REPORT ON

OPTIONS FOR DESIGNING
A GREEN INVESTMENT SCHEME
FOR
BULGARIA

ANNEXES

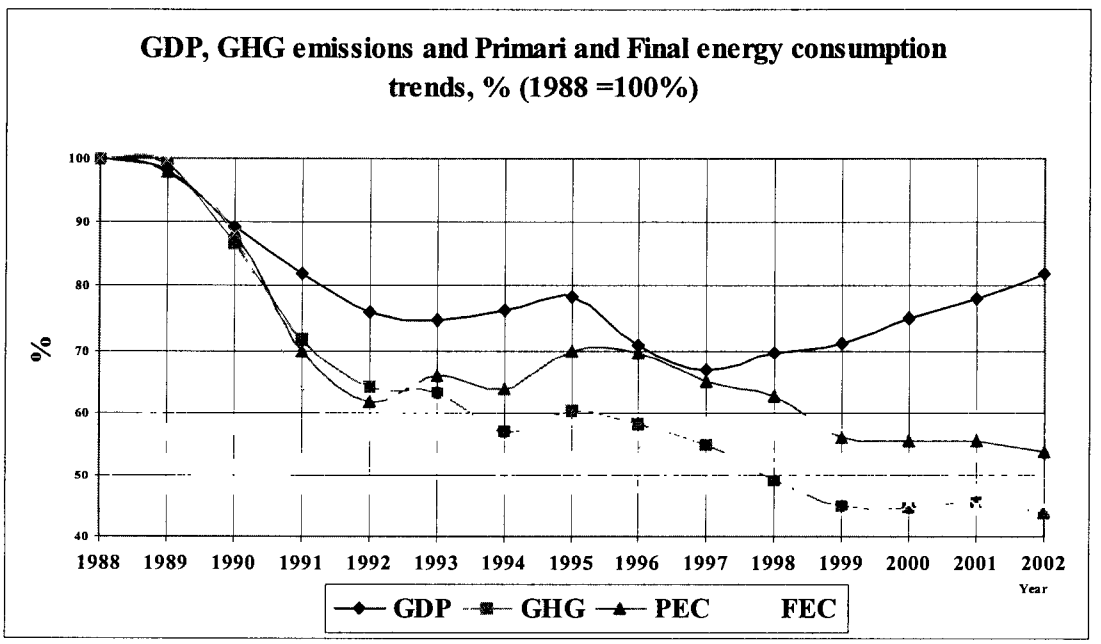
Bulgaria's GHG Emissions and Projections

The 2002 greenhouse gas (GHG) emission inventory revealed that the overall GHG emission expressed in CO_2 equivalent amounts to 62.4 million tons, not taking into account sequestration. The net emission (including sequestration) amounts to 54.1 million tons. The table below shows the emission levels of the six greenhouse gases, the total GHG emission and the relative share of the overall emission level compared to the base year 1988.

Table Overall GHG emissions (without sequestration in Mton CO_2 eq.)[1]

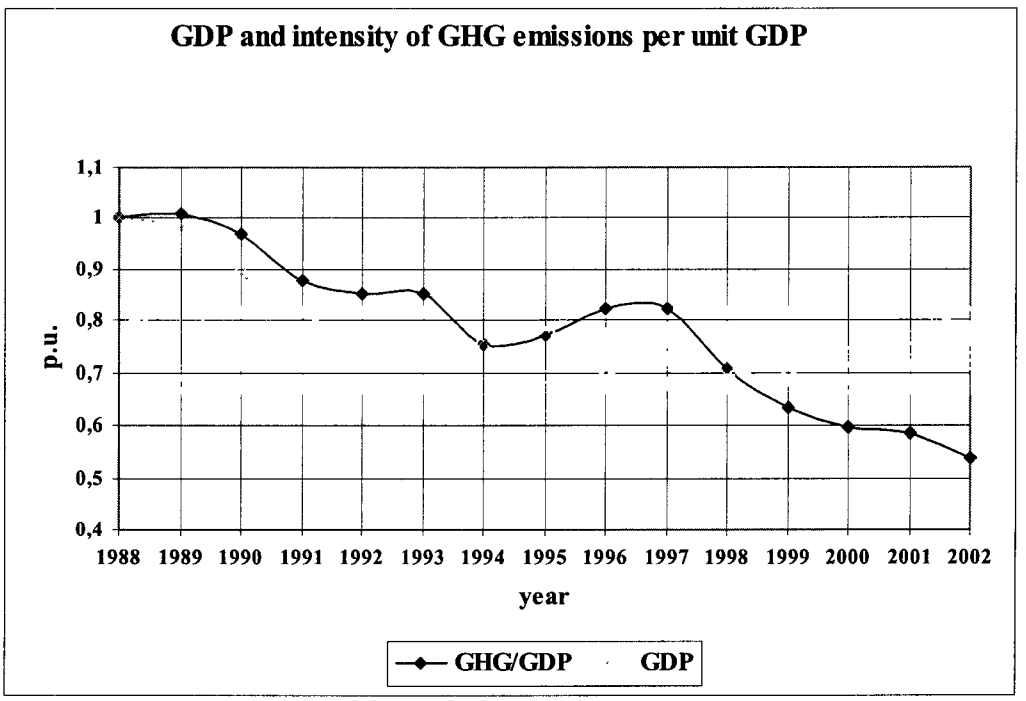
GHGs/ year	1988	1990	1992	1994	1996	1998	2000	2002
CO_2	102.5	82.8	58.7	58.3	59.7	51.6	46.7	46.8
CH_4	24.4	25.6	23.6	15.4	15.0	11.8	10.2	9.4
N_2O	14.9	13.7	9.2	7.7	8.2	6.6	6.7	6.3
HFCs/PFCs/SF_6	n.a.	n.a.	n.a.	n.a.	>0	0.1	>0	>0
TOTAL	**141 .8**	**122 .1**	**91.6**	**81.4**	**83.0**	**70.0**	**63.6**	**62.4**
Compared to 1988, %	**100**	**86.1**	**64.6**	**57.41**	**58.5**	**49.4**	**44.9**	**44.0**

Bulgaria's GHG emission trend during 1988-2002 reflects the economic development of the country. The period is characterized by a process of transition to the market economy (liberalization), restructuring of industry (privatization), removal of subsidies and stable decrease of the production of energy intensive industries at the expense of the non-energy intensive ones. As a result of the structural changes the share of industry in the Gross Domestic Product (GDP) has decreased from 61% in 1987 to 29% in 2002, while the share of services has increased from 22% to 50%. The trends of the GDP, GHG emissions, primary energy consumption (PEC) and final energy consumption (FEC) are given in the figure below.



[1] The total GHG emissions indicated in the table are calculated in CO_2 equivalent with the following Global Warming Potential coefficients for the main GHGs: CO_2=1, CH_4=21 and N_2O=310.

The structural changes of the economy have resulted in a drastic decrease of the final energy consumption by about 55%, whereas, in the same period, the primary energy demand has decreased by 45%. The final energy consumption per unit GDP has decreased by 42%, compared to 28% for the primary energy consumption per unit GDP. The figure below shows a stable decrease of FEC and PEC as well as the GHG emissions during the period 1988 – 2002. Contrasting with the trend of decreasing GHG, PEC and FEC, a significant increase of GDP can be observed after 1997, when its levels reached 67% of the base year value. In 2002 the GDP reached 82% of the base year level. Since 1997 growth of energy consumption and GHG emissions show decreasing trend while GDP growth shows positive trend.



Policies to reduce GHG emissions

Energy production

The production of heat, electricity, briquettes and oil products is the most important GHG emission source in the country. In 2002 the energy sector accounted for 48% of total emissions.

The GHG intensity decreased because of lower consumption of solid fuels. This lower consumption has been the result of the following policies pursued by the Ministry of Energy and Energy Resources (MEER):

- The liberalization of the coal market and removal of subsidies has resulted in a substantial decrease of local coal consumption of the district heating plants, thermal power plants and industrial boilers, as well as in the local heating of households and services (see next section). The local coal has been substituted by imported coal, natural gas and firewood;
- Improvement of hydropower plants. Measures were implemented to improve the hydropower plants efficiency through rehabilitation of turbines and pipes;
- Improved operation of the nuclear facilities at Kozloduy:

- projects on units 1 and 2 – increased electricity production (1 - 3% per year) due to improved load factor. In 2002 they produced 5 GWh compared to 3.9 GWh in 1997 (both units were shut down in December 2002);
- projects on units 3 and 4 - increased electricity production (5 - 10% per year) due to improved load factor .In 2003 they produced 5.4 GWh compared to 4.3 GWh in 1997;
- projects on units 5 and 6 - increased electricity production (5 - 10% per year) due to improved load factor. In 2003 they produced 11.8 GWh, compared to 8.3 GWh produced in 1998.

As a result the electricity production of the nuclear units has increased from about 15.8 GWh in 1999 to 20 GWh in 2002 (i.e. + 25%). Nuclear power therefore significantly contributes to lower GHG emissions, estimated at 4.8 Mton CO_2 eq. This figure is based on a weighted average emission of 1.2 kg CO_2/kWh from imported coal (1.0 kg CO_2/kWh) and domestic lignite (1.6 kg CO_2/kWh).

The following measures are mentioned in the National Climate Change Action Plan (Action Plan) developed between 1996 and 1998 and adopted by the Council of Ministers in 2000, but were only partly implemented:

- Accelerated development of hydropower energy; from all the stations envisaged to be constructed only Sredna Vatcha hydro-cascade is at the stage of contracting and detailed design (status 2004), while the cascades Mesta and Gorna Arda are at the stage of feasibility studies (status 2004). The measure to commission 20 MW micro hydropower stations per year (starting in the year 2000) has not been implemented yet (status 2004);
- Postponed privatization of the power sector has lead to delay in the rehabilitation and modernization of thermal power plants, including improvement of the auxiliaries and the heat rate;
- The old Action Plan and the Energy Strategy oblige MEER to pursue policies for natural gas supply. The development and implementation of the appropriate measures has been delayed due to high natural gas prices. Until 2003, 34 private distribution companies have been established. Distribution networks are being planned or under construction. Only 1.500 new natural gas consumers (1.000 of them being households) have been connected to the distribution network (status 2003). Therefore, a lower than expected increase of the natural gas consumption by new clients has been observed, which, as a consequence, resulted in a lower contribution to reduced GHG emissions;
- Introduction of natural gas turbines to upgrade district heating and industrial plants has been delayed due to high natural gas prices;
- Delay in the reduction of losses in electricity and heat transmission and distribution networks; the achieved reductions (minus 15-20% of total losses) are well below the expectations.

Residential and commercial/institutional buildings

In percentage reduction the residential and commercial/institutional buildings have achieved the most significant decrease of emissions (minus 78%, which equals about 6 Mton CO_2 eq.) compared to the base year. The liberalization of the energy market and, more specifically, the removal of subsidies account for these reductions. They resulted in a decreasing consumption of liquid fuels and coal and an increased use of natural gas, firewood and other biomass sources (the latter being almost tripled). Part of the emission reduction is the result of lower comfort levels in the buildings as it is estimated that only 70% of the heat demand that is necessary to meet the desired temperatures in the buildings is covered.

Industry

The Governmental policy for accelerated privatization has resulted in almost total privatization of the manufacturing industries. For cost efficiency reasons, the new owners of the enterprises have implemented several cost-saving measures to improve energy efficiency. The implementation of these measures resulted in significant decrease of the GHG emissions for the period 1997 - 2001. While GHG emissions, estimated at 6 Mton CO_2 eq. (42 % compared to the 1997 level), decreased, production output stabilized.

Transport

The old Action Plan did not envisage policy instruments to support GHG emission reduction in the transport sector. Privatization of road transport, significant cut of the subsidies for railway transport and the closure of economically inefficient railway routes resulted in a modal shift from rail to road and resulted in a relative growth of CO_2-emissions. The GHG emissions of the transport sector decreased by 43.5% compared to the base year. The emission decrease follows the drastic reduction of transportation activities (in km). The reduction in transported goods (in tonnes) for the period 1990-2001 is 75%. The significant difference between the emissions decrease and decrease of the transportation activities reflects the modal shift from rail to road. While the transportation activities in the railway decreased 65% the activities in road transport decreased 45% only. The main conclusion is that the GHG emissions from the transport sector have decreased slower than the total GHG emissions in the country.

Agriculture

In 1988 the share of agriculture in total GHG emissions amounted to 9.3%. In the period 1988-2001 a GHG emission reduction of 65% has been achieved. Measures to reduce emissions in the sector were not applied. This is a direct consequence of the overall decline in agricultural activities since 1988. The decrease in the animals breeding follows the reduction of the number of animals. The enteric fermentation emissions have decreased by 68%, and manure management by 72%. Due to reduced use of mineral fertilizers the GHG emission level of agricultural soils (responsible for 5.8% of Bulgarian GHG emissions in 1988) has considerably decreased. The decrease of GHG emissions is due to the governmental policy, which focused on shifting the property rights of agricultural lands and the reorganization of the production process in private farms.

Waste

The old Action Plan and the Governmental Waste Management Programs, approved in 1997, aimed at significant decrease of the waste generation. A decrease of the generated waste by 70% was achieved in the period 1988-2002, resulting in a comparable reduction in GHG emissions (especially methane). The decline was a result of reduced production of waste, separation of the waste and recycling.

Summary

1. In 2002 Bulgaria has achieved 79 million tons GHG emission reduction (minus 56%) compared to the base year 1988. The main drivers for this reduction were:
   - Governmental policies for transition to the market economy, restructuring of industry, privatization and liberalization;
   - Energy policy towards liberalization of the energy market and removal of subsidies;
   - Decrease of the population;
   - Decrease of the GDP.

2. The GHG emission intensity (GHG/GDP) of the Bulgarian economy decreased by 46% from 3.63 kg CO_2 eq./ $BGN_{(2002)}$ in 1988 to 1.95 kg CO_2 eq. / $BGN_{(2002)}$ in 2002.
3. The accounted emission reduction of 79 million ton results from two factors:
   - GDP and population decrease: 26 million ton (33%);
   - Economic and energy policies: 53 million ton (67%).

Baseline GHG emission projection scenario

Economic and demographic developments as well as general economic policies have ensured significant decrease of the GHG emissions in Bulgaria in the period 1988-2002. In this section a baseline scenario will be presented. In this scenario it is assumed that existing policies will be continued, i.e. the forecast for the development of the GHG emissions is based on the assumption that the policies and measures formulated in the old Action Plan will be implemented as well as all European pre-accession policies, which are already approved by the Bulgarian government. According to UNFCCC terminology this is called the "with measures scenario".

The GHG emission forecast is based on projections for the following indicators:

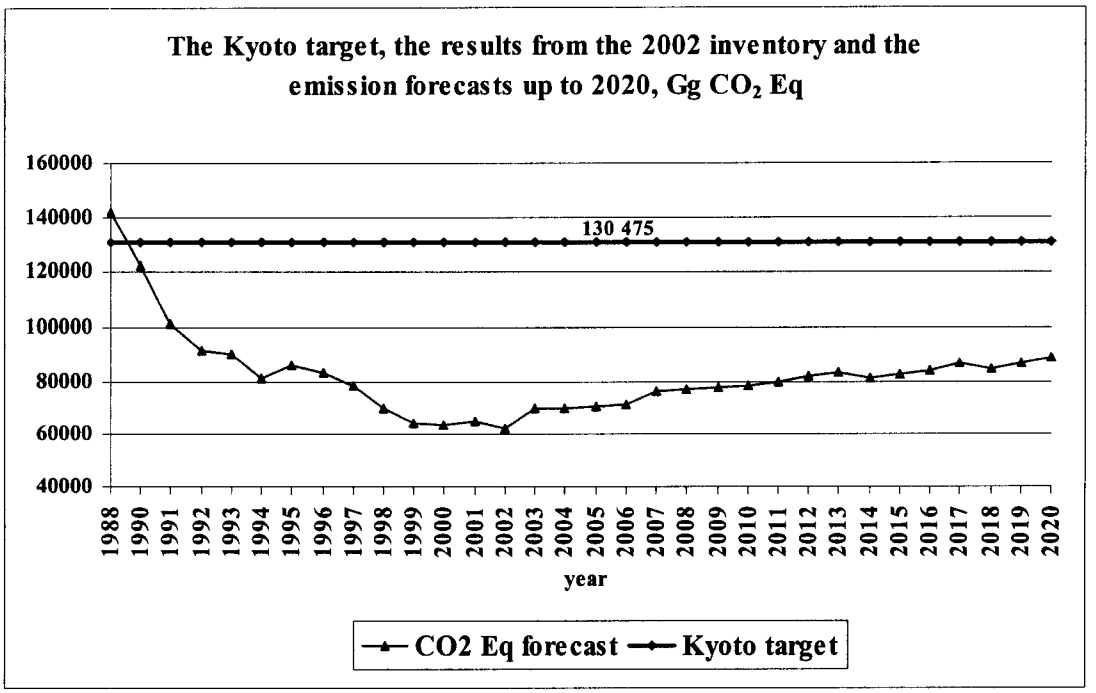
- Demographic development;
- GDP development of sectors and sub-sectors;
- Change in the energy-intensity of the industries and services as a result of improved energy efficiency / production technologies;
- Changes in the energy-intensity of households as a result of the development of income and improved energy-efficiency of dwellings and appliances.

For the demographic development official projections of the Government are used. According to these figures the population size will further decline with 0.8% per year in the period 2003-2009, followed by an annual reduction of 0.6% in the period 2010-2020. As a result, it is projected that in 2020 the country population will reach 6.9 million people.

The GDP forecast assumes a 5.25% growth for 2004-2005 and 5.5% for the 2006-2016 period. After then, the growth gradually declines to 3.5% in 2020. These growth figures are the official projections of the Agency of Economic Development to the Council of Ministers taken into account the positive impact of the EU pre-accession programs and the EU accession itself. The potential for accelerated growth exhausts by 2017. After then, it is assumed that the growth stabilizes at the average EU growth level.

The forecast of total GHG emissions are based on the cumulative forecast for each sector.

The Figure presents the Kyoto target together with the results from the 1988-2002 inventories plus the baseline emission forecasts up to 2020. The Kyoto target recalculated in the 2002 inventory, amounts to 130.5 Mton CO_2 equivalent. According to the projection emissions maintain well below the Kyoto target.

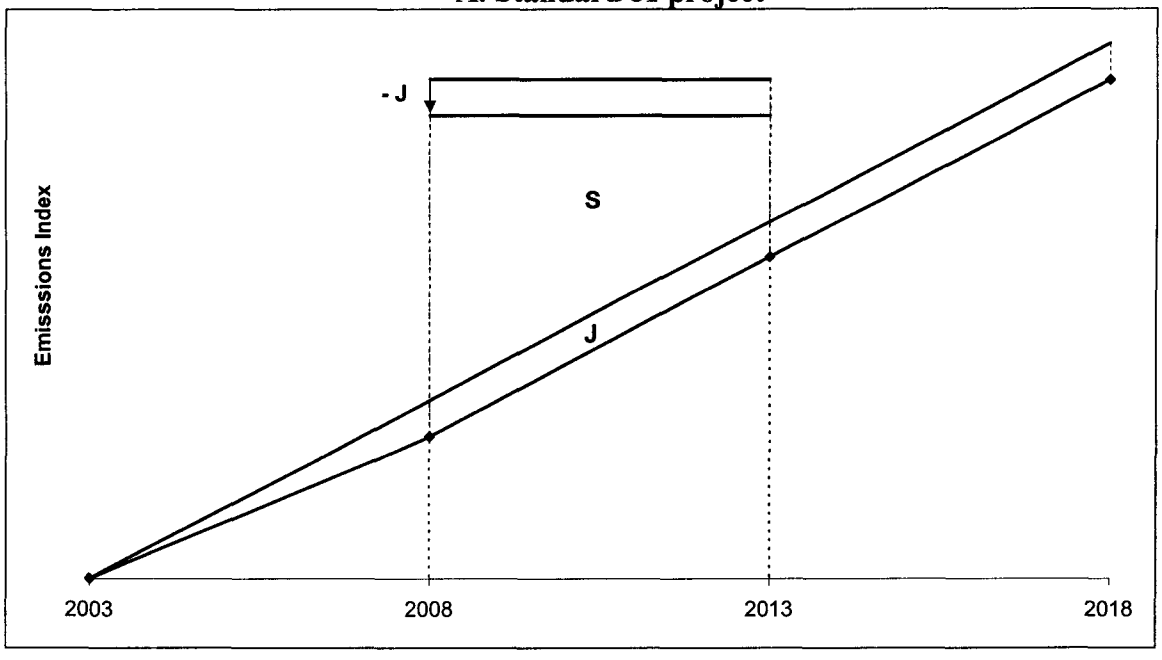


Although in the baseline scenario the Bulgarian GHG emissions are much lower than the Kyoto target, there is significant potential for further reduction of GHG emissions. This potential may be realized when conducting targeted policies for emission reduction expressed in accelerated introduction of additional policies and measures. GIS could be one of the most promising one.

The emission forecast shows that the country has a surplus of about 50 million AAUs per year for the first Kyoto commitment period. As there is significant number of JI projects under way and about 10 million ERUs could be transferred to the donors, the rest 40 million could be subject of emission trading and GIS. It means that the country can potentially sell about 200 million AAUs for the period 2008-2012.

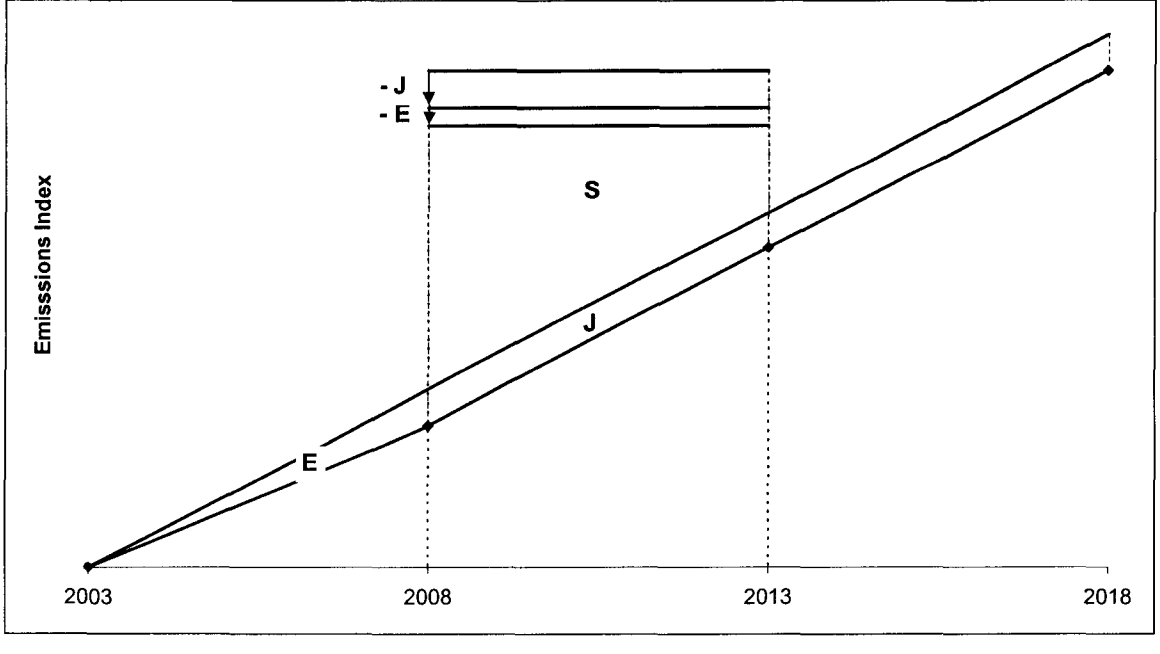
Impact of early and late crediting on National Emissions Balance

A. Standard JI project

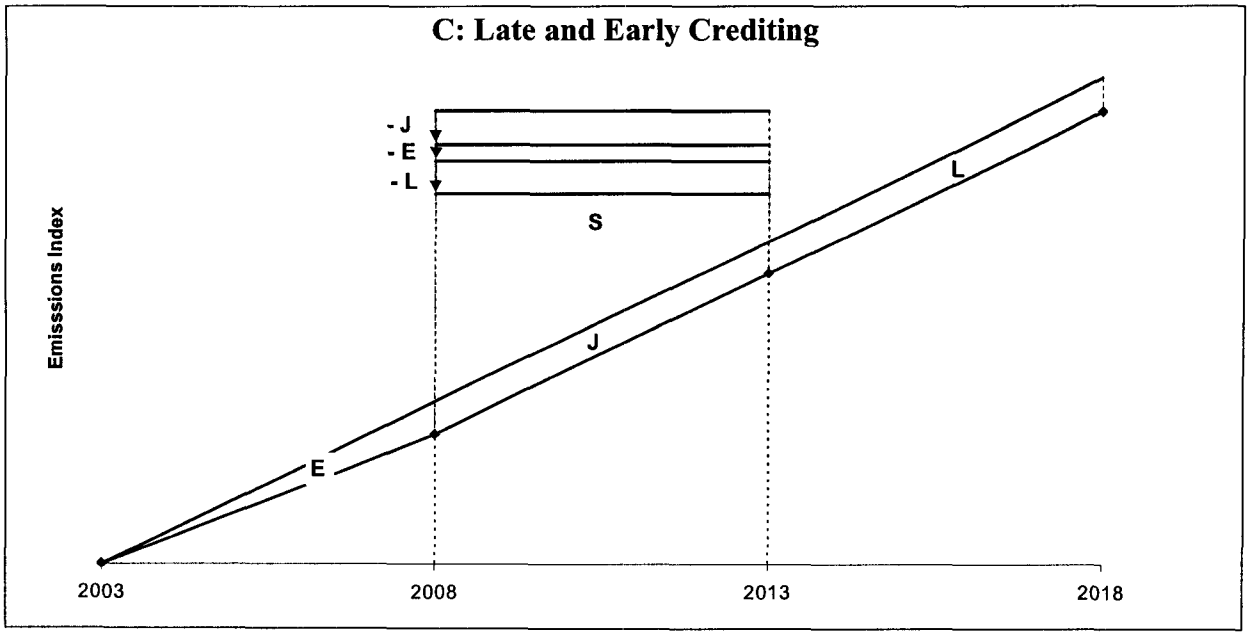


The buyer pays for the emission reductions generated by the project during the first commitment period (J) in exchange for an equivalent amount of AAUs turned into Emission Reduction Units under JI. If the project relies on accurate measurements of the emission reductions, the amount of "excess" AAUs does not change (The project frees-up an AAU for each emission reduction unit transferred).

B. Early Crediting



In the case of early crediting, the buyer pays for the emission reductions generated by the project before 2008 (E) in exchange for an equivalent amount of AAUs. The amount of excess AAUs is diminished by E because the emission reductions that are transferred as AAUs have been achieved before 2008.



In the case of late crediting, the buyer pays for some of the emission reductions generated by the project after 2012 (L), in exchange for an equivalent amount of AAUs: the excess AAUs is diminished by the same amount and becomes S – E – L. On the other hand, an amount of L has been reduced from the baseline projection during the second commitment period.

Institutional Requirements for the Establishment of a GIS

An investment scheme based on the promise to transfer Assigned Amount Units (AAUs) from the national registry account of Bulgaria to the account of another Annex I Party of the Kyoto Protocol, requires institutions that are capable of managing Bulgaria's AAUs as well as institutions equipped to implement an investment scheme. The former requires the capacity to acquire and maintain Bulgaria's legal ability to transfer AAUs on one hand, the monitoring of Bulgaria's emissions on the other. The latter requires the managerial capacity to administer one or several funds, to identify eligible projects and supervise their implementation. This annex describes the main functions and institutional requirements Bulgaria needs to fulfill in order to successfully implement a Green Investment Scheme (GIS).

I. Introduction: Existing Institutions

For the establishment of a GIS two institutional areas are of particular interest: (i) institutions that are best equipped to ensure Bulgaria's compliance with the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol; and (ii) institutions that are capable of implementing a GIS.

(a) Responsibilities in the Area of Climate Change

The Ministry of Environment and Water of the Republic Bulgaria (MoEW) represents the Government of Bulgaria in the matters related to climate change policies. The MoEW is also responsible for representing Bulgaria at the international level and its compliance with any obligation under the UNFCCC. It hosts the UNFCCC Focal Point and has nominated a National Coordinator on Climate Change, who coordinates the country's activities at the international and the national level and is the main contact person at the operative level for contacts with the UNFCCC Secretariat.

The MoEW also coordinates the preparation of Bulgaria's National Communications under the UNFCCC, the maintenance and updating of the greenhouse gas inventory, and compliance with any other reporting requirements. It plays a leading role in the application of, control of, updating and adaptation of the National Climate Change Action Plan. So far, Bulgaria has prepared and published three national communications (1996, 1998 and 2002). The fourth national communication is currently being prepared. The national communications are prepared in compliance with the guidelines of the UNFCCC and contain data about the emissions of the main greenhouse gases (GHG), scenarios and forecasts on future emission levels, as well as description of the different policies and measures for climate change mitigation at the national, regional and local level.

An inter-ministerial commission on climate change was set up in July 2000, with the goal of coordinating the activities of the various ministries and agencies engaged in implementing the National Climate Change Action Plan. The Chairman of the commission is the Deputy Minister of Environment and Water. Members of the commission include representatives of the Ministry of Economy, the Ministry of Finance, the Ministry of Justice, the Ministry of Transport and Communications, the Ministry of Regional Development and Public Works, the Ministry of Education and Science, the Ministry of Foreign Affairs, the Ministry of

Agriculture and Forests, the State Energy and Energy Resources Agency, the State Energy Efficiency Agency and the Privatization Agency.

The MoEW also hosts the unit which evaluates projects proposed under Article 6 of the Kyoto Protocol (Joint Implementation or JI projects). Upon the request for approval of a JI project and the submission of the necessary project documents, the MoEW convenes a meeting of the Steering Committee for Joint Implementation, which consists of representatives of relevant Ministries and whose responsibility includes the ultimate project approval. The Steering Committee evaluates proposed JI projects according to the existing national criteria for JI projects on the basis of a Project Design Document. If necessary, additional expert opinions and statements from the relevant ministries and organizations are requested. The Steering Committee makes recommendations to the Minister of the Environment and Water for Letters of Approval for each particular proposal. Once the Steering Committee on Climate Change has taken a positive decision with respect to a project, the MoEW issues a Letter of Approval for a JI project.

(b) Management of Investments and Funds

The implementation of a GIS depends on the close coordination between the relevant line Ministries. A GIS aiming at investing in climate change mitigating projects would include investments in the areas of energy, forestry and waste management as well as the implementation of training, public awareness and capacity building programs. It therefore requires the support and coordination of the following ministries and agencies: the Ministry of Environment and Water, the Ministry of Energy, the Ministry of Finance, the Ministry of Agriculture and Forests, The Ministry of Justice and Euro-integration, the Ministry of Regional Development and Public Works, The National Energy Efficiency Agency, along with the Council of Ministers.

In order to implement a GIS, Bulgaria should develop a portfolio of projects from the relevant sectors. The line Ministries would be required to supply information and, if necessary, to supervise the implementation of the projects. The National Trust EcoFund provides a model of a fund which provides financing for projects existing in Bulgaria.

<u>The National Trust EcoFund</u>

The National Trust EcoFund is a legal entity established pursuant to *"Debt-for-Environment" Swap Agreement* between the Governments of the Swiss Confederation and Bulgaria on October 23, 1995 and Article 66 of the *Environmental Protection Act.*[1] Its organization and activities are defined in the *Ordinance on the Structure and Functioning of the National Trust Eco-Fund*[2] adopted on the basis of Article 67 of the *Environmental Protection Act.* The goal of the EcoFund is to manage funds provided under debt-for-nature and debt-for-environment swaps, as well as funds provided by governments and international financial institutions and other grantors aimed at environmental protection in the Republic of Bulgaria. The reduction of carbon dioxide, methane, and CFCs is included in the listed priority areas of the EcoFund's

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1 Promulgated in State Gazette, Issue No. 91 of September 25, 2002, as last amended in Issue No. 86 of September 30, 2003.

2 Promulgated in State Gazette, Issue No. 41 of May 18, 2004.

activities. The fund's revenue can be sourced in resources allocated from the national budget, grants from international financial institutions, governments and other entities, repayments and interest payments on loans, interests, income from government securities and bonds and other external revenues consistent with the nature of the activities of the EcoFund.[3] The management bodies of the EcoFund are a Board of Directors, an Advisory Committee and Executive Bureau. The Board of Directors is comprised of seven members, including a Chairperson and two Deputy Chairpersons. The Chairperson of the Board is selected by the Council of Ministers. A Deputy Minister of Environment and Water, a Deputy Minister of Finance, a Deputy Minister of Agriculture and Forests, a representative of the Bulgarian Academy of Science, an NGO representative, and a representative of the municipalities in the Republic of Bulgaria are members of the Board of Directors. The Board defines the general strategy and policy of the EcoFund, it also decides on contracts and donations in favor of the Ecofund. The Advisory Committee of the Ecofund consists of representatives of the donors who have contributed to the Ecofund. The donors are entitled to reject projects proposed to be funded out of the resources they have contributed to the fund. The Executive Bureau runs the activity of the EcoFund, including project evaluation and selection, investment project implementation (contract preparation, project procurement, supervision of investment projects).

The Energy Efficiency Fund

Another example for a *sui generis* governmental structure is the Energy Efficiency Fund, which will be established under the recently adopted *Law on Energy Efficiency*[4] to fund activities aiming to increase energy efficiency. The Energy Efficiency Fund is responsible for managing the financial resources granted for energy efficiency investment projects in long- and short-term energy efficiency programs. The Energy Efficiency Fund performs its activity subject to the rules provided for in the *Law on Energy Efficiency*, the agreements with donors and the legislation in force. The Energy Efficiency Fund is not a part of the consolidated state budget.

With a view to the governance of the Energy Efficiency Fund the *Law on Energy Efficiency* provides that the Fund shall be managed by a Managing Board, consisting of seven members and including a representative of the Ministry of Energy and Energy Resources, a representative of the Ministry of Environment and Water, determined by the Minister of Environment and Water, the Executive director of the Energy Efficiency Agency, four representatives of individuals and/or legal entities having the status of merchants under the *Law on Commerce* or not-for-profit organizations under the *Law on Establishment of Non-Profit Associations*, with proven professional expertise. The members' mandate in the Management Board is set out to be two years. The Managing Board is responsible for the management of the whole activity of the Fund, and an Executive Director, elected by the Managing Board shall represent the Fund.

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[3] See Article 68 of the Environmental Protection Act, promulgated in the State Gazette Issue No. 91 of September 25, 2002, as last amended in Issue No. 86 of September 30, 2003.

[4] Promulgated in State Gazette, Issue No. 18 of March 5, 2004, effective as of March 5, 2004.

II. Institutional Needs

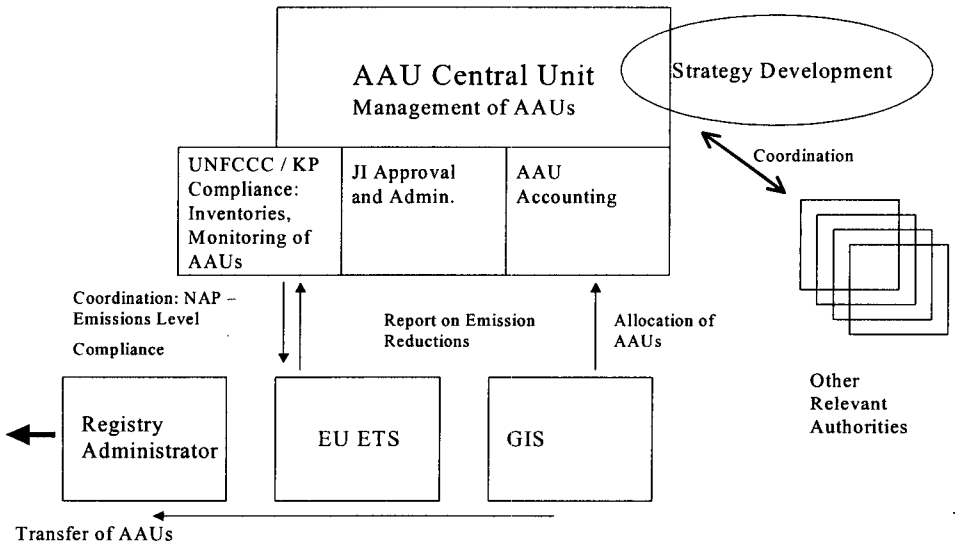
(a) Central AAU Management Unit

The transactions involving Assigned Amount Units impact Bulgaria's sovereign climate change obligations. Therefore, an AAU Central Unit should be established as the coordination point for the management of Bulgaria's AAUs. Such central administrative unit would be charged with overseeing the country's obligations under the UNFCCC and the Kyoto Protocol as well as strategically decide on the use and allocation of AAUs for Joint Implementation (under Article 6 Kyoto Protocol), International Emissions Trading in AAUs (under Article 17 Kyoto Protocol), and for an established national AAU reserve.

The AAU Central Unit is a key element for a credible and robust GIS. It is a priority that the AAU Central Unit has the necessary human and financial resources to comply with its mandate. Such mandate would include

(i) Providing strategic advice to the Government;
(ii) Accounting for the level of greenhouse gas (GHG) emissions in Bulgaria;
(iii) Overseeing the compliance with all obligations under the UNFCCC and the Kyoto Protocol;
(iv) Establishing and maintaining the eligibility of Bulgaria to participate in International Emissions Trading and JI;
(v) Accounting for AAUs;
(vi) Administrating AAUs of any GIS;
(vii) Coordinating with the relevant authorities implementing the EU Emissions Trading Scheme and administrating the national registry for Bulgaria; and
(viii) Coordinating with UNFCCC Focal Point and relevant Ministries.

It is essential that all these tasks will be coordinated by a central unit as they are interlinked and decisions on the different issues will be conditional on the status and fulfillment of requirements related to the other tasks. The AAU Central Unit would not execute all relevant functions, such as establishing and operating registries and monitoring GHG emissions, itself. It would, however, receive frequent periodic updates and reports from the technical units undertaking the specific tasks.



Picture 1: Administrative Functions of the AAU Central Unit

The AAU Central Unit would act as focal point for knowledge and expertise. Based on the information it collects, it would provide strategic advice to the Government. Additionally it would oversee the following activities:

(a) Accounting for Emissions – Compliance Check

Overseeing Bulgaria's GHG emission levels is a key requirement in order to ensure the compliance of the country with the quantitative emissions limitations under Article 3 of the Kyoto Protocol. Establishing the compliance level on the other hand is a condition for an efficient management of AAUs. The more transparent the emissions levels of Bulgaria are, the more reliable any forecast on further changes in the emission projections will be. Reliable knowledge about the emission levels also enables the country to hedge any non-delivery risks under Article 17 International Emissions Trading transactions, including the implementation of a GIS. It finally is a condition of the most financially and environmentally sound use of AAUs.

It is in this context essential that Bulgaria submits its national communications to the UNFCCC and establishes an efficient GHG inventory system. The level of accuracy in the monitoring of GHG will be further increased through the implementation of the EU legislative framework. So is Decision 99/296/EC devoted to monitoring CO_2 and other GHGs. It requires that member-states annually define, in compliance with the methodologies approved by the Conference of the Parties to the UNFCCC (COP), the anthropogenic emissions by sources and removals by sinks, which are not subject to the Montreal Protocol. Further help is expected through the implementation of the EU Directive on Integrated Prevention of and Control on Pollution, which will require the operator of individual installations to monitor GHG emissions.

In the context of the GIS, it will be important that the authority administrating the GIS forwards the monitoring reports of GHG reductions achieved through investments under the

GIS to the Central Unit for accounting. The Central Unit would on the other hand update the GIS administrative unit on the current emission levels and on the status of compliance and eligibility for International Emissions Trading.

(b) Eligibility for Trade

A successful Green Investment Scheme is based on the assumption that a country is legally authorized and eligible for the transfer of AAUs. In order to fulfil its contractual obligations under a GIS, a country must legally be enabled to transfer AAUs from its national accounts to the accounts of the buyers of AAUs, which have acquired a contractual right to a certain number of AAUs. This transaction would be governed by (i) the contract between the two parties defining the parameters of the GIS and the contractual rights to AAUs, and (ii) Article 17 of the Kyoto Protocol.

Article 17 establishes International Emissions Trading, which is based on the transfer of AAUs between registry accounts. In order to participate in an Article 17 transaction, countries have to meet a certain set of eligibility requirements defined in the Marrakesh Accords (the decisions of the COP implementing the flexible mechanisms defined under the Kyoto Protocol). The fulfilment of these requirements are a prerequisite for Bulgaria to be able to transfer AAUs to another Party and therefore to meet its contractual obligations under a GIS. The eligibility requirements are:

(i) The country is a Party to the Kyoto Protocol;
(ii) The country's assigned amount has been calculated and recorded in accordance with relevant guidelines and decisions;
(iii) The country has in place a national system for the estimation of emissions by sources and removals by sinks of all GHG;
(iv) The country has in place a national registry;
(v) The country has submitted annually the most recent required inventory;
(vi) The country submits the supplementary information (e.g. on sinks) on assigned amount and makes any adjustments and recalculations required.

A Party is considered to meet these eligibility requirements after 16 months have elapsed since the submission of its report to the UNFCCC Secretariat to facilitate the establishment of its assigned amount and to demonstrate its capacity to account for its emissions and assigned amount (unless the enforcement branch of the compliance committee finds that the Party does not meet these requirements).

It is possible that Bulgaria does not meet the eligibility requirements for the trade of AAUs at the time it enters into a contract which governs the sale and purchase of AAUs. This means that the contract must include a covenant through which Bulgaria warrants to meet the eligibility requirements at the time the AAU transfer is scheduled to take place.[5] The country may seek funds which enable it to meet these requirements. It can agree to return AAUs in exchange for such funding (structuring a forward sale of AAUs) and thus include the preparatory and regulatory tasks which need to be undertaken to meet the IET requirements in

[5] Under the rules of the Kyoto Protocol, any transfers of AAUs can take place only after 2008.

the GIS itself. However, such a transaction would require an appropriate risk-management which most likely would lead to a significant discount on the price paid for the AAUs.

Even where a country meets the eligibility requirements at the time it enters into a contract on a GIS, it may lose its eligibility in future. As the eligibility requirements for the participation in Art. 17 transactions need to be met at the time of the AAUs transfer, this poses an additional risk for the transaction. This means that the GIS and its underlying contracts need to define risk-sharing mechanisms which take into account the ineligibility of the country to transfer AAUs to the recipients' accounts.[6]

Consequently, ensuring the compliance with the eligibility requirements is a key function within the establishment of the GIS. The AAU Central Unit would forward all relevant information on the status of compliance to the registry operator and the entity administrating a GIS.

(c) Coordination with Registry Administrator

The AAU Central Unit would also receive periodic updates from the administrator of Bulgaria's National Registry. The establishment of a Registry is the single most important institutional requirement for the establishment of a trading mechanism.

According to Article 7.4. of the Kyoto Protocol, such registry will have to be established by January 1, 2007. In this context, each national registry is to have in place at least one holding account for legal entities authorized by the Party to hold Emission Reduction Units (ERUs), Certified Emission Reductions (CERs), AAUs and/or RMUs (Removal Units for sequestration activities) under its responsibility.[7] Since it is expected that Bulgaria will take all necessary steps in order to implement the European Emissions Trading Scheme by 2008, it will also ensure the timely implementation of the EU Registry Regulation. The Registry for the European Emissions Trading Scheme will include the registry as required by the Kyoto Protocol.

While National Registries are likely to be most frequently used for European or International Emissions Trading, they are also the key instruments in accounting for AAUs. Transfers of ERUs, import of CERs and recalculations of AAUs under Article 4 of the Kyoto Protocol (creating Removal Units or RMUs) need to be tracked in the National Registry. The Registry contains also the most reliable report on the availability of AAUs on Bulgaria's accounts. The registry provides the basis on which taking into all contractual obligations to transfer AAUs the Central Unit would establish any AAU surplus or liability.

In the Registry the actual transfer of AAUs, including the transfer of AAUs agreed to in the context of a GIS, would take place. The Registry Administrator would undertake the transfer following the instructions of the GIS administrator or the AAU Central Unit, depending on

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[6] An analysis of the extent to which Bulgaria meets Art. 17 participation agreements may be based on the following research work undertaken so far:
http://www.oecd.org/dataoecd/46/47/21022503.pdf [Bulgaria's institutional capacity];
http://www.oecd.org/dataoecd/5/40/2467141.pdf [inventories, registries].

[7] See Marrakech Accords – FCCC\CP\2001\13\Add.2

which unit would administer the AAUs for a GIS. The AAU Central Unit or the GIS administrator would account for the AAUs allocated to the GIS (or a particular window of the GIS) and instruct the Registry Administrator to undertake a transfer upon notification from the GIS manager.

(d) Coordination with the EU ETS

Upon accession to the European Community, Bulgaria will be obliged to subject itself to the EU Emissions Trading System (EU ETS). The Scheme will be linked to the mechanisms established under the Kyoto Protocol and allow ERUs and CERs for compliance purposes to be introduced into the Scheme. In order to avoid double counting of emission reductions, the EU ETS will also regulate the further approval of JI projects in Bulgaria. Under the EU ETS Bulgaria will have to establish and maintain a registry which allows the trade of EU Allowances between legal entities within Bulgaria and within the European Union.

The AAU Central Unit would have to coordinate its activities closely with the authorities in Bulgaria which will administer the EU ETS, namely with the entities which will develop the National Allocation Plan (NAP), verify emission levels and compliance, and administer the Registry. The EU ETS caps GHG emissions on the level of installations and translates International Emissions Trading into a domestic emissions trading scheme. This domestic scheme will be linked with the schemes of the other EU member states covering the whole Union.

The AAU Central Unit would have to take into account that the allocation of EU Allowances in Bulgaria will have important effects on the availability of AAUs for sale. The more generous Bulgaria's NAP will supply Bulgarian industry with Allowances, the smaller the AAU surplus; the more restrictive the allocation, the greater the AAU surplus. It will be a political decision by the Bulgarian Government how much limitation it will impose on its industries through the NAP, provided that the Plan will comply with the legal criteria defined for the establishment of national Allocation Plans (conformity with state aid rules, translation of the Acquis Communautaire and the Kyoto target into the NAP, etc).

(e) Coordination with UNFCCC Focal Point and Relevant Authorities

Furthermore, the AAU Central Unit would need to coordinate its activities with the UNFCCC Focal Point and other relevant Bulgarian authorities. The UNFCCC focal point should be responsible for reporting any recent development in the international negotiations to the AAU Central Unit. The UNFCCC focal point and the AAU Central Unit need to align their strategies in order to represent Bulgaria efficiently on the international level on one hand, and to translate the international agreement into domestic policy and law on the other.

What applies for the international level is equally relevant for the national level: the AAU Central Unit would have to coordinate with the relevant line Ministries with respect to sectoral priorities and potential investments. Such information is necessary to successfully negotiate transactions in the context of a GIS on the international level, to identify JI projects, set strategic priorities and to assess the emission reduction potential in different sectors.

(f) Management of and Accounting for AAUs

Finally, the coordination and supervision of all these tasks enables Bulgaria and the AAU Central Unit to manage the country's AAUs. The management function requires a careful accounting for all AAUs, which goes beyond the accounting function fulfilled by the Registry.

Management of AAUs is the central and core function of the Central Unit. A prerequisite for the management function is that the Unit is properly informed about the emissions levels, AAUs and contractual obligations involving the transfer of AAUs. Any contract which includes the acquiesce or transfer of AAUs would therefore need the clearance of the Central Unit. All contractual obligations would be accounted for as AAU liabilities. Such liabilities could be compensated through emission reduction and limitation activities. Resulting from the accounting activities, the Central Unit would also be enabled to develop a strategy with respect to further investments under a GIS as well as to further sales of AAUs.

The following issues should be taken into account when accounting for AAUs:

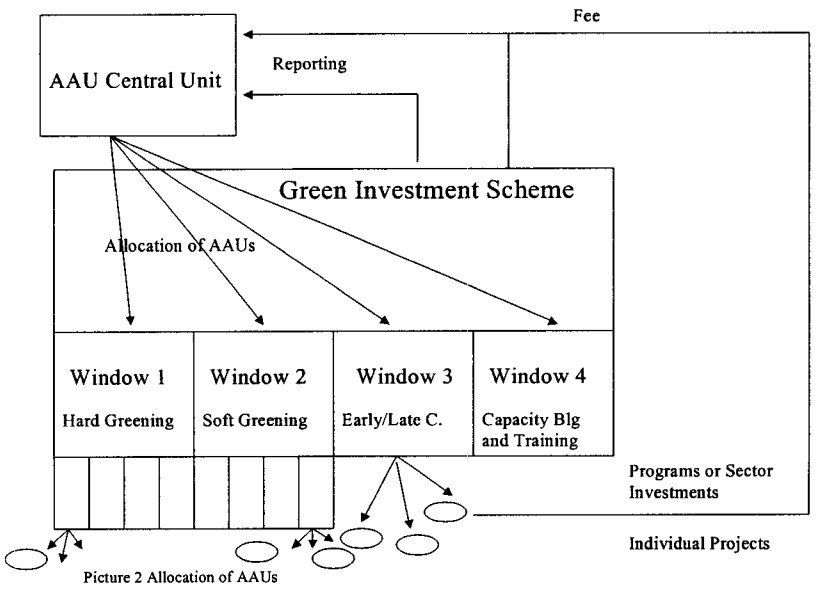
(i) Timing of accounting: the Unit must decide in which periodicity it would account for activities.
(ii) Quality of monitoring and reporting: information submitted for the purpose of accounting would need to be subjected to in-depth review before approval.
(iii) Emissions and Emission Reductions: approved emissions and emission reductions need to be accounted for by subtracting the appropriate amount from existing AAUs, RMUs, CERs or ERUs.
(iv) Reserve: the Unit should hold a commitment reserve (above the commitment period reserve established under the Kyoto Protocol); and
(v) Banking: excess AAUs can be 'banked' for use in a subsequent period.

In order to manage its AAUs successfully Bulgaria needs to decide how much AAUs it needs for compliance purposes, how much are bound in approved JI projects, allocated to early credits, and at which level it would establish its reserve. Subsequently, a portion of the remaining AAUs could be allocated to a GIS.

II. Administering the GIS

A GIS would require a special management function which oversees the obligations under GIS contracts. The GIS could be integrated in an existing function (e.g. the National Trust EcoFund) or be established as a legally independent entity which would administer the investments and any risk mitigation mechanisms specific to the GIS. The GIS would receive a specific allocation of AAUs which again could include allocations for the different windows under a GIS. Such allocations would include:

(i) allocation of AAUs for Greening of AAUs (Hard Greening);
(ii) allocation of AAUs for Greening of AAUs (Soft Greening);
(iii) capacity Building and Training;
(iv) allocation of AAUs for Late and Early Crediting.



Picture 2 Allocation of AAUs

All these allocations can be specified further. Under the window for Hard Greening, investments in energy efficiency, renewable energies or the forestry sector could be supported through specific programs. Soft Greening could include small scale energy efficiency demand side programs. The GIS could further administer specific funds for capacity building and training programs. Those programs could be targeted at groups within or outside of the public administration. Finally, the GIS should also comprehend a window which allows for the administration of "Early" and "Late Credits".

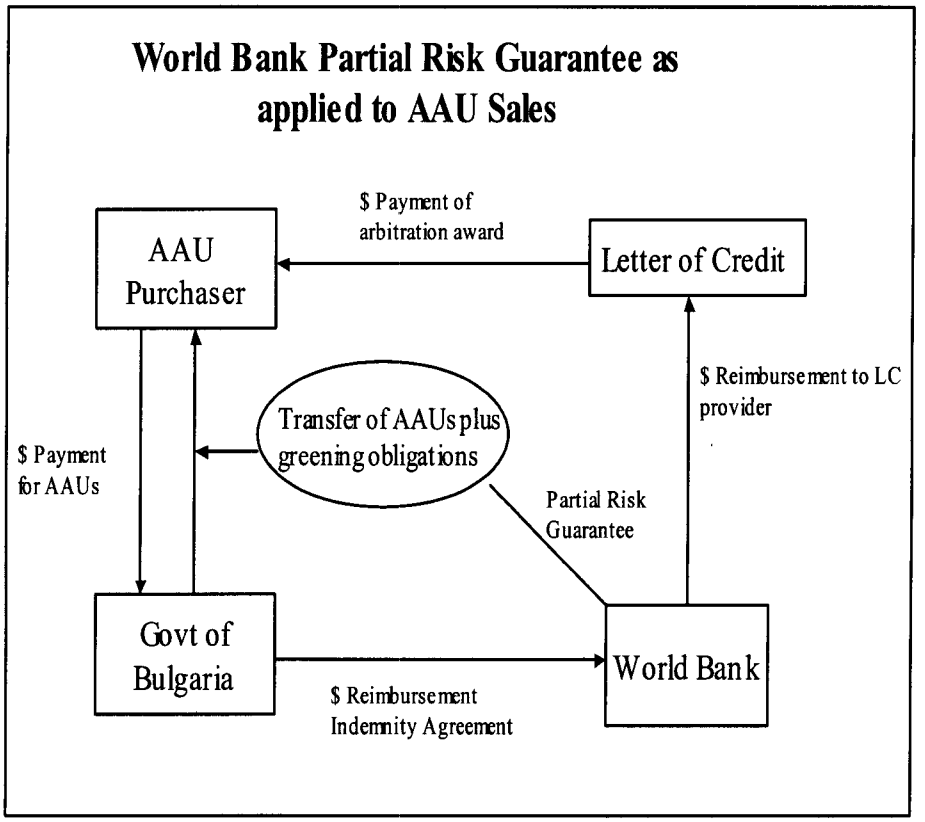
Early Crediting refers to emission reductions generated by future JI projects that occur before the start of the first commitment period in 2008 (hence: "early") and for which no ERUs can be issued. Yet the Bulgarian Government might want to promote JI and therefore give credit to such early emission reductions. Giving value to so-called Early Credits would attract investment into these projects before 2008. Under the GIS window the Government of Bulgaria would offer to exchange verified emission reductions into AAUs. This exchange could happen on a one-to-one basis, or at any other exchange rate (e.g. 1:2 - one AAU for each two mtCO2e). Because an AAU is a tradable, legal commodity while a pre-2008 emission reduction is not, the former has a value while the latter does not. By means of exchange the originator of early credits would hence receive a value for his environmental investments.

The AAU Central Unit would allocate AAUs to the individual windows and programs in accordance with the agreement with the AAU purchasers and GIS investors. However, it would not physically transfer any units. The AAUs would not leave the registry account of the Government of Bulgaria and the Government would not cease to own the AAUs until the transfer to the purchaser would happen. The AAU Central Unit would instead hold the AAUs of any GIS in trust and instruct the Registry Administrator to transfer AAUs upon notification of the GIS management.

Risk Hedging Structure

If a purchaser were to pay upfront for future delivery of greened AAUs, it might seek some form of risk mitigations to cover its financial exposure. A sovereign AAU buyer might have a higher risk tolerance than a private purchaser, as a sovereign has other recourse to address sovereign to sovereign contractual issues. The availability of risk hedging mechanisms might not be as significant a matter to a sovereign AAU purchaser when compared to a private purchaser. Conventional commercial risk hedging mechanism would not be available to an AAU GIS transaction until there is an understanding of AAU transactions in the market and a track record of government contract compliance. For the medium term, the most likely providers of risk coverage would be multilateral organizations such as the World Bank and European Bank for Reconstruction and Development (EBRD). The risk mitigation instruments available from the World Bank Group (the Bank partial risk guarantee and the MIGA guarantee) and from the EBRD are designed to assume political and government performance risks. While these guarantee instruments are similar in concepts, there are institutional differences. However, these risk mitigation instruments could work together on a co-financing basis to provide a political risk coverage package.

Alternately, one institutional risk mitigation structure could provide a first loss risk coverage to leverage the participation from other risk insurers. The first loss feature could address one of the major risks in an AAU transaction. This is the risk that when there is default in AAU delivery, the price of AAU at that time is substantially higher than the AAU price at contract. The AAU buyer would want protection not only for the actual funds transferred for the green investments but also for the AAU replacement value. The first loss mechanism could provide a cost effective over insurance scheme to cover a portion of the unknown replacement value. It should be noted that these multilateral political risk mitigation mechanisms are designed to support private sector investments into emerging economies. For these instruments to be applicable to a sovereign purchaser there would need to be substantial financial engineering, the approval of which is uncertain. An illustration of how the World Bank Group partial risk guarantee would operate is shown below.



The diagram above illustrates an application of the World Bank's partial risk guarantee mechanism in a typical structure, but can be modified to suit a particular transaction or situation.

Step 1 – The Government of Bulgaria and the AAU purchaser enter into a contract for the present payment of monies in return for the future delivery of appropriately greened AAUs.

Step 2 – The World Bank extends a partial risk guarantee to the AAU purchaser covering the Government's obligations under the AAU contract. The World Bank guarantee can only provide monetary compensation up to the amount guaranteed (generally a percentage of the AAU sale proceeds) but cannot ensure specific performance in the transfer of AAUs or cover their replacement value which is unquantifiable at the time the Guarantee Agreement is entered into.

Step 3 – The Bulgarian Government backstops the World Bank exposure by entering into an Indemnity Agreement where the Government reimburses the Bank if there is a payout under the guarantee.

Step 4A- There is a dispute between the Government and the purchaser on the validity or greenness of the AAUs. A dispute resolution proceeding (i.e.an arbitration) is resolved in favor of the purchaser and there is a monetary award.

Step 4B - (Note this procedural step is necessary because the Bank guarantee only covers a debt obligation. This step does not affect the substance of the guarantee mechanism.) There is in place a letter of credit (LC), up to the amount of the Bank guarantee, to cover the monetary award. If the Government does not pay the award, the purchaser would draw on the LC and the Bank would immediately repay the LC loan and seek reimbursement from the Government.

5.28 The strength of the Bank partial risk guarantee rests on the Indemnity Agreement between the Government and the World Bank. The decision of a government to request the partial risk guarantee is a signal to the market of the government's commitment to the transaction. A government's default under a commercial agreement between an AAU purchaser and the Government would be transformed by the guarantee into an obligation between the Bank and the Government.

Co-guarantee with other political risk coverage providers

5.29 As the Bank guarantee is very effective in mitigating government performance risks, the objective is to attract other political risk coverage providers and to minimize the Bank guaranteed amount. Other political risk providers could co-finance the transaction on a pari passu basis or the Bank guarantee could provide first loss coverage which triggers the co-financier's coverage after the Bank guarantee has been drawn.

- Co-guaranteeing with MIGA – The Bank and MIGA have co-guaranteed a number of transactions. MIGA guarantee would be available as a co-guarantor if the AAU purchaser is a private enterprise or a government owned entity that operates on a commercial basis.

- Co-guaranteeing with EBRD - EBRD has a partial risk guarantee instrument similar to the World Bank's. In the case of EBRD, an Indemnity Agreement from the Government may not be required.

- Co-guaranteeing with commercial risk insurers - This possibility needs to be explored. The pricing from private political risk insurers would be high. A first loss structure might be an option.

Other risk mitigation structure(s): The Bank guarantee could be structured to take the first loss with other risk providers coming after the Bank. The first loss guarantee structure leverages the Bank involvement reducing the risks for other risk providers, thus lower the cost coverage and allowing for over-insurance to cover the replacement value in case the AAU are not delivered.

Legal Requirements for the Establishment of a GIS

I. Introduction

1.1. Domestic Law

The establishment of a Green Investment Scheme (GIS) for Bulgaria requires a legal review of the proposed scheme under Bulgarian law. There is a gap in the domestic legislation in respect of the legal regulation of Assigned Amount Units (AAUs) transactions and the options for establishment of a GIS related thereto. In substance, Bulgarian law encompasses the statute law, established by acts of Parliament and the secondary legislation, adopted by the Council of Ministers and other competent governmental bodies, as well as the international treaties (bilateral and multilateral agreements) that have undergone a separate process of ratification by the Bulgarian Parliament and promulgation in the State Gazette.[1] Article 5, par. 4 of the Constitution of Bulgaria of 1991[2] provides that the entry into force of the international treaties is conditional upon their ratification by the Parliament and promulgation in the State Gazette. After the fulfillment of these conditions the international treaties become an inseparable part of the Bulgarian legislation and have priority over any contradicting domestic legislative act. Thus, the Constitution proclaims the general principle of priority of international treaties to which Bulgaria is a party over the local regulations.

International Emissions Trading through trading in AAUs as defined under Article 17 of the *Kyoto Protocol*, or through participation in Joint Implementation (JI) project activities, is not regulated under Bulgarian law.

1.2. International Law

1.2.1. Multilateral Agreements

In order for the Bulgarian State to be legally authorized and eligible to transfer AAUs to investors (from both the public sector and the private sector), the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol have to become a part of the domestic law. This requires, on one part, the entering into force of the Kyoto Protocol, and, on the other part, the ratification of the international treaties by the Bulgarian Parliament and promulgation of the ratification laws and the full text of the legal documents themselves in the State Gazette in accordance with the Law on the International Treaties.[3] At the time of writing of this Report Bulgaria has ratified the United Nations Framework Convention on Climate Change[4] and the Kyoto Protocol,[5] but it has not yet promulgated the full text of these documents. Because of this, and because of the fact that the Kyoto Protocol has not yet come

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1 The State Gazette is the official bulletin in Bulgaria for promulgation of legislative acts, court resolutions, subject to promulgation, notifications to individuals and legal entities, etc.

2 Promulgated in State Gazette, Issue No. 56 of July 13, 1991, effective as of July 13, 1991, as last amended in Issue No. 85 of September 26, 2003.

3 Promulgated in State Gazette, Issue No. 97 of November 13, 2001.

4 Law on ratification of the United Nations Convention on Climate Change (Promulgated in State Gazette, Issue No. 28 of March 28, 1995).

5 Law on ratification of the Kyoto Protocol to the United Nations Convention on Climate Change (Promulgated in State Gazette, Issue No. 72 of June 25, 2002).

into force itself, the emissions trading mechanisms and the commitments provided therein are not legally binding on the parties thereto, including Bulgaria.

1.2.2. Bilateral Agreements on Joint Implementation Projects

In practice, up to date Bulgaria has concluded government-to-government bilateral agreements on Joint Implementation projects, defined by Article 6 of the Kyoto Protocol with Switzerland and the Netherlands (*Law on ratification of Agreement on projects to combat climate change under Article 6 of the Kyoto Protocol between the Government of the Republic of Bulgaria and the Government of Switzerland,*[6] *Memorandum of Understanding on reducing the greenhouse gases emissions related cooperation between the Republic of Bulgaria and the Netherlands under Article 6 of the Kyoto Protocol*[7]). A Law on ratification of a similar Memorandum of Understanding concluded between Austria and Bulgaria is expected to be adopted by the Bulgarian Parliament. Again, with a view to implementing JI projects, defined by Article 6 of the Kyoto Protocol, in 2003 Bulgaria ratified the *Framework Agreement of the Prototype Carbon Fund and a Host Country between the Republic of Bulgaria and the International Bank for Reconstruction and Development, acting in its own capacity and as a Trustee of the Prototype Carbon Fund.*[8]

1.3. EU Law and the European Emissions Trading Scheme

For the evaluation of the establishment of a GIS under Bulgarian law, it has to be appreciated that Bulgaria is one of the countries seeking accession to the European Union (EU)[9] and aims at the completion of the legal reform in order to harmonize its laws and regulations with the European Community's *acquis communautaire*. Therefore, although Bulgaria is not a member state of the European Union and the EU legislative acts are still not binding upon the country, Bulgarian law aims to comply with EU law.

Bulgaria is currently in the process of negotiating its accession to the EU and to date has closed 26 of a total of 30 negotiation chapters. The negotiations on the chapters related directly to climate change have also been closed as follows: Environment (closed on July 30, 2003) and Energy (closed on November 18, 2002). The alignment with European accession requirements will be of particular benefit for climate change mitigation since some of the measures will lead to significant GHG emission reductions. Relevant EU environmental legislation contains about 300 regulatory acts, including directives, regulations, decisions and recommendations, as well as their amendments and additions. The base of this legislation, however, consists of about 70 Directives and 20 Regulations, related to air quality, waste management, water quality, nature protection, control on industrial pollution and minimizing of risk, chemicals and genetically modified organisms, noise, nuclear safety, civil defense,

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6 Promulgated in State Gazette, Issue No. 9 of February 3, 2004.

7 Approved by Minutes No. 13 of the Council of Ministers of March 23, 2000. Issued by the Ministry of Environment and Waters, Promulgated in State Gazette, Issue No. 46 of June 6, 2000, effective as of April 10, 2000.

8 Law on Ratification of the Framework Agreement of the Prototype Carbon Fund and a Host Country between the Republic of Bulgaria and the International Bank for Reconstruction and Development, acting on its name and as a Trustee of the Prototype Carbon Fund (Promulgated in State Gazette, Issue No. 26 of March 21, 2003).

9 Europe Agreement establishing an association between the European Communities and their Member States, of the one part, and the Republic of Bulgaria, of the other part (Ratification Law promulgated in State Gazette, Issue No. 33 of April 20, 1993, effective as of February 1, 1995. The Agreement has been promulgated as a separate body to State Gazette, Issue No. 61 of July 7, 1995).

etc. In concluding the negotiations, Bulgaria has committed itself to apply European legal requirements as of its accession date to the EU. This fact presumes that all Directives will be integrated (including those on GHG emissions trading) with the existing Bulgarian legislation.

Harmonizing with EC energy efficiency and security directives will also carry implications for GHG emissions in accession-candidate states. New policies for liberalizing electricity and natural gas markets will have to be approved, and the decisions taken will have a significant impact on the energy sector in the country. The Directives on liberalization of the electricity market (96/92/EC) and natural gas market (98/30/EC), as well as the forthcoming directive on electricity production from Renewable Energy Certificates, are of particular importance with respect to GHG emissions and the establishment of a GIS (especially with respect to possible double counting of achieved emission reductions). Of particular importance for the establishment of a GIS, is a careful review of the European Emissions Trading Scheme, which is based on *Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC.*[10] Although Bulgaria has not still transposed the EU Directive on Emissions Trading, the harmonization of the Bulgarian legislation, including in the field of emissions-trading scheme, is expected to complete in 2007 (the hoped-for date of the future accession).

In order for the member countries of the European Union to meet their international obligations to reduce greenhouse gas emissions by 8% below 1990 levels by 2012, as per the mandate of the Kyoto Protocol, the EU is implementing an EU-wide Emissions Trading Scheme (EU ETS). Through Directive the EU Parliament and Council have established a scheme which allows the trade of authorizations to emit a certain amount of greenhouse gases in the European Union (EU Allowances) from January 1, 2005.

The Directive in its current form is limited to emissions allowance trading within the EU, and does not link the EU ETS to emission reductions credits generated under the Kyoto Protocol. Therefore such credits, namely Emission Reduction Units (ERUs) and Certified Emission Reductions (CERs), cannot be used by operators of covered installations to meet compliance obligations under the EU ETS. To remedy this, the EU Parliament has adopted on April 21, 2004, a Directive amending the Directive establishing EU ETS in respect of the Kyoto Protocol's project mechanisms (the Linking Directive). Establishing the link between CDM and JI on the one hand and EU ETS on the other is the core objective of the linking directive. The proposed directive foresees the use of CERs and ERUs under the EU ETS. The scope of regulation will however be broader: the Linking Directive will also regulate the approval and accounting of JI projects in EU member states.

The approval of JI projects in EU member states raises a few very technical questions concerning the compatibility with the EU ETS. Most of these problems are related to the so-called double counting issue, i.e. how to avoid that the same emission reductions result in the issuance of ERUs and at the same time free up EU Emission Allowances. With respect to the double counting problem three different cases of JI projects in EU member states must be distinguished:

[10] *'Directive 2003/87/EC of the European Parliament and of the Council, of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC'* published in the Official Journal of the European Union on October 25, 2003; *L 275, 25/10/2003 P. 0032 – 0046.*

(i) JI project activities that are undertaken at sources covered by the EU ETS, e.g. the refurnishing or fuel switch in a power plant (above 20MW);
(ii) JI project activities that have no direct link to sources covered by the EU ETS but lead to emission reductions at such sources, e.g. the installation of a wind park or the improvement of energy end use efficiency (so called 'Indirect Projects');
(iii) JI project activities at sources that are not covered by the EU ETS.

The agreed version of the Directive leaves it up to the operator whether he wishes to engage in JI selling ERUs or whether he wishes to sell EU Allowances for any project activity that reduces CO_2 emissions. This proposal also allows the export of ERUs outside of the EU (namely to Japan which has expressed a strong interest in participating in the JI projects in Eastern Europe). Whether such conversion will be attractive to operators remains to be seen.

With respect to installations that are not covered by the EU ETS but whose emissions are linked to any emissions of installations covered by the EU ETS (→ indirect coverage) the agreed text of the Linking Directive allows the implementation of JI projects in the renewable energy and demand side sectors, as long as the governments of member states cancel an amount of EU Allowances equivalent to the amount of ERUs issued for JI projects. This means that the Member States' governments, in preparing their National Allocation Plans (NAP), need to establish a reserve of EU Allowances corresponding to the expected amount of ERUs issued and transferred to JI projects. The Allowance reserve needs to be taken into account when allocating the Allowances to the installation covered by the EU ETS (a larger reserve resulting in the allocation of fewer allowances).

II. Structuring a GIS

2.1. Legal Basis

International Emissions Trading through trading in AAUs as defined under Article 17 of the Kyoto Protocol, or through participation in JI project activities, is not regulated under Bulgarian law. Except for the signing of the UNFCCC and the Kyoto Protocol and the subsequent adoption of the ratification laws hereof, there is no legal basis for AAUs trading under Bulgarian law. The absence of a clear framework governing International Emissions Trading in Bulgaria and the fact that the Kyoto Protocol has not entered into force is an issue for the structuring of a GIS in Bulgaria.

In order to legally transfer AAUs under a GIS, Bulgaria will have to enter into an agreement (bilateral or multilateral) with the AAU purchasers defining the parameters of the GIS and the contractual rights to AAUs. This agreement will need to be ratified and promulgated in Bulgaria in order to become law. This structure could be simplified as soon as there is a legal basis allowing the transfer of AAUs in Bulgaria. Before the Kyoto Protocol has entered into force, however, any contract involving the promises of AAUs needs to address the issue of incapability of transfer. To transfer AAUs, the Government selling AAUs has to ensure that the eligibility requirements for the transfer of AAUs are met. Additionally, it is the seller's responsibility that there are no flaws in the legal, administrative and reporting requirements which would impede the transfer of AAUs. Finally, the selling Government has to ensure that it has the full legal title and ownership to the AAUs.

2.2. Delivery of Greening Obligations

Whether the greening obligations are based on soft or hard criteria, input or output measured, project or policy related, the Government has to deliver "greening" for the AAUs sold. In most circumstances, the AAU purchaser would transfer part or all of the funds prior to the AAUs being greened. Any problem with implementation that delays or eliminates greening would reduce the credibility of the GIS and the confidence potential AAU purchasers would have in the implementation capacity of the country. This would effectively undermine the GIS completely.

For the AAU purchaser, the principal responsibility is to make timely payment following a time schedule as per agreed in the contract with the selling Government. In most circumstances, the purchaser would pay an initial amount with subsequent installments based on verification of greening. The purchaser would have to pay according to the installment schedule upon receipt of a verification report. Alternatively, funds could be disbursed per pre-defined criteria. The purchaser has to ensure it meets the requirements to acquire AAUs and, in case of a private entity, that it is duly authorized to participate in the trade.

2.3. Key Contractual Terms

The contract between the seller and the buyer may include the following features:

(i) A payment schedule, including milestones that trigger payments;
(ii) AAU delivery schedule;
(iii) Modalities governing the transfer of AAUs;
(iv) "Greening" obligations on the side of the selling government;
(v) Price differentials reflecting the risk allocation in the contract (for instance, discounting the upfront payment if there are legal uncertainties on the status of AAUs);
(vi) Price re-openers based on market triggers to account for fundamental changes in AAU prices;
(vii) An option agreement on further purchases (call/put options);
(viii) In case of a treaty between governments: the agreement to have private entities participating in the GIS;
(ix) Default provisions and remedies;
(x) The possibility to re-allocate funds from hard to soft greening opportunities, depending on the success of different measures;
(xi) The possibility to broaden the agreement to include additional public or private funds;
(xii) Cancellation of certain projects and funds;
(xiii) How the effectiveness of greening projects will be monitored and reported; and
(xiv) Accounting provisions governing disclosure of GIS accounts to participants.

2.4. Proposed Transaction Structures

There are two basic transaction structures (based on an exclusive bilateral arrangement or on an established AAU fund) and two basic types of projects (public projects versus private projects). Regardless of the nature of the transactions, it is recommended that the Government establishes a central unit that accounts for and manages Bulgaria's AAUs (see Annex C).

Individually Negotiated Bilateral arrangement

The purchaser of the AAU would enter into a direct agreement with the Government of Bulgaria for the transfer of the AAUs. Such bilateral arrangement would allow direct negotiation for:

(i) Definition of the "greening" as applied in the transaction;
(ii) Price and amounts of the AAU to be transferred;
(iii) The timing of the payments - the initial amount and subsequent installments;
(iv) The selection of the "greening" project; and
(v) Transaction structuring and risk mitigation.

The bilateral arrangement is time intensive and would be suitable for large AAU transactions between sovereigns in the absence of an established AAU Fund.

AAU Fund

The Government could allocate a certain amount of AAUs to a dedicated Bulgaria AAU Fund and develop an associated AAU greening program. The program would ensure the efficient implementation of projects. This greening program would include projects and activities that provide different types of greening opportunities ranging from soft greening which are for environmentally beneficial projects unrelated to carbon emissions to hard greening which are projects with verifiable carbon emission reductions. The Participation Agreement for the fund would be signed by the Government of Bulgaria (as holder and owner of the AAUs) and the AAU purchasers.

The establishment of a GIS will eventually require a careful legal review of the proposed scheme under Bulgarian law. Whereas a more detailed review will require additional funding and lies outside of the scope of the current study, a general analysis of the proposed scheme under Bulgarian law is provided in the following section 3 of this annex.

Tendering AAUs

Following the example of the Government of New Zealand, the government could set aside AAUs for distribution to projects and use this pool in lieu of (or to replace) other subsidy schemes. The pool could be distributed either by using some criteria or through a tender process in which investment projects would compete with each other for AAUs by bidding for highest emission reductions achieved at lowest costs.

III. Options for Structuring a GIS Fund Under Bulgarian Law

The brief analysis of the different fund structures possible under Bulgaria law refers to the options for establishment of a GIS for Bulgaria and the ways of using revenues generated from trading AAUs for specific environmentally related purposes.

Herein below we have examined the following three options for structuring a GIS as a legal entity under Bulgarian law, namely:

(i) Option I where the GIS is designed and governed as a special-purpose corporation (a profit making entity) under Bulgarian private law, which is wholly owned by the Bulgarian state;
(ii) Option II where the GIS is designed and governed as a not-for-profit organization under Bulgarian private law, affiliated with the Bulgarian State; and
(iii) Option III where the GIS is designed as a governmental organization under Bulgarian public law, which receives funding from the state budget or directly from the emissions trading.

3.1. A GIS as a Special-purpose Corporation

A GIS may be structured as a special-purpose corporation (a profit making entity) under national commercial law, which is wholly owned by the Bulgarian State. Such legal entity should be prohibited from distributing dividends, whereas the profit that has been realized should be used for financing of investment projects in accordance with the purpose of the corporation.

The joint-stock company (JSC) ("Акционерно дружество") is an appropriate structure for conducting the activity of a GIS in Bulgaria, in particular in the form of a one-person-owned company where the single shareholder would be the Bulgarian State. Under Bulgarian law the provisions on establishment, corporate structure, governance and representation of such a JSC are set forth in the *Rules on the Terms and Conditions Coordinating the Exercising of the State's Rights in Commercial Companies with State Participation*[11] and the *Law on Commerce.*[12] The incorporation procedure requires the adoption of an act by the Council of Ministers on the establishment of the legal entity and registration with the Commercial Register of the District Court where its seat is located. Corporation owned by the State may be also established by virtue of an act (statute) of the Bulgarian Parliament. The rights of the State in a corporation to be established could be exercised by the Council of Ministers or the respective sector-specific ministers.

The Bulgarian Law on Commerce envisages two systems of corporate governance of a JTC, namely - one-tier system, comprising of Board of Directors, and two-tier system, comprising of Supervisory Board and Management Board. The members of the Board of Directors are appointed and dismissed from office and liability directly by the sole owner of capital. The

[11] Adopted by a Decree of the Council of Ministers No. 112 of May 23, 2003, promulgated in State Gazette, Issue No. 51 of June 3, 2003, as last amended in Issue No. 59 of July 1, 2003, effective as of July 1, 2003.
[12] Promulgated in State Gazette, Issue No. 48 of June 18, 1991, as last amended in Issue No. 58 of June 27, 2003.

Board of Directors may consist of three to nine members. In the case of the two-tier system, the sole owner of capital elects a Supervisory Board, and the latter appoints and dismisses from office the members of the Management Board and determines their remuneration. The Supervisory Board monitors and controls the activities of the Management Board of the company. The Supervisory Board does not take part in the management of the company and it represents the company only in its relations with the Management Board. The Supervisory Board may consist of three to seven members, and three to nine persons may be appointed as members of the Management Board. Members of the boards of a JSC may be capable individuals or legal entities, including representatives of different government bodies.

In view of making the management of the company simple, the company could be incorporated under the one-tier corporate governance system, and the sole owner of the capital appoints the Board of Directors. Furthermore, members of the Board of Directors may authorize one or more members of the Board to represent the company. Such authorization might be withdrawn at any time. Names of the members of the Board of Directors authorized to represent the company have to be entered into the Commercial Registry. Such authorization and its withdrawal is effective *vis a vis* third parties only if it has been entered into the Commercial Registry.

Examples for incorporation of similar corporations by the Bulgarian Government are the Bank Consolidation Company AD established to administer the revenues from the banking privatization and the legislative proposal for transformation of the existing Privatization Agency into a profit-making legal entity, 100% owned by the State, intended to act as an agent of the State in the privatization process.

3.2. A GIS as a Not-for-profit Organization

This option provides for the establishment of a GIS as a not-for-profit organization affiliated with the Bulgarian State and functioning in accordance with the Bulgarian private law, namely the *Law on Establishment of Non-Profit Associations.*[13] Such organizations can function as a public benefit non-profit organization for the purpose of protecting the environment, in order to avail of the preferential tax treatment. However, performance of business activity by such organizational structure is unusual and rather exceptional under Bulgarian law, and could be an issue with regard to the trade in AAUs and the subsequent investment of the revenues generated therefrom to be performed under a GIS.

3.3. A GIS as a Governmental Organization

A GIS may be designed as a *sui generis* governmental organization under Bulgarian public law, which receives funding from the state budget or directly from the emissions trading. Best example for organizing such a structure in the field of Bulgarian environmental law is the National Trust EcoFund.

Technically, in any event that the Government of Bulgaria might decide to structure a GIS as a *sui generis* governmental organization under Bulgarian public law, it would be free to do so

[13] Promulgated in State Gazette, Issue No. 81 of October 6, 2000, effective as of January 1, 2001, as last amended in Issue No. 120 of December 29, 2002.

pursuant to the following techniques. An act of Parliament (a law) might itself grant the status of a legal entity of the GIS, as well as provide for the terms of its operations. Alternatively, an act of Parliament might authorize an administrative agency to establish a GIS as a legal entity under public law, as well as to define the terms of its operations. A combination of both approaches is also possible.

Alternatively, and given existing constraints in the establishing of new funds, the Government of Bulgaria may also choose to use an existing fund for the purposes of the GIS. The National Trust EcoFund with its established track record in developing emission reduction projects could be used as a vehicle to administer and implement a GIS. With its governance structure, consisting of a Board of Directors, an Advisory Committee, and an Executive Bureau, it has established a track record in funding for environmental projects. The statutes of the EcoFund also allow for significant flexibility in the establishment of programs depending on the agreement with contributors to the fund.

3.4. General Notes Related to a GIS Under Bulgarian Law

The comments given herein below apply equally to all of the three options described above.

3.4.1. Establishment (Design and Governance) of a GIS

A GIS could be structured as a single multilateral agreement involving all the parties, or several bilateral agreements between Bulgaria and each individual party, which would allow different governance rules applying to the activities under the scheme. These legal instruments shall provide for mechanisms and procedures ensuring that the revenues from sale of AAUs are earmarked for environmental purposes and used in a way that benefits the Bulgarian society and the revenues are governed in a manner that is transparent, so that funds are not misused or wasted.

3.4.2. Special Purpose of a GIS

A GIS can be organized in two main ways: (a) a scheme with no link between the buyer of Bulgarian AAUs and the actual use of the income in Bulgaria – i.e. the income is used for financing projects designated and implemented independently of those involved in the AAUs transactions; and (b) a scheme where the buyer is involved in carrying out a project in Bulgaria. Since the core idea behind a GIS is to use revenues from sales of AAUs for specific environmental purposes, the entities under any of the above options (corporation, nonprofit organization or a governmental organization) would be organized in a way providing for the allocation of the funds generated by the GIS only to certain qualified projects and activities (environmentally related purposes). In the case of a special-purpose vehicle this would be achieved through the formulation of the exact purpose in its deed of incorporation (e.g. the purpose may be generally formulated as investment in projects and activities leading directly to additional emission reduction or by exhaustively enumerating such projects: enhancing energy efficiency, promoting renewable energy, encouraging reforms in relevant sectors to reduce emissions, reducing transport sector emissions, etc).

3.4.3. Potential Project Selection. Public Procurement and State Aid Issues

Access to GIS funding could be organized in a number of ways, including a tender, free distribution of AAUs, or allocation of funds in support of specific regional or sector projects. In this respect the establishment of a GIS will require a legal review of the proposed scheme under Bulgarian public procurement and state aid law.

3.4.3.1. Application of the Public Procurement Rules with Regard to AAUs Trading

The legal framework on public procurement rules and the procedure for award of public contracts in Bulgaria comprises the *Law on Public Procurement.*[14] With a view to the fact that the rights in the AAUs to be traded under a GIS initially reside in the Bulgarian State, public procurement rules are an important issue to be considered in structuring the scheme in Bulgaria.

The *Law on Public Procurement* explicitly lists the contracting entities obliged to procure goods, works and services pursuant to the public procurement procedure. The said list includes, among other procuring entities, state authorities, state agencies, legal entities established by a government authority by virtue of a statute.

The commercial activities that are subject to public procurement under Bulgarian law, i.e. those activities which if contracted out by an entity that is subject to the *Law on Public Procurement* must conform to the provisions of the *Law on Public Procurement*, are also listed exhaustively. Although these activities do not explicitly include trading in AAUs, they refer to various construction and delivery activities, which may be a part of the "greening" projects to be funded by a GIS and may fall within the scope of the *Law on Public Procurement.*

Due to the lack of practice on the newly adopted piece of legislation in the field of public procurement, it is recommended that the official opinion of the controlling authority - the Public Procurement Agency with the Minister of Economy should be requested on the application of the *Law on Public Procurement* with regard to the activity of a GIS, both in respect of AAUs trading and funding of "greening" projects.

A GIS may be explicitly excluded from the scope of the *Law on Public Procurement* pursuant to the agreement on its establishment (bilateral or international agreement, or even by the adoption of a separate domestic instrument, most likely a law by the Bulgarian Parliament). Such agreement needs to provide for the terms and conditions for assigning such public procurements related to AAUs trading, including specific procedures for selection of candidates, the procurement procedure and the award of the procurement contract, ensuring transparency and competition necessary for the non-discriminatory award of public contracts and the rational allocation of public money through the choice of the best offer presented. Implementing these principles shall enable AAUs purchasers and a GIS to obtain the best value for money, following certain rules on how to define the subject-matter of the contract, for the selection of the candidates according to objective requirements and the award of the contract solely on the basis of the price or alternatively on the basis of a set of objective criteria.

[14] Promulgated in State Gazette, Issue No. 28 of April 6, 2004.

3.4.3.2. Application of State Aid Rules in Respect of AAUs Trading

Other relevant matters, which may arise under Bulgarian law with regard to the allocation of the revenues generated in a GIS refer to the applicable regulations on state aid.

Due to the fact that its AAUs rights can be traded, Bulgaria will receive revenues, which increase the State's resources. If such revenues are assigned to the general state budget, their future use does not raise concerns regarding state aid and competition protection. If, on the other hand, the revenue is designated for a special purpose, State aid may be involved if certain enterprises or productions are favored. Since the revenues accumulated under a GIS are intended to be allocated for the implementation for environmentally orientated "greening" projects in Bulgaria, such activity may be considered subsidies, contravening the competition principles.

Under Bulgarian law state aid is governed by the *Law on State Aid*[15] and the *Rules on the Implementation of the Law on State Aid,*[16] which regulate the terms and conditions for monitoring and control of extended state aid, as well as for compliance of the extension with the free competition principles.

State aid for environmental protection is regulated by Section 3 of the *Rules on the Implementation of the Law on State Aid.* To a great extent this Section of the *Rules* follows the Community guidelines on State aid for environmental protection (2001/C 37/03). Since the *Rules on the Implementation of the Law on State Aid* are a relatively new piece of legislation, there is no established practice of the Commission on Protection of Competition on the application of their Section 3. However European law and the practice of the European Commission and the European Court of Justice/Court of First Instance can serve as guidelines for the Commission on Protection of Competition. According to Article 64(2) of the Association agreement between Bulgaria and the EU, the application of competition rules, shall be assessed on the basis of the criteria stemming from the application of the relevant provisions of the EC Treaty. Though EC law is not directly applicable in Bulgaria, the practice of the Commission on Protection of Competition in the area of State aid for environmental protection will follow the principles established in the EU.

Because of the lack of established practice, we would advise that the official opinion of the Commission on Protection of Competition should be sought on the application of the state aid-related restrictions in respect of a GIS for Bulgaria.

3.4.4. Allocation of Funds

A GIS may allocate the revenues from sales of AAUs to eligible public and private sector projects through (i) a donation or grant, (ii) an interest free or interest bearing loan facility, or (iii) equity participation (a GIS obtains or has the right to obtain an ownership in the project being financed) subject to our comments in Section 3.4.3. above concerning public procurement and state aid regulations.

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15 Promulgated in State Gazette, Issue No. 28 of March 19, 2002, in effect as of June 20, 2002.

16 Promulgated in State Gazette, Issue No. 68 of August 1, 2003.

3.4.5. Ownership of AAUs

From a legal point of view, the right to trade AAUs under the terms of the *Kyoto Protocol* resides in the Parties thereto, i.e. in the Bulgarian State in respect of Bulgaria's allowance emissions trading. Consequently, the establishment of a GIS shall include trading in rights of the Bulgarian State and the transfer of such rights shall be subject to the rules governing the disposing of State ownership, except as may be otherwise provided in the *Kyoto Protocol* by overriding mandatory modalities and procedures for transfer of the AAUs or such rights are vested in a separate legal entity owned by the State. As a general rule, the competitive procedures available under Bulgarian law (*Law on State Ownership*, *Regulation on the Implementation of the Law on State Ownership*) in respect of the management and disposal of State's title in ownership aim to ensure transparency and efficiency of the procedures and to protect the interests of the State.

4. Taxation and Other Issues

The current lack of explicit legislative regulation of emission trading under Bulgarian law also extends to applicable export and import regulations and the possible tax treatment of such activities. Therefore, the best possible approach would be that any contemplated tax exemptions or preferential regimes or incentives that should be made available to a GIS or the investors to whom the revenues from sale of AAUs shall be allocated, be introduced in the special deed (whether a multilateral agreement, a bilateral agreement or a statute) by virtue of which a GIS will be established, designed and governed. If such deed is an international agreement, Bulgarian tax laws will recognize the priority of its provisions over domestic legislation in compliance with the constitutional principle for priority of international agreements that have been duly ratified and promulgated. If such deed is a special Bulgarian law, it could again introduce tax preferences, which would prevail over the general provisions of tax laws. In any case, only through such a special deed a GIS could be clearly granted immunity from all taxation under Bulgarian law.

Otherwise, effective tax legislation does not offer many possibilities for benefiting from tax exemptions. Regardless of the form of establishment of a GIS chosen for implementation among the options referred to in Section 3 hereof, it will become in principle an addressee of tax legislation.

4.1. Corporate Tax Implications

Corporations, not-for-profit organizations and budget-funded enterprises (governmental organizations) are deemed to be legal entities for tax purposes and, therefore, are considered tax obligors for profits, yielded in result of their business activities. Budget-funded enterprises are subject to a specific final taxation at the rate of 4% on income from commercial activities, while the other tax obligors are liable for corporate tax of 19.5% on their profits. Certain expenses, booked by tax obligors are subject to alternative corporate taxes at the rate of 20%.

Corporate tax legislation currently provides for some general incentives, which might be considered by a GIS when allocating revenues for "greening" activities.

Thus, donations are deductible for tax purposes if made from the capital reserves of a tax obligor in an amount equaling up to 10 % of the financial result before transformation for tax purposes, when in favor of budget-funded enterprises, not-for-profit entities with nature-protecting purposes, public benefit non-profit organizations, municipalities, etc.

4.1.1. Tax Implications of Grants

Revenues from sale of AAUs that are allocated in the form of a grant will have both corporate and donations tax implications.

From corporate tax perspective, donations which do not fall within the tax incentive referred to above, but are booked as expenses, shall be subject to a final corporate tax at the rate of 20%. A lower rate of 15% shall apply if the grant is made in favor of any of the addressees, mentioned above under the donation tax incentive.

Both the expenses for grants and the final corporate tax charged thereon shall be deductible for profit tax purposes.

4.1.2. Tax Implications of Loans

Insofar as a GIS will be established through a local structure, any interest income, generated by it in result of revenues allocated in the form of loans, would be included in the overall tax base of the local structure and taxed by corporate tax on business profits.

Interest levels under granted loans should be agreed on arm's length basis, i.e. should not deviate from the statutory interest (equal to the Base Interest Rate announced by the Bulgarian National Bank plus 10%) by more than 25%.

4.1.3. Tax Implications of Equity Participation

With respect to income from equity participation of a GIS in the form of dividends and liquidation quota, distributed by local entities and partnerships, the tax treatment will differ depending on the structure for establishment of a GIS. If it is structured as a corporation (a profit making entity), dividend income will not trigger any tax burden. On the contrary, such dividend income will be deducted from the financial result of the corporation for corporate tax purposes. The liquidation quota received should be included in the overall business income of the corporation.

If, however, a GIS is organized as a not-for-profit legal entity or a governmental entity, its dividend and liquidation quota income will be subject to withholding tax at the rate of 15%, to be withheld by the payor of such income. Such withholding tax will not apply to dividend income when the dividends are offered in the form of new shares or increase of the nominal value of outstanding shares.

Capital gains of local entities deriving from the alienation of equity participation should be included in the overall tax base of business income taxable with corporate tax. Gains from sale of securities of public companies and tradable rights in stock of public companies, executed on the Bulgarian regulated securities market, are not only exempt from taxation but are also deductible from the financial result of the local tax obligor.

4.2. VAT Implications

Whichever structure for establishment of a GIS is chosen, under the general rules it will become a tax obligor for VAT purposes as well, once it has accumulated a taxable turnover of BGN 50,000 (fifty thousand) for a period of 12 consecutive months. The reaching of such threshold would trigger VAT registration obligation. The state and governmental bodies

(including legal entities incorporated by a special law) are excluded from the scope of VAT tax obligors when exercising their governmental powers and statutory liabilities under specific conditions. VAT registration obligation would not occur for a GIS structure also if the activities related to the sale of AAUs are explicitly stated in a law or other similar act to be VAT exempt. Under the general rules a VAT registered entity is under obligation to charge VAT of 20% on every taxable supply effected by it. It should be outlined that there is a scope of VAT exempt supplies, among which are also monetary grants, loans and equity participation. Grants of goods or services are VAT exempt only if made in favor of certain limited range of addresses, among which are also the state, municipalities, ministries, governmental institutions, governmental and municipal authorities.

For export of goods a lower VAT rate of 0% applies under certain conditions. However, the definition of goods for VAT purposes appears not to cover AAUs, since we consider it more appropriate to treat the latter as specific rights rather than as movables. Therefore, if AAUs could qualify as rights in intangibles, their sale will be considered as a service supply for VAT purposes and the lower rate of 0% could not apply. If no explicit VAT exemption is introduced for the sale of AAUs, it will be subject to VAT charge by the VAT registered seller.

As far as import of AAUs is concerned, it should be mentioned that principally customs authorities charge VAT upon import of goods, but insofar as we do not consider that AAUs will qualify as goods, VAT should not apply. In an exceptional hypothesis and under a complex of requirements, local VAT registered recipients of services are under obligation to charge VAT on the value of received services.

4.3. Donations Tax Implications on Grants

Apart from any other tax implications, donations are subject to donation's tax at the rate of 5%, payable by the donee unless otherwise agreed between the parties. Such tax is not due where the donee is the state or a municipality, where the donor or donee is a public benefit not-for-profit entity, as well as in the case of a contribution in kind in the capital of a corporation or a non-profit organization.

5. Conclusion

Based on the above analysis of applicable legal framework, a GIS may be established as a special-purpose (to earmark revenues from sales of AAUs for projects that would yield environmental benefits) entity under Bulgarian law (corporation, not-for-profit organization or governmental organization) by virtue of an international bilateral or multilateral agreement or an act of the Bulgarian Parliament or the Council of Ministers. Alternatively, the GIS could use an existing public fund for the administration of the GIS (such as the National Trust EcoFund).

Although AAUs trading is an increasingly used form of funding "greening" projects there is no clear framework governing this matter or pertinent practice in Bulgaria, especially when contrasted against the relatively sophisticated framework in the EU. Taxation, public procurement and state aid regulations, as well as investment framework as discussed above, are important issues to be considered in structuring a GIS.

GREENING POTENTIAL IN THE RENEWABLE ENERGY (SMAL AND MICRO HYDRO SECTOR)

1. Total hydro-energy potential of the country

Hydro energy is the main and currently almost the only renewable energy source in use for electricity production.

Bulgaria has scarce water resources (2380 m^3 per capita annually). Due to the high elevation of some country areas the theoretical hydro-energy potential accounts to 24.6 GWh in an average flow year. The technical potential is about 57% of the theoretical potential. It is estimated to be 15 GWh. These figures are achieved on a base of feasibility studies about future construction of HPPs allover the country territory.

Utilized hydro-energy potential

Up to now there exist 99 HPPs. Ten of them are decommissioned, i.e. 89 HPPs are currently operating efficiently in the national power grid. Compared to the total installed capacity the HPPs' share is 16.6% and 5-7% of the country electricity production. According to design data the installed capacity in HPPs reaches up to 1996 MW and the electricity generation in an average year should equal to 4.6 billion kWh. Due to rain decrease (cycle and global) and the significant water recourses used for water supply, irrigation and ecological purposes which have not been taken into account in the projects the average electricity generation during the last 25 years was only about 60% of the designed.

Actually the existing HPPs use 30% of the national technical potential.

2. Small HPPs

"Sreden Iskar" cascade

Forty dam sites with reservoirs and power plants with total capacity of 93 MW and annual electricity production of 520 GWh could be constructed there. The average annual utilization of the installed capacities will be 5590 hours.

Table 1 gives the main technical data, possible capacity and projected electricity generation for all the forty HPPs that could be constructed in the Sreden Iskar valley.

The preliminary economic assessment of the enumerated projects shows that they considerably differ with respect to their efficiency. In this connection, 14 HPPs are defined to be the most suitable cascade stages ("steps") which construction is more probable and hence they have to be considered initial and of top priority. Table 2 gives the most important technical and economic indices of these 14 HPPs included in the "Sreden Iskar" cascade.

Table 1.

HPP	Level	Inrush m	$Q_{constr.}$ m^3/sec	$W_{catched}$ $m^3.10^6$	Capacity kW	Electricity GWh
Rebrovo	480	9	30	615	2250	11.84
Tompsan	475	4	30	638	1050	5.93
Prokopanik	465	9	30	650	2250	13.60
Svoge-south	450	14	30	664	3450	21.62
Svoge-north	435	14	30	693	3450	21.56
Tzerovo- south	425	9	30	693	2250	14.05
Tzerovo- north	417	7	30	693	1800	11.28
Bov-north I	398	9	30	693	2250	14.50
Bov-north II	390	7	30	694	1800	11.03
sp. Balkan-south	380	9	30	694	2250	14.05
sp. Balkan-north	375	4	30	695	1050	6.46
Lakatnik-south	367	7	30	707	1800	11.51
Lakatnik-east	348	10	30	713	2550	16.58
Svrajen	336	11	30	718	2700	18.37
Svrajen-north	331	4	30	722	1050	6.07
Oplethia-east	320	8	40	821	2800	15.27
sp. Prolet	315	4	40	824	1400	7.66
Gabrovnitza	308	4	40	838	1400	7.08
Eliseina	301	6	40	844	2000	11.77
s. Eliseina	296	4	40	847	1400	7.09
Eliseina-east	283	4	40	851	1400	7.09
Zverino-west	275	4	50	931	3000	15.16
Zverino-east	260	7	50	944	1650	8.78
Zverino-north	255	4	50	945	1650	8.80
Cherepish	238	6	50	945	2500	13.19
Cherepish-south	246	7	50	945	3000	15.38
Lutibrod	230	7	50	945	3000	15.38
Lutibrod-east	219	6	50	948	2500	13.23
s.Oslen	177	7	50	945	3000	15.38
Sinio bardo	170	5	50	957	2250	11.13
Strupetz	152	9	50	959	3750	20.07
Roman-mill	145	4	50	953	1750	8.86
s. Roman	137	6.5	50	1077	3000	16.28
Radovanovo	130	5.3	60	1162	2700	14.32
Kunino	125	4	60	1171	2100	10.89
Karlukovo I	118	5	60	1179	2700	13.71
Karlukovo II	111.5	5	60	1183	2700	13.76
Reseletz-south	105	5	60	1186	2700	13.76
Reseletz	98	6	60	1186	3000	16.55
Cherven briag	90	6.5	60	1197	3600	18.09
TOTAL – 40	320÷90	266.3	40÷60	821÷1197	93000	520.00

Table 2.

No.	Name of HPP	El. capacity	Annual electricity. production	Capital investments	Annual costs	Specific capital investment
		kW	GWh	10^6 $US	$10^3$$US/ year	$US/kW
1	Prokopanik	4600	23,00	4,00	174	870
2	Tzerovo-south	2400	13,00	3,68	164	1533
3	Bov-north	3840	21,50	4,13	177	1076
4	Balkan-south	2650	14,00	4,12	178	1555
5	Balkan-north	3100	17,50	4,08	176	1316
6	Lakatnik	3100	17,50	3,96	173	1277
7	Svrajen-south	3100	18,31	3,88	173	1252
8	Svrajen-north	4400	26,00	4,10	175	932
9	Opletnia I	2650	15,00	3,89	174	1470
10	Opletnia II	2250	12,75	3,58	161	1591
11	Opletnia III	2650	15,12	4,04	177	1525
12	Cherepish I	3480	19,00	4,05	181	1164
13	Cherepish II	3480	19,20	4,39	147	1261
14	Lutibrod	1860	10,50	4,27	189	2296
	TOTAL	43560	252,38	56,17	2467	1289

The opportunity of separate construction of each stage, independent to the rest of the stages, permits lower value of required investments and their spacing out

"Gorna Arda" cascade

After the Maritza and Struma rivers, the Arda River is the third largest river of Bulgaria with regard to the high water. But at the same time it exceeds them in high waters volume, volume of constant outflow, specific high water with regard to time distribution and the impact of Mediterranean climate along the river.

The three river's steps already constructed are of great importance as far as they can be used as an example in case of further investments. New water catchments with plants are considered for construction. As a whole the cascade could provide total capacity of 174 MW and annual electricity production of 487 GWh. Four of the HPPs are of relatively high capacity while the other three are small HPPs (see table 3).

Table 3.

No.	Indices	Dimension	HPP		
			Srednogortzi	Malka Arda	Pesnopoi
1.	Water quantity	m3/sec	30	2.8	7
2.	Net inrush	m	26	137	114
3.	Processed water	$10^6 m^3$	372	39	81
4.	Electricity produced	10^6 kWh/y	22	12	21
5.	Installed capacity	MW	6.6	3.2	6.8
6.	Units	number	3	2	2

Table 4 gives the most important technical and economic indices of these small HPPs included in the "Gorna Arda" cascade.

Table 4.

No	Name	El. capacity kW	Electricity production GWh/y	Investment (10^6 $US)	Annual costs (10^6 $US/y)
1.	"Srednogortzi"	6600	22	13.73	1.26
2.	"Malka Arda"	3200	12	5.03	0.46
3.	HPP "Pesnopoi"	6800	21	4.45	0.41
.	TOTAL	16600	55	23.21	

"Sredna Vacha" cascade

The "Vacha" cascade as a whole is planned as combined cascade construction with down-lake plans (Tzankov kamak, Mihalkovo, Antonivanovtzi, Vacha II) as well as derivation plants (Teshel, Devin, Krichim and Vach I).

Six HPPs in the cascade with total capacity of 400MW are operating and a new HPP "Tzankov kamak" is under construction as Joint Implementation project. There are no other studied sites suitable for JI and GIS small hydro projects.

HPP on the Danube River

Two hydro-complexes could be constructed within the Bulgarian territory of Danube - "Nikopol - Tyrno Magurele" and "Silistra - Kalarash". These two "steps" can provide 3833 million kWh annually (installed capacity - 667 MW) for our country alone. "Nikopol - Tyrno Magurele" hydro-cascade has better technical and economic indices and it is first to be constructed. Bulgaria will have at disposal 402 MW capacity and annual electricity production of 2193 million kWh. The plants are not suitable for JI or GIS projects

3. Micro-HPPs

Theoretical and technically feasible micro-HPP potential in Bulgaria

Recently a great attention is paid to the micro-hydro-energy potential. This potential is represented by the micro-HPPs (without international recognition). In countries with high hydro potential the upper limit for such micro-HPPs is identified at 10,000 kW. For these plants usually alleviations are acceptable in respect to their automation and safety, depreciation rates and production costs, energy purchase prices, tax concessions, staff qualification and so on.

The 1982-88 study on the micro-HPPs over the whole country territory proves these potential to be a significant one. Within the range of 30-2,000 kW plant capacity 779 power plants data are systematized with total capacity of 237 MW and 921 million kWh electricity generation. These numbers include 730 micro-HPPs to be constructed with 210 MW capacity and 795 million kWh electricity production. The remaining 49 plants already exist. The above figures include the so-called technical potential. It includes water sources with winter flow above 100 l/sec situated in areas suitable for construction and exploitation. The theoretical potential is considerably higher but unspecified yet.

Data on the constructed micro-HPPs

The construction of micro-HPPs is not a new direction in the Bulgarian hydro-energy construction. At the beginning of last century some HPPs were constructed for the needs of some communities and especially as energy sources for lots of private industrial enterprises. Now these HPPs are considered micro-HPPs. The existing HPP with capacity to 2,000 kW are 49 but only 41 of them are in operation.

The remaining 8 are decommissioned because of different reasons. Their total capacity is 25.25 MW and the planned electricity generation is 121.4 kWh.

A characteristic feature of the existing micro-HPPs is their situation at the West highlands of the country. Predominantly these micro-HPPs have low water pressure, small water quantities and respectively not high capacity. Most of these devices are still in operation after exploitation of 50-60 years already.

The planned electricity production of the micro-HPPs is considerably different from the real one within the range of 60-65%. The key reason is the lower efficiency coefficient of the old devices.

Possibilities to construct new micro-HPPs

This annex does not account for the possibilities of Middle Iskar, Middle Struma, Downstream Maritza cascades which have total capacity over 2000 kW despite the fact that some of their unit capacities are equal or below those of micro-HPPs. These cascades have a potential of 270 MW that is similar by technical and economic indicators to micro-HPPs.

There are 730 micro-HPPs considered for construction. Their total capacity is 212 thousands kW. They have the characteristics of run-river power plants, i.e. they have potential of installed capacity utilization over 3500 h annually. The expected total electricity production in year with average humidity will be approximately 800 million kWh.

Tentative program for construction of first stage micro-HPPs

About 200 of the micro hydro projects have acceptable economical indicators and their construction could be beneficial, if special support for the renewable electricity production is introduced. Here we deal with 60 of them having economic or other advantages. The expectation of their construction in the following 10-15 years represents an average optimistic program. These micro-HPPs will provide about 36 MW capacity with electricity produced in years with average water flow about 128 million kWh.

The data in tables on the necessary investments are not updated on the base of the current situation and therefore they must be considered tentative.

The following table generalizes the basic technical and economic data on the projected first stage micro-HPPs.

Table 5

Indicator / Period	Number	kW	Electricity GWh	Investments 10^6 $US
until 2007	12	16049	57.92	15.18
2008 - 2012	20	10525	37.77	12.16
2013 - 2015	28	9453	32.36	13.08
Total	60	36027	128.05	40.42

If the necessary investments are available and a decision is taken to construction - step by step or partially - of facilities of the suggested groups of micro-HPPs some extra feasibility studies would be required. These are provoked by some changes related to the prices, ownership of the sites, laws and regulations and so on which are now discussed.

Recommended micro-HPPs by 2007

Table 6

1	Indicators Micro-HPP	Region	River	P, kW	E GWh	Investments $US 10^6
1	Sandanski II	Sofia	Sand. Bistritza	1000	6.70	0.90
2	St. Ribaritza II	Lovech	Ribaritza	1630	5.85	1.36
3	Bansêî II	Sofia	Damianitza	2000	8.00	2.10
4	Vlahina	Sofia	Vlahina	2000	6.20	2.14
5	Bansêî I	Sofia	Damianitza	2000	8.00	2.32
6	Lobach	Sofia	Struma	1300	4.60	1.20
7	Lopuha	Plovdiv	Chepelarska	87	0.49	0.13
8	Chiroka laka	Plovdiv	Chiroka laka	372	1.50	0.45
9	Kamchia	Varna	Luda Kamchia	900	4.50	0.60
10	Krastavichka 4	Montana	Lom	1500	4.58	1.13
11	Osinovlak VII	Sofia	Gabrovitza	1360	3.80	1.00
12	Rositza	Lovech	Rositza	1900	3.70	1.85
Total amount until 2007				16049	57.92	15.18

Recommended micro-HPPs for the period 2008-2012

Table 7

1	Indicators Micro-HPP	Region	River	P, kW	E GWh	Investments $US 10^6
1	Ravna	Haskovo	Taja	2000	7.25	3.56
2	Bogaevtzi	Sofia	Elechnitza	190	0.83	0.21
3	Oriahovo II	Plovdiv	Orechitza	130	0.69	0.19
4	Pilatovetz V	Montana	Ogosta	120	2.92	0.76
5	Borov dol IV	Burgas	Cham dere	100	0.33	0.13
6	Goliama reka III	Montana	Ogosta	640	2.73	0.63
7	Borov dol II	Burgas	Cham dere	170	0.35	0.18
8	Berkovitza III	Montana	Ogosta	260	1.03	0.28
9	Borov dol III	Burgas	Cham dere	240	0.80	0.20
10	Êîpilovtzi IV	Montana	Ogosta	355	1.22	0.30
11	Leva reka IV	Montana	Lom	360	1.28	0.37
12	Pilatovetz IV	Montana	Ogosta	1050	3.20	0.89
13	Borov dol I	Burgas	Cham dere	130	0.50	0.16
14	Bansko I	Sofia	Damianitza	2000	8.00	2.32
15	Oriahovo I	Plovdiv	Orechitza	150	0.81	0.26
16	Vodni pad	Plovdiv	Belmetzki dol	70	0-.38	0.13
17	Kotel I	Burgas	Kotelska	420	1.32	0.42
18	Pilatovetz VI	Montana	Ogosta	760	2.71	0.68
19	Goliama reka V	Montana	Lom	225	0.95	0.34
20	Churkovo	Plovdiv	Churetzka	95	0.47	0.15
			Total	10528	37.77	12.16

Recommended micro-HPPs for the period 2013-2015

Table 8

1	Indicators Micro-HPP	Region	River	P, kW	E GWh	Investments $US 10^6
1	Binkos	Burgas	Belenska	90	0.35	0.12
2	Tzaparevo VI	Sofia	Tzaparevska	800	2.51	0.82
3	Vintina	Plovdiv	Ålhovska	135	0.64	0.23
4	Kozarevo IV	Burgas	Kozarevska	200	0.68	0.25
5	Iabalkovo IV	Burgas	Selska	140	0.55	0.21
6	Sasa dere	Burgas	Belenska	80	0.30	0.16
7	Borov dol IV	Burgas	Cham dere	100	0.33	0.13
8	Cherechnitza	Plovdiv	Cherechovska	160	0.78	0.30
9	Chepelare	Plovdiv	Chepelarska	80	0.44	0.18
10	Chuprene VIII	Montana	Lom	405	1.44	0.57
11	Tzaparevo V	Sofia	Tzaparevska	90	0.41	0.15
12	Elenin vrah	Sofia	Elechnitza	460	1.44	0.56
13	Elechnitza II	Sofia	Elechnitza	480	2.14	0.87
14	Votrachka	Sofia	Votrachka	380	1.17	0.46
15	Tzaparevo III	Sofia	Tzaparevska	210	0.97	0.38
16	Kustendil III	Sofia	Novoselska	430	1.26	0.51
17	Ostretz II	Lovech	Ostrechka	530	1.82	0.80
18	Zla reka II	Lovech	Zla reka	520	1.77	0.77
19	Kustendil IV	Sofia	Novoselska	480	1.38	0.61
20	Kalofer	Plovdiv	Taja	198	0.81	0.36
21	Maraganevo I	Montana	Ogosta	580	1.74	0.65
22	Tzaparevo III	Sofia	Tzaparevska	330	1.10	0.52
23	Osenovlak V	Sofia	Gabrovnitza	480	1.38	0.70
24	Bunovo	Sofia	Bukovska	160	0.68	0.24
25	Paden	Sofia	Stara reka	540	1.72	0.68
26	Martinovo II	Montana	Ogosta	700	2.10	0.74
27	Osenovlak IV	Sofia	Gabrovnitza	440	1.23	0.67
28	Isiovtzi	Plovdiv	Cherechovska	255	1.22	0.45
			Total	9453	32.36	13.08

Who is interested in construction of micro-HPP

The restarted construction activity concerning micro-HPP is quite chaotic in the country. There are some small micro-HPP constructed or under construction. Their construction is not led by economic, energy or environmental adventures or proved importance to the production needs. In most cases their construction was meant as demonstration of the possibilities of machine building enterprises to gain new markets for their production despite the economic recession.

Recently micro-HPPs became subject of interest to business communities as firms, companies, communities, financial groups and so on showing not only commercial interests. Recently some international institutions also encourage the construction of micro-HPPs .

4. Average indicators of new construction sites for small and micro hydro plants

Sites that are most feasible from technical and economical point of view were selected for the analysis of possibilities for construction of small and micro HPPs. Nevertheless researches have proved that the construction of such HPPs is economically not feasible.

The average indices of small hydro are presented in Table 9. The annual income from electricity sale is calculated after the current price of 0.08 BGN/kWh (0.0485 USD/kWh).

Small Hydro – Indices Table 9.

Cascade	Capacity kW	Electricity production GWh	Investment 10^6 USD	Annual income 10^6 USD
Sreden Iskar	43 560	252.38	56.17	12.24
Gorna Arda	16 600	55.0	23.1	2.67
Total	60 160	307.38	79.27	14.9

Obviously the incomes from electricity sale are at average 19% of the investment and are therefore insufficient to secure the operation and maintenance costs (OMC) and the bay-back of the investment.

Even the average indices for small HPPs of the Sreden Iskar cascade (about 22% of the investment) could not cover the OMC, taxes and interests (from 9 to 15%) of the construction loan. Therefore the construction of HPPs is not developed and additional incentives are needed.

The average indices of micro HPPs are presented in Table 10. The annual income from electricity sale is calculated after the current price of electricity from micro HPPs – 0.06 BGN/kWh (0.036 USD/kWh).

Micro Hydro – Indices Table 10.

Plants	Capacity kW	Electricity production GWh	Investment 10^6 USD	Annual income 10^6 USD
Till 2008	16.049	57.92	15.18	2.08
2008 - 2012	10 525	37.77	12.16	1.36
After 2012	9 453	32.36	13.08	1.16
Total	36 027	128.05	40.42	4.60

As seen in the Table above, the situation with micro HPPs is even worse than that of small HPPs. The incomes from electricity sale are 11% of the investment at average and the operation and maintenance costs can hardly be covered, let alone servicing of the eventual construction loan. Therefore the construction of micro hydro is not developed. The only exceptions are some extreme cases of construction of HPPs on existing water-supply systems of big and medium settlements.

The basic reasons for small and micro HPPs being unviable can be determined as:

- high specific investment
- low loading factor
- low price of electricity from renewables.

The low loading factor is determined by the climatic conditions and could be changed only through reduction of the HPPs' capacities.

The two other factors could be influenced. The Bulgarian Energy legislation envisages introduction of "renewable energy certificates" which will expectedly stimulate the production of electricity from

renewable sources. This incentive allows increasing the buy-up prices but at the expense of an overall increase of the electricity price for final consumers, due to which can only be used for limited volumes.

The investments should be subsidized in order to stimulate the construction of small and micro hydro plants. GIS allows doing so.

Carbon balance of Small and Micro Hydro plants.

The electricity produced at the new HPPs belongs to the category of non-dispatch energy. The production volume is unpredictable and has fortuitous nature. The installed capacity at HPPs (small and micro) will hardly be able to cause changes in the schedule for commissioning of new capacities at nuclear plants, coal and natural gas-fired thermal plants.

The newly-commissioned HPPs will affect only the peak-load of the remaining electricity production capacities. They cannot replace the base nuclear capacities, as well as the other hydro-capacities from the load curve. The co-generated electricity cannot be replaced either. Thus the production of the new NPPs will influence the loading of thermal plants operating in off-peak load and in the secondary frequency regulation system. These are, first of all, plants operating on imported black coal, followed by plants on local brown coal and natural-gas combined-cycle plants – NGCC (in the future, when they are put in operation).

The emissions from the production of one kilowatt hour electricity from the coal-fired plants vary from 1.2 to 1.5 kg/CO_2/kWh which makes 1.3 kgCO_2/kWh on average. The level of CO_2 emissions from NGCC is far less (about 0.450 kgCO_2/kWh) whereas their share in the fuel mix is hardly predictable. It is expected that the NGCC capacity share will not be more than 5% (500 MW) in 2010 and it could not influence significantly the average emissions level. It could be accepted that the average emissions for one net kWh produced from TPP will be at the level of 1.2 kgCO_2/kWh. This value could be used as an average factor for the emission reduction.

The expected emission reductions and costs are presented in Table 11.

Expected Emission Reductions Table 11.

Cascade/Plants	Electricity production GWh	Annual emission reductions t CO_2	Investment 10^6 USD	Investment cost annual reduct USD/tCO_2.
Sreden Iskar	252.38	302.856	56.17	185.47
Gorna Arda	55.0	66 00	23.1	350.00
Total	**307.38**	**368 856**	**79.27**	**214.91**
Plants (till 2008)	57.92	69 504	15.18	218.4
Plants (2008 – 2012)	37.77	45 324	12.16	268.3
Plants after 2012	32.36	38 832	13.08	336.8
Total	**128.05**	**153 660**	**40.42**	**263.05**
Total	**435.43**	**552 516**	**119.69**	**216.62**

The proposed time schedule for construction of small and micro HPPs seems to be realistic. It could be accelerated if the GIS is introduced in 2004 or early 2005. The entire design and construction schedule for one plant takes no more than 2.5 – 3 years. This means that the emission reductions could be achieved not earlier than 2007 and it is insignificant. The main emission reduction could come in the period 2008 – 2012 and onwards. For the GIS projects we could expect to have small hydro projects in

operation in 2007 and to explore all the potential for the first Kyoto period. The micro hydro could follow the proposed schedule and the first operational HPPs could be expected in 2007 and onwards.

The second portion will gradually be introduced in 2008 – 2012 and will explore ½ of the potential during this period. The third group will be fully operational in 2013. The emission reductions potential for the period 2007 – 2020 is presented in Table 12.

Emission Reduction, kt CO_2 **Table 12.**

Plant/Year	Till 2007	2008 – 20012	2013 – 2020
Sreden Iskar	302.9	1,514.3	2,423.2
Gorna Arda	66.0	330	528
Plants 1 Group	69.5	347.5	556
Plants 2 Group	-	113.3	362.6
Plants 3 Group	-	-	310.6
Total	**438.4**	**2,305.1**	**4,180.4**

There is a potential for emission reduction of about 440 kt for the year 2007, potential 2.305kt for the first Kyoto period, and 4.180 kt for the period 2013 – 2020.

The investments required for the period till 2012 are estimated at about 107 million USD. Depending on the cost of the transferred emission reduction the support for the HPPs investment could reach from 21% (if 10 USD/t CO_2 is accepted) to 42% (if 20 USD/t CO_2 is accepted) for the first commitment period.

Such a support, if combined with timely introduction of the green certificates for renewable electricity could accelerate significantly the small and micro HPPs penetration in the power sector and generate some more considerable emissions reduction to a level of about 2.600 kt CO_2 for the first Kyoto period.

HOUSEHOLDS SECTOR : FUEL SWITCHING TO NATURAL GAS

Natural Gas Utilization in Bulgaria

Households Energy Demand

The life standard of Bulgarian households is low, compared to the life standard of the developed countries' households. The low income (4532BGN per household per year) determines the low level of the heat comfort in the dwellings. This problem is worsened due to poor thermal insulation of dwellings and the low-efficient appliances. In 2001 the average consumption of energy from a household was 32.3 GJ. Besides the consumption structure is unfavorable (see Table 1).

Table 1. Households Energy Demand, Year 2001

DEMAND	TJ	%
Heat - solar energy	375	0,4
Heat - electricity	24141	25,8
Heat-natural gas	574	0,6
Heat - briquettes	18560	19,8
Heat - coal	4416	4,7
Heat - LPG	2541	2,7
Heat - wood	8305	8,9
Heat-district heating	20495	21,9
Electricity - Appliances	7793	8,3
Electricity - Cooling	3721	4,0
Electricity - Lighting	2763	2,9
Total	**93684**	**100**

About 85% of the energy is consumed for space heating, hot water preparation and cooking and only 4% are used for cooling. A considerable share of the energy consumed for space heating (30%) is electricity and only 0.7% - natural gas. 41% of the energy consumed at households is electricity. Moreover, 63% of this electricity is used for heating. Half of the electricity in the country is consumed by households, which means that nearly 1/3 of the electricity in the country is consumed for heating in households. A reduction in consumption of electricity for heating could play decisive role for decrease of investments and emissions in the power sector. The high cost of electrical heating determines the use of electricity only in places where no alternative energy source is available. Establishing such an alternative energy source for heating could add significantly to reduction of electricity consumption and the GHG emissions related to it. Natural gas is the principal alternative of electricity in the households.

Natural Gas Supply in Bulgaria

The natural gas used in Bulgaria is mainly imported. Over 99% of it is import from the Russian stock company "Gasprom". The domestic extraction is negligible. The state retains nearly full control over the gas import and gas transmission sector through the government-owned company Bulgargas. Since the distribution network is underdeveloped, large industrial consumers dominate the gas demand. The major

consumers of gas in Bulgaria are companies from the following sectors: chemical fertilizers, district heating, oil refining, metallurgy, glass/ceramics/bricks production. Recently the gas consumption in Bulgaria has been steadily shrinking. In 1989-2002 period the natural gas consumption for energy purposes moved from 6.7 to 2.5 billion Nm^3 with an almost negligible households and services demand of 0.044 billion Nm^3 in 2002.

A National program for natural gas supply to the households was developed in the mid nineties, based on studies carried out by the Haskoning (Netherlands). Two scenarios and time schedules were elaborated: realistic and optimistic. According to the realistic scenario 1'200'000 people or 400'000 households will be supplied with natural gas by 2020, while according to the optimistic scenario these will be 2'000'000 people and 670'000 households respectively. The energy, economic and environmental benefits of natural gas use in households compared to the current situation are proven in the study. Despite that, eight years later, the households that are supplied with natural gas are less than 2000.

The government has launched a restructuring of the industry, with a focus on attracting private investment for development of local gas distribution networks. The structural reform in the **gas supply system** is in compliance with the requirements of the EU Directive for the general rules of the internal natural gas markets. A national company for extraction, import, transmission, storage, and natural gas trade and 34 private companies for gas distribution are established and licenses for operation at regional level. Part of these local gas distribution companies are established with private and some of them with private and municipal capitals. This model allows gradual transition to free market for natural gas and is based on the Western countries experience.

In accordance with the Law on Energy and the related ordinances, differentiated prices and tariffs for the natural gas were introduced. Differentiated prices for industrial, communal and commercial, and residential consumers that take into consideration the gas consumption mode, consumed volumes, safety requirements for the deliverer, requirements for continuous supply, and necessary investments are responsibility of the Energy Regulation Commission. Using transparent procedure, including proof of economic expenses and necessity for investments, the Commission periodically fixes upper price limits. Later on the prices will depend on state regulated taxes for transmission and distribution, and will tend to become market determined taking into account the possibilities for use of alternative fuels and for free access to the national gas transmission network.

Natural Gas Distribution Network

The natural gas distribution network in the country is currently under development. 34 companies were licensed to construct and operate distribution networks in 34 regions of the country. Each license envisages a deadline for the initiation of construction works and for gas supply to the consumers.

Gas supply to a given region requires accomplishment of a series of activities:

- Construction of the Main Gas Branch from the transmission network to the site and Automatic Gas Regulation station. The cost of the construction depends on the

distance between the transmission line and the site, and on the profile of the terrain. It varies typically between 6 and 10 million BGN.

- Construction of the regional distribution network. It depends on the type of the site, population density and terrain. An estimate of 10 – 20 million BGN is acceptable.
- Adjustment or replacement equipment of consumers. This cost is usually close to, or higher than the cost of gas delivery to the consumer.

The first two activities are obligation to the gas-distributing company. At receiving license companies usually have secured the funds for execution of the project. These are own funds and loans from local or foreign banks. In normal execution of the network construction the first customers (usually industrial consumers and municipal buildings) are supplied with gas within one year. During the following year all industrial and municipal consumers are supplied. During the first year after the initiation of gas supply about 30% of the potential household consumers are joined. Thus 90% of the households willing to have gas can be supplied within 3 years.

Activities for the initiation of gas distribution are currently being carried out on the territory or part of the territory of 34 municipalities. There is enough room for implementation of GIS in the households there. Thus at the time when GIS activity begins, the activities for support of households may also begin.

Barriers to the Natural Gas Supply to Households

Now the natural gas prices (as on July 2004) vary within the different distribution companies. For the households the lowest price is 362 BGN/1000 Nm^3 and the highest is 537 BGN, with an average price of 431 BGN/1000 Nm^3 (VAT excluded).

The price of 1000 Nm^3 in the transmission network is 227.50 BGN. This means that the price increases on average on 90% along the way from the transmission network to the gas inlets of the household buildings. Thus the high price of natural gas considerably impedes its competitiveness to electricity. The households natural gas price is only about 50 – 55 % lower than the average price of electricity for households (if 90% efficiency of the gas appliances and 60/40% day/ night tariff electricity mix are assumed and the low cost portion of electricity – 75 kWh per month out of the heating season and 225 kWh per month within the heating season is accounted for.

Considering that in order to use natural gas, a household should spend about 3000 BGN (VAT included) on gas appliances, we may say that the efficiency of fuel switching from electricity to natural gas is not so obvious. The average annual gas demand of one household is about 1200 Nm^3 and its total cost is 621 BGN per year (VAT included). If a household that consumes electricity for space heating preserves its life style, the annual savings from energy costs (in case fuel switching to natural gas is performed) will sum up to about 699 BGN which determines a simple pay-back period of the investment of 4 years and 4 months. This makes the measure unattractive to households, especially taking into account the low income level – about 7500 BGN per year before taxation per a household with two working members. The real income of such a household does not exceed 6000 BGN. An ordinary household is not likely to spend a half of its annual income on gas network and appliances that will reduce its costs by 11.5% of its annual income. In order to accelerate the fuel switching to natural gas at households, additional

incentives have to be implemented. Such an incentive could be the subsidizing for purchasing of gas appliances or no-interest loans for purchasing such appliances. The realization of these measures requires additional funding that could be obtained through GIS.

Emission Reductions

Reduction of CO_2 Emissions at Fuel Switching from Electricity to Natural Gas

Gas supply is most urgent to households that use electricity for space heating. Assuming that such a household consumes about 8800 kWh per year for space heating, hot water preparation and cooking, the amount of CO_2 emitted in generation, transition and distribution of this electricity throughout the Bulgarian Power System to the low voltage consumers will equal to 7.92 tons[1]. The same household would cover this demand in about 20% higher comfort with 1200 Nm^3 of natural gas which would emit 2.25 t CO_2[2]. Thus in this mode of fuel switching 5.67 t CO_2 will be reduced per household per year.

Reduction of CO_2 Emissions at Households that use solid fuel on heating

The expenses for space heating on solid fuel are more than two times lower than those for heating on natural gas. Therefore it is not expected that the average households will switch their heating from coal with heating to natural gas. These households would replace with natural gas only the electricity used for hot water preparation and cooking. The average costs on electricity per household for such purposes are estimated at 2900 kWh per year. If natural gas is used instead (at preserving the comfort) the consumption would be about 350 Nm^3 per year. Then the reduction of CO_2 emissions would be 0.65t CO_2 per household per year (see the footnote of the previous section).

Reduction of CO_2 Emissions at Households that use liquid fuels for space heating

The number of households that use liquid fuels for heating is very small due to the high fuel prices. They number to several thousand households. Nevertheless the fuel switching of such a household to natural gas would lead to the following emissions reductions (at preserving the comfort):

- from electricity 0.65t CO_2/a
- from heating (850 Nm^3 natural gas replace the liquid fuel) 0.498t CO_2/a.

Thus the total emissions reduction of such a household sums up to 1.15t CO_2/a.

Costs for the households on fuel switching and emissions reduction

The average household cost for fuel switch to natural gas is 3 000 BGN. The cost is divided in two categories – in-house network cost and cost of gas appliances. The costs of the two categories are expected to be equal.

If a household is heated on coal, and does not switch the space heating, these costs will decrease by about ¼ because no heating appliances will be bought. Thus the cost per a household will total up to about 2 200 BGN.

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[1] At average emission factor 0.9 kg CO_2 per kWh delivered to the final consumer in low voltage network.

[2] Natural gas combustion CO_2 emission factor 1.87 $tCO_2/1000\ Nm^3$

At households heated on liquid fuels (if there is no centralized heating boiler) the costs will not change as all kinds of appliances will have to be bought.

The annual emission reductions, the costs per households on these reductions and the price per ton annual emission reduction and for a five-year period (the first commitment period) are presented in Table 2.

Table 2. GHG emissions reduction and costs

Fuel	Annual emission reduction	Cost per households	Cost per t CO_2 reduction per year	CO_2 reduction for 5 years	Cost of CO_2 reduction for 5 years
	T CO_2/year	BGN	BGN/t CO_2	t CO_2	BGN
Electricity	5.67	3000	529	28.4	106
Coal	0.65	2200	3385	3.7	667
Liquid	1.15	3000	2609	6.5	522

It is obvious that the investment costs for emission reductions are very high for the households. The only option that seems to be acceptable is fuel switching from electricity to natural gas.

Limits and volumes

The fuel switching is limited to the total volume of households planned to be supplied with natural gas. As far as the country population has dropped on more that 10 % since the project for gas supply to households was developed, the number of households that could be connected to the gas distribution network should be reduced from 670 000 to no more than 600 000.

Greening should address the most promising in terms of GHG emissions reduction cases – the houses with electrical space heating. These houses are situated mainly in cities with population of more than 20 – 30 000 people living in blocks of flats. Having in mind the slow pace of expansion of the distribution network, no more than 50 000 households are expected to be supplied during the next three years (before the beginning of the first commitment period), but they probably will not be interested due to the lack of finance. The GIS project in this field could be limited to that part of these 50 000 households that has no financial resources to invest in in-house network and purchasing of appliances. About 70% of the population has lower than the average household incomes. Hence we could assume that the same share of the 50 000 households mentioned above could be addressed by GIS. In other words about 35 000 households with lower than average incomes could be supported by GIS in order to accelerate the penetration of gas-supply.

Accounting for the expected emissions reduction of 5.67t CO_2 from fuel switch of a household per year it turns out that about 992 thousand tons CO_2 emissions of these households can be greened for the five years of the first Kyoto period. At an emission price about 20 BGN/t CO_2 and greening of 1 million tons CO_2 in round numbers, we could receive 20 million BGN (10 million €) for stimulating the connection of low-income households to the gas-supply network. Besides the support of a household would cost 567 BGN on average, which allows subsidizing of 18.9% of the household's costs on gas-supply.

The acceleration of gas supply to low-income households via GIS would bring to more intensive gas-supply to the other households with higher income. Thus the greening effect will be bigger than the effect calculated above. The higher growth of households' natural gas consumption will bring to a reduction specific gas distribution costs and hence – to reduction of its price for households.

If GIS is implemented the number of households supplied with natural gas should grow at least to 100 000 till 2007. This would decrease considerably GHG emissions and electricity consumption. The peak load of the Power System would drop by 200 – 300 MW which would be a good support for the power sector in case of early termination of the operation of units 3 and 4 at Kozloduy NPP.

An estimate shows that the natural gas supply to households program implementation to the full extent would bring to the CO_2 emission reduction of 6.8 million tons CO_2 annually.

Conclusions

1. The natural gas supply to households is a promising option for GHG emission reduction in the country, as well as for reduction of electricity demand and peak load of the National Grid. Its penetration in the country is hindered by the low income of the households. An average household is not able to spend about half of the annual income to buy the necessary appliances and to install the in-house gas network.
2. Greening should address the most promising in terms of GHG emissions reduction cases – the houses with electrical space heating situated in cities with population of more than 20 – 30 000 people living in blocks of flats. About 35 000 households with lower than average incomes could be supported by GIS in order to accelerate the penetration of gas-supply.
3. GIS support for 35 000 households with lower than average incomes would bring to about 992 thousand tons CO_2 emission reduction for the five years of the first Kyoto period. The GIS support could be organized through a special social fund of at least 20 million BGN for stimulating the connection of low-income households to the gas-supply network. The GIS support for households would allow subsidizing of 570BGN to a low income household or more than 19% of the household's costs on gas-supply.

MUNICIPAL SECTOR (ENERGY EFFICIENCY)

General description of the municipal sector in Bulgaria

In Bulgaria there are 262 municipalities, which are the second tier of bodies of political power after the national government. The jurisdiction of municipalities may extend over one separate city, smaller neighboring towns, villages and rural areas. Municipalities are administered by a local authority elected by the population which has a certain power of authority with respect to local taxes, local expenditures and legislative initiative. Municipalities possess a building stock and are responsible for providing specific services to the population.

According to the size of their population municipalities may be divided in the following groups:

Size	No of municipalities	Population	% from total population
To 5 000 inhabitants	31	107 836	1.4
5 001-10 000	66	495 680	6.2
10 001-20 000	78	1 131 443	14.3
20 001-50 000	54	1 606 785	20.2
50 001-100 000	21	1 479 899	18.7
Over100 000	12	3 107 258	39.2
Total	262	7 928 901	100.0

Sourse:National Statistical Institute

Municipalities are significant energy consumers, since they fulfill a number of public functions which require significant use of energy. Energy consumption in municipalities covers the following main spheres:

- Buildings, which are municipal property: administrative centers, schools, cultural sites, sports facilities, medical and social care facilities;
- public transport;
- public services: street lighting, water supply and sewerage.

For this study only municipal buildings and street lighting has been analyzed.

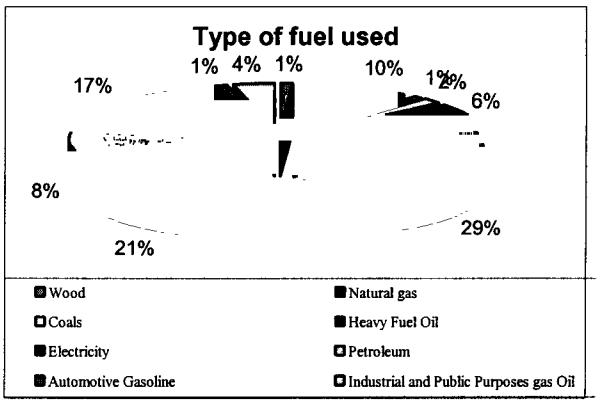
Energy Consumption in the Municipal Sector

The analysis of the potential for mitigation of GHG emissions in the public sector has been made on the basis of data on the energy consumption in municipal sites and on projects implemented by member-municipalities of the Municipal Energy Efficiency Network EcoEnergy. At the beginning of 2004 the membership of EcoEnergy comprised 54 municipalities and 6 regional associations of municipalities. In this way the membership of the network comprises a total of 156 municipalities. Members of the network account for 60% of the total number of municipalities in Bulgaria and represent above 68% of the total population of the country. The Center for Energy

Efficiency EnEffect has been assigned the role of Secretariat of EcoEnergy.

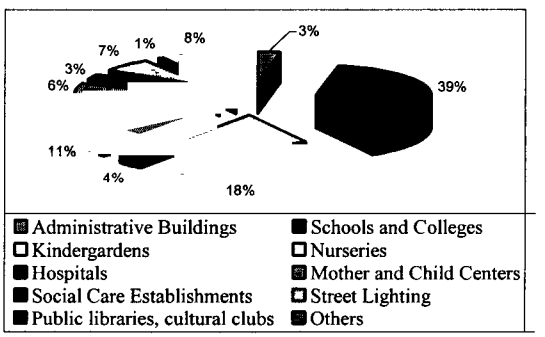
For the analysis provided in this annex data from the Information System on energy consumption in municipal sites has been used. The system includes data on the building stock municipal property and about the annual energy consumption of each building by types of fuels. To date information about more than 2,000 municipal sites has been entered in the database (This information includes description buildings: type of construction technology, number of floors, floor area and heated space, type of the in-house systems, type of fuel used). The information on energy consumption of the sites is entered by quarters and is collected and aggregated by EnEffect.

The figures illustrate the relative share of energy consumption by target groups[1] in the municipalities. It is evident from the graph that school buildings account for a significant share of the total energy consumption – 39%, followed by kindergartens (18%), hospitals (11%) and street lighting systems (7%).



Data for the energy consumption by types of fuel EcoEnergy member-municipalities shows that naphtha for space heating accounts for the highest share (29%), followed by electricity, mainly for street lighting and indoor lighting in buildings (21%), thermal energy for district heating (17%) and natural gas (10%).

Bulgarian municipalities spend about 4-8% of their budgets for purchase of fuel and energy. This is the consequence of the unsatisfactory state of repair of the buildings and in-house systems and the obsolete and poorly maintained technical equipment. Local authorities are permanently seeking



[1] A target group means a group of sites having similar rate of electricity consumption. For the purposes of energy planning EcoEnergy has identified 18 target groups, for which information is collected and processed in the database.

for ways and means to alleviate the burden of energy costs on municipal budgets. Self-restrictions on energy consumption is imposed by, for instance, switching off street lighting or maintaining of indoor temperature in the buildings below the norm requirements. Others turn to the implementation of individual measures or comprehensive projects for energy efficiency improvement.

A major barrier to the implementation of such projects is the grave shortage of financial resources – no funds for such retrofits are envisaged in municipal budgets, the banking system in the country is as yet reluctant to give loans to municipalities. Another major problem is that if municipalities achieve certain amount of savings related to an more effective use of energy, this automatically diminishes the amount of subsidized energy expenses to be included in the next year budget, which does not allow for the municipality to keep the savings for refunding a bank loan or implementing another energy efficiency project.

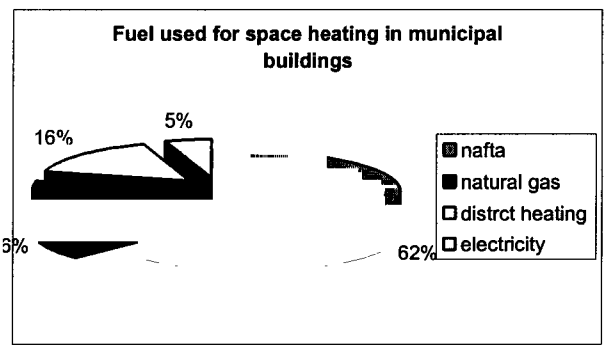
Review of the Investment Requirements and Energy Conservation Potential in the Municipal Cector

Municipal buildings

For the purposes of this analysis data about 430 municipal sites in 27 EcoEnergy member-municipalities have been processed (schools, kindergartens, nurseries). These types of sites have been selected because they account for a significant share in the total energy consumption in their respective municipalities (and hence for a large share of the energy costs paid from the municipal budgets). The types and the total number of sites by municipalities are shown in Annex 1.

The distribution of the types of fuel used for space heating is as follows:

- naphtha 62 %
- district heating 16 %
- natural gas 16 %
- electricity 6 %



On the basis of the performed 28 energy audits and the developed business plans[2] for energy efficiency projects in municipal schools, kindergartens and nurseries it has been found out that:

- the real energy consumption in municipal buildings is substantially lower than the standards – on the average some 20% below the normalized rate[3];
- reduction of energy consumption by 20 –30 % on the average is possible even without fuel shift through application of energy efficiency measures on the building envelope and the in-house space heating system;

[2] The projects have been worked out by EnEffect in the framework of the project "Energy Efficiency Strategy to Mitigate GHG Emissions". Energy Efficiency Demonstration Zone in the City of Gabrovo, Republic of Bulgaria"

[3] Normalized energy consumption is that, under which the norm requirements for indoor temperature and lighting rates are met.

It has been assumed that energy efficiency measures (without fuel switch) will be applied in all the buildings, comprising: replacement and/or automation of the heating boiler, repair and weather-stripping of windows, measures on the in-house space heating systems and fitting of thermostatic radiator valves (only for kindergartens and nurseries). These are the measures, which have proven their effectiveness and feature a relatively short payback period on investments (2-3 years).

The total investments requirements for implementation of energy efficiency projects in all the 430 sites amount to USD 6 997 000 (Table 1).

The energy savings by types of fuels/energy carriers are as follows:

- naphtha 27 417 MWh/year
- natural gas 7075 MWh/year
- district heating 7 028 MWh/year
- electricity 2 211 MWh/year

The results from the energy savings and required investment were calculated after extrapolating the actual results from 28 energy efficiency projects, taking into account the difference between size of building, fuel used, different usage of buildings, etc. We consider the results to be correct enough to serve as a base for estimating the total potential in municipal sector in Bulgaria.

Table 1: Number and kind of the Municipal Cites in EcoEnergy

Municipality	Number of the Cites	Population
Belene	9	12 816
Belogradchik	6	8 908
Botevgrad**	6	36 642
Bourgas	22	212 594
Veliko Tarnovo	21	90 597
Vidin	24	82 981
Gabrovo	19	80 032
Gorna Oryahovitza	21	55 551
Dobrich	40	100 399
Zlatograd	9	15 143
Kazanlak	14	185 482
Kardjali	21	76 509
Lovech	18	64 166
Montana	16	63 769
Omurtag	13	26 951
Pazardjik	24	128 856
Pernik	23	105 867
Razlog	5	20 907
Svishtov	23	48 214
Stara Zagora	20	173 185
Haskovo	15	100 509
Berkovitza	12	23 085
Levski	8	27 312
Krumovgrad	6	30 410
Sevlievo	15	45 466
Targovishte	20	62 027
	430	**1 878 378**

Table 1 Results for 430 buildings in EcoEnergy

Table 1 Results for 430 buildings in EcoEnergy

Building type	Nr	Boiler change	Automation	Repair and isolation of windows	Thermostatic valves	Total	Boiler change	Automation	Repair and isolation of windows	Thermos tatic valves	Total	USD/MWh
		Investment, USD.				USD	Energy saving MWh				MWh	
Kindergarten	164	830 375	301 125	653 165	279 500	2 064 165	4 870	2 508	3 363	419	13 831	149
School	231	1 643 500	515751	2 311 729		4 471 011	8 165	4 946	14 526	**3 521**	27 637	161
Nurseries	35	205 063	61 313	126 898	56625	449 898	1 106	600	560	**3 521**	2 684	167
Total	**430**	**2 684 219**	**880 000**	**3 095 418**	**337 750**	**6 997 386**	**14 171**	**8 066**	**18 465**	**3 521**	**44 222**	**158**

Street lighting systems

According to 1999 data provided by the NEC a national total is about 1 000 000 luminaires are installed in street lighting systems in municipalities and about 90% of them use high-pressure mercury bulbs. The total installed capacity for street lighting in the country is 270 MW. At 3800 hours mean annual operation of the street lighting systems, the total annual electricity consumption for street lighting would be 1 026 000 MWh/year.

In recent years projects for energy efficiency reconstruction of street lighting systems were implemented in part of the municipalities in the country. The experience from the projects implemented in EcoEnergy member-municipalities shows that in the event of replacement of the old luminaries by energy efficient ones the total installed capacity is diminished 3 – 3.5 times. EnEffect's observations have revealed that to date about 160 MW of the total installed capacity for street lighting uses inefficient bulbs. The savings that would be realized through implementation of energy efficiency projects amount to 405 000 MWh/year and the total investment requirements – to USD 45 000 000.

Greening Potential in Municipal Sector

For estimation of the CO2eq reduction potential it is accepted that projects will be realized in municipal buildings[4] as follows:

- ✓ Municipalities with population 10 000 – 20 000 in 3 schools, 4 kindergartens and 1 nursery
- ✓ Municipalities with population 20 000 – 50 000 in 6 schools, 9 kindergartens and 2 nurseries
- ✓ Municipalities with population 50 000 – 100 000 in 12 schools, 14 kindergartens and 5 nurseries
- ✓ Municipalities with population over 100 000 in 25 schools, 28 kindergartens and 10 nurseries

Thus the total number of municipal buildings would be 1 110 schools, 1 428 kindergartens and 411 nurseries. Other types of buildings as social houses, administrative buildings, museums etc have not been included because their number is very small compared to these. An average amount of reduced CO2 was calculated based on the energy saving data for the 430 buildings discussed above as follows: for schools 34 tCO_{2eq}/building, for kindergartens 24 tCO2eq/building and for nurseries 21 tCO2eq/building. Of course this figures depend on the size of buildings, conditions, etc, but for the means of this analysis and extrapolating them to all municipalities in the country we consider them to be accurate enough. The required investments for implementing project in these building will amount 40 – 50 mln USD.

On the basis of the estimated savings after application of the energy efficiency measures the potential for avoided emissions in $CO_{2equivalent}$ has been calculated. The annual emissions reduction in $CO_{2equivalent}$ for selected types of buildings amounts to 80 643 tonnes. The total potential for municipal sector in Bulgaria including street lighting systems would be 826 884 tCO_{2eq} (Table 2). The price per tone reduced for the First commitment period will amount around 23 USD per tone CO_{2eq}. If we include in the required investments the design of the projects and project management costs, the price for tCO_{2eq} will increase 10-15% and will be 27 USD/tCO_{2eq}. It is obvious that the potential from street lighting projects is much higher and it will be good for municipalities applying for "green projects" to bundle municipal buildings with street lighting to ensure better efficiency.

[4] Data for the number of different buildings is calculated based on data in EcoEnergy information system

The way of diminishing the project management and implementation costs is if municipality uses an Energy Service Company for example, they will take care for implementation of all projects in buildings and in the street lighting system in certain municipality. This will also secure the municipality for receiving a certain amount of energy and budget savings, leaving the possible risk for implementing the projects to the service company. Possible financial scheme for these projects could be 50 % "Green investment", 40 % bank loan and 10 % municipal funds. Municipal funds will be used mainly for project design and management.

Table 2 Potential for reducing CO_2 emissions in municipal sector

	CO_{2eq}	2008-2012	
	t/year	tCO_{2eq}	USD/tCO_{2eq}
Total buildings	80 643	403 215	124
Street Lighting	746 241	3 731205	12
Total municipal sector	**826 884**	**4 134 420**	**23**

Time schedule for the implementation:

- ✓ for municipalities with up to 50 000 inhabitants

  Detailed energy audits, design - 4 months (during heating season)

  Implementation of projects – 7 - 8 months (during spring and summer); it is realistic that with good organization and coordination of activities projects in up to 15-18 objects are realized for one year (especially having in mind that the size of the buildings in those type of municipalities is not too big)

- ✓ For municipalities with 50 000 – 100 000 *inhabitants*

  Detailed energy audits for all buildings and street lighting, design - 4 months (during heating season)

  Implementation of projects – two years due to the fact that most of the work must be done out of the heating season and during school and kindergarten holidays

- ✓ For municipalities with over 100 000 inhabitants

  Detailed energy audits for all buildings, design - 8 months (during heating season)

  Implementation of projects – three years due to the fact that most of the work must be done out of the heating season and during school and kindergarten holidays

Conclusions

On the basis of the calculated potential for energy savings and respective GHG emissions in municipal sites, in compliance with the objective of this analysis, one may make the general conclusion that there is a substantial potential for reduction of GHG emissions.

The projects would be much more effective if they are grouped by municipalities or if several municipalities implement simultaneously measures in an identical group of sites – school buildings, kindergartens, etc.

COGENERATION IN THE DISTRICT HEATING AND INDUSTRY

1. Public District Heating and Heat Consumption in the Industry

The District heating companies (DHC) are supplying about 18 % of the Bulgarian households and the commercial sector with heat. Some of the DHC used to supply steam to industries. Recently the industrial demand for steam and heat has dropped drastically due to the industrial decline. Some of the industrial enterprises have constructed own heat sources – small and medium size natural gas boilers. Now the district heating companies are supplying with heat mainly households and public and commercial buildings. The total heat production for 2001 accounts for 108,261TJ, including 57,576TJ heat demand in the industry and 51,172TJ heat produced in DHC. This amount of heat production allows to produce about 25TWh electricity in cogeneration, if efficient combined heat and power production by natural gas turbines or motors is utilized. In 2001 the total electricity production in the country was 43.5TWh, including 5.8TWh electricity cogeneration. It is obvious that there exists significant additional potential for cogeneration. It is concentrated in the District Heating Plants and in the industrial enterprises.

Part of the DHC has relatively stable economic indexes. Some are burning natural gas for co-generation (TPP Sofia and TPP Plovdiv), others are burning natural gas for heat production only. Natural gas is burned in steam generation or water heating boilers.

2. Upgrading of DHP with Gas Turbines

The recently developed natural gas combined cycle and cogeneration modules allow to increase the efficiency of cogeneration up to the level of 90 %. Seven of the district heating plants in the country could be extended by installation of gas turbines for electricity production and heat exchangers for heat utilization of the exhausted gases for district heating.

TPP Sofia

The total installed thermal capacity in TPP Sofia amounts to 1786,5 MW: 924,6 MW steam generators of which 3SG of 54,7 +3SG of 151,2 + 3SG of 157; 697,8 MW water boilers - 6 WB x 116,3. By 2008 steam generators 2, 3, 4, 5, and 6 will be decommissioned. Three steam generators with production capacity of 220 tons per hour, one turbine of 25 MW, and six water boilers will remain operational. The average annual electricity and thermal energy supplies for the period 1996 – 2000 were respectively 406 500 MWh and 1 842 453 MWh. The heat production of the plant allows installing additional gas turbines and steam turbines with capacity of 110 MW. The investment requirements are estimated at 120 mln euro. The expected annual utilization of the installed power capacity is 6000 h. The heat rate for electricity production is 180 g.c.eq./KWh. The annual CO_2 emission reduction compared to a new lignite fired power plant is estimated to be 597,64 Gg /CO_2 eqv., or 8964,65 Gg for 15 years life time of the turbine. The emission reduction cost is 13,38 euro/CO_2 eqv. if the life time if the life time of the turbine is considered.

Index	Unit	TPP Sofia
Installed capacity	MW	110
Load factor	h	6000
Electricity production	10^6kWh/a	660
Investments- total	Euro10^6	120
Hate rate for electricity production	g.c.eq./kWh	180
Annual CO_2 emission reduction	Gg	597,64
Life time emission reduction	Gg	8964,65
Costs of emission reduction	Euro/t	**13,39**

The expected average annual electricity production 660 10^6 KWh/a with load factor 6000 h.

TP Zemliane

The main heat generating capacity of TP Zemliane consists of 5 water boilers (two units type BK -100 and three units type ПТВМ -100), each with thermal capacity of 116,3 MW_{th} (100Gcal/h). The total installed capacity of TP Zemliane is 581,5 MW_{th} for hot water supply. The reported average annual production of thermal energy during the period 1996 –2000 was 1 239 122 MWh. The heat production of the plant allows installing gas turbines with total capacity of 60 MW. The investment requirements are estimated at 36 mln euro. The expected annual utilization of the installed power capacity is 6000 h. The heat rate for electricity production is 161,5 g.c.eq./kWh. The annual CO_2 emission reduction compared to a new lignite fired power plant is estimated to be 336,88 Gg /CO_2 eqv., or 5053 Gg for 15 years life time of the turbine. The emission reduction cost is 7,12 euro/CO_2 eqv. if the life time if the life time of the turbine is considered.

Index	Unit	TP Zemliane
Installed capacity	MW	60
Load factor	H	6000
Electricity production	10^6kWh/a	360
Investments- total	Euro10^6	36
Hate rate for electricity production	g.c.eq./kWh	162
Annual CO_2 emission reduction	Gg	336,88
Life time emission reduction	Gg	5053,24
Costs of emission reduction	Euro/t	**7,12**

TPP Plovdiv

The total installed thermal capacity in TPP Plovdiv is 660 MW_{th} - 4SGs x 157+ 1SG x 32.

During the period 1996 - 2000 the average annual production of electricity and thermal energy was 110 314 MWh and 532 953 MWh respectively.

The heat production of the plant allows installing additional gas turbines with capacity of 100 MW. The investment requirements are estimated at 60 mln euro. The expected annual utilization of the installed power capacity is 5800 h. The heat rate for electricity production is 161,4 g.c.eq./kWh. The annual CO_2 emission reduction compared to a new lignite fired power plant is estimated to be 542,85 Gg /CO_2 eqv., or 8142 Gg for 15 years life time of the gas turbines. The emission reduction cost is 7,37 euro/ CO_2 eqv. if the life time if the life time of the turbine is considered.

Index	Unit	TPP Plovdiv
Installed capacity	MW	100
Load factor	h	5800
Electricity production	10^6kWh/a	580
Investments- total	Euro10^6	60
Hate rate for electricity production	g.c.eq./kWh	161
Annual CO_2 emission reduction	Gg	542,85
Life time emission reduction	Gg	8142,76
Costs of emission reduction	Euro/t	**7,37**

TP Plovdiv

The total installed capacity in TP Plovdiv is 410 MW_{th} (3WBs x 116,3 MW + 3SGs x 8.7 + 2SGs x 18). The reported average annual production of thermal energy for the period 1996 – 2000 was 398 279 MWh.

The heat production of the plant allows installing gas turbines with total capacity of 25 MW. The investment requirements are estimated at 15 mln euro. The expected annual utilization of the installed power capacity is 5760 h. The heat rate for electricity production is 161 g.c.eq./kWh. The annual CO_2 emission reduction compared to a new lignite fired power plant is estimated to be 134,7 Gg /CO_2 eqv., or 2021Gg for 15 years life time of the gas turbines. The emission reduction cost is 7,42 euro/a/t CO_2 eqv. if the life time if the life time of the turbine is considered.

Index	**Unit**	**TP Plovdiv**
Installed capacity	MW	25
Load factor	H	5760
Electricity production	10^6kWh/a	144
Investments- total	Euro10^6	15
Hate rate for electricity production	g.c.eq./kWh	161
Annual CO_2 emission reduction	Gg	134,78
Life time emission reduction	Gg	2021,65
Costs of emission reduction	Euro/t	**7,42**

TP Burgas

The total installed capacity in TP Burgas is 366,3 MW_{th} - 2WBs x 58,15 + 2WBs x 116,3 +2PGs x 8,7. The average annual production of thermal energy during the reported period 1996 – 2000 was 418 287 MWh.

The heat production of the plant allows installing gas turbines with capacity of 30 MW. The investment requirements are estimated at 18 mln euro. The expected annual utilization of the installed power capacity is 6000 h. The heat rate for electricity production is 157 g.c.eq./kWh. The annual CO_2 emission reduction compared to a new lignite fired power plant is estimated to be 169,77 Gg /CO_2 eqv., or 2546,50 Gg for 15 years life time of the turbine. The emission reduction cost is 7,07 euro/ CO_2 eqv. if the life time if the life time of the turbine is considered.

Index	**Unit**	**TP Bourgas**
Installed capacity	MW	30
Load factor	h	6000
Electricity production	10^6kWh/a	180
Investments- total	Euro10^6	18
Hate rate for electricity production	g.c.eq/kWh	157
Annual CO_2 emission reduction	Gg	169,77
Life time emission reduction	Gg	2546,50
Costs of emission reduction	Euro/t	**7,07**

TP Vratza Mladost

There are two water heating boilers with total thermal capacity of 116,3 MW (2WBs of 58.15). During the period 1996 -2000 the reported average annual production of thermal energy was 129 807 MWh.

The heat production of the plant allows installing gas turbine with capacity of 10 MW. The investment requirements are estimated at 6 mln euro. The expected annual utilization of the installed power capacity is 5740 h. The heat rate for electricity production is 167 g.c.eq./kWh. The annual CO_2 emission reduction compared to a new lignite fired power plant is estimated to be 53,23 Gg /CO_2 eqv., or 798 Gg for 15 years life time of the turbine. The emission reduction cost is 7,51 euro/a/t CO_2 eqv. if the life time if the life time of the turbine is considered.

Index	Unit	TP Mladost-Vratsa
Installed capacity	MW	**10**
Load factor	H	**5740**
Electricity production	10^6kWh/a	**57,4**
Investments- total	Euro10^6	**6**
Hate rate for electricity production	g.c.eq/kWh	**167**
Annual CO_2 emission reduction	Gg	**53,23**
Life time emission reduction	Gg	**798,39**
Costs of emission reduction	Euro/t	**7,52**

TP Vladislav Varnenchik

This plant is part of the Varna District Heating Company. The installed thermal generating capacity is 250 MW_{th} - 2WBs x116+ 2SGs x 8,7. During the period 1996 - 2000 the reported average annual production of thermal energy was 138,983 MWh.

The heat production of the plant allows installing gas turbines with capacity of 8 MW. The investment requirements are estimated at 4,8 mln euro. The expected annual utilization of the installed power capacity is 6000 h. The heat rate for electricity production is 167 g.c.eq./kWh. The annual CO_2 emission reduction compared to a new lignite fired power plant is estimated to be 44,49 Gg /CO_2 eqv., or 667 Gg for 15 years life time of the turbine. The emission reduction cost is 7,19 euro/a/t CO_2 eqv. if the life time if the life time of the turbine is considered.

Index	Unit	TP Varna
Installed capacity	MW	8
Load factor	H	6000
Electricity production	10^6kWh/a	48
Investments- total	Euro10^6	4,8
Hate rate for electricity production	g.c.eq/kWh	167
Annual CO_2 emission reduction	Gg	44,49
Life time emission reduction	Gg	667,29
Costs of emission reduction	Euro/t	**7,19**

3. Upgrading of Industrial Heating Plants with Gas Turbines

The industrial heat demand has decreased drastically during the transition period and is stabilized at the level of 57,000TJ. Significant part (17,500TJ) is situated in the chemical industry, where cogeneration is well presented. The other industrial sectors (excluding chemical industry and metallurgy) consume 34,500TJ heat. The main potential for cogeneration is situated there. Dozens of enterprises in the food and drinks industry, paper industry, textile and other industries are expressing interest to replace the old oil and gas water heating boilers with modern cogeneration based on gas turbines and motors. The necessary investments are estimated to be 900 Euro per installed electrical kilowatt. Typically the heat demand of these enterprises varies in the range from 5MW to 20MW and the peak load utilization from 4,500 to 8,000 hours. It is considered that at least 40MW cogeneration could be introduced every year beginning from 2006 and till 2012. The average loading factor is estimated to be at the level of 7300 hours for the units introduced till 2009, and 6500 for the others. The capacity of these cogeneration units and the electricity produced are shown in the table.

Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Total capacity, MW	40	80	120	160	200	240	280	280
Electricity production, GWh	292	584	876	1168	1428	1688	1948	1948

4. Tentative Program for Upgrading of the DHP with Gas Turbines

The total installed capacity for electricity generation for the above mentioned DHP projects could reach 343MW, with annual electricity production of more than 2030 GWh (more than 2% of the in-country gross electricity demand). Additional potential for installation of about 100MW exists in the TPP Sofia East, as well as about 60 MW in TP Lulin (Sofia DHC). All the above mentioned projects were identified during pre-feasibility studies. Not all of the projects have got official support from the relevant ministries.

It could be expected that if the green certificates for the cogeneration of electricity are introduces in 2006, the DHP will be upgraded gradually as shown in the table:

New cogeneration capacities, MW

Plant / Year	2006	2007	2008	2009	2010	2011	2012	2013
TPP Sofia	110	110	110	110	110	110	110	110
TP Zemliane			60	60	60	60	60	60
TPP Plovdiv		100	100	100	100	100	100	100
TP Plovdiv		25	25	25	25	25	25	25
TP Burgas	30	30	30	30	30	30	30	30
TP Vratza - Mladost		10	10	10	10	10	10	10
TP Vladislav Varnenchik			8	8	8	8	8	8
Total capacity, MW	140	275	343	343	343	343	343	343

The following table gives the electricity production of the new cogeneration capacities:

Electricity production of the new cogeneration capacities, GWh

Plant / Year	2006	2007	2008	2009	2010	2011	2012	2013
TPP Sofia	660	660	660	660	660	660	660	660
TP Zemliane			360	360	360	360	360	360
TPP Plovdiv		580	580	580	580	580	580	580
TP Plovdiv		144	144	144	144	144	144	144
TP Burgas	180	180	180	180	180	180	180	180
TP Vratza - Mladost		57	57.4	57.4	57.4	57.4	57.4	57.4
TP Vladislav Varnenchik			48	48	48	48	48	48
Electricity production, GWh	840	1621	2029	2029	2029	2029	2029	2029

Carbon balance of the DHP and Industrial CHP plants.

The electricity produced at the new industrial CHPs belongs to the category of non-dispatch energy. The production volume depends on the heat load and is base load. The expected production volumes will be able to cause changes in the schedule for commissioning of new capacities at the scheduled new lignite coal fired thermal plant.

The expected emission reductions are presented in the table:

CO_2 Emission reductions for the period 2006 – 2013, kt

Plant / Year	2006	2007	2008	2009	2010	2011	2012	2013
TPP Sofia	598	598	598	598	598	598	598	598
TP Zemliane			337	337	337	337	337	337
TPP Plovdiv		543	543	543	543	543	543	543
TP Plovdiv		135	135	135	135	135	135	135
TP Burgas	170	170	170	170	170	170	170	170
TP Vratza - Mladost		53	53	53	53	53	53	53
TP Vladislav Varnenchik			44	44	44	44	44	44
Total emissin reduction, DHP	767	1498	1880	1880	1880	1880	1880	1880
Total emissin reduction, Industrial plants	273	546	819	1092	1335	1578	1821	1821
Total emissin reduction	1040	2044	2699	2972	3215	3458	3701	3701

CO2 emission reductions by periods and type of cogeneration plants are given in the next table

Emission reduction, kt

Plant/Year	**Till 2007**	**2008 – 20012**	**2013 – 2020**
District Heating plants	2266	9398	15037
Industrial Plants	819	6646	14571
Total	3085	16044	29608

There is a potential for emission reduction of about 3,085 kt for the period till 2008, 16,044 kt for the first Kyoto period, and 29,608 kt for the period 2013 – 2020.

The investments required for the period till 2012 to install 623 MW cogeneration capacities are estimated at about 512 million Euro. Depending on the cost of the transferred emission reduction the support for the CHPs investment could reach from 30% (if 10 Euro/t CO_2 is accepted) to 60% (if 20 Euro/t CO_2 is accepted) for the first commitment period.

Such a support, if combined with timely introduction of the green certificates for cogeneration of electricity could accelerate significantly CHP construction by upgrading of the DHP and industrial cogeneration.

WASTE MANAGEMENT

1. Legislation and programs

Considering the problems related to implementation of the waste-related legislation in recent years and the targets set for implementation of the EU standards on environmental protection, the National Assembly adopted a Waste Management Law (WML) in September 2003. This law fixes the overall requirements for environmental and public health protection related to waste generation, disposal, collection, transportation, utilization and treatment. The adoption of WML provided the legislative framework for complete harmonisation of the National legislation with the requirements of the relevant EU Directives and of the National Program for implementation of Directive 1999/31/EC on waste disposal. A National Programme on Waste Management for the period 2003 – 2007 was elaborated and is currently under implementation.

All cities in the country operate landfills. The typical amount of waste to be disposed at regional landfill sites varies between 50,000 and 100,000 ton per year. The Governmental policy is to close down small landfills and to focus on larger, regional landfill sites. In the future, these regional waste disposal sites will play an essential role in Bulgaria's waste policy. At present, controlled extraction of landfill gas does not occur in Bulgaria. The future solid waste disposal sites (SWDS) will be located near the cities and will be managed in a modern way.

2. Waste Collection

Over the past years a number of landfills have already been modernized. Waste collection services and disposal techniques have been improved. The quantities of solid urban waste generated during the period 1998-2001 are presented in Table 1 below.

Table 1. Quantities of waste generated during the period 1998-2001

Year	Quantity,['000 ton]			
	1998	1999	2000	2001
Solid urban waste	4,103	4,141	4,224	4,003

Source: The data provided by the National Statistical.

The sources of data about the solid urban waste are the municipal administrations, whose range of functions comprises also waste management. Subject to survey are municipal landfills for solid urban waste, servicing the human settlements on the area in which organized waste collection is in place. During the period 1998-2001 the quantities of solid urban waste collected at the municipal landfills vary in the range between 498 kg/inhabitant/year and 518 kg/inhabitant/year. The rate of accumulation of waste reaches its highest value in the year 2000, when generation of 3,318 thousand tons of solid urban waste was reported for 1,190 settlements, inhabited by 78.6% of the total population of the country. According to the National Statistical Institute (NSI) data 99.6% of the waste collected in the course of the year have been deposited in landfills. By 31 December 2001 the number of landfills servicing human settlements with organized waste collection and transportation was 663 and a total of 3.2 million tons of solid urban waste has been deposited in them. As compared to 1997 the quantity of generated solid urban waste has diminished by 12%.

Table 2. Reported quantities of solid urban waste and waste generation rate

Year	Collected quantities of solid urban waste *Tonnes*	Serviced population *Inhabitants*	Population country total *Inhabitants*	Waste generation rate *Kg/inh./year*
1998	3,196,836	6,414,948	8,230,371	498
1999	3,213,349	6,353,133	8,190,876	506
2000	3,318,022	6,402,154	8,149,468	518
2001	3,210,846	6,360,064	7,928,901*	505

** The data refers to the population census by March 1, 2001. Source: NSI*

3. Solid urban waste composition

Recently the Executive Environmental Agency is regularly performing surveys of the composition of the waste. Data sows relatively stable composition with about 55% biodegradable mater. The 2002 waste composition data are given in figure 1.

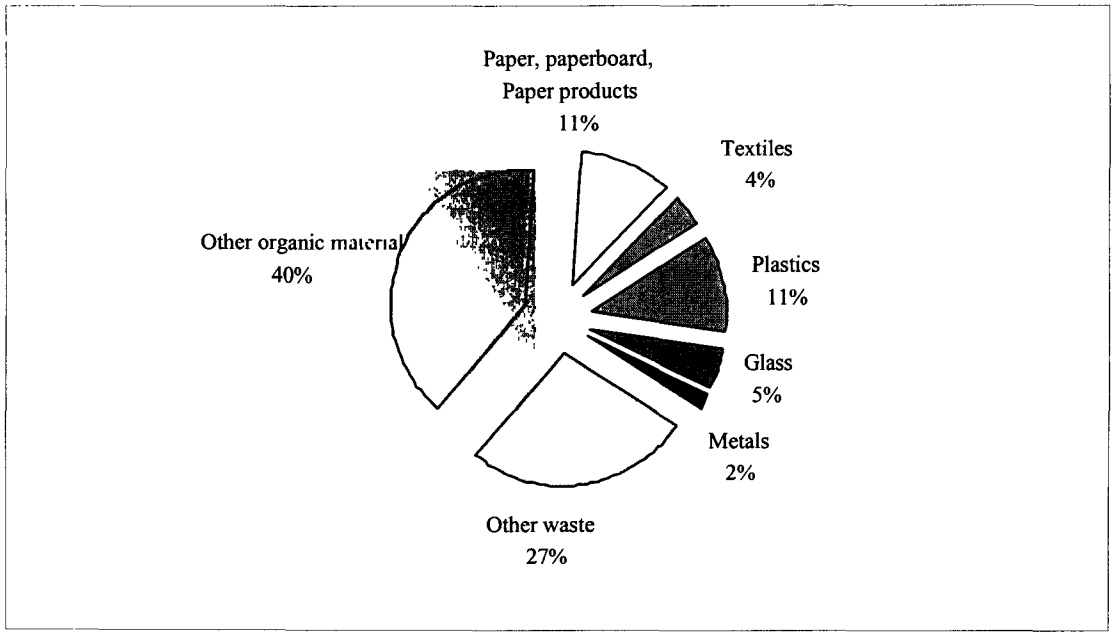


Figure 1. Composition of municipal waste in 2002.

4. Landfills or Waste incineration

According to data provided by the NSI, by December 31, 2001, the number of landfills servicing human settlements with organized waste collection was 663. Fifty nine (59) of these landfills service settlements with a population above 20,000 people, which corresponds to approximately 70% of the total population of this country. In the framework of the project National_Program for Diminishing of the Number of and Risks from Landfills and Previous Waste-related Pollution, in 2001 these landfills were audited, listed and evaluated. The results from the inventory permit categorization of the investigated landfills in four groups in terms of the risks for the environment and human health. The obtained results served as the basis for the establishment of a Registry of Landfills and Previous Waste-related Pollution in the framework of the National Environmental Monitoring System, maintained by the Executive Environmental protection Agency. By the end of 2001 the Registry contained entries for 275 landfills.

In implementation of the National Waste Management Program, in the period 1999-2002 twelve landfills have been constructed, reconstructed and commissioned into regular operation (Antonovo, Vratsa, Gorna Malina, Gotse Delchev, Karlovo, Madan, Rudozem, Sandanski, Trojan, Suhodol, Tsalapitsa and Varna). They comply with the requirements of EU Directive 1999/31/EC concerning waste disposal.

Simultaneously, construction of six new regional landfills for solid urban waste has started with financial support from the EU under the ISPA Program – Montana, Pernik, Rousse, Sevlievo, Silistra and Sozopol. The total value of all projects is above 75 million USD, including 56 million USD (or 75% of the total value) grant under ISPA. The rest of the funding is provided from the state budget. Each regional landfill will service a population of 100,000 inhabitants on the average. The implementation of the project will help resolve the problems of waste disposal of a total of 665,000 inhabitants of the respective regions. The implementation of the sites is a step forward

towards application in practice of the requirements of the European Directives with respect to solid urban waste disposal. It is further in full compliance with the policy of the Ministry of Environment and Waters for creation of a system of modern facilities and equipment for waste treatment on a regional basis. Construction of methane recuperation systems at these landfills is also envisaged.

Construction of other 10 regional landfills was further launched in 2003 with funding allocated from the state budget – Dobrich, Dospat, Lovech, Omourtag, Oryahovo, Petrich, Harmanli, Shumen, Razgrad and Yambol.

In order to ensure application of Directive 1999/31/EC concerning waste disposal, the National Program for Landfill Management envisages the implementation of 54 investment projects for reconstruction of existing landfills and construction of new regional landfills for decontamination and treatment of solid urban waste. The regions to be serviced and the time schedule for implementation of the projects are laid down in the Program for Application of the Directive. The investment requirements for the period 2003-2007 amount to 170 million USD.

Currently, the investments required for construction of new regional landfills, complying with the regulatory requirements, are provided in the framework of the ISPA Program, as well as from the state budget, the Program for Landfill Management and Environmental Protection (the Environmental Protection Fund) and under bilateral projects. The serviced municipalities and landfill operators have no responsibilities with respect to procurement of financing for the construction works. The required funding for the new regional landfills for the period 2003-2007 has been determined on the basis of the Implementation Program for Directive 1999/31/.

The investment requirements for each of the landfills have been determined by means of the model described in the Implementation Program for Directive 1999/31/ under the following assumptions:

- Service life: 15 years
- Period of preparatory activities and construction works: 3 years
- Fill-up density 0.95 t/m^3 for the landfills with capacity above 5,000 t/year and 0.75 t/m^3 for the landfills with capacity below 5,000 t/year.
- Average fill-up depth within the range of 3 to 18 m, depending on the landfill capacity.
- Landfill area, determined as a function of the required capacity and the service life of the facility, as well as the assumed fill-up density and average depth.

Waste Incineration

Waste incineration is not a common practice in the country. To date there is no facility for municipal solid waste incineration in Bulgaria. The main reasons for that should be sought in the high costs for_construction of incineration facilities as compared to the existing practice of waste disposal in landfills, the relatively low calorific value of the mixed waste in the country and the limited capacities of municipalities to invest in municipal infrastructure for waste decontamination and treatment.

5. Methane Generation and Capture

As a result of anaerobic and aerobic dissolution of the organic component of the municipal solid waste, the greenhouse gas methane is released.
Methane emissions in the country are reported under the annual GHG emissions inventories. The estimates are based on the 1996 Revised IPCC Guidelines tier 1 methodology. The disposed waste and methane emissions for the period 1997-2001 are given in table 3.

Table 3. Methane emissions from landfills

Type of landfill	1997	1998	1999	2000	2001
1. Managed landfills					
Municipal solid urban waste deposited at solid urban waste landfills, Gg	2,749	2,320	2,193	2,281	2,345
CH_4 emissions, Gg	246	208	153	160	164
2. Non-managed landfills					
Municipal solid urban waste deposited at solid urban waste landfills, Gg	864	846	1,003	990	853
CH_4 emissions, Gg	47	46	42	41	36
Total emissions from municipal solid urban waste	**293**	**254**	**195**	**201**	**199**

The analysis of GHG inventory for the last few years shows that the solid municipal waste landfills are the biggest source of methane among all sources of CH_4 that are covered by the inventory. Thus for example during 2001 4199 Gg CO_2eq methane is emitted (21 is applied as Global Warming Potential for methane).
At present, landfill gas extraction and utilization is not practiced in Bulgaria mainly because of the economical reasons. The income from landfill gas extraction and utilization for power generation is too low to meet the investments that are required for methane extraction and electricity generation. Regulation No 13/1998 of the Ministry of Environment and Water on Conditions and Requirements for Construction and Operation of Waste Disposal Sites sets legal obligation to extract landfill gas from landfills, but there is no one site, where the gas is extracted yet. As far as all the newly constructed waste disposal sites are equipped with methane capturing wells, it could be expected that the first significant quantities of methane will be captured in 2007.

6. Methane Emission Forecasts from Waste

This forecast is based on the National Programme for Municipal Solid Waste (MSW) Reduction by the end of 2014. According to this programme the MSW should be reduced to 350 kg per capita by the end of 2014. This means that the reported MSW amount of 455 kg per capita (in 2001) will reduce by about 2 % annually till the end of 2014. After this period a stabilisation at 350 kg per capita is expected. Another important point in this programme is the envisaged landfill methane capture. It is assumed that after 2007 certain percent of the methane generated is captured. The percentage of methane to be captured is shown in table 4.

Table 4. Forecast of the percentage of the methane capture

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
% of CH_4 Capture	0	10	13	16.9	28.6	34	38.3	40.7	40.7

After the year 2015 this methane capture level will remain stable.

Table 5 presents a forecast for the methane generation, emissions and captured emission from MSW landfills in case this programme is implemented.

Table 5. Forecast for the methane generation, emissions and capture, Gg

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CH_4 generation	184	181	177	174	170	167	163	160	157	154	154
CH_4 emitted	184	181	177	156	148	139	127	114	104	95	91
CH_4 captured	0	0	0	17	22	28	36	46	53	59	63

7. Electricity Production from Captured Methane

The usual practice is to flare the captured methane. Thus the methane emissions are reduced drastically. Usually during the flaring more than 95 % of the captured methane is oxidized to CO_2

and H_2O. Unfortunately the energy generated during the flaring is not utilized. There are three options to utilize the energy content of the captured methane:

- The first is to burn the methane in boilers for heat production,
- The second is to co-generate heat and electricity,
- The third is to produce electricity.

The first two options are applicable in all the cases, when there is heat demanding site next to the waste disposal site. Usually the sites are situated far from the cities and industrial or commercial buildings. That is why usually there is no heat demand close to the waste disposal. Typically only the third option – electricity generation option is applicable at the sites, where methane is captured.

The electricity generation from landfill methane is subject to special treatment by the National Electricity Grid. According the Energy Law the Grid operator should purchase all the renewable electricity at preferential prices. As far as methane from the landfills is considered renewable energy source the electricity sell is ensured.

The captured quantity of methane can be utilized in piston gas motors where electricity is generated. Because of the presence of admixtures in methane, a comparatively low efficiency is accepted for this type of machines, at the size of 30%. The received electrical energy from the burning of one ton captured methane will be about 4.2MWh. The quantity of electricity that could be generated from the all captured methane is given in table 6.

Table 6. Estimate of the electricity that could be generated from captured

Year	2008	2009	2010	2011	2012	2013	2014	2015
CH_4 captured, kt	17	22	28	36	46	53	59	63
Electricity generation, GWh	72	92	117	150	191	222	245	261
Installed capacity, kW	12,058	15,362	19,571	24,967	31,808	37,058	40,909	43,473

8. Investment costs in electricity production from captured methane

The investment cost should include the cost of delivery and installation of motor-generator groups and tie in to the grid. As the unit capacity depending of the methane flow is expected to be in the range of 0.5 – 2 MW, the tie in to the grid is feasible at medium voltage (20 kV) level. An investment cost of 650 USD per installed kilowatt seems reasonable in the mentioned conditions. It is accepted that the methane capture installations are available for free. Table 7 illustrates the annual investments requirements within the period 2007-2014 considering that the construction is performed one year before the start up. The total investment cost of installation of 43.5 MW for production of 261 GWh electricity from landfill gas is 28.3 million USD.

Table 6. Annual investments, thousand USD

Year	2007	2008	2009	2010	2011	2012	2013	2014	Total
Annual investments	7,838	2,147	2,736	3,508	4,447	3,412	2,504	1,666	28,258

9. CO2 Emission Reduction and Costs

The electricity produced at the waste disposal sites belongs to the category of non-dispatch energy. The production volume is unpredictable and has fortuitous nature. The installed capacity at 43.5 MW will hardly be able to cause changes in the schedule for commissioning of new capacities at nuclear plants, coal and natural gas-fired thermal plants.

The newly-commissioned waste gas capacities will affect only the -load of the remaining electricity production capacities. They cannot replace the base nuclear capacities, as well as the other hydro-

capacities from the load curve. The co-generated electricity cannot be replaced either. Thus the production will influence the loading of thermal plants operating in off-peak load and in the secondary frequency regulation system. These are, first of all, plants operating on imported black coal, followed by plants on local brown coal and natural-gas combined-cycle plants – NGCC (in the future, when they are put in operation).

Emissions from the production of one kilowatt hour electricity from the coal-fired plants vary from 1.2 to 1.5 kg/CO_2/kWh which makes 1.3 kgCO_2/kWh on average. The level of CO_2 emissions from NGCC is far less (about 0.450 kgCO_2/kWh) whereas their share in the fuel mix is hardly predictable. It is expected that the NGCC capacity share will not be more than 5% (500 MW) in 2010 and it could not influence significantly the average emissions level. It could be accepted that the average emissions for one net kWh produced from TPP will be at the level of 1.2 kgCO_2/kWh. This value could be used as an average factor for the emission reduction.

The expected emission reductions and costs are presented in Table 8.

Table 8. Estimate of the emission reductions from electricity generated from captured methane

Year	2008	2009	2010	2011	2012	2013	2014	2015
Electricity generation, GWh	72	92	117	150	191	222	245	261
CO_2 emission reduction, kt	87	111	141	180	229	267	295	313

The emission reductions potential for the period 2007 – 2020 is presented in Table 9.

There will not be any reduction before the first Kyoto period. The emission reduction will gradually increase in the period 2008 – 2015, reaching the maximal level of 313 kt.

Table 9 Emission Reduction, kt CO_2.

Period	Till 2007	2008 – 20012	2013 – 2020
Emision reduction	0	747	2,439

There is a potential for emission reduction of about 747 kt for the first Kyoto period, and 2,439 kt for the period 2013 – 2020.

The investments required for the period till 2014 are estimated at about 28.3 million USD. Depending on the cost of the transferred emission reduction the support for the projects investment could reach from 26% (if 10 USD/t CO_2 is accepted) to 52% (if 20 USD/t CO_2 is accepted) for the first commitment period.

Such a support, if combined with timely introduction of the green certificates for renewable electricity could accelerate significantly penetration of the landfill gas utilization in the power sector and generate considerable annual emissions reduction of more than 300 kt.

Forest-Related Carbon Investment Opportunities in Bulgaria
(prepared by the Bank team)

1. General Considerations: Forest-Related Carbon Offset Project Options

There are different possibilities to relieve the atmosphere from higher contents of carbon dioxide:

A. Increase carbon sequestration by:
- expansion of forest areas
- increasing the forest growth rate or

B. Reduce carbon being released from actual forest stocks by
- prevention of forest fires and forest degradation
- prevention of conversion to other land uses
- increasing the stocking of biomass or

C. Increase the volume and persisting time carbon in wood products by
- replacing materials that need high fossil energy inputs by wood products
- supporting the use of long lasting wood products
- increasing the conversion rate in the timber production process or

D. Replacing fossil fuels by using wood - fuel switch.

In Bulgaria, there are many forest-related carbon offset opportunities. The carbon offsets in the expansion of forest areas and in promoting fuel switch options are easier to quantify and may be favored by AAU purchasers for green investment schemes. However, improvement in forest management such as thinning operations, increasing the average volume of standing stock and forest fire prevention are useful for climate mitigation. Green investment schemes, unlike JI projects, do not require stringent baseline comparison. Therefore, to maximize carbon-related benefits in Bulgaria (i.e. both from JI and green investment schemes), efforts should be made to channel AAU funding in forest management and other forest-related areas that produce more difficult to quantify carbon offsets. In addition, green investment schemes do not require that the areas were not forested on December 31, 1989 (a requirement under the Kyoto Protocol for JI projects). Therefore, efforts should be made to channel AAU funding in reforestation of sites burnt after December 31, 1989.

2. Overview of the Forest and Energy (Fuel switch) Sectors in Bulgaria

a) Forestry Sector

Forest lands occupy some 3.9 million ha. or 35% of the country, mainly situated in the mountain regions. They have a key role for economic growth, from a main source of livelihood for the population and play a critical role for biodiversity conservation, watershed protection, climate change mitigation. The forest area has increased by 8% from 1960- 2000. Approximately 518,000 ha (13%) are non-wooded forest areas. The forestry sector in Bulgaria has undergone major changes in the last ten years due to the move to a market economy and restitution of expropriated forests to their previous owners. As of today, ownership is 86% state, 8% private individuals, 5% municipalities and the remainder owned by religious, schools, co-operatives etc. Over the past decade, the forestry sector's main performance indicators have showed a downward trend. There has been a significant backlog in forest management activities as financing gaps in the forestry administration continue to widen.

Bulgarian forests have suffered extensive fire damage with 133,000 ha burnt between 1991 and 2001. Reasons for this increase are seen in the agricultural restructuring process, climate warming, insufficient thinning rates and fire prevention measures. Less than 2% of fires are due to natural

causes. Fires have mainly affected relatively young coniferous plantations that are most susceptible to fire, but also mature stands including some broadleaved species. Non-realized thinning volumes amount to about 2.8 million m^3 due to a combination of (a) budget constraints, (b) lack of roads and (c) lack of availability and proximity to markets for small roundwood. The yearly reforestation rate has decreased from 50,000 ha (average from 1950 – 70) to about 10,000 ha in the 1990s, due to severe budget limitation. To address these issues, the Government of Bulgaria (GoB) has decided to restructure the Bulgarian forest administration in order to provide the right framework, incentives and safeguards for an efficient, transparent and accountable forest organization in Bulgaria. Several models are being considered. A new State Forest Management Organization might be created on the basis of a gradual reform.

b) Energy Sector – related to Fuel Switch

Bulgaria's energy sector is dominated by nuclear power and imported fossil fuels. More than 70% of the energy consumption is based on imported fuels. The rest of fuel consumption comes mainly from low-grade coals and limited hydropower generation. The use of firewood is common in private rural household heating with an average consumption of about 5 m^3 per household per year, which may add up to as much as 6 million m^3 per year nation-wide. While wood was the prevalent fuel source for heating buildings prior to WWII, high subsidies for fossil fuel introduced under the centrally planned economy caused many wood-burning systems to be replaced by high pollution and low-efficiency heavy oil and coal heating systems.

Bulgaria has a high potential of using fuelwood and other biomass from agriculture to generate heat and electricity in a profitable and ecologically beneficial way. Examples from other countries (i.e. western Europe countries) have shown that with proper technology, such residues can provide valuable fuel for use in boilers in public buildings and municipal heating systems that presently rely on fossil fuel. Emissions from the burning of sustainable biofuels (e.g. thinnings, wood chips, briquettes or pellets) do not increase the greenhouse effect, because the released CO_2 has been sequestered before (and will be fixed again) by plant growth in a short-term cycling process. Therefore, projects replacing otherwise accountable emissions from fossil fuel (oil, coal or gas) with climate-neutral biofuels produce carbon offsets for every ton of replaced fossil CO_2. There is some evidence that in many towns economically viable possibilities exist to replace old heating systems with modern biomass burners.

Beside a positive effect on the climate, fuel switching would improve the structure of Bulgarian forests. Many young and medium-aged forests contain too many trees due to arrears in silvicultural operations. This over-stocking increases the occurrence of diseases, fires, and other natural hazards. By creating a new market for a new type of forest products, namely residues from harvesting and thinning operations for woodchips to be used in energy production, it could become economically attractive for Bulgarian forest enterprises to improve forest structure through more frequent silvicultural measures. By doing so, they would improve the general condition of forest stands. In due course, this would presumably also increase carbon sequestration (even if this effect is difficult to measure).

The average harvesting volume envisaged in the forest management plans (AAC) for 1996-2000 was 5.2 million m^3 per annum. Compared to the estimated increment (13.7 million m^3 per annum), the average harvesting volume planned accounted for only 37%. Officially, the current harvest averages 4.4 million m^3 per annum (84% of the AAC), including 3.2 million m^3 for industrial needs and 1.2 million m^3 for the local population. In 2001, the official harvesting volume dropped to 2.9 million m^3. However, it is possible that the official volume is underestimated. In particular illegally harvested

timber is not accounted. Meanwhile surveys of fuel wood use among rural populations suggest that total fuel wood consumption may be as high as 6 million m^3 annually.

Nevertheless, non-commercial thinnings extracted from forests are generally left to rot on piles in the forest. There are 17 regions in Bulgaria where the average volume of wood that should be, but is not, harvested, is more than 30,000 m^3. The usage of about 30,000 m^3 of the wood in any of these 17 regions in Bulgaria would not disturb the fuel wood balance and would create certainty of firewood delivery.

Wood utilization for heating could be effective for regions where district heating networks are not developed and where there is no prospect for the development of natural gas supply network. In these regions, small scale (14-300 kW) wood, wood chip and briquettes burning boilers could be installed in public and social buildings, and in private enterprises and households that are currently heated by electricity and residual oil.

3. On-going Initiatives in Forest-related Carbon Offsets

a) The Forest Development Project

The World Bank is currently preparing an investment loan for the equivalent of US$30 million blended with a GEF grant for the equivalent of US$7.75 million– the Bulgaria Forest Development Project (FDP). The FDP was scheduled for presentation to World Bank Board in early 2004 but issues of forest policy reform have brought project development to a halt. The FDP's development objective is to increase the contribution of forests to the national economy and to benefit of rural populations through sustainable management of state, private and communal forests. The global development objective is to improve conservation of forest ecosystems through mainstreaming biodiversity into forest management and through improved conservation of critical ecosystems. The Project consists of five components: (i) strengthen public forest sector management, (ii) strengthening of capacities of non-state forest owners, (iii) supporting state forest management transition to market economy, (iv) promotion of biodiversity conservation in forest management and (v) project management and monitoring. The FDP's investments with quantifiable benefits have a high rate of return (20% for forest-fire related activities; 18.5% for forest thinning; 23% for forest roads).

b) The Fuel Switch pilot project

Currently, the Bank is managing a Japanese PHRD grant of approximately US$892,000, the objective of which is to define the actual costs and benefits of switching from fossil fuels to wood for small-size municipal building heating systems. The PHRD grant would finance the design and construction of a pilot fuel switching facility, and the subsequent monitoring of their operations and costs which would serve as model for replication for funding for e.g. via the private sector and potential AAU fund. For this reason, significant resources are being spent on design, installation, and the close monitoring of operations for a couple of years under varied situations (i.e. different wood types, various transport distances for wood chips, various storage systems, etc.) The grant components are: (i) design and feasibility studies for fuel switch options, (ii) heating system switches at two sites, (iii) securing the fuel supply chain, (iv) harnessing the carbon market, (v) dissemination/public awareness initiative and (vi) grant management. The Fuel Switch project is due to be completed in two years' time. The results would be analyzed for lessons learned with the objective of replications. Much of the funding from the PHRD grant is used for the design of a fuel switch pilot so the carbon emission reductions from the facility are not expected to be substantive. However, if this fuel switch model is replicable, subsequent projects would be more cost effective and in the aggregate could produce substantial carbon offsets.

c) The Bulgarian-German initiative

The Bulgarian Government with financial support from Germany has started a feasibility study to promote JI – Bioenergy –Forestry Sinks. The study has two components: fuel switch and forest sinks. For the fuel switch component, the study is to select suitable fuel-switch locations with a capacity of 5-10 MW per plant, with preference for combined power and heat production, the main consumer being an industrial enterprise preferably owned by a foreign company.

For the forestry component, the study would explore JI options for:

- Energy plantations/afforestation on agricultural sites.
- Afforestation, coppice forest management with oaks on eroded sites
- Transformation of oak-coppice forest into high forest stands
- Reforestation of forests previously destroyed by fire
- Conservation of standing natural forests.

The study will also explore forestry investments without JI option for:

- Use of existing oak-coppice forests
- Use of industrial waste wood
- Use of forest waste wood
- Bio-energetic use of agricultural crops

The JI – Bioenergy – Forestry Sinks study is to be completed in 2004. Again, the initiative is only a study with no investment plan. However, the study would lay the groundwork for subsequent investments.

4. Proposals for AAU funding

The FDP could provide immediate co-financing or parallel financing opportunity for AAU funding by expanding selected project components. AAU funding could also support a stand-alone investment and utilizing the data and support resources that would exist to implement the FDP.

a) Reforestation of 10,000 ha of Degraded Areas

Recent forest fires have destroyed large areas of Bulgaria forests particularly in the South East of the country. The FDP would fund the reforestation of circa 600 ha (out of the 133,000 ha that have been burnt). Given the extent of destruction by forest fire, more funding is needed than is available from the Project. It is unlikely that the new State Forest Management Organization, which needs to be financially self-sufficient, will have the required resources to rehabilitate all burnt areas. The natural development process is likely to be unsuccessful because broadleaf species require the present of old seed trees in the area and because of economic reasons natural timely succession to broadleaf trees would not be possible. Reforestation quickens the regeneration process by planting a diversity of species adapted to local conditions and by other forest management measures.

Another 10,000 ha of burnt area could easily be identified and afforested as a co-financed or parallel financed with the Bank project from proceeds from the sale of Bulgarian AAUs. The acreage would be selected based on a number of criteria including: economic rate of return, employment opportunities for the local population, environmental benefits and ecotourism potential. Investments will include an operational investment plan, identification of areas with highest benefits or lowest costs, contracting of labor, purchasing of saplings, preparation of the soil and planning of the saplings in the designated areas, including subsequent early thinning. The selection of the 10,000 ha could be

based on specific economic, ecological and social criteria to be developed between the AAU purchaser and the Government.

The quantifiable rate of return for afforestation tends to be low – in the range of 4% to 6%. However, reforestation provides new business and direct and indirect employment opportunities for the rural population. There will be eventual revenues from wood harvesting and increase in fuelwood, promoting fuel switching. Reforestation can ameliorate growing conditions for non-wood products. The economic value of replanted areas is also expected to be higher than that of naturally regenerated sites. The long-term environmental benefit of reforestation is in the prevention of erosion, damage to watershed and prevention of siltation. In addition, reforestation with a suitable mixture of species increases the bio-diversity and the development of ecotourism, which depends on a sustained environment in a natural or semi-natural stage.

The estimated average afforestation cost is approximately €1,000 per ha. In addition, the annual operating costs for the first five years of afforestation is approximately €100 per ha. After the fifth year, the operating costs for afforestation activities are minimal. Therefore the afforestation cost for 10,000 ha would be €10 million and the operating costs for first five years would be €5 million, totaling €15 million for the afforestation effort. For an AAU purchaser interested in assisting Bulgaria in its afforestation efforts, the green investment scheme could support the annual operating costs and contribute toward the initial afforestation investment. The contribution of AAU funding to the total capital investment would depend on the AAU price negotiation between the AAU purchaser and the government.

If additional resources can be found to support afforestation, such as the EU-funded SAPARD program, it is likely that more than 10,000 ha can be identified and afforested.

As shown in the table below, different tree species show distinct growth over their lifetime and they differ also in their wood densities. This means that some species are more efficient in capturing carbon dioxide and from the carbon economy point of view.

Carbon sequestration potential of selected tree species

Species	Forest Area (%)	MAI (m^3/ha/a)	Dry Wood Density (t/m^3) With range	Carbon Sequestration (t/ha/a)	CO_2 equivalent
Quercus spp.	32	2 – 6	0.64 (0.38 - 0.90)	0.6 - 1.9	2.1-6.65
Pinus spp.	26	2 – 7	0.49 (0.30 - 0.86)	0.5 - 1.7	1.75-5.95
Fagus sylvatica	17	4 – 9	0.66 (0.54 - 0.84)	1.3 - 3.0	4.55-10.5
Picea abies	5	4 – 12	0.43 (0.37 - 0.54)	0.9 - 2.6	3.15-8.75
Robinia pseudoacacia	3	5 – 7	0.73 (0.54 - 0.87)	1.8 - 2.6	6.3-9.1
Pseudotsuga douglasii	< 1	10 - 17	0.47 (0.36 - 0.63)	2.4 - 4.0	8.4-14

From Feasibility study completed by GFA-Terra Systems on Forest-Related Carbon Offset Investment Opportunities in Bulgaria

While planning the rehabilitation activities, it is important to make sure that the composition of tree species is suitable for the soil types and other prevailing conditions. It is important not to repeat the mistakes of the past, where pine trees have been planted indiscriminately of site and climatic conditions and in combination with negligence of thinning has led to losses from forest fires and pests. Assuming a variety of trees native to Bulgaria, the average carbon offset from 10,000 ha of afforestation activities for a 12-year time period, which corresponds to the end of the second

commitment period of the Kyoto Protocol (2017), would be about 480,000 tons of CO_2 assuming an average sequestration rate of 4 t CO_2e per ha and year (600,000 t CO_2 before 2020). This is equivalent to €25 or about US$30/t CO_2 based on a project lifetime of 20 years. Please note that this cost is gross of any benefits, i.e. it assumes that the only monetary benefit of afforestation is the sale of carbon. This is an oversimplification. In most cases, the plantings will generate benefits or cost savings. However, such benefits are not included in this simple cost calculation. A proper cost-benefit analysis would reveal lower costs. In particular, the cost per ton would be lower for afforestation projects conducted on less degraded land or where the goal is not purely conservation. In such cases, additional wood harvesting would increase the return on investment and reduce the cost per ton.

b) Afforestation of Agricultural Land for Energy Purposes

The production of wood fuel through the establishment of energy plantations is not currently competitive compared to wood fuel supply from forests. However, the National Program for Agriculture and Rural Development 2000-2006, points out that 2.5 million ha of agricultural land are in a process of ongoing degradation and are suitable for afforestation.

Implementing a national program for energy plantations may be desirable, as otherwise extensive agricultural regions without dense forest cover would be excluded from any fuel-switch schemes (see the discussion of fuel switches below). Besides, such a program would have considerable positive social and environmental side effects.

Due to the specific rotation design of energy plantations, part of the production area is permanently stocked with trees while other parts are continuously harvested for providing wood fuel. Assuming a rotation period of 4 years for the plantation, three-quarters of the area is permanently sequestering carbon. The growth rate of the trees depends on soil quality and climatic conditions, and ranges from only 4 m^3 per ha and year to 13 m^3 per ha and year, thus leading to sequestration rates from 6.5 (poor, degraded sites), 13 (average sites) to 21 tons of CO_2 per ha and year on very suitable sites.

In order make fuel from energy plantations competitive with wood fuel from forests, price differences for wood chips could be compensated by carbon payments. On very good sites €5/t CO_2 would be sufficient to cover the incremental cost. However, an equivalent of up to €55/t CO_2 would be required for establishing plantations on sites of average quality.

c) Potential Fuel Switch Opportunities for Municipal Buildings

Taking into account the actual and potential supply and demand of wood, the recent feasibility study – conducted as part of the fuel switch pilot project – concludes that the country could decide to progressively build up facilities of about 5 million MWh of thermal energy. However, there is a limited number of municipal buildings suitable for centralized heating in the country. Therefore, other energy utilization for part of this wood should be found, for example cogeneration of electricity (about 1 million MWh) and thermal energy at District Heating Companies (the Bulgarian-German initiative is assessing the potential for large-scale fuel switch).

These facilities would create an additional stable market for a supply of about 4-5 million m^3 of wood annually (including 3-4 million m^3 from coppice forests, and 1 million m^3 would from artificial coniferous forests). This would be a considerable contribution to reaching the EU targets on electricity production from renewable energy sources. The next step is the identification of a first wood-energy portfolio project for small-scale biomass-based fuel switch in municipal buildings with centralized heating systems that are situated in settlements where gas supply is not planned, that are attractive for investment under a Green Investment Fund.

A preliminary assessment shows that there are 23 municipalities in regions with high potential for additional wood production. About 435 buildings in these municipalities have been identified to have local boilers using liquid fuel. If these public buildings were to be heated at a comfortable level, which is 20% higher than the current energy usage, the annual energy need for these buildings would amount to 144,205 MWh. A program for fuel switch for these buildings would lead to the utilization of 129,785 MWh of energy (at 90% of the heat demand) produced from wood biomass, which results in 34,263 tons of CO_2 (emission factor for LFO 0.264t/MWh)

Constrained by the availability of biomass boilers, only 30% or about 130 buildings could be switched in the first three years with the potential of 100% fuel switch by 2012. The potential carbon emission reductions are shown below.

GHGs emission reductions from a fuel switch program

Emissions	Annual reduction	Up to 2008	2008-2012	2013-2020
CO_2 tonnes	34,263	25,000	138,000	280,000

The equipment cost[1] to organize an independent fuel wood supply is about US$80,000 and the investment cost for 2,000 kW of boiler system is US$200,000, i.e. a cost of per project of about US$140 per installed kW. The implementation of the fuel switch would reduce annual emission of 34,263 tons of CO_2 due to the reduction in fuel oil consumption by 129,785 MWh. The total investment cost of the fuel switch project is estimated at US$8.8 million. This is equivalent to US$13/t CO_2. As in the case of afforestation, the analysis does not include possible benefits from a switch to wood fuel, in particular cost savings due to reduced oil consumption. It only takes into account the greenhouse gas emissions.

The feasibility and sustainability of the fuel switch program for municipal buildings depends on (i) the availability of wood resources, (ii) capacity for collection, processing and regular delivery of wood products in the form and quantity needed, and (iii) capacity for production of efficient wood biomass fired boilers.

More information on actual fuel switch project proposals is available in the report "Forest-Related Carbon Offset Investment Opportunities in Bulgaria", prepared by Gerald Kapp et al. (GFA-Terra Systems) and Andreas Schulte (University of Paderborn) in February 2002, and the Feasibility Study for the Implementation of the Fuel Switch Grant, prepared by GFA-Terra Systems of behalf of the Ministry of Agriculture and Forests in 2004.

d) Forest Fire Management

Better forest fire prevention and management would avoid carbon emissions into the atmosphere. Fire prevention and management involves the following items: purchase of fire-fighting trucks; provision of mobile radio and communication equipment to facilitate fire detection and co-ordination of fire fighting activities; construction, erection and equipping of watch towers to improve fire detection; supply of protective clothing, hand tools, back pumps and trail bikes to assist fire fighters; provision of training in fire fighting and integrated fire management control; community education and awareness campaign; development of a fire danger rating and early warning system; and fire study tours in the Mediterranean region.

[1] Two chainsaws, agricultural wheel tractor, mobile chipping machine, trailer 30 m^3, sky-line system. This equipment could supply one municipality with chipped wood for a boiler with installed capacity of 2,000kW, or two neighboring municipalities with similar installed capacity of boiler systems.

Based on estimates by World Bank consultants, emissions of 46,000 t CO_2 could be saved per annum over the project life (20 years) if fires were better managed on an area of around 416,000 ha for a cost of US$ 6.55 million, which represents a unit cost of about US$7 per t CO_2. However, monitoring may be more complex to design and implement. In particular the without-project case is hard to establish.

5. Conclusion

The forestry sector offers attractive options, ranging from forest management to use of forest thinnings for energy production. The cost of each option is summarized in the table below. Each option assumes sales of carbon emission reductions for 20 years. Please note that these costs are all gross of ancillary benefits. In other words, they assume that the carbon sale is the only return to the investment. This is of course not the case since fuel switch investments allow monetary savings on fossil fuel use, while afforestation produces timber and non-timber forest products, etc. In order to capture these benefits and arrive at net comparable costs, a proper cost-benefit analysis is necessary. Such an analysis goes beyond the scope of this study.

Summary of options for the forestry sector

Activity	Indicative cost / t CO_2 *
Forest fire management	US$7
Fuel switch to biomass	US$13
Afforestation of degraded land	US$30
Afforestation for energy	US$6-66

* Cost = Average cost, i.e. total investment costs, divided by total emission reductions. This cost excludes benefits other than carbon sales.

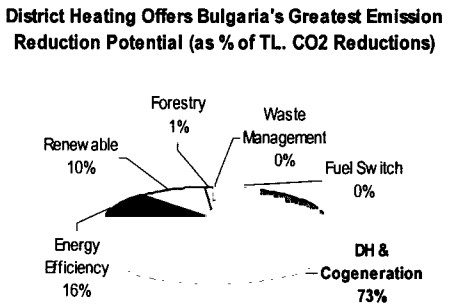
Illustration of GIS with AAU Sales Proceeds

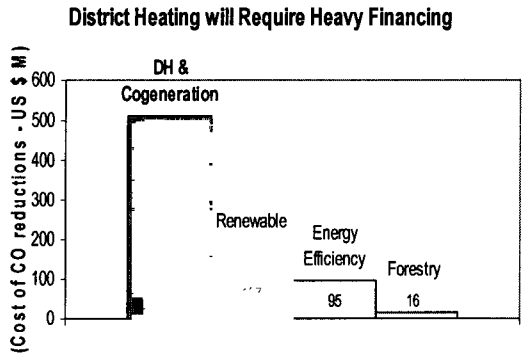
AAU Financing Leverages Project Returns and Assists Bulgaria

Careful design of a GIS will help adequately capitalize projects for lenders and drive project returns higher for commercial sponsors in Bulgaria. GIS benefits are not limited to the commercial sponsors, however. A GIS Fund directly helps Bulgaria achieve two goals:

(i) Reduce emissions in Bulgaria;
(ii) Encourage new energy technology investment by leveraging available AAU-generated funds.

By offering investors subordinated debt or equity participation from the GIS Fund, investors will gain financial leverage through additional tax shields provided by available debt, and time value of money driven benefits of long term maturity principal repayment. District Heating and & Co-Generation represent the best opportunities for CO2 reductions and the largest dollar volume Greening Priorities in Bulgaria.





District Heating Project Background

District heating networks are usually owned and maintained by the local municipality and run from a centralized boiler house. They are an efficient way of providing heating and hot water in densely populated areas. They often suffer from a low capital investment levels, infrequent maintenance, and high system losses. As a result, household heating costs in Central and Eastern Europe (CEE) are generally higher than the EU average.

Commercial Sponsor's Perspective

For commercial sponsors, district heating projects have a double sided nature to them. They provide many opportunities, but the business model is not quickly scalable. Furnaces and other equipment must be updated on a local level for each project. Therefore, transactions are structured on a local, municipal level, which in turn can take time to develop and usually involve public procurement and legal issues at local levels for each new project.

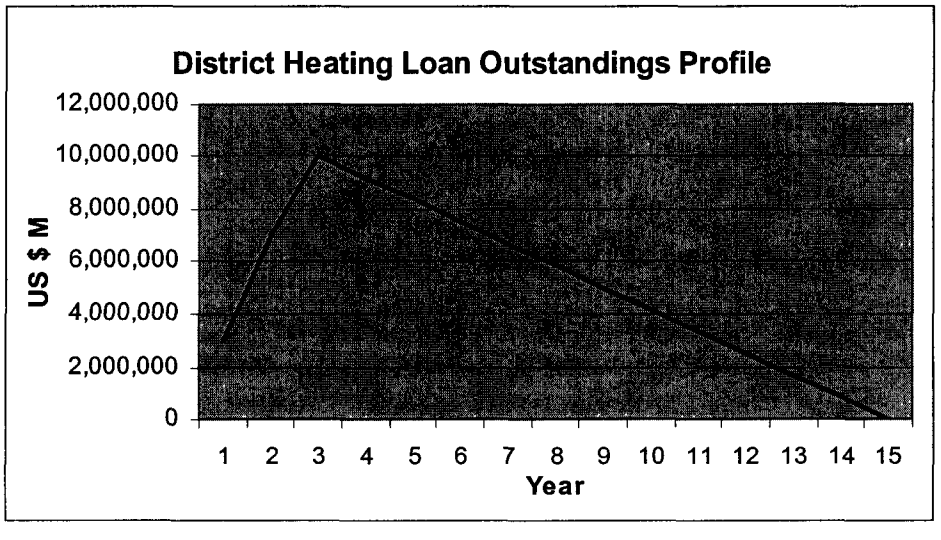
Some heating companies encounter difficulties because they have not priced in the cost of doing business over the long term. Sponsors must have a long term view and understanding of core issues that drive their projects' profitability and in return and must price the following factors into the project structure accordingly:

(1) offtakers must pay a sufficient price for the energy on time to sustain a financing structure.
(2) Fixed asset costs and equipment needs over the life of the project must be accounted for in the business plan
(3) Coal and raw supply costs must be priced in appropriately to avoid a mismatch between variable supply costs and long term, fixed energy contract prices to offtakers.

Companies that fail or that experience operating difficulties often neglect one or more of the above factors.

Drawdown Profiles for District Heating Projects are Better Suited to Banks

District heating projects' staggered drawdown profiles are best suited for bank financing during initial years (example below based on $10M TL project costs) due to issuance carrying costs for fixed income financing. Even though fixed income refinancing may be possible once the project company is fully developed in year four or five, project idiosyncrasies may obstruct broad investor appeal and could prevent a clean, easy refinancing from taking place.

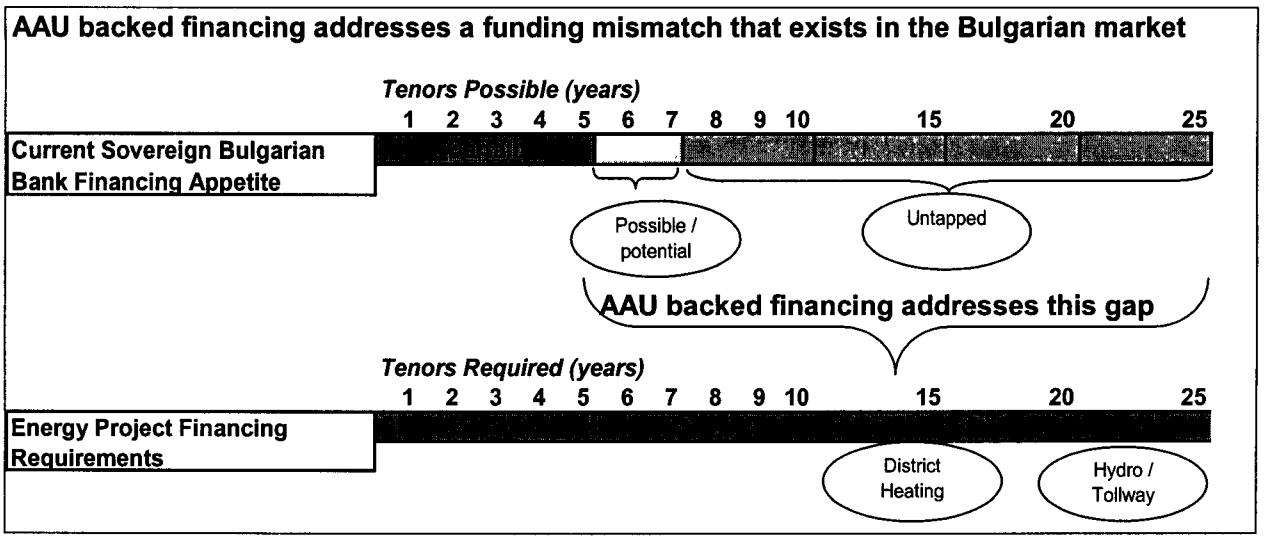


Commercial Bank's Perspective

Since sponsors often prefer non-recourse financing structures, lenders will look for comprehensive security packages and a meaningful equity contribution (35-50% equity/total capitalization). The better acquainted a bank is with a commercial sponsor and the more experience a sponsor has in similar transactions in similar markets, the more inclined it is to accept a lower sponsor equity contribution from the sponsor. Loans typically finance critical

investments in a number of smaller heating sub-projects, reducing energy consumption and improving heating services for customers.

Project finance in Central and Eastern Europe has at times been difficult to promote due to investor/lender concerns over legal and security issues that do not have precedents in the subject market, but there have been successes. There are several successful projects (EKG Kladno and Harpen CR in the Czech Republic just to name two) that did not have precedents to rely on, so the Bulgarian State should not be discouraged if it does not readily see AAU backed examples in other markets. There is an opportunity to establish a critical market benchmark that will raise Bulgaria's profile in the capital markets and establish it as a leader in this sector.



GIS Fund's AAU Generated Proceeds Directly fill this Financing Gap in a Number of Ways to Supplement Projects

(i) Equity participation - AAU Fund may invest in a project through negotiations with the sponsor to make a project more 'bankable'. The uses of funds may go toward heavier asset investments for a specific project, or subsidies of energy prices in regions of higher unemployment, where households have less disposable income to pay heating costs.

(ii) Subordinated debt – sponsors may have internal restrictions or commercial banks may have maturity restrictions that prevent a conventional energy funding structure. AAU Fund can provide longer term subordinated debt to fill the gap and finance the Fund's target sector projects. This AAU Fund commitment will foster long term market liquidity and confidence, encouraging banks to participate in longer term financing to establish new benchmarks. This in turn creates new capital markets opportunities for Bulgarian issuers commercial and public alike.

(iii) Credit Enhancement – AAU Funds can be applied toward debt service reserve accounts, or other structural components of a typical project financing. This will address any unique shortfalls or project specific components to make a project 'bankable'.

GIS Fund projects will directly green AAU's. GIS benefits are not limited to the commercial sponsors and banks, however. A GIS Fund directly helps Bulgaria achieve many goals

(i) Establishes new capital markets benchmarks for longer term maturities;
(ii) Increases liquidity in Bulgaria's basis and interest rate swap markets;
(iii) Provides funding non-recourse to the State;
(iv) Reduces emissions and ensures compliance with the Kyoto Protocol;
(v) Improves heating efficiency and reduces heating costs to end users;
(vi) Encourages new energy infrastructure investment into Bulgaria; and
(vii) Provides a nominal return to the State through soft greening.

By offering investors subordinated debt or equity participation from the GIS Fund, investors will gain financial leverage through additional tax shields provided by available debt, and time value of money driven benefits of long term maturity principal repayment.

An example is provided in the next two pages to illustrate this leverage concept for a $1 million project that is financed in two scenarios.

(i) status quo approach with 50% sponsor equity, but without GIS funding, and
(ii) 25% sponsor equity / 25% GIS subordinated debt, repayable in year 15, with 8% annual interest payable.

The project internal rate of return improves from 14% to 24% as a result of the GIS financing leverage, turning this project from a borderline commercial decision to an attractive investment opportunity. Also, this support will also make a compelling and persuasive argument for all potential investors in the region to consider investing in Bulgaria.

AAU financing can thus be used to fill in the long term gap shown above. AAU Funds for supplementary equity, debt, or credit enhancement provides a concrete solution to the financing gap that exists currently in the market for project financing.

Status Quo Energy Projects Funded WITHOUT GIS Leverage

Year	0	1 2004	2 2005	3 2006	4 2007	5 2008	6 2009	7 2010	8 2011	9 2012	10 2013	11 2014	12 2015	13 2016	14 2017	15 2018
Project Revenues	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Expenses	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000	1,900,000
5% net margin	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Tax Rate:	19.5%	19,500	19,500	19,500	19,500	19,500	19,500	19,500	19,500	19,500	19,500	19,500	19,500	19,500	19,500	19,500
After-tax income		80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500
Investor's Project Cash Flow Streams	(500,000)	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500	80,500
IRR	**14%**															

Assumptions

Sponsor's $500,000 cost represents 50% of total project company capitalisation
Commercial bank interest included in 'Expenses'

Sponsor contributes 50% equity	$	500,000
GIS contributes 0% sub. Debt	$	-
GIS charges 8% on its contribution	$	-
GIS sub debt is repaid in year 15	$	-

No terminal value

Projects Funded WITH GIS Leverage are Attractive for Sponsors

Year	0	1 2004	2 2005	3 2006	4 2007	5 2008	6 2009	7 2010	8 2011	9 2012	10 2013	11 2014	12 2015	13 2016	14 2017	15 2018
Project Revenues	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Expenses	1,920,000	1,920,000	1,920,000	1,920,000	1,920,000	1,920,000	1,920,000	1,920,000	1,920,000	1,920,000	1,920,000	1,920,000	1,920,000	1,920,000	1,920,000	2,170,000
5% net margin	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	(170,000)
Tax Rate:	19.5%	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	15,600	(33,150)
Free Cash Flows:		64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	(136,850)
Investor's Project Cash Flow Streams	(250,000)	64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	64,400	(136,850)

IRR 24%

The GIS contribution makes investing in Bulgaria clearly more attractive over non-GIS funded projects in other markets

Assumptions

Sponsor contributes 25% equity	$	250,000
GIS contributes 25% equity/sub.debt	$	250,000
GIS charges 8% on its equity/sub debt	$	20,000
GIS sub debt is repaid in year 15	$	250,000

No terminal value