PROMITHEAS – 4

Prioritization of research needs and gaps

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Abbreviations

ACRONYM	NAME
BAU	Business as usual scenario
CDM	Cleaner development mechanism
CRF	Common Reporting Forms
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EIB	European Investment Bank
ETS	Emission trading scheme
EU	European Union
GDP	Gross domestic product
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
JI	Joint implementation
kWh	Kilowatt-hour
M/A	Mitigation / Adaptation
MW	Megawatt
AI	Annex I
NAI	Non Annex I
KP	Kyoto Protocol
NC	National Communication
NIR	National Inventory Report
O&M	Operation and Maintenance
OPT	Optimistic scenario
PES	Pessimistic scenario
QA/QC	Quality assurance / Quality control
RES	Renewable energy sources
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
WB	World Bank

1. Introduction

Background

The major change in Earth's climate as a consequence of human activity is one of the most serious problems facing humans in the next decades. Climate change will affect all countries and regions. It is apparent that significant mitigation actions (reductions of greenhouse gas emissions) are needed and these would require concerted effort of many countries.

Another response to climate change is adaptation. Even the most effective reductions in emissions would not prevent further climate change impacts, making the need for adaptation unavoidable (Klein R., 2007).

The introduction of appropriate mitigation and adaptation policies require multidisciplinary research in many fields.

Objective and scope

The objective of this report is to summarize the research needs and gaps encountered during the work on Promitheas-4 project, in relation to the development and evaluation of mitigation and adaptation policy portfolios.

The countries covered by this report are the 12 beneficiary countries of the project: Albania, Armenia, Azerbaijan, Bulgaria, Estonia, Kazakhstan, Moldova, Russia, Romania, Serbia, Turkey, and Ukraine.

A central part of Promitheas-4 project is the development and evaluation of scenarios for these countries by 2050, based on the implementation of different M/A policy portfolios, with the objective to identify the best policy portfolio for each country. During this work, research gaps and needs have been identified in the following fields:

1. Established national procedures, sources, and data for M/A policy portfolios in the 12 countries, including national GHG inventory, reporting and verification (section 2.1 of this report).
2. Availability of historical data (1990 – 2010) needed as a basis for the scenario development in the 12 countries. The data concerns demographics, economy, climate, policies and measures, energy demand in all economic sectors, energy transformation (supply) per energy source, and others (section 2.2 of this report).
3. Availability of modelling tools that can simulate the effects of M/A policies on important variables, such as energy, emissions, and costs (section 2.3 of this report).
4. Availability of information for the development of M/A policy scenarios in the period 2011-2050, including climate, demographics, economy, energy demand, and energy transformation forecasts, planned M/A policies and others (section 2.4 of this report).
5. Availability of multi-criteria evaluation methods for M/A policy portfolios, as well as availability of information to carry out the scenario evaluation in the 12 countries (section 2.5 of this report).

The research needs and gaps for the 12 countries in sections 2.1, 2.2, 2.4, 2.5, and 2.6 are based on the country-specific information, presented in Chapter 3 of this report.

2. Research needs and gaps per category

2.1. Established national procedures, sources, available M/A policy data and information

2.1.1.1. Inventories

The project beneficiary partners represent two groups of countries from the viewpoint of UNFCCC: Annex I Parties and Non-Annex I Parties. Seven of the project partners are from Annex I Parties[1] and the other 5 are from non-Annex I Parties to UNFCCC.

Annex I Parties in general have established National Inventory Systems. Normally the responsible authority is the ministry in charge of the environmental policy, which transfers the obligation for preparation of the National Communications (NC), National Inventory Report (NIR), Common Reporting Forms (CRFs) and other documents to the corresponding executive agencies.

The collection of information is organised according to CoM acts allocating the roles and obligations of ministries, institutions, companies and organisations. Considerable role in this process is granted to the national statistic institutions.

The Parties' inventories are recognised as "generally in line with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF".

The common needs of AI Parties could be presented as follows:

- Strengthening of institutional, legal and procedural arrangements, better coordination and interaction between participating bodies
- Improving the technical competence of the inventory teams and undertaking the signing of contracts with external consultants in due course
- Reinforcing direct communications with national statistic and respective experts from the statistical office and other institutions
- Improving the transparency of the inventory regarding documentation of methods, data, recalculations and uncertainty estimates
- Improving the consistency between data reported to the IEA and data from national statistics
- Improving the completeness of reporting by providing the relevant figures on apparent energy consumption

It is worth pointing out that in Estonia almost the whole necessary information is publicly accessible. In Kazakhstan the national statistic is not harmonised with the EU one and many categories are not estimated.

[1] **Annex I Parties**: Bulgaria, Estonia, Kazakhstan, Romania, Russia, Turkey and Ukraine. (Kazakhstan is considered an Annex I Party for the purposes of the Protocol but remains to be a non-Annex I Party for the purposes of the Convention.)
Non-Annex I Parties: Albania, Armenia, Azerbaijan, Moldova and Serbia

NAI Parties have similar to AI Parties' needs, but an additional list of gaps might be generated:

- The National Systems are at different low stages of development. Regulatory framework concerning organisational, administrative and informational issues needs improvement. In some of the countries there is no responsible organisation.
- The energy balances are not reliable, missing information about energy consumption particularly for households, commercial organisations, services and transport.
- The standard Eurostat NACE codes are not implemented, Azerbaijan still uses the old USSR system for inventory of emissions.
- Information about some categories is poor, particularly in the case of waste and agriculture.

Obviously the NAI Parties need research for identification of the shortcomings of the NIS in order to develop a plan for improvement.

2.1.1.2. Reporting

The inventory of GHG is the first step and a basis for the formulation and implementation of national M/A policy. The reporting under the Convention includes two sets of documents: periodic National Communication (NC), covering all aspects of the implementation, and annual National GHG Inventory (NI) submission by developed countries on greenhouse gas emissions and removals, together with LULUCF report under Kyoto Protocol.

Annex I Parties submit NC every 4 – 5 years following the decisions of the COP. The NIR together with CRF and supplementary information has to be submitted by the April 15th.

The COP, Cancun, 2010, by decision 1/CP.16, enhance reporting in NC by biennial reports (BR). The BR shall outline the progress in achieving emissions reduction and the support to non-Annex I Parties. The BR should be submitted by January 1st, 2014.

The reports of all 7 countries are assessed by ERT as submitted in accordance with the UNFCCC reporting guidelines and generally in line with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF.

Further improvement can be directed to

- Prioritization of the needs for improvements on the basis of key categories' analyses and development of plan for improvement
- Improvement and enrichment of the capacity of national statistics
- Research on development of country specific emission factors
- Improvement of consistency in relation to addressing discrepancies between the NIR and the CRF tables

- Improvement of completeness of reporting on all sectors and mainly LULUCF and waste, transportation and agriculture
- Eliminating systematically the gaps leading to notations NE, NA

The NAI Parties are obliged to submit an Initial Communication within three years after joining the Convention. The COP 17 / 2011 in Durban, South Africa adopted also NAI Parties "consistent with their capabilities and the level of support provided for reporting" also to "submit their first BR by December 2014".

All NAI Parties have submitted their Initial Reports under art. 7 paragraph 4 of KP and also, with exception of Serbia, the Second National Communications. Some of the countries (Albania) are in a process of development of Third National Communication.

The reports are produced by teams of local and international experts supported by UNEP and GEF. They collect the necessary information with the support of the responsible ministries.

The experts usually start with analyses of the existing information sources and involved structures in order to reveal the deficiencies of the system and propose plans for improvement.

The needs of NAI are similar to these of Annex I Parties, but to a greater extent.

2.1.1.3. Verification

The main techniques for verification are the national and inter-countries comparisons: with other national data, scientific publications, different approaches (reference vs. sectoral), emission factors, activity data, uncertainties, measurements.

All Annex I Parties have included in their NIR the comparison of Reference Approach with Sectoral Approach. The differences in some countries and for some fuels are significant but as a rule they have a trend to decrease. The main reason for the differences is the inaccuracy of the energy balances.

The Parties use also the comparison of energy balances provided by the national statistic and the Eurostat data base, and comparisons between Tier 1 method and ETS of the EU.

In the country reports / communications the verification is considered as a part of QA / QC process. The Annex I Parties have developed QA / QC programmes targeting to ensure transparency, completeness, consistency, comparability and accuracy according to Chapter 8 “Quality Assurance and Quality Control” of the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000).

NAI Parties have less developed verification techniques, except for Moldova which has introduced richer quality control forms and checklists, audits by experts who were not directly involved in the national inventory compilation, comparing data obtained from different sources.

Numerous possibilities for improvement of the quality of National Inventory are identified but it is worth mentioning just the most general ones:

- Enhancing the comparison sources and techniques

- Standardising of documentation and archiving, using NACE code for statistical classification of economic activities
- Enhancing quality assurance (QA), quality control (QC) and verification activities, by setting-up sustainable MRV system
- Using electronic links and automated procedures for data entry and storage of sources and references
- Further automation of the process of calculation of emissions, avoiding to the possible extent manual operations.

2.2. Historical M/A data

2.2.1. Background

Historical data are very important for the development of reliable M/A scenarios. The value of each scenario variable in the base year (i.e. last year with available historical data) is the starting point for scenario forecasts. Additionally, having a longer time series of historical data shows the development trend of variables and allows revealing the statistical relation among them.

Historical data time series are especially useful for building business-as-usual (BAU) scenarios, in which usually (as in the approach adopted in Promitheas-4 project) variables follow their historical trends.

In this context, below are summarized the historical data gaps and research needs most common for the 12 project beneficiary countries, in the field of energy demand, energy transformation, and non-energy data (climate, demographics, economy, and adaptation). The historical period covered is 1990 - 2010.

2.2.2. Non-energy data

In the majority of countries, there are no available data about the frequency of extreme events, such as floods, heat waves, and frost days. On the other hand, given that most countries dispose of detailed meteorological records for climate parameters (such as temperature, wind, moisture, precipitation etc.), the annual number of heat waves and frost days can be calculated and published by the respective meteorological national authorities.

Additionally, in most of the countries there are no available data for all or some of the following types of water resources: surface waters, ground waters, overlaps, and renewable fresh water. In some countries these data are collected by the national hydrological services, but it is not published in the statistical releases.

Another data gap related to water is that in most countries there are no data about the energy sector water use, particularly by hydro power plants and for cooling purposes. These data are normally available at individual energy plants and can be collected.

A common problem for many countries is the unavailability of data about the added value in the industrial sub-sectors. In some cases, the national statistical services have available these data, but they do not publish them.

Finally, in several countries there is no official information about the M/A policies and measures. This problem is most common regarding financial incentives (soft loans and subsidies) and land management (i.e. surfaces of different types of land). Normally both types of data can be collected from the respective institutions - funding providers and land management units.

2.2.3. Energy demand data

In most countries energy demand data per economic sectors (households, industry, services transport) is either missing completely (Kazakhstan and Ukraine) or for a long period of time (typically for 1990s in many countries). However, for the latest years, the majority of the countries have available data.

The data availability problems at sub-sector level are much more serious. In the transport sector, none of the countries has available data for fuel consumption, disaggregated per passenger and freight transport. Additionally, there are no data for the activity level, which makes impossible to calculate the energy intensity for each type of transport.

In the service sub-sectors (Health, Tourism, and Other services) and industry sub-sectors (Iron and Steel, Chemicals, Non Ferrous Metals, Non Metallic Minerals, Mining and Quarrying, Machinery, Food and Tobacco, Paper and Pulp Print, Wood and Wood Products, Construction, Textile and Leather) there are no energy demand data in the majority of countries. The main reason is that many countries use different classification of sub-sectors compared to the abovementioned one adopted in Promitheas-4. Depending on the particular data classification in each country, this may be a problem for the scenario development or not.

Energy demand cost data, consisting of total and per energy carrier (coal, oil, natural gas, biomass, electricity, and heat) cost of each economy sector and sub-sector, are not available in the majority of the countries. This is a major obstacle in obtaining financial results from the scenario modelling tools. The national statistical services could be obliged to collect and publish these data.

2.2.4. Energy transformation data

The major data gaps in the field of energy transformation (consisting of both energy production and distribution) are the economic and technical data about energy capacities. In none of the countries there is availability of the economic data required by the scenario modelling tool (LEAP) to make cost-effective dispatching of capacities and calculation of the overall transformation cost per scenario. In particular, these data are: capital costs, fixed O&M costs, variable O&M costs, salvage value, and interest rate. In some countries (with more regulated markets) all of these data are available at the energy regulatory authority; in other countries these data are available at the regulatory authority (or another entity) for a part of the capacities and the remaining data could be collected from the individual enterprises. The abovementioned energy cost data, however, cannot be published in some countries, due to confidentiality (e.g. competition at the power market in Romania).

The technical data about the transformation processes required by the modelling tool to calculate the expected contribution of process (respectively the need for new capacities) are also unavailable in any of the 12 countries. These data include maximum availability, capacity credit, and process efficiency of each energy

transformation process. Such data, if not currently collected by a relevant energy authority, could be collected by each individual plant.

2.2.5. General comments

The collection of historical data since 1990 proved to be impossible and/or irrelevant for most of the countries because several countries underwent major restructuring, or even regained their independence in the early 1990s. These were accompanied by major changes in the statistical information. Additionally, substantial changes in the data classification took place in the whole historic period 1990-2010 due to the gradual transition of the national statistics to the Eurostat methodology. In many cases, these changes resulted in data incomparability.

Another major issue is data accessibility. The first problem is that in almost all countries there are no available data in electronic format for the period 1990 – 1999. In several countries this period is even longer. Publishing the data electronically would very much facilitate the data collection process.

The second data accessibility problem is not publishing available data. It is a common problem in many countries that some data are available only upon request to the responsible authority. In some cases, the institutions that have the available data disagree to share it, although the data are not confidential.

2.3. M/A policy models

The models described in the report *Selection of Models for Mitigation/Adaptation Policy* (Felderer 2011, p.7) - ENPEP-BALANCE, MARKAL/TIMES, MESSAGE, MERCI, LEAP and IMAGE - provide an adequate overview of energy models that display the effects of mitigation policies on important variables. In general, a model that depicts reality most accurately is favourable. Additionally, according to the pre-defined requirements (a to i) (Felderer 2011, p.7), also other factors played an important role in order to evaluate the models as for instance the transparency of the model and training possibility and costs.

2.3.1. Research fields in the modelling framework

In the context of transition analysis, a bottom-up modelling approach is preferable because bottom-up models integrate different technologies and substitution possibilities to uncover the impacts of mitigation policies. Hybrid models which include top-down aspects also take into account macroeconomic impacts of mitigation policies as for example tax effects.

In contrast to mitigation policies, for which the presented models provided an adequate tool, adaptation policies and their effects on the economy and the environment are not directly integrated in the models. The instability and rising vulnerability of human and natural systems is not well assessed as for instance feedback mechanisms are not well considered. Accordingly, also adaptation measures such as building up dams and developing drought-resisting plants and their effects are not well pictured in the presented models. Recent research efforts aim to formulate adaptation through in terms of a control variable and to integrate adaptation measures explicitly in models (Patt et. al. 2010, p.385ff).

Some energy models set up in industrialized countries are not well adapted to describe the dynamics in transition economies (Bhattacharyya and Timilsina 2010).

The informal sector and inefficiency for example in energy supply play an important role so that an optimization under the assumptions of perfect information with optimal market clearing conditions may lead to biased results (e.g. MARKAL, MERCI, MESSAGE). An adequate representation of the situation in developing countries requires controlling for the urban-rural divide, the prevalence of inequity and poverty and capital flow barriers (Bhattacharyya and Timilsina 2010, p.500 and Urban et.al. 2007). Accounting models include more accurately non-price policies measures than optimization models (Bhattacharyya and Timilsina 2010, p.501). LEAP, a simulation and accounting model, makes it possible to integrate typical features of developing economies. However, the challenge for the analyst when dealing with LEAP consists in defining the exact functional relationship between for example the supply shortages, capacity and political factors. The model provides high flexibility, but leaves the module composition to the analyst. Hence, the profoundness and explanatory power of the model depends on the availability of data. No direct adaptation cost modules are foreseen in LEAP, but it is possible to associate external values with different greenhouse gases (GHGs) and local air pollution.

Furthermore, the lack of a financial market within a macroeconomic model becomes an urgent weakness in times of financial crisis when investment decisions are deferred because of uncertainty, increasing indebtedness of households, enterprises and states and constrained fiscal policy (Tommi et. al. 2013). In order to assess more realistically the resulting effects of mitigation and adaptation measures, the decision behaviour of consumers and producers has to be better captured in times of stringent financial constraints.

Optimization models face challenges to account for non-price factors and policies so that informal and imperfect markets are difficult to control for. Moreover, simulation models are in general very sensitive to the parameters chosen and sometimes to the chosen starting conditions. In contrast to the optimization modelling approach, accounting models do not automatically choose the least-cost systems so that differences between demand and supply forecasts may occur.

2.3.2. Aspects related to economic theory

Economic theory is built on strong economic assumptions which mirror a distorted picture of the reality and may lead to mistaken policy evaluation.

One field of research deals with the development of more accurate utility functions. Usual utility functions cover well monetarised benefits, such as the consumption of goods, but leave aside non-price preference for instance health and secure employment (Sudhir and Sen 2000). If an optimization models aims to compare different scenarios of environmental policies and to calculate costs and benefits from the regulatory instruments, also preferences for biodiversity, for healthy life and diversified nutrition could be included.

A further severe assumption is perfect foresight of agents in an intertemporal optimization problem. The agent maximizes its utility over the whole optimization period being conscious about future development and foresees different decision possibilities connected to relative prices. The perfect foresight assumption facilitates mathematical calculation. However, optimization models already include agents which have myopic expectations and act short-sighted (Felderer 2011, p.18). Research to depict more adequately choice forming processes that include information and

expectation about current and future situations, as one of the major topics in economic science, is still on-going.

The assumption about the representative consumer or producer is a favoured concept in economic theory in order to facilitate the mathematical solution of economic models. However, the integration of a heterogeneous demand structure is particularly important in developing countries. In this regard, mitigation policies affect the consumers differently. The effects of mitigation and adaptation policies are differently distributed among different agents within a country but also between countries. Some households have a better access to modern and efficient energy supply than others and energy costs have different shares on the income between the households for instance. In a population with a very heterogeneous demand structure characterized by spatial, economic and social differences, a model should control for the heterogeneous structure (Bhattacharyya and Timilsina 2010, p.500).

Furthermore, the importance of the discount rate in economic models in order to have convergence processes is strongly discussed in the context of environmental analysis. Time preferences for different environmental states are not very convincing. The value of environmental services and products for human society will never undercut a certain threshold level as economic activities depend on these services and products whose substitutability has a limit. Evaluating different environmental policies through price-related optimization, the distributional effects of environmental cost and benefits have also to be accounted for. In addition, intergenerational responsibility should be included to a certain extend to mirror better the preference to care about the future. When considering macro-economic models, it would be interesting to allowing multiple equilibriums formation in order to picture more realistically the dynamics of economies.

2.3.3. Research gap and need regarding environmental benefits and costs

A hybrid modelling approach aims to establish a coherent linkage between macro-economic dynamics and technical relationships stemming from an engineering framework as for example an accounting model. Especially, the connection between environmental and macroeconomic modelling reveals a demanding research field.

In this regard, feedback mechanism should be included to assess the full environmental costs and benefits of mitigation policies. According to the geographical location of a region, the climate change can have direct profound effects on the production (IPCC 2007, Chapter 3). Other effects show up more slowly for instance the glacier melting. Independently of the time perspective, the climate change and other environmental damages affect human society and economic activities and should be hence integrated in the models.

Another trend in environmental research is to extend the analytical framework and to include better and more detailed environmental indicators and factors going beyond GHGs calculations. Some models account for water pollution, waste production and land use but often only in relation to activities of energy production (e.g. ENPEP-BALANCE). Health problems as the result of increased droughts and polluted air, the disapproval of biodiversity loss are only some issues rising from environmental damage that have to be better accounted for in order to assess the real cost and benefits of policy intervention (Venkatachalam L. 2007 and IER 2013) .

The handling of uncertainty remains a challenge when dealing with climate change policies. As extreme events like flooding and droughts will occur more often, the necessity emerges to include such events in the modelling so that economic costs and potential and benefits from adaptation interventions get transparent (IPCC 2012).

Climate change implies long term developments that exceed the typical long-term perspective of economic models of 20 to 30 years increasing up to 100 and 200 years (Bhattacharyya and Timilsina 2010, p.499). Remaining research challenges lie in the methodological handling to incorporate long term developments into short term functional relationship for instance the increasing vulnerability of an ecosystem.

Moreover, the need for more comprehensive research leads to a broader perception of political strategies for a more sustainable development. The inclusion of life-cycle concepts and green economic growth that systematically encompasses products, strategies and behaviour in optimization, accounting and econometric models will be crucial for good policy evaluation.

2.4. Development of M/A scenarios and policy portfolios

2.4.1. Background

Within Promitheas-4 project, climate change M/A policy scenarios are developed for the 12 project beneficiary countries and each scenario is based on assumptions for a number of scenario variables (independent variables), such as economic variables, climate variables, energy consumption, etc. In order to obtain reliable scenario outcomes (dependent variables), it is fundamental to have reliable information for the future development of the independent variables.

Below are summarized the research gaps and needs related to the independent variables necessary for the scenario development in the 12 countries. The time horizon considered is 2011 – 2050.

2.4.2. Economy and demographics

Given the correlation between economy (GDP) and energy consumption, it is essential for the scenario development to use high quality economic forecasts. Taking into account the last 22-24 years of the transition from a centrally planned economy to market economy and the recent years of economic crisis, it is not feasible to define the economic evolution up to 2050 based on historical data.

The available GDP forecasts for the 12 countries have a very short time horizon, typically until 2017 or 2020. Additionally, many of the available forecasts are obsolete, as they did not take into account the economic crisis. Furthermore, given the large differences in the energy intensity of the different economic sectors, it is important to consider how the GDP share of each sector and sub-sector is expected to evolve over time. For many countries such information is not available, while in the others it too general and in many cases the time horizon is too short (similarly to the GDP forecasts). Therefore, new and long term (by 2050) GDP forecasts, including GDP distribution per sector or sub-sector are needed.

Unlike GDP forecasts, there are available demographic forecasts for all countries by 2050. It is, however, sometimes confusing for the scenario developer to decide which forecast to consider, given the availability of several contradicting projections.

2.4.3. Climate

Long term climate forecasts, developed in several scenarios considering the anthropogenic GHG emissions, are important for the definition of both mitigation and adaptation policies.

Although most of the countries are covered by temperature and precipitation forecasts (only few exceptions, such as no precipitation forecast in Estonia), in most cases these forecasts are very general and with high degree of uncertainty. Additionally, some of these forecasts (e.g. those covering Azerbaijan and Bulgaria) are obsolete. Therefore, further research on temperature and precipitation in the studied region is needed.

In few countries only there are forecasts for the extreme events (annual number of floods, heat waves and frost days) and for the water resources (surface waters, ground waters, overlaps, and renewable fresh water) and these forecasts are rather general. A serious problem in this regard, as outlined in section 2.2, is the lack of historical data, especially concerning heat waves, frost days, ground waters and overlap. Therefore, initially the research efforts in most countries need to focus on the calculation of historical data for heat waves and frost days, based on the available climate data, as well as on the collection of information about the water resources.

2.4.4. Energy

Energy (including transport) is the main contributor to GHG emissions. Therefore, the energy-related assumptions have a great effect on the outcomes of M/A policy scenarios.

Information about the energy policy of the 12 countries, however, is very limited. In particular, there are two main gaps:

- The planned energy policy objectives and measures, if such plans exist, have time horizon by 2020 and in rare cases by 2030.
- The expected effect of the planned energy policy measures (in terms of energy, emissions, costs, etc.) is rarely quantified in publically available documents. Where such quantification is available, it is usually limited to energy efficiency and renewable energy policy effects.

In most countries, energy demand forecasts are not available. Exceptions are Armenia (forecast until 2020) and Kazakhstan (forecast until 2030). In several countries there are available forecasts by 2020 for the renewable energy (e.g. when these countries have National Renewable Energy Action Plans), or for the electricity demand only (e.g. in relation to their plans for the development of electricity capacities) only. For the modelling purposes, it is important to develop energy demand forecasts by 2050 broken down per sector or sub-sector and per fuel (energy carrier) consumed by each sector and sub-sector. In this relation, among the others, the research needs to focus on:

- availability of energy resources, such as locally available biomass, wind, solar, geothermal, and hydro resources. The theoretical, technical, economic (under specific conditions), and market penetration potentials need to be considered.

- Energy efficiency potential and possible rates of its realization in each end-use sector (industry, transport, etc.).
- Possibilities for fuel switch (e.g. from coal to nuclear power plants, from oil to gas heating devices, from petrol to electricity in transport, etc.).

The forecasts about energy transformation capacities are also scarce. In most cases, only plans for the development of the electricity capacities by 2020 (rarely by 2030 or 2050) or renewable energy capacities by 2020 are available. In the majority of countries, there are no plans for phasing out of the existing energy capacities, especially when the expected year is after 2020. It is recommended to develop, therefore, forecasts for the energy capacities (phasing out of the existing and construction of new ones) in a longer term.

Concerning transmission and distribution losses, forecasts are available in few countries only and they cover only the period by 2020. Projections for their levels by 2050 would be useful for the assessment of the necessary electricity and heat capacities for this period.

Furthermore, the energy system modelling requires input of technical (maximum availability, capacity credit, and process efficiency of each energy transformation process) and economic (capital costs, fixed O&M costs, variable O&M costs, salvage value, and interest rate) parameters of the energy capacities, but there are no available studies for their future value. Moreover, as mentioned in section 2.2.4, there are no even available historical data for their values in the 12 countries. Therefore, initially the efforts need to focus on the inclusion of these data in the statistical system.

2.4.5. Adaptation

In the 12 project countries, there are almost no specific studies about the climate change impact on the vulnerable to climate change sectors of economy, such as agriculture, forestry, waters, energy, and health. It is important to assess how the conditions affected by climate change - temperature, CO_2, glacial run-off, precipitation, etc. and the interaction among them – would affect each sector. For example, in the energy sector, the research could cover the climate change impact on the heating and cooling loads and on availability of renewable energy resources (water, biomass, wind, solar, and wave energy).

Based on studies about climate change impacts, assessments to identify the adaptation needs and the best options to address these needs need to be carried out. In some countries (e.g. Bulgaria, Kazakhstan, Ukraine) adaptation needs are mentioned in official documents and cover several or all vulnerable sectors, while in others the needs are stated for individual sectors only. Almost all needs, however, are stated very generally (e.g. there is no quantification) and are not based on country specific studies. Therefore, research on the adaptation needs is necessary, covering technical, socio-economic, and environmental aspects. Among the others, the following topics could be in the research focus:

- In agriculture: change in land topography, use of artificial systems to improve irrigation and water availability, protection against soil erosion, change of farming systems and timing of operations, change of crops, etc.;

- In the forestry: better forest management practices and options to expand the forest area;
- In water sector, the adaptation needs and solutions at both the supply and demand side need to be studied. At the supply side the research could cover identification of critical thresholds and better management of water resources, while at the demand side – options to reduce the water use in households, industry, and other sectors.
- In the energy sector: changes in the energy supply

Furthermore, based on the identification of adaptation needs, research on the design of adaptation policies and measures is necessary. In most of the 12 countries, there are no planned adaptation policies and measures, while in the others they are both very limited and with short-term horizon. In order to take into account the characteristics of each sector, it is recommended that sectorial adaptation policies are developed under the responsibility of the national authorities in charge of the respective sectors (e.g. the adaptation policy in the agricultural sector is under the responsibility of the Ministry of Agriculture, etc.).

2.5. Evaluation of M/A policy instruments

In Promitheas-4 project, the scenarios developed for the 12 beneficiary countries have been evaluated by using the multi-criteria evaluation tool AMS. The tool is based on a criteria tree, including environmental performance, political acceptability, and feasibility of implementation of each policy scenario (Konidari P., Mavrakis D., 2007). The weight coefficients of all criteria and sub-criteria are pre-defined and users need only to grade the scenario's performance under each sub-criterion.

The method AMS has been applied in all 12 countries. The main gaps and needs encountered during its application are as follows:

- *Lack of capacity to apply a multi-criteria evaluation method.* In most of the countries there is no experience with the application of multi-criteria evaluation tools for climate change M/A policies. Additionally, in most of the countries, due to inappropriate background, the national teams experienced substantial difficulties in understanding and using the tool and needed assistance.
- *Absence of policy monitoring or evaluation procedures.* The lack of such procedures results in a difficulty to understanding the performance of the implemented policy instruments.
- *Limited policy evaluation reports.* Information about results of implemented policies (policy evaluation reports) is rarely available.
- *Absence of ex-ante information about the policies.* In many cases, researchers are unable to quantify the estimated effects of existing and planned policies, because these are either not quantified at all, or not published. For example, it would be useful to provide for these policies ex-ante information about environmental performance, cost efficiency, effects on competitiveness and equity, and feasibility of implementation.

2.6. General needs and gaps

Some needs and gaps are common for all or most of the categories reviewed above (sections 2.1 to 2.5). These are as follows:

- *No access to information.* In many cases researchers were unable to access existing information. In many cases the statistical information (data, policies, policy results, etc.) is available, but cannot be accessed easily.
- *Language barrier.* The language barrier has two aspects. Research tools, methodologies and approaches for the development and assessment of M/A policy mixtures that are developed and used widely in EU are not disseminated properly towards scientific communities located in emerging economies among other reasons because of the poor use of the English language from their part. The other aspect is the availability of information only in the national languages (no translation in English) and the related difficulties experienced by foreign researchers to access it. For example, two National Communications to UNFCCC (Russia and Ukraine) and many authorities' websites are available only in the national languages.
- *Inadequate national implementation network.* In several countries there is limited information about climate change policy (especially concerning adaptation) and in most countries there is no information about results of policy implementation. Additionally, the understanding of climate change policy does not always correspond to the understanding laid down in the international documents. Furthermore, often the websites of the pertinent authorities contain very limited information (e.g. even official reports are sometimes not available) and/or researchers need to spend much time to locate it.
- *Inadequate background.* The researchers had to get familiarized with the terms used in climate change policy, the scientific standards applied in EU, and the energy modeling tool and the multi-criteria decision analysis method.

3. Research needs and gaps per country

3.1. Albania

3.1.1. Established national procedures, sources, available data and information about M/A policy

3.1.1.1. GHG inventory

The Ministry of Environment, Forests and Water Administration (MOEFWA) is the main responsible institution for climate change issues in Albania. In its structure the General Directorate on Environmental Policies and the Agency of Environment and Forestry are included. Other governmental entities engaged in environmental policy are: Ministry of Agriculture, Food, and Consumer Protection; Ministry of Public Work, Transport, and Telecommunications; Ministry of Economy, Trade, and Energy; Ministry of Health, and others. Their involvement is provided in Laws and Governmental Decrees.

The Mission of MOEFWA is to draft and propose policies, strategies and action plans for the protection and the administration of environment, forests, waters and fisheries in order to achieve sustainable development, and to improve the quality of life. The accomplishment of this mission is carried out through participation, initiation and coordination of the activities. The main responsible body regarding the National Inventory Report is the General Directorate on Environmental Policies.

The following needs are stated:

- Strengthening the cooperation between Institutions involved in climate change issues (Ministries, Governmental Agencies, Institute of Statistics, etc.);
- Involvement of universities and their research institutes in the area of climate change (Polytechnic University, Agricultural University, etc.).

3.1.1.2. Reporting

The reporting process is based on data provided by Institute of Statistics, Ministries and other institutions. Data gaps are filled by exploiting various methodologies, such as correlation, interpolation, extrapolation, and surveys. Also, default emission factors from IPCC 1996 Revised Guidelines are used.

Regarding the reporting process, the main areas where further research is needed are: data collecting, processing and publishing.

Data collecting and processing

As mentioned above, uncertainties in the national inventory of anthropogenic emissions could be vanished by improving the statistical data collection system. As a result, several needs could be highlighted:

- Differentiation of the data collected from Albanian Institute of Statistics regarding the energy use in different sub-sectors, processes, technologies, etc;

- Revising the data collection system on oil and gas production and consumption (the official statistics on their usage are widely believed to underestimate the used amount);
- Building up a database that will serve to monitor the transport sector and its sub-sectors. This is important, because this sector has the most GHG emissions in the country.
- Building up databases to monitor energy performance of buildings (residential, commercial, services, and public buildings). These databases would ensure that the data on energy performance in buildings will be available to other ministries and agencies, as well as for compiling the Energy Balances and GHG Inventories;
- Designing the data collection system regarding the disposal of refrigeration units and refrigerant substances. Many of HFC and PFC have very high global warming potential than carbon dioxide;
- Designing the data collecting system regarding heat waves, frost days, floods;
- Designing the data collecting system regarding land use changes.

Data publishing

One of the most evident problems for Albania is the lack of reports regarding the climate change issues. Also, the related data when are available they are not published in the institutions website. The existing reports refer to an early period and they need to be updated. The need related to this issue is to periodically update and publish national inventories of anthropogenic emissions by sources and removals by sinks.

3.1.2. Historical M/A data

In this section the needs and gaps related to historic data necessary for the scenario development are outlined (Maraj A. et al, 2012).

Climate, economy, and adaptation

- There are no available data regarding the Frequency of extreme events (heat waves, floods, frost days, etc) for the whole studied period 1990-2010. Institute of Geosciences, Energy, Water, and Environment is responsible for collecting these data. It is recommended to publish these data.
- There are no available data regarding the groundwater volume. Institute of Geosciences, Energy, Water, and Environment is responsible for them. Publishing these data is recommended.
- For the annual average household income, there are data available only for 2006 and 2007. The Institute of Statistics is responsible for the collection and publication of these data.
- Regarding the GDP distribution per sector, data are missing for the period 1990-1995. Institute of Statistics is responsible for the management of these data.

- In the Manufacturing Value Added in the industrial sectors, there is no data for time period 1990-1999 and 2006-2010. Institute of Statistics is responsible for them.
- In the area of adaptation, there are no available data for water use in the energy sector. Institute of Statistics is responsible for the management of these data.

Energy Demand

Much energy demand data are not available, including:

- In the Energy Demand in the following sectors: Households, Agriculture, and Other Services data are available only for a part of the studied period.
- There are no data about the number of tourists. This applies to the whole studied period.
- Regarding the Energy Demand in the Industry sector - Iron and Steel, Chemicals, Non Ferrous Metals, Non Metallic Minerals, Mining and Quarrying, Machinery, Food and Tobacco, Paper and Pulp Print, Wood and Wood Products, Construction, Textile and Leather, there is no data for the studied period.
- The Energy Demand in the Transport sector is not disaggregated into Passenger and Freight transport. Consequently, there are no available data for Passenger Rail, Domestic Air Transport, Passenger Inland Water, Maritime Passenger, Freight Road, Freight Rail, Freight Inland Water, Maritime Freight, Pipelines.

For all of these data the Institute of Statistic is in charge and it need to make the necessary steps to collect, process, and publish the data.

Energy Transformation

Substantial historical energy transformation data are not available for the whole studied period 1990-2010, in particular:

- Amount of energy produced by oil, natural gas, and coal.
- Statistical Differences for primary and secondary fuels.
- Oil refining.
- Biofuel Production.
- Coal Transformation

For all of these data the Institute of Statistic is in charge and it need to make the necessary steps to collect, process, and publish the data.

Other Energy Data

- Regarding the Stock Changes of primary and secondary fuels, there are no available data. Institute of Statistics is responsible for them.
- Regarding the energy resources - primary and secondary- there are no available data. Institute of Statistics is responsible for them.

3.1.3. Development of M/A scenarios and policy portfolios

In regard to the research needs and gaps linked with the national report of Albania on scenarios development, the following issues have to be highlighted (Maraj A. et al, 2012):

3.1.3.1. Key assumptions

Regarding to demographic forecasts for Albania till 2050, there are ones from United Nations (UN, 2011). However, no official national forecasts have been found.

There are three GDP projections for Albania. The first is obtained from International Monetary Fund (IMF), which provides projections for Albanian GDP till 2017 (IMF, 2011). The second is obtained from International Energy Agency (IEA), which provides a constant value for Albanian GDP till 2035. The third is obtained from Ministry of Finance of Albania, which provides projections for Albanian GDP till 2014 (Ministry of Finance, 2012). A recent GDP forecast is needed until 2050.

Concerning climate forecasts till 2050, data are available at the Second National Communication to UNFCCC (UNFCCC, 2009). However SNC refers specifically to the Drini river area and does not offer studies for the whole country. There are both existing and planned capacities of hydro power plants in other parts of the country, so it is important for the scenario development to develop climate forecasts covering the whole country.

Also, there are no forecasts for the frequency of heat waves and frost days. So, additional research efforts on climate forecasts are needed.

3.1.3.2. Adaptation

In the field of adaptation, there is no specific information concerning the climate change impacts and the country's needs to adapt to them. Additionally, there are no planned adaptation measures. Studies in these areas are needed.

Transport sector

Transport sector constitutes the main source of GHG emissions in Albania (Maraj A. et al, 2012). This way, this sector is very important for Albania and several efforts are needed:

- To examine the long-term of impacts of transport sector on climate change projections.
- To analyze options for adapting impacts of transport sector, including the possible need to alter assumptions about infrastructure design and operations.

Agriculture sector

Agricultural sector is considered the main contributing sector to Albanian GDP. This way, this sector is very important for Albania and several efforts are needed:

- New and conservative technologies of soil processing is implemented in Albania during the last years, which lead to both a significant fuel saving and big amount of carbon conservation into the soil. But there are no studies that would show the limits of such technologies dissemination and what may be the speed of their implementation up to 2050.

- Identifying the environmental factors associated with expanded production of biofuels and bio-based products.
- Assessing the interaction with hazards, directly or indirectly arising from atmospheric conditions (rainfall, flood, frost, drought, hail, heat waves, and seasonal shifts).

3.1.3.3. Energy Demand

Energy demand calculation in different scenarios depends mainly from data, policies and proposed measures. There are several sectors and subsectors of economy in which the energy demand data are not available. As result, further studies are needed, especially concerning tourism, health services, and the subsectors of industry and transport. The proposed studies must be detailed enough to allow developing specific scenarios, meaning that they need include fuel shares, fuel/energy cost, and data on the activity level (e.g. person-km and tonne-km in the case of transport) (Maraj A. et al, 2012).

The effect of climate change on energy use in residential sector needs to be evaluated. These are related with energy use for heating, cooling, water heating, etc.

3.1.3.4. Energy Transformation

Albania is distinguished by low energy security (44% of electricity was imported at 2011). Also, there are high technical and commercial losses from the distribution system, which amounted to 35.6% at 2011 (ERE, 2012). There are no projections for their level until 2050.

The National Strategy of Energy offers policies and measures till 2020 (AKBN, 2003). After 2020, there is a gap regarding the expected policies.

For the scenario development it is important also to have forecasts of the installed capacity, maximum availability, and variable cost. The action plan for installing capacities from renewable energy sources till 2020 is available (NREAP, 2012). However, there are no plans and estimations for the time period beyond 2020.

Taking into account that Albania is vulnerable to climate change effects, several studies are needed on:

- assessment of impact of temperature rise and droughts on hydro energy potential;
- improving the capacity of water management models;
- assessment of impacts of climate change on energy production from biomass;
- wind resources changes (intensity and duration); and
- assessment of electricity transmission and distribution system.

The potential for CHP should be determined for several parts of the country. There is a project for the south-eastern part of the country, but till now it is not implemented (AKBN, 2003).

Finally, there are no studies on gas distribution, transiting, and exploitation. After the Trans-Adriatic-Pipeline was approved on 28.06.2013, new studies are required for

Albania (TAP, 2013). The Albanian Strategy of Energy does not offer any policy or measure in this field (AKBN, 2003).

3.1.4. Evaluation of M/A policy instruments

The main difficulties in developing and evaluating M/A policy portfolios were:

- Inadequate national implementation network: The Albanian entities involved in climate change policy issues are not approachable through the Internet. There is no web-site for the Albanian Designated National Authority. Additionally, limited information was available about the intentions of the government to introduce new policy instruments or modify those already implemented.
- Non-existent or limited published research work on mitigation and adaptation issues: Policy oriented research work was not found for Albania. There are no papers estimating the possible impacts that CDM projects may have for the Albanian climate change policy or about understanding the performance that policy instruments for the promotion of energy savings may have for the country. Vulnerability studies or studies for the Albanian Renewable Energy Sources potential conducted by national institutes were not located.
- Use of energy models and policy evaluation methods: No such research work was found for Albania. The key assumptions were selected carefully based on available information about the country as described in the relevant report. Evaluation was based on LEAP outcomes and information coming from available official documents and studies conducted by international and European entities.
- Inadequate background: The Albanian team was not familiarized with the Multi-Criteria Decision Analysis methods. It encountered strong difficulties in conducting the evaluation and needed assistance.

3.2. Armenia

3.2.1. Established national procedures, sources, available data and information about M/A policy

3.2.1.1. Energy

Energy data are generally available and is considered to be of sufficiently high quality. The primary issues identified for energy data are:

- Lack of Data on Prices of Imported and Exported Fuels. Import and export prices for electricity and other energy sources are not provided to National Statistical Service (NSS). Lacking data on actual prices, estimates are developed, based on regional prices from other countries. Accurate price data are required for generating optimal recommendations for energy strategy.
- Lack of Standardized Forms for Data Collection from Energy Suppliers. Some data reported to NSS by power plants is reported in monetary units, rather than volume or quantity units as is needed for Energy Statistics.

- Energy Consumption and End-Uses. For the energy sector, the data gaps and data quality issues are primarily related to final energy use and consumption. The lack of energy consumption and end-use data for households, commercial and service organizations, industry, and agricultural enterprises limits the use of a disaggregated "bottom-up" approach for the national Energy Balance and the GHG Inventory. Disaggregated consumption data for different fuels are required for higher Tier methods (Tier 2 and 3) for preparing a Greenhouse Gas Inventory (IPCC guidelines).
- Lack of Effective Codes to Classify End-Users by Sector. For electricity and natural gas, the primary end-use consumption fuels in Armenia, there are monopoly distribution companies, which should facilitate the reporting of final consumption by sub-sectors. However, the two distribution companies do not use the same codes to identify customer sectors, and neither company uses the standard Statistical Classification of Economic Activities (NACE codes) used in the European Community. The lack of standardized sector and sub-sector codes means that for electricity and gas distribution data, it is not always possible to accurately separate industrial, commercial, and agricultural users, because analysts must rely on the names of the entities to classify them. It is also not possible to accurately identify the specific sub-sectors for industry, service/commercial, and agriculture.

The most important data gaps and data quality issues in the energy sector are related to energy consumption and end-uses for each sector, including:

- Household Sector. Data on the type of fuel used for end-uses, such as space heating, air conditioning, water heating, lighting, and cooking are not available. These data for disaggregated fuel consumption by end-use by sector are required for a bottom-up approach for Tier 2 analysis of GHG emissions. It is also noted below in the LULUCF sector that fuel wood consumption and use of animal waste for fuel are estimated for households. No data on actual final consumption is available. Data on the use of solar panels for hot water and solar photovoltaic systems are also not available. These are very small and probably not significant at this point in time, but baseline data on the square meters of solar panels installed for different end-uses will be required for monitoring and evaluation of the National Renewable Energy Action Plan (NREAP) for Armenia, when it is finalized.
- Commercial and Service Organizations. This sector, which includes private and public sector organizations, also does not have data on fuel use by space heating/cooling, water heating, motive power (lifts), office machinery and equipment, lighting. Attempts to estimate total energy consumption for this sector are hindered by the lack of standardized codes for classifying end-use customers by sector. Data on the use of solar panels for hot water and solar photovoltaic systems are also not available. These are very small and probably not significant at this point in time, but baseline data on the square meters of solar panels installed for different end-uses will be required for monitoring and evaluation of the NREAP for Armenia, when it is finalized.

- Industrial Enterprises. Data on the industry sector as a whole is available from the electricity and gas distribution companies. Data are not available by sub-sector within the industry sector. A further issue is that some industrial companies operate in more than one industry sub-sector – for example, in cement production and production of petroleum products. The gas and electricity distribution companies can aggregate consumption for multiple meters for a single enterprise, but they are not able to identify the specific sub-sectors for which consumption occurs. More detailed and systematic data on fuel consumption by end-uses, such as equipment for space heating/ventilation, water heating, process heating, motive power (lifts), and lighting are not available for the industry sector. The need for disaggregated fuel by end use data are particularly important for major industries, such as chemical production; iron and steel; food, beverage and tobacco; and construction.
- Agricultural Enterprises. Data on fuel consumption by end-uses and the types of equipment used for space heating and ventilation, glass houses, farm machinery/equipment, lighting, dwellings, refrigeration/cooling, and irrigation are not available.

3.2.1.2. Transport

Data on the Armenian vehicle fleet are noted as a major source of uncertainty for estimating GHG emissions. The number and types of vehicles are estimated from a vehicle registry maintained by the Police Department; however, the vehicle registry is widely believed to be inaccurate on several counts. First, the actual counts of vehicles are believed to represent an estimate, rather than an accurate count. Second, vehicles are registered based on the original equipment for fuel use (primarily petrol). Many of the vehicles in Armenia are modified to be able to use compressed natural gas (CNG), as well as petrol, but this type of modification is not recorded in the vehicle registry. The amount of CNG delivered to vehicle fuelling stations is available, but additional data on fuel consumption by type of vehicle and vehicle characteristics are required for Tier 2 methods for the GHG Inventory.

The total imports of kerosene and diesel are recorded as being consumed by the Transport sector, even though households and agriculture use some of these fuels.

3.2.1.3. Land Use, Land-Use Change, and Forestry (LULUCF)

The UNDP Climate Change Unit proposal for the Third National Communication indicated that special attention would be paid to this sector to reduce the high level of uncertainty associated with estimates in the prior National Communication. The lack of a data collection system for the LULUCF sector was identified as the main obstacle in preparation of the Second GHG Inventory for the SNC.

The most recent inventory of forests is from 1998 and is outdated. The estimates of the amount of cropland and forest land remaining in Armenia are noted as two key sources of uncertainty in LULUCF for the GHG Inventory.

Estimates of wood harvest do not account for a large amount of illegal and unreported cutting in rural areas for household use.

3.2.1.4. Agriculture

Data on the number and type of livestock were an important source of uncertainty for the Second National Communication estimates for methane emissions from enteric fermentation and manure management. For Tier 2 methods, additional data for feed digestibility, milk productivity, as well as the types of manure handling facilities and practices are needed.

Consumption of oil products, as well as natural gas used for heating animal enclosures is not reported to NSS and good estimates are not currently available.

The lack of information on fertilizer (N content) and application practices is an issue in the agriculture sector.

For the IPCC 2006 guidelines, the structure of the soil inventory will need to be revised. Currently, an old Soviet Union terminology and classification system is used. This system does not match up with the current international terminology and system used in the EU. Additional data gaps in the agriculture sector include:

3.2.1.5. Waste

Detailed country-specific activity data on types of solid waste from household, yard/garden, commercial and service, and industrial sectors are not collected. The Waste sector inventory is done mainly based on aggregated data on landfills and urban and rural population.

Activity data for wastewater handling for domestic, commercial, and industrial sectors are not collected. Wastewater discharges are reported only as a total for Armenia per industrial and domestic-commercial sectors.

3.2.1.6. Industrial sector

The data for emissions from cement production is done based on data provided from 2 existing factories, and was possible to apply tier 2 calculation. First time is collected activity data for F gases, which revealed that this sector in 2010 GHG Inventory has become a key source sector, however there are uncertainties connected with data source identification.

3.2.1.7. Organization of inventory and collaboration among institutions

Up to now, there are no any organizations responsible for inventory. National inventory is still prepared by the group of experts working under the UNDP umbrella and its financing. As a positive development can be considered that UNDP Third National Communication expert team is developing the GHG inventory based on 2006 IPCC guidance.

Armenia has just being started to create some structure responsible for GHG Inventory in regular basis. Now there is the on-going USAID project titled “Technical Support for the Development of Systems for Armenia’s National Energy Balance and Greenhouse Gas Inventory”. The main activities of this project are addressed to:

- support to carry out Gap Analysis to identify specific concerns and suggestions related to availability and quality of data for preparation of an Energy Balance and GHG inventory;

- assist to develop and modify legislative and regulatory basis to authorize and mandate provision of existing administrative data, and reporting of new primary data for preparation of Armenia's Energy Balance and GHG inventory; and
- support to build capacity within the Government of Armenia for regular reporting of the Energy Balance and GHG inventory.

It is expected that the main institution responsible for data collection will be SRIE-ESC under the general administration from Ministry of Energy and Natural Resources.

3.2.2. Historical M/A data

The requested data provision is limited, in particular, the information available in Armenian Statistical Service. The Statistical yearbooks have published since 1995. The data for the period 1995-2000 are incomplete and some of the needed data are unavailable. Public Service Regulatory Commission (PSRC) has begun the publication of new data since 2003. For the energy sector, the data gaps are primarily related to final energy use and consumption. There is no energy consumption and end-use data for households, commercial and service organizations, industry, and agricultural enterprises. Data on the use of solar hot water collectors and solar photovoltaic systems are also not available.

3.2.2.1. Climate Statistics

No data for surface water, heat waves per year and frost days per year are published. Some data on water resources such as ground waters and total renewable fresh water are available in several sources but they do not coincide with each other and it is too hard to identify the exact database. Publishing of such data can be obligated to the National Statistical Service of RA.

3.2.2.2. Demand

There are no available data on the amount of the different fuel types consumed in households, agriculture, transport, services, industry and their subsectors. The demand costs of the consumed fuel types are also unavailable for those sectors. The same problems, both for fuel share and for costs, are typical for the Sectors of Tourism and Health, which are not indicated in our statistical reports as separate sectors.

3.2.2.3. Transformation

In Armenia, Public Services Regulatory Commission (PSRC) collects all the economic and technical data of the companies, involved in the electrical (power) and gas sectors. Information about variable and fixed O&M costs, salvage values, capital costs and other economic data, as well as data of electricity generation, self-consumption (own-use), electricity and gas transmission and distribution, losses in the networks and others are used to set the tariffs for each company. No separate economic data of companies are published, but it can easily be obtained upon an official request. In the country none of the above-mentioned data are available for coal, oil, biomass, as well as for different types of renewables (wind, solar, small HPPs etc.).

3.2.2.4. Non Energy Sector

The information on Non Energy Sector is also constrained, due to the fact that the data in Second National Communication on Climate Change are only available up to 2006 and the Third National Communication on Climate Change is under the preparation.

3.2.3. Development of M/A scenarios and policy portfolios

3.2.3.1. Background

This section describes the research needs and gaps in Armenia, identified during the work on the report "Development and assessment of Mitigation / Adaptation Climate Change policy portfolios for Armenia" (Sargsyan et al, 2013), as well as during the attempts to develop additional scenarios, based on more optimistic and more pessimistic key assumptions.

3.2.3.2. Key assumptions

Related to demographics, there are no national long-term (up to 2050) forecasts about the average annual rate of change of the Armenian population, therefore the data published by the United Nations (United Nations, 2011) have been used. This forecast is not reflecting the latest changes in the population growth; so, additional studies are needed.

The same can be noted for national long-term forecasts for GDP growth. All available forecasts in Armenia have time horizon only until 2030. Therefore, GDP growth forecast until 2050 needs to be researched.

The GDP distributions per sector in scenarios were based on the historical data available on both national and international open publications. The available forecasts of GDP distribution per sector have time horizon mainly till 2020 and latest publications (end of 2012) provide forecasts till 2025 (RA Strategy Development Program Outlook for 2012-2025, 2012). As a research need the forecast of the GDP distribution per sector for the studied timeframe can be recommended.

There are certain forecasts for the frequency of extreme events and water resources, however additional research efforts are needed to assess additional sources of information which can contribute to more reliable forecasts.

Only regional forecasts with different geographical coverage exist in the field of water use per consumption sectors: households, agriculture, industry, and energy by 2050. Considering the mountainous terrain of Armenia with not equal distribution of water resources there is a need to assess the adaptation needs within the range of precipitation forecast scenario uncertainties. There are data for 2 river basins but to have integral picture for whole country there is a need to conduct additional studies/projections.

3.2.3.3. Policies and measures

Related to the climate change adaptation, there is information per sector included in the 2nd National Communication. There are more detailed studies for forest (UNDP) and agriculture sector (WB). The 5-year action plan for implementation of UNFCCC was adopted by Governmental decision (# 1594-N, 2011) and envisages certain measures aimed at adaptation to climate change: development of National

Adaptation Plan by 2015, and measures for adaptation of forest ecosystems. However there is lack of specific assessments on the economic impact on agriculture, pastures, infrastructures and energy sectors in Armenia; the assessments are rather general. For the development of appropriate adaptation policies specific studies are necessary to be done. There are preliminary activities launched by the Armenian Government to these issues.

3.2.3.4. Energy demand

The forecasted energy demand per sector in BAU is simply linked to the GDP per capita in Household sector and to GDP for other sectors. Such estimations are no so strongly reasonable, especially in case of long-term planning. In Armenia most of demand forecasts are prepared by 2020, which reflects the current developments vision. Over long-term (after 2020) objectives of Armenian development include EU integration target, which will result to change of demand structure and composition. These will harm the fuel mix used in each sector. Examined period is too long for the exact estimation of fuel shares, as well as penetration of renewables and other energy sources in the country energy balances. So, additional studies of each fuel in each economy sector until 2050 are needed.

3.2.3.5. Energy transformation

Many energy sector development plans (including least-cost generation plans) have been elaborated in the period of 1994-2012. Each of them reflects a specific development option and depends on the political and economic situation in the country, in the region, and in the world. Unfortunately, no comprehensive long term energy system development plan beyond 2025 is available, which will exactly define the timescale of phasing out generating capacities (e.g. nuclear and thermal), as well as the dates of new plants commissioning. Plan for the installed capacity per renewable energy type and application (electricity and heating/cooling) by 2025 is available in the National Strategy. The losses in Transmission and Distribution networks are the factor significantly influencing on the energy balance. There have been no special studies in the field of long term changes at electricity losses level done in the country yet.

The scenario inputs request the data such as efficiency levels, capacity credit, maximum availability, and other technical parameters of each type of energy production capacity, which have never been available in the country's statistics.

3.2.4. Evaluation of M/A policy instruments

The main difficulties in developing and evaluating M/A policy portfolios for Armenia were:

- There is no specific information about how major economic sectors would be affected by climate change in terms of financial costs and benefits and competitiveness. A study initiated by UNDP in cooperation with Stockholm Environment Institute (2009) was conducted and the economic impact was assessed for 4 sectors: agriculture, water, energy and forest. The study indicated that there were certain limitations for making assumptions, as there are gaps in disaggregated data, yields of certain crops, forest inventory, and sector specific studies. Although there are several planned adaptation measures, for none of them there is any

information about the expected policy set-up, environmental effect, socio-economic effect, and cost to the Government to implement it. There is also no assessment concerning sharing the responsibilities between private and public sector. Certain studies are underway in the framework of 3rd National Communication preparation, the final document is expected in 2014.

- Inadequate national implementation network: There were two available national web-sites that had relevant reports on M/A climate policy issues, but these were conducted with the support and assistance of GEF and USAID and without covering the whole spectrum of issues. The web-sites of the pertinent authorities had no information specifically on climate policy issues. The language barrier for researchers not speaking Armenian was intense when searching for information at the web-sites of Ministries.
- No research work was found on the evaluation of climate change policy mixtures or instruments.
- No reports were spotted for having information about the performance of the implemented policy instruments.
- Inadequate background: The Armenian team was not familiarized with the Multi-Criteria Decision Analysis methods. It encountered strong difficulties in conducting the evaluation and needed assistance.

3.3. Azerbaijan

3.3.1. Established national procedures, sources, available data and information about M/A policy

The climate change adaptation and mitigation are very actual issues, but at the same time they are quite new for Azerbaijan.

In Azerbaijan is used still the old system of USSR on inventory of emissions of polluting substances in atmosphere is used. (A management under the control of pollution of atmosphere, Reference: GIDROMETISDAT, 1979). In Azerbaijan is spent tool sampling and their processing in stationary laboratories. The condition of 14 components is supervised (including: a dust, soot, phenol, NO, NO_2, Cl, H2S, SO2, HCl, H2SO4, SO4). Tests are selected 3 times a day (07-00, 13-00 and 18-00). From parameters the temperature, humidity and pressure of air, speed and direction of wind is supervised.

- For preparation of national inventories and national data on emissions creation in the countries of the special groups, prosecuting these subjects on the basis of official bodies is expedient:
- To carry out actions for training of experts for improvement of the account of emissions;
- There will be useful an establishment of constant contacts of national groups on emissions with similar groups of other countries, participation in seminars, courses on training and an exchange of experience;
- The reporting on emissions of the enterprises to make opened;

- To make accessible data of gaugings of concentration of components in emissions at the enterprises that will help accumulation of the information for working out of issue factors;

Prompt and vigorous activity to mitigate the impacts of climate change will significantly reduce the costs associated with the process of adaptation. In the context of climate change, the envisaged economic growth and energy consumption growth in the next 20 years, republic will set the basis for the laws and regulations.

Several documents are already in the preparation process and include the following:

- Timely action to improve weather forecasts, food security, freshwater resources, a rapid response to an emergency or disaster, early warning systems and insurance coverage can reduce damage from future climate change and bring many immediate practical benefits.
- The ability of Azerbaijan to adaptation (and most CIS countries), it is particularly important because the economy is heavily dependent on climate-sensitive sectors such as agriculture. They are also less able to adapt in comparison with more industrialized countries.
- Avoid economic losses. Without adaptive temperature increase of 2,5 ° C may reduce the gross domestic product at 0.5-2%, with losses in most developing countries will be high
- Methods of adaptation are vital. Adaptation at the national level includes the development of effective implementation of adaptation strategies. This involves improving the scientific basis for decision-making, development of methods and means for determining the cost of adaptation, the development of education programs, improving the practical training and raising public awareness about this issue, especially among young people, mobilizing forces on the individual and community levels, technology development and transfer of technical achievements, as well as maintenance of local measures to overcome difficulties.

Vulnerability and adaptive capacity of natural resources and agriculture of Azerbaijan are estimated on the base of the definition of the relationship between the current climate change and water management, agro-climatic resources, forest ecosystems, agricultural productivity and socio-economic aspects for different areas: Water resources, the coastal area of the Caspian Sea, Agriculture, Forestry.

3.3.2. Historical M/A data

Information gaps concerning Key Assumptions:

- No official data about frequency of extreme events.
- No data are available for the volume of surface waters and ground waters
- No data are available for policies and measures section.
- No data are available for the energy water use.

Information gaps concerning Energy Demand:

- For Demand section, Household, Agriculture, Tourism, Health Services, Other Services, Industry, all available data are for years 2007-2010
- Absence of accessible information about the annual load duration curve
- In Transport sector, available data are for years 1995-2010.

Information gaps concerning Energy Transformation:

- All financial data required in this section of the database are not available. In particular, there is no data about the capital costs, Fixed O&M costs, variable O&M costs, and Salvage Value of the energy capacities in the Transformation branches. All available data, for example Exogenous capacity, is for years 2007-2010
- There are no data about the average preferential tariffs of electricity generated from CHP.

General information gaps:

- Most data in the period 1990-2000 are not available electronically and are available only in paper editions, which are should be accessible at the libraries of the Azerbaijan State Statistical Committee.
- In several categories of data (i.e. industrial sub-sectors and services sub-sectors), the classification has changed over years and this makes comparison impossible.

3.3.3. Development of M/A scenarios and policy portfolios

Background

This section describes the research needs and gaps in Azerbaijan, identified during the work on the report "Development and assessment of Mitigation / Adaptation Climate Change policy portfolios for Azerbaijan" (Shirinabyli, 2013), as well as during the attempts to develop additional scenarios, based on more optimistic and more pessimistic key assumptions.

Key assumptions

The scenarios were based on a study that made projections for the GDP distribution per sector. There are serious problems related to the applicability of this study to the developed scenarios: (1) it has time horizon only till 2017; (2) the sectors are presented in a more aggregate form than needed. Therefore, it is recommended to develop a new study on the GDP distribution per sector with a longer time horizon and lower sector aggregation.

In the area of climate forecasts by 2050, there is very limited information available for both precipitation and temperature, but neither of the studies is recent nor their results have sufficient degree of certainty. No forecasts for the frequency of extreme events and water resources have been found. Therefore, additional research efforts on climate forecast are needed.

In the field of water use in households, agriculture, industry, and energy by 2050, there are only regional forecasts with different geographical coverage (Europe, Eastern Europe, South-Eastern Europe, etc.) and these cover only a part of the data needed to assess the adaptation needs within each scenario. No studies about Azerbaijan have been found.

Policies and measures

There is very limited information about what types of policy instruments the country intends to include in short term planning (until 2020). There are no planned mitigation policies and measures for the period beyond 2020 and this makes it difficult to build up realistic scenarios until 2050.

In the field of climate change adaptation there is almost no specific information. There are almost no specific assessments on the impact of climate change on the agriculture, forestry, and energy sectors in Azerbaijan; these assessments are rather general. Studies in this field are needed, in order to design appropriate adaptation policies.

Energy demand

The total energy demand in BAU scenario is easily estimated, as it is proportionate to the GDP per capita in the Household sector and to GDP in all other sectors. However, this estimation is much more complicated in OPT and PES scenarios, as the effect of specific mitigation measures has to be added. Not only there are no available policy objectives and plans for the period beyond 2020, but the available information does not allow adequate assessment of the effect of planned (by 2020) policies on the energy demand in the period 2020 - 2050.

Energy transformation

The energy transformation modelling by 2050 requires good knowledge on the energy capacities in the period. There are, however, no plans and estimations of the energy capacities beyond 2020. For example, it is difficult to assess when the existing coal and nuclear units will be phased out.

Transmission and Distribution losses are another factor influencing the energy balance, but no estimation for their levels beyond 2020 has been found.

3.3.4. Evaluation of M/A policy instruments

The evaluation of the three policy portfolios that were developed for Azerbaijan encountered the following difficulties:

- Inadequate national implementation network: There are only limited official documents regarding the few already implemented policy instruments for renewable energy sources and the Clean Development mechanism. No national documents regarding the performance of implemented M/A policy instruments and the future introduction of new ones. Most of the already implemented policy instruments are in force for more than 5 years, but there are no concrete results about their effectiveness.
- Non-existent or limited published research work on mitigation and adaptation issues: Policy oriented research work was not found. There were no published papers on Azeri climate change policy issues. There are no papers regarding possible climate change policy options and their effect for the country.
- Use of energy models and policy evaluation methods: No research work was found regarding M/A scenarios and the evaluation of climate change policy mixtures or instruments for Azerbaijan.
- Language barrier: Most web-sites of the pertinent authorities have a functional version in the native language and not in English.

The aforementioned factors reflect the difficulties that researchers have in accessing information so as to conduct their climate change policy research, but also the lack of such research. The country needs research oriented to climate change policy, which is currently at a very low level. Most of the official documents that were used are from UNDP, EBRD, and EC.

3.4. Bulgaria

3.4.1. Established national procedures, sources, available data and information about M/A policy

3.4.1.1. Inventory

Executive body responsible for the development of NIR is the Executive Environment Agency (ExEA). Inter-institutional groups for coordination of climate policy are established by the Ministry of Environment and Waters (MoEW). They support also the development of the National Inventory Report.

The responsibilities of the institutions, organisations and firms as well the information flows are regulated by regulations of the CoM and official agreements between participants.

Due to the extreme complexity of emission inventory system, encompassing various types of information sources, research results, methods and expertise, it requires permanent efforts of the concerned institutions and wide range of experts. In this regard the organisation and management of the system for closer collaboration is essential.

Some generally defined needs may be stated:

- Strengthening the national system, improving the technical competence of the experts and using in case of necessity
- Reinforcement and maintenance of the institutional, legal and procedural arrangements
- More active role of the Inter-institutional Commission on Climate Change (ICCC), better relation with Branch Business Associations, collaboration with external organizations as University of Forest, Bulgarian Academy of Science and others
- Improvement of transparency of the inventory regarding selection factors and procedures: emission factors, calculation and verification methods, data, judgment of experts, recalculations, estimation of uncertainties etc.

3.4.1.2. Reporting

Reporting is based on the national system for collection of data and background information on emissions and removals assessment, ,and covers also archiving of the data, publishing of the results, participation in inventory reviews, verification and quality management of the inventory. The following works for enhancement of reporting can be shortly presented:

- Research on prioritization of the needs of improvements on the basis of analyses of key categories and development of plan for improvement

- Further improvement of the structure, differentiation and enhancement of the scope of the information collected, processed and provided by the National Statistical Institute (NSI) – processes, activities, energy sources and use, technologies and losses of energy, use of land, waste etc - for gradual replacement of the experts' estimations.
- Research on enhancement of the completeness of the report in various sectors and categories, in order to proceed with systematic replacement of Tier 1 by higher Tier approaches and of categories reported by "NE" by activity data.
- Improvement of the information on activities under Article 3, paragraph 3 of the Kyoto Protocol concerning "greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990" and according to decision 15/CMP.1.
- Additional systematisation of data, better uncertainty assessment, improvement in KP-LULUCF accounting and reporting processes especially in the field of tracking land use changes and providing information etc. for enhancement of the quality of reports.

The needs of research could be grouped into two categories: Specific research and Basic research.

3.4.1.3. Verification

The following measures in the field of verification are necessary for the Bulgarian NIS:

- Enhancement of the comparison sources and techniques
- Improvement of the consistency between data reported to the IEA and data from national statistics
- Better documentation and use of electronic links and automated procedures for data entry and storage of sources and references. Consistency with other reporting systems should be ensured as well;
- Standardisation of documentation and archiving;
- Introduction of alternative approaches for comparison of emissions;
- Efforts for further automation of the process of calculation of emissions - many manual operations, in parallel with the automated ones, are used to introduce the data and manual checks are performed during the validation process. This kind of operation is a precondition for errors
- Efforts for reduction of errors and inaccuracies in the energy balances.

3.4.2. Historical M/A data

Information gaps concerning **Historical data**:

- No data are available for the volume of surface waters and ground waters for any year in the studied period. The institution that manages these data is the Ministry of Environment and Waters.

- No data are available for the added value of the following industrial sectors: Iron and Steel; Chemical and Petrochemical; Non Ferrous Metals; Non Metallic Minerals; Transport Equipment; Machinery; Food and Tobacco; Paper Pulp and Print; Wood and Wood Products; Textiles and Leather; Mining; and Recycling. The lack of data applies to the whole studied period. The National Statistical Institute (NSI) disposes of the primary data needed to calculate the added value of these sectors.
- Data for the volume of the water used in the Hydro Power Plants is not collected at national level in the studied period. These data are available at the individual HPPs and could be requested, if needed.

Information gaps concerning Historical data for **Energy Demand**:

- Except for households, no energy demand cost data are published for the specific sectors of the national economy (agriculture, services, industry, and non-energy use) and their sub-sectors. This applies to the whole studied period. These data could either be calculated on the basis of the data provided by energy suppliers, or estimated based on the average energy prices.
- No energy demand data are available for the particular service sub-sectors, such as tourism and health services. This applies to the whole period 1990-2010. However, as the National Statistical Institute disposes of the primary energy data, which can be used to make calculations for each subsector.
- In Transport sector, the energy demand data in each type of transport (road, rail, air, and water) is available, but it is not further broken down into passenger transport and freight transport. This applies to the whole studied period.
- In Transport sector, data on the final energy intensity is not available, due to lack of data on person-kilometres. The latter cannot be collected, but only estimated.

Information gaps concerning Historical data for **Energy Transformation**:

- All financial data required in this section of the database are not available. In particular, there is no available data about the capital costs, fixed O&M costs, variable O&M costs, and salvage value of the energy capacities in the Transformation branches. The State Energy and Water Regulatory Commission (SEWRC) publish data concerning only some individual energy transformation capacities, but these are not sufficient to estimate the average. SEWRC does not collect data from all relevant organizations, but these can be collected if needed.
- There are no data about the maximum availability, capacity credit, and process efficiency of any Transformation process. Such data are available at the individual energy production companies.
- There are no data about the average preferential tariffs of electricity generated from CHP. In Bulgaria, these tariffs are determined individually for each installation, based on the costs and return on capital.

General information gaps:

- Most data in the period 1990-2000 are not available electronically and are available only in paper editions, which are accessible at the libraries of the Bulgarian National Statistical Institute (NSI).
- In several categories of data (i.e. industrial sub-sectors and services sub-sectors), the classification has changed in 1990s in relation to the harmonization with Eurostat requirements. This makes comparison of these data impossible.

3.4.3. Development of M/A scenarios and policy portfolios

3.4.3.1. Background

This section describes the research needs and gaps in Bulgaria, identified during the work on the report "Development and assessment of Mitigation / Adaptation Climate Change policy portfolios for Bulgaria" (Nikolaev A. et al, 2013), as well as during the attempts to develop additional scenarios, based on more optimistic and more pessimistic key assumptions.

3.4.3.2. Key assumptions

Concerning demographics, there are two quite different forecasts about the average annual rate of change of the Bulgarian population (each containing three variants for low, medium, and high growth) – the one published by the United Nations (United Nations, 2011) and the one published by the National Statistical Institute (NSI, 2012). Therefore, depending on the selected forecast, the scenario results would be different.

Similarly, there are two quite different forecasts for GDP growth – the one by IMF (IMF, 2012) and the Bulgarian Agency for Economic Analyses and Prognoses (AEAP, 2008). While the former has time horizon only till 2017, the latter is outdated (e.g. does not take into account the economic crisis). Therefore, a recent GDP growth forecast till 2050 is needed.

The scenarios were based on a study (Angelov I., 2004) that made projections for the GDP distribution per sector. There are serious problems related to the applicability of this study to the developed scenarios: (1) the study is outdated (published in 2004); (2) it has time horizon only till 2020; (3) the sectors are defined in a very aggregate form. Therefore, it is recommended to develop a new study on the GDP distribution per sector with a longer time horizon and lower sector aggregation.

In the area of climate forecasts by 2050, there is information available for both precipitation (Alexandrov V., 2004) and temperature (MoEW, 2004), but neither of the studies is recent nor its results have sufficient degree of certainty. No forecasts for the frequency of extreme events and water resources have been found. Therefore, additional research efforts on climate forecast are needed.

In the field of water use in households, agriculture, industry, and energy by 2050, there are only regional forecasts with different geographical coverage (Europe, Eastern Europe, South-Eastern Europe, etc.) and these cover only a part of the data needed to assess the adaptation needs within each scenario. No studies about Bulgaria have been found.

3.4.3.3. Policies and measures

In the field of climate change adaptation, there is almost no specific information. The Third National Action Plan for Climate Change 2013-2020 (3rd NAPCC, 2012) includes neither any adaptation objectives nor planned measures. There are almost no specific assessments on the impact of climate change on the agriculture, forestry, and energy sectors in Bulgaria; these assessments are rather general (Nikolaev et al, 2012). Studies in this field are needed, in order to design appropriate adaptation policies. The Bulgarian Government has already taken steps to initiate such studies.

3.4.3.4. Energy demand

The total energy demand in BAU scenario is easily estimated, as it is proportionate to the GDP per capita in the Household sector and to GDP in all other sectors. However, this estimation is much more complicated in OPT and PES scenarios, as the effect of specific mitigation measures has to be added. The effect of the currently planned policy objectives is estimated only by 2020, but not beyond 2020. Additionally, it is very likely that more stringent policy objectives and policies are enforced after 2020 (e.g. in relation to new EU initiatives), but no such information is currently available.

Another important point in energy demand modeling is the fuel mix used in each sector. There is a plan for the shares of renewable energies in the national balance by 2020 (Resubmitted NREAP, 2011), but neither the time horizon is sufficient, nor these shares are differentiated per economic sector. Another study (Sulakov S., 2012) estimates the electricity share in the total final energy demand in 2050, as well as this share in the final energy demand in the transport sector by 2050. These studies provide only a small piece of the necessary information and comprehensive research is needed to provide a reasonable estimate of the share of each fuel in each sector of the economy until 2050.

3.4.3.5. Energy transformation

The energy transformation modeling by 2050 requires good knowledge on the energy capacities in the period. Plan for the installed capacity per renewable energy type and application (electricity and heating/cooling) by 2020 is available in NREAP (Resubmitted NREAP, 2011). Additionally, the National Electricity Company disposes of estimations for the electricity capacities by 2020. There are, however, no plans and estimations of the energy capacities beyond 2020. There is no information about the expected year of phasing out the existing nuclear power plant and some of the existing thermal power plants.

Transmission and Distribution losses are another factor influencing the energy balance, but no estimation for their levels beyond 2020 has been found.

Furthermore, the scenario input data include efficiency levels, capacity credit, maximum availability, and other technical parameters of each type of energy production capacity used in the country. These values are neither available for the base year (2010) nor studies for their future development in the country have been found.

3.4.4. Evaluation of M/A policy instruments

Policy evaluation is not well known as a research tool, but during the project its application was indispensable, in order to reach sound results. The understanding of criteria, sub-criteria, and the assignation of values presents difficulty.

Another general problem is the limited (free) access to scientific publications that may include information about the performance of different policy instruments. Only publically available publications are accessible at BSREC.

There is no specific information about how major economic sectors would be affected by climate change in terms of financial costs and benefits and competitiveness. Additionally the Bulgarian Government does not provide specific (i.e. quantitative) information about any planned climate change adaptation measures (including ones related to water management, forest management, and agriculture). In particular, for none of the measures there is any information about the expected policy set-up, environmental effect, socio-economic effect, and cost to the Government to implement it. It would be helpful, if the Ministry of Environment and Waters develops both studies about the climate change impact on economy and policy plans with specific adaptation measures.

There are no assessments of what are the Government's and society's financial costs and revenues of implementing the current climate change mitigation policy. Additionally, there are no such estimations about the planned (by 2020) mitigation policy. Both for the current and planned mitigation policies, cost estimations can be made by the Sustainable Energy Development Agency, the Ministry of Transport, Information Technology, and Communications, and by the Ministry of Environment and Waters for the respective policies in their domains.

No information is available about the effectiveness and the equity (distributional effects) of the currently enforced mitigation policies in the country. The provision of this information could also be responsibility of the three abovementioned institutions.

3.5. Estonia

3.5.1. Established national procedures, sources, available data and information about M/A policy

Estonia has been preparing greenhouse gas emission inventories since 1994. Inventory reports are submitted to UNFCCC Secretariat and the European Commission annually.

According to the UNFCCC reporting guidelines on annual inventories (FCCC/SBSTA/2006/9) the greenhouse gas emissions and removals are divided into the following sectors: Energy, Industrial processes, Solvent and other product use, Agriculture, Land use, Land use change and Forestry (LULUCF), and Waste. All necessary information is available from the National Inventory Report (NIR, 2013).

Estonia's national GHG inventory system is designed and operated according to the guidelines for national system under article 5, paragraph 1, of the Kyoto Protocol (Decision 20/CP.7) to ensure the transparency, consistency, comparability, completeness, and accuracy of inventories. Inventory activities include planning, preparation, and management of the inventories. The quality of the inventory is

ensured in the course of the compilation and reporting, that consists of four main stages: planning, preparation, evaluation and improvement.

The quality management of the inventory is a continuous process (NIR, 2013).

Verification activities are usually done for each sector separately. The QC/QA plan for different sectors includes the QC activities described in the IPCC GPG (IPCC, 2000). Activity data are checked annually for updating. Emission factors are compared with IPCC default and with emission factors of other countries.

Since the Estonian QA/QC plan was under development (2011), the verification criteria were evaluated and some recalculations were done in NIR 2013. Regarding the uncertainty assessment, as there was no specific research carried out in Estonia, the uncertainty of Finland and IPCC (IPCC, 1997) were used in the last Inventory Report (NIR, 2013).

The last reports are prepared for the inventory period 1990-2009 and 1990-2011 (NIR, 2011, NIR 2013).

Information is publicly accessible through the user interface of the registry web page https://khgregister.envir.ee and at Climate web: http://www.keskkonnainfo.ee/index.php?lan=EE&sid=582&tid=525&l3=339&l2=323&l1=320.

Nearly all of the data necessary to compile the Estonia's inventory are publicly available. The main exception relates to the reporting of emissions from Consumption of Halocarbons and SF6 (CRF 2.F). Under the category Consumption of Halocarbons and SF6 there are several subcategories (for example Commercial and Industrial Refrigeration, Foam Blowing, Fire Extinguishers etc) where activity data are collected directly from private companies active in this field on condition that the data remains confidential. Therefore data from companies has been summarised and presented on subcategory level (NIR, 2013).

3.5.2. Historical M/A data

Quite remarkable quantity of historical data needed as a basis for the development of M/A scenarios were not available for Estonia. Also, the analysed period (1990-2010) was very long. Estonia regained its independence in 1991 and therefore a lot of information is either not available or not reliable before 1992 and in some cases even before 1999. Mainly it is caused by use of different methods, formats and units of estimation, and different requirements. Most of the data were obtained from Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/) and Statistics Estonia (www.stat.ee).

Generalised gaps by the key assumptions (non-energy historical data), energy demand and energy supply sections are:

3.5.2.1. Non-energy historical data

A lot of climate statistics was not available or was partly available for Estonia, e.g. frequency of extreme events and water resources. The Estonian Meteorological and Hydrological Institute (EMHI) was responsible for these data that can be obtained by special request. From 01.06.2013 the Institute was merged with Environmental Information Centre and the new organization is Environmental Agency, KAUR (www.keskkonnaagentuur.ee). Economic data was available only from the year 1999

to 2010. Nevertheless, it could be possible to obtain the data, if a special request to Statistics Estonia is sent.

Detailed information about data *availability for the next categories are:*

Demographics

- There is no data available for Net migration (person) during 1990-1997 in local Statistic Office of Estonia. Moreover, those data are different in Eurostat and Statistics Estonia.

Climate Statistics

- No data are available about frequency of extreme events, including:
    - Floods per year (is applicable only to few parts of Estonia, where sea storms can cause some floods in coastal and river's mouth areas);
    - Heat waves per year (not applicable to Estonia, as the country maritime climate is wet and cool);
    - Frost days per year (data can be obtained upon a special request from EMHI (KAUR));
    - Water resources: Surface Waters (km^3) and Ground waters (km^3) data are different in Statistics Estonia and Eurostat (information can be clarified by special request to responsible organizations); there is no available information for Overlap (km^3)

Economy

- GDP
    - There is no data available for Real GDP, GDP Deflator, GDP Growth for the years 1990-1999;
    - There is no data available for Real GDP Growth per capita for the years 1990-1993;
    - There is no data available for Annual average household Income (EUR) for the years 1990-1994 and 2008-2009.
    - GDP distribution per sector: there is no national data available for whole period. Data available only for value-added per sector.
    - GINI: there is no national data available for period 1990-1999.

Industry

- Manufacturing Value Added: there is no national data available for the period 1990-1999.

Adaptation

- Water Use - there is no national data available for year 1990;
    - Hydro power water use (km^3) - since energy production from hydro power plants is relatively small, no data are available for hydro power water use. This information can be estimated at each site if needed.

Transportation

- Pass Transport Index – there is no data for years 1990-1999, 2001-2005, 2009-2010.

Policies and Measures

- Financial incentives such as soft loans and subsidies are not available for the whole period.
- Land Management
  - Data for Surface of Arable Land (km²) are not available for the years 1990-2000, 2002, 2004, 2006, 2008 and 2009;
  - Data for Surface of orchards and vineyards (km²), Surface of meadows and pastures (km²) and Surface of irrigated land (km²) are not available for the whole period;
  - Surface of Forests (km²) are not available for the years 1990, 1998.

3.5.2.2. Energy demand

Most of the data regarding energy units was available for Estonia. But information on costs (specifically "Demand cost") was not available.

In the transport sub-sector, the energy consumption for "passenger" and "freight" in different types of transport was not available. Statistics Estonia does not collect data that distinguishes passenger and freight transport, regarding energy units. For this reason, also the "Fuel Share" for transport was not available.

Detailed information about data availability for this category is following:

Demand – Households

- Number of households is not available for the period 1990-1999, 2008-2009;
- Demand cost (EUR) is not available for the whole period.

Demand – Agriculture

- Demand cost (EUR) is not available for the whole period.

Demand – Tourism

- There is no available data for Tourism sector in Estonia for the whole period.

Demand – Health Services

- There is no available data for Health Services sector in Estonia for the whole period.

Demand – Other Services

- Demand cost (EUR) is not available for the whole period.

Demand – Industry

- Demand cost (EUR) is not available for all sub sectors for the whole period;

- Non Ferrous Metals: there is mismatching for Total Energy (TOE) for the years 2004-2005 while fuel shares are known.

Demand - Transport

- Overall problem, Statistics Estonia does not provide any data separately for passenger and for freight transport. Data available for total transportation only;
- Demand cost (EUR/person-km) is not available for all sub sectors for the whole period;
- Transport Road, Transport Rail, Domestic Air Transport, Transport Inland Water, - Fuel Share: there is no available data for period 1990-1998;
- Maritime Passenger sector does not have any data available for Total Energy (TOE), Final Energy Intensity (TOE/person-km), Demand cost (EUR/person-km);
- There is no available information for Pipelines as well.

Demand -Non Energy Use

- Demand cost (EUR) is not available for all sub sectors for the whole period;

3.5.2.3. Energy Supply

Since many power stations, CHP plants, and boiler houses in Estonia use mixed fuels, then the data on each specific fuel (e.g. maximum availability for biomass) was not available. Statistics Estonia publishes data on all power stations, CHP plants and boilerhouses separately. This made it more difficult to build the Energy Supply part of the scenarios for Estonia. Also data regarding costs was not available.

Detailed information about data availability for the next categories:

Transformation - Transmission and Distribution

- There is no available information for electricity and heat losses during the period 1990-1998;
- There is no available information for losses for oil, natural gas, coal/oil shale for the whole period;
- There is no available information for variable O&M cost for electricity, heat, oil, natural gas, coal/oil shale (EUR/GJ) for the whole period;

Transformation – Own Use

- There is no available information for losses for heat, oil, natural gas, coal/oil shale during the whole period;
- There is no available information for the interest rate for investments in electricity, heat, oil, natural gas, coal/oil shale for any transformation process for the whole period;
- There is no available information for exogenous capacity, salvage value, and fixed O&M cost of any transformation process;

- There is no available information for the historical production for oil, coal/oil shale for the whole period.

Transformation –Pump Storage

- There is no available information for pump storage for the whole period.

Transformation – Heat Production

- There is no available information for import and export targets for the whole period;
- The information of output price (EUR/kWh) is available from the year 1999;
- The fuels share data are missing for the period 1990-1998;
- For the dedicated heat plants, the data gaps are as follows:
    - data for interest rate (%), capacity credit (%), process share (%), variable O&M cost (EUR/GJ), capital cost (EUR/MW), salvage value cost (EUR/MW), fixed O&M cost (EUR/MW) are not available for the whole period;
    - data for exogenous capacity (MW), historical production (GJ) is missing for period 1990-1998;
    - maximum availability (%) and process efficiency (%) are not available for the whole period.

Transformation –Electricity Generation

- There is no available information for import and export targets for the whole period;
- The information of output price (EUR/kWh) is available from the year 1999;
- There is no wind onshore – fuels information;
- Data for interest rate (%), capacity credit (%), maximum availability (%), variable O&M cost (EUR/GJ), capital cost (EUR/MW), salvage value cost (EUR/MW), fixed O&M cost (EUR/MW) are not available for the whole period;
- process efficiency (%) for biomass, nuclear, natural gas, coal/oil shale, peat and biogas are not available for the whole period.

Transformation – Biofuel Production

- There is no available information for biofuel production sector for the whole period.

Transformation – CHP Production

- There is no available information for import and export target, output price (EUR/kWh) is for the whole period;
- Initial data for interest rate (%), capacity credit (%), maximum availability (%), variable O&M cost (EUR/GJ), capital cost (EUR/MW), salvage value

cost (EUR/MW), fixed O&M cost (EUR/MW) are not available for the whole period;

- Process efficiency (%) is not available for the whole period.

3.5.2.4. Other energy information

Detailed information about data availability for the other information is provided below:

Statistical Differences

- There is no available information for the primary and secondary statistical differences during the period 1990-1998 in Statistics Estonia.

Stock Changes

- There is no available information for primary and secondary stock changes for the whole period in Statistics Estonia.

Resources

- There is no available information for resources during the period 1990-1998 in Statistics Estonia;
- There is no available information for biofuels and lubricants (GJ) for the whole period in Statistics Estonia.

3.5.3. Development of M/A scenarios and policy portfolios

There were difficulties with data collection for the modelling of the scenarios within the project. There are also needs for improvement of data integration and sharing to provide more adequate information for generating research in climate policy, to realize and estimate climate change potential and risks etc. The area of Estonia is rather small and downscalling of Global Circulations Models is needed that can provide a more precise projected result for the local or micro scales.

The detailed information about availability of information for the period until 2050, including demographics, climate statistics, economy, adaptation, policies and measures, energy demand, energy transformation, and other issues is provided below:

Demographics

- The version "medium variant" of the population projections for all scenarios was used. The projection for population changes is provided in big time span from UN report (UN, 2010). As Estonian results are very sensitive for the projections of population and the growth trends in Demand side are interconnected with Population rate, so the time span as 2011-2025-2050 seems to be a big gap and data of population growth rate between given years should be provided.

Climate Statistics

- Precipitation is the most variable climatic characteristic in Estonia, especially from islands to uplands. There are no reliable projections for Estonia by year 2050.

- No forecast information is available for Frequency of extreme events (Frost days, Heat waves, etc.).
- For Water resources the information found is very contradictory and the results are not reliable.

Economy

- There were problems for finding out the GDP growth rate for different types of scenarios for Estonia. Several sources have been analysed, such as data provided by Ministry of Finance, Stability Programme 2011, the most important banks of Estonia (Bank of Estonia, SEB, Swedbank, Danske, Nordea) in order to get three different projections for GDP. Only Stability Programme 2012 has provided the information for three scenarios as baseline, negative risk and the long-term forecast. As Estonian results are very sensitive for the projections of GDP and has interconnected and influenced other sectors, more accurate information is needed for further research or for future development of new scenarios and corrections of existing ones.
- There are no projections about GDP distribution per sector in Estonia.

Adaptation

- No forecast information is available for Water Use.

Demand

- There is no forecast information available for energy demand.

Transformation

- The long-term forecast for Transmission and Distribution losses is not available, only short-term forecast provided by Elering (DPEES, 2010).
- The projection of Electricity generation sector is provided mostly for the year 2020 by Eesti Energia (EE, 2012). The source provided information of development of wind energy in Estonia is Inforse-Europe in 2011, where projected number of 4 GW for 2050 seems to be too optimistic in light of cutting of feed-in-tariffs.
- In the heat production sector, also a long-term forecast is needed, because it could have a significant impact on the overall energy supply in Estonia.
- Another issue that could be useful and helpful for Estonian scenarios development is the information about district heating and local networks. As for today the district heating is forming about 70% of heat energy supply in Estonia, but the applied scenario model (LEAP – the Long Range Energy Alternatives Planning system) is not covering the local heat energy networks.

3.5.4. Evaluation of M/A policy instruments

Regarding needs and gaps related to the evaluation of climate change policy scenarios, the following problems could be mentioned:

- There is a lack of information for evaluation the stringency for non-compliance.
- The lack of data for estimation implementation network capacity sub-criterion - the existing implementation network does not provide the necessary information in English, describing full range of climate change policy issues in the country. There is limited number of official reports regarding national climate change policy issues for Estonia in English as well as lack of information in transportation sector and inconsistencies in the reporting of emission projections regarding the energy sector.
- For administrative feasibility there is no information on how awareness-raising programmes are monitored in Estonia and the problems with the availability and credibility of data mentioned for implementation network capacity sub-criterion can be also linked with administration issues.
- As there is no adaptation strategy in Estonia at the moment, there is a lack of knowledge on methods and approaches how to analyse adaptation options and chose possible actions and adaptation measures.

There is a need to participate in the international educational and training programmes in M/A policies and their evaluation; perhaps to organize special educational programmes at the universities of Estonia, as there are no such courses at the moment. There exist environmental protection courses, but climate change aspects are studied very modestly.

3.6. Kazakhstan

3.6.1. Established national procedures, sources, available data and information about M/A policy

Kazakhstan is implementing GHG inventory on annual basis since 2000.The responsible government agency for compliance with international obligations of Kazakhstan under the UN Framework Convention on Climate Change and the Kyoto Protocol is the Ministry of Environmental Protection(MEP .Kazakh Research Institute of Ecology and Climate(KazNIIEK[2]) is its Working Body, which is responsible for national GHG inventory report in particular : collecting necessary national information from the Agency of Statistics, business and mining companies and other relevant ministries and authorities, preparation and common reporting format tables. Preparation of the National GHG Report is included into the state budget program of MEP. Emission factors are obtained from enterprises or IPCC Guidelines as default values in case of the absent the national ones.

The quality of data affects the results of GHG inventory. The activity data are collecting and reporting according to the requirements of national inventory system and IPCC Guidelines. All reporting tables contain data in accordance with CRF reporting tables. CRF tables are produced with the using of CRF Reporter software. The final results and total emissions are presented in Gg or thousands of tons according requirements. National inventory reports of Kazakhstan for 2008 and 2009

[2] (http://www.ecoclimate.kz

(in Russian only) are available at the web site of the UNFCCC[3] secretariat alone with the review report of the 2010 submission and CRF tables. The Second Communication (2009) is also available at the UNFCCC website (English and Russian variants).

The main gaps are in the field of receiving national statistical data due to the fact that the harmonization with foreign statistics is going slowly and it leaves much to be desired in view of requirements for data to be used for GHG inventory, its structure differs dramatically from Eurostat, especially on activity's level disaggregation. Besides Kazakhstan is independent since 1991 the information for 1990-2000 is non-consistent. The forms of reporting to nationals statistics are very different from the forms of European Statistic, that is why even information received from enterprises according to requests do not satisfy the expected requirements and even poor or do not correlate to final data of available national statistics. The duplication of figures in national statistics sometimes could be estimated while working in close coordination with experts from the Agency of Statistics. Moreover it was defined out that the Departments of the same agency do not coordinate between each other and provide different data, error may be up to 50%. The national statistics presents only in national currency and USD dollars; mostly in Russian only(very few in English), energy data including national fuel balances is presented in tons of coal equivalent only, heat - in Gcal or Gcal/h only, etc. the specific information is absent or do not agree with results. The national fuel balance is nor readable and needs a lot of clarification. A lot of necessary information is either absent, or not disaggregated or detailed in national statistics at all or should be recalculated because if different standards of dimensions and etc. Another difficulty is to get or analyze the dynamics of data because reporting forms of national statistics change from year to year dramatically, thus often the dynamics is missed.

Another gap is access to the information: more detailed information should be taken from several sources which do not correlate between each other, or information is very limited and often the official statistical year books provide different data for the same one specific year. It should be mentioned that economic data presented in different reports, journals, statistical publications or official and operational information is in national currency and or US dollars only. Access to more detailed energy information (special bulletins, regarding work of electricity and heat sectors) is not public available, the information is provided only according to consideration and official request of the ministry, besides it does not provide full necessary of any dynamic info.

Another our observation is that data on GHG inventory (even including information presented in CRFs) for the same historical years differs essentially because of annual recalculations

Quick look into Summary tables of CRF for 2009 shows that the GHG emissions from “Solvent and other product use» and International bunkers are not estimated. There is space for improvement of reporting of GHG emissions in industrial process and agriculture; Fugitive emissions from fuels in energy sector, Land Use, Land-use Change and Forestry and Wastes.

[3] http://unfccc.int/).

Kazakhstan QA/QC plan and uncertainty assessment is currently under development and is planned to be used for evaluation during development of the Third National Communication. The Second National Communication (2009) does not include such analysis.

In conclusion, there is a big niche for improvements including processes of data preparation, reporting and verification.

3.6.2. Historical M/A data

Gathering the required historical data for the period 1990-2010, which served as a basis for the scenario development, was a difficult and took much time in Kazakhstan for the following reasons:

- due to the substantial difference between the data classification in the national statistics and EuroStat (Kazakhstan is not covered by European Statistics), it was not possible to find a large share of the data required by the common project template (mainly based on Eurostat classification);
- as Kazakhstan is independent since 1991, national statistics in national currency appeared since 1993 and in Euro currency - since 2000, the database for the period 1990-2000 could not be filled on a constant and systematic basis.
- the data for 1990-2000 if available is only in publications of National Statistics which are accessible at the Agency of National Statistics library or stores.
- Economic data classification has been changed in 1993, in 2000, and in 2005 due to harmonization with international standards, but it is still very different from the Eurostat classification, used as reference for the historical data structure for scenario development in this project. This makes data comparison impossible.

The following gaps per type of data could be identified:

- The historical data on climate (Precipitation, Temperature and Water resources) is available mostly for the period 2000-2010, but not for 1990-1999. For individual years in the period 2000-2010 some of the climate data was not available in statistical or other official sources. No historical data at country level is available on Frequency of extreme events from official sources for the whole studied period. The responsible institution for these data is the Ministry of Environment Protection.
- The historical disaggregated information on economy sectors is available for some years of analysed period, but its classification does not comply with the Eurostat disaggregation per specific sectors or sub-sectors. There are no available data for specific sectors, such as Tourism and Industry. In terms of disaggregated information, there is no available data for the value added of the following industrial subsectors in the analyzed period: Machinery; Food and Tobacco, Wood and Wood Products; Textiles and Leather, Iron and Steel; Non Ferrous Metals; Non Metallic Minerals; Transport Equipment, Mining, Paper Pulp and Print, Recycling. The National Statistics Agency is the responsible institution for these data.

- Policy and measures: there is no available information in official sources about carbon tax, feed in tariffs, quotas, and financial incentives. The institutions to be involved are: Ministry of Environment Protection, Ministry of Industry and Innovative Technologies, Committee on Natural Monopolies, Ministry of Finance, Ministry of Economy and Budget Planning.
- Adaptation. No data are available for energy water use (cooling water and Hydro power water use) for the period 1990-2010. This information could be obtained from the companies via official requests organised by the National Statistics Agency.
- Energy Demand: The main gap is that National statistics do not provide disaggregation of energy per economy sectors (Households, Agriculture, Tourism, subsectors of Industry, Transport sub-sectors) as required for the scenario development. UN provide statistical data on energy demand per sectors of economy for the period 2000-2010, but the National Agency of Statistics should work on this and provide such data.
    - No data are available for the energy demand costs for all subsectors (under Households; Agriculture, Services, Industry, and Non-Energy Use) for the period 1990-2010. National Statistical Agency could make the calculations and provide these data.
    - In Transport sector the energy demand data are available only for Rail, Road, Air, Pipelines and Water subsectors for the period 2000-2010. No other detailed disaggregation is available (such as maritime passenger, inland water passenger, freight, passenger road, and passenger rail).
- Energy Transformation. The gaps are absence of information on variable O&M costs; interest rates, exogenous energy capacities, capital costs, maximum availability of installations, fixed costs, salvage value, process efficiency and historical production - no data are available at country level.
    - For own energy use the historical data are not available on the related energy capacities, the Frac potential, and the interest rates.
    - No data are available for Pump Storage.
    - Information related to Heat Dedicated Plants except historical production, process share, exogenous capacity, raw losses, raw efficiency and electrical capacity is not available.
    - Financial data related to Electricity Generation required for the database is private information in Kazakhstan, not publically available. Information on Process efficiency at country level is not available.
    - The Ministry of Industry and Innovative Technologies is the responsible institution for gathering the above information and it could make it public. Special studies to collect the above information could be helpful.

- Oil refining, gas works and coal transformation: Specific data on oil import target for the period of 2000-2010 and for coal transformation for the period 2006-2010 is available only. All other necessary data, including all abovementioned financial data and technical data are not available. The responsible institution for collecting and processing such information is the Ministry of Oil and Gas.

3.6.3. Development of M/A scenarios and policy portfolios

This section is about the research needs and gaps in Kazakhstan identified during work on the report "Development and assessment of Mitigation / Adaptation Climate Change policy portfolios for Kazakhstan" (Inyutin S., et al, 20012) and during/after the national Promitheas-4 project workshop on 14 June 2013.

3.6.3.1. Adaptation

A spectrum of adaptation needs was considered for the following sectors: energy, agriculture, forestry, water resources. It should be noted that there are no specific state plans or programs on adaptation policy in Kazakhstan. The spectrum of adaptation needs are presented more in indirect manner in the National report on Environment Protection (2009)[4], the Sectoral Program Zhasyl Damy for 2010-2014 (GOK Decree № 924, 09/2010), The State Program for Regeneration and Afforestation of the Lands of the Forestry Fund for 2003-2020 (Government Decision No. 737 from 17.06.2003)[5], and Statistical Yearbook (2011).

The component of adaptation in climate change policy is not fully developed because the country has not set an adequate framework to reduce its vulnerability to climate change. Moreover, the design and assessment of relevant policy instruments require data related to the frequency of extreme events, low-income groups, biodiversity, the health sector, etc., which are not available at the moment.

There are no specific studies on adaptation needs developed in the last years. In this regard, it is recommended to do research and develop studies for the climate change impact on each of the most affected sectors and to assess the adaptation needs for the period up to 2050 in Kazakhstan.

3.6.3.2. Energy demand

Energy demand was presented for the following sub-sectors: households, agriculture, industry, construction, transport, and non-specified. The energy demand in BAU was estimated according to GDP per capita in the Households and to GDP in all other sectors. As for OPT and PES scenarios the effect of mitigation options were included accordingly, in particular the current policy interventions developed up to 2020, and for Electricity generation the estimates in energy demand are included by 2030 according to the Study of Institution named "Energia" (2011) and Concept on electricity sector development up to 2030 (MINT, 2012). These studies provide information, but not till 2050. More comprehensive research is needed to provide estimate of the share of fuel in energy balance of the economy till 2050. Nevertheless, the comparison of results received with modeling with LEAP and with other tools

[4] http://www.eco.gov.kz/

[5] http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=335064

used for Kazakhstan (MARKAL, the Concept of Sustainable Growth to Low Carbon economy, 2011) and recently finished Study "On Green Economy" prepared for the Ministry of Environment Protection and presented at national workshop demonstrate similar results /tendencies on energy demand and global warming potential (in CO_2 eq.) up to 2050.

3.6.3.3. Energy Transformation

There is a plan for the installed capacities up to 2030 used for OPT and PES scenarios, taking into consideration the increase of RES share in accordance with the Strategic Plan 2020. There are no plans or schedule of phasing out the existing capacities beyond this year. There is available information only in % of the wear of existing capacities and some information on available capacities (Wind Power report, 2011 and operational MINT data, 2012) with some difference in figures. There is detailed information available up to 2015 according to governmental plans of development, but there is a lack of information for the period beyond 2020. Therefore, studies with time horizon up to 2050 are needed.

Forecasts of the Transmission and Distribution losses are available from the Strategic Plan 2020, but no studies for the development beyond 2020 have been found.

3.6.3.4. Additional comments

For further analysis on cost and benefits, research on the financial parameters of the technologies used (capital costs, variable O&M costs, demand costs, etc.) is needed. This research could be done in the frames of a State order. Additional research on RES development and on the barriers overcoming, training on Capacity building of local bankers and local business could be provided in the frames of technical assistance by International Agencies and Financial Institutions.

Taking into mind the intents of Kazakhstan to develop Internal Emission Trading Scheme, Feed in Tariff system for RES (wind, hydro, solar), special studies are necessary to be developed in these aspects, especially in connection to the European Emission Trading System and adaptation of European standards for statistics improvement related to presentation of economy and energy information and harmonization with European standards on energy efficiency for appliances, lighting, etc.

3.6.4. Evaluation of M/A policy instruments

The difficulties to carry out an evaluation of the policy scenarios in Kazakhstan are the following:

- The difficulty to understand the scenario evaluation method and lack of practical experience were serious barriers to apply the method. Therefore, assistance had to be provided to the national team.
- At national level there is lack of information on the financial costs and effects of climate change on economy. In the country, there is neither an adaptation policy nor planned measures for any sector vulnerable to climate change. Development of such studies is needed in Kazakhstan. The main institution that could be involved is the Ministry of Environment Protection.

- There is a limited number of official reports regarding climate change mitigation policy of the country. There is no available information on the cost efficiency and the feasibility of implementation of the existing and planned climate change policies.

3.7. Moldova

3.7.1. Established national procedures, sources, available data and information about M/A policy

This section contains description of the needs and gaps related to the national reports part of Deliverable 2 "Procedures, sources and data for Mitigation/Adaptation policy portfolios", developed by Moldova team in the Task WP.1.2 "Mapping national procedures, sources, available data and information". The needs and gaps related to the 3 chapters of the national reports (national GHG inventory, reporting and verification) are described.

In the area of greenhouse gas inventory, reporting and verification the following needs and gaps have to be highlighted (MoE of RM / UNEP 2013), (USAID 2013):

- Designing and operating the national system to support compliance with UNFCCC and Kyoto Protocol commitments and enable Republic of Moldova consistently estimate emissions and removals of air pollutants;
- Strengthening institutional arrangements, including legal and technical aspects for periodic (biannual, as specified in Decision 1/CP16) preparation of the National Greenhouse Gas Inventories, meeting the Party's commitments under the UNFCCC;
- Improving the quality of inventory by adopting higher tier methodological approaches (Tier 2 and 3), specifically for key sources;
    - For instance, assess the possibility of using EEA's COPERT model for estimating non-CO2 emissions from 1A3 'Transport' source category; as activity data are not available in full extent to run COPERT model, assess the possibility of drafting the data collection protocols, data collection and submission procedures, and developing a database for capturing data from the mandatory technical inspection of vehicles; this activity may require also amending the relevant legislation framework on vehicles and the rulebook for technical inspection of vehicles to specify recording data on vehicle characteristics, fuels used, emission controls, and kilometers driven; the data collection forms and procedures for collecting and submitting the required data will need to be developed as well;
- Developing country specific emission factors and methodologies, specifically for key source and sink categories;
- Reducing the inventory uncertainties by improving the statistical data collection system, inclusive through:

- Revising the Statistical Report No. 1-BE "Energy Balance", making possible the preparation of the National Energy Balances according to International Energy Agency (IEA) and EUROSTAT guidelines.
- Assessing the possibility to provide assistance to the Ministry of Regional Development and Construction and to the Agency on Energy Efficiency to establish databases to monitor energy performance in buildings (residential and commercial/service/public buildings); these data could be used to establish databases similar in design and function to the U.S. Energy Information Administration's Residential Energy Consumption Survey (RECS) and the Commercial Buildings Energy Consumption Survey (CBECS) databases; these databases could be used to support obligations for reporting on implementation of the National Energy Efficiency Action Plan (NEEAP) to the Energy Community, including penetration of new energy efficient technologies; the databases would also ensure that the data on energy performance in buildings is available to other ministries and agencies, as well as for compiling the Energy Balances and GHG Inventories;
- Improving the data collection system on biomass consumption; many stakeholders reported that biomass use, especially woody biomass use, is the largest data quality issue in the Republic of Moldova's energy statistics; the official statistics on biomass use for fuel are widely believed to underestimate the amount used, perhaps by as much as a factor of three, according to the Forestry Research and Management Institute;
- Improving the data collection system on F-gases (HFC, PFC and SF6) consumption, necessary for estimating the GHG emissions from 2F 'Consumption of Halocarbons and SF6' source category.

- Enhancing quality assurance (QA), quality control (QC) and verification activities, by setting-up a sustainable MRV system, inclusive through:
  - Assessing possibilities on building the national capacities for strengthening the Republic of Moldova's MRV requirements to the United Nations Framework Convention on Climate Change (UNFCCC), which may include: (i) preparation of a Greenhouse Gas Inventory, based on the 2006 IPCC Guidelines; (ii) preparation of Energy Balances, based on the IEA and EUROSTAT guidelines; (iii) MARKAL/TIMES and LEAP modelling to support development and periodic revising of the national energy policies, as well as reporting requirements to the Energy Community, based on National Energy Efficiency Action Plan (NEEAP) and the National Renewable Energy Action Plan (NREAP).

3.7.2. Historical M/A data

This section describes the needs and gaps related to the historical data used for the scenarios in the Republic of Moldova (RM).

During the collection of the historical data for the development of Moldavian scenarios (Dupleva I. et al, 2013), the following needs and gaps have been identified:

General

- RM needs to develop data collection forms and detailed procedures to establish the legal foundation, guidelines and procedures for annual preparation of energy balances and other statistic datasets, required for MARKAL and LEAP models application, according to International Energy Agency (IEA) and Eurostat guidelines.
- RM has formally adopted the NACE codes (Statistical Classification of Economic Activities in the European Community) for classifying enterprises by their primary economic activity. In this context, RM should develop the required legislation to require the electricity and natural gas distribution companies to include NACE codes in customer records for non-residential customers and report energy consumption to National Bureau of Statistics (NBS) and Ministry of Economy (MoE) by NACE categories.
- Also, because of Transnistrian region (Administrative Territorial Units on Left Bank of Dniester) secessionism no proof data was available for respective territory. That imposed to develop country scenarios only for the right bank of Dniester river.

For the following sectors the data are not available and need extra analyses:

Climate Statistics

- "Frequency of extreme events" index is not covered by the national statistical system. The data have been provided by the State Hydrometeorological Service of RM, which makes the data publically available on request, in accordance with the stipulations of the Law on Access to Information, adopted through a Parliament Decision No. 982-XIV of 11.05.2000.

Economy

- GDP distribution per sector, Manufacturing Value Added - the information for the 1990-1998 periods is not available. National Bureau of Statistics disposes of data in MDL and USD only, not in Euro.

Adaptation

- "Energy water use (km^3)" index is not covered by the statistical system of the Republic of Moldova. The respective information is treated as 'Not available' and/or as 'Included Elsewhere', specifically for cooling water use at CHPs.

Transportation

- Passenger Transport Index, index of passenger volume per GDP, is not available for the whole period 1990-2010.

Demand

- Households: Information about energy demand cost (in EUR) is not available for the whole period and about the number of households - for the period 2000-2005;
- Agriculture: Information about energy demand cost (in EUR) is not available for the whole studied period;
- Industry: demand cost (in EUR) is not available for the whole studied period;
- Transport: for the whole studied period no information is available about energy demand cost (in EUR);
- Non Energy Use: for the whole studied period no information is available about total energy (in toe), demand cost (in EUR), fuel share (in %);

Transformation

- Own energy use: No data are available for "Raw Losses", "Interest Rate", "Exogenous Capacity" (for 1990-1998), 'Maximum Availability", "Capacity Credit", "variable O&M Cost", "Capital Cost", "Salvage Value", "Fixed O&M Cost" and "Historical production" for all types of energy;
- Pump Storage: No data are available for "Raw Losses", "Interest Rate", "Exogenous Capacity", 'Maximum Availability", "Capacity Credit", "variable O&M Cost", "Capital Cost", "Salvage Value", "Fixed O&M Cost" and "Historical production" for all types of energy and for the whole period;
- Heat Production: No data are available for Heat import and export targets and output price. For 1990-2002, no data are available about fuels. Concerning Dedicated Heat Plants, there is no data for "Interest Rate", "Exogenous Capacity", 'Maximum Availability", "Capacity Credit", "Process Share", "variable O&M Cost", "Capital Cost", "Salvage Value", "Fixed O&M Cost" and "Historical production" (for 1990-1999);
- Electricity Generation: No data are available for Electricity Import Target for 1990-1999, for electricity Export Target, and electricity price. Additionally, the following data are not available for the electricity installations: "Interest Rate", "Exogenous Capacity", 'Maximum Availability", "Capacity Credit", "Process Share" (for 1990-1999), "Process Efficiency", "variable O&M Cost", "Fixed O&M Cost", "Salvage Value", "Capital Cost", "Historical production" (for 1990-1999);
- CHP Production: No data are available for CHP Export Target; Import Target (for 1990-1999); and Output Price. Concerning the landfill CHP, no data are available for "Interest Rate", "Exogenous Capacity" (for 1990-1999), "Maximum Availability" (for 1990-1999), "Capacity Credit", "Process Share", "Historical production"; "Process Efficiency", "variable O&M Cost", "Fixed O&M Cost", "Salvage Value", "Capital Cost", "Historical production". In the field of Natural Gas CHP, no data are available for "Interest Rate", "Capacity Credit", "Process Share", "Salvage Value", "Capital Cost"; "Exogenous Capacity", 'Maximum Availability" "Process Efficiency", "variable O&M Cost", "Fixed O&M Cost" and

"Historical production" (all for 1990-1999); Concerning biogas CHP, there is no data for "Interest Rate", "Exogenous Capacity", 'Maximum Availability", "Capacity Credit", "Process Share", "Salvage Value", "Capital Cost"; "Process Efficiency", "variable O&M Cost", "Fixed O&M Cost" and "Historical production" (all for 1990-1999).

Stock Changes

- Primary fuel data are not available for 1990-1999.
- Secondary fuels data are not available for 1990-1999.

Resources

- Primary fuels import data are not available for 1990-1999.
- No data for secondary fuels production and export is available for 1990-1999.

3.7.3. Development of M/A scenarios and policy portfolios

This section describes the research needs and gaps linked with the scenario development. It covers the availability of information for the period 2011-2050, including demographics, economy, climate statistics, adaptation, policies and measures, energy demand, energy transformation, and others.

In regard to the research needs and gaps linked with scenarios development, inclusive on sectorial level, the following issues have to be highlighted (Dupleva I, et al, 2012), (MoE of RM / UNDP, 2013):

Energy

- As the country is distinguished by low energy security (70% electricity import) and low capacity to pay for energy consumed specific studies are needed to assess and demonstrate the share of affordable renewable electricity to cover power demand during the years.
- The potential for CHP should be determined for the country, taking into consideration that 4500 hours of high and constant heat demand is needed to make such projects economical.
- Centralize heating demand for the years up to 2050 needs to be revised because of persisting factors leading the consumers to select autonomous heating systems.
- The total energy demand in BAU scenario is easily estimated, as it is proportionate to the GDP per capita in the Household sector and to GDP in all other sectors. However, this estimation is much more complicated in OPT and PES scenarios, as the effect of specific mitigation measures has to be added. The effect of the currently planned policy objectives is estimated only by 2020, but not beyond 2020. Additionally, it is very likely that more stringent policy objectives and policies are enforced after 2020 (e.g. in relation to new EU initiatives which the R. of Moldova embraces), but no such information is currently available.
- Another important point in energy demand modeling is the fuel mix used in each sector. According to the Energy Strategy up to 2030 the shares of

renewable energies are pre-established in the national balance by 2020, but neither the time horizon is sufficient, nor these shares are differentiated per economic sector.

- The energy transformation modeling by 2050 requires good knowledge on the energy capacities in the period. Plan for the installed capacity per renewable energy type and application (electricity and heating/cooling) by 2020 is available in the Energy Strategy up to 2030. There are, however, no plans and estimations of the energy capacities beyond 2020.
- Transmission and Distribution losses are another factor influencing the energy balance, but no estimation for their levels beyond 2020 has been found.
- Assess the possible effects (both positive and negative) of climate change on energy consumption:
    - (i) effects of global warming on energy use for space heating;
    - (ii) effects of global warming on energy use for space cooling;
    - (iii) market penetration of air conditioning and heat pumps (all-electric heating and cooling), and changes in humidity.
- Conduct studies of possible effects (both positive and negative) on energy production and supply:
    - (i) assessment of impact of increase temperatures and droughts on hydro energy potential;
    - (ii) impacts of climate change on energy production from biomass;
    - (iii) wind resources changes (intensity and duration); and
    - (iv) electricity transmission and distribution.
- Research on efficiency of energy use in the context of climate warming, with an emphasis on technologies and practices that save cooling energy and reduce electrical peak load.
- Assessments should be focused on linkages and feedbacks among climate change effects, adaptation, and mitigation; linkages between effects at different geographic scales; and relationships between possible energy effects and other possible economic, environmental, and institutional changes.

Transport

- To identify the share of green vehicle penetration, like hybrid one, into the national transport sector
- Examine the long-term impacts of climate change on the transport sector in light of climate change projections to determine whether, when, and where the impacts could be consequential, particularly in light of the long planning horizons for transport infrastructure.
- Analyze options for adapting to these impacts, including the possible need to alter assumptions about infrastructure design and operations, the ability

to incorporate uncertainty into long-range decision making, and the capability of institutions to plan and implement mitigation and adaptation strategies.

- Identify entry points for incorporating climate change information into long-term capital improvement plans, facility designs, maintenance practices, operations, and emergency response plans.

Agriculture

- New, conservative technologies of soil processing are implemented in the country during the last years, which lead to both a significant fuel saving and big amount of carbon conservation into the soil. But there is no study that would show the limits of such technologies dissemination and what may be the speed of their implementation during the years up to 2050.
- Identifying the environmental factors associated with expanded production of biofuels and bio-based products (e.g., applying more efficient and sustainable agricultural, forestry, and land management practices and certification schemes to supply higher yields per unit of input without degrading the environment)
- Concerning climatic impacts, research needs to address not only change in temperature and precipitation and its impacts on agriculture, but also the interaction with hazards, directly or indirectly arising from atmospheric conditions, such as rainfall, flood, frost, drought, hail, heat waves, seasonal shifts (length of growing season, bud break, quality aspects), and changes in pest and disease patterns.
- Crop specific evaluations should be conducted to determine changes in seasonal development, characteristics of production, cultivation methods, etc., under climate change.
- Crop models are required to assess the impacts of climate change and increased atmospheric concentration of CO_2 on various crops, pastureland and livestock. Further, crop simulation models need to be interfaced with Geographic Information Systems in order that these models can be applied for regional planning and policy analysis.

Water Resources

- An assessment of climate change impacts on water resources is required to be focused on:
    - (i) defining critical thresholds in water resource;
    - (ii) improving the capacity to calibrate state-of-the art rainfall runoff models;
    - (iii) understanding of the economic and social impacts of climate change on water quantity, supply, and demand including irrigation, drinking-water supplies, recreation/tourism, hydropower and industry, and system losses.

Forestry

- Establish the climatic thresholds that correspond to the distribution limits of a forest type or species and develop a bioclimatic model to predict future steady-state forest distributions under a range of plausible climate change scenarios.
- Collect historical analogues and life-history information to estimate how long it might take for the forest boundary to migrate a given distance, and use this information to speculate about what may happen during the transition period and to modify the steady-state prediction if it is unlikely to be reached in the assessment period.
- Calibrate a biogeochemistry model to predict changes in productivity and carbon stocks in each forest type, with and without the effects of elevated CO2 concentrations (and, where appropriate, nitrogen deposition) and then use an economic and demographic model to project the demand for forest products and the land area which is likely to be available.
- Improve understanding of adaptive capacity including the inherent adaptive capacity of trees and forest ecosystems and the socioeconomic factors determining the ability to implement planned adaptation measures.

Human Health

- Available risk assessment data, including the short-, medium- and long-term effects of climate change on public health, need to be thoroughly reviewed and considered. All health statistics (data on communicable diseases, non-communicable diseases, ambulance call-out, hospitals, etc.) need to be utilized in risk assessment and in identifying vulnerabilities in the health sector.
- Quantitative research is required to identify the regions most vulnerable to the adverse health effects of climate change.
- Improved disease burden estimates need to be established, based on latest climate models to estimate:
    - heat-related mortality statistics based on existing mortality and population data at the national level and in key cities;
    - the impacts of projected changes in climate, taking into account various forms of acclimatization; and
    - climate - water and foodborne diseases relationships using panel data on income and health to project cause-specific deaths and disability-adjusted life year (DALY) rates by demographic group.
- In depth studies on the socio-economic assessment of climate change in the health sector would be beneficial, including:
    - the health 'damage' costs of climate change under different mitigation scenarios; and
    - the costs of preventing death, illness and injury under different mitigation scenarios (i.e. adaptation measures).

3.7.4. Evaluation of M/A policy instruments

The main difficulties were:

- Inadequate national implementation network: The available official documents were extremely limited. The majority of the bibliographic references that were used are from the European Commission, UNEP, UNDP, UNECE, EBRD, and World Bank. Many reports are not updated. The websites are not user friendly and the information is not directly accessible. In most of them there is no English version to facilitate foreign researchers. The Climate Change Office under the Ministry of Environment and the Designated national Authority for CDM does not have an own website.
- Nonexistent or limited published research work on mitigation and adaptation issues: Policy oriented research work was not found.
- Use of energy models and evaluation methods: No research work was found on the evaluation of climate change policy mixtures or instruments.
- Inadequate background: The Moldovan team was not familiarized with the Multi-Criteria Decision Analysis methods and encountered strong difficulties in conducting the evaluation.

3.8. Romania

3.8.1. Established national procedures, sources, available data and information about M/A policy

This section describes the research needs and gaps in Romania related to the national GHG inventory, reporting and verification, identified during the elaboration of the report "Mapping National Procedures, Sources, Available Data and Information for Romania".

3.8.1.1. Inventory

The Ministry of Environment and Climate Change (MMSC) is the specialized body of the central public administration, subordinated to the Romanian Government, in charge with the preparation of national climate policies. MMSC also supports the development of the national inventory of greenhouse gas emissions in compliance with the IPCC requirements. The competent authority responsible for the preparation of the National Inventory Report (NIR) is the National Environmental Protection Agency (ANPM), under the MMSC subordination.

The responsibilities of institutions, research institutes, and the economic operators that are supporting this process are regulated through cooperation agreements between participants.

In August 2011, the UNFCCC compliance committee found irregularities in Romania's 2012 GHG emissions inventory resulting from the weaknesses of the Romanian system for evaluating its GHG emissions, in particular with respect to reports on land use, land use changes and forestry (LULUCF). So, due to its failure to comply with the requirements of the inventory's methodology, Romania was banned from the trading of surplus carbon emission credits. This was possible due to the following gaps that need to be solved:

- lack of cooperation between ministries and delays in the creation of the legal framework required to use the surplus certificates;
- lack of experience in trading these certificates with respect to the procedures at a local and international level

Therefore, there are needs to:

- strengthen cooperation between the public authorities with environment-related functions and impacts;
- establish climate-change-related working groups in relevant areas such as energy efficiency, transport or waste emissions;
- reinforce and maintain the institutional, legal and procedural arrangements between all involved participants;
- implement measures for enhancing the institutional capacity.

3.8.1.2. Reporting

Reporting is based on the Romanian established system for estimating anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol, and for reporting and archiving inventory information as well as UNFCCC reporting guidelines on annual inventories.

The archiving of the data used in emission estimations is done according to the provisions of the Ministry of Environment Order no.1474/2008 for approving the Procedure on processing, archiving and storage of data specific to the National GHG Inventory (NGHGI).

There are specific needs for improving the country's report, such as:

- calculation of specific emission factors / other parameters relevant to NGHGI for energy sectors, industrial processes, agriculture and waste to allow the use of higher tier calculation methods;
- improvement of methodology used for Land use, Land Use Change and Forestry;
- identification of practical ways to improve the estimation of emissions/removals specific to land use, land - use change and forestry (LULUCF) activities under Article 3.3 of the Kyoto Protocol and the selected activities under Article 3.4 of the Kyoto Protocol (forest management and re-vegetation);
- improvement of the methodological issues (data collection, emissions estimation) on GHG emissions recovery within the Industrial Processes and Waste activities;
- improvement of the structure and differentiation of the information collected, processed and provided by the National Statistical Institute (INS) for better correlation with the reporting requirements;
- improving of data disaggregation considering the IPCC classification;
- improving of the accuracy and consistency of datasets

Also, research studies regarding the following issues should be prepared:

- waste management optimization for the decrease of GHG emissions;
- development of agricultural practices with GHG mitigation potential;
- modernization of transport sector for GHG emissions decrease;
- urban planning through climate-friendly spatial structures.

3.8.1.3. Verification

The following needs have been identified for improving the verification procedure:

- improvement of transparency at sector level by providing a cumulative table on the status of emissions/removals estimation for every sub-sector;
- improvement of the NGHGI archiving structure;
- improving the quality of the uncertainty assessment;
- better documentation and use of electronic links and automated procedures for data entry and storage of sources and references;
- improving the use of data specific to other reporting mechanisms, such as use of ETS data, at the GHG inventory level;

3.8.2. Historical M/A data

3.8.2.1. Non-energy data gaps

In Romania, there are several gaps concerning non-energy historical data needed to build climate change M/A scenarios, in particular:

- No official data about the frequency of extreme events for the whole period 1990-2010;
- No data are available for the overlaps of surface and ground waters for the whole period 1990-2010;
- No data are available for the added value of particular industrial sub-sectors for the years between 1990 and 1998. In several categories of data (i.e. industrial sub-sectors and services sub-sectors), the classification has changed over years and this makes comparison impossible;
- No data are available for the volume of the water used for Cooling and Hydro power water use; for Industry and Agriculture water use the data are available only starting from 2007;
- No data for pass transport index for the period 1990 – 1998;
- No data are available for Surface of irrigated land for the period 1990 - 1996;

3.8.2.2. Energy Demand data gaps

- No energy demand cost data are available for the specific sectors of the national economy (Households, Agriculture, Services, Industry, and Non-Energy Use) and their sub-sectors;

- No energy demand data are available for the particular Service sub-sectors, such as Tourism and Health Services (the Statistical Yearbook and the Energy Balance of Romania do not present this data structure);
- In Transport sector, the energy demand data in each type of transport (Road, Rail, Air, and Water) is available only starting with year 2009, but it is not further broken down into Passenger transport and Freight transport.
- In Transport sector, data on the final energy intensity is not available, due to no available inputs to calculate it.

3.8.2.3. Energy Transformation data gaps

- All financial data required as input for the scenarios are not available. In particular, there is no data about the capital costs, Fixed O&M costs, variable O&M costs, and Salvage Value of the energy capacities in the Transformation branches.
- There are no data about the Maximum Availability, Capacity Credit, and Process Efficiency of any energy transformation process;
- No data are available for the installed capacity of dedicated heat plants;
- There are other data that for market competition reasons are confidential (for example data for: the capital costs, the fixed costs, the variable costs of operating of different types of power plants in Romania on different types of resource).

3.8.2.4. Research needs

Studies devoted to certain problems that can lead to the required data appear to be necessary, if financial resources will be available in the future. These studies could cover the following:

- Households - the number of households, the mean area of a household, the number of electrical devices, the efficiency of these devices, the energy consumptions, etc. In November last year (2011) a census of the population and households was performed by National Institute of Statistics and there were questions about the electric devices of the households. The final results are not published yet. It is expected that the final results to be published in the second half of year 2013;
- Primary energy resources – a study presenting the reserves, resources and availability of energy resources;
- The National Power System: the necessity of a centralized database of the National Power System on all types of power plants, all types of primary resources used to contain all costs required in the database;
- The transformation sector: the inventory of the large energy consumers by industry branches in order to identify the energy consumption and the main measures to conduct to the primary energy savings and to the increasing of the energy efficiency;
- Transport sector: the identification of the possibilities to introduce new type of vehicles for goods and passengers transport. Also the creation of a

database with the energy consumption/energy efficiency of the transport vehicles would be very helpful.

The re-opening of the National Energy Observatory would be a good solution for a better data completeness related to the energy sector. It should be noted that the National Energy Observatory was an entity established at the end of 2004 under the coordination of the Ministry of Economy and Commerce. Unfortunately because the lack of financial resources this entity was closed at the beginning of 2007.

3.8.3. Development of M/A scenarios and policy portfolios

3.8.3.1. Background

This part of the report describes the research needs and gaps in Romania, identified during the elaboration of the report "Development and assessment of Mitigation / Adaptation Climate Change policy portfolios for Romania" (Vasile C. et al, 2012), and during the work of developing additional scenarios, based on more optimistic and more pessimistic key assumptions.

3.8.3.2. Key assumptions

For the development and assessment of mitigation/adaptation climate change policy portfolios, reference scenarios on social, demographic and technological development of Romania on long-term (up to 2030, 2050) are necessary to be defined. However, taking into account the last 23 years of the transition from a centrally planned economy to market economy and the period 2009 - 2012 of the economic crisis is difficult to define social, demographic and technological evolution up to 2030/2050 in Romania. The key assumptions for the creation of scenarios are related to the macroeconomic projections, diversification of energy sources, the restructuring of the industrial sector, the development and modernization of agriculture sector etc.

For covering these gaps the following studies need to be developed:

- analysis of scenarios of socio-economic and technological development of Romania, in the context of new European energy-environment policies;
- multi-criteria analysis for prioritizing the scenarios, taking into account economic, environmental, security and social criteria;

For GDP evolution two different forecasts for GDP growth have been used: one by IMF (IMF, 2012) and one by the National Prognosis Commission (June 2012). The IMF prognosis has time horizon only till 2017, and the latter is very optimistic and does not take into account the economic crisis. Therefore, a GDP growth forecast till 2050 that takes into account the economic crisis effects is necessary.

No forecasts for the frequency of extreme events and water resources are available. So research efforts on climate forecast are needed.

No studies about Romania in the field of water use in households, agriculture, industry, and energy by 2050 have been found, but only regional forecasts with different geographical coverage (Europe, Eastern Europe, South-Eastern Europe, etc.) and these cover only a part of the data needed to assess the adaptation needs within each scenario. No information about forecasts for surface waters, groundwater or total renewable freshwater resources have been found.

3.8.3.3. Policies and measures

Since January 1st 2007 Romania became a member of the European Union and its energy policy takes into account the EU requirements. The post - accession development objectives are linked to European approaches.

There are a lot of strategies in Romania especially for the period 2007 - 2013, or up to 2020/2030, but all these strategies are obsolete if we take into consideration the present situation. For this reason it is necessary for the Romanian Government to approve new strategies related to future social and economic development of Romania, to energy sector, industrial sector etc.

There are no planned GHG mitigation measures for the period after 2020, specifying the necessary investments and operating costs. Additionally, the following gaps have been identified:

- lack of hierarchy of options for reducing GHG emissions in line with the average cost for reducing these emissions;
- lack of assessments regarding the affordability by population and enterprises when selecting specific reduction measures;
- lack of clear policies on taxes.

In this respect the following studies should be elaborated for the energy sector:

- the main technological, legal and financial measures to promote a new national policy of GHG emissions reduction;
- the required investment and operation costs for mitigation options;
- the hierarchy of the mitigation alternatives according to the average cost of the avoided GHG;
- evolution of fuel costs in Romania and the world market;
- studies regarding the impact of environmental policies on the Romanian economy competitiveness;
- studies regarding the rates, fees, support schemes for promoting clean and efficient technologies;
- studies regarding the reduction of energy consumption in the residential and services sectors, etc.

For the non-energy sector studies in the following fields are needed:

- forestry capability in view of implementing atmospheric carbon sequestering options;
- evaluation of agriculture CH_4 emissions from animal digestion and in the fermentation of animals dejections and N_2O emissions subsequent to the application of nitrogen fertilizers;
- appraisal of emissions resulting from industrial processes;
- solvents and other products whose emissions have been determined in correlation with the economic and technologic evolution;

- the management of liquid and solid wastes for the appraisal of CH_4 and CO_2 emissions.

In the field of climate change adaptation, the only existing document is a "Guide regarding the adaptation to climate change effects". However, the recommendations and the adaptation measures presented in this guide are not based on detailed studies and climate scenarios for the vulnerable sectors. Such studies are needed in order to elaborate appropriate adaptation policies.

3.8.3.4. Energy demand

For estimating the evolution of total energy demand in the optimistic and pessimistic scenarios the effect of specific mitigation measures must be taken into account. But there are no policy objectives available for the period 2020-2050.

For the energy demand modeling the plan for the shares of renewable energy in the national balance by 2020 presented in the National Renewable Energy Action Plan 2010 has been used. But these shares are not differentiated per economic sector and also there is no such information available for the period up to 2050. Therefore, studies regarding energy demand and supply after 2020 as well as the improvement of transport sector for reducing the fuel consumption should be elaborated.

3.8.3.5. Energy transformation

For the energy transformation modeling by 2050 the plan for the installed capacity per renewable energy type and application (electricity and heating/cooling) by 2020 available in National Renewable Energy Action Plan was used. Additionally, on the Ministry of Economy website a discussion document that presents the main directions of the Romanian electricity sector until 2035 is available, but this document is outdated and does not take into account the effects of the economic crisis. The main identified gaps in the field of energy transformation are as follows:

- There are no plans or estimations for the energy capacities for the period up to 2050;
- No available estimations for the levels of Transmission and Distribution losses for the period after 2020 have been found;
- There are no forecasts available for the heat production in district heating plants;
- No forecasts are available for coal transformation.

It is necessary to elaborate studies regarding:

- planned measures for the reduction of fuel consumption by reducing losses inside the national power system and inside the heating transport and distribution system;
- economic indicators related to energy conversion (refineries and coke factories, production of electricity and heat);

3.8.4. Evaluation of M/A policy instruments

No information was found about the costs that the government has to pay for implementing the Romanian policy instruments. Both the National Action Plan for

Energy Efficiency and the National Action Plan for Energy from Renewable Sources do not provide such costs.

No information is available on how the Romanian climate policy affects the national competitiveness.

There is no information about climate change adaptation measures in Romania. Additionally there is no information of how these measures will affect competitiveness. The Romanian implementation network has no such studies, showing a gap that needs to be covered.

As research needs identified here we can mention studies to assess:

- the impact of the public investments in energy infrastructure over the environment;
- the impact of the support scheme for RES and energy efficiency over the consumers (industrial and residential ones);
- the use of revenue from emission trading (JI/CDM, GIS, ETS), penalties, fees for investments in new and efficient technologies to reduce the negative impact of climate change;
- the total amount of administrative costs needed for exerting the national M/A climate change policy (planning, management, verification, monitoring, etc.);
- the total amount for research on M/A climate change issues.

3.9. Russia

3.9.1. Established national procedures, sources, available data and information about M/A policy

Activities, connected with support of national GHG inventory, are conducted by Institute of Global Climate and Ecology (IGCE). IGCE collects data in the aggregated form from Federal ministries and agencies. Quality assurance is perfomed on two layers: primary procedures to verify the quality of these data are performed by the correspondent agencies by means of special internal techniques; secondary monitoring and verification of the activity data, as well as parameters and calculations made on the basis of these aggregated data, is performed by IGCE.

According to "Report of the individual review of the annual submission of the Russian Federation submitted in 2010" (Gugele et al. 2011), following improvements could be made to national GHG reporting system:

- providing more detailed information on activity data;
- further development of country-specific emission factors in the energy sector, and other parameters to move to higher-tier methods, including
    - development of country database for carbon emissions produced by non-energy use of fuels;
    - reflecting the change of the role of coal in economy in calculation of CO2 emission factors for solid fuels, and refinement of the CH4

emissions from coal mining estimates based on new detailed data on production;

- development of national CH4 and N2O emission factors for energy sector;
- reallocation of fuel consumption and emissions by auto producers from energy industries to manufacturing industries and construction;
- improvement of the emissions estimation procedure for civil aviation;

- ensuring consistency of time-series for detailed emissions from subcategories of energy, manufacturing and construction sectors;
- improving consistency of data obtained from reference and sectorial approach;
- provision of detailed fuel consumption data from the energy balance in the national inventory report, and other measures to provide more transparent information on the activity data, methods, emission factors and other parameters used for energy, LULUCF and waste sectors;
- provision of better reasons for revised data in the industrial processes and waste sectors and reflection of such revisions in NIR;
- improving forest management statistics section, namely using annual times-series on harvestings and destructive forest fires levels from instead of mean values estimated on the basis of detection of areas harvested/burnt;
- provision of more detailed data used for calculating biomass stock changes;
- decreasing the role of expert judgement to estimate uncertainties and providing explanations for large volatility of uncertainty estimates over several periods, ensuring consistency in using 95% confidence interval for all category uncertainty estimates, ensuring that changes in NIR parameters are all reflected in the uncertainty estimates;
- general improvement of quality procedures, paying special attention to the correspondence between national and IPCC land definitions and to the consistency of the time series of activity data and associated estimates of emissions and removals;
- improvement of the documentation of the quality assessment procedures, implementing such procedures on systematic basis, documenting all results of the checks in the archive;
- provision of more detailed information on algorithm of calculation of carbon stock changes and emissions/removals;
- disaggregating input and reported data of the carbon budget per region;
- ensuring consistency in reporting of land uses and land-use changes;
- ensuring better timeliness of reporting.

3.9.2. Historical M/A data

Climate data. Huge territory of the country and great variability of climate parameters makes estimation of average yearly precipitation, temperature and frequency of extreme events hard. There are various sources of data disaggregated over several regions and inconsistent over several time periods. Hence, proper synchronisation, homogenisation and bridging procedures should be applied to existing data.

Water data. There are only point estimates of water resources and water use in details, needed for national database, for several years. Hence, more data should be collected or estimated to ensure consistency and proper depth of data.

Manufacturing value added and GDP distribution per sector. Official source in Russia for information about manufacturing value added is Rosstat. Since its inception in 1992 the method for calculation manufacturing value added was changed twice by Rosstat, which makes historical data essentially non-continuous and thus inapplicable for extrapolation-like predictions. For National Report data was disaggregated and aggregated again according to industry nomenclature, required by data template. Unfortunately this method is not free from errors, therefore there is a gap in correctly calculating continuous manufacturing value added time series with appropriate industry nomenclature.

Energy demand and supply. There is huge gap concerning energy balances in Russia. Although Soviet Union was one of the first countries to adopt energy balances of the whole economy, after the dissolution of USSR calculating balances by official bodies was suspended. There are several international agencies which estimate energy balances of Russian Federation. While information required for national energy balances is collected and stored on regional level by regional state statistics bodies, methods and nomenclature slightly differ from region to region, which raises question of national-wide method for aggregating and synchronisation of energy data across Russia. Appropriate regulation was adopted by Government in December in 2012 and first detailed national energy balance is expected to be presented in 2014. Still there is definitely a need for back-calculation of energy balances for 1990-2012 years. There is no accessible information about the annual load curve so as to run the scenarios.

Cost of energy demand. No consistent data exists, covering all periods and sectors in consideration, collected by official sources.

Energy transformation. Only point estimates for financial data (capital costs, Fixed O&M costs, variable O&M costs, Salvage Value) are available, and none of it is from official sources. Also there is lack of consistent and detailed data on Maximum Availability, Capacity Credit, and Process Efficiency for energy transformation processes. Such information could be found for various regions, periods, plants, and need to be aggregated, synchronised and verified.

Feed-in tariff. No data on feed-in tariffs for RES-generation is available in Russia, although all necessary legislation. Lack of information could be connected with either non-transparency of calculation methods and ambivalent legislation, or low penetration of feed-in tariffs.

3.9.3. Development of M/A scenarios and policy portfolios

Primary research need and gap in this section is lack of rigorous approaches and instruments, allowing quantitative analysis of regulatory impact of policy instruments on future energy balances, especially energy consumption structure and energy intensity. Namely, there is research need connected with such impact assessment of various measures, proposed by Federal Law on energy efficiency and subsequent legislation in support of mentioned Federal Law. Further, there is no instrument (except for expert opinion), allowing translation of measures and goals, proposed in national strategies (Government of Russian Federation, 2009), Transport strategy - (Government of Russian Federation, 2008), Railways strategy, Water strategy, etc. to the required quantification in the scenario modelling.

There are numerous policy instruments of various levels, regulating energy economy and energy efficiency in Russia (strategies, concepts, laws, bylaws, programs, and other regulations). At the same time none of it has implicit goal of reducing GHG emissions or adapting to global climate change. Still, many policy instruments both already adopted and being developed could imply effects, which may allow classifying these documents as M/A policies.

First, there is research gap concerning more robust classification of national regulatory policies as related or non-related to M/A instruments. While to some extent such an attempt was made under current project, the need for more systemic approach is urgent. Moreover, analysis of Russian legislation and related documents revealed dominance of mitigation-like policy instruments over adaptation-like. Such imbalance could be the result of either real prevalence of GHG-reduction intentions among policymakers, or the flaw of the analysis itself. Therefore, more thorough analysis of legislation is needed and development of special procedure for detecting adaptation policies implied features in legislation.

Second, there is a need for classification scheme of documents related to national energy strategy of Russian Federation. Such classification should specify, in particular, inheritance and inclusion relationships between documents. There is also a need for developing unified framework for comparison quantifiable goals, proposed by various regulations. Various documents developed by national agencies use different units of measurement and systems of goals; rely on aggregated or absolute numbers in some cases, while using per capita, per unit, or relative numbers in other; have different number of scenarios, with unclear inheritance scheme and ways of obtaining estimated numbers. Development of such unified framework possibly may indicate inconsistencies and contradictions between goals and key assumptions of regulatory policies.

3.9.4. Evaluation of M/A policy instruments

The evaluation of the three policy portfolios that were developed for Russia encountered the following difficulties:

- Inadequate national implementation network: The web-sites of the pertinent authorities have no actual information for climate change issues. This is justified since climate change policy is not a priority for Russia. No national documents regarding the performance of implemented M/A policy instruments and the future introduction of new ones were found. Even for the currently implemented policy instruments the accessible information

was limited. Official national documents or reports were not available at least in English as observed in the relevant references of the PROMITHEAS-4 reports for Russia. Significant institutes participating in the implementation of the Russian climate policy such as SREBANK had no available information. National vulnerability assessments for adaptation needs, studies for the potential of the renewable energy resources of the country are not mentioned or included.

- Non-existent or limited published work on mitigation and adaptation issues: There was a considerable number of papers in scientific journals for Russia, but the majority concerned energy policy issues and not climate change policy issues. Usually Russia - as part of a wider group of countries - is studied for the implementation of international agreements or policy instruments (Kyoto Protocol, International emission trading scheme).
- Use of evaluation methods: No research work was found on the evaluation of climate change policy mixtures or instruments in Russia.
- Inadequate background: The Russian team was not familiarized with the European standards in writing scientific papers, using an energy model or with the Multi-Criteria Decision Analysis methods and encountered strong difficulties in conducting the work.

The aforementioned factors reflect the difficulties that national researchers have in accessing information so as to conduct their climate change policy research. On the other hand, foreign researchers have difficulties in locating such information sources and understanding the Russian climate policy. The country needs research oriented to climate change policy issues which currently is at very low levels. Most of the official documents that were used are from UNDP, EBRD and EC.

3.10. Serbia

3.10.1. Established national procedures, sources, available data and information about M/A policy

The Ministry of Environment, Mining and Spatial Planning and its Climate Change Division coordinated all activities in preparation and publishing of The Initial National Communication of the Republic of Serbia (Ministry of Environment and Spatial Planning, 2010), which include Inventory of emissions of greenhouse gases. This document, issued in November 2010, is the very first and until now, the only one national report regarding climate change issues. The only officially available data for national GHG inventory (for 1990 and 1998) are from this document.

A team of national experts (representatives from various R&D institutions) worked on the initial GHG inventory, under the coordination of the Institute for Nuclear Sciences VINČA and in collaboration with representatives of government institutions. For each sector, and additionally for the energy sub–sectors, a team of 3 experts was formed who were in charge of acquisition, systematization, documentation and archiving of the data. All institutions included in GHG inventory creating are mentioned in the report covering mapping national procedures, sources, available data and information. However this was project established for initial GHG inventory and the fact that until now there is further communications and national inventories means

that this approach is not sustainable, so **national procedure for regular GHG inventories publication is not established**.

GHG inventory for the year 1990, as the base year, covers GHG emissions from the energy sector, industrial processes, waste, agriculture, land–use change and forestry. In the course of the preparations for the inventory, all available data in the period 1990–1998 were analysed, but due to irregular working conditions in most sectors and years, and due to missing data, only data for the year 1998 are given, in accordance with the guidelines for national inventories for non–Annex I countries.

The uncertainty of the calculations of the GHG for 1990 was determined according to the internationally recommended method (IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Tier 1 Method). The estimated uncertainty of the total GHG emissions in the Republic of Serbia for the year 1990 is 10.5%.

The comparison of the results of the calculations of the available/combusted fossil fuels in the energy sector and the emission of the carbon dioxide according to the Reference Approach and Sectorial Approach for 1990 and 1998, given in tabular form in Annex 3 of the Initial national communication of the Republic of Serbia under the UNFCCC, indicates relatively small discrepancies in the emissions of CO2 by these two methods (1.92 % for 1990 and 1.32 % for 1998).

Systematic observations of meteorological parameters, hydrological and terrestrial observations, as well as air-quality monitoring exist. Republic Hydro Meteorological Service (RHMSS) of Serbia fulfils Serbian obligation towards Global Climate Observing System (GCOS) and so meets the obligations arising from the UNFCCC referring to systematic climate observation and international data exchange.

Statistical Office of the Republic of Serbia (SORS) is special professional organization in the system of state administration of the Republic of Serbia that performs the expert tasks related to adopting programs, organization and conducting of the statistical surveys, methodology creation, collecting, processing, statistical analysis and publishing of the statistical data – including data for all key categories according to IPCC (except Land–use change and forestry).

Land–use change and forestry is covered by "Report on the State of the Environment in Republic of Serbia". This report is issued annually by the Serbian Environmental Protection Agency (EPA).

However, there is no systematic collecting, analysing, systemizing and reporting of data nether by RHMSS, SORS nor EPA for national GHG inventory.

3.10.2. Historical M/A data

For the reviewed historical period, data related to energy consumption (total and by sector) and energy transformation sector (inputs and outputs) are not available in electronic version, except for the period 2007-2010. Other requested data for the database are hard to access even when they exist (for example reserves of fossil fuels). There is no systematic database at the level of the country, where required data can be easily found. Some of the data were not collected at all. Some of data are confidential (oil and gas reserves).

Official energy balances of the country for 1991-2007 do not exist.

Additionally there is a difference between Energy balances related to consumption in the household sector, provided by Statistical Office of the Republic of Serbia and Ministry of Energy, Development, and Environmental Protection of Republic of Serbia, because the former does not include the substantial amount of biomass consumed in the household sector. The Balance provided by the Ministry (including all biomass) is published in Official Gazette of the Republic of Serbia, but it is not electronically available.

Data about costs of different fuels for different consumers are not available. For future investigations, related to optimization of energy supply (general and per sector) such kind of data are necessary and of great importance. Statistical office of the Republic of Serbia could be the institution obliged to collect costs related to energy production, transformation, transmission and distribution, and consumption.

As specific comments, the following issues can be emphasized:

- Data concerning energy sector are not available for most of the years for the historical period analysed. As mentioned above, even official energy balances for period 1991-2007 do not exist, since relevant data were not systematically collected. As the consequence, data about total final energy consumption, consumption by sector, and fuel shares are not available. Although there are data about the final energy consumption in transport, there are no detailed data concerning passenger transport, freight transport, road transport, rail transport, air transport, and water transport.
- Concerning final consumption in household sector no data are available for the costs of any kind of fuel or energy, since they were not collected. A detailed analysis related to the structure of energy used in household sector for the Republic of Serbia has never been done. A study that could provide such kind of data would be of great importance and help in future.
- Concerning final energy consumption in industry no data are available for the period 1990-2006.
- Data about energy consumption of industry sub sectors: Mining and quarrying, food, beverages and tobacco, textile and leader, pulp and paper, chemicals and petrochemicals, non-metallic minerals, iron and steel, machinery, transport equipment and others, and corresponding structure of fuel consumption per sub sector are not available. A detailed study that could provide all listed data would be of a special interest, as a basis for the analyses and determination of the effect of policy measures.
- Concerning final consumption in industry sector and sub sectors, no data are available for the costs of any kind of fuel or energy, since they were not collected.
- Data about energy consumption in Tourism and Health Services are not collected.
- Data about fright transport are not detailed enough. Only overall data are available, not divided to road, rail, water etc. Also, costs of fuels are not available since not collected.

- Transformation sector - data about costs: of fuels, variable costs, fixed costs do not exist, for the whole period analysed.
- Data about efficiency of transformation processes cannot be found explicitly. For some of processes efficiency can be calculated from the Balance.
- Data about installed capacities of auto producers does not exist.
- Detailed data about capacities of dedicated heat plants does not exist.
- Data about stock changes are available only for period 2007-2010.

Data about non energy emission of GHG gases (industrial processes, agriculture and waste) are not available in Serbia. These sources of GHG emission are only reported for two years 1990 and 1998 in Initial National Communication of the Republic of Serbia under the United Nations Framework Convention on Climate Change (Ministry of Environment and Spatial Planning, 2010). Because of that, these sources of emissions cannot be included in the climate change scenarios.

Removal of CO_2 in forests (sinks) is also reported only for 1990 and 1998 in Initial National Communication. These data for other years is not available, and consequently cannot be included in scenarios, although projections of future surface of forests, irrigated land, meadows and pasture, orchards and vineyards, arable land are available (Ministry of Environment and Spatial Planning, 2010).

It can be concluded that the lack of almost all historical data are a serious problem in creating mitigation and adaptation scenarios and policy portfolios.

3.10.3. Development of M/A scenarios and policy portfolios

Mitigation and Adaptation scenarios (Business as Usual, Optimistic and Pessimistic) and related policy portfolios were developed based on numerous and various historical data (1990-2010), as well as on available information and projections for the period until 2050. As key drivers for scenarios development population and GDP growth rate are chosen.

Three different projections about the future population of the Republic of Serbia can be found for period until 2032 (Statistical Office of Republic Serbia, 2012). Also, United Nations provides projections in "2010 World Population Prospects" of the United Nations (UN, 2010). As new population census was conducted in 2011, new projections should be included in the scenarios (Statistical Office of the Republic of Serbia, 2013).

Concerning another key driver, GDP growth rate, there are no estimations for the future period, provided by a relevant domestic institution. Some of projections that were announced before economic crises (Stamenkovic S. et al., 2010) turned out to be overestimated and very optimistic. The same authors who provided projections of GDP growth rate until 2025, admitted that it is not realistic to expect such growth rates, since some of the assumptions had not been met (Stamenkovic S. et al., 2011). There are IMF projections (IMF, 2012, 2011), but they are only in short term and do not cover all scenario period. Projections that concern future possible redistribution of GDP shares among sectors are not available. Since the period analysed in scenarios is long (40 years), it cannot be expected that GDP distribution per sector will remain unchanged. Since GDP is the key driver in scenarios development, such projections

are of great importance, in order to get more reliable projections of future energy consumption.

As mentioned above, historical data about final energy consumption can be found at Statistical office of the Republic of Serbia only from year 2007. Due to this fact it must be emphasized that developing a scenario that follows the historical trend was not possible. Projections of energy consumption provided by Strategy of energy sector development of the Republic of Serbia are available only until 2015 (Ministry of Mining and Energy, 2005). In near future it is expected a New Strategy of Energy Sector Development to be adopted, with projections until 2030.

Modelling energy transformation sector assumes that there are reliable data about future development of the sector: capacities that will be built, year of their start of operation, capacities that will be withdrawn, year of withdrawal etc. Concerning electricity generation sector such data about new capacities are available and presented in Strategic and Development Projects of Electric Power Industry of Serbia (EPI, 2011b). However, reliable data about years of old thermal power plants withdrawal do not exist, so this issue needs further research. As the Republic of Serbia is obliged to fulfil requirements of Large Combustion Plants Directive (LCP), it is expected that some of lignite fired thermal power plants or units will be withdrawn. Some projections can be found (Sudes, 2012), but official data are not available yet.

Similar projections for other transformation sectors do not exist. There are no data about future development of district heating systems (capacities to be built or withdraw, fuel switch), coal drying facility (old plant with very negative environmental impact), or possible future indigenous production of biofuels.

3.10.4. Evaluation of M/A policy instruments

The evaluation of the three developed M/A policy portfolios for Serbia encountered the following difficulties:

- Inadequate national implementation network: A large part of the official documents had a confusing perception of what is climate change policy. Due to this fact there were delays for the researchers in understanding and using the necessary information for the development and evaluation of the M/A policy portfolios.
- Non-existent or limited published research work on mitigation and adaptation issues: Policy oriented research work was not found. There was a considerable number of papers in scientific journals concerning climate change issues in Serbia, but policy information was almost absent.
- Use of evaluation methods: No research work was found on the evaluation of climate change policy mixtures or instruments.
- Inadequate background: the Serbian team was not familiarized with the Multi-Criteria Decision Analysis methods and encountered strong difficulties in conducting the evaluation.

3.11. Turkey

3.11.1. Established national procedures, sources, available data and information about M/A policy

3.11.1.1. National GHG Inventory

Turkey's "Greenhouse Gasses Emission Inventory Working Group" was formed by the ratification of the United Nations Framework Convention on Climate Change and signing of Kyoto Protocol. The aim of the Coordination Board was to improve the greenhouse gasses emission inventories of Turkey. The Minister of Environment and Forestry is the chairmanship of the Coordination Board. The other members of the Board are Ministry of Foreign Affairs, Ministry of Energy and Natural Resources, Ministry of Public Works and Settlement, Ministry of Transport and Communication, Ministry of Agriculture and Rural Affairs, Ministry of Industry and Trade, Ministry of Finance, Ministry of Health, of Development, Prime Ministry Undersecretariat of Treasury, Turkish Industrialists' and Businessmen's Association, Union of Chambers and Commodity Exchanges of Turkey and other related organizations under the coordination of TurkStat.

3.11.1.2. Reporting

In Turkey, the major actor of the preparing of GHG inventory is the Turkish Statistical Institute. Input data are collected from related organizations. GHG Emission Inventory Working Group coordinated by TurkStat has prepared the National Emission Inventory and Common Reporting Format (CRF) tables in accordance with the UNFCCC Reporting Guidelines on Annual Inventories (http://unfccc.int/resource/docs/2004/sbsta/08.pdf). The methodologies used in the calculation of emissions are based on the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Country specific methods have been used in electricity production and road transportation as recommended by the IPCC Guidelines (TurkStat, 2011).

3.11.1.3. Verification

QA/QC and verification of data have been done by Turkish emission inventory working group for each source category and the procedures are explained in NIR in detail.

Control of quality of the inventory was carried out by sector experts both on the basis of the emission factors and activity data. There was also internal quality control:

- control of consistency to ensure data integrity, its correctness and completeness;
- determination and correction of errors,
- documentation and archiving of material used for the inventory preparation and QC activities (TurkStat, 2011).

In order to reduce errors and remove the main shortages of the Turkish system, the following are necessary:

- Organization in a manner to facilitate the user for using the e-library of Climate Change Department of the Ministry of Environment and Urbanization.
- Establishment of web-sites to increase awareness about climate change.
- Increase of the number of official reports regarding climate change adaptation.
- Update of the web-site of The Ministry of Energy and Natural Resources for the session of publications.
- Available of the documents on the "Energy-Environment-Climate Change" session not only in the Turkish language but also in the English language.
- Efforts for reduction of errors and inaccuracies in the energy balances.
- Standardization of documentation and archiving.
- Introduction of alternative approaches for comparison of emissions
- Increase of Turkish implementation network
- Recent studies or reports regarding the performance of the current policy portfolio or for related climate change issues.
- Increase of the implementation network capacity and performance, as well as an organized, updated and easily accessible e-library with documents regarding mitigation and adaptation climate change issues available in English language.

3.11.2. Historical M/A data

Information gaps concerning non-energy historical data:

- Limited data for water use are collected by TURKSTAT. TURKSTAT takes the raw data from water utilities of each city.
- All the historical GDP data are unavailable before 1998.
- No data about heat waves and frost days are available for the studied period. The Turkish Meteorological Station measures the all related parameters (such as temperature, wind, moisture, precipitation etc.) in 325 stations in the country. If the heat wave and frost day are defined, the heat waves and frost days in a year can be calculated.
- No historical data about surface, ground and renewable fresh waters, as well as overlaps are available for the whole period.

Information gaps concerning Historical data for Energy:

- Although there are many CHP and bio-fuel production plants, they are not included separately in Energy Balance Tables.
- For all transport modes (road, rail, air and maritime), the energy use data are not broken down to passenger and freight.
- The output fuel data by type in Refining Process is not public due to national interest, so it is unattainable.

3.11.3. Development of M/A scenarios and policy portfolios

3.11.3.1. Background

This section describes the research needs and gaps in Turkey, identified during the work on the report "Development and assessment of Mitigation / Adaptation Climate Change policy portfolios for Turkey", as well as during the attempts to develop additional scenarios, based on more optimistic and more pessimistic key assumptions.

3.11.3.2. Key assumptions

There are two different forecasts about the average annual rate of change of the Turkish population – the one published by the United Nations (United Nations, 2011) and the one published by TURKSAT. TURKSAT published a new population projection till 2050 at 2013. However, the projection does not include variants that can be used for different scenarios.

Similarly, there are forecasts for GDP growth –one by IMF (IMF, 2012) till 2017 and one by the Ministry of Development till 2017. A recent GDP growth forecast till 2050 is needed.

Although TURKSTAT published some historical information about GDP distribution per sector, there is no data available for sectorial growth projections and GDP distribution per sector. Therefore, a study on growth forecasts is needed for sectors with a meaningful aggregate level and the GDP distribution per sector with a long time horizon (preferably till 2050).

There is information about climate projection maps (temperature, precipitation etc.) in National Communication published in 2007. As Turkey has 3 main climate zones, projections are also different spatially. Also, the time series of projections are not available. Therefore, more detailed climate forecast is needed. In addition, it is recommended to estimate extreme events and water resources changes in future with climate forecasts.

Due to lack of detailed historical data for water use in households, agriculture, industry, and energy, future projections are also not available. An institutional structure needs to be established for collection and evaluation of the data.

3.11.3.3. Policies and measures

Turkey has many mitigation measures to reduce the amount of greenhouse gases till 2023. Therefore, it is recommended to develop measures in a long time horizon. The institutional structure needs to increase its capacity to monitor the amount of reductions.

Turkey has many targets for adaptation to climate change in Climate Change Adaptation Strategy. But, policy instruments should develop to reach these targets. In order to develop effective policies, specific studies on the impact of climate change on the water resource, agriculture, energy and forestry sectors are also needed. Ministry of Forestry and Water Affairs and Ministry of Environment and Urbanization have already started to projects related with adaptation.

3.11.3.4. Energy demand

Due to lack of activity data in many sectors, energy demand projections are based on GDP growth. GDP growth projections are available till 2017, so, this situation combined with the limited horizon of planned measures (until 2023) decreases the accuracy of energy demand projections. Detailed long-term projections for the energy demand are needed.

3.11.3.5. Energy transformation

A good knowledge on the energy capacities in the period is required for energy transformation modeling by 2050. Turkish Electricity Transmission Corporation (TEIAS) has generation capacity projection till 2020. This projection includes both fossil fuel based plants and renewable energy sources. Also, there are targets for nuclear and renewable till 2023 by Ministry of Energy and Natural Resources.

For energy modeling, transmission and distribution losses are also important, but no estimation for their levels till 2050.

3.11.4. Evaluation of M/A policy instruments

In Turkey there is no data for the emission reductions and costs of implementation of measures. Lack of data about effectiveness and equity of the policy measures is a gap in the scenario evaluation. Also, the effects of the measures are not monitored systematically.

Turkey has also many adaptation targets in the Strategy Document and Action Plans which were approved by the Government. But, there is no systematic numerical historical data (especially water use and water resources etc.) about adaptation measures, effectiveness of measures and sectorial costs of adaptation to climate change.

The policies related with climate change are determined by The Coordination Board on Climate Change re-established in 2004. The Climate Change Department of the Ministry of Environment and Urbanization is the chairmanship of the Board and all related ministries and institutions are included. The Climate Change Department has an e-library with relevant documents about climate change, but not organized in a manner to facilitate the user. In some case there was no English version.

There is limited published research work on mitigation and adaptation issues. Policy oriented research work was found mainly for renewable energy.

Finally, no research work was found on the evaluation of Turkish climate change policy mixtures or instruments.

3.12. Ukraine

3.12.1. Established national procedures, sources, available data and information about M/A policy

3.12.1.1. Inventory

Ministry of Ecology and natural resources of Ukraine is the main body in the system of central executive authorities in the formulation and implementation of national policy in the field of environmental protection, climate change, performance

of requirements within the competence of the UN Framework Convention on Climate Change and its Kyoto Protocol, etc. The Government body responsible for the development of the GHG inventory is the State Environmental Investment Agency of Ukraine (SEIA). Ukraine's inventory is generally in line with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance FCCC/ARR/2011/UKR for LULUCF and the ERT commends Ukraine for the improvements made since the last submission. According to UNFCCC expert review team Ukraine should (UNFCCC, 2012):

- continue to increase transparency across all aspects of the NIR, including the provision of more precise descriptions of methodologies that differ from those of the IPCC and to consider using tabular formats to streamline the presentation of information where appropriate;
- develop a consolidated inventory improvement plan that encompasses improvements beyond one year;
- more strictly apply the IPCC good practice guidance QA/QC methods to improve the consistency between the data reported in the NIR and the CRF tables;
- improve the accuracy of the key categories by updating country specific EFs or undertaking studies to develop country-specific EFs.

3.12.1.2. Reporting

Reporting is based on the national system for collection of data and background information on emissions and removals for the UNFCCC, the Kyoto Protocol and the EU Commission, which covers the archiving of the data used in emission estimations, the publishing of the results, participation in inventory reviews and the quality management of the inventory.

The key recommendations are that Ukraine:

- continue reporting the categories that were included in the revised estimates submitted during the review week in response to questions raised by the ERT;
- improve the timeliness of the annual submission by submitting the complete inventory (CRF tables and an NIR) by 15 April of each year;

3.12.1.3. Verification

In order to reduce errors and remove the main shortages of the Bulgarian system, the following are necessary:

- Better documentation and use of electronic links and automated procedures for data entry and storage of sources and references. Consistency with other reporting systems should be ensured as well;
- Standardisation of documentation and archiving;
- Introduction of alternative approaches for comparison of emissions;
- Develop a consolidated inventory improvement plan that encompasses improvements beyond one year; (UNFCCC, 2012).

- Serious approximations in the process of calculation of emissions because of the uncertainties due to unreliable allocation of hard fuels by categories.
- Efforts for reduction of errors and inaccuracies in the energy balances.

3.12.2. Historical M/A data

Information gaps concerning Historical data for Key assumptions:

- No data are available in climate statistics for frequency of extreme events (more specifically - heat waves per year, frost days per year) for any year in the studied period. As far as territory of Ukraine can be divided into four different climatic regions: cool snow forest climate, steppe climate, Mediterranean climate, and mountain tundra climate, calculation of the previously mentioned parameters is almost impossible. All the climate statistics in Ukraine collected by Central Geophysical Observatory.
- No data are available for GDP Deflator with the reference year 2009 for the whole studied period.
- No data are available for the manufacturing value added for all the industrial sectors. The lack of data applies to the whole studied period. The State Statistic Service of Ukraine (SSSU) has available the primary data needed to calculate the added value for all the sectors.
- No data are available for the volume of water for cooling in energy water use for any year in the studied period. State Statistical Service of Ukraine is responsible for all statistical data and should include this indicator to the list.

Information gaps concerning Historical data for Energy Demand

- No energy demand cost data are collected for the any sector of the Ukrainian economy (Households, Agriculture, Services, Industry, and Non-Energy Use) and their sub-sectors. This applies to the whole studied period. This indicator could be calculated for all the sectors mentioned above based on the data provided by energy companies and SSSU.
- There are no available data for energy demand, consumption and costs, final energy intensity for the particular Service sub-sectors, such as Tourism and Health Services. This applies to the whole period 1990-2010. These sectors are included by SSSU to a common branch “Other”.
- In Transport sector, the energy demand data in each type of transport (Road, Rail, Air, and Water) is available, but it is not further broken down into Passenger transport and Freight transport. This applies to the whole studied period.
- There are no data for final energy intensity and demand cost (including per fuel) for all Transport subsectors.

Information gaps concerning Historical data for Energy Transformation:

- All financial data required in this section of the database are not available. In particular, there is no available data about the capital costs, Fixed O&M

costs, variable O&M costs, and Salvage Value of the energy capacities in the Transformation branches.

- There are no data about the Maximum Availability, Capacity Credit, and Process Efficiency of any Transformation process.
- There are no available data for import and export targets for all transformation branches for the whole studied period.
- No data for potential, efficiency and raw losses available for all transformation branches. This applies to the whole studied period. This data available only at the individual energy production companies.

General information gaps:

- Ukrainian statistic reports have different structure, branches and content compared to Eurostat. Only 3 energy balances (years 2009-2011) published by SSSU respond to the requirements of the Eurostat.
- Most data (such as branches and sub-branches of energy demand, transformation and production) for the period of 1990-2000 is not available that is why all calculations done using data form year 2000. Because of a different statistic collecting system previously mentioned data were collected and provided by IEA.

3.12.3. Development of M/A scenarios and policy portfolios

3.12.3.1. Non-energy data and information

Concerning demographics, there are forecasts of the United Nations (United Nations, 2010), but no Ukrainian documents or government projections were found on this issue. Ukrainian scientist and government should pay more attention to this issue, as far as average annual rate of change of the population has negative direction.

There are 12 different forecasts for GDP growth from European and Ukrainian sources. For scenario development projections made by International Monetary Fund were used. Time horizon of these IMF projections is only till 2017. Therefore, a recent GDP growth forecast till 2050 is needed as far as none of these scenarios have forecasts for such a long period. The latest forecasted year is 2020 (3rd,4th,5th NC Ukraine, 2009). As for the climate forecasts by 2050, there is no information available for both precipitation and temperature in the Ukrainian and international sources. No forecasts for the frequency of extreme events and water resources have been found. Therefore, additional research efforts on climate forecast are needed.

In the field of water use in households, agriculture, industry, and energy by 2050, there are only regional forecasts with different geographical coverage (Europe, Eastern Europe, South-Eastern Europe, etc.) and these cover only a part of the data needed to assess the adaptation needs within each scenario. No studies about Ukraine in this issue have been found.

In the field of climate change adaptation, there is almost no specific information. Ukraine has only project of the National action plan on climate change adaptation to the period till 2020 (NAP 2020 project, 2011) that includes neither any concrete projections of adaptation objectives nor planned measures, only activities. There are almost no specific assessments on the impact of climate change on the agriculture,

forestry, and energy sectors in Ukraine; these assessments are rather general. More studies in this field are needed, in order to design appropriate adaptation policies.

3.12.3.2. Energy demand

The total energy demand in BAU scenario is easily estimated, as it is proportionate to the GDP in all Ukrainian sectors of economy. However, this estimation is much more complicated in OPT and PES scenarios, as the effect of specific mitigation/adaptation measures has to be added. The effect of the currently planned policy objectives is estimated only by 2030 (according to Energy Strategy of Ukraine till 2030), but not beyond 2030. Additionally, it is very likely that more stringent policy objectives and policies are enforced after 2030 (e.g. in relation to new EU initiatives and national policies), but no such information is currently available.

Another important point in energy demand modeling is the fuel mix used in each sector. There are no exact plans for shares of renewable energies in the national balance. Projections presented in the Energy strategy of Ukraine till 2030 and Updated Energy strategy of Ukraine till 2030 according to the comments of national stakeholders do not correspond to the real situation in the country. Other national documents provide only a small piece of the necessary information and comprehensive research is needed to provide a reasonable estimate of the share of each fuel in each sector of the economy until 2050.

3.12.3.3. Energy transformation

The energy transformation modeling by 2050 is very important study for Ukraine that requires good knowledge on the energy capacities in the period. There are no plans and estimations of the energy capacities by 2050 in Ukraine. Most of the Ukrainian power plants and energy equipment are outdated. There is no information about the expected year of phasing out the existing nuclear power plant. More studies in this field are needed

Transmission and Distribution losses are another factor influencing the energy balance, but no estimation for their levels beyond 2030 (Energy Strategy of Ukraine till 2030) has been found.

Furthermore, the scenario input data include efficiency levels, capacity credit, maximum availability, and other technical parameters of each type of energy production capacity used in the country. These values are neither available for the base year (2010) nor studies for their future development in the country have been found.

3.12.4. Evaluation of M/A policy instruments

There is no specific information about how major economic sectors would be affected by climate change in terms of financial costs and benefits and competitiveness. Additionally the Ukrainian Government does not provide specific (i.e. quantitative) information about any planned climate change adaptation measures (including ones related to water management, forest management, and agriculture). For none of the measures there is information about the expected policy set-up, environmental effect, socio-economic effect, and cost to the Government. It would be helpful, if the Ministry of Ecology and Natural Resources develops both studies about

the climate change impact on economy and policy plans with specific adaptation measures.

There are no assessments of what are the Government's and society's financial costs and revenues of implementing the current climate change mitigation policy. Additionally, there are no such estimations about the planned mitigation policy. Both for the current and planned mitigation policies, cost estimations can be made by the responsible ministries for the respective policies in their domains. No information is available about the effectiveness and the equity (distributional effects) of the currently enforced mitigation policies in the country.

Most of the web-sites of the pertinent authorities did not have an English version to facilitate foreign visitors. Even in the Ukrainian version the relevant information about mitigation/adaptation issues was limited and expressed in terms that did not coincided with those used internationally creating difficulties in understanding.

Policy oriented research work on climate change mitigation and adaptation issues was not found.

The Ukrainian team was not familiarized with the Multi-Criteria Decision Analysis methods and encountered strong difficulties in conducting the evaluation.

4. Conclusions

This report describes the research needs and gaps encountered during the work on Promitheas-4 project, in relation to the development and evaluation of mitigation and adaptation policy portfolios in Albania, Armenia, Azerbaijan, Bulgaria, Estonia, Kazakhstan, Moldova, Russia, Romania, Serbia, Turkey, and Ukraine.

The report covers: the national GHG inventory, reporting and verification; availability of historical data; availability of M/A policy modelling tools; development of M/A policy scenarios, and the evaluation of these scenarios.

In the field of **GHG inventory, reporting and verification**, the needs could be summarized as follows:

- Strengthening of institutional, legal and procedural arrangements, as well as the capacity and coordination of participating bodies
- Improving the transparency of the inventory and data consistency
- In non-Annex I countries, the regulatory framework concerning organisational, administrative and informational issues needs improvement, energy balance data need to become more reliable and complete, and the standard Eurostat NACE codes need to be implemented.
- Improving the completeness of reporting.
- Quality assurance (QA), quality control (QC), and verification activities need to be enhanced, by setting-up sustainable MRV system
- Using electronic links and automated procedures for data entry and storage of sources and references, further automation of the emission calculation
- Improvement and enrichment of the capacity of national statistics
- Research on development of country specific emission factors

Concerning the **historical data**, the most important needs are as follows:

- To integrate data about frequency of extreme events, availability and use of water resources, land management, and added value of industrial sub-sectors into the national statistical system.
- To make available energy demand data, both in energy and financial units, not only for each sector of economy (transport, industry, services), but also for their sub-sectors.
- To make available economic and technical data about energy capacities

In the field of **M/A policy modelling tools**, the main research needs are the following:

- Adaptation policies and their effects on the economy and the environment are not directly integrated in the models, so their integration is needed.
- Some energy models reflect well the situation in more developed countries but need to be adapted to the characteristics of economies in transition.

- Tools need to better reflect the economic functions, such as utility, agents' time horizon, heterogeneous demand structure, discounting rate, and consideration of environmental costs and benefits.

The **development of M/A policy scenarios** faced several barriers related to the availability of information for the dynamics of the independent scenario variables. In this context, the main research needs are as follows:

- Development of a long-term (e.g. by 2050) national GDP forecasts, considering how the GDP share of each sector and sub-sector is expected to evolve over time.
- Development of reliable long-term climate forecasts, possibly in scenarios, depending on the anthropogenic GHG emissions. While temperature and precipitation forecasts need only to become more precise, other forecasts (extreme events, water resources, etc.) are missing in almost all countries.
- Assessment of the effects (energy, emissions, costs) of the current and planned M/A policies.
- Development of energy demand forecasts by 2050, broken down per sector / sub-sector and per fuel consumed in each sector / sub-sector. These forecasts include assessment of the energy efficiency potential and renewable energy potential.
- Development of long-term forecasts for the energy transformation capacities, including constructing new and phasing-out of existing capacities, expected cost and technical parameters (efficiency, availability, etc.) of each type of capacity.
- Assessment of the climate change effects on each of the vulnerable sectors, identification of the adaptation needs, and design of policies and measures to address these needs.

Finally, the main research needs in the field **of evaluation of M/A policy scenarios** are the following:

- Ex-ante evaluation of policies, including feasibility of implementation and effects on the environment, costs, competitiveness, equity, etc. (a similar need was identified in the development of M/A scenarios – see above).
- Establishment of policy monitoring and evaluation procedures to better understand the performance of the already implemented policies; publication of the monitoring and evaluation results.

It is important to identify the **funding programmes** that could support the aforementioned research. The available programmes funding relevant research actions in the 12 project beneficiary countries have been extensively reviewed in the Promitheas-4 report "Overview of EU and international funding programs for supporting research and knowledge transfer" (Radulov L., 2001). Below some examples of appropriate international funding programmes supporting the identified research needs are provided:

- Horizon 2020 is the EU Framework Programme for Research and Innovation running from 2014 to 2020. It is the main instrument funding research in EU. Environment protection, including climate change, is one of the priority directions of the programme. The concrete programme priorities will be published on 1st January 2014.
- The thematic programme for Environment and Sustainable Management of Natural Resources including Energy under the Development Co-operation Instrument promotes the Community's environmental and energy policies abroad. It funds both adaptation and mitigation policy measures, including strengthening the policy-making capacity in the field of sustainable energy.
- ENPI's "Twinning Initiative" aims to contribute to the development of modern and efficient administrations by funding cooperation between the EU and the Newly Independent States in Eastern Europe and Mediterranean for implementation of the EU legislation.
- The Instrument for Pre-accession Assistance (IPA) supports the EU candidate and potential candidate countries to better comply with EU standards. IPA provides support to many areas: institution building and collaboration among stakeholders; cross-border cooperation, human resources development, and others.
- South East Europe Transnational Cooperation Programme (SEE), funded mainly by ERDF, provides support to numerous types of transnational cooperation action, including capacity building in the field of environment policies, cooperation among countries and within the countries to address environmental problems.
- The Special Climate Change Fund (SCCF), under UNFCCC, finances a wide variety of actions related to adaptation of non-Annex I parties.
- The Least Developed Countries Fund supports projects that meet the specific needs of developing nations. This includes preparing and implementing National Adaptation Programs of Action, which aim is to identify "urgent and immediate needs" of each LDC.
- GEF's Small Grant Programme (SGP) supports the development, sharing, and promotion of community-level strategies and implement technologies that could reduce threats to the global environment.
- European Economic Area (EEA) Grants 2009-14 and Norway Grants finance climate change research under Priority sector "Environmental and Climate Change related Research and Technology"
- USAID's climate change funding focuses on institutional and human capacity building, scientific and technological advances, economic growth, improving governance and business management, and creating the legal and regulatory environments needed to address climate change in developing countries.

Further details (participating countries, eligible measures, etc.) about these and other programmes are available in the abovementioned report (Radulov L., 2011).

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