilities of the plants subject to regulation, definitions and roles of the regulatory entities, definitions and roles of the verification entities and principles of operability of ETS. In this context, certain design elements discussed in earlier sections of this study begin to interact with each other. In order to successfully coordinate such an interaction there is a need for a well-designed *Monitoring, Reporting, Verification and Accreditation (MRVA) system* and its legal basis.

A well-designed greenhouse gas emission monitoring system regulation plays a key role in minimizing technical risks observed in legal loopholes such as deficient implementation, redundant counting and transferring emissions outside the system. Also, monitoring system clarifies in which scope the entities covered in the ETS legislation will be subjected to regulation. Each plant subjected to regulation within the scope of ETS has to report its annual emissions.

A reliable reporting scheme must be established for archiving and managing the monitored greenhouse gas emissions in a reliable emission data base.

A verification system that implements the quality assurance process of the monitored emissions is among indispensible components of an ETS. Subjecting the greenhouse gas emissions to the approval of a third party facilitates the inclusion of data in the ETS scheme in a manner consistent with the legislation, comparable and transparent way. This kind of data is the guarantee of environmental integrity of the ETS.

Definition of the accreditation requirements of verification entities is a factor which affects the quality of verification process directly. A successfully designed accreditation system defines the necessary equipment that the verification entities need to perform verification services.

3.4.2.8. Stakeholder Participation

(This section has been written in accordance with the *Carbon Pricing Instruments Handbook* prepared in the scope of Climate Reality Project.)

Stakeholder participation is an important design element that strengthens the legality of ETS practice. Just as in the other policy designs, stakeholders should be determined for ETS, also. The most important points in determining these stakeholders are understanding why it is important to have the participation of stakeholders in the scope of ETS and what the priorities off these stakeholders are in ETS scheme. In this context, proper and timely arrangements to be made about stakeholder participation in ETS design will strengthen the public support for this mitigation measure. These arrangements can be listed as keeping the ETS stakeholders informed (for example providing information to public in stakeholder consultation meetings about the purposes of ETS), including stakeholders in the process (for example, feedback from public being taken into consideration by policy makers) and ensuring that stakeholders have the right to voice their opinions in the mitigation policy (for example, holding a referendum for implementing the ETS).

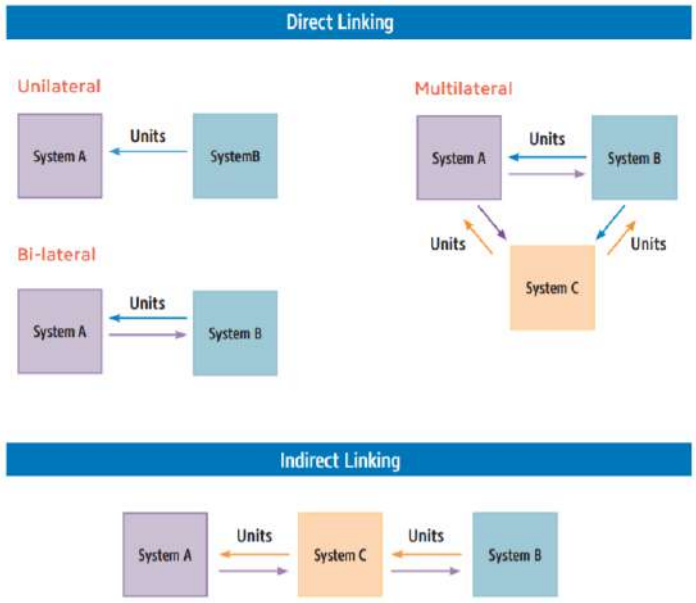
The most important stakeholders are the ones representing the government bodies. In the first stages of the design process it is important to provide detailed information to all government offices (departments, ministries, etc.) that could be included in the ETS scheme about the operation of the planned ETS. This measure plays a very critical role for preventing disputes that may arise between government offices at the stages when ETS becomes operational. For example, New Zealand government of the time started the policy making process at the design phase of the present ETS with an inter-departmental structure, named *Emission Trade Group*, assigned from employees of Ministry of Environment and Ministry of Treasury. Also, in addition to government bodies, market representatives and non-government organizations are included in ETS schemes as effective stakeholders.

3.4.2.9. Linking Markets

Linking of the markets (ETS's) becomes accomplished when it is allowed to use the carbon price units (allowances/certificates) of one or more markets in the related ETS to facilitate compliance of the entities subject to regulation in the scope of an ETS with law.

There are three types of links, namely *unilateral, bi-lateral and multi-lateral* links. In the unilateral link type, of the two linked ETS's, units of the first ETS are accepted in the second ETS. However, units of the first ETS cannot be used in the second ETS. In the bilateral link type, units of the other ETS are accepted in both ETS's. Multi-lateral link, on the other hand, is made in the different ways. Direct multi-lateral link is the linking of 3 or more ETS's as a result of an agreement covering all ETS's. As a result of this type of linking, allowances of all ETS's included in the linking scheme are accepted in other ETS's. Indirect linking is accomplished when two or more ETS's accept the units coming from a third system. These units may be allowances of the ETS's or carbon units used within the scope of a carbon offset mechanism. Linkage types are shown in Figure 25 in schematic form.

Figure 25: *Linkage Types of ETS's. Source: Life Enerji, Ecofys & Future Camp*



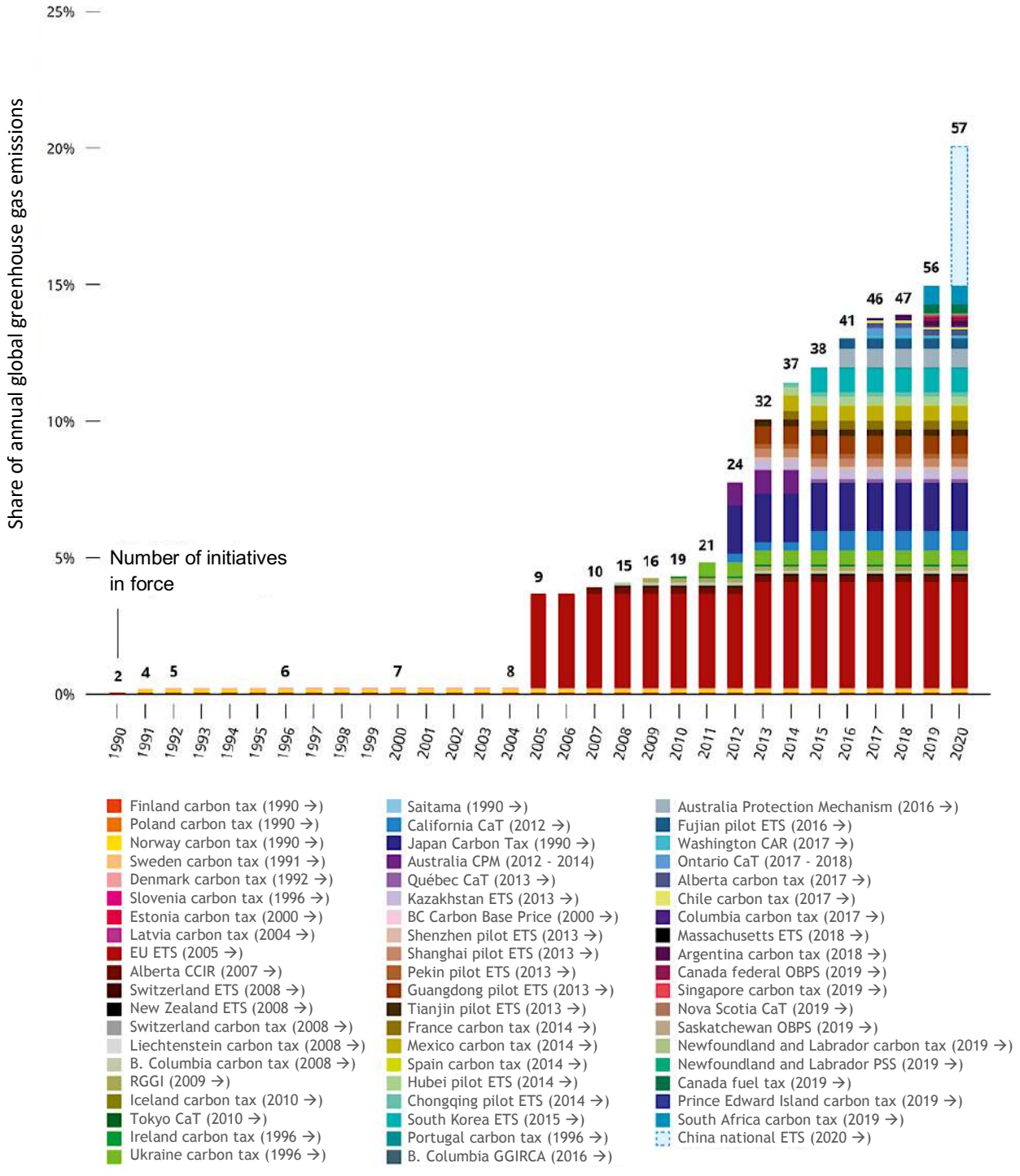
Linking of two or more ETS's to each other successfully depends on the compatibility of basic design characteristics of these ETS's such as emission cap, Offset use, observation of temporal flexibilities or market/price stability.

Linkages made without regard to this compatibility may cause disruptions in ETS's. For example, while it looks possible in theory to link an ETS designed with absolute emission cap to an ETS designed with intensity-based emission cap, it is possible to encounter some problems. Because, the ETS designed with intensity-based emission cap is perceived as having smaller volume compared to the ETS designed with absolute emission cap, it becomes difficult to find an emission reduction target at a common level in case these ETS's are linked to each other.

3.5. Case Analyses

According to World Bank data there are 57 carbon pricing (carbon tax and ETS) initiatives in operation in the world as of 2019. Number of these initiatives, which was 16 in 2009, increased rapidly in the last 10 years and it is expected to increase in the future. As reflected in Figure 26, taken from '*State and Trends of Carbon Pricing 2019*' report prepared by the World Bank, the carbon pricing practices implemented in the world cover 20% of the global greenhouse gas emissions. Starting from this point, analyzing some carbon pricing practices in operation will shed light on the practices to be implemented in the future.

Figure 26: *Share of Global Emissions Covered in Regional, Sub-National and National Carbon Pricing Practices. Source: World Bank*



All carbon priding practices listed in Figure 26 consist of mandatory carbon markets (carbon tax and ETS). Operation of the markets, principles and carbon prices don't vary appreciably in countries/regions where voluntary carbon markets are implemented. In this context, case analyses are selected from mandatory carbon markets (carbon tax and ETS) that became different practices in accordance with the market dynamics of the countries/regions they are applied in.

3.5.1. Carbon Tax Practices in the World

As shown in Figure 14, there are 25 Carbon tax practices in effect in the world. Five of these carbon tax practices will be discussed in this section of the study in accordance with the *Carbon Taxation Policies Case Studies Report and Climate Reality Project Carbon Pricing Instruments Handbook* published by Economy and Foreign Policy Research Center (EDAM).

3.5.1.1. Mexico Carbon Tax

Mexico Carbon Tax practice became effective on 1 January 2014. Taxation covers fossil fuel sales and importations made by fossil fuel producers and suppliers. Carbon price determined for one ton of greenhouse gas emission is approximately 3.5 US dollars. For this reason, compared to the practices applied in EU (6.70 $/ton CO_2e) and United Kingdom (15.75 $/ton CO_2e) Mexico Carbon Tax is seen as a modest practice. Also, considering that the carbon price required to keep the global temperature rise at 4 degrees centigrade in year 2100 must be kept at a value of 80 to 120 US dollars, it is difficult to say that Mexico Carbon Tax practice is a successful carbon pricing instrument. Mexico Carbon Tax, which does not subject any activity related with natural gas such as production, distribution, usage and importation, collects approximately 1 billion US dollars per year.

3.5.1.2. South Africa Carbon Tax

South Africa is the country that makes 14th largest greenhouse gas emission of the world. Carbon tax practice was presented to the South Africa national parliament as a draft law in 2013 and planned to be put into effect in 2017. But, due to political and operational delays, it was made into a law in the second quarter of 2019. Transportation and all other emission-intensive sectors will be regulated within the scope of this carbon tax. Unit price of South Africa carbon tax in reference scenario (in a scenario where there are no incentives and exceptions) is determined as 8 US dollars. But allowing the use of offset units at certain ratios and tax exemptions to be applied in some sectors being in varying rates between 60-90% reduces the effective unit price of South Africa carbon tax to levels between 0.4-3 US dollars. South Africa government stated that they are planning to raise the unit price of carbon tax by 4.5% every year until 2022. The revenue to be earned from carbon tax is planned to be used for establishing and managing results-based climate change mitigation measures such as *Independent Power Generators Program, Electricity Demand Side Management Program, Improved Free Basic Energy Program and Carbon Capture and Storage Discount*.

3.5.1.3. Norway Carbon Tax

Norway carbon tax is the second carbon tax in history and it was made effective in 1991 together with Sweden carbon tax. Unit price of Norway carbon tax was determined approximately as 18 US dollars in 1990's; its current price varies depending on the regulated sector. For examples, the tax received from unit ton CO_2e emission from petrol and diesel is 50 US dollars. Average price of Norway carbon tax calculated by considering the tax prices determined for different products and activities is approximately 60 US dollars.

Norway carbon tax covers 80% of greenhouse gas emissions of Norway together with Norway ETS, which is applied at national scale. Norwegian government, which makes substantial amounts of reductions in the unit price of carbon tax for sectors such as fishing, domestic aviation and shipping, keeps the most industrialized sectors of the country outside the scope of pricing, which make 18% of national emissions. Even though Norway's carbon tax is perceived as unsuccessful because Norway's annual gr eenhouse gas emissions increased by 15% between the years 1990-2005, achievement of 70% increase in Norway's Gross National Product shows that Norway's carbon tax is not an unsuccessful macroeconomic practice. Application of different unit carbon price for different sectors causes questioning of success of Norway's carbon tax in the future by some economic authorities. According to data obtained from Norwegian Petroleum, Norwegian Government is expected to earn 640 million US dollars in 2019. As can be seen in Figure 13, revenue earned from Norway carbon tax is used in general as support for general government budget and tax reduction (for households and some companies) purposes.

3.5.1.4. Sweden Carbon Tax

It is the third carbon tax introduced after Finland levied the first carbon tax of history in 1991. Unit price of Sweden carbon tax was 44 US dollars in the first years when it was introduced and it increased steadily in years. As of 2019, price of Sweden carbon tax per unit of greenhouse gas is 137 US dollars.

Swedish government applies some other energy taxes in addition to carbon tax; it seems that the most powerful driving force of this government's greenhouse gas reduction plans is these tax practices. Activities for distribution, processing and use of fuels such as natural gas, gasoline, coal, liquid fuel, liquefied petroleum gas and house heating oil are regulated under the scope of Sweden carbon tax. However, entities in the sectors of manufacturing industry, agriculture, common production plants, forestry and culture fishing are required to pay 50% of the carbon tax. Some facilities such as regional heating plants regulated within the scope of EU ETS began to be exempted from carbon tax since 2014.

Swedish government gains revenue of approximately 3.7 billion US dollars per year by means of the application of carbon tax. This revenue is transferred to the general budget of Swedish government in its entirety.

Carbon tax implemented by the Swedish government is considered to be one of the most successful macroeconomic climate change mitigation tools. Such that, according to the data of Swedish government, the greenhouse gas emission reduction of 15% achieved by Sweden between 1990-1995 has been recorded as a result of this successful implementation. Also, government official indicated that in a scenario where carbon tax is not applied, greenhouse gas emissions of Sweden as of year 2000 would be 20-25% higher. Parallel to this, it is considered that the most effective instrument Sweden has used for achieving the success of 24% reduction of greenhouse gas emissions in years 1990-2014 is still the carbon tax. In the indicated time period, Sweden's Gross National Product has increased 62%.

3.5.1.5. British Columbia Carbon Tax

British Columbia Carbon Tax is a sub-national carbon tax introduced in 2008. In this carbon tax practice almost all fuel types used in British Columbia and 70% of greenhouse gas emissions made from households, companies and industrial facilities are subjected to regulation. Starting unit price of British Columbia Carbon Tax was determined as approximately 7.62 US dollars in 2008. Within the time period until 2012 when it

reached 23 US dollars, Canadian Government increased unit carbon price approximately 4 US dollars every year.

As a result of application of carbon tax, fossil fuel consumption fell 16% within the borders of British Columbia. In other parts of Canada, fossil fuel consumption increased in this period of time, albeit slightly. On the other hand, Gross Domestic Product continued to increase in British Columbia, as in other parts of Canada. The revenue earned from British Columbia is used to make reductions in taxes collected from households and companies.

3.5.2. Emission Trading System Practices in the World

Emission trade is the most accepted practice among carbon pricing applications in recent years. In this context, there are 18 emission trading systems in operation in the world today. Five of these ETS practices are discussed in this section according to European emission trading system and Its Followers prepared under the guidance of emission trading system practices map published on the website of *International Carbon Action Partnership and Italian* economist Simone Borghesi.

3.5.2.1. European Union Emission Trading System

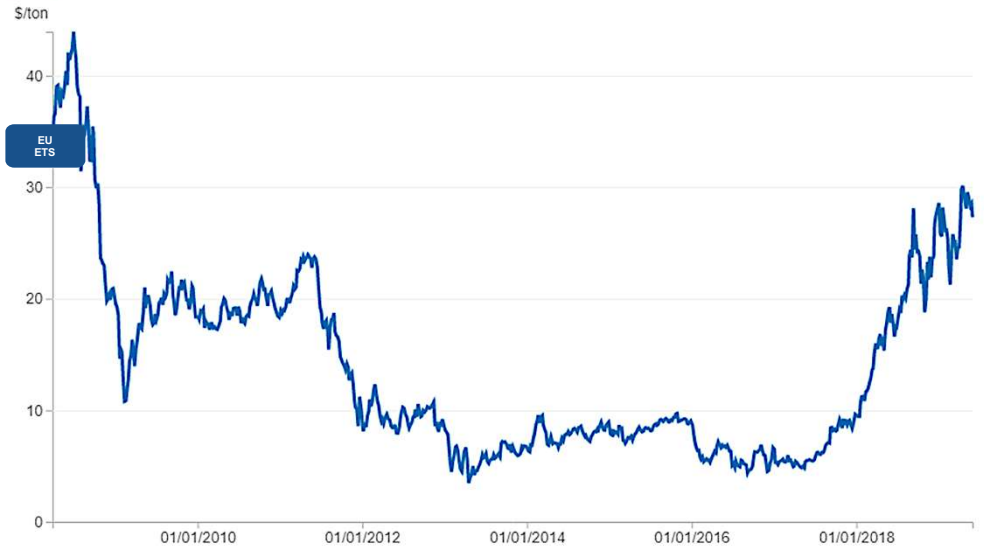
EU ETS is the first mandatory emission trading system put into practice and it has the characteristic of being a prototype for other ETS systems that were established since 2005 until today and for the ones to be established in the future. This macroeconomic mitigation instrument that covers approximately 2 billion tons CO_2e/year greenhouse gas emissions from more than 11000 plants regulates 40% of EU's emissions. With these features, EU ETS is one of the most important and experienced components of European Union's legislation in combating climate change.

Presently 28 EU member states are subjected to regulation within the scope of EU ETS as well as Norway, Iceland and Lichtenstein and three member states of European Economic Area (EEA) and European Free Trade Association (EFTA). Linking of EU ETS to Switzerland ETS is being considered. Official approvals are being expected from EU and Switzerland Parliaments by the end of 2019 at the latest for implementing the proposal that foresees the application of bilateral linking.

EU ETS's third stage will be completed at the end of 2020; its third stage will cover the time period between years 2021-2030. Current carbon price of EU ETS is approximately 24 US dollars. Change of EU ETS carbon price by years is shown in Figure 27.


LIBERTY
2011
IN GOD WE TRUST
E PLURIBUS UNUM
UNITED STATES OF AMERICA

Figure 27: *EU ETS Allowance Prices (2008-2019). Source: ICAP*



Consumption side regulation is practiced within the scope of EU ETS. Sectors subject to regulation are electricity sector, industries and domestic aviation. Greenhouse gas coverage of EU ETS is determined as CO_2, N_2O, and PFCs.

Allowances were distributed according to free allowance method at the first stage of EU ETS, but transition was made to auction method in the two following stages. EU ETS allows unlimited banking of allowances since 2008 but does not allow the practice of borrowing allowances. As of 2019, plants regulated within the scope of EU ETS can notify their emission reductions by using carbon offset at the rate of 50%.

In the time period that passed since EU ETS was made operational until now, revenue of approximately 42 billion US dollars was earned; the amount collected in 2018 is approximately 17 billion US dollars. It is planned to use the revenue to be collected in the fourth stage for climate change mitigation technologies under two mechanisms, namely Innovation Fund and Renovation Fund and for the innovations to be made in European industry.

If it is found that an entity subject to regulation within the scope of EU ETS made any irregularity in its emission declarations to be made in emission reporting period or ETS stages, some legal sanctions are applied for that entity. For example, an entity that was found to have made irregularity pays a fine of 118 US dollars for each ton CO_2e emission that it did not declare. Also, this entity is disclosed through relevant e-mail lists and social media accounts of EU.

3.5.2.2. California Emission Cap and Trade Program

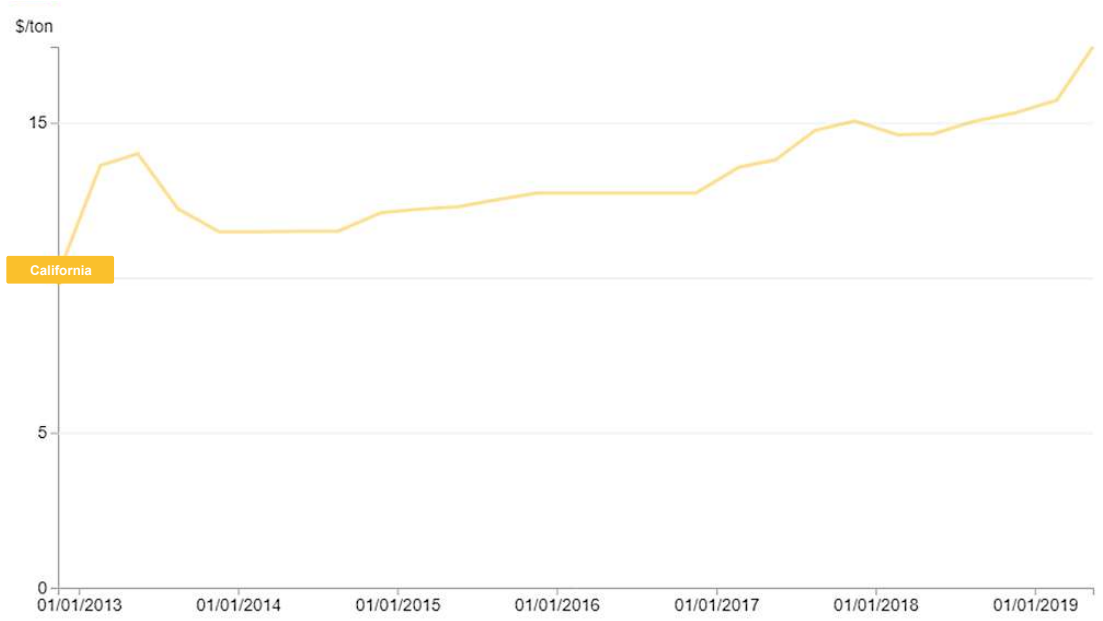
California Emission Cap and Trade Program (*Cap and Trade Program-CaT*) is an emission trading system that was put in effect in 2013 within the scope of Global Warming Combat Act passed in 2006. The government of California, which has the sixth largest economy of the world plans to lower the approximately 429 million ton CO_2e greenhouse

gas emissions to the levels of 1990's by year 2020. In this context, California CaT was designed to cover approximately 500 plants that are responsible for 80% of the total emissions at state level.

California Emission Cap and Trade Program was linked bilaterally with Quebec Emission Cap and Trade Program in 2014. In addition to this, these two linked emission tirade system were multi-laterally linked to Ontario ETS directly on 1 January 2018. But, Ontario ETS was closed in second quarter of 2018.

California CaT will complete its third stage at the end of 2020. Fourth of California CaT will cover the period of time between years 2021-2023. Present carbon price in this emission trading system is approximately 18 US dollars. Change of the allowance prices by years is shown in Figure 28.

Figure 28: *California Emission Cap and Trade Program Allowance Prices (2012-2019). Source: ICAP*



Fuel side regulation and consumption side regulation are applied within the scope of California Emission Cap and Trade Program. Pricing scope covers facilities that emit CO_2, CH_4, N_2O, SF_6, HFCs, PFC's, NF_3 and other fluor containing greenhouse gases. Also, in order for a facility to be covered in California emission trade scheme it must be emitting 25000 tons CO_2e greenhouse gases annually.

Depending on the sectors subject to regulation, allowances are distributed but by auction and free of charge in California Emission Cap and Trade Program. allowances are distributed to certain sectors free of charge at certain rates. However, in sectors where carbon leak is very high, allocators are distributed 100% free of charge. Government of California allows banking of allowances by imposing certain limits; but it does not allow borrowing of allowances. As of 2019, facilities subject to regulation can make emission reduction declaration by using offset units covering maximum 68% of their greenhouse gas emission reductions.

In the time period from the date California Emission Cap and Trade Program was launched up to now, a revenue of approximately 9 billion US dollars was

collected; the amount collected in 2018 is approximately 3 billion US dollars. Revenues collected from emission trade are used to increase the tax reductions to be made for low income groups or to support Greenhouse Gas Reduction Fund.

If it is found that an entity subject to regulation within the scope of California Emission Cap and Trade Program made any irregularity in its emission declarations to be made in emission reporting period or ETS stages, some legal sanctions are applied for that entity. These sanctions may be in the form of compensation penalty, fine penalty or prison sentence.

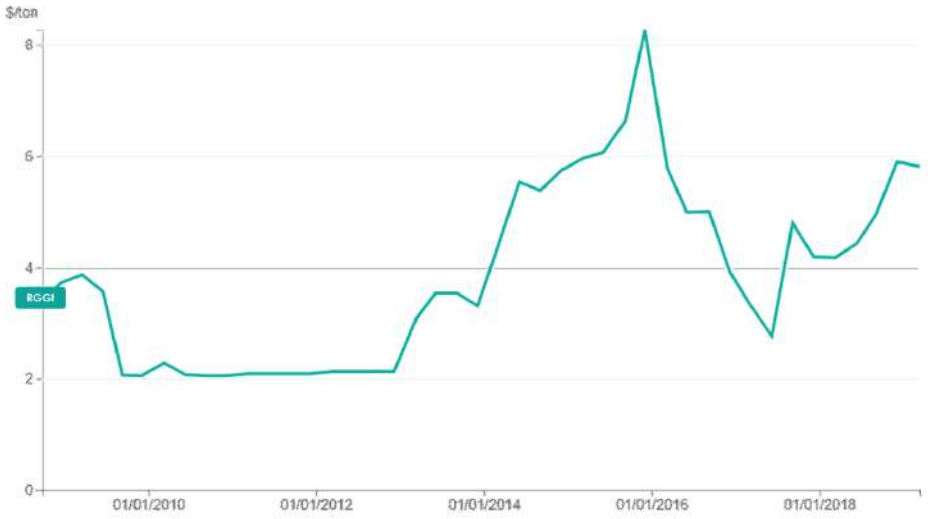
3.5.2.3. Regional Greenhouse Gas Initiative (RGGI)

Regional Greenhouse Gas Initiative (RGGI) is the first mandatory emission trading system of USA as a memorandum of understanding to regulate greenhouse gas emissions in the states of *Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island* and *Vermont*. Even though New Jersey was one of the states subject to regulation in the earlier stages of RGGI, it left RGGI to establish its own emission trade scheme in the later stages of RGGI. However, New Jersey and Virginia are expected to re-join RGGI in accordance with the agreement signed in June 2019 between RGGI member states and New Jersey and Virginia

Governments of member states of RGGI, which is responsible for 463 tons CO_2e greenhouse gas emission plan to make a reduction of 50% in greenhouse gas emissions in electricity sector in 2020 compared to greenhouse gas emission levels of 2005 and to make a reduction of 30% in 2030 compared to greenhouse gas emission levels of 2020. Even though RGGI is considered as one of the strongest macroeconomic mitigation instruments designed to achieve these reduction targets, emissions caused by activities subject to regulation within the scope of RGGI consist of 18% of the total emissions made by member states.

RGGI *control periods* (stages) are designed to be repeated every 2 years. In this context, RGGI will complete its fourth control period at the end of 2020. Present price of RGGI allowances is approximately 6 US dollars. Change of RGGI allowance prices by years is shown in Figure 29.

Figure 29: *Regional Greenhouse Gas Initiative Allowance Prices (2008-2019). Source: ICAP*



Consumption side regulation is practiced in the scope of RGGI. This pricing scope covers only 165 electricity generating facilities that make CO_2.

Allowances are distributed by auction method in Regional Greenhouse Gas Initiative and banking of the allowances is allowed. But borrowing of allowances is not allowed. In addition to this, as of 2019, facilities subject to regulation can make emission reduction declaration by using offset units covering maximum 3% of their greenhouse gas emission reductions.

In the time period from the date Regional Greenhouse Gas Initiative was launched up to now, revenue of approximately 3 billion US dollars was collected; the amount collected in 2018 is approximately 240 million US dollars. Revenues collected from emission trade are used to support climate change mitigation measures financially.

If it is found that an entity subject to regulation within the scope RGGI made any irregularity in its emission declarations to be made in emission reporting period or ETS stages, some legal sanctions are applied for that entity. For example, if it is found that an entity made deficient emission reduction, that entity is made to make three tons of emission reduction in the next control period for each ton of emission that it was required to make but it did not.

3.5.2.4. Quebec Emission Cap and Trade Program

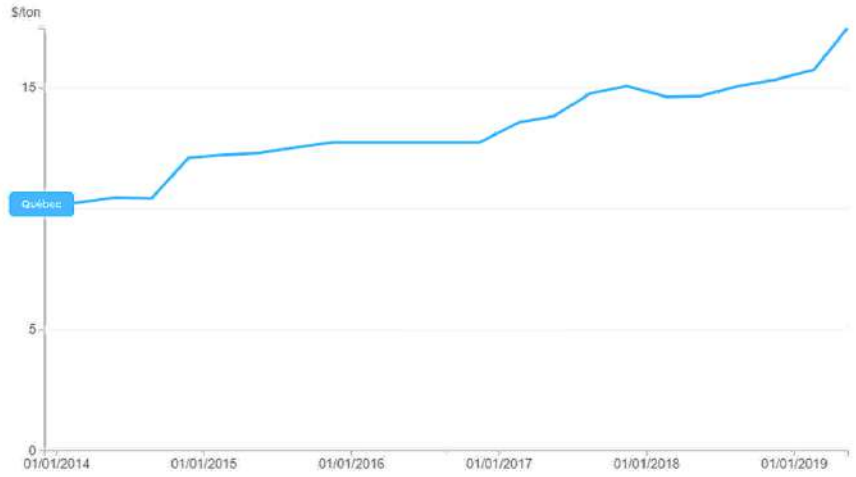
Quebec Emission Cap and Trade Program was founded in 2012 and made operational in 2013. This ETS practice, which is seen as one of the most successful applications among the macroeconomic climate change mitigation instruments operating within the borders of Canada, was bilaterally linked to California Emission Cap and Trade Program in 2014.

Quebec makes approximately 79 million tons CO_2e greenhouse gas emission per year. With the present climate change policies practiced in Quebec it is foreseen to make a reduction of 20% in greenhouse gas emissions in 2020 compared to greenhouse gas

emission levels of 1990 and to make a reduction of 30% in 2030 compared to greenhouse gas emission levels of again 1990. Considering that Quebec Emission Cap and Trade Program covers 80% of the total greenhouse gas emissions made in Quebec, one of the instruments that Quebec government relies on to achieve these targets is the option of emission trade.

Quebec Emission Cap and Trade Program was designed to have adaptation periods lasting three years, except for the first adaptation period. First adaptation period began in 2014 and lasted two years. Present allowance price of this emission trade practice is approximately 18 US dollars. Change of Quebec Emission Cap and Trade Program allowance prices by years is shown in Figure 30.

Figure 30: *Quebec Emission Cap and Trade Program Allowance Prices (2013-2019). Source: ICAP*



Source side regulation and consumption side regulation are practiced in the scope of Quebec Emission Cap and Trade Program. This pricing scope covers only 149 plants (74 industries and 75 fossil fuel distributors) that make emission of CO_2, CH_4, N_2O, NO_3, SF_6, HFC's, PFC's and other fluor gases.

Allowances are sold to some entities by auction method and distributed free of charge to some entities in Quebec Emission trade practice. For example, while electricity generators and fossil fuel distributors have to by 100% of the allowances, allowances are distributed free of charge to facilities with high carbon leak risk such as ceramic and cement producers. According to Quebec government data, 21 emission allowance auctions were held as of 1 January 2019, 17 of which were held together with California. Banking of allowances is allowed under certain limits. But borrowing of allowances is not allowed. In addition to this, facilities subject to regulation can make emission reduction declaration by using offset units covering maximum 80% of their greenhouse gas emission reductions.

In the time period from the date Quebec Emission Cap and Trade Program was launched up to now, revenue of approximately 2.2 billion US dollars was collected; the amount collected in 2018 is approximately 642 million US dollars. Revenues collected from emission trade are transferred directly to *Quebec Green Fund*. This fund was founded by Quebec government for financially supporting the action plans developed for climate change combat.

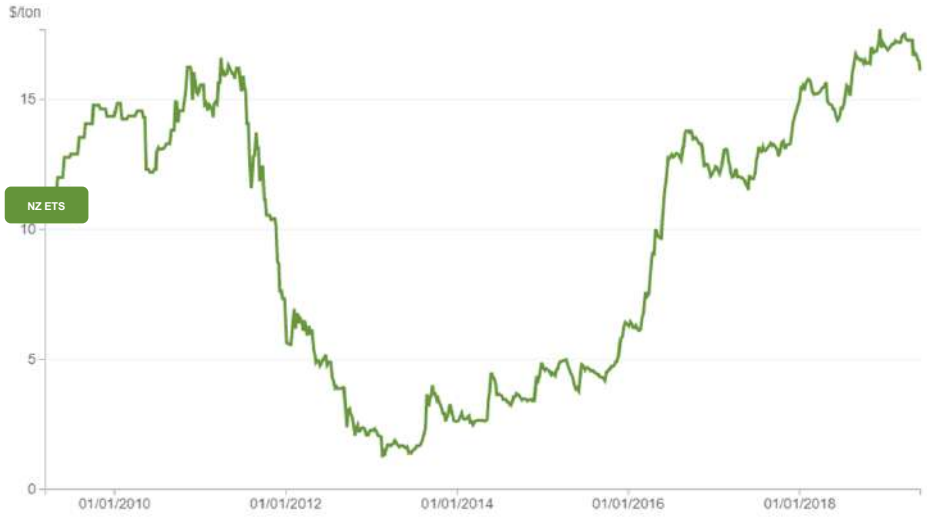
If it is found that an entity subject to regulation within the scope Quebec Emission Cap and Trade Program made any irregularity in its emission declarations to be made in emission reporting period or ETS stages, some legal sanctions are applied for that entity. For example, if this irregularity is made by an entity, the fine for each ton of CO_2e emission varies between approximately 2 US dollar and 385 US dollars; if it is made by a government employee its fine varies between approximately 7,700 US dollar and 2,300,000 US dollars. If this irregularity is made by an individual other than a government employee he gets a prison sentence of 18 months.

3.5.2.5. New Zealand Emission Trading System

New Zealand Emission Trading System was made operational in 2008. New Zealand ETS, which covers highest number of sectors compared to other ETS practices in the world, is based on the *Climate Change Combat Law 2002*, passed by the New Zealand government of the time. New Zealand ETS started functioning as part of New Zealand's adaptation process to Kyoto Protocol in a manner to be linked to all carbon markets in the world and it was transformed to a national carbon market in 2005.

New Zealand's annual greenhouse gas emission is 78.7 million tons CO_2e. New Zealand government plans to make a reduction of 5% in greenhouse gas emissions in 2020 compared to greenhouse gas emission levels of 1990, to make a reduction of 30% in 2030 compared to greenhouse gas emission levels of 2005 and to make a reduction of 50% in 2050 compared to greenhouse gas emission levels of 1990. New Zealand ETS has been designed as a macroeconomic component of this climate change mitigation plan. New Zealand Emission Trading System adaptation periods were designed annually. However, five-year adaptation periods are applied for some entities subject to regulation in forestry sector. Present value of New Zealand ETS allowance price is approximately 16 US dollars. Change of New Zealand ETS allowance price by years is shown in Figure 31.

Figure 31: *New Zealand Emission Trading System Allowance Prices (2009-2019). Source: ICAP*



New Zealand ETS was designed on source side regulation scheme. However, some large fossil fuel user facilities may be subject to regulation according to consumption side regulation principles. This pricing scheme covers 2448 facilities that make emission of CO_2, CH_4, N_2O, SF_6, HFC's and PFC's.

Allowances are distributed free of charge in New Zealand Emission Trading System. However, pursuant to the decision taken by the New Zealand government in 2018, allowances will be sold to all regulated sectors except for forestry sector by auction methods starting from 2020. In a scenario where allowances sold at fixed price are allowed to be banked, borrowing of allowances is not allowed in any scenario in this ETS practice. New Zealand government prohibits the use of offset in 2015. Before this date, it was allowed to use carbon offset units coming from Kyoto Protocol mechanisms in New Zealand ETS.

If it is found that an entity subject to regulation within the scope New Zealand Emission Trading System made any irregularity in its emission declarations to be made in emission reporting period or ETS stages, some legal sanctions are applied for that entity. For example, an entity fails to make a declaration in the determined schedule; it pays a fine of approximately 21 US dollars for each undeclared ton CO_2e greenhouse gas. Also, the fine for the technical errors (for example, calculation) that the entities may make in reporting of the emissions is designated as 16600 US dollars. In addition to this, for cases where entities are found to be manipulating their greenhouse gas emission data knowingly, the fine has been designated as 35000 US dollars.

3.6. Present Situation of Carbon Pricing in Turkey

Paris Climate Agreement, which was accepted in 2015 and took effect in 2016, has been a historical step in global climate change combat. Because, all parties to United Nations Framework Convention on Climate Change (UNFCCC) agreed on the issue of solving the climate crisis first time in the history. Before the Paris Climate Summit, Turkey declared on 21 September 2015 its Intended Nationally Determined Contribution (INDC) foreseen to be achieved as of 2030 as 21% reduction from increase.

The fact that Paris Agreement has taken effect in may party countries, turns the attentions to party countries that have not yet put the agreement in effect. It is known that necessary evaluations are being made in Turkey to put Paris Climate Agreement in effect. In this framework, Turkey is evaluating the greenhouse gas emission reduction measure options that it can use in case it puts Paris Climate Agreement in force. Among carbon pricing options, which are one of these possible measures, discussions draw attention such as establishing mandatory carbon market and improving the presently applied voluntary carbon markets. In this context, present situations of carbon pricing practices and initiatives in Turkey are analyzed in this section of the study.

3.6.1. Emission Trading System

The idea of using market-based macroeconomic instruments such as ETS and carbon tax for the solution of global climate crisis has been discussed in the literature for a long time. Legal and institutional studies aimed at using and putting in force of these instruments have been in the rise in Turkey for the last five years.

As discussed in earlier sections of the study, emission trading system is the most preferred carbon pricing mechanism in the world. As shown in schematic form in Figure 14, Turkey is among the countries that are considering implementing ETS. Especially the presence of an operational greenhouse gas monitoring, reporting and inspection system in Turkey puts the country in a position of a state that has the capacity to implement ETS. On the other hand, it is the subject of a discussion whether Turkey market is ready for the implementation of an emission trading system. Some studies have been conducted in Turkey on this issue. Road Map Report for Establishing a Greenhouse Gas *Emission Trading System in Turkey,* published within the scope of Partnership for Market Readiness (PMR) First Phase Activities organized by World Bank, as explained in Box 8, has been the first comprehensive that examines the effects and dynamics of a possible ETS practice in Turkey

In addition to this, as indicated in the article published by İklim Haber in September 2018, a site study was made on whether Turkey is ready for an emission trading system titled "Emission Trading System in Turkey" by İstanbul Bilgi University Environment, Energy and Sustainability Application and Research Center. Within the scope of this study, which is supported by TÜBİTAK 1001, important results have been obtained concerning understanding of the opinion of companies in Turkey about ETS and the expectations they have. Survey studies were made within the scope of the study with 404 companies that are in operation in 13 industry provinces including İstanbul, Kocaeli, Bursa and Gaziantep. These survey studies showed that seeing ETS as an effective policy instrument in combating climate crisis increased the possibility of ETS being supported to Turkey by 50.2%.

Box 8: PMR Project First Phase Results

PMR works as a guide application for implementing countries aimed at the effective use of market-based emission reduction mechanisms. PMR program has 18 implementing countries and Turkey is the first country that signed the program. In this context, the first stage activities PMR conducted in Turkey, which are role models for other PMR applications, were completed between years 2014-2018. In these activities, capacity development projects were executed for Turkey to have a new market-based reduction mechanism. In these studies, which were conducted in lien with the requests of T.R. Ministry of Environment and Urbanisation, reports prepared by bodies from Turkey such as Life Enerji and outside Turkey such as Ricardo, Ecofys, Future Camp, Vivid Economics were published. These reports are listed below, some of which were published publicly in official website of PMR Turkey.

- Guide for Preparation for Emission Trade System Operators in Turkey
- Road Map Report for Establishing a Greenhouse Gas Emission Trade System in Turkey
- Assessment of Suitability of Market-Based Emission Reduction Mechanisms for Turkey Executive Summary
- Assessment of Market-Based Emission Reduction Policy Options in Turkey Final Report
- Report of Assessment of Carbon Leak Risk within the Scope of carbon Pricing Policies in Turkey.

Most up-to-date studies on emission trading system in Turkey will begin in August 2019 within the scope of PMR Turkey Second Phase. In PMR Turkey Second Phase activities to be conducted for establishing an emission trading system in Turkey legal and instructional infrastructure will be formed for pilot application of emission trading system and legislation will be prepared by taking into account the practices in other countries. The related activities are listed below.

- Determining Emission Cap and Developing National Allowance Plan
- Developing ETS Transaction Registration System in Turkey
- Developing Emission Trading System (ETS) Simulation
- Developing Legal and Institutional Capacity for ETS Pilot Operation

As shown in *Figure 14*, which was taken from *State and Trends of Carbon Pricing report* prepared by World Bank, number of ETS practices put into effect in the world has made a very rapid increase in the last five years and this increase is expected to continue in the future. In the same report Turkey was stated as one of the countries considering implementation of ETS and Turkey's establishing its own emission trading system would be one of the most critical steps that Turkey can take to achieve science-based goals set forth in Paris Agreement.

3.6.2. Voluntary Carbon Market

Turkey has become one of the most active operators of voluntary carbon markets with the greenhouse gas reduction projects it has implemented since 2005. Such that, according to the data obtained from *Voluntary Carbon Market Analyses*: *General Outlook to 2018 and First Quarter Trends* report, Turkey has been one of the five countries that have operated highest number of voluntary carbon projects in this period of time. These countries and number of voluntary carbon projects they implemented are listed as India (442), China (426), USA (351), Turkey (124) and Brazil (97).

Turkey is subject to Gold Standard and Verified Carbon Standard (VCS) among the voluntary carbon market standards. According to the report titled *Voluntary Carbon Markets in Turkey* published in 2017, 75% of the voluntary carbon projects are Gold Standard projects and 25% are VCS projects. The same report indicates that when the implemented carbon projects are compared for emission reduction, 72% of the reductions are made by Gold Standard projects and 28% by VCS projects. Unit prices of VER credits issued by Gold Standard and VCS vary between 30 Euro cents and 85 Euro cents. As indicated in Box 9 the amount of certified emission reduction in Turkey in Gold Standard scope equals to the one-year greenhouse gas emissions of Belgium.

Most of the voluntary carbon projects implemented in Turkey are renewable energy projects. Buyers of carbon credits generated in voluntary carbon market dominated by Wind Power Plant projects,

Box 9: The 100 Millonth Carbon Credit certified in Turkey. Source: Life Enerji

Gold Standard stated in its monthly bulletin published in May 2019 that more than 100 million tons of CO_2e of emission reduction was certified through voluntary carbon projects implemented since 2006. In this context, it was indicated that the 100 millionth carbon credit belonged to Silivri Wind Power Plant voluntary carbon project executed by Life Enerji within the borders of Turkey. It is stated that this reduction made by Gold Standard is equivalent to neutralization (equalization) of Belgium's one year of greenhouse gas emissions.

Solar Power Plant projects and Hydroelectric Power Plant projects may be international institutions from outside Turkey such as Google, European Bank of Reconstruction and Development (EBRD) or institutions from inside Turkey such as Turkey Industrial Development Bank (TSKB), Garanti Bank and TAV Airports.

It is considered that Turkey's having an operational voluntary carbon market will make it easier for it to adapt to CORSIA, which will take effect in 2021 and to the emission trade scheme planned to be established.

4. ECONOMY MODELS IN GLOBAL CLIMATE COMBAT

Concrete measures put forward by UN with Paris Agreement such as restricting the global temperature rise not to exceed 2 degrees in 2100 and ensuring financial flow of 100 billion USA dollars to Green Climate Fund (GFC) for climate finance in developing countries every year, certain radical practices and transformation in development paradigms of the countries are on the agenda. One of the climate change combating components where these policies will be observed the most is, without doubt, the changes expected in economic models. The way to mitigate the adverse effects of climate crisis and turn them to benefit depends on the updating of global economy within sustainable approaches and applications. Within this scope, there are a series of economic models that were applied up to now and being presently applied. These models are basically classified under the titles of *Green Economy, Low Carbon Economy, Economy of Renewable Energy and Adaptation Economy* and it is known that they have some common points in theory and application stages.

4.1. Green Economy

Green economy can be defined as *the system of economic activities related with the production, distribution and consumption of goods and services resulting in improved human welfare in the long term without subjecting the future generations to significant environmental risks or ecologic scarcities*. In this sustainable economy model traditional systematic growth concept is abandoned and a low-carbon, resource-effective and socially inclusive economic development design is made. Green economy breaks the dependency of economy on environments (in the sense of resource and effect) and aims to perform production and consumption within the bearing capacity of the planet.

Basic actions targeted within Green Economy are listed as reducing of waste generation and use of raw material and energy consumption observed at production and consumption stages significantly and supporting new technologies and innovative practices parallel to the above measures. The applications to be conducted within this scope can be listed as follows in accordance with the report titled *Shades of Green: Introduction to Green Economy for Parliamentarians*, published by United Nations Environment Program (UNEP) in 2019:

- Reducing the use of the capital goods such as products, equipment or mechanical tools that are presented to the consumer as economic outputs, re-using and recycling of the same
- Making capital-intensive investments in renewable energy (solar, wind, bio, etc.) and in applications where common energy use is encouraged (public transport, etc.)
- Making policy changes that will be made with cost effective means and ensuring that environmental resources urea used co-equally (for example, fuel efficiency rules to be imposed for automotive industry, taxation for electricity consumption over a certain level, etc.)
- Application of policies and laws that facilitate equal, supportive and participative employment (for example, protecting/ improving collective bargaining rights of employees, etc.)
- Making financial policy reforms that ensure/facilitate internalization of externalities, spending of public funds on green investments making consumer and producer behaviors sustainable (for example, carbon markets, carbon tax, etc.)

In fact, combating climate change requires more than the set of technologic improvements, innovations and environmental policies to be implemented at basic level. In this context, three approaches began to draw attentions that can be evaluated as supportive for Green Economy dynamics in economy by time. These approaches are listed as *Sharing Economy, Circular Economy* and *Low Carbon Economy*.

4.2. Sharing Economy

Sharing Economy means a style of consumption and ownership that makes individual goods (car, house, business machine, etc.) accessible for many people. Sharing Economy is based on common services tradition provided by public or private operators (for example, public transport, local taxi services, house renting services). The basic change presented with this approach is the use of on-line platforms to facilitate the consumption of this type of products by more people. For example, in the context of climate change combat, renewable energy cooperatives are one of the best practices of sharing economy. renewable energy cooperatives are collective and local energy generating plants that are built to decrease dependency of a certain community on traditional energy resources (natural gas, petrol, coal, etc.) and traditional energy provider entities (public and private companies responsible for energy generation and distribution). Providing for requirements of consumption and production in different fields of development such as energy requires a significant economic transformation and sharing economy presents creative and solution-oriented practices.

4.3.Circular Economy

Circular Economy focuses on production process and consists of green recycling principles applied all components of economy. Cyclic model encourages the improvement, renewal and re-use of materials by encouraging efficient and sustainable management of natural resources over their life cycle.

Circular Economy abolishes the concept of "*From Cradle to Grave*" in the sense of product consumption and raw materials; it applies the concept of "*From Cradle to Cradle*" that reduces the demand for new resources and energy inputs and minimizes the pressures applied on the environment regarding extraction, carbon emissions and waste generation. That is, circular economy basically depends on product design that aims to extend the life of a product almost indefinitely by replacing every broken or unused part in that product.

In the report titled Circular Economy Deficit[4] prepared by UNEP and GEF in 2019 it is stated that the present global economy is operated with a budget of 92.8 billion tons of mineral, fossil fuel, metal and biomass. The same report underlines that the present global economy is 9% cyclic. Under the light of this information, in the report prepared by UNFCCC Secretariat in January 2019 it is indicated that circular economy is an extremely critical solution for achieving the goals set forth in Paris Climate Agreement.

[4] Cyclic Economy Deficit Report.

4.4. Low Carbon Economy

Various definitions were made for low carbon economy up until now. As a result of these definitions some new concepts emerge as sub-headings of *Low Carbon Economy such as low carbon energy, low carbon life, low carbon society, low carbon city, low carbon community* and *low carbon tourism*. While these concepts that are interrelated with each other yet have some basic differences define Low Carbon Economy, they do not discuss by themselves the aspects of Low Carbon Economy that differentiate it from other sustainable economy models.

Low Carbon Economy is a development model that focuses on minimization of greenhouse gas emissions. Two basic concepts emphasized in line with this are; 1- source efficiency and 2- energy efficiency. In the regulation published by European Commission in 2012 underlines that a low carbon European economy to be built within the borders of EU can be accelerated with smart heating and cooling systems (low energy/ energy efficient) and electric/hybrid cars to be used. (EFFECT-Dialog Platform on Energy and Resource Efficiency in Baltic Sea Region, 2013).

Within the scope of Paris Agreement, some countries /regions that made relatively ambitious climate action commitments are making improvements in their plans for transition to low carbon economy and designating ***Zero Carbon Economy*** goals. A new zero carbon growth plan was generated in European Union where the target group is comprised of certain sectors. In this new economy practice, it is indicated that it is possible for energy-intensive sectors operating within the boundaries of EU to reduce their carbon emissions to zero by 2050. As discussed in two recently published studies titled *Industry Transformation 2050 – Zero Emission Policies of EU Heavy Industry* and *Industrial Strategies Form a Climate Neutral Europe* innovations such as reducing the use of raw materials and technologic improvements planned to be made in steel, chemical and cement sectors, which are responsible for 14% of the carbon emissions of EU, is seen as the most powerful driving force of EU's zero carbon economy plan.

Switzerland, which is not a member of EU but adopted many of EU's policies, draws attention as one of the countries preparing to make radical changes on the way to zero carbon economy. In up-to-date reports published by Intergovernmental Panel on Climate Change (IPCC) it was indicated that Switzerland Federal Government Council has set a net zero carbon emission target for year 2050. In this context, it is aimed that Switzerland economy to decrease carbon emissions by 95% by 2050 and to conduct R&D studies to decrease CH_4 and N_2O emissions.

Ensuring transition to Low Carbon or Zero Carbon Economies depends on facilitating energy efficiency through technologic innovations covering all sectors and obtaining a green gross domestic product through renewable energy. In other words, this approach is dependent on application of practices that reduce greenhouse gas emissions without compromising economic growth and implementation of climate-resistant actions. When viewed from this point of view, it may be considered that Green Economy is the most important step taken for transition to Low Carbon Economy.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