CARBON FUNDS IN CLIMATE POLICY

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CeDeWu

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List of Acronyms

AAU	Assigned Amount Unit
ADB	Asian Development Bank
AIE	accredited independent entity
CAF	*La Corporación Andina de Fomento*
CCS	carbon-dioxide capture and storage
CDM	Clean Development Mechanism
CDM EB	Clean Development Mechanism Executive Board
CER	Certified Emission Reduction Unit
CITL	Community Independent Transaction Log
CMA	Conference of Parties serving as the meeting of the Parties to the Paris Agreement
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
COP	Conference of Parties
DFP	designated focal point
DNA	designated national authority
DOE	designated operational entity
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
ERPA	Emission Reduction Purchase Agreement
ERU	Emission Reduction Unit
ET	Emission Trading
EU	European Union
EU ETS	European Union Emission Trading System (Scheme)

EUA	European Union Allowance
EUAA	European Union Aviation Allowance
EUTL	European Union Transaction Log
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
GIS	Green Investment Scheme
IBRD	International Bank for Reconstruction and Development
ICAO	International Civil Aviation Organization
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
ITL	International Transaction Log
JBIC	Japan Bank for International Cooperation
JDB	Japan Development Bank
JI	Joint Implementation
JISC	Joint Implementation Supervisory Committee
lCER	long-term Certified Emission Reduction Unit
LDC	least developed country
LULUC	Land use, land-use change and forestry
NEFCO	Nordic Environment Finance Corporation
PDA	Project Development Agreement
PDD	project design document
PIN	project idea note
PoA	Programme of Activities
RMU	Removal Unit
SPV	special purpose vehicle
tCER	temporary Certified Emission Reduction Unit
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change

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Preface

Climate policy needs international cooperation to ensure the implementation of its premises. At the global level, the premises are elaborated at the United Nations forum. The United Nations Framework Convention on Climate Change (hereinafter the UNFCCC) and the Kyoto Protocol to the United Nations Framework Convention on Climate Change (the so-called Kyoto Protocol) have been the most influential agreements as for now. The Kyoto Protocol created the first global system of targets for reduction of greenhouse gases (hereinafter GHGs). The Kyoto Protocol has been ratified by, among others, all of the European Union (hereinafter the EU) member states. In order to facilitate the fulfilment of commitments under the Kyoto Protocol, the member states have taken a number of measures at the EU level, including the establishment of the European Union Emissions Trading System (also known as the European Union Emissions Trading Scheme, hereinafter the EU ETS).

The general principle of climate policy implementation at both international and the EU level, is to reduce GHG emissions in the cost-effective manner, which is intended to be achieved by using of a set of economic instruments, including tradable permits for GHG emission in particular (called carbon credits; the term carbon credit is derived from carbon dioxide, with other GHGs converted against carbon dioxide). During the first commitment period of the Kyoto Protocol, on the demand side of the market for carbon credits (called the carbon market), there were not only the signatories to the Kyoto Protocol, for whom the reduction targets had been set, but also some entities covered by the EU ETS.

A number of specialised institutions, the so-called carbon funds, operate on the carbon market. They pool funds collected from one or more investors and buy carbon credits. Investors in those funds expect to obtain benefits in the form of carbon credits (that can be used to meet the obligations imposed by the law or to realise voluntary pursuits) or capital gains (credits purchased by the fund are sold on the market). Carbon credits can be purchased on the primary market, which includes the Kyoto Protocol project-based mechanisms, or on the secondary

market. Research into economic aspects of environmental protection and environmental policy is well developed on the theoretical and empirical grounds, in the foreign literature in particular. The studies concern, in the first place, the costs and benefits of environmental protection and the tools of environmental policy. The number of studies into the global and EU climate policy is rising, too. However, the current state of research into carbon funds is limited to some analyses of the carbon funds' share on the primary market for carbon credits generated by projects implemented under Joint Implementation (hereinafter JI) and the Clean Development Mechanism (hereinafter CDM), types of projects selected and, to a very little degree, their organisation (ownership and management). There have been no studies yet aimed at a complex analysis of the organisation and activity of the carbon funds which purchase carbon credits directly from JI and CDM projects. The public debate over the public investment vehicles has given an impulse to research carbon funds of public nature.[1]

One can argue that the organisation and activity of carbon funds is affected by the character of the implemented climate policy. As a result, an analysis of carbon funds should be preceded by research into the political and legal environment as well as organisational situation in which carbon funds operate, and by a comparison of the two aforementioned project-based mechanisms from which carbon funds purchase carbon credits.

The primary objective of the original research presented in this book is stated as follows:

An analysis and evaluation of the organisation and activity of public and mixed carbon funds on the primary market for carbon credits with regard to the climate policy.

In relation to the aforementioned issues, two hypotheses have been formulated:

1. **The agreed climate policy rules condition the presence of a single organisational model as well as the scope of the activity of a carbon fund of public nature.**
2. **The effectiveness of carbon funds of public nature at least equals the effectiveness of all the other entities purchasing carbon credits directly from the JI and CDM projects.**

Effectiveness is understood as a degree of achieving an established aim.

[1] For the purpose of this study, carbon funds of public nature comprise public carbon funds and mixed carbon funds. Public carbon funds are understood here as entities in which 100% of the capital belongs directly or indirectly to the public sector, whereas in the case of mixed funds more than 5% of the capital comes directly or indirectly from the public sector of one country (cf. Subchapter 4.1).

To achieve the main goal of the study and to either confirm or disprove the above-stated hypotheses the following sub-objectives have been distinguished:

1. A comparison and evaluation of the assumptions, forms and organisation of global and the EU's climate policy.
2. Defining carbon funds' essence and the recognition of carbon funds that purchase carbon credits from the JI and CDM projects, and of the public and mixed carbon funds, specifically.
3. Identifying the determinants of the model of carbon funds of public nature.
4. An analysis and evaluation of the effectiveness of carbon funds of public nature.

The main subject of the book is the organisation and activity of public and mixed carbon funds which purchased carbon credits on the primary market (directly from the JI and CDM projects) as of 1 January 2013. The analysis of the organisation and activity of carbon funds covered the years 1999-2012. The study focused on selected aspects of the organisation and activity of public and mixed carbon funds, namely: the goals, organisational forms, management, scope of activity, investment decision-making grounds, ways of funding the projects, and risk-taking aspects. The analysis also concerned the effectiveness of investment decisions made by carbon funds of public nature in comparison with all the other entities purchasing carbon credits directly from JI and CDM projects.

The conditions and regulations concerning global and the EU's climate policy as well as the construction and functioning of the JI and CDM are also a focus of this book. The timeframe of the relevant analysis ranged from 1992 to the end of 2015, thus allowing the exploration of the assumptions concerning those mechanisms and their implementation. The following methods were employed in the original research: the descriptive analysis (cause-and-effect, comparative with the elements specific for political science and law studies used for the analysis of global and the EU's climate policy rules) and the statistical analysis (the Kruskal-Wallis test and tests for normality).

The study involves an extensive Polish and foreign literature coverage on the subject of the theoretical aspects of environmental protection and environmental policy instruments. The analysis also refers to numerous agreements and laws, as well as guidelines published in the United Nations' and the EU' documents.

The data used comes from the JI and CDM Pipeline databases (provided by the UNEP Risø Centre). Apart from that, the analysis is also based on the information and documents made available on the websites of carbon funds and of other entities purchasing carbon credits coming from JI and CDM projects on the primary market.

The book consists of five chapters and an annex.

The first chapter deals with the issue of the environmental policy, the climate policy in particular. It presents an overview of the main trends in the theory of

economics regarding the exploitation of natural resources and environmental services as well as the conceptual basis for climate policy. Furthermore, external environmental costs and the tools for internalising them are discussed in detail. Special attention is paid to tradable pollution permits and to the practical implementation of this tool.

The second chapter explores the development of global and the EU's climate change policy. It also presents an overview of carbon units used in the emission reduction and the limitation system created by the Kyoto Protocol and in the EU ETS. The chapter concludes with a comparison of global and the EU's climate policy.

The third chapter consists of an analysis of two projects-based mechanisms – the JI and CDM. A comparative analysis of those mechanisms, along with a discussion about the possible financing structures for projects implemented under them, allows for a better understanding of the carbon funds' activity on the primary market for carbon credits generated by both the JI and CDM.

The next two chapters are the most important part of the book. They show the results of a detailed study on the organisation and activity of carbon funds of public nature. The outcomes make it possible to verify both the hypotheses. The fourth chapter starts with a clarification of what is meant by "carbon fund." The remaining part of the chapter considers the key determinants of the organisation and operations of carbon funds of public nature. Based on the presented scrutiny, a model of a carbon fund of public nature is defined, and the first hypothesis is verified.

The last chapter deals with the results of a statistical analysis of public and mixed carbon funds' effectiveness in comparison with all the other entities that purchase carbon credits directly from project-based mechanisms. Based on this research, the second hypothesis is verified.

The annex contains some basic information on carbon funds of public nature and an overview of the statistical tests used in the analysis.

The book adopts an interdisciplinary approach to the subject of carbon funds' organisation and activity. It combines the achievements of various disciplines as well as areas of study and practice, including finance, organisation and management, statistics, economic theory pertaining to the natural environment, the practice of environmental protection, as well as climate change policy.

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Chapter 1

The Economics of Climate Policy – the Theoretical Framework

Economy is inseparably linked to the environment. This relationship takes the form of a feedback loop. The environment provides mankind with environmental goods and services that are essential to performing all kinds of activity, including the economic activity while the man impacts the environment and transforms it.

Economics is a science that studies the issues of the alternative use of limited resources in order to achieve goals of different priority [Robbins 1945, pp. 12-13]. The author of this commonly accepted definition points out that not all the goods necessary to conduct economic activities are limited, and provides the example of air (the term "free good," which was created by Say, refers to air [Dyduch 2013, p. 14]) [Robbins 1945, pp. 14-15]. Nowadays, there is no doubt that ecological goods and services, including the assimilative capacity of air, are limited, and that they are part of the economic problem.

1.1. The Ecologisation of Economics vs. the Economisation of the Natural Environment

Interest in the exploitation of the natural environment and non-renewable resources as well as in the relation between the economy and the environment changed over time. By the mid-twentieth century, the very problem of the overexploitation of resources and the assimilative capacity of the environment was subject of research of very few economists. In fact, in the past, ecological barriers to economic growth were not even taken any notice of [Fiedor 2002, p. 38].

In particular, water and air were regarded as inexhaustible and nobody took into account the fact that water and air's capability to assimilate contaminants could ever be exceeded [Fiedor 2002, p. 38 and Dyduch 2013, p. 14].

However, no ideas, including those questioning the validity of the commonly accepted views, are born in an intellectual vacuum, and their originators typically draw from the achievements of their predecessors (even though this heritage forms the basis for criticism). Costanza, Cumberland, Daly, Goodland and Norgaard [1997, pp. 32-52] created an extensive list of thinkers and scholars whose concepts are particularly useful in considering the relation between the economy and the environment. This list was extended and organised by Rogall [2010, pp. 118-124]. The below-mentioned synthesis is based on the achievements of those thinkers. It is shaped in such a way that it covers the concepts of the economic thought starting with neoclassical economics, and includes the views that are justifiable on grounds of fulfilling the purpose of this study.

Under the commonly known classification of economics, mainstream economics and heterodox economics are isolated. Schools of heterodox economics differ from the mainstream in terms of policy matters, assumptions and/or methodology [Landreth and Colander 2005, p. 407]. As noted by Poskrobko [2012, p. 11], they all study the relationship between the economy and the environment. An important point to remember is that mainstream economics is dominated by neoclassical economics. Neoclassical economics engages formalism[2] in the economic analysis and assumes that the institutional environment and resources are given. It focuses on the market mechanism and the way the acts of the rational and fully informed stakeholders contribute to the achievement of the equilibrium [Landreth and Colander 2005, pp. 549-554]. Thus, neoclassical economics has a limited interest in natural resources and environment matters [Rogall and Oebels 2010, p. 5]. For this reason, the trends in economics that focus on studying the relationship between the economy and the environment are classified primarily as heterodox approaches to economics.

The neoclassical economics paradigm gave rise to environmental economics. This approach to economics is concerned with the environment (efficient allocation of resources in particular without questioning their primary allocation) [Costanza et al. 1997, p. 42]. The representatives of environmental economics do not challenge consumer sovereignty and the concept of *homo oeconomicus*, and they do not allow for any allocation mechanisms other than the market and prices, either. They postulate the undisturbed market economy as well as free trade and call for a continuous economic growth. Furthermore, they consider natural resources as input factors of production and they believe natural resources can be substituted. This assumption leads them to the conclusion that the optimal use of resources is

[2] One should have in mind that formalism reveals its own limitations when it comes to analysing the social, cultural, historical and natural contexts [Rogall 2010].

the primary goal of natural resources management [Rogall 2010, p. 174]. Harold Hotelling (1895-1973) was one of the forerunners of this approach. In the article *The economics of exhaustible resources*, published in 1931, he argues that the behaviour of the owner of mineral resources depends on the anticipated changes in the value of the resources and the interest rate. Hotelling assumed that maximising profits is the guiding principle of the owner. Therefore, the owner forgoes to extract minerals on condition that he or she expects an increase in the resources' value. The rise has to be high enough so as to generate profits greater than those the owner would possibly make if he or she extracted all the minerals and put the proceeds in an interest-bearing deposit [Hotelling 1931].

Another approach to economics, known as neoclassical environmental economics, recognises the existence of externalities (cf. Subchapter 1.3), therefore, it accepts the need to protect the environment. Its representatives hold the view that the objectives of the environmental policy should be achieved in an economically optimal way. This stance is called the economisation of the natural environment [Fiedor 2002, p. 22].

Criticism of neoclassical environmental economics resulted in the emergence of another school of economic thought that deals with the relationship between the economy and the environment, i.e. ecological economics. As opposed to neoclassical environmental economics, ecological economics assumes the existence of "ecological safety barriers." It acknowledges consumer sovereignty and the allocation function of the market only to a limited extent (consistent with "ecological safety barriers"). Moreover, representatives of this approach do not accept the concept of *homo oeconomicus* uncritically [Rogall 2010, p. 174]. Ecological economics questions the possibility of the substitution of some types of natural resources. While neoclassical environmental economics postulates an optimal use of those resources, ecological economics recognises the need to preserve them [Rogall 2010, p. 174]. Its representatives follow the principles of intra– and intergenerational equity. They accuse the neoclassical optimisation analysis of being useless in solving environmental problems and ensuring intergenerational equity. Hence, they set a paradigm of the ecologisation of economics against the paradigm of the economisation of the natural environment [Fiedor 2002, p. 22], and they also advocate for strong or very strong sustainability (see later), which results in the approval of the concept of the steady-state economy[3] [Rogall 2010, pp. 162, 174-175].

Under the paradigm of the ecologisation of economics, natural resources are recognised as the most important curb on modern economic development. For this reason, non-deteriorated quality of the environment (or more strictly: natural

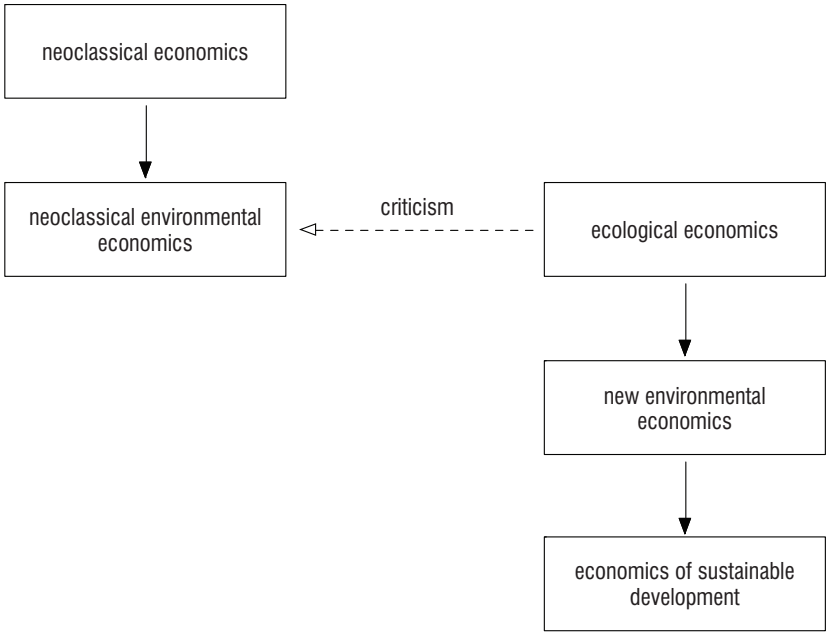
[3] According to Daly [1996] a steady-state economy is a system that ensures a stable supply of material goods at a level sufficient to achieve an adequate standard of living. Such a system functions properly on condition that population is relatively constant.

capital constancy) is the primary goal of development. Therefore, the paradigm of the ecologisation of economics strongly advocates for the supremacy of environmental considerations and environmental aspects of development over development objectives traditionally set in economics [Fiedor 2002, p. 22].

In many ways, new environmental economics (later renamed to economics of sustainable development) inherits the overall foundations of ecological economics, yet it develops its thought as well [Rogall 2010, pp. 117-118]. While ecological economics focuses on not exceeding the tolerance limits of nature, the representatives of new environmental economics/economics of sustainable development go one step further and reflect on how to secure high enough environmental, economic and socio-cultural (the triangle of goals) standards for the present and future generations within those limitations [Rogall 2010, p. 128]. New environmental economics/ economics of sustainable development promotes the concept of strong sustainability (see later) and the idea of selective growth.[4]

Figure 1.1 shows the relationships between economic schools described earlier.

Figure 1.1. Formation of schools of economic thought that reflect upon the relationship between the economy and the environment



Source: author's own work.

[4] Selective growth occurs when the increase in resource productivity exceeds the growth in gross domestic product (hereinafter GDP) [Rogall 2010, p. 165].

There are two issues that need to be clarified within the context of the deliberations undertaken above: the idea of sustainable development and the concept of sustainability.

Sustainable development is an interdisciplinary idea that integrates three fields: environmental, economic and social [Barbier 1989, p. 441; cf. Barbier and Markandya 2013, p. 39]. There is not a single commonly accepted definition of sustainable development. Still, it appears that the so-called Brundtland Commission's definition is the most recognised one [Barbier and Markandya 2013, p. 36]. The concept keeps evolving though.

Table 1.1 presents selected definitions of sustainable development.

Table 1.1. Selected definitions of sustainable development

Author	Year	Definition
Goodland and Ledec	1986	"[…] a pattern of social and structural economic transformations (i.e. development) which optimizes the economic and other societal benefits available in the present without jeopardizing the likely potential for similar benefits in the future [.....] A primary goal of sustainable development is to achieve a reasonable and equitably distributed level of economic well-being that can be perpetuated continually for many human generations."
The United Nations World Commission on Environment and Development (Brundtland Commission's) – basic definition	1987	"[…]meets the needs of the present without compromising the ability of future generations to meet their own needs."
The World Commission on Environment and Development (Brundtland Commission's) -extended definition		"[...] sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs."
Pearce, Markandya and Barbier	1989	"[...] the creation of a social and economic system that guarantees support for the following aims: increase in the real income, the improvement of the level of education, and the improvement in the populations' health and in the general quality of life."
The MIT Dictionary of Modern Economics	1992	"The maximization of the net benefits of economic development, subject to maintaining the services and quality of natural resources over time."

Source: Goodland and Ledec 1986, pp. 35-36, cited in: Lawn 2001, p. 35, United Nations World Commission on Environment and Development 1987, Pearce, Markandya i Barbier 1989, p. 13, Pearce 1992, p. 417.

It should be noted that the concept of intergenerational equity is embodied in most of the definitions. This implies that sustainable development is a development that neither imposes burdens on future generations, nor occurs at the expense of future generations. Most authors perceive sustainable development as a process, while some other as a target state. The authors also emphasise the importance of

intra-generational equity, which is defined as a fair distribution of prosperity among contemporary living people.

One of the major problems in the operationalisation of the sustainable development concept is setting a meter of growth. The concept comprises not only economic issues, but also environmental and socio-cultural ones. Barbier [1989, p. 442] noticed that the experience of developed countries has revealed that economic growth measured merely in terms of output growth leads to some resources allocation patterns, which may not be reconciled with sustainable development. They include:

- a decrease in the labour per unit of output,
- an increase in capital intensity of production,
- an increase in energy and raw material consumption per unit of output,
- an increase in environmental degradation and ecological stress.

Therefore, sustainable development requires a comprehensive integration in the following fields: environmental, economic and social (socio-cultural) [Munasinghe 2003, pp. 9-10, Munasinghe and Swart 2005, pp. 112-120].

The concept of sustainable development has become the fundament of global and the EU climate policy and has determined the path of development of the EU (cf. Chapter 2).

The concept of sustainability is in turn related to the assets passed on to future generations. Since the concept of sustainable development means "meeting the needs of current generations without compromising the ability of future generations to meet their own needs" then the overall welfare should not decline over time. In other words, the total stock of capital (all the assets: natural, physical and human) should be left no worse off [Barbier and Markandya 2013, pp. 40-41]. In this context, the authors distinguish weak and strong sustainability. Assuming perfect substitutability between factors of production, weak sustainability means that the aggregate stock of capital passed on to future generations is at least equal to its current size (the so-called principle of constant capital) [Turner, Pearce and Bateman 1993, pp. 55-56, Barbier and Markandya 2013, pp. 40-43]. In contrast, proponents of the strong sustainability view break up with the assumption of perfect substitutability between the environmental resources (that make life possible and that are essential to the proper human condition) and man-made capital, and call for the protection of the former. Thus, the total stock of capital should not be reduced, while the natural capital, that is not subject to substitution, should remain intact [Turner, Pearce and Bateman 1993, p. 56, Barbier and Markandya 2013, pp. 40-43]. The weak sustainability view is derived from the paradigm of the economisation of the natural environment, whereas the strong sustainability view is connected to the ecologisation of economics. Turner, Pearce and Bateman differentiate four levels of sustainability: very weak, weak, strong and very strong [Turner, Pearce and Bateman 1993, p. 30].

1.2. Climate Policy in Regard to Environmental Policy Conducted by the State

Environmental policy is "a conscious and purposeful activity performed by the state, local governments and businesses regarding environment management, namely the exploitation of resources and environmental values, protecting and shaping ecosystems or selected elements of the biosphere" [Górka, Poskrobko and Radecki 2001].

Graczyk [2013] lists the following interest areas of environmental policy, i.e. climate protection, protection and exploitation of air, protection and exploitation of water, conservation of fauna, conservation of nature and space, protection against waste and promotion of renewable energy. Therefore, the policy focused on climate protection is comprised within environmental policy.

Basically, the literature search for a definition of climate policy is doomed to failure. One of the very few existing definitions was provided by Fransen and Cronin [2013, p. 3]. The authors use the term climate policy to refer to "actions that can be taken or mandated by a government to accelerate the application and use of measures that curb GHG emissions." It should be noted that their definition is derived from a definition of "policies" that is included in the Third Assessment Report: Climate Change 2001 prepared by the Intergovernmental Panel on Climate Change (hereinafter the IPCC) [Intergovernmental Panel on Climate Change 2001, p. 381]. The authors highlight the protective dimension of climate policy. However, taking into account the current practice, their definition seems to be inadequate as they failed to consider another dimension of climate policy. While mitigation aims at limiting climate change by reducing GHGs concentration, adaptation is referred to some specific actions taken in order to adjust to those climate change effects that have already occurred or are anticipated. Arvai and his co-workers [2006, pp. 223-224] noted that the idea of adaptation to climate change became, over time, an area of interest of both scientists and politicians. In the next report of the IPCC [Intergovernmental Panel on Climate Change 2007b], adaptation was mentioned, alongside mitigation, as the second crucial field of the policies. The raised status of adaptation should be taken account of when attempting to define climate policy.

Ahmad [2009, p. 1] emphasises that climate policy, in terms of both mitigation and adaptation, is of cross-sectoral character, and therefore it should engage the whole government.

Overall, climate policy (also known as climate change policy) is a response approach to address climate change or, more precisely, global warming. Particular authors segue from the issues of climate change/global warming to the subject of climate policy, without defining the latter.

The World Meteorological Organization [World Meteorological Organization 1992, cited in: World Meteorological Organization 2014] defines climate as

a "synthesis of weather conditions in a given area, characterised by long-term statistics (mean values, variances, probabilities of extreme values, etc.) of the meteorological elements in that area." It should be noted that the commonly quoted definition refers to a statistical description and the typical values of some selected meteorological indicators. According to IPCC [2013, p. 1450], the time series used for making estimations should cover a period of several decades, three at least.

It is important to clarify what is meant by climate change. This term refers to "a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer" [Intergovernmental Panel on Climate Change 2013, p. 1450]. The causes of climate change are considered to be both natural (e.g., solar cycles, volcanic activity changes) and anthropogenic (changes in atmospheric composition and in land use) [Intergovernmental Panel on Climate Change 2013, p. 1450]. It should be noted that in the United Nations Framework Convention on Climate Change the term climate change is used to refer to human-caused climate change, which is additional to the observed natural variability. The intention behind this was to differentiate between changes resulting from different factors [Intergovernmental Panel on Climate Change 2013, p. 1450].

Global warming is, in turn, defined as "the gradual increase, observed or projected, in global surface temperature, as one of the consequences of radiative forcing[5] caused by anthropogenic emissions" [Intergovernmental Panel on Climate Change 2007a, p. 815]. Human activity (including industry and transport) results in increasing concentration of certain gases (primarily carbon dioxide) in the atmosphere. These gases are responsible for the so-called greenhouse effect. The greenhouse gases absorb terrestrial radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. They emit infrared radiation, thereby retaining the radiation in the Earth's system (it enters the Earth's system in the form of solar radiation) [Intergovernmental Panel on Climate Change 2013, p. 1455]. This effect was initiated and is sustained by natural causes, but human activity, which accounts for the increased greenhouse gases concentration in the atmosphere, intensifies it and, thus, leads to an overall warming of the Earth's system [Dessler and Parson, 2006, pp. 20-22] (therefore, some authors use the term "the enhanced greenhouse effect" [Intergovernmental Panel on Climate Change 2013, p. 1455]). Scientists agree about the presence of global warming and they claim "it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century" [Intergovernmental Panel on Climate Change 2013, pp. 17-19]. In spite of this, scientists have not yet reached a consensus on the predicted magnitude of the Earth's system's warming and the effects of climate change in different parts of the world [Hoffman 2013, pp. 5-6, Houghton 2004, p. 10]. Still, the

[5] Radiative forcing is a net change of radiation in the atmosphere as a result of external (natural or anthropogenic) climate change factors [Intergovernmental Panel on Climate Change 2013, p. 1460].