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by

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INTERNATIONAL GREENHOUSE GAS EMISSION TRADING – A POTENTIAL SOURCE OF FINANCIAL SUPPORT TO POLISH COMPANIES*

Abstract

Anthropogenic greenhouse gas emissions (GHG) cause worrying climate changes. Mitigation of climate change has gradually gained significance on the international policy arena. The Kyoto Protocol allows for international GHG emission trade. Countries whose emission levels are significantly below the targets set in the Kyoto Protocol have the possibility to sell their excess emissions in the global carbon market. This paper aims at proving that this will bring macro-economic and environmental benefits to Poland – a country with a significant emission reserve.

Keywords: climate change, green investment scheme, global carbon market

JEL codes: Q32, Q52, Q54, Q55, Q56

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1. Introduction

The concept of emissions trading appeared in 1960s. However, it is the Kyoto Protocol that contributed most to its wider application. The Kyoto Protocol contains GHG emission targets for developed countries (including Poland) for 2012. For Poland the target is to reduce GHG emissions by 6% in comparison to 1988. The 2004 estimates show that due to macroeconomic changes in the region and decrease of the energy intensity of the whole Polish economy, total emissions were on the level of 68% (ca. 363. 5 mill t CO2e) of 1988 emissions levels. This means that Poland is much below the Kyoto target and has a significant emission reserve that may be either used by the growing economy or sold within the international trading scheme, under the Kyoto Protocol. So far, there has been no decision taken but Poland could gain significant income from emission reserve sales. The following paper is presenting possibilities of using the emission reserve, their strengths and weaknesses.

2. Climate change – a challenge to economic growth and an international policy issue

2.1. Anthropogenic greenhouse gas emissions

Greenhouse gases are elements of the atmosphere able to trap solar energy within the atmosphere. There are six GHG gases (Szweykowska-Muradin 2003): carbon dioxide (CO2) – a dominant GHG gas, methane (CH4), nitrous oxide (N2O), the so-called industrial gases, containing fluorine: fluoro hydrocarbons (HFC), perfluorocarbons (PFC) and sulphur hexafluoride (SF6). Also water steam and ozone give strong greenhouse effect.

To simplify calculations of their influence on climate, global warming potential (GWP) factors were defined. A GWP factor enables a recalculation of all the GHG gases into carbon dioxide equivalent (CO2e), as presented in Table 1. Data in the table is calibrated to carbon dioxide as it is the most common GHG gas and all the other gases GWP is referred to this of CO2. Data in the table show that e.g. 1 t CH4 is 21 times more climate damaging than 1 t CO2 (1 t CH4 = 21 t CO2e), etc.

Table 1

Global warming potential (GWP) values for each greenhouse gas

Greenhouse gas	GWP value
Carbon dioxide	1
Methane	21
Nitrous oxide	310
fluoro hydrocarbons	150-11 700
perfluorocarbons	6 500-9 200
sulphur hexafluoride	23 900

Source: Inwentaryzacja emisji gazów cieplarnianych i ich prekursorów w roku 2003, Krajowe Centrum Inwentaryzacji Emisji, Warszawa, 2005 oraz Dr M. Szweykowska-Muradin, Wprowadzenie – podstawowe informacje nt. handlu emisjami CO2, Monitorowanie i raportowanie emisji CO2 w ramach europejskiego systemu handlu uprawnieniami do emisji, Warsaw, 2004.

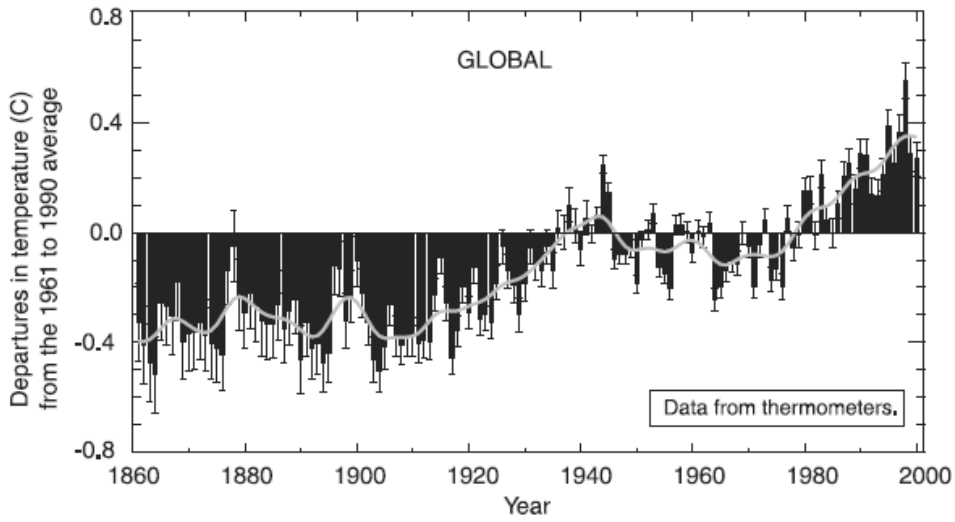
Greenhouse gas emissions are common in nature by, e.g. evaporation (water steam) or volcanoes eruptions (CO2 and CH4). It is considered, however, that it is the anthropogenic GHG emissions that lead to an imbalance in the delicate climate of the earth. The main anthropogenic GHG sources are (Blachowicz *et al.* 2002, p. 8):

- fossil fuel production and energy production from fossil fuels (80% CO2 emissions, 20% CH4 emissions, significant amounts of N2O),
- deforestation (especially tropical forests destruction),
- agriculture (mostly animal – and rice production),
- production of lime and cement,
- waste disposal,
- cooling substances in refrigerators, etc.

The gathered scientific data confirm that the increase in GHG concentrations lead to increasing the temperature of earth (Heilprin 2006, p. 1). In the last century, the air temperature at the earth's surface has increased on average by 0.6 º C and in Europe by nearly 1°C. This is an unusually fast increase (UNFCCC 2002, p. 8). The period since 1900 has been the warmest period in modern history and the 1990s the warmest decade of the last millennium. The tendency of warming has continued into the XXIst century as well, as presented in Graph 1.

Graph 1

Increase in the earth's temperature in the last 140 years



Source: Climate Change Information Kit, UNEP, UNFCCC, 2002.

This graph presents the continuing trend in temperature increase, starting from the beginning of the XXth century, speeding up as time goes by. The Intergovernmental Panel for Climate Change (IPCC) foresees that the average global temperature will increase by 1.4-5.8°C due to human activities. Scientists warn that exceeding the 2°C limit will cause the Greenland iceberg to melt. This, in turn, will cause flooding at sea shores across the whole planet and extreme weather phenomena will further increase in frequency.

2.2. International agreements aimed at mitigating climate change

In the late sixties, the international community started discussing the need to limit climate change. However, it was as late as 1979 the climate change conference – the first milestone in climate policy – took place. During the conference, it was agreed that climate change is an important issue. Also, a declaration for monitoring and mitigating climate change was prepared. At last, the World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP) and the International Council of Scientific Unions (ICSU) agreed to create the World Climate Programme (WCP) (UNFCCC 2002, p. 36). In 1988 the International Panel for Climate Change (IPCC) was founded and two years later (1990) the IPCC published its first report

evaluating the most up-to-date knowledge on climate change and potential directions for fighting this phenomenon (UNFCCC 2002, p. 36).

In 1992 during the earth summit ”Environment and Development” in Rio de Janeiro, the *United Nations Framework Convention on Climate Change (UNFCCC*), Agenda 21 and the Convention on Biodiversity were signed. The UNFCCC convention was aimed at stabilizing the GHGs concentration in the atmosphere at the level preventing human – caused climate change. The climate convention went into force on the 21st March 1994, after ratification by 50 countries.

Countries participating in the convention were divided into developed countries (mostly OECD countries) and developing countries. The developed countries[2] were obliged to preparing climate strategies by 2000[3], transfer of clean technologies[4], realization of sustainable development policies and protection of the environment, especially forests, which are GHG emissions sinks. Parties obliged themselves to consider climate change issues in other sectoral policies and to prepare periodical inventories (monitoring and reporting) of GHG emissions based on the joint methodology, approved by the conference authority – Conference of Parties (COP) (UNFCCC 2002, p. 19). COP was founded to promote and implement the Convention as well as to carry out periodical review of the existing obligations and efficiency of the existing climate policy (UNFCCC 2002, p. 37). COP consists of representatives of all of the participating states.

During the third Conference of Parties in December 1997, the Kyoto Protocol was signed. The Kyoto Protocol is an agreement to the UN Framework Convention on Climate Change. So far it has been the most important international climate policy act. The Protocol defines the reduction target for the developed countries at the level at least 5% for years 2008-2012 in comparison to the base year – 1990[5]. Developed countries were granted emission *assigned amount units* (AAU) for the whole five year period, calculated on the base year emissions, diminished by the agreed reduction (5% on average). One AAU equals 1 t CO2e. Developing countries were assigned neither reduction targets nor AAUs to enable them to undergo unrestricted economic growth.

Based on the assumption that greenhouse gas emissions are a global problem, regardless of their source. The Kyoto Protocol allows for several types of emissions trading (see also chapter 3)

- international emissions trading – AAU trade,
- *Joint Implementation* (JI), trade of additional emission reduction units (ERU); joint implementation may be realized through the cooperation of two developed countries: an investor country and a host country. By investing in emission reduction in another country, the investor (a government or a commercial entity) gains ERUs. Each ERU is equal 1 AAU. Each JI project must be approved by the governments of countries participating in the project because, along with the transfer of ERUs, the equal amount of AAUs must be transferred to the investing country thus decreasing the total AAU limits of the host country,
- clean development mechanism (CDM), trade of *certified emission reductions* (CER); this mechanism is realized when a developed country (or developed-country-based entity) invests in an emission reduction project in a developing country. By doing so, the investor gains CERs. Each CER is equal 1 AAU. Each CDM project must be approved by governments of countries participating in the project. The developing country hosting the project does not lose any AAU (as it is not assigned any). The investing country, however, gains extra AAUs – the amount equal to the reduction achieved by the project.

CDM credits (certified emission reductions or CERs) may already be generated and used in 2005-2007. JI credits (emission reduction units or ERUs) may be generated and used in 2008-2012. The difference is caused by the fact that CDM projects create new AAU units while JI projects allow only for the transfer of AAUs from one developed country to another. All the three mechanisms are integral parts of the carbon market, characterized in more detail in chapter 3.

The Kyoto Protocol came into force on the 16th January 2005, after ratification by 141 countries, including 30 developed ones[6] (UNFCCC 2002, p. 45). Poland, the country with sixth highest level of emissions in 1988 (base year for Poland)[7], ratified the Kyoto Protocol on the 26th July 2002 (CIRE 2006). Polish climate policy is further discussed in chapter 4.

In 2005, the first round of talks on the post-Kyoto period (post-2012) started (New Scientist 2005). They were continued during the Nairobi Meeting of Parties – periodical climate convention conference in November 2006. A new UNFCCC working group, focused on the post-Kyoto issues, was started. In May 2006, the Kyoto Protocol review started. The review will contribute to improving future actions against climate change (Ad Hoc Working Group 2006). The discussions on climate change policy develop in two directions:

- defining new emission reduction targets to keep the temperature increase below 2°C[8] (30% reduction by 2020 and even 50% reduction by 2050 in comparison to 1990) (Hohne 2006), increasing the amount of countries participating in international climate change agreements in the post-Kyoto period,
- increasing cooperation on research and technological development with focus on low emissions technologies (Hohne 2006).

Also, combining various GHG emission trading schemes is considered. However, it is probable that no decision will be taken before 2008.

2.3. Cost of climate change mitigation

Climate change constitutes more than just changes in the natural environment. The consequences of climate change may also be severe for the global economy. Table 2 presents the estimated decrease in global GDP in the case of temperature increases of ca. 2.5°C.

Table 2

Estimated global GDP decrease caused by climate change

No.	Geographical area	Estimated global GDP decrease [%]
1.	United States	0.5
2.	European Union	2.8
3.	Africa	3.9
4.	India	4.9

Source: Climate Change Information Kit, UNEP, UNFCCC, 2002.

According to the data presented in this table, it is the developing countries – India and African countries – that will bear most of the costs of climate change. These impacts relate to change of local climates, desertification of

interiors and flooding of low-lying coastal areas. All of these factors limit the possibility of using land for agricultural purposes and even for living on. The European Union countries may also have to bear significant costs of climate change. Comparatively, the USA will be the least affected of all the geographical regions.

Realization of the emission reduction policies in developed countries will bring extra costs related to climate change. Developed countries may expect a GDP reduction by 0.1-1.1% by the year 2010 (UNFCCC 2002, p. 48) due to climate change impacts. It is based on this information that Western European countries analyze and implement cost-effective reductions, such as emissions trading (see chapter 2.2). It is considered that economies in transition may significantly limit the costs of reduction by increasing energy efficiency (UNFCCC 2002, p. 48). For example, in Poland in 2006 possibilities to increase energy efficiency per unit GDP still existed, especially in the energy sector, responsible for the majority of emissions (see also chapter 3.2).

3. Global Carbon Market

Climate change is a global environmental problem because the global warming effect is neither related to the location of emission sources nor to the location of emission reductions (see chapter 2.1). This allows for wide application of market mechanisms thus limiting emissions-reduction costs.

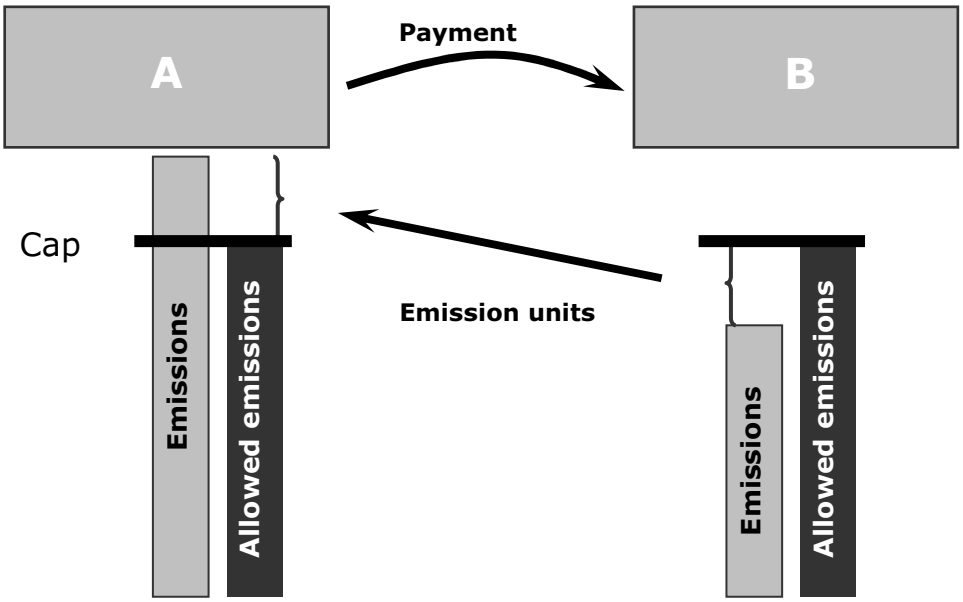
The concept of emissions trading appeared in the USA in the late 1960s when Cocker, in a paper published in 1966 and Dales in 1968, concluded that using market mechanisms for stimulating emission reductions would be cheaper than administrative measures. Since then, many papers were published by mainly American economists, who analyzed the efficiency of emissions trading (Stranlund *et al*. 2002, p. 2). Cap and trade emissions trading schemes, as presented in the graph below, are considered to be the most efficient.

Within the cap and trade system, limits are set for the participants. If the limit is lower than participants' emissions, the participant has to either reduce emissions or buy emission allowances (or reduction units) to cover excess emissions. The global limit remains the same or lower and only par-

ticipants' limits may change. Also, participants whose emissions are lower than limits may generate extra income by selling their excess allowances. The price of emission units (allowances or reduction units) is set on a free market, dependent on the demand and supply, costs of possible reductions and realized climate policy. Companies, governments and even individuals may be participants in such schemes. There is also a complex system of monitoring and verification of emissions based on uniform methodologies to allow control of the scheme. Emission reports prepared by participants are subject to verification[9].

Graph 2

Emission trading concept



Source: I. Kolacz, Rynki handlu emisjami na świecie, Szczyrk, 13-15.02.06.

Emissions trading was put into practice for the first time in the USA in 1990 when the SO2 emission trading scheme was started. The scheme resulted in reductions of emissions of 40% beyond the limits. The scheme allows for trade of both emission allowances and emission reduction units (Fiedor, Jakubczyk 2002, p. 38; EPA 2006; Stranlund *et al*. 2002, p. 4). The scheme has been continued. Its second phase started in 2000. So far (2005) it has resulted in further reductions of 34% SO2 emissions compared to 1990 (EPA 2005, p. 2).

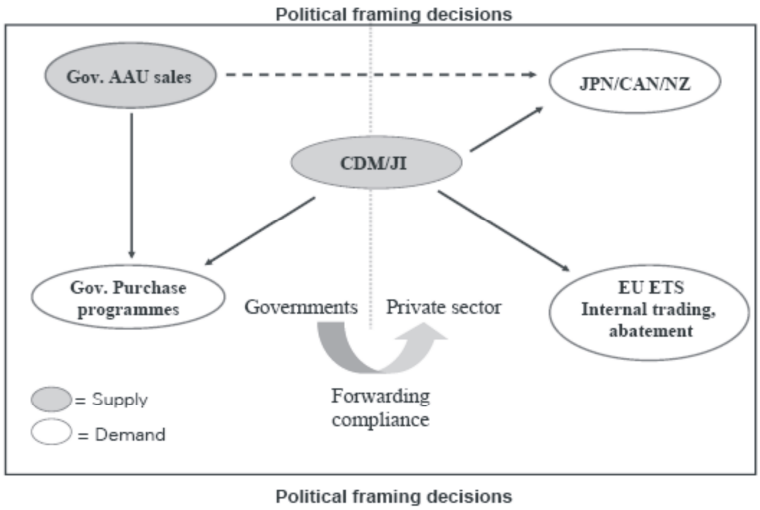
At present, there are many emission trading schemes in the world. Most of them are related to greenhouse gas reduction. The major schemes are:

- The Kyoto Protocol emission trading (see chapter 2.2),
- European Union emission trading scheme (see chapter 3.2),
- British and Danish emission trading schemes, prior to the EU scheme (see chapter 3.3),
- Voluntary but legally-binding schemes in north-eastern states in the US, New South Wales (Australia) and Japan (see chapter 3.3),
- Voluntary emission reduction unit schemes (offsets, see chapter 3.3).

A trend of unification and correlation amongst schemes into a global carbon market can be currently observed. A currency (an allowance or a reduction unit) used in one scheme can usually be used in other schemes and exchanged into another scheme's currency. Graph 3 presents the interplay between the schemes.

Graph 3

Interplay among GHG emissions trading schemes



Source: Carbon 2006: towards a truly global market, Point Carbon 2006.

As it is presented in the graph, the Kyoto Protocol and International emissions trading constitutes the framework for the whole carbon market. It is supported by flexible mechanisms and regional/national schemes (EU ETS,

Japanese or Canadian[10] emission trading). In the supporting schemes, it is the private sector that takes most initiative. Thin arrows in the graph present unit flows.

3.1. Kyoto Protocol emission trading scheme

Within the Kyoto Protocol, there are two types of emission-trading instruments allowed:

- International AAU trade – trade between governments with AAU as the currency,
- International emission reduction units trade/transfer; emission reduction units (CERs and ERUs) are created by CDM or JI projects. AAU transfer follows the CER/ERU transfer. Both the private sector and governments are active in this area (see chapter 3.1.2 and 2.2).

3.1.1. Assigned Amount Units

Under the Kyoto Protocol, each developed country has been allocated a certain amount of AAUs to be used in the years 2008-2012. The AAUs may be either used to cover the country's emissions or they may be traded or cancelled. International AAU trade takes place at the level of governments. In case of an AAU transaction, the selling country diminishes its AAU amount and therefore lowers its emission limit and, at the same time, the buying country increases their limit.

One of the first AAU transactions was the sale of AAUs from Slovakia to a Japanese Sumimoto Corporation (GHG Markets 2006). However, AAU trading is still rare, also because these units are allocated for years 2008-2012.

3.1.2. Emission Reductions Units/Certified Emission Reductions

The so-called Kyoto mechanisms are support mechanisms to help governments to fulfil their Kyoto commitment. Both types of units – CERs and ERUs) may be converted into EU ETS allowances (EUAs). Emission reductions generated in JI/ CDM projects may be used twofold:

- they may be bought directly by governments via, e.g. carbon funds (see chapter 3.4.1).

- they may result from corporate-sector investments in host countries; companies investing in JI/ CDM may
  - sell the emission reduction credits to the governments,
  - convert the credits to EU ETS allowances to cover their own emissions,
  - use the credits to improve their green image by realizing voluntary reduction targets.

Both CERs and ERUs are, in a way, supportive credits to AAU as they simplify reaching the reduction targets. Therefore, there is a set of additional requirements for JI/CDM investments:

- emission reduction requirement,
- additionality requirement,
- requirement for AAU transfer in the case of ERUs and the creation of new AAUs in the case of CERs.

A set of calculation methodologies was developed in order to ensure the smooth realization of the Kyoto mechanisms and accurate accounting of units. There is an obligation for the annual monitoring of emission reductions generated by these projects and verification of emission reports. Both the host and investor countries must approve the project.

Delay in implementation of the International Transaction Log (ITL), an international credit register, is an extra difficulty in the realization of JI/CDM projects. All these factors make purchase of CERS and ERUS a higher risk investment than purchase of EUAs. Therefore, CERS and ERUs are, at least in theory, cheaper than EUA (see chapter 3.5).

3.2. European Union emission trading scheme

The European Union Emission Trading Scheme (EU ETS), started on the 1st January 2005, and is obligatory for companies' operating installations where the most emission intensive activities are carried out[11]. In this way, part of the responsibility for GHG emissions reductions has been transferred to the installation operators. The scheme covers ca. 50% of the European CO2 emissions and is the biggest emissions market in the world at present. Each EU country prepares national allocation plans to allocate emissions allowances (EUAs) to the companies for each phase of the scheme. Allocation

plans are then approved by the European Commission. The scheme is limited to CO2 only for the first (2005-2007) and second (2008-2012) phases of the scheme. One EUA equals 1 t CO2 and allowances are allocated for the whole period.

Companies participating in the scheme may use allowances for their own emissions, they may sell them, buy them, cancel them and transfer them between years within the same phase. They are also obliged to monitor emissions as well as provide the national administrators with positively verified (by independent verifiers) annual emission reports. In accounting terms, allowances are assets and are presented in financial reports. If a company does not comply (i.e. does not have sufficient amount of allowances to cover its emissions), it has to pay a penalty of 40 €/t CO2 in the first phase and 100 €/t CO2 in the second phase. In addition to paying this penalty, the installation needs to buy or transfer allowances to cover all the emissions. Companies may also use CERs and ERUs, although there is a 10% limitation on the use of JI/CDM project credits to cover their emissions.

3.3. Voluntary emission trading markets

Voluntary emissions trading markets are developing alongside the Kyoto Protocol. These initiatives have been created for various reasons:

- In countries where there are no obligatory GHG trading schemes (USA, Australia, Japan),
- In sectors not covered by obligatory schemes (e.g. aviation, transport individual consumption of goods),
- To increase ecological awareness (many NGOs in the whole world offer voluntary reduction credits, such activities are most popular in Great Britain, the Netherlands and the USA).

Emission reductions (ERs) are usually generated in offset projects, such as reforestation or investments in renewable energy sources. Some projects are monitored and emission reports are prepared for them. In this case, *verified emissions reductions* (VERs) are created and sometimes they may be converted to either CERs or ERUs. Voluntary credits are usually used for

fulfilling voluntary reductions targets, learning-by-doing before joining an obligatory scheme or greening a company's image.

3.4. Carbon market actors

There are many actors in the CO2 market. The key market actors are characterized below.

3.4.1. Governments

The Kyoto Protocol distinguishes between two groups of countries:

- Developed countries, which have emission targets and were allocated AAUs,
- Developing countries, which do not have emission targets and were not allocated AAUs.

Developed countries

Developed countries, listed in Annex 1 to the Kyoto Protocol, who have ratified the Protocol, are the main market actors in the Kyoto market. They may:

- trade AAUs,
- allow for the implementation of JI projects in their own territories (and thus enable the transfer of AAUs to investing countries),
- allow developed-country organizations to invest in JI/CDM projects in other countries (and thus enable the transfer of extra AAUs to their accounts).

Countries that have to **reduce emissions** to meet their Kyoto targets are usually net buyers of AAU, CERs and ERUs, either directly or through the use of carbon funds[12] (in the case of CERs and ERUs). Carbon funds are investment programs using carbon credits as financial instruments to generate profit. Carbon funds may either purchase reduction units directly or invest in projects generating emission reductions (Environmental Finance 2006, p. 121). At present, there are 45 different carbon funds (mostly EU-15 countries) with a total capital of 4.6 billion USD engaged in reduction projects (Environmental Finance 2006, p. 2, Preface). Japan and the Netherlands are the most active countries in the purchase of reduction credits because internal (national) reductions are very expensive due to the high

degree of energy efficiency of their industries (Environmental Finance 2006, p. 8). Carbon funds can also be created in international economic organizations, such as the World Bank which has established the Prototype Carbon Fund (see below). Overall, AAUs, CERs and ERUs are mostly purchased by European (56%) and Japanese (38%) actors (Capoor 2006, p. 27).

Developed countries that **have emission reserves** (in relation to their Kyoto target) may either directly sell AAUs or allow for implementation of JI projects in their territories and thus allow for transfer of AAUs to other countries. Income from the sales may be used freely by the governments: countries may either use them for general budgetary needs or create so-called *green investment schemes (GIS)*. *Green investment schemes* appear to be a very supportive tool for long-term climate policy in countries with an emission reserve; basically they make AAUs more green by reinvesting income from AAU sales in further emission reduction projects (Environmental Finance 2006, p. 123) such as defining energy efficiency standards and putting them in place. In financial terms, GIS serve as a tool for multiplying capital by turning emission reserves into modern, low-emission intensive technologies. According to the author's knowledge, two GIS proposals have been prepared: one for Bulgaria and one for Russia. However, none of them have been implemented yet. The Polish government is also considering creation of a GIS (see chapter 4) which may be a very profitable solution for Poland.

New EU Member States and post-soviet republics (especially Ukraine and Russia) have the potential to be the biggest AAU sellers e.g. it is expected that Ukraine, where 2004 emissions remain at 57% of the emissions in 1990, will be able to sell 510 Mt CO2e. According to the *Japan Bank for International Cooperation* this amount is sufficient to covering all of the EU's reduction needs (Kolacz *et al*. 2006, p. 3). Poland also has a significant emission reserve of ca. 100 Mt CO2[13] (Ministry of Environment 2006, p. 53).

There are a lot of uncertainties related to the methodologies used for calculating the emission reductions from JI projects. There are currently no sales of ERUs on the spot market because these carbon credits will only be available from 2008. Therefore, in 2005, ERUs constituted only 3% trade on the carbon market (Capoor 2006, p. 29). At present (April 2007), the share

is slighly increasing. However, JI project mechanism is stronly interrelated with the EU ETS scheme because most potential JI host countries also participate in the EU ETS scheme. Also, lack of sufficient legislation regulating the realisation of JI projects hampers their common application.

Developing countries

Developing countries do not have emission reduction targets (and therefore have no AAUs) however they can freely sell CERs. In return, they import modern technologies, mostly in the energy sector. The financial gain from realization of CDM projects usually remains in the developed countries. Asian countries are the biggest sellers of carbon credits (76%). China is the top seller (66%) and India, previously a leader in CER sales, now provides only 3% of these credits. Latin America is a source of 17% CERs in the carbon market (Capoor 2006, p. 29).

3.4.2. International financial institutions

International organizations have also been interested in the carbon market. Financial institutions such as the World Bank, Fortis Bank, Rabobank, KfW and European Bank for Reconstruction and Development have been managing carbon funds, focusing on climate saving investments in developing countries and economies in transition (Environmental Finance 2006). The World Bank is particularly active in this field, managing a set of programs.

3.4.3. Greenhouse gas emitters in the commercial sector

A proportion of the commercial sector in the EU is obliged to participate in the carbon market by obligatory participation in the EU ETS scheme and some are also involved in national emission trading schemes. There are also companies who have set their own voluntary targets in the frame of corporate social responsibility policies. As a result, the private sector, especially those in manufacturing, participate in all kinds of transactions, trading EUAs, ERUs, CERs, ERs, VERs and even AAUs (see chapter 3.1.1). The European carbon market has been dominated by ca. 100-200 large producers, mostly energy concerns, interested in reducing risk related to their CO2 reductions (Capoor 2006, p. 27; Ecofys). It is hard to estimate the total

amount of actors participating in the global market due to the large number of OTC trade as well as many voluntary initiatives that exist.

3.4.4. Organizations facilitating operation of the carbon market

There are facilitators in the carbon market as well as direct participants, these include:

- Brokers, trading all types of carbon credits,
- Exchanges, trading mostly EUAs,
- Financial institutions as investors, brokers, crediting investments, participating in exchanges,
- Non-governmental organizations, mostly providing voluntary carbon credits,
- Consultants and developers, providing consultancy services as well as developing reduction projects all over the world,
- Verifiers, verifying emission reports, financially responsible for their materiality.

In 2005, exchanges and trading platforms started becoming dominant in the market. They simplify trade, limit the risk and make the carbon market more transparent. At present (2006) there are six exchanges, 6-8 international brokers and an increasing number of small brokers, operating in the European market trading EUAs. *European Climate Exchange ECX* is the biggest platform and it serves ca. 70-80% all the exchange transactions in (Capoor 2006, p. 7). This exchange is a daughter company of the *Chicago Climate Exchange*- the first climate exchange in the world operating in the voluntary market. Companies under the EU ETS scheme, big banks, investment funds and other financial institutions are active in the exchanges. Some of them invest and some speculate (Capoor 2006, p. 7).

3.5. Prices

The AAU price is not known as details of the few transactions that had taken place so far have not been published. The EUA price, after increasing to 31-32 €/t in late 2005/beginning of 2006, went down to 12 €/t in April 2006 and further decreased to slightly over 1 €/t[14]. ERU prices remain at 6-10 €/t, while CER price are at 6-15 €/t, depending on the type of project and

the risks related to its realization. Voluntary credits cost from 50 €c to several Euro per tonne CO2, depending on the project.

3.6. Trade rules and volumes

In all the schemes related directly to the Kyoto Protocol (the Kyoto Protocol market, EU ETS, voluntary markets, see, respectively chapters 3.1, 3.2 and 3.3), there are detailed rules relating to the carbon credits trade. It is often possible to exchange carbon credits between various schemes. Transactions can be divided into the following categories (Capoor 2006, p. 3):

- trade with allowances (EUA /AAU),
- trade with reduction units (CERs, ERUs, ERs, VERs).

The second type of transactions has higher transaction costs and also higher risk than allowance trade (see also chapters 3.1.2 and 3.5). These differences are related to the fact that after having realized the investment, the actual emission reductions achieved may differ from those predicted during the original financial and economic analysis of the investments. Both types of credits can be sold both on the spot and on the forward/future markets[15].

The European carbon market is the most significant one at present, its trade having increased by 3700% since 2003 (Capoor 2006, p. 14). At the same time, CER/ERU trade is increasing as it is possible to convert these units into EUAs as part of compliance with the EU ETS scheme (Capoor 2006, p. 23). The EU ETS market also influences the CER price and increases interest in CDM investments. ERU prices remain low due to possible conflict with EU ETS and insufficeint legislation (see chapter 3.2).

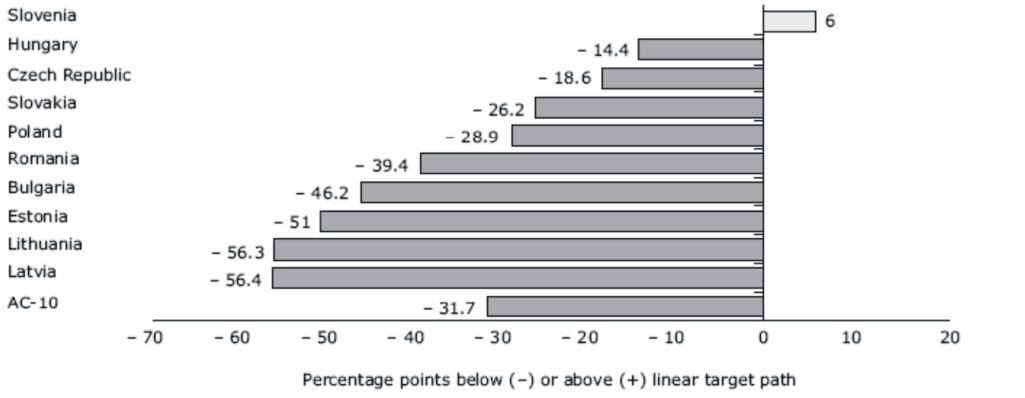
4. Polish emissions reserve

The Kyoto Protocol sets national GHG emissions targets for 2012. Most EU-15 countries have to reduce national GHG emissions to reach their targets. However, emission forecasts for the Central and Eastern European countries (except Slovenia)[16] show that emissions in their economies remain significantly below the Kyoto targets, as presented in Graph 3. The reductions evident in the Graph 3 were primarily caused by economic transitions that

occurred at the beginning of 1990s. Socialistic economies were focused around heavy industry.

Graph 4

Estimated distance to the Kyoto target EU-10 (2003)



Source: Greenhouse gas emission trends in Europe, European Environmental Agency, 2003.

Attention was paid neither to cost of production (including energy costs) nor environmental protection. After the economic transitions, a serious break-down of the local economies and most of the energy-intensive industries took place. Instead, modern privatized companies and services appeared and invested heavily in new technologies. These investments were stimulated by international competition and steadily more strict environmental requirements. These activities, as well as the closure of heavy energy-intensive plants, led to a significant emission reserve in Central and Eastern Europe. This emission reserve now contributes to the competitive advantage of these countries.

4.1. Polish climate policy

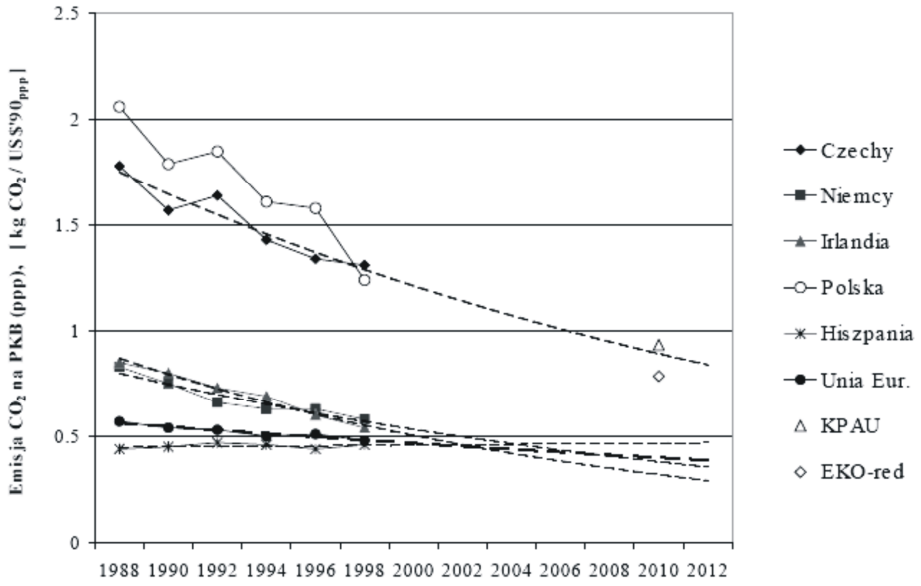
The Climate Convention (see also chapter 2.2) obliged Poland to stabilize greenhouse gas emissions and increase their sinks. The Protocol to the Convention (Kyoto Protocol, see chapter 2.2) obliges Poland to reduce its emissions by 6% of 1988 levels by 2012. Emissions in 1988 have been estimated to be 564 416 Mt CO2e. In 2003, GHG emissions were 382 641.3 Mt CO2e, which is less than 68% of 1988 emissions. These significant re-

ductions relate mostly to the modernization of energy production facilities, utilization of landfill gas and the utilization of methane in agriculture.

In the Kyoto period (2008-2012) the average annual emission limit for Poland is 513.3 Mt CO2e with CO2 emissions limited to 448Mt (Ministry of Environment 2006, p. 52)[17]. Total emission in the EU ETS sectors is forecast to be 372 Mt CO2 (that is ca. 83% total CO2 emissions). The proposed national allocation plan cap for the years 2008-2012 is 279 608 285 t CO2, (further reduced by the European Commission to 208 515 395 t CO2/year, European Commission 2007) that is ca.75% Kyoto limit and nearly 100 Mt CO2 less than the Kyoto target for these sectors (Ministry of Environment 2006, p. 53). Assuming an AAU price of 5€, the 100 Mt reserve represents capital of ca. 500 000 000 € annually. This constitutes 1.14% of the 2006 Polish state budget. As a comparison, the total planned income of the National Fund for Environmental Protection and Water Management in 2005 was over 1 484 mill PLN, that is ca. 371 000 000 € (NFOSiGW 2004, p. 1).

Graph 5

CO2 emission per unit GDP – international comparison



Source: Gaj H., Potencjały i koszty redukcji CO2 w technologiach produkcyjnych, konferencja: Handel emisjami od strony prawnej, organizacyjnej i technicznej, Warszawa 15-16 czerwca 2004.

Additionally, there is still a significant potential for increases in energy efficiency (which could be translated into further emission reductions) in Po-

land, as unit GHG emission factor per GDP is still high in comparison to other countries, even in comparison to countries with similar climatic conditions e.g. Germany and similar climatic and economic conditions, such as the Czech Republic**Błąd! Nie można odnaleźć źródła odwołania.**[18].

Due to international obligations within the Kyoto Protocol and EU climate policy, the Ministry of Environment published the document "Polish Climate Policy. Strategies for GHG emissions reductions in Poland by 2020"[19]. The short- and medium-term goals (2003-2012) defined in the document are aimed at implementing instruments for realization of the Climate Convention and the Kyoto Protocol requirements. Long-term goals for the years 2012-2020 suggest further GHG emission reduction to reach the level of 30-40% reduction in comparison to the base year (1988). The climate policy also assumes wide use of flexible Kyoto mechanisms, i.e. carbon trading, including sales of the emission reserve (Ministry of Environment 2000, p. 30). National environmental funds are other sources of finance for emission reduction projects. Last, but not least, international financing from the World Bank, Global Environmental Fund (GEF), EU structural and cohesion funds are also considered as potential sources of financing for emission reduction activities.

4.2. Initiatives on utilization of the Polish emission reserve

Ideas on the use of the Polish emission reserve appear in public statements of experts and public officers in relation to several mechanisms:

- Prototype Carbon Fund (PCF) is an international financial instrument founded by the World Bank (Ministry of Environment 2006); its aim is to gather carbon credits through the implementation of emission reduction investments and the use of sinks. The purchase of these credits is financed by Annex 1 countries. The rules for the investments and the fund itself are similar to those of Joint Implementation projects. The PCF for Poland favours projects in renewable energy sources. As a result of the realization of such projects Poland will transfer the agreed amount of ERUs to foreign investors (participants in PCF) in the years 2008-2012, as chosen by the World Bank. The agreement obliges such transfers to occur by December, 31st, 2012 (Ministry of Environment 2006).

- Sales of ERUS through the realisation of Joint Implementation projects. Poland started co-operation with Finland, Canada, Denmark and other countries in the Baltic region with the aim of realising a set of Joint Implementation projects (Ministry of Environment, p. 1). Poland also allows sales of ERUs to any investor country after the individual approval of JI projects.
- Green Investment Scheme – a concept of AAU sales in the international carbon market coupled to reinvestment of revenues in the Polish economy in order to decrease the environmental footprint of the economy. This idea has appeared in the public debate, however, not extensively. The concept of the green investment scheme was discussed in more detail in an article written by Yoshito Umeda (Umeda 2005), prepared based on the Japanese International Trade Organization report[20] entitled „Report on investigating the possibilities of implementing *Green Investment Schemes in Central and Eastern European countries*" (2005). This report compares five countries in the region: Poland, Bulgaria, Czech Republic, Romania and Slovakia in five aspects: political support for GIS, AAU reserve, possibilities for private sector engagement, administrational structure and legal maturity. Poland was ranked last but one – before Romania, although it has the largest emission reserve, 448 Mt AAU in the whole 2008-2012 period, according to the authors of the report (Umeda 2005, p. 6). The report points out that in Poland there is no political support for GIS, demonstrated by lack of an official government opinion related to this concept. Little administrative support and legal immaturity are considered other important drawbacks. Y. Umeda does not agree with such a low score for Poland. This latter opinion is also supported by the author of this article, since it seems possible to incorporate a GIS into the existing climate policy support mechanisms.

5. Economic use of the Polish emission reserve

5.1. Possible solutions

There are four possible approaches to using the emission reserve (Evans 2001, p. 2). No economic use of the reserve (that is: no sales in the inter-

national carbon market) is one possibility. This approach means accepting the emission reductions related to the restructuring of the economy. The possibility of selling excess AAUs could act as the source of additional funds to invest in reduction activities. Therefore, leaving the reserve without any economic use seems to be a waste of capital, gathered at the high social costs related to the transition of economies.

The concept of indirect AAU sales through the use of the Kyoto flexible mechanisms (either individually or through carbon funds) brings income to the economy. Yet, realization of JI projects is still hampered by high legal risk related to the underdeveloped JI regulations and delays in the implementation of the International Transaction Log (ITL) – an international register for emission reductions. Additionally, most potential host countries for JI projects also participate in the EU ETS and therefore they must comply with the Linking Directive aimed at avoiding the so-called double counting of emissions (first as ERUs and then as saved EUAs). The process of JI project approval is complex, which is another obstacle against the broad application of JI projects to sell the emission reserve. The table below shows advantages and disadvantages of this approach.

Table 3

Advantages and disadvantages of the broad JI mechanism application

Disadvantages	Advantages
• Complex approval process • No reinvestment of income in further reduction activities • Possible high costs of project realization and transactions • Most experience in realization of flexible mechanisms remains in the investor EU-15 countries, which limits the added value of realization of these projects to the host country economy	• The private sector usually is more effective in investments, with lowest possible reduction costs per tonnes saved CO2; this limits global climate change mitigation costs • Broad application of JI projects will increase competitiveness in this market niche and further strengthen the trend described above • Engaging the private sector in realization of JI projects may contribute to higher economic growth in the host country • The role of the state may be limited to registering transfer of ERUs and following transfer of AAUs; this would minimize public administration costs

Source: own analysis of the author.

AAU direct sales followed by transfer of the generated income to the state budget. In this way certain budgetary expenses could be paid, including covering part of the budget deficit. The table 4 presents advantages and disadvantages of this approach.

Table 4
Advantages and disadvantages of the direct AAU sales and use of the generated income to cover general budget expenses

Disadvantages	Advantages
• funds used for current budget expenses will not have any economic effect related to (the promotion of) further emission reductions; the reserve will decrease along with sales of AAUs and economic growth of the economy • This situation might lead to problems with reaching the Kyoto- and post- Kyoto reduction targets (to be) defined in the international climate agreements (Evans 2001, p. 3)	• Simplicity- a country selling AAUs in the international carbon market must assure minimal administration procedure related to AAU sales, define the acceptable price level and AAU transfer • There is no need forseparate national monitoring and verification of emission reports on the installation level. • There is no need to comply with acceptable EU state aid rules • Possibility of reducing budget deficits

Source: own analysis of the author.

Creating a green investment scheme (GIS) is the fourth approach. The scheme enables further engagement with the private sector in additional emission reductions. These reductions would contribute to maintaining an emission reserve and thus act as a source of extra income to the economy. Private investors usually realize more effective investments than the state. Therefore, supporting private investors in the implementation of emission reduction projects could be an interesting option. This support could take the form of a subsidy scheme for emission reduction projects, financed from income generated by AAU sales. To make it simple, the scheme could resemble the EcoFund (conversion of the Polish debt into environmental projects): the state negotiates sales of large quantities of AAUs with buyers and obliges itself to reinvest the income in supporting environmental investments. The categories for the investments could be subject to the approval of the AAU buyer. Next, local economic entities (both private and public sector) could apply to the GIS fund for subsidies based on simple and clear rules.

A green investment scheme was proposed for several countries in the region, Bulgaria (Word Bank 2004) and Russia (Tange *et al.* 2002), amongst others.

Table 5

Advantages and disadvantages of a GIS

Disadvantages	Advantages
• A complex scheme, if based on JI/CDM rules • High operation costs related to creating and maintaining detailed rules and guidelines for financing of emission reduction projects, employing a range of experts for evaluation of projects[21], monitoring and verification of emission reports at the project level • Need to create clear rules for maintaining competitiveness between sectors	• Demonstration of serious concern for climate change issues on the international stage. • Generation of further emission reductions and thus potential further income from AAU sales • Strengthening economic growth and support for Polish economic entities • Faster update of clean technologies • Independent governance of the scheme. • Monitoring and verification of reduction projects could be based on the approved JI/ CDM methodologies

Source: own analysis of the author.

Many potential buyers, including Japan and OECD countries are also interested in GISes. Some NGOs, e.g. *International Institute for Sustainable Development*, see reinvestment of income from AAU sales into further reduction projects as the most pro-environmental approach.

5.2. Comparison of possible solutions

Using the emission reserve should meet several environmental and economic criteria (Evans 2001, p. 7):

- Stimulating further reductions – using the reserve to promote further emission reductions in the economy,
- Decreasing emission reduction costs – investing in the cheapest reduction options and thus increasing the economic effectiveness of reduction projects,
- Simplicity – simple administration, clear rules, low operation costs, well - organized monitoring and verification scheme,

- International acceptance of the chosen approach – due to clear and simple rules as well as compliance with international economic agreements and laws related to climate change, including the EU ETS scheme and general economic policies such as acceptable public aid to private entities, etc.,
- Popularity in the country using a GIS – clear rules, simple access to subsidies for various actors, low transaction costs.

The evaluation was extended by three additional criteria: international acceptance, acceptable state aid and avoiding double-counting. Table 6 presents the impact of a chosen approach on meeting the criteria described above. As it is proposed in (Evans 2001, p. 7), the approaches are evaluated in the 5-grade scale from "strong negative impact" to "strong positive impact".

Table 6

Quantitative evaluation of the impact of each approach in meeting the criteria for economic use of the emission reserve

Criteria for economic use of an emission reserve	Approaches			
	No economic use of the reserve	Indirect AAU sales with use of flexible Kyoto mechanisms	Direct sales of AAUs and transfer of the generated income to the state budget	Green investment scheme
Stimulus for further reductions	-2	1	-2	2
Decreasing emission reduction costs	-2	1	1	2
Simplicity	2	-1	1	1
International acceptance	0	1	-1	2
Popularity of the scheme	0	2	-2	2
Acceptable state aid to entities	0	0	0	-1
Avoiding double counting	0	-2	0	-1
Total	**-2**	**2**	**-3**	**7**

Source: own analysis of the author.

The author has quantified the evaluation as follows:

--	Strong negative impact	-2
-	Negative impact	-1
0	No impact	0
+	Positive impact	1
++	Strong positive impact	2

The quantitative evaluation is presented in the Table 6. Based on the outcome of this simple analysis, presented in Table 6, the following can be concluded:

- No economic use of the reserve is simple, requires no effort and does not directly influence the international image of the country. It does not create need for compliance with climate and economic agreements and laws. But it does not bring any enhancement to further emission reductions or possibilities to limit costs related to emission reduction and further transformation of the economy.
- Indirect AAU sales via JI projects is a much better solution, however, it is significantly limited due to Poland's participation in the EU ETS scheme and its rules of avoidance of double-counting of emission reductions; also, complex administration of such projects hinders sales.
- Using income from AAU sales on general budget expenses will not stimulate pro-active climate mitigation behaviour in the economy; however, it may contribute to global decrease in reduction costs (cheapest reductions realised globally); it may also decrease the budget deficit of Poland.
- GIS will allow for modernising the economy, activating economic entities, strengthening economic growth, decreasing energy consumption and decreasing emission reduction costs. It will maintain the additional income source (emission reserve). Finally, it will be well received internationally, provided clear rules are created and international agreements met.

Therefore, the author considers a GIS to be the optimal solution for economic use of the capital in the form of an emission reserve.

5.3. Options for a green investment scheme in Poland

It is possible to construct a GIS in two ways:

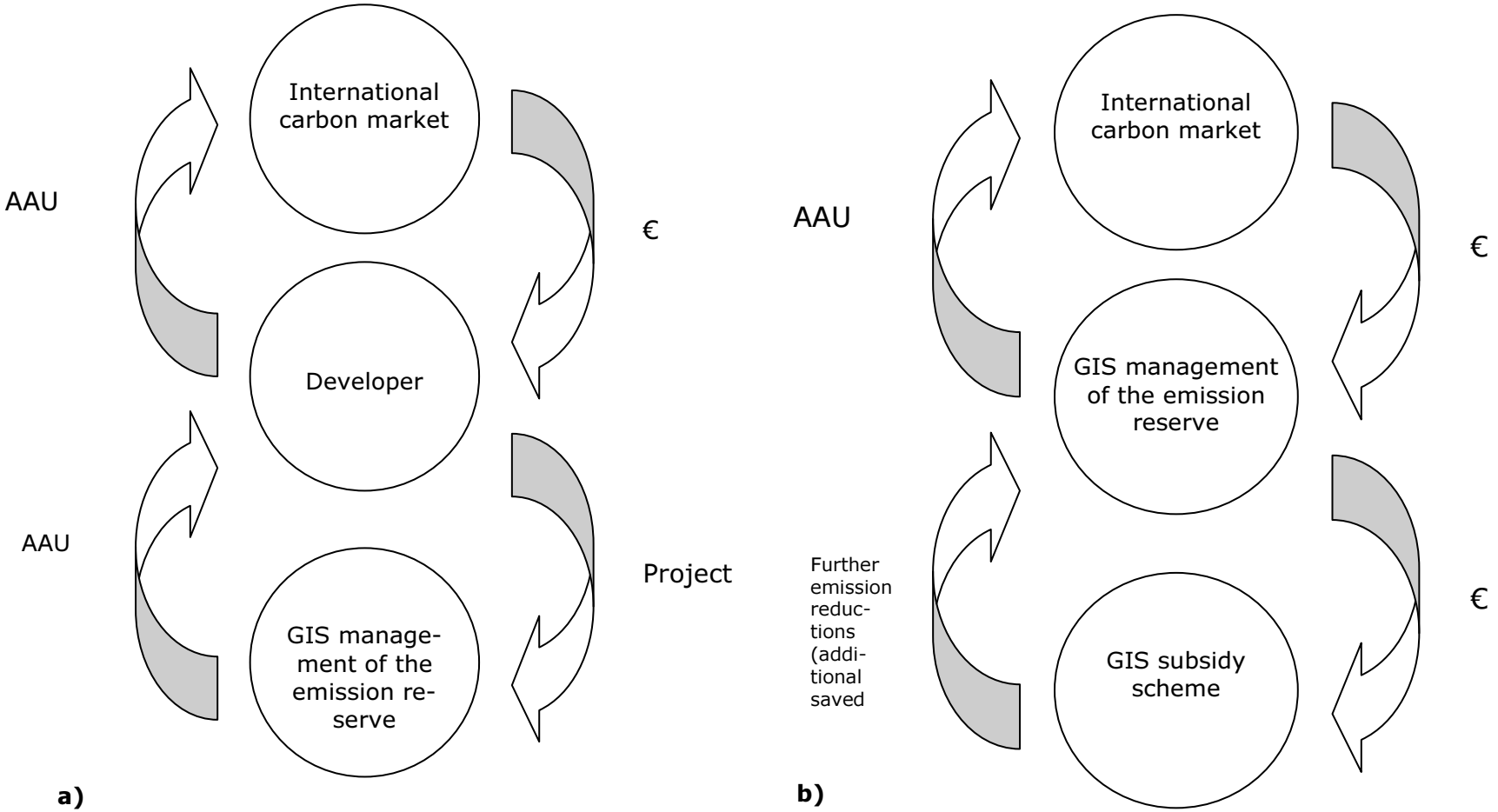
1. Purchase of reduction projects through a state-owned emission reserve: project developers provide the state with reduction projects and in return they receive the saved AAUs; these AAUs may then be freely sold by the developers in the international carbon market (Graph 6a). This solution is similar to the JI scheme, however, it is the state that actually purchases reduction projects (and ERUs) and exchanges them for AAUs.
2. Fund being an intermediary between the international carbon market and emission reduction projects: the fund is managed by an independent management board e.g. an agency (Graph 6b).

In this case, it is the state agency that sells AAUs directly into the international carbon market and redistributes the income to reduction projects in the form of subsidies for projects within pre-defined categories. The author tends to consider this solution as simpler than the first one. It allows for the negotiation of better prices for AAUs (stronger negotiation position of the seller i.e. the state in comparison to developers) and more widespread redistribution of income from AAU sales. However, it requires better institutional preparation of the seller-state than in the first case.

Both of the aforementioned variants have their pros and cons. However, the author tends to consider the latter variant to be a better one: is can be clearer, it supports the local economy to a wider extent and it may also contribute to wider and more equal redistribution of income throughout the whole Polish economy.

Graph 6

Possible GIS designed, as discussed in the paper



Source: based on 1, Kokorin A., WWF Russia, IISD, Climate Change Knowledge Network, Green Investment Schemes as a Way of Promoting Environmentally – Sound Cooperation among Russia, Canada, Japan and Other Nations under the Kyoto Protocol, International Institute for Sustainable Development, 2003.

6. Conclusions

Climate change leads to negative environmental and economic changes. Therefore, it is becoming a growing concern of the international community and an important element of international and national policies. A set of measures to mitigate climate change and to add a carbon constraint into the economy are being implemented. Emissions trading is one of the most interesting tools to support climate policy as it incorporates free market mechanisms into environmental protection. It is based on the assumption that there is a discrepancy between demand and supply of emission allowances (AAUs and EUAs). At present, the global carbon market is emerging and international emissions trading, under the Kyoto protocol, seems to be the backbone of this market. Therefore, governments – main actors in the Kyoto scheme- are also the most influential players in the global carbon market. They have a unique position of strongly influencing the changes in the market and using the emission trading tool to support the desired changes in their economies.

Poland belongs to countries with a significant emission reserve a capital created by the drastic transition of the economy from a socialist system into a free-market economy. This capital could be used to enhance further emission reductions, strengthening local economy, activating local stakeholders and encouraging a more rapid uptake of modern technologies, which would contribute to lower energy consumption and thus lower production costs. This paper discussed possibilities of using the emission reserve to reach these strategic goals. Green investment schemes are considered the most effective way of use the emission reserve capital.

Due its decent institutional and legal development (experience with environmental funds, conversion of the international debt into an environmental subsidy scheme, participation in the EU ETS scheme), Poland is considered capable of constructing and properly managing a simple and efficient green investment scheme.

NOTES

[1] Izabela Kielichowska, graduated from the Scandinavian Department, University of Gdansk, Poland, Energy Planning and Sustainable Development post graduate course at the University of Oslo, Norway and the Poznan-Atlanta MBA Program. Through her whole professional career so far, she has been engaged in energy efficiency, renewable energies and climate change issues. Her main focus is climate and energy efficiency strategies in industries but she has also been involved in policy development and evaluation. Currently, she is the work field manager for carbon and energy solutions for the Polish industry as well as the manager of the Warsaw office in Ecofys. In the paper, the author wants to express her interest in possible use of emission trading schemes to support cost effective energy efficiency improvement in the Polish economy. This approach will not only allow efficient use of the capital (emission reserve) but also, realization of cost effective measures to limit costs of production, decreasing carbon footprint and apeeding up intake of new technologies to the Polish economy.

[2] Known as Annex I countries – Annex I to the Convention, lists these countries.

[3] Reduction targets for post-2000 were defined in the Kyoto Protocol, see chapter 2.2.

[4] Technologies not emitting GHG gases.

[5] Only for Poland and Hungary, 1988 was set as the base year due to restructuring of economy in 1990.

[6] Ratification by 55 conference parties, emitting at least 55% of the global GHG emissions was the minimum requirement.

[7] The list of biggest emitters consists of the USA, EU, Russia, Japan and Canada.

[8] This is a long term reduction proposed by the European Commission.

[9] Verification is not foreseen in AAU trade.

[10] In organisation.

[11] Defined in Annex I to the Directive no. 2003/87/EC, establishing the scheme, no EC/87/2003:

- Combustion installations with a rated thermal input exceeding 20 MW (except hazardous or municipal waste installations)
- Mineral oil refineries
- Coke ovens
- Metal ore (including sulphide ore) roasting or sintering installations
- Installations for the production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour
- Installations for the production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or lime in rotary kilns with a production

capacity exceeding 50 tonnes per day or in other furnaces with a production capacity exceeding 50 tonnes per day
- Installations for the manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day
- Installations for the manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day, and/or with a kiln capacity exceeding 4 m3 and with a setting density per kiln exceeding 300 kg/m3
- Industrial plants for the production of (a) pulp from timber or other fibrous materials (b) paper and board with a production capacity exceeding 20 tonnes per day.

[12] Carbon fund: an investment vehicle that seeks either to repay investors in carbon credits, or to use income from selling such credits to generate or enhance investment returns. Such funds can either simply buy credits, or invest in the underlying projects and claim title over emission reductions they generate.

[13] Polish emission reserve is discussed in more detail in chapter 4.

[14] March 2007; the observed fall of prices is cause by overallocation for phase I (2005-2007) resulting in small demand and large supply of allowances; the EC is taking serious steps in create more demand in Phase II (2008-2012).

[15] Except ERUs, which will be generated only after 2008 and therefore can only be sold in future/forward transactions.

[16] Malta and Cyprus, as developing countries do not have reduction targets; see chapter 2.2.

[17] In governmental documents the author of this article found no actual forecast for the whole economy nor for particular greenhouse gases, therefore only the reserve in the EU ETS sectors will be considered as a potential for AAU sales; however, it seems necessary to prepare a detailed analysis on the size of the Polish emission reserve.

[18] Implementation of the new EU energy policy and Directive on efficiency of end-use energy no. 2006/32/WE, published on the 5th April 2006, aiming at improving energy efficiency 1% annually are extra incentives for implementing activities to increase energy efficiency in the Polish economy.

[19] Climate policy is also realised by the national energy policy and design of the national allocation plans.

[20] Chapter 3.4.1 presented Japan as one of the most active buyers in the carbon market due to high costs of internal GHG emissions reductions.

[21] Requirement of validation and verification of emission reports by independent accredited verifiers, as required under the Kyoto - and the EU ETS schemes could be a solution to this bottleneck – yet a complex one.

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Zasady udzielania i umarzania pożyczek oraz udzielania poręczeń, kredytów i dotacji ze środków Narodowego Funduszu Ochrony Środowiska i Gospodarki Wodnej, Uchwała Rady Nadzorczej nr 154/05 z dnia 19.12.2005, Uchwała rady nadzorczej nr 8/06 z dnia 18.01.2006, Uchwała rady Nadzorczej nr 32/06 z dnia 25.04.2006.

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