A NATIONAL STRATEGY FOR JOINT IMPLEMENTATION IN THE CZECH REPUBLIC

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Contents

Executive Summary

Chapter 1
Introduction

Chapter 2
UNFCCC, Kyoto Protocol and Joint Implementation
   The Climate Change Convention
      The Protocol to the UNFCCC
      COP-3, Kyoto
   Joint Implementation as a Basic Concept
      UNFCCC and JI
      Objections against JI
   Joint Implementation and Emission Trading
      Operationalizing of JI
      Comparison of Credit and Allowance Trading
   Pilot Phase of Activities Implemented Jointly
      Basic principles of AIJ
      Baseline and additionality
   Comparison of National AIJ Programs
   Economies in Transition and Joint Implementation

Chapter 3
International Demand for GHG Offsets and Market Development
   Basic Assumptions
      System definition
      Data available
      Baseline emission data
      Marginal abatement costs
      Transaction costs
   Options for the Market Organization
      Market Options
      Typology of design parameters
      Possible market scenarios
      Institutional/organizational set up
   Monetary value of GHG market volumes
      Methodology: types of simulation models
      Simplified model for analysis
      Theoretical market volume and market value
      Sensitivity analysis
   Offsets and Financial Flows
      Flows between the regions analyzed
      Rents to host and to investor countries
      Sensitivity
Risk Factors

Chapter 4
Greenhouse Gas Emissions in the Czech Republic
National Emissions Inventory of GHGs
Emission Projections
Methodology for CO₂
Baseline and mitigation scenarios
Abatement Costs and Reduction Potential
Overall cost curves
Sectoral cost curves
Reduction potential
Qualitative Sectoral Analysis – Industry, Transport, and Renewables
Industry
Transport
Renewable energy sources

Chapter 5
Czech Republic and Joint Implementation
State of the Environment in the Czech Republic
Recent Development of Climate Policy in the Czech Republic
AIJ in the Czech Republic
National Strategy for Joint Implementation
JI as a part of National Climate Policy
The role of the Government
Strategic options for the Czech Republic
Additional policies
Socio-economic Costs and Benefits
Local environmental benefits
Benefits from technology transfer effects

Chapter 6
Institutional Arrangement
Role JI authorities in the Czech Republic
Supporting functions
Regulatory functions
Administrative Procedure for AIJ Projects
Interministerial JI Commission
Administrative Procedure
Information system
Feasibility study
Project Assessment
Monitoring and reporting

Chapter 7
References

Appendices
Executive Summary

A. Basic Concepts

The UN Framework Convention on Climate Change (UNFCCC) enables Parties to this Convention to implement mitigation measures jointly with other Parties. Because of the difference of abatement costs estimated for various countries, an international cooperation would decrease the overall costs of policies and measures, which Annex I countries will have to implement.

Credit and allowance trading are two different forms of emission trading, which is supposed to become an efficient mechanism making this cooperation possible. Future development of emission trading has been established by the Kyoto COP-3 (Conference of the Parties to the Convention, December 1997).

B. Kyoto Conference

At COP-3, industrialized countries (so called Annex I countries) adopted a legally binding Protocol under which they will reduce their collective emissions of greenhouse gases (GHGs) by 5.2%.

This 5.2 % reduction in total emissions of Annex I countries will be achieved through following national reductions:

- 8 % by Switzerland, many Central and East European countries including the Czech Republic, and the European Union (the EU will reach its target by distributing differing reduction rates to its member states),
- 7 % by the US,
- 6 % by Canada, Hungary, Japan, and Poland,
- Russia, New Zealand, and Ukraine are to stabilize their emissions,
- Norway may increase emissions by 1 %, Australia by 8 %, and Iceland by 10 %.

Three various mechanisms of emission trading are included in the Protocol:

1. An international emissions trading regime will be established allowing industrialized countries to buy and sell their excess emissions limits (allowance trading).
2. Industrialized countries will be allowed to buy and sell emission credits generated on the base of individual projects - joint implementation (JI) projects.
3. A "clean development mechanism" (CDM) will enable industrialized countries to finance emissions-reduction projects in developing countries and receive credits.

The main focus of this study is on the JI based credit trading compared with allowance trading, but in principle both schemes (allowance trading and credit trading) could coexist. Acceptance of a project based crediting system is generally expected after 2000 as a first step towards other more advanced forms of emission trading. The discussion on operational details of emission trading will continue at the COP-4 in Buenos Aires (November 1998).

C. Activities Implemented Jointly

Experience collected during a pilot phase of JI (so called AIJ), which has been launched by COP-1 (Berlin 1995) and which does not include credits, will be evaluated by 2000. It is expected that pilot JI initiatives - AIJ - will generate standards for recording transactions and other components of a trading system.
Basic rules of project assessment are being worked out during AIJ. Reduction achieved by an individual project is related to project baseline and methodology for the determination of this baseline currently being developed. Also the requirement of additionality is very important.

D. Prospective Market

Marginal abatement costs (MACs) show a large variation across above regions, which creates the potential for trading. The market for GHG credits discussed in this study consists of four regions (Annex I countries only):

1. Western Europe
2. North America
3. Pacific Region and
4. Economies in Transition (EITs).

The results of the econometric model simulations are as follows:

- total market value of offsets could vary between 900 and 2200 mil. USD,
- the most sensitive parameters are the commitments and the market restrictions,
- the economic profit of the trading will be shared between sellers and buyers,
- distribution of overall financial benefits between the supplier (host) countries is based on the differences in marginal abatement costs and supply volumes,
- the financial flow to EIT countries was estimated between 0.9 and 2.2 bil. USD per year.

E. Scenarios and Reduction Potential of the Czech Republic

The objective of this study is to examine tradable reduction potential of the country, identify suitable areas for the development of JI projects, identify pre-requisites on national level and propose strategic options taking into account outcomes of the Kyoto Conference (COP-3). To fulfill this task, the project team defined two baseline scenarios (low and high economic growth) linked to two mitigation scenarios. Since CO₂ represents about 83% of the present total GHG emissions in the Czech Republic (97% of CO₂ comes from combustion processes), the study does not deal with other GHG and non-combustion sources of CO₂.

The emission scenarios are taking into account substantial decrease in economic performance (first half of 1997). The key parameters derived from scenarios were used as an input to energy model MARKAL. The main results of the modeling are as follows:

- in all baseline scenarios, the CO₂ emissions are growing even if the 1990 level will not be reached by 2010,
- suitable policy and technical measures will have to be implemented to achieve stabilization well below the 1990 level with respect to emission limits adopted in Kyoto,
- the present favorable difference between emission cap (national emission limit for the first budget period declared at COP-3 is 8% below 1990 emission level) and actual emissions is only a temporary advantage (till 2010 - 2015), if no efficient measures are taken,
- at about 2005, the difference represents 10 - 30 mil. tons of CO₂, which is the maneuvering space for future emission trading.

This study presents first estimates of MACs for the Czech Republic and compares the data available internationally on MACs. The MACs are lower in the Czech Republic in comparison with majority of OECD countries, which indicates a trading potential in the Czech Republic.

F. Obstacles to JI

The Czech Government (the Ministry of the Environment, MOE) takes a positive stance toward greenhouse gas (GHG) emission offsets. However, the study identifies several barriers to emission trading and JI present in the Czech Republic:

- complexity and novelty of the issue;
- lack of experience with environmental policy based on economic instruments;
- preference for command-and-control regulation at the level of state administration;
- lack of environmental awareness and capacity in the private sector (both owners and management);
- strong role of the state in the Czech power industry;
• absence of clear operational guidelines for, and complexity of, offset project assessment (including guidelines for baseline calculations, additionality assessment etc.).

G. Domestic Prerequisites

The Czech Republic needs to develop its own strategy about emission trading. This strategy needs to take into account that the country's role as a host to JI projects may be limited and come to an end around the year 2010. This temporary role as a host country complicates the position of the Government compared to that of pure investor or host countries. To maintain its own flexibility in complying with UNFCCC and Protocol commitments, the Government needs to define clear boundaries on the GHG offset market (volume, rules, monitoring etc.).

The study indicates that for the Czech Republic to take advantage of offset trading, a number of institutional and administrative structures have to be put in place. These include a JI information system, a JI office at the MOE, an interministerial JI commission, other government agencies (State Environmental Fund, Czech Energy Agency), and a system of accredited private consultants and verifiers. Clear rules for project assessment need to be set. Assessment procedure should be linked to environmental impact assessment (EIA) and the general public should have access to the decisions of the JI commission.

To improve the responsiveness of the energy, transport, industry and municipal (residential) sectors to JI, the following additional measures should be considered:

• elimination of distortions in energy prices (subsidies),
• co-financing of municipal JI projects by the State Environment Fund, the Czech Energy Agency or the Phare Energy Fund, and facilitation of commercial credits,
• carbon emission tax combined with concessions on direct taxes, etc.

Since the Czech Republic's national climate policy is linked to efforts for local environment protection, priority should initially be given to JI projects that do not only lead to GHG emission reductions but also protect the local environment and/or human health.

H. Strategic Options

The study proposes four basic strategic options for the Czech Republic with respect to JI. They are dependent on the future ability of the Czech Republic to comply with national emission limits. A combination of several options is also possible.

a) Political approach to JI

The first strategic option is a pragmatic, political approach that would include the following steps:

1. The Czech Republic hosts about 5-10 emission offset projects.
2. JI administrative procedures (rules, assessment criteria, decision mechanism) are formulated by the MOE in cooperation with the Ministry of Industry and Trade.
3. A designated institution (Czech Energy Agency or State Environmental Fund) is given the authority to carry out projects, including technical and administrative tasks.
4. As an EU accession country, the Czech Republic coordinates its approach to emission trading with the EU so as to minimize the implementation cost of EU environmental legislation.

b) Project Pipeline

A second strategic option would be the preparation of an extended project pipeline to accelerate the preparation and implementation of carbon offset projects, building on the pipeline designed as part of this study. The identification of a pipeline of specific projects should facilitate the matching of foreign investors with Czech partners, the preparation of projects according to specific JI requirements (baseline, additionality etc.), as well as their effective assessment and monitoring.

The study recommends a stepwise increase of the involvement of the Czech Republic in emission offset projects under this strategic option. Given the relatively large uncertainty about GHG emissions (8-10% for combustion CO₂) and the possible growth of baseline emissions in the period 1996 - 2005, the study recommends to:

• limit the volume of credits to 1-2% of national emissions (e.g. 1.5 million tons of
CO₂ / yr.) at the initial stage of trading (2000 - 2005),

- improve the quality of the GHG emission inventory and projections (shorter time, lower uncertainty, e.g. a range of 2-5% as achieved in the inventories of most OECD countries),
- use the resource rent captured from offset projects to enhance domestic GHG reductions, which means seeking a minimum price of 10 US$/ ton CO₂ and sharing achieved reductions with foreign investors,
- limit JI projects to more advanced technologies only (transfer of Best Available Technology),

**c) GHG Fund**

Since 1993 hundreds of properly documented and regularly monitored projects have been financed by the Czech Energy Agency or the State Environmental Fund. This work could form the basis of a national GHG Fund in which carbon credits could be pooled and traded internationally (the third strategic option).

A portfolio of small but replicable projects (energy saving, municipal heating systems, renewables etc.) could be created. The quality of credits generated through such a portfolio may well be higher than that of standard JI projects (diversification, safety margin). The operational costs of the GHG Fund and activities related to the trading of credits (e.g. project monitoring and verification, improvement of national inventories and projections, carbon offset trade analysis etc.) would be covered from revenues of the fund.

**d) Allowance trading**

Project based emission trading like JI does not allow countries to obtain credit for sector or economy-wide measures, such as the removal of subsidies on energy and fuel prices, carbon taxation, support of railway or municipal transport, incentive schemes for energy saving in small family houses etc.

Under the fourth strategic option the Czech Republic would push for the establishment of an international allowance trading system. If such a system were put in place, aggregate (as opposed to project-by-project) trading would become possible. The government would have the right to sell (or buy) allowances and redistribute the revenues, say, via the GHG Fund mentioned above. In such a case, allowance trading could become a source of funds for complementary domestic measures. Assuming a national emission cap at 8% below 1990 levels by 2008 - 2012 and the stabilization of actual emissions at 1995 level, about 10 million tons of CO₂ could be offered annually as tradable allowances.
1 INTRODUCTION

The aim of the study, which was launched in August 1997, conducted in the Framework of the Swiss-World Bank Collaborative Initiative on National AIJ/ JI Strategy Studies and finalized before the Kyoto Conference, is to provide the Czech authorities with information for better understanding opportunities presented by potential international markets for GHG offsets and develop domestic mechanisms for their potential use. The study therefore served as an analytical background for the Czech delegation during the Kyoto deliberations. After the COP-3, the project team modified partially the text of the final draft with respect to the outcomes of the Conference.

The main part of the mathematical modeling including scenarios has been carried out before COP-3. Since a flat rate, 5% reduction of GHG emissions, has been expected as a most probable result of Kyoto, our pre-Kyoto conclusions stayed therefore mostly unchanged.

In order to achieve the above aim, the proposed study quantifies the potential for reductions of GHG emission in various sectors of the Czech economy, identifies the abatement costs and proposes possible scenarios suitable for the Czech Republic. The specific objectives of the study are as follows:

- highlight the opportunities created by a possible market for AIJ/ JI projects and/or GHG offsets/ credits,
- flesh out possible issues and concerns with GHG offsets trading and possible trading mechanisms and develop policy options and strategies,
- analyze the choices the Czech Republic is facing in addressing climate change and support the decision making process at the government level with respect to AIJ/ JI,
- contribute to the discussion on approval/ acceptance, development, monitoring and evaluation of pilot AIJ projects,
- disseminate information on the potential of JI as an investment source for the enhancement of energy efficiency of the Czech energy, industrial, residential and public sectors,
- develop a pilot pipeline of possible JI projects.

At the initial phase of the project, the project team expected to collect a group of prospective projects, mature for AIJ or interesting from the point of view of the “Global Carbon Initiative” of the World Bank. We have however identified gaps in the administrative procedures of the MOE, which must be filled before the development and implementation of larger numbers of JI/ AIJ projects goes ahead. A system for project development has been therefore proposed.

There are fundamental problems to solve with respect to the conflict of interests of the Government responsible for the compliance of the Czech Republic with UNFCCC and the private sector (domestic project developers and foreign investors) interested in credit trading. These problems are common for all host
countries and the project team believes that this study will contribute to their solution.

The project team would like to thank the MOE, the Swiss Trust Fund and the World Bank for active support of this study. Especially, our fruitful discussions with Anne Arquit Niederberger, Sam Fankhauser, Johannes Heister and Peter Kalas helped us to approach the above objectives. Finally, the help of Erich Lippert and Sam Fankhauser reviewing the final draft of the study is highly appreciated. The coordinator of study would also like to thank Lenka Rencová of MOE and Vít Gajdušek, Envitypo, for their technical assistance with the manuscript.
The Climate Change Convention

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in June 1992 at the Rio Earth Summit. Its ultimate objective is the "stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The UNFCCC sets out two guiding principles - the precautionary principle (action is necessary even in absence of the final scientific evidence of damage) and the principle of the "common but differentiated responsibilities", which assigns the lead in combating climate change to developed countries. Both developed and developing countries accept a number of general commitments.

All Parties submit "national communications" containing inventories of GHG emissions by source and GHG removals by "sinks". They adopt national programs for mitigating climate change and develop adaptation strategies. They should also promote technology transfer and sustainable management, conservation, and enhancement of GHG sinks and "reservoirs" (such as forests and oceans). In addition, the Parties should take climate change into account in their relevant social, economic, and environmental policies.

Industrialized countries undertake several additional commitments. Most members of the Organization for Economic Cooperation and Development (OECD) plus the states of Central and Eastern Europe - together referred as Annex I Parties - are committed to adopting policies and measures aimed at returning their GHG emissions to 1990 levels by the year 2000.

Whereas the negotiations of the UNFCCC were initially based upon the precautionary principle, the Second Assessment Report of IPCC, which was presented at COP-2 in Geneva (1996), goes a further step by stating that "... balance of scientific evidence suggests that there is a discernible anthropogenic influence on the global climate", which indicates unacceptable social, economic and ecological impacts being possible to take place in coming decades. If developed countries do not start an appropriate action now, future generation will be confronted with increased economic costs of abatement having less time to react properly.

The Protocol to the UNFCCC

The first Conference of the Parties to the UNFCCC (COP-1), which took place in Berlin (March - April 1995) launched a negotiation on strengthening of the commitments of developed countries beyond 2000. COP-1 established an open-ended Ad Hoc Group on the Berlin Mandate (AGBM) to begin a process launching an appropriate action for the period beyond 2000, including the strengthening of the commitments of Annex I Parties through the adoption of a Protocol or another legal instrument at COP-3 (Kyoto 1997). At COP-2 (Geneva 1996), the mandate of AGBM was strengthened and defined in detail.

COP-3, Kyoto

After two weeks of negotiations, ministers from 160 countries reached agreement at the end of COP-3 (December 10, 1997) on a legally binding Protocol under which industrialized countries will reduce their collective emissions of GHGs by 5.2%.

The agreement aims to decrease aggregated emissions of a basket of six GHGs by 2008-12, calculated as an average over these five years. Emission cuts of the three most important gases,
carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$), will be measured with respect to the base year 1990. Cuts in three long-lived industrial gases, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride ($SF_6$), can be expressed with respect to the base year 1990 or 1995.

If compared to expected emissions level for 2000, the total reductions required by the Protocol will actually be about 10%, since many industrialized countries have not succeeded in meeting their earlier non-binding aim of returning their emissions to 1990 levels by the year 2000, and their emissions have in fact risen since 1990. Compared to the emissions level that would be expected by 2010 without emissions-control measures, the Protocol target represents a 30% cut.

The 5.2% reduction in total emissions of Annex I countries will be achieved through national reductions of 8% by Switzerland, many Central and East European countries including the Czech Republic, and the European Union (the EU will reach its target by distributing differing reduction rates to its member states); 7% by the USA; and 6% by Canada, Hungary, Japan, and Poland. Russia, New Zealand, and Ukraine are...
to stabilize their emissions, while Norway may increase emissions by 1%, Australia by 8%, and Iceland by 10%.

The Protocol encourages governments to pursue emissions reductions by improving energy efficiency, reforming the energy and transportation sectors, protecting forests and other carbon "sinks", promoting renewable forms of energy, phasing out inappropriate fiscal measures and market imperfections, and limiting methane emissions from waste management and energy systems (Art. 2). The Protocol enables countries a certain degree of flexibility in how they measure their emissions reductions.

In addition to reductions from various industrial and economic sectors, carbon dioxide emissions from deforestation and carbon dioxide reductions resulting from newly planted trees (which act as carbon "sinks" by absorbing CO\textsubscript{2} from the atmosphere) will also be accounted.

Three various mechanisms of emission trading are included in the Protocol:

- an international emissions trading regime will be established (Art. 16bis) allowing industrialized countries to buy and sell their excess emissions rights amongst themselves (allowance trading),
- it will eventually allow industrialized countries to buy and sell fixed amounts of GHG emission reductions (credits, emission reduction units) on the base of individual projects (joint implementation projects),
- a "clean development mechanism" (CDM, Art. 12) will enable industrialized countries to finance emissions-reduction projects in countries not included in Annex I and receive credit for doing so.

Because of objections from developing countries, however, details of how trading would operate will be discussed at the COP-4 in Buenos Aires (1998). By the time the Protocol becomes binding and details such as penalties for overselling of allowances are ready in a couple of years, it is expected that pilot trading initiatives (AlJ) will generate standards for recording transactions and other components of a trading system. Since the Czech Republic will figure in the first budget period (2008 - 2012) as a country selling its allowances and/ or hosting JI projects, the last option (CDM) is not discussed in this study.

**Joint Implementation as a Basic Concept**

**UNFCCC and JI**

Joint implementation" is anchored in Article 4, Paragraph 2(a) of the UNFCCC, "... developed country Parties and other Parties included in Annex I ... implement such policies and measures [on the mitigation of climate change, by limiting its anthropogenic emissions of GHGs and protecting its GHGs gas sinks and reservoirs] jointly with other Parties and may assist other Parties in contributing to the achievement of the objective of the Convention ...".

Article 3, Paragraph 3 urges governments to take "... into account that policies and programs to deal with climate change should be cost/effective to ensure global benefits at the lowest possible costs" and notes that "... efforts to address climate change may be carried out cooperatively by interested Parties".

From an economic point of view, joint implementation (JI) is based upon the difference of the abatement costs, which are supposed to be higher in the energy efficient industrialized countries than e.g. in EITs or developing countries. This difference of abatement costs is based not only upon difference of cost curves per se but it depends also upon the level of commitments to stabilize or reduce GHG emissions (Figure 1).

The exchange of benefits (investment, emission reductions, protection of local environment and human health, infrastructure development etc.) between cooperating countries provides a real incentive. Cross-border cooperation will therefore be more cost effective than if every Party to the Convention will implement abatement within its own borders. Barret (1992) has estimated that implementation of the EU target on stabilizing EU-wide CO\textsubscript{2} emissions at the level 1990 by 2000 would be about one order

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1 The most important GHGs are carbon dioxide (CO\textsubscript{2}), methane (CH\textsubscript{4}) and nitrous oxide (N\textsubscript{2}O), to which this paper refers collectively as GHGs.
of magnitude less expensive compared to a requirement that each member State would stabilize only its own emissions. Recently Grubb and Vrolijk (1997) have concluded that the costs to the major OECD countries associated with reducing domestically CO\textsubscript{2} emissions by 5\% from 1990 levels are the same as those arising from a flat-rate reduction of about 14\% across all industrialized countries, if full allowance trading (inter-governmental) is implemented.

**Objections against JI**

In preparing for COP-1, objections of developing countries (G-77 and China) were raised (Mitchell 1996). JI was often mentioned as a means for Annex I Parties to avoid domestic abatement actions to meet the obligation of UNFCCC. Several objections have been raised frequently during the process of the negotiations on UNFCCC (Dudek and Wiener 1996, Mitchell 1996):

- JI would transfer obligations from developed to developing countries,
- JI would limit economic development as well as the political sovereignty of poor countries (eco-imperialism),
- JI would deplete stock of low-cost reductions available to the host countries ("low hanging fruits").

These problems, which have been partly resolved in further phases of the development of operational rules for AIJ, are additional to debates on cost-effectiveness, relatively high transaction costs and investment risks. Another concern is related to "carbon leakage", which means the possibility that highly GHG emitting industrial processes - and thereby related GHG emissions - "migrate" from developed to developing countries producing GHG intensive goods for export to developed countries.

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A number of environmental organizations also recalled the guiding principles that have shaped the development of the UNFCCC and which have implications for the design of a politically acceptable mechanism for joint implementation, for example (Greenpeace, 1994):

- additionality – JI should be additional to the obligations of Annex II countries to transfer capital and technology to developing countries to pay the full incremental costs of measures to mitigate climate change and additional to projects that would have been carried out anyway,
- equity – JI projects should be socially acceptable and contribute to local socio-economic development and capacity building,
- transparency – the development of JI projects should involve the local community, NGOs and interested parties to ensure that the full palette of local social, economic and environmental costs and benefits can be taken into consideration.

Due to the political resistance to the JI and crediting of emission reductions, COP-1 decided on „Activities Implemented Jointly“ (AIJ) as a pilot phase of JI. During the pilot phase no credits shall accrue any party involved (see also 2.4.).

Joint Implementation and Emission Trading

Operationalizing of JI

Emission trading is a mechanism which is supposed to support national efforts to reduce GHG emissions in a flexible and cost-effective way. Basically two prospective alternatives of emission trading have been discussed after COP-1 and implemented into the Protocol (see 2.1.2):

- allowance trading limited to Annex I Parties,
- trading of credits generated by climate protection projects in either Annex I (joint implementation) or non-Annex I Parties (clean development mechanism).

The first option, which is discussed in this study as an allowance trading (see BOX 1) and which would involve OECD and EIT countries (Annex I), seems to be, at least on the first glance, less complicated than the second one (Boehm 1994, Stewart et al. 1996). The allowance trading among Annex I Parties would be monitored on the basis of their national aggregated emissions (outcome of the standard annual emission inventories). Trading participants have assigned emission limits on their national level, which serve as the reference necessary for allowance trading.

To assess JI projects, the concept of project baseline has been adopted. Emission reductions are calculated from the difference between two emission levels - project baseline and project performance (Heister 1996, Michaelowa 1997). It may be sometimes impossible to establish the baseline in a transparent and verifiable way or to quantify project performance with necessary precision (e.g. forest growth) as it is discussed later (see 2.4.2.).

The preparation and assessment of individual JI projects is more laborious and therefore the overall transaction costs are supposed to be higher than for allowance trading. Also monitoring and verifying of the individual JI projects is expected to increase the total operational costs.

Comparison of credit and allowance trading

Since both options are anchored in the Protocol, their differences are substantial with respect to the national strategy. Credit trading (sometimes mentioned as „project based JI“) is supposed to include the following steps:

- identification of projects and project baselines,
- direct investment into selected (approved) projects,
- monitoring and verification of project performance (emissions are measured against project baseline),
- issuing of tradable credits by government,
- certification of credits by an independent international body,
- trading of credits by national/ sub-national subjects or via intermediaries.

Allowance trading will take place between Parties committed to reduction targets (Baron and Mullins 1996, Anderson et al. 1997). If one country emits less than the given emission cap, it is allowed to sell the difference between the actual emission levels and the cap. These
emission allowances can be bought by another Annex I Party the emissions of which are larger than national emission limit. In this case only national emissions are monitored via emission inventories. In Table 1, the principal differences between the both basic options of emission trading are shown.

Allowance trading combined with banking of the emission allowances during the budget period enhances the flexibility of the system. Both options of emission trading anchored in the Protocol are expected to be combined into one effective international market with GHGs emissions (Joshua 1997).

There are also proponents of „free“ emission trading on the level of sub-national entities in different countries, which would not be regulated by national Governments. However any GHG emission trading is related to the compliance with UNFCCC or Protocol respectively, which is responsibility of sovereign national Governments. This problem is discussed in relation to the national strategy in Chapter 5.4.

Discussion on enforcement or non-compliance procedures indicates that only effective enforcement mechanisms (penalties, e.g. 100 USD/ ton of CO$_2$, or trade restrictions such as export quotas) can make UNFCCC operational.

**Table 1.**

**Principal differences between allowance trading and credit trading**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>ALLOWANCE TRADING</th>
<th>CREDIT TRADING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commodity</td>
<td>Allowances (emission rights)</td>
<td>Credits (emission reduction units)</td>
</tr>
<tr>
<td>Property right</td>
<td>Use of atmosphere</td>
<td>Emission reduction units</td>
</tr>
<tr>
<td>Compliance</td>
<td>Based on emission inventories</td>
<td>Based on project monitoring</td>
</tr>
<tr>
<td>Institutions</td>
<td>International market</td>
<td>Ad hoc trades approved by governments</td>
</tr>
<tr>
<td>Reference</td>
<td>National cap</td>
<td>Project baseline</td>
</tr>
<tr>
<td>Emission monitoring</td>
<td>National inventories</td>
<td>Project performance</td>
</tr>
<tr>
<td>Incentive for seller/ host</td>
<td>Revenues to national budget (environmental fund)</td>
<td>Revenues to project host entity, technology transfer</td>
</tr>
<tr>
<td>Incentive for buyer/ investor</td>
<td>Lower abatement costs</td>
<td>Lower abatement cost</td>
</tr>
<tr>
<td>Implementation of reductions</td>
<td>Policy instruments and measures</td>
<td>Direct technology investment</td>
</tr>
<tr>
<td>Transaction costs</td>
<td>Low</td>
<td>Possibly high</td>
</tr>
<tr>
<td>National implementation cost</td>
<td>Possibly high</td>
<td>Low</td>
</tr>
<tr>
<td>Reduction potential</td>
<td>Large</td>
<td>Limited</td>
</tr>
<tr>
<td>Time horizon</td>
<td>After 2010</td>
<td>About 2000</td>
</tr>
<tr>
<td>Development</td>
<td>International market construction as a whole</td>
<td>Gradual evolution of market</td>
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**Pilot Phase of Joint Implementation - Activities Implemented Jointly**

**Basic principles of AIJ**

Due to the debate surrounding JI before COP-1, the political resistance to the crediting of emission reductions (see also 2.1.2.) and a lack of operational criteria and common methodologies, a decision was taken by the Parties at COP-1 to “establish a pilot phase for Activities Implemented Jointly (AIJ) among Annex I Parties and, on a voluntary basis, with non-Annex I Parties that so request” (see Decision 5/ CP.1, reproduced in BOX 2).

This name change from JI to AIJ and the decision that "no credits shall accrue to any Party...during the pilot phase" were deliberated in order to overcome the lack of agreement surrounding the JI instrument. As a corollary to the decision on crediting, the COP-1 also recognized that AIJ between Annex I and non-Annex I Parties "will not be seen as fulfillment of current commitments of Annex I Parties under Art. 4.2(b) of the Convention".
The COP-1 decision also gives a number of AIJ project eligibility criteria:

- AIJ projects should bring about real, measurable and long-term environmental benefits related to the mitigation of climate change that would not have occurred in the absence of such activities,
- AIJ should be compatible with and supportive of national environment and development priorities and strategies and contribute to cost-effectiveness in achieving global benefits,
- all AIJ projects under the pilot phase require prior acceptance, approval or endorsement by Governments of Parties participating in these activities,
- the financing of activities implemented jointly shall be additional to the financial obligations of Parties included in Annex II to the Convention within the framework of the financial mechanism (the Global Environment Facility) as well as to current official development assistance (ODA).

This name change from JI to AIJ and the decision that "no credits shall accrue to any Party...during the pilot phase" were deliberated in order to overcome the lack of agreement surrounding the JI instrument. As a corollary to the decision on crediting, the COP-1 also recognized that AIJ between Annex I and non-Annex I Parties "will not be seen as fulfillment of current commitments of Annex I Parties under Art. 4.2(b) of the Convention".
BOX 2
Activities Implemented Jointly under the pilot phase
(Excerpt from COP-1 Decision 5/CP.1)
The Conference of the Parties,
Recalling that, in accordance with Article 4.2(d) of the United Nations Framework Convention on Climate Change, the Conference is required to take decisions regarding criteria for joint implementation as indicated in Article 4.2(a),
Noting that the largest share of historical and current global emissions of GHGs has originated in developed countries, that per capita emissions in developing countries are still relatively low and that the share of global emissions originating in developing countries will grow to meet their social and development needs,
Acknowledging that the global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their common but differentiated responsibilities and respective capabilities and their social and economic conditions,
Recognizing that,
(a) According to the provisions of the Convention, the commitments under Article 4.2(a) to adopt national policies and to take corresponding measures on the mitigation of climate change apply only to Parties included in Annex I to the Convention (Annex I Parties), and that Parties not included in Annex I to the Convention (non-Annex I Parties) have no such commitments,
(b) Activities implemented jointly between Annex I Parties and non-Annex I Parties will not be seen as fulfillment of current commitments of Annex I Parties under Article 4.2(b) of the Convention; but they could contribute to the achievement of the objective of the Convention and to the fulfillment of commitments of Annex II Parties under Article 4.5 of the Convention,
(c) Activities implemented jointly under the Convention are supplemental, and should only be treated as a subsidiary means of achieving the objective of the Convention,
(d) Activities implemented jointly in no way modify the commitments of each Party under the Convention,
1. Decides:
(a) To establish a pilot phase for activities implemented jointly among Annex I Parties and, on a voluntary basis, with non-Annex I Parties that so request;
(b) That activities implemented jointly should be compatible with and supportive of national environment and development priorities and strategies, contribute to cost-effectiveness in achieving global benefits and could be conducted in a comprehensive manner covering all relevant sources, sinks and reservoirs of GHGs;
(c) That all activities implemented jointly under this pilot phase require prior acceptance, approval or endorsement by the Governments of the Parties participating in these activities;
(d) That activities implemented jointly should bring about real, measurable and long-term environmental benefits related to the mitigation of climate change that would not have occurred in the absence of such activities;
(e) That the financing of activities implemented jointly shall be additional to the financial obligations of Parties included in Annex II to the Convention within the framework of the financial mechanism as well as to current official development assistance (ODA) flows;
(f) That no credits shall accrue to any Party as a result of GHG emissions reduced to sequestered during the pilot phase from activities implemented jointly.

Note: Two further decisions were taken by COP-1 regarding the AIJ pilot phase, but are not reproduced here. For the full text, refer to document FCCC/CP/1995/7/Add.1

The COP-1 decision also gives a number of AIJ project eligibility criteria:

- AIJ projects should bring about real, measurable and long-term environmental benefits related to the mitigation of climate change that would not have occurred in the absence of such activities,
- AIJ should be compatible with and supportive of national environment and development priorities and strategies and contribute to cost-effectiveness in achieving global benefits,
- all AIJ projects under the pilot phase require prior acceptance, approval or endorsement by Governments of Parties participating in these activities,
- the financing of activities implemented jointly shall be additional to the financial obligations of Parties included in Annex II to
the Convention within the framework of the financial mechanism (the Global Environment Facility) as well as to current official development assistance (ODA).

COP-1 also decided to "establish a framework for reporting, in a transparent, well-defined and credible fashion, on the possible global benefits and the national economic, social and environmental impacts as well as any practical experience gained or technical difficulties encountered in AIJ under the pilot phase" and that "Parties involved are encouraged to report to the COP through the secretariat using the framework thus established". Each COP "shall review the progress of the pilot phase...with a view to taking appropriate decisions on the continuation of the pilot phase". A conclusive decision on the pilot phase should be taken before 2000.

**Baseline and additionality**

Since the performance of an AIJ project is measured against a baseline (reference emission scenario), the construction of this scenario is a critical problem (Michaelowa 1997). A project related baseline represents a number of assumptions, which must be set ex ante - before project assessment and acceptance. For example if a reconstructed power plant creates an additional capacity, its performance depends upon the fuel chosen for the reference scenario (hard coal, lignite, mix of fuels etc.). A project baseline can be also influenced by a technical development or by price effects. Sometimes effects on GHG emissions of a JI project exceeds the narrowly defined project boundaries and the project has indirect effects on emissions from other sources (Heister 1996).

In many cases, the assumptions of reference scenario (baseline) are unpredictably changed during the project lifetime. However this "dynamic" baseline increases the uncertainty on the side of foreign investors due to unpredictable change of credited reductions. Despite the fact that project baselines are defined in very different ways, there are attempts to categorize them (Michaelowa 1997).

With respect to the benefits related to the AIJ/ JI, projects must be (Dec. 5/ CP.1):

- real,
- measurable,
- with long-term positive effects,
- additional.

The last requirement of „additionality” means that the resulting benefits would not have otherwise occurred (reductions „would not have happened anyway”). A special problem is connected with so-called no-regret-projects. It is difficult to prove for many projects, whether they „would have happened anyway” and if so, when they would have been implemented. The emission reduction from this type of JI projects should be credited only until the date when it is assumed (reference scenario) that the investment would have been made anyway. The no-regret projects should be credited therefore only for a part of their life-time.

Different methods to determine additionality have been discussed by Carter (1997), who concluded that an ultimate adoption of one particular method of additionality determination will depend upon next development of Protocol, emission trading and outcome of AIJ.

In this respect AIJ gives the necessary experience not only to estimate GHG reductions but also assess other environmental benefits. Incentives to exaggerate or overestimate overall benefits may be driven by the interest of investors to achieve greatest possible volume of credits or to achieve positive assessment of the AIJ project proposal. The lack of guidelines for baseline determination is, besides lack of credits and problems with additionality, the main reason why the private sector is not interested in development of AIJ projects (J-O. Wilums 1997, J. Palmisano 1997, Nordic Council of Ministers 1997).

**Comparison of National AIJ Programs**

This part of the study is based upon a synthesis of national AIJ programs prepared by the secretariat to UNFCCC and published October 7, 1997 (FCCC/ SBSTA/ 1997/ 12). Twelve countries submitted reports on national AIJ in 1997, twice as many as in 1996. With stricter reporting standards in effect, they reported on 39 projects. All activities have received endorsement by the designated national authorities for AIJ.

All Parties involved in AIJ are invited to submit information using an uniform reporting format
(URF) for their national programs, including contact information, descriptions of the program structure as well as the process for obtaining approval including procedure and criteria, and a summary of activities.

Of the nine countries which submitted AIJ program reports for this document, six did so for the first time (Costa Rica, Japan, Mexico, Poland, Sweden and Switzerland) while three countries updated the program reports submitted in 1996 (Germany, Norway and the USA). No updates were received from Australia, Canada and the Netherlands. A detailed analysis of reports received has allowed the secretariat some preliminary conclusions:

- the majority of current AIJ is between Annex I Parties, with EITs as host countries,
- the total amount of GHGs estimated to be reduced or sequestered by 39 activities considered is unevenly distributed over the various types of activities. Six forestry preservation and afforestation activities account for 57% of the abatement impact and 34% are attributable to one fugitive gas activity (see Table 2). Twenty-nine activities related to energy savings account for 9% of the GHG abatement effect. Most AIJ under the pilot phase are relatively small in terms of investment and their individual contribution to GHG abatement is limited. A more significant effect would, however, be achievable through the replication of such projects,
- participating countries use the pilot phase to gradually acquire procedural and institutional experience while achieving mitigation effects. Investor as well as host countries have gained experience, for example in the application of criteria in support of decision 5/ CP.1, and have developed additional criteria to reflect national priorities. Host countries which set up an AIJ unit appear to be successful in attracting financial resources and in ensuring the AIJ potential is utilized in priority areas of national development. An increasing number of countries are designating national focal points for AIJ and indicating interest in technical workshops, seminars and conferences on AIJ,
- countries, however, appear to be approaching the pilot phase cautiously. Information on the AIJ is disseminated insufficiently and government incentives appear inadequate. This may explain the hesitation of the private sector to invest,
- all projects result in capacity building and technology transfer.

The national AIJ reports which have been taken for this synthesis report show variations in structure and coverage.

<table>
<thead>
<tr>
<th>AIJ PROJECT TYPE</th>
<th>NUMBER OF PROJECTS</th>
<th>% OF GHG REDUCED/SEQUESTERED (CO₂equiv.)</th>
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<td>1.9</td>
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<td>34.4</td>
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<td>Afforestation</td>
<td>2</td>
<td>25.1</td>
</tr>
<tr>
<td>Forest management</td>
<td>4</td>
<td>31.9</td>
</tr>
</tbody>
</table>

Identification of the project baseline and description of the activity scenario including system boundary and leakage were, in most cases, not sufficiently addressed. The description of the project baseline was usually brief. Some countries reported baselines that assumed no change in the level of activity, for example, assuming a static, energy/heat consumption over the lifetime of the activity.

**Economies in Transition and Joint Implementation**

Due to its past extensive economic development, the Czech Republic as other EITs shows higher GHGs emissions as compared with OECD countries if a variety of criteria (cumulative
emissions, emissions per capita, emissions per unit of GDP, etc.) is used. Three Annex I countries in EIT group are among 15 major global CO$_2$ emitters - the Russian Federation (3rd), Ukraine (7th) and Poland (12th).

Annual emissions of CO$_2$ from CEECs and CIS have reached 4,800 mil. tons in 1988, which corresponds to 24% of the global carbon dioxide emissions. Since 1988, CO$_2$ emissions decreased in EITs resulting in about 18% of the global share (Mullins et al. 1996). This sharp fall has been caused by the closing down of energy-intensive industry caused by the decay of former Soviet and eastern European markets.

Analyzing the emission and economic data available for the Czech Republic, Hungary and Poland, it is evident that in those countries, which find themselves in an advanced stage of economic transition, the GHG emissions are not proportional to the economic re-growth and CO$_2$ emissions per unit of GDP are slowly decreasing. This is caused not only by stepwise elimination of energy subsidies but also by ongoing modernization of industrial and energy sectors.

The carbon intensity in EITs is however still several times higher in comparison with OECD or EU averages. The economically feasible saving potential in this group of countries is estimated as 20 - 50% of their total consumption of energy resources. For example, EITs use 20 - 50% more energy to heat buildings and industry takes 15 to 100% more energy per unit of production (Mullins et al., 1996).

It is therefore important to assess the economically feasible reduction potential of different sectors and calculate abatement costs for different types of projects (fuel switching, energy savings, renewable energy sources etc.). First analysis of costs of abatement measures implemented in EIT countries have indicated that these costs vary from country to country supposed to be generally lower than in OECD countries (Mullins et al. 1996). This variation is due to several factors, inter alia:

- varying efficiency of energy use,
- different level of infrastructure and technology development,
- different volume of low cost measures (mainly energy savings).

Emission trading has therefore a potential of enhancing or triggering the utilization of low cost measures in EITs. This type of mutually beneficial cooperation can overcome barriers to financing energy efficiency projects in EITs, which have been identified (Mullins et al. 1996) as:

- lack of investment because of weak domestic banking system and macroeconomic instability, (high inflation, high interest rates, short term loans only, lack of credit history),
- slowly proceeding privatization of energy, industry and housing sectors (lack of management incentive, state-owned energy monopolies, low rents and tenants-house owners problems),
- deformed energy prices (energy subsidies, externalities not internalized, social concerns),
- lack of information and experience on project development,
- lack of legislation and technical standards,
- weak institutional framework (lack of human capacities, lack of procedures to administer projects etc.).

It would be therefore useful not only to utilize the pilot AIJ phase for launching dozen of model projects in EITs, but to create a more receptive environment in those countries with respect to the next phase of JI including GHGs emission trading.

Since the beginning of the 90s, the majority of OECD countries adopted detailed climate policies on government level (see BOX 3). These policies are part of their national environmental and/or energy policies (or action planes) and adequate policy instruments are therefore developed. JI is closely related to development of more flexible approach, differentiated emission commitments and common policies and mitigation measures recommended for Annex I countries.
An active participation of EITs in negotiations on JI has been rather limited in initial phase which might be caused by:

- limited human resources available for UNFCCC related activities (research, administration, negotiations etc.).

- reduced levels of GHGs emissions, which are substantially below 1990 levels,

- low priority of environmental problems (and especially the global ones) in policy agenda of the new democracies.

- low level of public environmental awareness in comparison with western society,

Undeveloped climate policies (closely related to energy policies) is an explanation for the less active approach of EITs towards JI as compared with the majority of OECD members (see BOX 4). Moreover, the part of reduction of CO$_2$ emissions caused by economic depression (inherent to the first stage of economic transformation) is only temporary.

**BOX 3**

**Climate policies in OECD countries**

The climate policy of EU is highly important for the Czech Republic as an associated country to EU. On March 3 1997, the EU Environmental Council adopted a position with respect to national emission limits that set a quantifiable reduction objective - 15% reduction of the aggregated emission of the three main GHGs by 2010. In the Communication from the Commission issued by October 1, 1997 the Commission informs on possibilities to reduce CO$_2$ emissions of 800 mil. tons, sets the strategy and estimates the direct costs of such a reduction in the range of 15 to 35 billion ECU annually by 2010. A set of common policies and measures aims to energy sector, industry, transport, energy savings and enhanced use of renewables. The Communication stresses that the choice of the right strategy with the right mixture of instruments is not only important from the technical and economical point of view, it is the core of the political challenge of making progress to protect the global climate. This mix of instruments includes regulation, economic incentives including market based options, negotiated agreements with major industrial emitters and a broad spectrum of technical options. In Switzerland, where climate policy is subsidiary to other sectoral policy such as energy and transport, a CO$_2$ Law has been drafted and is currently discussed in the Swiss Parliament. Dutch climate policy is based in substantial extent upon covenants: legally binding commitments between producers and Dutch government. As an element of energy policy over thirty covenants have been concluded with industrial sectors and major firms with regard to energy efficiency and AIJ. The USA, Norway, UK or Germany are other examples of OECD countries with detailed climate policies, which are developed in context of environmental, energy and economic national priorities. CO$_2$ taxation forms the base of the Norwegian climate policy.
**BOX 4**

**AIJ in Annex I countries**

Since COP-1, AIJ national programs and/or national contact points have been established in many Annex I countries. The extent in which governments of individual Annex I countries support AIJ is very different - from only formal to effective administrative and financial support. Countries which are supposed to be in a strong position of investor countries, mainly JUSCANZ and non-EU European countries are usually the most proactive ones. However, there are large differences among many EU members and Nordic countries, Netherlands and Germany, which are supporting AIJ via pilot projects. The nature of this administrative support is naturally quite different if an Annex I country plays role of host.

Since September 1994 a national JI secretariat is in operation within the International Department of the Polish National Fund for Environmental Protection and Water Management in Warsaw. The secretariat carries out following activities:

- contribution to methodological progress at the international level and facilitating the development of the Polish expertise,
- establishing guidelines for project selection, monitoring, reporting and verification that are compatible with decisions taken under the UNFCCC,
- official reporting to the UNFCCC regarding Polish AIJ/ JI activities,
- identification of prospective AIJ projects,
- dissemination of information on JI among Polish industry,
- contacts with foreign investors and assist them to identify the prospective Polish partners,
- development of project monitoring systems,
- coordination of review and approval of AIJ project.

Polish secretariat has received 65 JI project proposals from industry and municipalities. They are divided into 5 categories:

1. Fuel conversion and/or modernization of boilers (42 proposals)
2. Energy saving systems (8 proposals)
3. Landfill gas utilization (7 proposals)
4. Renewable sources of energy (6 proposals)
5. Afforestation (2 proposals)

3 International Demand for GHG Offsets and Market Development

Basic Assumptions

System definition

- regions: Four regions are considered: Western Europe (WE), North America (NA), the Pacific region (PAC) and the EITs,
- main sectors: power sector, industry, transport residential sector,
- time horizons: 2010 is the main focus, 2005 an intermediate horizon,
- greenhouse gases: CO$_2$ as the leading GHG is considered,
- two scenarios are considered:
  - one scenario assumes a 5% and 15% reduction of CO$_2$ emissions in Annex I countries by 2005 and 2010 respectively,
  - regarding a possible Kyoto agreement on commitments and JI conditions, the 2005 stabilization and 5% reduction by 2010 seems more realistic.

Data available

The main data sets needed for the quantitative analysis are the following:

- baseline CO$_2$ and GHG emissions by countries and regions for 1990, 2000, 2010 (and partially 2020),
- marginal (CO$_2$) abatement cost curves by regions and countries,
- transaction costs.

All of these data sets are collected from various secondary sources, as explained in the following sections.

Baseline emission data

As shown in the Table 3, there is a significant growth of total world GHG and CO$_2$ emissions projected. If no measures are taken, total CO$_2$ emissions will increase from 22 billion tons in 1990 to 34 billion tons in 2010 and 47 billion tons in 2030.
Table 3. Carbon dioxide (CO\textsubscript{2}) and aggregated GHG emissions (CO\textsubscript{2}, CH\textsubscript{4} and N\textsubscript{2}O) and baseline projections for 1990, 2000, 2010 and 2020 - million tons of CO\textsubscript{2} (equivalent)

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<th>1990 GHG</th>
<th>2000 CO\textsubscript{2}</th>
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<td>EITs</td>
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<td>4501</td>
<td>2735</td>
<td>2865</td>
<td>4363</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>83</td>
<td>124</td>
<td>70</td>
<td>101</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Czech Rep.</td>
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<td>197</td>
<td>136</td>
<td>148</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>20</td>
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<td>-</td>
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</tr>
<tr>
<td>Hungary</td>
<td>72</td>
<td>89</td>
<td>69</td>
<td>78</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Latvia</td>
<td>23</td>
<td>28</td>
<td>17</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>Poland</td>
<td>415</td>
<td>614</td>
<td>397</td>
<td>460</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Romania</td>
<td>171</td>
<td>253</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Russian Fed.</td>
<td>2389</td>
<td>3079</td>
<td>1978</td>
<td>1978</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>Slovakia</td>
<td>58</td>
<td>72</td>
<td>49</td>
<td>60</td>
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<td>Non-Annex I</td>
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<td>-</td>
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<td>-</td>
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<td>China</td>
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<td>-</td>
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<td>-</td>
<td>4363</td>
<td>-</td>
<td>6049</td>
<td>-</td>
<td>-</td>
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<tr>
<td>India</td>
<td>545</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2972</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL World</td>
<td>22000</td>
<td>-</td>
<td>27000</td>
<td>-</td>
<td>34000</td>
<td>-</td>
<td>-</td>
<td>47000</td>
<td>-</td>
</tr>
</tbody>
</table>

:** IPCC 1997, IPCC 1991, INFRAS 1996.**

**Remark:** In IPCC and UNFCCC reports, the Czech Republic is not mentioned as an OECD member (since 1996) as Poland and Hungary, the Czech Republic is included in a group of EITs. This classification is respected in this report as well.
Table 4.
Marginal abatement costs of CO₂ emissions (USD/ton of Carbon)

<table>
<thead>
<tr>
<th>COMPARED TO 1990</th>
<th>STABILIZATION</th>
<th>-5 % until 2010</th>
<th>-10 % until 2010</th>
<th>-20 % until 2020</th>
<th>-50 % until 2050</th>
<th>SOURCE</th>
</tr>
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<tr>
<td>ANNEX I</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>-</td>
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<td>1</td>
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<tr>
<td>OECD</td>
<td>-</td>
<td>-</td>
<td>19</td>
<td>-</td>
<td>120</td>
<td>1</td>
</tr>
<tr>
<td>West. Europe</td>
<td>18</td>
<td>-</td>
<td>19</td>
<td>46</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Belgium</td>
<td>15</td>
<td>20</td>
<td>40</td>
<td>66</td>
<td>-</td>
<td>2,3,4</td>
</tr>
<tr>
<td>Denmark</td>
<td>0</td>
<td>-</td>
<td>6</td>
<td>11</td>
<td>-</td>
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<td>0</td>
<td>1</td>
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<td>-</td>
<td>4</td>
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<td>-</td>
<td>16</td>
<td>43</td>
<td>-</td>
<td>4</td>
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<tr>
<td>Greece</td>
<td>24</td>
<td>60</td>
<td>230</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Iceland</td>
<td>23</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Italy</td>
<td>23</td>
<td>120</td>
<td>430</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Netherlands</td>
<td>28</td>
<td>-</td>
<td>20</td>
<td>32</td>
<td>-</td>
<td>3,5</td>
</tr>
<tr>
<td>Norway</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Spain</td>
<td>18</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Switzerland</td>
<td>25</td>
<td>-</td>
<td>100</td>
<td>173</td>
<td>-</td>
<td>3,5</td>
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<tr>
<td>UK</td>
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<td>0</td>
<td>12</td>
<td>37</td>
<td>-</td>
<td>4</td>
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<td>USA</td>
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<tr>
<td>Japan</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>CEE</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>13</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Russian Fed.</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>India</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>6,7</td>
</tr>
<tr>
<td>TOTAL</td>
<td>8</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

Sources: 1 - GREEN, 2 - ECON 58/96, 3 - Bahn 97, 4 - IPPC SAR 1996, 5 - MARKAL, 6 - Kadokodi, 7 - IEG Delhi

Marginal abatement costs

Empirical and theoretical estimates of marginal abatement costs vary according to source and model simulation. They generally increase with the percentage level of reduction, and they are high in the OECD, lower in the EITs and the lowest in developing countries. Table 4 overviews different model results and gives some average values for marginal abatement costs in different regions and countries. Figure 2 shows the corresponding regional curves.

Generally, the marginal abatement costs of reductions (compared to 1990) differ more between countries than between regions, see e.g. Italy and France (see Table 4). It should be considered, that the individual estimates are influenced by the methodology used. For the estimation of the behavior of individual regions, marginal abatement costs (MACs) as linear functions of CO₂ reduction are approximated (Figure 2). It must be stressed, that the individual MAC curves have been aggregated from different sources (see Table 4) and the comparison is therefore very rough.
Figure 2.
Marginal CO₂ emissions abatement costs for the four regions of interest compared to baseline emissions.

Transaction costs
To calculate the incremental costs related to the administration of JI projects we can use the experiences with actual AIJ pilot projects. ECON estimates the cost related to feasibility studies, follow-up and evaluation of the project on 5 to 8% of the total project costs. Other estimations range from 10 up to 30% (ECON 1996).

It can be assumed that the transaction costs will be relatively higher during the first few years, and that they will decrease as learning effects become effective. To make the model simulations simple we assume transaction costs of 10% of the project costs. The implications of these (and other) assumptions are discussed in following sections.

Options for the market organization
Market options
Ultimately, concrete projects - anticipated or realized - represent the physical basis for any market with GHG reduction products. However there is a variety of institutional forms to organize this market.

(a) Allowance Trading and Credit Trading
In our context the fundamental categories to distinguish between are:

1. CO₂ emission allowance (or permit) trading versus.
2. JI-based credit trading.

An overview of the differences between allowance trading and credit trading is given in 2.3.2. Emission allowances are traded by individual emitters independently with respect to the realization of further reduction projects. In this system, the full volume of allowances is put on the market by a central and well organized responsible trading agency. The most problematic aspect of establishing an allowance trading system is the normative scheme for the initial allocation of emission rights in buyer countries, because of far reaching variations in distribution consequences.

Contrary to this, credit trading can only take place on the basis of concrete CO₂ emission
reduction projects. Since the claimed or actual emission reduction of these must have been verified and certified by officially authorized procedures, the market volume of tradable credits builds up only slowly over time in accordance with the volume of projects certified.

The components for the sales price for credits are:

- investment per ton of reduced CO\(_2\) emissions,
- transaction costs, possibly including a risk premium,
- rent or profit which can be shared between the government (a royalty) and the domestic project owner and which is likely to be paid annually after delivery of credits.

All arrangements will be governed by long term contracts between foreign investors and the domestic project owners that may be subject to government approval. The contract would cover such questions as the up-front investment, the payment schedule, the determination of price for credits in relation to some market price, guarantees, the possibility to buy back projects and reclaim future credits from those projects if the host country needs them, etc. An example for such a long term contract are contractual arrangements in the gas industry, where for instance, the price of gas is pegged to the oil price.

JI is clearly amenable to credit trading, as it does not require international agreements in allowance trading schemes. Also, even within credit trading schemes, clearing house or market facilitating institutions which buy and sell credits from many individual projects - and which therefore manage a whole portfolio of projects - play a useful role: they can lower transaction costs and risks for the individual market player - a firm or a government. The World Bank has taken such an initiative (The Global Carbon Initiative with the World Bank “Carbon Investment Fund”, see BOX 5).

While we focus on JI-related credit trading in this report it is expected on the base of the Kyoto Protocol that an allowance trading scheme will coexist with the credit trading scheme, and that the latter can be a learning and „buy-in“ phase into a future allowance trading scheme. This approach is logical because a number of methodological problems to be solved are specific to allowance trading, such as compliance and sanction mechanisms, allowing banking and borrowing. On the other hand project based credit trading can be started at small scale and expanded gradually. Once the JI market is amenable to expand broadly allowance trading can be superimposed on credit trading. In the long run it could be possible that allowance trading supersedes credit trading.

---

3 Or - more generally - GHG.
4 In principle not only verified, actual reductions can be traded as credits, but also intermediary products such as preliminary or detailed projects, accepted projects etc. Intermediary products with higher uncertainties - such as preliminary projects - will catch lower market prices because of higher risks involved.

5 With a subset of Annex I countries participating in it.
Typology of design parameters

Any system of allowance or credit trading must be defined in terms of key design parameters, structured within a hierarchy of variables at the international and national level:

Hierarchy of commitments

1) International: UNFCCC (COP) negotiates and decides on:
   i) Global reduction target (2010) compared to 1990 and/or baseline perspective.
   ii) National commitments contributing to the global target or criteria and rules for such commitments and - possibly - country specific differentiation of such commitments (Paterson, Grubb 1996).

2) National
   Each country defines its way to fulfill its commitment by:
   i) Introducing a GHG tax system.
   ii) Introducing a domestic allowance trading system: Government allocates or auctions (part of) the emission permits, for simplicity generally restricted to CO₂. A multitude of schemes is possible.
   iii) Applying government programs.
   iv) Applying emission standards.

A set of sanctions must exist and be applied in every system: (a), and (b) are examples of market based systems. Such a hierarchical scheme of commitments must be defined for any GHG-JI/AIJ trade option.

For example it must be specified which parties are eligible for trading (governments, sectors, or individual firms) and who is allowed to trade with them. The crediting scheme rules then specify - inter alia - which parts of one's commitment (government or firm) can be traded and which part must be fulfilled domestically.

A) Macro scenario design parameters
   At the macro level the market scenario can be defined by the following set of design parameters:
   Commitments

Box 5

The Global Carbon Initiative of the World Bank

The World Bank is currently working on a three year Activities Implemented Jointly (AIJ) program whereby pilot projects are implemented to reduce GHG emissions in developing countries and EITs (The Global Carbon Initiative of the World Bank, 1997).

The World Bank has developed the concept of a carbon offsets market under following prerequisites:
- a protocol to the UNFCCC (anticipated in Kyoto, 1997) whereby all OECD countries and the EITs will submit themselves to binding GHG emissions reduction commitments,
- a framework to purchase carbon offsets by OECD countries (from EITs and/or developing countries) and then to receive credits for these offsets,
- high marginal abatement costs in the OECD countries and low MACs in the non OECD countries,
- verification of offsets by some authority.

The World Bank is exploring the future establishment of a carbon investment fund (CIF) as one possible mechanism, which would act as a market intermediary by obtaining funds from investors (both government and private sector) and investing in projects which would result in carbon emissions reductions. There is a considerable reduction of risks and transactions costs assumed, because the carbon investment fund would contain a well-diversified portfolio of carbon offsets and standardized investment deals would occur.

The developing countries and the EITs could have following advantages to the CIF:
- a significant portion of the trade value would represent net income of the developing countries or EITs in the form of resource rent flows,
- large-scale technology transfer would be stimulated in the developing countries and EITs,
- through the spread of increasingly energy efficient technology, a carbon offsets investments would benefit national and regional environmental circumstances,
- with a strong focus on private sector investors, an investment fund would substantially increase private sector resource flows to developing countries and EITs.

1. strong commitments (-15 % reduction for Annex I until 2010, flat rate reduction as a percentage to 1990),
2. weak commitments (stabilization for Annex I until 2010)
3. emission/ GDP (energy efficiency based commitments).

Forms of trading allowed
1. AIJ/ JI crediting (only project level)
2. Trading Carbon Emission Entitlements (TCEE)

Geographic extension of trading
1. only OECD
2. only Annex
3. global (UNFCCC)

Trading parties
1. individual companies
2. governments

Crediting rules/ restrictions
1. no restrictions, full crediting of reductions achieved
2. limited restrictions, only a specified percentage of obligations is tradable (e.g. 50 %)
3. no crediting

Enforcement instruments
• CO₂/ energy tax: uniform international, nationally individual,
• domestic rules for target allocation and national trading scheme.

Possible market scenarios

By combining the design parameters described under section 3.2.2, different market organization scenarios can be developed. We distinguish between a main scenario (A1) with assumedly higher political probability, and a few alternative scenarios (A2, B, C). Other combinations are possible as well.

Institutional/organizational set up

We are assuming that a restricted JI regime will be started, with restrictions as indicated in Table 5:
• only Governments of Annex I countries are participating,
• only 30 % of the reduction commitments (OECD) are allowed for JI, with full credit at project level.

In order for the Czech Republic to become a host country with a supply (offer) of 0.5 - 2 mil. t CO₂ of project based credits, a organizational/ institutional set up has to be developed and made operational (see Chapter 5).

For this the following institutional instruments must be developed and rendered operational, reliable, and efficient: intergovernmental agreement; project verification and approval; project level organizational framework for host-investor cooperation; project impact monitoring/ verification; information system on project opportunities; credit award - reporting and - management system; financial flow schemes (domestic level); regulation or guidelines on the establishment of baseline data and for calculating net-cost and reductions at project level; scheme at national level for monitoring/ managing national commitment and development of GHG-inventories.

---

6 Possibly differentiated between groups of countries
7 TCEE or EAT (Emission Allowance Trading)
8 To be built up over a period of 5-10 years, with a stepwise build up.
### Table 5.
**Macro - Definition of JI credit market organization scenarios**

<table>
<thead>
<tr>
<th>SCENARIO</th>
<th>GEOGRAPHIC EXTENT</th>
<th>CREDIT TRADING PARTICIPANTS</th>
<th>CREDITING RULES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Annex I</td>
<td>Governments only</td>
<td>30% crediting</td>
</tr>
<tr>
<td>A2</td>
<td>Europe (WE+EITs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>UNFCCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>Annex I</td>
<td>Companies and governments</td>
<td>30% crediting</td>
</tr>
<tr>
<td>B2</td>
<td>Europe (WE+EITs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>UNFCCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>Annex I</td>
<td></td>
<td>Full crediting</td>
</tr>
</tbody>
</table>

As outlined above we focus on “strong” commitments.

---

Monetary value of GHG market volumes

**Methodology: types of simulation models**

Figure 3 depicts the overall logical framework of quantitative analysis. Some market volume estimates are already available from earlier studies and simulations with complex economic models such as GREEN and others (OECD, ECON, World Bank). However, it must be noticed that these models were run for a given set of assumptions and market scenarios. These are not known in detail nor do they necessarily coincide fully with those defined in chapter 3.2 above.

For this reason, INFRAS has begun developing a simplified economic model for the estimation of the trade volumes monetary values of buyers’ and sellers’ rents and of traded volumes and financial flows to and/or from each of the four regions considered (see section 3.1.1).
Figure 3.
Logical procedural framework of analysis
Simplified model for analysis

The simplified model analysis which INFRAS is elaborating is not a full scale economic model such as GREEN or MARKAL in this sense: It does not consider the economic repercussions of GHG-trading in terms of impacts on economic structure, GDP, capital and labor etc. (and its feedback onto GHG-emissions and MACs). The simplified model is a partial equilibrium micro economic type model which uses fixed economic perspectives and works with the following inputs:

- the MAC curves\textsuperscript{10} (as demand and as supply side offset market information and
- the baseline CO\textsubscript{2} emission perspectives for each of the regions to be analyzed\textsuperscript{11}.

With these inputs a (single) world market equilibrium price for CO\textsubscript{2} (GHG) offsets is estimated as an intermediary variable. Using it, estimates are then derived for the maximum theoretical potential for domestic and interregional trade volumes and values. In practice the JI volume will build up slowly over time (see section 3.3.4). The lower the market restrictions, the transaction costs and other market barriers, the faster this build up can be expected.

Market prices of carbon offsets, market values and trade volumes depend on the assumption about the market organization and the type and structure of the offset market on demand and supply side. Methodologically the market equilibrium in the carbon offsets market is given by the equality of the marginal abatement costs (MACs) between the regions:

\[ \text{MAC}_\text{W-Europe} = \text{MAC}_\text{NA} = \text{MAC}_\text{Pacific} = \text{MAC}_\text{EIT} \]

The demand curves of the buyers’ countries are similar to the marginal abatement cost curves. To simulate the total demand of OECD countries and the total supply of EITs we can use aggregated demand and supply curves. Figure 4 illustrates the general approach.

\textsuperscript{10} Modified by transaction cost assumptions

\textsuperscript{11} Supply and demand curves for GHG offsets are treated as fixed, exogenous „inverse functions“ of each other.
The theoretical simulation of the CO₂ offsets market between the Annex I countries follows a step-by-step approach. The aggregated MAC curves of the EIT group represent the supply curve. The aggregated MAC curves of the OECD countries are the basis for the aggregated demand of buyer countries.

If restrictions on offsets trading among OECD countries are specified, the analysis must be adapted: Buyer countries will have to fulfill their own domestic obligations first. If only +/-30% of the total obligations can be fulfilled by buying offsets from EIT countries, investor's country's MACs (and willingness to pay) will be higher at the point where they start buying). If there is a commitment of a 5% reduction of CO₂ emissions for Western Europe, these countries must reduce emissions by about 3.5% domestically. The MACs for the rest of the reductions needed (demand for offsets) will be higher. If the difference between the MACs of OECD and EITs are big enough, the willingness of OECD countries to pay will be higher than the marginal abatement costs in EIT countries. To estimate market prices and values of offsets further assumptions about the type of market competition are necessary.

Theoretical market volume and market value

Assumptions on market organization
As mentioned above the results of the model simulations depend on the assumptions made on the type of offsets market, the degree of competition on the demand and supply side, e.g. for the static equilibrium analysis, as explained under section 3.3.2., the following are the main assumptions:

- full competition on demand and supply side,
- equilibrium at fully developed markets is considered,
- there is no single dominant player, neither on the demand nor on the supply side,
- if MACs of buyer countries are significantly higher, than MACs of seller (host) countries, - for example due to trading restrictions - the
market price is assumed to be the average of the two MAC curves,

- transaction costs are 10% of the total project costs,
- commitments: -5% for each Annex I country until 2010 (main scenario, optimistic),
- crediting: 30% of total obligations can be fulfilled by offsets trading, 70% must be done domestically,
- offsets trading is restricted to Annex I countries: EITs with OECD; there is no trade among OECD countries.

Simulation results
Annex I countries shall reduce CO₂ emissions domestically until 2010 by at least 3.5% compared to 1990. The remaining 1.5% can be traded. Table 6 summarizes the simulation results for the four Regions defined.

Under these new conditions higher MACs are relevant, namely those which prevail after fulfilling the domestic obligations. The EIT countries have by far the lowest MACs. If the EIT countries sell all of the 150 mil. t offsets which OECD countries are allowed to JI-trade, this would correspond to 5% of the EIT baseline in 2010. The marginal cost to reduce the last ton of these 150 mil. t CO₂ are about 6 USD. This is still the lowest MACs of the 4 Annex I regions, and would hold even if transaction costs of 100% were added to it.

Table 6.
Model simulations on the basis of a 5% reduction commitment and a 30% crediting share of total commitments. (Each Annex I country has the 5% reduction commitment)

<table>
<thead>
<tr>
<th>REGION</th>
<th>CO₂ EMISSION TARGET 2010 (mil. tons CO₂)</th>
<th>DOMESTIC REDUCTIONS COMP. TO BASELINE (mil. tons CO₂/%)</th>
<th>MACs FOR THE LAST UNIT DOMESTICALLY (USD/tons CO₂)</th>
<th>OBLIGATIONS WITH TRADING (mil. tons CO₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Region</td>
<td>1440</td>
<td>-269/ -15.7</td>
<td>30</td>
<td>21</td>
</tr>
<tr>
<td>North America</td>
<td>5230</td>
<td>-1620/ -23.6</td>
<td>15</td>
<td>78</td>
</tr>
<tr>
<td>Western Europe</td>
<td>3259</td>
<td>-248/ -7.1</td>
<td>18</td>
<td>49</td>
</tr>
<tr>
<td>Total OECD</td>
<td>9929</td>
<td>-2137/ -17.7</td>
<td>15</td>
<td>148</td>
</tr>
<tr>
<td>EITs</td>
<td>3294</td>
<td>-1185/ -27 13</td>
<td>4</td>
<td>50</td>
</tr>
</tbody>
</table>

As illustrated in Figure 5, on the basis of the JI framework assumptions made all OECD regions would buy offsets from EITs. The market price realized would depend on different economic and political factors and it must be somewhere between the MACs of EITs (6 USD) and the marginal benefit of OECD (15 USD). Therefore the total market value of offsets could vary between 900 and 2200 mil. USD. This amount includes transaction costs of 90 (to 270) mil. USD. As a probable outcome a market value of 1.5 billion USD is assumed.

Sensitivity analysis
At the level of offset market potential the most sensitive parameters are: The commitments and the market restrictions imposed by UNFCCC (e.g. 30% of the reduction is tradable) and the uncertainties in MACs and in transaction costs. Considering possible uncertainties in all these factors, a factor of two (or more) variations of the market value estimated are assumed to be possible.

At the level of the practically possible dynamic build up of the market, these uncertainties are less important than the various market expansion constraints: qualified human resource availability, technology transfer absorption capacity, management of the financial risks involved in a project or in a portfolio, political support at national level and the corresponding build up of the necessary institutional structure (guidelines for projects, baseline definitions, procedures for project acceptance and for offset verification and issuing credits), etc.

13 Reductions or increases depend on new baseline projections: 3000 mil. t CO₂ in 2010 for all EIT countries.
Figure 5.
Simulation of the maximum potential CO$_2$ offset market if 30% of Annex I countries 5% reduction targets can be traded (D = Demand, S = Supply).

Rough and indicative estimates for the Czech situation suggest that in order to reach a trade volume (credit trading based) of some 0.5 mil. t CO$_2$/yr. within 3-5 years, all of the administrative and political prerequisites would have to be fulfilled in such a manner that they would not be the constraining factors for offset market development.

Offsets and financial flows

Table 7.
Matrix of potential financial flow of CO$_2$ offsets trade: for the main scenario (A1) an average price of 10.5 USD/t CO$_2$ is assumed.

<table>
<thead>
<tr>
<th>OECD REGION</th>
<th>AVERAGE FINANCIAL FLOW TO EITs (Mil. USD/yr.)</th>
<th>MIN.-MAX. (Mil. USD/yr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Europe</td>
<td>520</td>
<td>300-740</td>
</tr>
<tr>
<td>North America</td>
<td>820</td>
<td>470-1170</td>
</tr>
<tr>
<td>Pacific Region</td>
<td>230</td>
<td>130-330</td>
</tr>
<tr>
<td>Total</td>
<td>1550</td>
<td>900-2200</td>
</tr>
</tbody>
</table>

Flows between the regions analyzed

The model analysis in section 3.3.2 also yields estimates for the financial flows from each of the three OECD-Investor regions (PAC, WE, NA) to EIT countries which result from the potential market volume of between 0.9 and 2.2 billion USD/yr. Table 7 summarizes these results, showing an average overall potential flow to EIT countries of some 1.5 billion USD.
Rents to host and to investor countries

The economic profit of this trading will be shared between sellers and buyers. Assuming an average price of 10.5 USD, the producer rent of EITs would be 800 mil. USD and the consumer rent of the OECD 1.3 billion USD: Pacific 400 mil. USD, Western Europe and North America 450 mil. USD each (including transaction costs). These rents are the benefits over and above the project costs; they are relative to a situation without JI.

Sensitivity

At the level of distribution of overall financial benefits between the different supplier (host) countries the most sensitive parameters are the differences in MACs and supply volumes between these countries. A possible scenario would be the following: Assume that Russia - with its large volume of emissions - in fact would have (significantly) lower MACs than, for example, small countries like the Czech Republic. This could - theoretically - push the CR out of the offset market almost completely, if supply of Russia could meet more or all of the OECD demands at lower costs (and prices) than other EIT countries. This distribution analysis could be done only if approximations of EIT-country specific MACs were available, and if the corresponding differences in factors influencing transaction costs could be assessed explicitly.

At the level of individual projects, the feasibility of investments is sensitive primarily to the following parameters and assumptions: Project cost (investment, operation and maintenance costs), achievable CO\textsubscript{2} reduction, useful life span and interest rate on capital. While investment costs will be fairly well known (+15 %) at the time of the investment decision, uncertainties in the other factors can easily push the price of the credits which an investor would pay up or down by a factor of up to 2. This is why the problems of reinsurance may become important fairly soon.

Risk factors

Because of a specific character of GHG emissions as a traded commodity, the risk connected with these transactions should be considered and a adequate risk management applied. There is however a difference between the risk situation connected with the allowance trading and with the joint implementation.

The allowance trading will take place on a relatively efficient, standardized and transparent international market, with clear price signals and institutional settlement. In this situation, primarily the commodity price fluctuation (in relation to the expected rents) is the main risk factor.

In terms of risk position, the joint implementation as a system based on individual transaction is facing additional risk factors like standard international investment projects. The risk factors will influence the price and the capital movement.

We can identify following types of risk:

- business and financial risk (investor and host company specific risk),
- political risk (country specific risk),
- risk related to the CO\textsubscript{2} trading (GHGs market specific risk).

Business and financial risks are obvious ones related to foreign investment (see e.g. Rodriguez and Carter, 1984). Political risks involve vulnerability of the returns of a project (tradable credits) to the political acts of a sovereign government (general property rights rules, taxes etc.). Specific political risk related to the CO\textsubscript{2} trading is given by the fact, that the property rights to CO\textsubscript{2} as a commodity are not clearly defined at the level of individual polluters (see Chapter 5).

The management of risk connected with CO\textsubscript{2} trading (the reduction of uncertainty created by risk) must focus particular risk components specific for the concrete transaction. The choice of tools is very diversified and has to follow general rules for risk management. All these factors influence significantly the credit quality, price and its volatility.

We refer to the risks that hosts or investors may realize less benefits (or meet higher costs) than expected at the time of making decisions to realize a project. Risk generally increases with increasing time horizons over which the benefits of an initial investment are expected to flow back (20 - 30 years lifetime of a power plant; even longer horizons involved in forest management projects). It is evident that under these conditions stability is an important risk...
control factor at the company and at the political level.

At the project level this can be due to an overestimation (biased or inadvertently) of GHG reduction potential or an underestimation of project- and/or transaction costs.14

Clearing house and/or credit brokering- and insurance institutions can narrow down the risks by pooling the risks of a large number of individual projects.15

Project developers - when selling offsets - might incline to overestimate the performance, for example by including GHG reductions resulting from measures with erratically zero net costs. However, since CO₂ emissions can be monitored relatively easily and simply at the fuel input side uncertainties related to this are small.

Significant risks can arise at international levels: If - unexpectedly - new hosts with very large offset supplies come on the market with attractive offset prices this could do two things. First, other, smaller suppliers might be pushed out of the market. Secondly, those who might have bought credits earlier and for higher prices will suffer losses. Risks related to non-compliance with UNFCCC are discussed separately in Chapters 2 and 5.

14 It can also occur that verification and approval agencies do not fully accept the calculations of the project parties.
15 It must be realized however, that the statistical distribution of risks and benefits will be skewed: very few projects will perform better than theoretically planned.
National Emissions Inventory of GHGs

Annual emission inventories have been presented in the Second National Communication of the Czech Republic for 1990-1995. The emission inventories are structured accordingly to the IPCC 1995 Guidelines for National Greenhouse Gas Inventories. In the above period, average CO$_2$ emissions amounted 83.9 %, while methane and nitrous oxide contributed 11.7 % and 4.4 % to the total aggregated emissions (GWP values recommended by IPCC are used). A substantial part of the methane and nitrous oxide emissions is related to the combustion processes and therefore correlate with CO$_2$ emissions.

![Figure 6. GHG emissions in 1990-1995 (mil. tons of CO$_2$ equiv.)](image)

This report therefore deals with emissions of CO$_2$, which is the main GHG for the Czech Republic. The structure of CO$_2$ emissions is given in Figure 7 indicating that the non-combustion industrial sources of CO$_2$ (non-energy) represent only about 3 - 4 % of the total emissions of this gas. In 1995, public energy production emitted 51 %, industry (industrial processes and autoproducers) 23 %, residential sector 10 % of total CO$_2$ emissions. Tables with detailed data are available as Appendix I.

The results of the inventory of GHGs show that about 83 % (in 1995) of the total GHG emissions consist of CO$_2$, with the largest source of CO$_2$ coming from combustion processes (approx. 97 % of all CO$_2$ emissions). For this reason, the GHG emissions projections are mainly concentrated on the future projections of CO$_2$ emissions from combustion processes.
In the observed period, a substantial decrease of emissions has been achieved in the energy and transformation sector, agriculture and forestry, commercial/institutional sector and in the residential sector (see Table 8).

Emissions from industry and transport have increased on the other hand. This structure and trend of emissions led the authors of this study to examine combustion emission sources in energy production and transformation, industry, the residential sector and commercial/institutional with respect to emission projections and abatement costs. We didn’t examine transportation in detail because this sector is not as relevant for JI and AIJ as the other ones.

**Emissions projections**

In its **First National Communication**, the Czech Republic presented only a “worst case” scenario, which was a kind of “frozen energy efficiency scenario” combined with steep economic growth (GDP growing about 5% annually).

With regard to the fact that the effect of current economic transformation, and the effect of adopted measures are to a large extent synergetic processes, the scenario is based upon the following assumptions:

- the transformation will continue, and the Czech economy will exhibit the positive growth of GDP since 1994,
- the development of the national economy will be extensive (a large energy demand will be required to produce the GDP),
- the speed of technological innovations which will create energy savings will be slow,
- the population will be constant (in the range of ±0.2%),
- the measures described will be implemented slowly, or not at all.
Table 8.
Energy Related Carbon Dioxide Emissions in 1990-1995 (mil. tons)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy sector^a</td>
<td>94.1</td>
<td>90.0</td>
<td>84.5</td>
<td>83.7</td>
<td>61.4</td>
<td>66.6</td>
<td>68</td>
</tr>
<tr>
<td>Industry^a</td>
<td>23.1</td>
<td>23.3</td>
<td>20.3</td>
<td>17.0</td>
<td>33.4</td>
<td>30.1</td>
<td>34</td>
</tr>
<tr>
<td>Transport</td>
<td>8.0</td>
<td>6.9</td>
<td>8.1</td>
<td>8.3</td>
<td>8.3</td>
<td>8.9</td>
<td>10</td>
</tr>
<tr>
<td>Commercial/ Institutional</td>
<td>9.5</td>
<td>7.4</td>
<td>6.2</td>
<td>5.9</td>
<td>5.1</td>
<td>4.9</td>
<td>-</td>
</tr>
<tr>
<td>Residential</td>
<td>21.5</td>
<td>19.0</td>
<td>15.4</td>
<td>15.3</td>
<td>13.6</td>
<td>12.6</td>
<td>18a</td>
</tr>
<tr>
<td>Agriculture/ forestry</td>
<td>4.9</td>
<td>3.6</td>
<td>2.2</td>
<td>1.7</td>
<td>1.9</td>
<td>1.5</td>
<td>-</td>
</tr>
<tr>
<td>Total energy related CO$_2$ emissions^a</td>
<td>160.1</td>
<td>148.8</td>
<td>135.6</td>
<td>130.7</td>
<td>123.6</td>
<td>124.6</td>
<td>130</td>
</tr>
</tbody>
</table>

Note:

a) Till 1993 emissions in energy sector include both public and autoproducer power and heat sources, since 1994, autoproducers are included in industry (IEA/OECD methodology of energy balance),
b) Determined by the "IPCC Reference Approach"; other data were calculated using a "Detailed Technology-Based Calculation" procedure,
c) Preliminary estimate of the Czech Hydrometeorologic Institute,
d) aggregated with other sectors (agriculture, forestry, commercial/institutional).

Source: The Second National Communication

Furthermore, the scenario features the export of products with a low value added, and the import of machinery and equipment.

It appears that, the carbon dioxide emissions in 2000 (CO$_2$ emissions in 1990 formed 89 % of GHG emissions) will not exceed their amounts of 1990, respectively will be lower by 12 %, in spite of a moderate increase of emissions in 1995 - 2000.

This first projection of CO$_2$ emissions exhibits a drop in 1990 - 1994 and a moderate growth in 1995 - 2000 as an expected result of the economic transformation. Aditional effects of adopted, planned and considered measures on this baseline scenario have been estimated using expert judgment. It must be kept in mind, that only the emission inventory for 1990 was available for the First National Communication and that the emission trends have been estimated on a base of energy balances for 1990-1992.

In case of the Second National Communication, a more advanced approach to projections has been taken because emission inventories for 1990 - 1994 have been available along with a better understanding of the dynamics of the economic transformation. Two emission scenarios ("baseline" and "with measures" projections) are based upon energy scenarios:

- "baseline" (most unfavorable development) scenario characterized by a fast economic growth and lack of both restructuring and new measures. This scenario is based upon the "worst case" scenario discussed above. It takes into account the two main factors which substantially limit CO$_2$ emissions - putting the Temelin Nuclear Power Plant (2000 MW) into operation in the year 2000 and consistent enforcement of emission limits as outlined in the Clean Air Act and subsequent decrees,
- "with measures" (favorable development) scenario, which presents a trajectory of development with the lowest volume of expected emissions. It shows the emission estimates under the most favorable circumstances. It has been however difficult to assess an overall effect of individual measures and the resulting scenarios because of their strong synergy effects.

The methodology used has been based upon a prognosis of national economy development and expected structural changes, demand for final energy consumption and finally, structure and installed capacity of energy production (in this part of projection MARKAL, EFOM and LEAP models have been applied). The resulting projection of carbon dioxide emissions is based upon consumption of primary energy sources (PES), from which CO$_2$ emissions are calculated.
The Second National Communication describes in detail the expected development of the national economy assuming a 4.7% annual growth rate of GDP for the baseline scenario. This is based upon the assumption that an extensive economic development with slow substitution of coal with natural gas and rising exports of goods with low added value will take place in 1995 - 2005.

**Methodology for CO₂ Emission Projections**

The methodology used for CO₂ emissions projections within this project is a modified one used for preparation of the Czech Republic's Second National Communication. Because the latest energy balance for the Czech Republic has been available (in a preliminary version) for 1995 while macroeconomic data is available both for 1995 and 1996, the year 1995 was chosen as the base year for emission projections, nevertheless basic data for the period 1990-1996 were analyzed.

Taking into account the time frame of expected international emission commitments (Protocol to UNFCCC), year 2010 was selected as a time horizon for the projections. This horizon has been split into two periods as follows:

- near-term horizon (5 years), i.e. year 2000; and
- medium-term horizon (15 years), i.e. till 2010.

Key scenario assumptions, including basic macroeconomic projections, were prepared especially for this project (see Appendix II for detailed information about scenario assumptions).

Key groups of parameters and assumptions used to formulate the scenarios are:

- GDP total and split by sector (i.e., industry, construction, agriculture and forestry, transport, commerce and services),
- structural changes in industry and production of selected energy intensive products,
- population and/or number of households,
- housing stock split by category (single-family houses, multi-family houses),
- floor area utilized by commerce and services,
- discount rate which is used in the model form calculation of the demand for new investment,
- world energy prices,
- energy pricing and taxation policy,
- energy conservation programs,
- environment protection policy and/or emission limitation and reduction targets,
- technology options.

Since no official macroeconomic medium-term scenario is available, two options (high growth and low growth) were prepared in the above time horizons (see Figure 8 and Table 9):

- high growth scenario in which the present economic stagnation is followed by moderate economic growth combined with deep restructurization of the national economy in the near-term horizon and faster economic growth in the medium-term horizon; and
- low growth scenario in which the present economic stagnation will continue by the economic depression within the whole near-term horizon; restructurization of the national economy will start only in a medium-term horizon which will generally mean a moderate economic growth in this period.

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Figure 8.
GDP Forecast – Low and High Growth Rate Scenarios

Separate accounting models were built to project the following variables:

- GDP growth and branch structure changes forecast,
- population growth,
- number and structure of dwellings,
- floor area occupied by commerce and services, and
- transport performance.

Table 9.
Macroeconomic Forecast for the Czech Republic – 1994 prices (bill.CZK)

<table>
<thead>
<tr>
<th>GDP SHARE OF SECTORS</th>
<th>YEAR 1995</th>
<th>LOW GROWTH RATE</th>
<th>HIGH GROWTH RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total GDP</td>
<td>1198.0</td>
<td>1383.0</td>
<td>1564.7</td>
</tr>
<tr>
<td>of which in %:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>5.2</td>
<td>4.8</td>
<td>4.6</td>
</tr>
<tr>
<td>Industry</td>
<td>34.1</td>
<td>33.3</td>
<td>32.5</td>
</tr>
<tr>
<td>Construction</td>
<td>7.3</td>
<td>6.9</td>
<td>6.9</td>
</tr>
<tr>
<td>Transport</td>
<td>5.9</td>
<td>6.0</td>
<td>6.3</td>
</tr>
<tr>
<td>Others</td>
<td>47.5</td>
<td>49.0</td>
<td>49.7</td>
</tr>
</tbody>
</table>

The basic tool employed for the energy demand and supply projections, energy related CO$_2$ emissions projections and for the analysis of mitigation options was the MARKAL model, which represents an engineering optimization approach.

Large database of potential technology options, which consists of technology options both on the demand as well as supply side, has been built. Both technologies that are already available or in use and those that are expected to be available in the future were included. Each technology was characterized with respect to its costs and features (e.g., performance, lifetime, environmental characteristics, fuel and energy consumption).

A very detailed description of energy and CO$_2$ emissions projections – MARKAL model,
scenarios, assumptions and results are subject of a separate report (SRCI, Prague 1990).

**Baseline and mitigation scenarios**

For the purpose of mitigation analysis at least two different scenarios are necessary. One scenario should reflect a baseline, while the other should reflect the impact of mitigation options. For the purpose of this project four scenarios are defined:

- two “baseline” or “reference” scenarios as a description of a plausible future in which no specific policy actions are taken to encourage actions that reduce GHG emissions or enhance carbon sinks. Only replacement of existing technologies after depletion of their lifetime by technologies available on the market is supposed. These scenarios differ by the general macroeconomic performance of the national economy. One scenario assumes high economic growth while the other assumes only slow economic growth,
- two “mitigation scenarios” tight to each baseline scenario describe the future, which is essentially similar to that in the baseline scenario with respect to overall economic and social trends. The only exception is that policies and measures (programs) are implemented to reduce GHG emissions or enhance carbon sinks. The alternative mitigation scenarios reflect different degrees of emission reductions with respect to the base year (1990) to which the reduction of GHG emissions relate. These mitigation scenarios are as follows:
  - **mild mitigation scenario** in which reduction of GHG emissions by 5% in 2010 is assumed,
  - **strong mitigation scenario** in which the proposal of the EU on GHG reduction for Kyoto conference are included (i.e., stabilization of GHG emissions by 2000, and reduction by 7.5% and 15% towards 2005 and 2010, respectively.

Developing a mitigation strategy requires identification and analysis of different policies and measures that government could take to encourage implementation of technologies and practices to reduce GHG emissions or enhance carbon sinks.

Thus two types of options are analyzed in the project:

- policy options (e.g., energy pricing and taxation policy, energy saving promotion policy),
- technology options (e.g., energy demand and supply technologies).

Two general approaches are possible for the mitigation assessment:

- **top-down method** which takes into account a macroeconomic perspective, wherein mitigation costs are defined in terms of losses in economic output, income, or GDP,
- **bottom-up method** which focuses on individual processes such as end-use energy consumption, different energy supply technology options. For each relevant process, the approach attempts to estimate the costs associated with changes that result in GHG emission reductions.

Taking into account experiences with the preparation of the Second National Communication, the bottom-up approach was chosen even if this does not allow to assess the impact of the general macroeconomic development. The MARKAL model, which is based upon an engineering optimization approach, has been used as a basic tool for the analysis of mitigation options. Results of analysis of potential mitigation options were used for calculation of the reduction potential and construction of cost curves of GHG mitigation (see chapter 4.3).

The resulting baseline scenarios are compared with scenarios presented in both National Communications in Figure 9. In Figures 10 and 11, baseline scenarios are plotted together with mitigation scenarios (“with measures” scenarios). The difference between baseline scenarios (Figure 9) is given mainly by different macroeconomic assumptions and different GDP growth rates.
The scenarios presented in this study are therefore more realistic taking into account a substantial decrease of economic performance (first half of 1997) and the economic impacts of massive floods (summer 1997).

In all baseline scenarios, the emissions are growing even if the 1990 level will not be reached by 2010. It is therefore evident that certain policies and measures will have to be implemented to achieve stabilization well below the 1990 level with respect to emission limits adopted by the Czech Republic in Kyoto. The present difference between the emission cap (national limit) and actual emissions will be only temporary (till 2010 - 2015) if no efficient measures are taken. This difference representing 10 - 30 mil. tons of CO$_2$ (given by the national emission limit declared at COP-3), which is the maneuvering space for future emission trading, can be positively maintained if an early action is taken (before 2000) since the preparation and implementation of efficient policies and measures requires several years.

**Abatement Costs and Reduction Potential**

An economically feasible reduction potential depends upon abatement costs and upon the amount of financial resources available. The part of the reduction potential in the Czech Republic, which can be utilized for credit or allowance trading, is given by the following factors:

- "market price" of CO$_2$ (or price proposed by particular demand),
- marginal abatement costs.

Additional financial resources are in this case created by a potential flow of money from buyers to sellers (hosts to investors).

The reduction potential can be estimated by means of cost curves which relate the quantity of carbon dioxide or other GHG reduced by mitigation options to the cost per unit amount (e.g. ton) reduced. Three different parts of a cost curve can be distinguished (Figure 12) and it is therefore necessary to distinguish a "low-cost" (or even negative net cost) potential,
economically feasible potential and a technically feasible (theoretical) reduction potential. The non-linearity of the MAC curves means that abatement becomes increasingly more and more expensive.

The average costs of GHG reduction reflect the additional costs per unit GHG reduced for a mitigation scenario, calculated relative to the baseline. The incremental cost is defined as the difference in cost per unit of GHG reduction when a specific mitigation scenario is compared to the previous scenario on the cost curve, rather than with the baseline. Thus the incremental costs show how expensive each additional step becomes per unit of extra GHG reduced. The marginal cost of GHG abatement is the cost of not emitting the last unit of GHG from the system. In an optimization model this unit is by definition the most expensive one.

Figure 10.
Low Growth Scenarios with Mild and Strong Mitigation Options

Figure 11.
High Growth Scenario with Mild and Strong Mitigation Options
Another issue to consider, when calculating cost curves, is the time dependence of the costs of mitigation options. In a dynamic model, the choice of mitigation options in one year (or time period) depends on the choice of policies and measures made in the previous year. Static models only give a "snapshot" of the costs, with no time dependency included. Cost curves derived from bottom-up models address direct technological costs, but usually ignore non-technical market factors and cost impacts of structural changes. Hence, the costs calculated in these models do not reflect GDP changes as in the case of econometric models (social costs) and are therefore likely to be underestimated.

**Figure 12.**
A theoretical MAC curve (< 0 = "low hanging fruits" or negative net cost area, 0 - 50 = low-cost area, >50 = high-cost area). See also: World Bank (May 1997), The Global Carbon Initiative.

**Overall cost curves**

Overall (aggregated over national economy) marginal CO\(_2\) cost curves, calculated using the MARKAL model for both high and low baseline projections are shown in Figures 13 and 14 for the year 2010. For other years than 2010 cost curves were not calculated as relevant emission targets\(^{17}\) are met without additional measures.

In the figures data on CO\(_2\) reduction represent the difference between the baseline and mitigation scenario (not related to baseline year 1990). This is because CO\(_2\) emission projections for 2010 are lower than actual emissions in 1990 in both high and low baseline scenarios and thus reduction needed for meeting the reduction target level is lower than the targeted one. The difference is about 6% and 13% in case of the high and low baseline scenario, respectively. There are no additional costs expected for reduction by 5% both in the high and low scenario.

It is evident from Figure 13, that to meet the 15% reduction target in 2010 with respect to the emission level in 1990 would require a 3% reduction with MAC about 570 CZK per ton (USD 17 per ton) of CO\(_2\) in case of the low baseline scenario. In case of the high baseline scenario (Figure 14) it would be necessary to reduce CO\(_2\) emissions by 9% in 2010 with respect to the baseline emissions in 2010 at MAC about 1,993 CZK (USD 60) per ton of CO\(_2\). Numerical values and methodological details are given in Appendix III. The reduction target of 8% announced by the Czech Republic in Kyoto will be therefore met within "business as usual".

\(^{17}\) Stabilisation of emissions or reduction by 7.5% in 2005 as compared to the 1990 level in mild mitigation and strong mitigation scenarios, respectively.

With respect to the emission trading, the potential of low-cost measures will be rather
limited after 2005 and actually it has been utilized substantially in the first half of the 90s (see 5.1.). If we define the economically feasible reduction potential as those policies and measures with MACs below 40 USD/ton (average mitigation costs are about 15 - 20 USD/ton), such a potential is about 8% for the high and about 9% for the low growth scenario. In absolute volumes, this reduction potential represents about 12 mil. tons of CO₂ in both cases. After using up this potential, the Czech Republic will be in the same position as other OECD countries.

**Sectoral cost curves**

Sectoral cost curves have been calculated for the energy sector (both for public producers and autoproducers), residential and commerce and services sectors (see data in Appendix III).

The energy sector includes both the public energy sector and autoproducers. Similar as in case of the overall marginal CO₂ reduction cost curves those for the energy sector were calculated using the MARKAL model for both high and low baseline projections. The results are presented in Figures 15 and 16 for the year 2010. In these figures, data on CO₂ reduction represent the difference between the baseline and the mitigation scenario (not to the baseline of 1990).

This is because CO₂ emission projections for 2010 are different than actual emissions in 1990: higher in the high baseline scenario and lower in the low one. The difference is about 5% above the base year and 2% below the base year in case of the high baseline scenario and low one, respectively.

![Figure 13: Marginal Cost Curve – Czech Republic, Low Baseline Scenario](image-url)

**Figure 13.**
Marginal Cost Curve – Czech Republic, Low Baseline Scenario (year 2010 compare to 15 % and 20 % reduction target of 1990 emission level, 1995 prices)
Figure 14.
Marginal Cost Curve – Czech Republic, High Baseline Scenario (year 2010 compare to 15 % reduction target of 1990 emission level, 1995 prices)

Figure 15.
Marginal Cost Curve for Energy Sector, Low Baseline Scenario (year 2010, 1995 prices)
A different methodological approach was used to calculate the CO₂ reduction cost curve for the residential sector, than in the case of overall and energy sector cost curves. The discrete step CO₂ reduction cost curve was calculated using only the list of mitigation options without utilization of the MARKAL model. The result represents the ranking of individual mitigation options by their contribution to the CO₂ reduction potential by their reduction cost. The largest CO₂ reduction potential is related to thermal insulation of walls, which is fairly not the cheapest option. The cheapest option is installation of energy efficient lighting while the most expensive is the change of windows.

A similar methodological approach was used to calculate the CO₂ reduction cost curve for the commerce and service sector as in the case of the residential sector. The discrete step CO₂ reduction cost curve was calculated using only the list of mitigation options without utilization of the MARKAL model. The result represents the ranking of individual mitigation options by their contribution to the CO₂ reduction potential by their reduction cost. The largest CO₂ reduction potential is related to energy efficient lighting, which is the cheapest option. The most expensive option is the change of windows.

Figure 16.
Marginal Cost Curve for Energy Sector, High Baseline Scenario (year 2010, 1995 prices)
Comparing the overall abatement costs with abatement costs in the energy sector, one can estimate that about 75 - 85 % of the overall reduction of 12 mil. tons CO\textsubscript{2} would be achieved in the energy sector since the economically feasible potential (MACs lower than 40 USD) is rather limited in the residential and commercial sectors (about 1 mil. tons of CO\textsubscript{2}).

Because this study is based upon more advanced emission scenarios in comparison to the previous efforts and represents the first detailed attempt to calculate MACs, we can formulate the following conclusions related to the reduction potential and JI:

- the potential of the low-cost measures is rather limited and it has been actually used up in the first half of the 90s, the economically feasible potential (MAC lower than 40 USD) is about 8 % for the high growth scenario and about 9 % for the low one. This reduction potential represents 12 mil. tons of CO\textsubscript{2} in both cases,

- in case of high economic growth, MACs related to 15 % reduction at 2010 can reach 60 USD/ ton of CO\textsubscript{2}, which is comparable with other OECD countries.

To compare our MACs with the published data available for European countries (see Table 4), we have calculated „Europe average“ MACs for stabilization, 5 % reduction and 10 % reduction related to 2010 (Belgium, Denmark, France, Germany, Greece, Italy, Netherlands, Switzerland and UK) and plotted them against our estimates in USD/ ton CO\textsubscript{2} (1 USD = 28 CK in 1995) in Figure 19.
Qualitative Sectoral Analysis - Industry, Transport, Renewables

Besides the estimation of MACs for energy, the residential and commercial sector, a qualitative assessment of areas interesting for AIJ/JI projects has been carried out for transport, industry and renewable sources of energy. In these cases, we have also tried to carry out the similar modeling experiments as well, but the limited availability of economical and energy data made such modeling impossible.

Also wide variety of individual technologies and the fact that some industrial sub-sectors are represented by one or two producers limit the usefulness of such effort. Calculation of MACs for the transport sector requires models quite different from MARKAL or other energy balance models available in the Czech Republic. Moreover, due to the lack of an official

![Discrete Step CO₂ Reduction Cost Curve - Commerce and Service Sector](image_url)
Figure 19. 
MACs estimates (in 2010) for both scenarios (low and high growth) compared with European average MACs.

transport, energy and industrial policy of the Czech Republic it is very difficult to set any sectoral scenarios reaching beyond 2000.

Industry

Under conditions of central planning, the Czech industry was characterized by increased energy intensity especially due to a large share of heavy industry. This was reduced after 1990 because of low competitiveness. The analysis of the present situation has been influenced by the limited amount of producers in individual sub-sectors and unavailability of technical and economical data. Generally, the energy consumption has a lower impact on the final prize of products than e.g. in the EU, which presents a weak motivation for energy savings.

A substantial part of production technologies is imported from other OECD countries. The production of the majority of commodities has therefore the equal energy intensity like in other OECD countries and an eventual increase of this intensity is caused by the fact that the production lines are not used at their full capacity, e.g. the capacity of cement kilns lies now about at 65%. In the paper and pulp industry, where reconstructions or innovations of the existing technology are expected, the consumption of heat per unit of comparable production is higher by about 20%.

The expert team however identified areas for reductions of energy consumption (20 - 60%) via new production technologies in metallurgy (hot casting, steel production, aluminum welding) or in the chemical industry (sodium hydroxide, caustic soda, polypropylene, ethylene, etc.). The utilization of industrial waste heat (recuperation or use by residential sector) in metallurgy, ceramic, glass and cement industry is another example of prospective JI projects. The use of heat pumps in food industry is another field to utilize waste heat. Coal-to-waste wood switching or production of wood briquettes (pellets) as an environmental friendly fuel are examples of prospective AIJ projects.

Investment risks must be assessed very carefully in case of individual JI industrial projects because of non-transparent and rapidly changing owners (in many cases involvement of investment funds established in the beginning of voucher privatization), lack of motivated and skilled management, debts etc.

Transport

The share of the Czech transport sector in overall CO₂ emissions (7.1% in 1995) is relatively low in comparison with a global average of 25% (Michaelis, 1996). This is due to a combination of two factors:

- underdeveloped road transport till 1990, e.g. in comparison with the EU,
- high overall CO₂ emissions.
The activity of transport sector grows since 1990 simultaneously with its substantial restructuring. There is a decrease of railway transport, which is technically obsolete in comparison with the EU standard and therefore non-competitive with road transport. The road vehicle fleet grows fast since 1990 approaching the OECD-EURO average. The annual consumption of fuel per vehicle (1.0 toe/veh.) is substantially lower than the OECD-EURO average (1.33 toe/veh.).

A substantial part of the Czech passenger car fleet is obsolete (70% of the fleet has an average age of 14.5 years) and therefore with a high fuel consumption (about 8 l/100 km). In Table 10, the basic indicators related to the CO₂ emissions in the transport sector are shown.

Table 10.
Trend of transport related CO₂ emissions, fuel consumption and vehicle stock (1990 = 100)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport related CO₂ emissions (mil. tons CO₂/yr.)</td>
<td>8.0</td>
<td>6.9</td>
<td>8.1</td>
<td>8.3</td>
<td>8.3</td>
<td>8.9</td>
<td>9.7</td>
</tr>
<tr>
<td>Car fuel consumption (mil tons/yr.)</td>
<td>3.8</td>
<td>2.4</td>
<td>2.8</td>
<td>3.1</td>
<td>3.5</td>
<td>3.6</td>
<td>4.3</td>
</tr>
<tr>
<td>Vehicle stock (veh./100 inhab.)</td>
<td>25.9</td>
<td>27.0</td>
<td>27.6</td>
<td>29.2</td>
<td>31.5</td>
<td>33.2</td>
<td>36.1</td>
</tr>
</tbody>
</table>


A transport scenario is based upon the following assumptions:

- growing share of new cars with reduced mileage consumption (ca. -10%),
- increasing transport intensity,
- effect of the approximation to the EU.

Two important measures are in place in the EU. The first one is a voluntary agreement by car manufacturers to achieve a 10% reduction in average new vehicle CO₂ emissions per kilometer between 1993 and 2005. The second measure is an EU-wide minimum fuel tax: European Council Directive 92/82/EEC sets minimum rates for excise duties on fuels. These are 0.245 ECU/liter for diesel, 0.337 ECU/liter for leaded gasoline and 0.287 ECU/liter for unleaded gasoline.

Despite the positive effect of the growing share of new cars, the contribution of transport to total CO₂ emissions is expected to reach 9-10% related to the fast grow scenario, which means that they should approach 12 mil. t CO₂/yr. at 2005. Since the transport requires a well balanced spectrum of policies and measures, the space for project based JI is rather limited. There are however municipal transport projects (e.g. diesel fuel-to-LPG switch) with an JI potential, especially if technical measures (investment) are combined with parking fees, fuel taxation policy, restrictions of individual driving etc. A batement costs related to such projects must be estimated case by case.

Renewable energy sources

The present share of renewable energy sources in the Czech Republic is about 2%. Especially biomass including straw and forestry waste presents an accessible and realizable potential of about 20 MW (CSM Assoc. Ltd., 1997). The use of biomass for district heating systems has been found highly competitive with conventional sources of heat. The realizable potential of wind energy is estimated to be over 100 TWh/yr. (CSM Assoc. Ltd., 1997) however the experience gained in the 90s is not sufficiently positive (reliability, price). Solar heating appears to be cost effective for small scale systems (family houses, swimming pools etc.).

If the environmental benefits and reduction potential of renewables are to be realized, revenue support via subsidies is necessary. A limited number of pilot projects has been supported by the State Environmental Fund and the Czech Energy Agency. This group of projects is highly suitable for AIJ due to their
environmental benefits. A package of small scale projects (e.g. a single program organized by MOE) could be used to generate tradable credits (see 5.4.3).
5 The Czech Republic and Joint Implementation

State of the Environment in the Czech Republic

At the end of the 80s, the quality of the environment of the Czech Republic was alarming. There are substantial positive changes of the environment quality since 1990, inter alia:

- emissions of SO\(_2\) have been decreased by 50 %,
- emissions of particulate matter have been decreased by 72 %,
- emissions of CFCs covered by the Montreal Protocol have been substantially eliminated,
- organic pollution emitted into surface waters has been decreased by 79 % (expressed as BOD\(_5\)).

Total costs of the environmental protection amounted 2.1 % of GDP in 1992, 2.2 % in 1993 and 2.7 % in 1994 - 1996, which is more than in the majority of OECD countries (Report on the State of Environment, 1997). More than 80 % of the total costs are related to air and water pollution. The relative share of the municipal and private sector has been increased from 27 % in 1992 to 67 % in 1995. The flow of investment into air and water protection, waste management and energy savings determines the rate of environmental improvement.

The air pollution caused by an excessive use of brown coal is the main environmental problem. Despite extensive coal-to-gas switching which started in 1992, coal represented about 55.5 % of primary energy carriers used in 1994, which is a substantially higher share than the OECD average (23.2 % OECD, 21.2 % OECD-Euro). The country suffers not only from this environmentally unfavorable structure of energy carriers but also from lower energy efficiency (see Table 11).

It must be stressed that since 1992, energy efficiency and specific CO\(_2\) emissions are improving (Figure 20). One can estimate, that a low-cost or even no-cost reduction potential, which might be about 10 - 15 % of the total emissions in 1990, has been spent in the first half of the 90s.
Table 11.  
Comparison of basic indicators

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions of CO₂ per capita (tons of CO₂/inhab.)</td>
<td>12.0</td>
<td>12.5</td>
<td>7.6</td>
<td>11.1</td>
</tr>
<tr>
<td>Emissions of CO₂ related to energy consumption (tons of CO₂/toe)</td>
<td>3.0</td>
<td>3.1</td>
<td>2.3</td>
<td>2.4</td>
</tr>
<tr>
<td>Carbon Intensity of GDP (tons of CO₂/1000 USD of GDP)</td>
<td>1.3</td>
<td>na</td>
<td>0.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Energy efficiency (toe/1000 USD of GDP)</td>
<td>0.44</td>
<td>0.36</td>
<td>0.21</td>
<td>0.25</td>
</tr>
<tr>
<td>Consumption of PES per capita (toe/inhab.)</td>
<td>3.9</td>
<td>4.0</td>
<td>3.3</td>
<td>4.6</td>
</tr>
</tbody>
</table>

Remark: na = not available. PPP based values of GDP are used.

Figure 20.  
Development of energy efficiency end CO₂ emissions per GDP in the 90s

Recent Development of Climate Policy in the Czech Republic

According to the Resolution of the Czech Government No. 323/93, the Minister of the Environment and the Minister of Industry and Trade are both responsible for the commitments related to the UNFCCC. Because of the multisectoral character of climate policy, an inter-ministerial committee on climate change was established in relation to the preparation of the first National Communication in 1994. Despite there is no special document on climate change formulated on the level of the Czech Government, basic elements of the „climate policy“ have been developed in 1994 - 1996 as evident from:

- the first and second National Communication,
- official statements on COP-1 and COP-2.
These elements are:

- domestic priorities of the State Environmental Policy (air and water protection, waste management, reduction of human health risk factors, clean-up of old environmental damages),
- limited knowledge of vulnerability of the country related to climate change and limited financial resources for climate specific mitigation and/or adaptation policies,
- ongoing economic transformation which has a synergetic potential with environmental protection,
- integration of the Czech Republic into the group of European democratic and developed countries (OECD-EURO), the EU pre-accession activities of the Czech Republic.

Analyzing the National Communications, the State Environmental Policy (MOE 1995) and the EU Questionnaire (MOE 1996, part Environment), one can identify the following important features of the Czech position:

- responsible approach to the UNFCCC and its objective - the country acts as an Annex I country since 1993 using „flexibility“ (Article 4.6) in a minimal extent (acceptance of 1990 as a baseline year and support of the EU reduction targets. The Czech Republic initiated a consultation process on the UNFCCC between associated countries and the EU,
- the necessity to start with a still not fully explored potential of low-cost measures and utilization of economic transformation (plasticity of legislative, innovative atmosphere, inevitable modernization of production technology, willingness of the government to use economic instruments),
- limited financial resources for environmental protection that are supposed to be mainly used to comply with the EU up to 2005.

Despite a generally positive approach to JI at the MOE level, one can however identify several barriers to JI and/or emission trading present in the Czech Republic:

- complexity and novelty of the issue, no experience with pragmatic environmental policy based on economic instruments,
- lack of knowledge of the economically feasible reduction potential as well as of low-cost measures,
- the specific situation of the private sector (lack of responsible owners and management, strong role of the government in power industry, subsidies etc.),
- investment risks specific for EITs,
- nonexistent detailed operational rules, complex assessment of AIJ/JI projects (including guidelines for baseline calculations, additivity assessments etc.).

Another possible source of the cautious approach of the MOE to JI in last years are as follows:

- fear from not fulfilling UNFCCC commitments (future compliance),
- no knowledge of the economically feasible reduction potential as well as of low-cost measures,
- limited human resources to deal with AIJ/JI projects, technical problems (baseline calculations, monitoring etc.).

Generally the Czech Republic will have to strengthen its institutional background with respect to the increased quality of national inventories, transparency of its projections and assessment of policies and measures implemented. These are widely recognized prerequisites for any system of emission trading. The ability to use the future potential of JI will depend upon the administrative structures build today as well as upon the position the country will earn during the pilot phase of AIJ.

**AIJ in the Czech Republic**

The Czech Republic has been positive to JI/AIJ on the UNFCCC scene since 1994. At COP-1, Minister of the Environment, mentioned activities implemented jointly in his speech at the ministerial segment of the conference. In April 1996, the first Deputy Minister of the Environment expressed the official support to JI in his opening speech at the Regional Conference on Joint Implementation in Prague. He pointed out a specific situation of the country, which is ready to host pilot projects of AIJ, and after 2000 act as an investor country. He stressed the importance of domestic efforts to improve and protect the Czech environment heavy damaged during the previous decades.
However, the development of AIJ projects in the Czech Republic has not been without problems. This is specially the case of the Decín project as mentioned by Billharz (1997). Besides uncertainty about future GHGs levels (difficult projections), the author has identified additional obstacles to AIJ projects:

- lack of an official policy,
- lack of procedures to assess AIJ projects,
- unavailable information on AIJ for business and industry.

The reconstruction of the coal based municipal heating facility at Decín-Bynov (coal to gas switching) has been one of the first projects proposed as a JI/ AIJ (see BOX 6). After COP-2, a national contact point for AJI was established within the Foreign Relations Department (MOE) and criteria for AIJ project assessment have been drafted. A set of basic criteria have been published in the MOE Bulletin (Věstník MZP, No. 2, April 15, 1997), see Appendix IV. The number of AIJ projects approved/developed in the CR (Table 12) is relatively small in comparison with e.g. Poland (see BOX 4).

Table 12.
Status of different projects developed in the Czech Republic as AIJ

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>INVESTOR COUNTRY</th>
<th>TECHNOLOGY</th>
<th>DATE OF SUBMISSION</th>
<th>DATE OF APPROVAL</th>
<th>REPORT TO UNFCCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decín</td>
<td>USA</td>
<td>Coal to gas switching</td>
<td>November 1996</td>
<td>April 1997</td>
<td>By USA, concurred by MOE</td>
</tr>
<tr>
<td>Krkonoše Nat. Park</td>
<td>Netherlands</td>
<td>Reforestation</td>
<td>January 1995</td>
<td>March 1997</td>
<td>-</td>
</tr>
<tr>
<td>Cízkovice</td>
<td>France</td>
<td>Cement factory</td>
<td>November 1997</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Škoda AG, Mladá Boleslav</td>
<td>FRG</td>
<td>Power/ heating plant reconstruction</td>
<td>August 1996</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cheb</td>
<td>FRG</td>
<td>Modernization of municipal heating system</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Jeseník</td>
<td>Denmark</td>
<td>Wind farm</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Kladno</td>
<td>USA</td>
<td>Power plant reconstruction</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: MOE, JI Quarterly (web site), SEVEN, Center for Clean Air Policy, Nordic Council of Ministers
The present personal capacities available at the MOE are far from being sufficient in any respect. The expert background for project assessment is rather limited in comparison with e.g. the Czech Energy Agency or State Environmental Fund. The administrative procedure of the project assessment and approval is not established as a transparent one and the assessment therefore consumes an excessive time. The documentation for individual projects, which have been submitted since 1995, differs from case to case. There are problems with baseline calculations for some projects, e.g. Decín, which prevent the MOE from reporting to the Secretariat accordingly to the format adopted by SBSTA (see 2.4.1.). The present situation may have obviously a negative impact on the position of the CR as a host country.

**National Strategy for Joint Implementation**

**JI as a part of national climate policy**

The objective of the following part of this study, which is based upon the analysis carried out in Chapters 2-4, is to elaborate on relevant national JI strategy in a broader context and advice on institutional arrangement to facilitate the eventual participation of the Czech Republic in the GHG offset market. With respect to the above analysis, it is evident that this JI/AIJ national strategy must be therefore developed as a part of national climate policy.

Vice versa, more detailed climate change policy should be an integral element of the „second generation“ State Environmental Policy. As many policies and measures, which are being effective for GHG emission reductions (see e.g. EU proposal of common policies and measures for Protocol), have multiple positive effects on the local environment (reduction of SO$_2$, NO$_x$ or CO emissions, reduction of traffic noise, reduction of waste dumping and recycling, enhancement of biodiversity, etc.) or on local economy (energy saving, development of infrastructure etc.), they will be more supported by general and local public.
The national climate policy elaborated in a context of local environment protection should therefore use emission trading not only to enhance GHG emission reductions but to protect also the local environment and/or human health. To improve the receptivity of the energy, transport, industry and municipal (residential) sector to JI, the following measures should be considered if emission trading should among instruments of the state environmental policy:

- total elimination of deformed energy prices (subsidies),
- co-financing of municipal and industrial projects reducing GHG emissions (see e.g. the Decin model) from the State Environmental Fund, the Czech Energy Agency or Phare Energy Fund combined with generation of credits (see 5.4.3),
- tax deductions for JI projects implemented.

To utilize the potential of emission trading, the Czech Republic, as well as other EITs, must develop its own strategy to play the role of a host (seller) country as soon as possible. It should be stressed that this temporary position of the host country creates even a more complicated role of the Government than in the case of investor countries. It should be kept in mind as well, that after the first budget period (2012), see Figure 9, the Czech Republic can find itself in a position of investor/buyer, since the emission projections indicate growth and the national emission limit accepted in Kyoto is supposed to become more strict after the first budget period.

The Government of the Czech Republic should at first set clear boundaries for the GHG offset market (volume, rules, monitoring etc.) to maintain its own flexibility to comply with UNFCCC or Protocol commitments, respectively. Since many factors determining emission trading are still negotiated, it would be premature to propose a detailed single strategy, which would be based on mere speculations.

The Role of Government

With respect to the potential GHG market, there are two basic options for the implementation of emission trading (as discussed in detail in Chapters 2 and 3) - JI based credit trading and allowance trading. The role of a host’s Government differs substantially in both cases.

The emerging JI-based credit market is supposed to be a relative small market between 2000 - 2005. Particular contractual agreements can be facilitated by independent brokers.

The functioning of the credit trading requires the setting of some key parameters on national level like the allocation (initial assignment) of emission limits, defining the time period, monitoring and enforcement. By contrast with the limited use of tradable permit schemes within countries, there is no experience with international trading systems.

With respect to the strategy of the Czech Republic, the following additional aspects should be stressed:

- GHG/ CO₂ emissions as a traded commodity have a specific character in terms of property rights. The economic interest in selling the emission credits is at the level of individual polluter, but the liability for compliance is at the government side (based on the legally binding commitments). There is a clear conflict between the private sector and the government which must be solved on a legal basis,
- the fact that property rights are not clearly defined influences the JI-based projects in which the private subjects are supposed to trade. This situation makes the role of the Czech government very important and requires its interventions. It is necessary, to solve this discrepancy in interests and responsibility by setting a sufficient framework of rules and mechanisms. In every case, the government’s position must be strong enough to assess properly every transaction,
- the price of the GHG emission unit is a very important signal, which will determine the benefit of all transactions (with respect to the MAC on both sides).

For the Government of the Czech Republic, the following problems (connected with the main risks and benefits) should be solved with respect to the favorable trading option:

- need of clear price signals to avoid the selling of emission credits for very low prices,
- delegation of responsibility for compliance with project performance to the subjects of JI-based credit trading,
• probability of default of trading partners (risk of the non-compliance, default in cash flow),
• transaction costs.

Allowance trading contracts will be standardized and actively traded on an international government market avoiding the problems with allocation of property rights. One can expect that at this market price signals (at the level of marginal abatement costs of reduction for GHG emissions traded) will be influenced by many political decisions. Unsolved problems of international law (compatibility with UNFCCC) and non-compliance, which have to be negotiated at COP-4 and further, delay this way of trading. The Czech government in this case should support also this mode of trading, which is less complicated from the point of view of the host countries (no allocation of emission limits, only allocation of profits).

**Strategic Options for the Czech Republic**

Based on the results of the MAC analysis for the Czech Republic, which are summarized in Chapter 4, the position of the Czech Republic with respect to the potential GHG market can be characterized as follows:

• there is a limited potential for low-cost measures (with respect to the Kyoto reduction target, - 8 % for 2008 - 2012),
• there is a rapid increase in MACs, if the reduction is more than 10 % (related to 1990 level),
• sectoral cost curves show large differences. The lowest reduction costs are in the energy sector. In the residential sector and in the commerce and service sector, the costs are comparable with other OECD countries.

With respect to that situation and to the predicted energy demand, the position of the Czech Republic has to be carefully evaluated. For defining the position of the Czech Republic, two key parameters are important:

• marginal abatement costs,
• price of commodity (GHG emission reduction) traded.

We propose four strategic options based upon our previous discussion on UNFCCC negotiations, the national reduction potential and MACs, role of the Czech Government and operational aspects of trading. These options are related to the future ability of the Czech Republic to comply with reduction commitments and on the development of emission trading with respect to the UNFCCC Protocol. They reach from an improvement of the present political support of AIJ to fully fledged allowance trading reaching annually about 100 mil. USD.

I. Political approach to AIJ

To express its political support and fulfill its promises given at COP 1-3, the Czech Republic should host 5-10 AIJ projects. The transition and operational costs for the MOE should be minimized via clear assessment rules and commitment of self-reporting (monitoring of project performance).

The present situation, when MOE has no capacity for monitoring the project actually approved, must be changed as soon as possible. An immediate designation of one person at least, full capacity of which should be devoted to AIJ/ JI agenda is inevitable in any case. Besides the co-ordination of the national AIJ activities, this person must follow the UNFCCC debate and participate pro-actively.

Shift of project technical assessment and monitoring from MOE to the State Environmental Fund and/ or to the Czech Energy Agency should be carried out while keeping on the co-ordination role of MOE. Both institutions, which are better equipped technically, can use a computerized approach for the first screening of projects submitted, which is available at present.

AIJ administrative procedures (rules, assessment criteria, decision mechanisms) should be formulated at the MOE in cooperation with the Ministry of Industry and Trade. A proper institution (the Czech Energy Agency or State Environmental Fund) should be delegated to carry out AIJ activities on a technical and administrative level as soon as possible.

This solution should result in a total emission reduction achieved after 2000 of about 10 - 20 mil. tons of CO\textsubscript{2} yr. to utilize it for emission trading as well as for negotiations with the EU. It should be kept in mind that, the reduction of 100 mil. tons of CO\textsubscript{2} yr. in FRG have been achieved mainly due to the reunification of Germany (modernization of the former GDR's
It enables certain EU members to increase their GHG emissions between 1990-2000 by more than 10%. An „expanded EU bubble“ involving the more advanced associated EITs, would bring economic benefits to both sides since there are concerns in the EU, that the environmental expenditures (mainly waste water management) of associated countries to meet the Community environmental law (acquis) will require substantial financial support from the EU.

II. Project Pipeline
The design of this system (pipeline), which would enable a „bottom up“ approach to the project development and generation of credits, is presented in Chapter 6. This system should enable matching foreign investors with its Czech partners, preparation of projects with respect to the specific requirements of AIJ/JI (baseline, additionality etc.), their effective assessment, monitoring and verification of reductions achieved.

The preliminary guidelines for AIJ/JI were published in the Second National Communication of the Czech Republic (1997). Two additional constraints are mentioned there:

- projects must include “...a significant reduction of GHG emissions (at least 10% per annum) in comparison with the initial state...”;
- “The investments of foreign firms’ investments into subsidiaries located in the Czech Republic, made solely to meet emission limits such as those outlined in the Air Protection Act, shall not be considered as AIJ”.

Since when one of the main objectives of the pilot phase is to obtain sufficient information on projects the criteria for approving them projects should not be over-restrictive. In that sense it does not seem to be reasonable to limit AIJ projects by numerical criteria e.g. minimum reduction, cost of mitigation etc.

The second constraint is an example of a criterion which is only a modification of “additionality“ requirement. This requirement must be applied to all projects. The above mentioned constraints should be removed (except those established by decisions of the COPs) and the MOE should support the process of acceptance of AIJ/JI projects because:

- JI/ AIJ is in accordance with the national environmental policy as expressed in "Guidelines for AIJ projects" declared in the Second National Communication,
- JI/ AIJ is the best the way to gain enough experience for further stages of the JI process,
- the process of acceptance will provide necessary experience by through “learning by doing“ not only for government authorities but also for experts which will prepare and evaluate AIJ projects.

Special attention must be paid to:

- introduction of a clear, transparent and fair practice in determining the baseline and amount of mitigated GHGs. These procedures should be based on the experience of Czech authorities in the international development of such guidelines and should be flexible enough to accommodate international methodological developments and decisions,
- negotiation of agreements and letters of intent concerning future obligations related to emission credits.

For the formulation of more investor friendly guidelines the following three general principles should be respected:

- only verifiable criteria should be used as constraints,
- projects must be considered from different points of view, because there is no simple approach which can be applied. This concerns especially a possible impairment of the environmental situation as a secondary effect of an AIJ/JI project,
- there are two important aspects which will play a crucial role during later phases of JI:

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18 If the mitigated emissions per project and the number of projects will remain at the present level, the only harm from an unfair baseline is a bad precedent. but if the total of mitigated emissions will, however, substantially increase it may endanger the fulfillment of the commitments the country made to the FCCC.
19 Where proposed JI projects might lead to increases in other problems such as air pollution, waste water discharges, or waste disposal, appropriate mitigation measures should be incorporated into the JI project.
The situation will rapidly change once transfer of emission credits is allowed.

The state government policy should be more restrictive in an initial phase and opened gradually with an establishment of “good practice” in the market. 

Criteria for Evaluation of JI Projects

Guidelines for Baseline Setting
To establish the amount of emission savings and the incremental costs of savings it is crucial to develop the baseline of the project. The baseline includes the expected development during the lifetime of the JI project in the case that the JI project would not be implemented.

General Approaches to Baseline Setting
The baseline definition appeared to be a crucial problem of not only GHG emission projections but also of all JI projects. For a project with a fixed technological solution and therefore fixed and operational incremental costs, the baseline determination is a determination of investor costs of TME.

There are generally two approaches to baseline determination.

1. The first one assumes that there is only a limited number of project types to which any real project can be attributed. Then it is only a matter of effort to set more or less detailed guidelines which ensure that TME will help in the global mitigation of GHG emissions and their fair distribution among partners with non-equal power (poor and wealthy countries). In this approach, a government issues baseline guidelines and regulates the compliance with them. Each project should be evaluated according to these guidelines. This approach is reflected by the effort of the FCCC secretariat to establish and set up international guidelines (see http).

2. The second approach rejects the possibility of setting up verifiable guidelines which can reflect all details in any project. If the partner(s) would like to bias a baseline in its favor, it is costly or even impossible to disclose it. A solution is to find partners in a project which may have opposite interests in baseline determination and let them negotiate under supervision of a third party. At the present time it seems to be impossible to find a partner interested in lowering the emissions projected by the baseline other than the host government. This approach can for the most part only be taken by countries with emission caps and has to be developed.

General principles of a correct baseline
Whichever approach will be chosen for the Czech Republic, there are a few general principles of baseline scenario construction which are tentatively preliminary agreed as recommended. Baselines, according to the FCCC paper, should be:

- transparent,
- created ex ante and
- fixed in time i.e. it is impossible to change it during the project lifetime. This does not mean however, that a baseline methodology cannot change
- precise appropriately adequately to the scale of the project and resolution of the monitoring criteria
- should be open to verification by a third party. This does not mean however, that each project must be verified.

The first national condition is that the baseline of a project must be set in the framework of the national policy, i.e., respecting the economy and technology development and policies and measures (P&M) both already in effect and those prepared for the lifetime of the project. This as a means that the project fulfills the requirement for “an environmental” additionality and for a positive influence on the national GHG inventory. The baseline scenario must correspond in size to the project, i.e., must cover the same area of business.

We do not think that there is a necessity to explain all principles appreciated internationally. But the last two (correspondence of the baseline scenario in size to the project and to the expected national development, including P&M) must be explained in the following examples.

The first example is a project of cogeneration plant reconstruction. An old cogeneration plant must meet emission limits for SO₂, NOₓ and therefore the baseline is not the status quo (doing nothing). A long with a decrease in local pollution, the measures initiated by those limits may also result in a decrease of CO₂ emission which must be taken into account in the baseline. According to present data the cheapest option is, in most cases, a retrofit of the boiler, which may be the baseline scenario. Fuel
switching (to gas or biomass) is usually a more expensive option which can be a matter of an AIJ/JI project.

Correspondence in size in this project means: the project may contain an increase of thermal output of the plant presuming that some more buildings will be connected to the centralized heating system. In this case the baseline scenario must contain emission (and their development over time) caused by the heating systems used.

The second example is a replacement of a simple boiler by a cogeneration unit. The situation is the same when mitigated emissions from a fuel switch are discussed.

In such a project, however, emissions mitigated due to electricity production can be a matter of a possible transfer. Then setting the baseline can be a matter of discussion. The emission coefficient i.e. amount of CO₂ per unit of electricity produced can vary according to the position of the new source on the load curve.

It is not possible to evaluate this number for each project individually and it may be set by definition. Possible options are: a national mix of all sources, a national mix of fossil fuels, a mix of power producers of specific position on the load curve. We suggest a default value of 0.8 kg CO₂/kWh which is roughly the Czech mix expected after the Temelín nuclear power plant comes into operation.

The third example is an aforestation project. An evident baseline is a zero sink. But a state subsidy to support aforestation may change the situation. For a forest in private ownership an estimate must be carried out to assess the influence of this policy on the amount of aforested land and this is used in the baseline.

In the previous section a warning was issued to use a calculated criteria as limits for acceptance of a project. But there should be figure quantities which can be used to sort projects from a certain point of view (e.g. rate of financial feasibility or cost of mitigation). To increase reliability we would like to establish a methodology for the creation and interpretation of these quantitie figures.

**Net present value of the project**

The cash flow is the difference between all revenues and expenditures which are related to the project in a set period. The following items are included in the revenues and expenditures:

We get the cash flow (CF) by subtracting the expenditures from the revenues:

\[
CF = \text{Revenue side turnover} - \text{Expenditure side turnover}
\]

Given the possible irregularity in dividing costs (such as investment costs), it is best to compare the sum of the annual cash flows over the period of the project’s lifetime. We use the cumulative discounted value of the cash flows. The use of discounting accounts for the change in the value of money over time. The discount rate accounts for the inflation rate, the effect of interest rate levels and the project’s risk factor. What is most precise is to determine the discount rate for each project separately, but for the sake of simplification it is of course possible to set a single discount rate for certain types of AIJ projects, or for all projects. The sum of discounted cash flows is called the **net present value** (NPV).

\[
NPV = \sum_{z=1}^{n} \frac{CF_z}{(1 + d)^z}
\]

where \(CF_z\) = the cash flow in Year \(z\),

\(d\) = the discount rate,

\(n\) = the lifetime of the project.

**The incremental costs of mitigation**

The overall cost of reducing emissions is the **incremental net present value** (INPV), i.e. the difference between the net present value of the reference scenario (baseline) and that of the AIJ project for its lifetime.

\[
INPV = NPVA - NPVB
\]

where \(NPVA\) = the net present value of the AIJ project

\(NPVB\) = the net present value of the baseline

The incremental costs per unit of mitigated emissions (c) are the ratio of the incremental net present value to the mitigated emissions over the whole lifetime of the project (S)

\[
c = \frac{INPV}{S} [\text{CZK/t CO₂ ekv}]
\]

**Administrative procedure for D development and processing of the pilot phase administrative procedure**

Project based credit trading in a general sense will be useful for the Czech Republic as for
other developed countries. The pilot AIJ is a "learning by doing" process and even negative experience is valuable. We however recommend a rather stepwise increase of the involvement of the Czech Republic in credit trading. First, it is necessary to decide on a total volume of credits (e.g. in % of the annual emission cap) and such a decision must be based on national commitments and reliable emission projections (scenarios).

With respect to about a two year delay of national emission inventory (preliminary inventory for 1995 was available only, when this study was completed), a relatively large uncertainty of GHGs emissions (8 - 10 % for "combustion" CO\textsubscript{2} and to the possible growth of emissions ("without measures" scenario) in period 1996 - 2005, the following steps are recommended:

- set the total volume of credits to 1-2 % of the national emissions (e.g. 1.5 mil. tons of CO\textsubscript{2} yr.) at the initial stage of credit trading in 2000 - 2005,
- select suitable Czech subjects (project developers) and allocate carbon reduction units among them, together with responsibilities (property rights), e.g. using the form of legally binding covenants between MOE and the subjects chosen. MOE would not interfere into the negotiation of price between the Czech project developers and its foreign partners (investor),
- set minimum price of the credited reductions at about 10 USD/ton of CO\textsubscript{2}, a minimum share of foreign investment to e.g. 1 mil. USD per project, and minimum volume of the total investment, e.g. 200 mil. CZK (about 5.5 mil. USD),
- limit JI projects to more advanced technologies only,
- set transparent rules for the assessment of project baselines and additionalities prevent baseline cheating (perverse incentives could lead to investors and project developers claiming more reductions than it would be really achieved).

The role of the Government would be safeguarding the compliance with UN FCCC, project assessment and verification of reductions. In cases, where government trading is not supposed, 10 - 15 larger projects or project packages (50 kt of CO\textsubscript{2} yr. reduction minimally up to a total of 1 mil. tons of CO\textsubscript{2} annually) would be approved in an initial stage.

The equilibrium analysis modeled in section 3.3 describes the maximum potential trade volume under the assumption that all offsets which are economically tradable will be traded. In this section we look at JI-build up of CR only, which corresponds to some minus 5 % of the total of EITs in terms of CO\textsubscript{2} emissions.

First, under a JI project based credit trading scheme it takes time to bring certifiable projects and offsets to the market, because every ton must be projected and implemented. The speed of this build up is constrained by various socio-economic, technological, human-resource related, and administrative factors. One could expect that the "market" price will start relatively high, then fall, and rise again once MACs in EIT countries rise because the most economic credits have to be sold.

III. The GHG Fund

Since 1993 hundreds of properly documented and regularly monitored projects have been financed by the Czech Energy Agency or the State Environmental Fund. This work could form the basis of a national GHG Fund in which carbon credits could be pooled and traded internationally. Revenues from this trading would increase with time because of increasing activities of the Czech Energy Agency and the recently established PHARE Energy Fund. Either an umbrella GHG fund should be established acting as a subject trading internationally the above credits or the statuses of the above agencies should be modified to enable them such trading activities.

Operational costs of the GHG Fund and activities related to the generation of credits (e.g. project monitoring and verification, improvement of national inventories and projections, carbon offset trade analysis etc.) will be covered from revenues of this fund (e.g. 10 - 15 % of the total income) and the rest will be allocated to the Czech Energy Agency and the State Environmental Fund, eventually to the PHARE Energy Fund proportionally to the volume of credits generated.

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\textsuperscript{21} As a variation of the market scheme is earlier trading with intermediary products such as offsets (not yet registered) than with certified credits.
Standardized assessment procedures (baseline calculations) could be developed for groups of small projects (energy saving in the residential sector, coal-to-gas switching in centralized heating systems, co-generation units, biomass utilization etc.). Transparent and simple rules on project assessment and monitoring must be prepared to maintain low transaction and operational costs with respect to JI projects (especially small ones) and reduce administrative burdens. Much of these efforts depend on the proper application of the emerging international (methodological) framework for JI. Thus, direct participation of the Czech authorities is crucial.

In the case of government credit trading, the volume of credits is estimated to be about 1-3 mil. tons CO₂/yr (see Second National Communication of the Czech Republic) by about 2000, which represents annual revenues of about 5-30 mil. USD as an annual income for the State Environment Fund and Czech Energy Agency. The responsibility for meeting the projected reductions (property rights with respect to credits) will be delegated to both agencies which will negotiate prices with foreign investors and sign the respective contracts. The quality of credits generated by a portfolio of several smaller projects (diversification) and with guaranty given by these government agencies would have a positive impact on the prices.

IV. Allowance trading

From the point of view of policies and measures, this option has been described (Mullins and Baron, 1997) as a „black box“ configuration. Any project based emission trading does not enable to gain revenues from the use of economic instruments such as removal of subsidies of energy and fuel prices, carbon taxation, support of railway or municipal transport, support of energy saving in small family houses etc.). Moreover, the Czech Government may decide that the administrative requirements for monitoring and verification of a large number of individual projects are too expensive (proposed strategic options II and III should keep the costs reasonably low). Since the allowance trading is made possible on the base of the Protocol, the Czech government will have the right to sell (or buy) allowances and redistribute the revenues (or individual emission caps) via the above GHGs Fund.

In such a case, the stabilization scenario would be supported in the most effective way via additional financing by allowance trading. If we suppose the 8% reduction at 2010 with respect to 1990 (national limit declared at COP-3) as a binding commitment and the stabilization achieved at 1995 level, about 15-20 mil. tons of CO₂ could be offered annually as tradable allowances, which means annual revenues of about 100-200 mil. USD. The revenues allocated via the Czech Energy Agency or the State Environmental Fund can mobilize equal volumes of commercial loans, which in total represent annual direct investments of 5-15 billion CK into the energy, industrial and residential sector. However, an early launching of an international allowance trading system is more complicated than in the case of a credit trading scheme (see 2.1.1).

Finally, it must be stressed, that the four strategic options presented can be mutually combined into a flexible, stepwise developed national system enabling the Czech Republic to utilize the potential of emission trading on international levels.

Additional policies

Besides deciding on the above mentioned steps (incl. their combinations), which influence development of AIJ/JI projects, other supportive actions of the Czech Government and the MOE, respectively, are recommended:

- pro-active role in discussions of emission trading operational procedures should be taken by the Czech Republic (including reporting on the existing AIJ projects) on the UNFCCC and OECD basis,
- information, education and awareness programs should be prepared and supported by the MOE since „climate literacy“ is very low in the Czech Republic. In this respect, the pro-active role of the Czech NGOs is expected,
- dissemination of information on benefits of JI among the Czech industrial management, municipalities and local authorities. Internet is a suitable information medium to disseminate information on support of JI/ AIJ domestically and abroad. Identification of NGOs, which are active in this field, and their support via annual grants is highly recommended.
• last but not least, all national efforts, which actually result in a substantial GHG emission reduction, such as removal of subsidies, investment into energy saving and more efficient industrial technologies and/or cleaner technologies (e.g. coal-to gas switching) must be quantified and reported internationally.

As soon as more accurate emission data, improved use of energy and econometric models to prepare projections and more consistent scenarios are available, the uncertainties related to future compliance with national emission caps will be reduced to the extent comparable with the majority of OECD countries. The problem of uncertainties is mainly caused by uncertain scenarios or emissions inventories, which present input data for modeling. It should be kept in mind, that elaboration of long term, plausible and consistent scenarios is difficult especially in conditions of economic transformations, which require more ad hoc decision making than in the „business as usual” conditions of a fully developed market economy.

**Socio-economic Costs and Benefits**

**Local environmental benefits**

Local environmental benefits from JI projects can be considered as an additional byproduct of climate change policy. Reductions in air polluting emissions such as SO\(_2\), NO\(_x\), particles (PM\(_{10}\)) are of primary importance and interest.

Corresponding benefits could even be expressed in monetary terms if once considered as pollution abatement costs (or avoided damage costs) for meeting national or local standards. Such costs could either be (partially) deducted from JI project costs, or added on the benefit side.

Such benefits of reduced air polluting emissions are proportionally higher for JI projects to reduce NO\(_x\)/SO\(_2\) and particle emissions in or near densely populated urban agglomerations\(^{22}\). More concrete analysis and conclusions are only possible if the geographical distribution of projects and CO\(_2\) reductions can be assumed or are known. However, judging from analysis of multimedia benefits from environmental improvement programs, it can be safely said that local environmental benefits may be significant. This is particularly important for heavily polluted urban areas where programs also involve fuel switching from (brown) coal to natural gas. The same set of criteria used routinely by the State Environmental Fund can be therefore used as additional to assess AIJ/JI projects.

**Benefits from technology transfer effects**

It can be assumed that JI projects have a potential for technology transfer from the investor to the host firm and country. The host country (firm) can profit from getting direct access to advanced energy conversion and management technology.\(^{23}\)

However, there are some prerequisites which must be met for these potential benefits to be realized. The key condition is that the host country is capable to absorb in a sustainable way the management of the technology transferred. Human resource development (technical and managerial/financial know how, as well as institutional structures needed) must be adapted in such a way that technologies transferred can be successfully operated, maintained and replaced by local professionals and institutions. In the case of the Czech Republic, the technology transfer potential is very high due to long industrial (technology) tradition, developed infrastructure and qualified human resources.

\(^{22}\) Of course one must consider the differences in emission transmission and transformation phenomena for large and fine particles, and short, medium and long range transport and photo-chemical phenomena related to air pollution phenomena.

\(^{23}\) Examples are power plants, CHP-facilities, heat recuperation technology, automation and control equipment, heat- and power-transmission and -distribution technology etc.
Role of JI Authorities in the Czech Republic

The design of project development is based upon findings and conclusions of previous parts of the study (see especially Chapters 5.3 and 5.4.). The whole system should consist of several elements: JI decision-making authorities at government level, an administrative service (JI office), supporting agencies, an information system, accredited private consulting and verifying firms.

This system should assist foreign investors and domestic project developers of JI projects on one hand and safeguard the national compliance with Protocol on the other. The backbone of this system is an appropriate structure of authorities and their supporting and regulatory functions.

At the initial stage of AIJ/JI (pilot phase) both governments (investor and host) play two roles: supporting (sometimes as the sole investor) and regulatory. An increasing role for private bodies as investors is expected during the fully developed JI. Governments will act in this phase mainly as regulators, but this role is irreplaceable because governments need to fulfill their international commitments (compliance with UNFCCC and Protocol). The key rule is that the supporting role must be separated from the regulatory role and the best way to do this is through institutional separation.

The supporting functions can be carried out by a specialized office at MOE, the State Environmental Fund (SEF) and the Czech Energy Agency (CEA). The regulatory function is to be executed by a JI interministerial commission.

Supporting functions

During the pilot phase, government (MOE, SEF, CEA) will provide some incentives to start the AIJ/JI process and to attract possible investors. In the case of the Czech Republic, this means mainly:

- capacity building i.e. establishment of an AIJ/JI office (at the MOE) and training its staff and building a list of reliable organizations which will later serve as consulting companies in the field,
- investment support (SEF, CEA) for projects where not enough private funds are available and mitigation costs are lower in comparison to domestic projects,
- information service for domestic project developers and foreign investors.

It is supposed that the capacity building will be finished during the pilot phase (1998-1999). Then SEF and CEA will take the supporting role (see Chapter 5). During the normal JI phase the supporting role will include also the allocation of foreign investment into portfolio(s) of small projects and trading of the carbon offsets (credits).

The regulatory functions

The regulatory functions consist of project assessment, approval, recording and supervision of two other activities: verification and credit trading.

Project acceptance, approval and recording

Records must be kept for all AIJ/JI projects in all stages of development and operation. Recording of acceptance/approval of AIJ/JI projects is an irreplaceable role of the MOE. A JI office (JIO) and an interministerial JI commission (JICOM) should be established. A JI office (JIO) and a commission at the Ministry of Environment, which will
provide these functions as explained in the next chapter section.

Verification of mitigated emissions

Companies (private) can verify mitigation of emissions. The reason for separating the verification from the registration process is as follows:

- it is a very specialized activity that requires professional experts,
- private organizations can provide their services at lower costs because they do not need to keep personnel for this task only.

A company will check the project but the final decision is issued by the JICOM/JIO.

Monitoring and verification concerns all stages of project development and operation: verification of the baseline, environmental benefits, and saved emissions in comparison with those projected in the proposal, etc. Self-monitoring and reporting obligation must be taken by the project operator (see analogy with EMAS) to reduce the monitoring costs.

The government should finance the verification carried out by private firms. The crucial point of the verification process is the baseline setup. This will be regulated by guidelines issued by the JICOM. A accreditation of verifiers should be started as soon as possible. The accreditation scheme of EMAS developed recently by MOE could be modified for this purpose.

Development and Processing of the Pilot Phase Administrative Procedure

Registration and approval procedures for AIJ/JI projects will vary during the different stages and phases of the AIJ/JI process. During the pilot phase, when there is rather limited experience with AIJ projects, the criteria for approving the projects should not be over-restrictive and a simple and fast procedure would be appropriate. This respects one of the main objectives of the pilot phase, to obtain enough information on projects to lay the groundwork for JI policy in later phases.

As there is a lack of knowledge, it is reasonable to establish a process, which would allow enabling improving of the procedures and rules for approving the AIJ projects to be developed/improved. Also in the course of time, the policy can change, and therefore the procedure should differ be flexible. In this respect, the participation of the MOE (JIO) in the current development of methodologies at an international level (UNFCCC, OECD) is recommended. At least one person should be involved in SBSTA seminars and other UNFCCC and OECD Annex I Expert Group related activities.

Interministerial JI Commission

An interministerial commission (JICOM) of several members will be set up so that no single person in order to bears all the responsibility, be the only one person, as well as to prevent corruption and excessive lobbying, there will be set up a commission of several members. The JICOM will carry out facilitate two important functions:

- it will approve endorse the procedure and rules and
- according to them it will grant decide on approving the AIJ status to the projects.

The leading role in the AIJ/JI process is to be played by the MOE and the Ministry of Industry and Trade, but in order to harmonize the views of different sectors, it is recommended advisable to establish the JICOM on an interministerial basis chaired by MOE (deputy minister level). All decisions of the JICOM will have to be available to the general public. Relationship between the decision-making activities of the JICOM and the following EIA procedures applied to the projects approved by JICOM should be elaborated.

Administrative procedure

Following the Figure 21, first the JIO should first prepare a proposal of pilot phase procedure and rules for approving AIJ projects. On the basis of this proposal the commission will decide on establish the obligatory procedure and rules or return it to the JIO for the revision. After approval of endorsement the procedure and rules, for AIJ projects will be implemented and thus the JIO (or an independent company which is not involved in the procedure) can
summarize new experience and in evaluation of their effectivity and adequacy. 

This feedback will be reflected in the new proposal by the JIO for the improved procedure and rules by the JIO, which again should be endorsed/approved by the JICOM. The administrative procedure described schematically in the Figure 22 should include project registration.

The investing organization (Czech legal entity) submits an application form and an assurance to JIO. The assurance may take one of the following two forms:

- preliminary acceptance of the project as AIJ from the investing country’s responsible AIJ office (national focal point),
- a fee covering the costs of project evaluation (it will not be returned if the project is not approved).

The application form contains the basic information on the investors, the project and the potential GHG savings and it is a simplification of the Universal Reporting Format recommended by the FCCC Secretariat.

On the basis of the application, the JIO will decide on the registration within seven days. Incomplete proposals will be returned to the submitting corporation in the same period and they can be resubmitted and will be taken as a new submission. The submitting organization can ask the JICOM to reverse the JIO negative decision.

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25 There are two basic schemes of financial involvement in an AIJ/1I project assumed:
- domestic and foreign investor(s) will form a new organization(s) (legal entity)
- a foreign loan is offered to a domestic organization.

The newly formed or borrowing corporations registered in the Czech Republic, which will invest, operate and own the results of the project are alone entitled to submit a proposal to acquire AIJ/1I status and negotiate with the JIO.

26 The purpose of assurance is to discourage the submission of projects which have little chance of being carried out.
Figure 21. Scheme of the development of the pilot phase administrative procedure for developing and processing of the PP administrative procedure.
Figure 22.
Scheme of the project development of AIJ projects
Information system

An information system should be developed stepwise by creating a Web site on the Internet. This Web site should be operated by JIO after it is established. It should comprise information about the procedure and the rules for approving the AIJ projects.

For all the AIJ projects approved by the Czech Republic the Web page will include the information about the investors, the projects and the potential GHG savings. The project can be put on a Web page on request of the project developer as soon as it is already registered at JIO. There will be a place where projects which are seeking foreign partners could be advertised for possible projects which are seeking for foreign partners.

Feasibility study

Within six months after registration, the applicant (domestic project developer and foreign investor) should submit a feasibility study to the JIO. The feasibility study includes all important information about the project: general, technical, environmental, financial, risk aspects and other relevant information (See Appendix V). It may include a proposal of sharing of carbon offsets (credits) in further phases. The JIO checks the completeness of the feasibility study and decides on eventual the revision.

Project Assessment

If the feasibility study fulfills the formal requirements, the JIO immediately selects an appropriate accredited consultant to check the data and to assess the technical, and financial feasibility and the environmental benefits of the project. The company will submit its evaluation report to the JIO within four weeks.

Recommendation of by JIO

On the basis of the assessment by the accredited consultant the JIO will recommend the JICOM to approve the AIJ status. It should be done within six weeks from the submission of the feasibility study. Again, if the information included in the feasibility study was not sufficient for the assessment, the JIO can return the study back to the applicant and after the revision it should be resubmitted to the JIO. It is clear that JIO assesses the technical and financial feasibility of the proposals only to the extent that affects project monitoring of the project and verification (certification) of the credits.

Official approval by JICOM

Within 4 weeks of receipt of a recommendation from the JIO, the JICOM will decide on the project’s AIJ status and inform the applicant. To comply with this termination time frame, the JICOM should meet regularly, e.g. once in a month. The decision is based on pre-defined rules and criteria, which may vary in the course of time (some suggestions for possible criteria are indicated in Appendix V). The Minister of Environment should be empowered to revise negative decisions of JICOM.

Monitoring and Reporting

Under the pilot phase, AIJ national programs monitor the reductions achieved from the AIJ projects and report them to the FCCC secretariat on a yearly basis. Thus the operator is required to report about the actual emission performance to the JIO annually. An independent verification of emission reductions will have to be conducted by organizations accredited/approved by the JICOM. The provided monitoring should be transparent and should follow a standard reporting format.
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