
United Nations Development Programme

Government of the Republic of Belarus

Final Evaluation of UNDP/GEF Project: Belarus: Biomass Energy
for Heating and Hot Water Supply
(Project BYE/03/G31)

Final Evaluation Report

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ABBREVIATIONS

APR	Annual Progress Report
BIES	Belinvestenergoberezhnie (State Energy Investment Enterprise)
BY	Belarus
CEE	Committee of Energy Efficiency
CHP	Combined Heat and Power
DEE	Department of Energy Efficiency (formerly CEE)
EE/EC	Energy Efficiency/Energy Conservation
ESCO	Energy Service Company
EU	European Union
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographic Information System
GoB	Government of Belarus
IRR	Internal Rate of Return
JI	Joint Implementation (Kyoto Flexible Mechanism)
KPI	Key Performance Indicator
M&E	Monitoring and Evaluation
MoE	Ministry of Economy
MoF	Ministry of Forestry
MoHPU	Ministry of Housing and Public Utilities
MoNREP	Ministry of Natural Resources and Environmental Protection
MTE	Mid-Term Evaluation
MTce	Million tonnes of coal equivalent
MToe	Million tonnes of oil equivalent
PDF	Project Development Facility
PIR	Project Implementation Report
PMU	Project Management Unit
RE	Renewable Energy
RF	Revolving Fund
RFP	Request for Proposal
RUE	Republican Unitary Enterprise
SC	Steering Committee
SOE	State Owned Enterprise
ST	Study Tour
TA	Technical Assistance
UNDP	United Nations Development Programme
USD	United States dollar

EXECUTIVE SUMMARY

Background

In 2005, Belarus had a power-generating capacity of 7,800 MW generating 30.96 TWh of electricity, with natural gas-fired power plants accounting for 90%, oil-fired plants accounting for 9%, and hydropower and wood waste for the remaining 1%¹³. Approximately 26% of the electricity demand is met through the import of electricity from Lithuania and Russia, another source of hard-currency expenses for the government of Belarus¹⁴.

Belarus has limited indigenous energy resources and is, therefore, heavily dependent on imports of primary energy fuels, mainly from Russia. Energy imports from Russia are purchased in part with hard currency providing the current government very strong economic and political incentives to reduce energy consumption. In 2005, net imports accounted for 86% of Belarus' total primary energy consumption.

Russia's recent actions, however, to introduce market-based prices for its energy exports to the CIS countries have raised concerns for the Government of Belarus (GoB). Their actions have served as warnings of the likelihood that Russian preferential energy prices to Belarus would be phased out.

Since the 1990s, the Government of Belarus has recognized the importance of reducing its historically excessive dependence on energy imports from Russia and the need for action to strengthen its energy security. This has been reflected in a number of GoB programs that outline government strategy and develop concrete action plans to modernize the energy sector, improve energy efficiency, and increase the use of domestic energy resources.

A top priority of the GoB was to develop wood biomass as a domestic energy source as it is abundant in Belarus, covering 38% of the country. The annual increase in wood resource is estimated to be 25 million compressed cubic meters. Logging activities predominantly from harvesting, forest management have yielded an estimated 10 million cubic meters per year in 2002 with increases anticipated from year to year. These corresponding increases in the amount of wood-waste were expected to provide necessary fuel supplies to support a national program that increases the domestic energy generation, replacing imported natural gas and heavy oil. There are currently about 6,000 boiler houses (between 0.3 and 10 MW) in Belarus, a significant portion of which can be converted to biomass.

In 2002 prior to the commencement of the Project, the GoB faced a number of challenges related to increasing domestic biomass energy generation:

- Lack of incentives for enterprise managers to convert to biomass fuel. These managers had relied on financing from government grants to maintain hot water

¹³ International Energy Agency energy profile for Belarus:

http://www.iea.org/Textbase/stats/countryresults.asp?COUNTRY_CODE=BY

¹⁴ World Bank, Infrastructure Department Europe and Central Asia Region, "Belarus: Addressing Challenges Facing the Energy Sector", http://siteresources.worldbank.org/BELARUSEXTN/Resources/BelarusEnergyReview_July2006-full.pdf

and heating. Government grants were provided to enterprises irrespective of their fiscal performance;

- Selection from competitive bidding of least-cost boiler technologies, and not those that provided the best thermal efficiency;
- Lack of a developed market for foreign technologies that were viewed as being more efficient; and
- Lack of fiscal resources to finance the government's intended goals of increased domestic biomass energy generation.

The UNDP-GEF Project “Belarus: Biomass Energy for Heating and Hot Water Supply” was commenced in 2003 with the **development goal to reduce GHG emissions of Belarus by removing barriers to economically feasible wood and wood waste utilization for heat, hot water and power supply.**

To achieve this goal, the Project was designed with a number of barrier-removal **objectives**:

- Objective 1: Strengthen institutional capacity to support biomass energy projects;
- Objective 2: Establish a track record for investments in sustainable biomass energy projects, including both fuel supply and demand. This would include developing demonstration sites using specific technologies (foreign or domestic) that incinerate firewood for heat and power generation, as well as advanced technologies to collect and process logging waste to supply wood fuel to the boiler plants;
- Objective 3: Develop straightforward financial “starter” mechanisms in a challenging investment climate that will allow continued financing for biomass energy projects. This would include the formation of a revolving fund mechanism to support biomass financing needs for the next 21 years; and
- Objective 4: Overcome negative perceptions of biomass energy and provide public and private investors with much-needed market information.

The expected **results** for the Project include:

- Substantial progress towards elimination of barriers to widespread use of wood waste for fuel in Belarus;
- Six investment projects (5 demand side and one supply side) being implemented;
- Replication mechanisms in place through awareness-raising activities, investment-friendly policies and the availability of decision making tools and finances through a revolving fund;
- Close working relationship with an institute as an exit strategy after the completion of the project;

Context and Purpose of the Evaluation

For all UNDP projects funded by GEF, a final evaluation (FE) is required after completion of a project to provide a comprehensive and systematic account of the performance of the completed project by evaluating its design, process of implementation and achievements vis-à-vis GEF project objectives and any agreed changes during project implementation. As such, the FE for this Project will serve to:

- promote accountability and transparency, and to assess and disclose levels of project accomplishments;
- synthesize lessons that may help improve the selection, design and implementation of future GEF activities;
- provide feedback on issues that are recurrent across the portfolio and need attention, and on improvements regarding previously identified issues; and,
- contribute to the GEF Evaluation Office databases for aggregation, analysis and reporting on effectiveness of GEF operations in achieving global environmental benefits and on the quality of monitoring and evaluation across the GEF system.

Assessment of Project Outcomes and Sustainability

The overall rating of the Project results is S (satisfactory). This is based on the Project achieving all of its intended outcomes including strengthening institutional capacity to support the development of biomass energy projects in Belarus, demonstrating biomass supply and demand-side projects, setting up of a revolving fund to finance biomass energy projects and raising awareness of biomass energy projects in Belarus.

The overall Project sustainability is rated at ML (moderately likely). This is primarily based on post-project funding not being in place (for the twinning arrangement (Outcome 1), management of the mobile missions unit (Outcome 6), management of the GIS (Outcome 7), and management of the Belarus biomass website (Outcome 1)), and the revolving fund needing to be operational under the September 2008 revised charter that incorporates international best practices (Outcome16).

The sustainability of the development of biomass energy projects will be enhanced by the efforts by the GoB to generate revenue from the carbon market through JI and IET.

Assessment of specific Project outcomes and sustainability are summarized in Table A.

Table A: Summary Assessment of Project Outcomes and Sustainability

Project Objectives	Intended Outcomes (from project planning matrix in ProDoc and "Indicators" in the 2008 PIR)	Project Outcome Assessment (Rel=Relevance, Eff=Effectiveness Efy=Efficiency Ov=Overall Rating)	Sustainability Assessment	Actual Outcomes (as of October 2008)
Global Environmental Objectives: Reduce GHG emissions and fossil fuel consumption	<u>Intended GHG Outcome:</u> CO ₂ emissions are reduced by an accumulated total of 720,000 tonnes at the sites up to 2015 (10 years) and 1.08 million tonnes in 15 years	Rel – HS Eff – HS Efy – HS Ov – HS	Likely	<u>Actual GHG Outcome: CO₂ reductions are forecast to be 693,000 tonnes up to the Year 2015 (10 years) and 1.116 million tonnes to the Year 2020 (15 years) for demonstration projects</u> <ul style="list-style-type: none"> The impact of this outcome is very positive and provides an excellent basis for sustained decreases in GHG emissions and fossil fuel consumption in Belarus
Immediate Objective Sustainable use of biomass as an energy source is promoted and increased in Belarus	<u>Intended Outcome 1:</u> By the end of the project the biomass used per year for district heating is increased by 280,000 m ³ of wood chips (loose) or 35,000 tonnes coal equivalent	Rel – HS Eff – HS Efy – S Ov – HS	Likely	<u>Actual Outcome 1: Increased use of wood biomass for district heating.</u> <ul style="list-style-type: none"> Over 310,000 m³ of biomass was used annually in the four demonstration projects in Uzda, Mosty, Vileika and Orekhovsk, meeting the 280,000 m³ target.
	<u>Intended Outcome 2:</u> By the end of the project, 5 demand sites are operating clean and efficient biomass district heating units, and 1 fuel supply delivery mechanism is being successfully demonstrated	Rel – HS Eff – HS Efy – S Ov – S	Likely	<u>Actual Outcome 2: Four demand sites are operating clean and efficient biomass district heating units with one fuel delivery mechanism being successfully demonstrated.</u> .

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	<u>Intended Outcome 3:</u> By the end of the project, the Government is in a position to identify the most cost-effective boiler conversion sites and biomass fuel delivery mechanisms and has developed a plan for implementation	Rel – HS Eff – HS Efy – S Ov - HS	Likely	<u>Actual Outcome 3:</u> GoB is able to identify the most cost effective conversion sites and fuel delivery mechanisms through their databases of boiler sites, and have developed a national plan for implementation: <ul style="list-style-type: none"> • A national implementation plan was approved by the DEE in 2007 • The plan is supported by committed funding of over USD 80 million in 2007 from the budget and innovation funds.
	<u>Intended Outcome 4:</u> By the end of the project, the Government has allocated additional funding to the conversion of boilers to biomass fuels (EE Department Funding only)	Rel – HS Eff – HS Efy – HS Ov - HS	Likely	<u>Actual Outcome 4:</u> Additional funding of USD 5.95 million was allocated by the DEE during the 2004-2008 period for Project investment sites to make up for the higher investment costs than originally projected in the approved project document, and to the Revolving Fund to match GEF's contribution
Objective 1: Strengthen institutional capacity to support biomass energy projects	<u>Intended Outcome 5:</u> By the end of month 6, a twinning arrangement (TA) has been established and is functioning	Rel – S Eff – HS Efy – HS Ov - HS	Moderately Likely	<u>Actual Outcome 5:</u> A twinning arrangement between BIES and LEV (Austria) was established in 2005: <ul style="list-style-type: none"> • This arrangement can be closely linked to the improvement of knowledge in Belarus on biomass energy projects with all Project stakeholders, and to a large extent, the high quality of

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				<p>demonstration projects in Belarus</p> <ul style="list-style-type: none"> • Importance of this twinning arrangement diminished due to presence of other foreign companies and institutes supporting foreign biomass energy investment such as. Germany, Austria, Sweden, Finland, Lithuania, and Latvia. • Funding for post-project assistance not yet identified.
	<p><u>Intended Outcome 6:</u> The national capacity to monitor boiler emissions and measure wood fuel quality will be increased by the end of year 3</p>	<p>Rel – HS Eff – S Efy – MS Ov - S</p>	<p>Likely</p>	<p><u>Actual Outcome 6: A modern mobile emissions monitoring facility has been equipped with modern equipment.</u></p> <ul style="list-style-type: none"> • The foreign monitoring equipment has been purchased and certified in Belarus, providing the DEE with the necessary equipment to monitor emissions from biomass projects including PM_{2.5}, PM₁₀, NO_x, SO_x, and CO, as well as testing fuel stock for calorific values; • BIES has been tasked with managing and maintaining this equipment. Accreditation of laboratory equipment is underway with the Standardization Committee for official use of equipment

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				in Belarus
	<u>Intended Outcome 7</u> : By the end of year 3, a GIS system with relevant biomass planning data is functioning	Rel – HS Eff – HS Efy – S Ov – HS	Moderately Likely	<u>Actual Outcome 7: A GIS system for planning of biomass conversion projects was established in Year 4:</u> <ul style="list-style-type: none"> The DEE has been appointed for promotion of biomass use with BIES responsible for further GIS update and joint use with the DEE for biomass resources planning. Contractual arrangements between BIES and the GIS caretaker have not yet been completed
	<u>Intended Outcome 8</u> : By the end of the project, a concrete and realistic plan for continuation and scaling up results is developed and disseminated, and next steps identified	Rel – HS Eff – HS Efy – HS Ov – HS	Likely	<u>Actual Outcome 8: A national plan for scaling up of biomass has been drafted and disseminated amongst stakeholders in December 2006, and approved by the DEE in October 2007:</u> <ul style="list-style-type: none"> Plans for scaling up are contained in the "National Plan (Strategy) for Ensuring Sustainable Development and Efficient Use of Wood Fuel for Energy Supply (Heat and Electricity Production) in the Republic of Belarus for 2006-2012"
Objective 2: Establish a track record for investments in sustainable biomass	<u>Intended Outcome 9</u> : By the end of year 4, five demand-side projects are operating as designed	Rel – HS Eff – S Efy – S	Likely	<u>Actual Outcome 9: Four demand-side investment projects are operating as designed.:</u>

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		Ov - HS		<ul style="list-style-type: none"> • Three of the demo projects are related to heat and power generation; • Fourth demo project on heat generation only; • All demonstration projects are serving as model operations for future biomass projects and training platforms to demonstrate best practices for planning, design, construction and operations of such projects • Fifth investment was not implemented due to request for withdrawal by site owner (Radon health facility) that had been approved by the Project Steering Committee). However, the impact of the four demand-side demonstration projects has met expectations of the Project
	<p><u>Intended Outcome 10</u>: Total fuel savings, from all 5 projects of approximately 35,000 tonnes coal equivalent per year and emission reductions of 72,000 tonnes per year is achieved from year 4</p>	<p>Rel – HS Eff – S Efy – MS Ov - S</p>	Likely	<p><u>Actual Outcome 10</u>: Fuel savings from four demonstration projects is 26,536 tce with annual emissions of 60,743 tonnes CO₂eq.</p> <ul style="list-style-type: none"> • Late start-up of three out of the four the demonstration projects in Year 4 with only one of the demonstration projects, Volat-1, having been in operation for over 2 years since 2004. • CO₂ reduction targets in the Prodoc would have been attained if the

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				demonstration projects had been started earlier. Projected fuel savings and emission reductions for 2008 are 35,100 tce and 72,300 tonnes respectively
	<u>Intended Outcome 11</u> : By the end of year 3, the 'biomass fuel supply' project is operating efficiently and cost effectively according to design parameters	Rel – HS Eff – MS Efy - S Ov - S	Moderately Likely	<u>Actual Outcome 11: In Year 4, a biomass fuel supply project is operating efficiently in Vileika:</u> <ul style="list-style-type: none"> The State forestry enterprise "Vileiskiy Leskhoz" has catalyzed the growth in the number of suppliers to the Vileika CHP to three as the market for wood chip grows Vileiskiy Leskhoz is not viable solely as a wood chip supplier to a CHP due to government set low prices of wood chips. To sustain the enterprise, VL sells wood chips at higher prices to other buyers in Lithuania.
	<u>Intended Outcome 12</u> : Reduction in long-term fuel preparation and delivery costs for the wood harvesting company of over 20% as a result of the techniques implemented in the project	Rel – HS Eff – HS Efy – S Ov - HS	Likely	<u>Actual Outcome 12: Actual costs for wood fuel preparations have been reduced by 30 to 50% depending on the wood harvesting technology</u> <ul style="list-style-type: none"> The Project provided technical assistance to identify the appropriate equipment to supply wood chips including the locally made "Amkodor"

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				wood chipping machine for BelGRES, and the German made "Jenz Hem 420" chipping machine for the Vileiskiy Leskhoz.
Objective 3: Develop straightforward financial "starter" mechanisms in a challenging investment climate that will allow continued financing for biomass energy projects	<u>Intended Outcome 13:</u> Investment briefs on 5 to 10 replication projects are available in the second half of year 3 of the project	Rel – HS Eff – HS Efy – S Ov - HS	Likely	<u>Actual Outcome 13: Investment briefs for 12 projects were available at the end of the Project</u> <ul style="list-style-type: none"> Investment briefs prepared by Belarusian Thermal Engineering Institute. Quality of briefs adequate for obtaining finance
	<u>Intended Outcome 14:</u> Non-DEE funding sources for the replication projects identified and expressions of interest received from the relevant organizations	Rel – HS Eff – HS Efy – HS Ov - HS	Likely	<u>Actual Outcome 14: Non-DEE funding sources for replication projects has been identified including:</u> <ul style="list-style-type: none"> equity finance for Pinskdrev CHP (USD 4.5 million) several other projects for RF funding in in the pipeline including Petrikov CHP (USD 4.2 million equity finance) and Pruzhany CHP (USD\$12 million from a Finnish bank)
	<u>Intended Outcome 15:</u> The government will leverage a certain percentage of its current funding for energy projects through the revolving fund mechanism	Rel – HS Eff – S Efy – S Ov - S	Likely	<u>Actual Outcome 15: The Government of Belarus has transferred USD 1.54 million to match the GEF revolving loan funds:</u> <ul style="list-style-type: none"> First tranche was transferred in 2006 (USD 0.84 million); Second tranche transferred in November 2007 (USD 0.70 million)

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				near the completion of the Project
	<u>Intended Outcome 16</u> : The revolving fund will be established and will be operating effectively by the end of the project.	Rel – HS Eff – MS Efy – MS Ov – MS	Moderately Likely	<u>Actual Outcome 16</u> : <i>A revolving fund has been established that has a charter incorporating international best practices for revolving funds:</i> <ul style="list-style-type: none"> • NEFCO assisted with new charter in September 2008 • Charter amendments removed many of the concerns raised by previous evaluations of the RF. • NEFCO have formally expressed their interest in co-financing biomass projects with the RF. This would raise the prospects of a sustained RF for 21 years. • Future BIES operations of the RF will require technical assistance to manage the fund to international best practices.
Objective 4 : Overcome negative perceptions of biomass energy and provide public and private investors with much-needed market information	<u>Intended Outcome 17</u> : Surveys at the end of Years 2 and 4 on participants in the study tours (ST) via reports and questionnaires show growing interest in the use of biomass in Belarus	Rel – HS Eff – HS Efy – HS Ov – HS	Likely	<u>Actual Outcome 17</u> : <i>Surveys in Years 2 and 4 of the Project indicated excellent reviews of the study tours and positive impressions of opportunities in biomass energy development</i> <ul style="list-style-type: none"> • The study tours targeted senior to mid-level policy makers and were essential in overcoming technical barriers and in facilitating knowledge transfers from

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				biomass projects in developed countries <ul style="list-style-type: none"> • A survey of participants confirmed that the study tours had a significant impact on their knowledge of biomass energy development • There will be a sustained interest in biomass in Belarus based on the catalytic impact of study tours
	<u>Intended Outcome 18:</u> Information leaflets, brochures and videos are published and distributed to target audiences each year	Rel – HS Eff – HS Efy – HS Ov - HS	Likely	<u>Actual Outcome 18:</u> <i>A number of brochures, leaflets and guidebooks have been published and disseminated through the Project's website.</i> <ul style="list-style-type: none"> • There has been a steady stream of publications since 2004 being made available to all stakeholders on the Project website • All published material available on the Project website (www.bioenergy.by) providing all stakeholders with easy access to information; • Funding in place for post-project publications.
	<u>Intended Outcome 19:</u> The project is mentioned at the Council of Ministers (CoM) at least 3 times a year, and regularly in the press	Rel – HS Eff – HS Efy – HS Ov - HS	Likely	<u>Actual Outcome 19:</u> <i>Since its Inception, the Project has been mentioned to the Council of Ministers on a consistent basis</i> <ul style="list-style-type: none"> • The Project Director regularly attends meetings with the Council of Ministers,

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				<p>and has been able to regularly communicate on the progress of the Project,</p> <ul style="list-style-type: none"> • NPD uses the Project effectively to develop recommendations for the GoB towards its goals of increasing the share of biomass generation in Belarus
	<p><u>Intended Outcome 20</u>: By the end of the project, demand for biomass boiler installations has increased</p>	<p>Rel – HS Eff – HS Efy – HS Ov - HS</p>	<p>Likely</p>	<p><u>Actual Outcome 20</u>: <i>There has been a remarkable increase in the number of biomass fired units in Belarus since 2004</i></p> <ul style="list-style-type: none"> • Over 350 small and medium-sized biomass fired units (average size of 1.2 MW) were built under a MoHPU modernization program during the 2006 - 2007 period at a cost of USD 30 million • In 2007, one large-size and 390 small and medium-size boilers were converted to biomass
<p><i>Overall Project Rating</i></p>		<p>S</p>	<p>Moderately Likely</p>	

Replicability or Catalytic Role of Project

This Project deserves significant credit for catalyzing the development of biomass energy projects for hot water, heating and power generation in Belarus:

- The completion and operation of the Volat-1 project demonstrated to many stakeholders in 2005 that domestically available biomass was a viable fuel alternative for Belarus. Furthermore, Volat-1 demonstrated that modern boiler technologies can be successfully implemented in Belarus through the inputs of foreign institutions and companies;
- The Vileika Leskhoz project provided a successful demonstration of setting up and operating a wood fuel supply service to a CHP project, in particular, the Vileika CHP demonstration project. This fuel supply demonstration catalyzed the formation of more than 10 similar wood chip supply units in Belarus; the Vileika experience was recognised at the Government level as excellent exemplary demonstration of biomass supply and combustion technologies and was recommended for replication within Belarus;
- The Project's technical assistance to the Ministry of Housing and Public Utilities (MoHPU) on the design and selection of energy efficient boilers was catalytic in the rapid expansion of their program since 2005 totalling over 350 MoHPU boiler houses throughout Belarus. The energy savings and CO₂ emissions reductions from this assistance are significant;
- The Project's role in the setup of a revolving fund has catalyzed the interest of a foreign institute, NEFCO, in providing financing instruments for the development of biomass energy projects.

M&E During Project Implementation

The 2003 Prodoc contains a reasonably detailed M&E plan that was considered acceptable for that time. Since 2003, GEFs M&E requirements have become more specific with the independence of the GEF Monitoring and Evaluation Unit that reports directly to GEF Council. The main reporting tool for this Project was a combined APR/PIR report.

While these reports provided clear and concise reports of Project progress and issues, there were subtle changes in reporting from year to year on the indicators for project objectives. These changes were made necessary due to a need to simplify and reduce the number of indicators, and to retrofit the log-frame to GEF changes to "outcome" reporting.

Improvements that could have been made to the Project's M&E system include:

- Consistent format for reporting project performance with the correct usage of terms "indicators", "outcomes" and "outputs" in the Project log-frame. Log-frame can be an effective tool for monitoring project progress;

- The inputs of an M&E specialist. While Project performance did not suffer from poor M&E reports, M&E reporting quality would have been more consistent with the inputs of an M&E specialist on the PMU.

Ratings of the Project's Monitoring and Evaluation system are as follows:

- *Quality of M&E design – Moderately Satisfactory.* This is mainly due to the fact system was designed in 2003;
- *Quality of M&E implementation – Satisfactory.*

The Project has also generated data related to increases in the numbers of biomass boiler houses and CHP projects, contributing to the development of a long term monitoring system. Due to the strong drivenness of the Government of Belarus on this Project to reduce its dependence on imported fossil fuels, the monitoring system is housed within BIES to complement their other activities that include:

- management of the RF and other accounts that finance renewable energy developments and energy efficiency initiatives;
- energy audits and feasibility studies;
- development of PINs and PDD for JI projects; and
- GIS and its databases on boiler houses that are continually updated. This would include all biomass projects with or without RF financing.

Assessment of Processes Affecting Attainment of Project Results

Preparation and Readiness:

The Project designs from the PDF B Phase were well prepared, comprehensive and easy to understand. The roles and responsibilities of all government institutions were clear with counterpart funding and enabling legislation to meet project objectives.

Country Ownership and Drivenness:

To a significant extent, Project results have been attained with strong ownership and drivenness of the Belarusian government. Evidence supporting this includes:

- Issuance of a number of Government decrees;
- the GoB maintaining its financial commitment by transferring government funds (USD 1.54 million) in 2006 and 2007 to match the GEF contribution to the RF; and
- approval by President (Decree #575 dated 15.11.2007) of "State Integrated Program of Modernization of Belarusian Energy System Generation Facilities, Energy Efficiency and Increase of Share of Domestic Fuel and Energy Resources Use till 2011". This document charts the government strategy into developing biomass energy projects after the completion of the Project.

Stakeholder Involvement:

With Belarus having a centrally planned economy, stakeholder involvement of relevant government personnel has been a key to the success of the Project. This included MoNREP, MoF, MoE, DEE, MoHPU, CoM and a number of stakeholders from private enterprises and relevant technical institutes throughout Belarus who were consulted throughout the development and implementation of the Project. These efforts were sustained throughout the entire duration of the Project with workshops and informal meetings concluding with the final Project Workshop of April 2008.

The Project also consulted with a number project proponents in Uzda, Mosty, Vileika and Orekhovsk, many of whom seemed to be well entrenched into their communities. Project involvement in these regions has provided beneficiary communities with reliable sources hot water and heating using local wood biomass as a fuel. This has indirectly led to community economic benefits such as steady employment, community centers for recreation and sport, and greenhouses for fresh produce.

Financial Planning:

Overall financial controls of the Project were adequate. Expenditures until the end of April 2008 were just over USD 3.0 million.

Management of the budget has been satisfactory in achieving the Project objectives. The revolving fund has been utilized, notwithstanding the decreased value of the US dollar, to provide financing for the 5 demonstration projects. The aforementioned rising costs have been offset by government grants and an increase in project proponent equity. This has been reflected in the Project exceeding its co-financing objectives by a factor of nearly 4.0 from 2003 estimates.

Supervision and Backstopping by UNDP:

Review of the Project APRs/PIRs reveals satisfactory supervision and backstopping efforts by UNDP Belarus and the UNDP-GEF Regional office in Bratislava. UNDP deserves significant credit for the successfully setup of the revolving fund. The establishment of the RF was delayed until Year 3 (2006) of the Project, and sustainability issues were not resolved until the end of the Project in September 2008 due to continued stakeholders' consultations over the ultimate arrangement of the Revolving Fund. The sustained attention by UNDP throughout the Project duration was critical in resolving the Project RF financing issues

Co-Financing, Delays and Project Outcomes and Sustainability:

The Project exceeded its co-financing objectives by a factor of nearly 4.0 from 2003 estimates. The co-financing has had a direct effect on achieving the intended Project outcomes and spurring sustained growth of biomass energy projects in Belarus. The Project has also contributed to attracting foreign investments and foreign suppliers with modern equipment to the Belarus market. The infusion of foreign funds from NEFCO

into the Belarusian biomass energy sector should further contribute to its sustained growth.

Project delays were experienced in the implementation of the demonstrations. The Project, however, has done well to overcome these delays related to last minute changes to the location of two original demonstration projects, and late delivery of a Russian-sourced steam turbine.

Lessons Learned

- Project success was based on relevance to national goals and government policy and strong government support at all levels of government. This Project received strong support from the Prime Minister's office to the Council of Ministers due to the acute need for foreign experience to facilitate urgently needed bioenergy project investments. As such, the Project benefited from this support to be able to achieve most of its objectives and intended outcomes.
- Demonstration sites programs are best implemented in increasing order of complexity. The Volat-1 demonstration was the least complex of the demonstration projects with only a heating and hot water component, and was implemented within an 8-month period in 2004. This provided the required quick response by the Project to demonstrate the viability of biomass energy projects in Belarus. In hindsight, if the Project had started with the Mostovdrev CHP, delays would have been experienced in the delivery of the steam turbine, possibly changing the perception of implementing biomass projects. Depending on the country, a poor demonstration can adversely impact the rate of adoption of a new technology;
- Project implementers need to manage the expectations of stakeholders in terms of realistic time periods on realizing benefits from GEF financing instruments. In the case of this Project, two years were required from the PDF B Phase to transfer GEF funds for financing a demonstration project. The two years would have involved the approval of the full project, Inception Mission and then project implementation to setup the Project's revolving fund. As such, Project implementers should be familiar with the approval process for the use of GEF financing instruments, and provide the stakeholder with the option of seeking another source of project financing. This was the case with the Vileika Stroidetali demonstration site where the site owner completed boiler conversions to biomass before the arrival of the GEF funds;
- Project implementation success is dependent on the stability of the government stakeholders involved with the Project. Top level decision makers and key technical specialists who took part in first study tour were dedicated to biomass production and related transportation issues. Many of these study tour participants are still involved today with biomass projects. In comparison, similar projects in other countries have not had the successes of this Project due to the frequent movement of government officers within their civil service. As a consequence of these movements, corporate memory of their project activities is lost within a short period of time, and project resources are used to familiarize

new officers with the project;

- Introduction of a new financial mechanism such as a revolving fund requires detailed and thorough preparations including existing legislation of host country on revolving funds and regulations governing sustainable use of the RF. While the experience of other countries in the setup of an RF may be useful, it cannot replace the effort required to understand host country legalities and nuances that ensure the outcome of a functional RF;
- Probabilities of project success are enhanced with additional sources of funding. In the case of this Project, the devalued US dollar and the doubling of the cost of equipment, construction materials and labour since project commencement, were threats to achieving original project objectives of 6 demonstration projects:
 - shortfalls in Project accounts were guaranteed by government who raised their planned contribution of USD 2.1 million to USD 5.8 million USD;
 - site owners raised their equity from USD 3.37 million to an estimated USD 13.0 million;
 - successful Project outcomes have garnered the interest of the NEFCO (Nordic Environmental Finance Corporation) to co-finance biomass energy projects with revolving fund.

Recommendations

Recommendations to assist the GEF and future designers of similar projects include:

- Greater scrutiny over project preparations should be made as these greatly affect the outcomes of projects: realistic schedules, absorptive capacities of stakeholders. These project preparation reviews should be done by qualified personnel from the Country Office;
- Future projects incorporating revolving funds or other GEF non-grant instruments new to the country should place the appropriate efforts in understanding the legal nuances of the host country and merging international best practices with local practices to increase the probabilities of an outcome of a functional RF. Effort should be invested early in a project or during project preparations to better assess these details.

Recommendations specific to this Project include:

- Operate the RF under the NEFCO-revised charter of September 2008 with fund replenishment being guaranteed by the Department of Energy Efficiency. Important reasons for this recommendation includes:
 - The NEFCO-revised charter provides measures reducing the risk of RF depletion through set interest rates and loan terms, systems for evaluating borrowers and defined procedures and penalties for defaulters. However, as the RF policy is to keep interest rates lower than commercial rates, fund replenishment by DEE would need to be

guaranteed to maintain the original fund levels of USD 1.54 million. While this does not promote growth of capital within the fund, this mechanism would assure that the fund does not decline over a 21-year period;

- *It would positively respond to NEFCO's offer to cooperate and even co-finance biomass energy and other clean energy production projects.* This would provide Belarus with an alternative source of funding for biomass conversions from a foreign donor.

- *Explore and implement strategies to increase the reliance of project stakeholders on financing biomass energy projects through the RF.* Currently, the proportion of RF finance to other sources of financing is in the order of 5% to 25% for biomass energy projects. Presumably, project proponents are financing through funds with lower interest rates or even grants. The GoB with NEFCO or other foreign institutes should explore the feasibility of additional incentives that would make RF funds more competitive with other funding source. One of these incentives may be the lowering of interest rates in compensation for the generation of carbon credits from ERUs or VERs. Discussions with NEFCO (who have setup a carbon finance unit) will be required to determine the significance of ERUs or VER credits and the extent of interest rate reduction;

- BIES should seek technical assistance to manage their RF under the new charter. Technical assistance would be required to enable fund managers to use Project-purchased software to evaluate creditworthiness; to strengthen RF management on best practices for lending and collection of loans; build capacity for clear and segregated financial RF accounting; legal analysis; and train staff to ensure repayments and manage other fund management issues.

1. INTRODUCTION

This report summarizes the findings of the Final Evaluation Mission conducted during the June 23 – July 4 2008 period for “Belarus: Biomass for Hot Water and Heating Supply” (herein referred to as the “Project”) implemented by the United Nations Development Program (UNDP), Project Code BYE/03/G31 and with financing support from the Global Environment Facility (GEF). The Project Document (Prodoc) provides details to remove key barriers to the increased utilization of local biomass resources for local energy supplies. Project activities include:

- Strengthening institutional capacity to support biomass projects;
- Establishing a track record for investments in sustainable biomass projects that includes both supply and fuel demand;
- Developing financial mechanisms that will facilitate the development of biomass projects; and
- Overcoming negative perceptions of biomass energy through the provision of biomass market information to private investors and the public.

1.1 Background

1.1.1 Overview of Belarus and Its Economy

Belarus, which borders Poland to the west, Russia to the east, Ukraine to the south, and Latvia and Lithuania to the north, has limited indigenous energy resources and is therefore highly dependent on imports. Natural resources are limited, and, apart from small deposits of natural gas, oil and peat, its most important natural resource are the forests that cover 38% of the country. Winters are cold and summers are cool and moist, and there is a great need for heating during the winter months. The country is divided into 6 oblasts (districts), and one municipality (consisting of the capital Minsk).

Belarus was one of the Soviet Union's major industrial regions specializing in the production of machinery and equipment. Although these industries have declined significantly in scale since independence from the USSR in 1991, heavy industry and manufacturing continue to make an important contribution to the economy. Moreover, Belarus has retained close political and economic ties with Russia, signing a treaty on a two-state union that envisions greater political and economic integration. Belarus was severely impacted economically from the 1998 financial crisis in Russia but has been recovering with a GDP growth of 6% in 2000 to 10.4% in the first half of 2008. The industrial sector continued to be the source of this growth, at 10.3% in 1999, 8% in 2000, and 9.9% in 2006¹⁵. Factors that have supported the healthy growth of the Belarusian economy include:

- significantly improved external environment for Belarus exports both to Russia and the EU (especially since 2001) and strengthened domestic demand;
- recent improvements in labor productivity, energy efficiency, and capacity utilization;

¹⁵ Belarusian government website: http://www.government.by/en/eng_analytics291.html

- government investments in housing construction and preferential financing of state-supported sectors and enterprises;
- Russian subsidies in form of preferential energy prices charged to Belarus for gas, crude oil, and electricity imported from Russia;
- Provision of affordable, reliable, and sufficient energy to the national economy by the energy sector over the past decade.

1.1.2 Overview of the Belarus Energy Sector

In 2005, Belarus had a power-generating capacity of 7,800¹⁶ MW generating 30.96 TWh of electricity, with natural gas-fired power plants accounting for 90%, oil-fired plants accounting for 9%, and hydropower and wood waste for the remaining 1%. Approximately 26% of the electricity demand is now met through the import of electricity from Lithuania and Russia, another source of hard-currency expenses for the government of Belarus.

Currently, Belarus has limited indigenous energy resources and is, therefore, heavily dependent on imports of primary energy fuels, mainly from Russia. Energy imports from Russia are purchased in part for hard currency providing the current government very strong economic and political incentives to reduce energy consumption. In 2005, net imports accounted for 86% of Belarus' total primary energy consumption.

Belarus does enjoys a strategic location between Russia and the European Union allowing it to play a key role as a transit route for oil and gas exports from Russia to EU markets. Belarus is also able to convert crude oil supplied from Russia into refined product exports. One of the benefits Belarus received from this transiting arrangement was lower prices for gas from Russia as the fuel is not subject to export duties due to a Russian-Belarusian Union agreement.

Russia's recent actions to introduce market-based prices for its energy exports to the CIS countries have raised concerns for the Government of Belarus (GoB). Their actions have served as warnings of the likelihood that Russian subsidies to Belarus for energy commodities would be phased out.

1.1.3 Biomass Energy in Belarus

Since the 1990s, the Government of Belarus has recognized the importance of reducing its historically excessive dependence on energy imports from Russia and the need for action to strengthen its energy security. This has been reflected in a number of GoB programs that outline government strategy and develop concrete action plans to modernize the energy sector, improve energy efficiency, and increase the use of domestic energy resources.

A top priority of the GoB has been to develop wood biomass as a domestic energy source as it is abundant in Belarus, covering 38% of the country. The annual increase in wood resource is estimated to be 25 million compressed cubic meters¹⁷. Logging

¹⁶ International Energy Agency energy profile for Belarus:

http://www.iea.org/Textbase/stats/countryresults.asp?COUNTRY_CODE=BY

¹⁷ The Prodoc specifically mentions the exclusion of the forests near Chernobyl. As a result of the Chernobyl catastrophe in 1986, economic activity on 36,000 hectares of forests was banned due to the high degree of contamination. This area of forest,

activities predominantly from harvesting, forest management have yielded an estimated 10 million cubic meters per year in 2002 with increases anticipated from year to year. With these anticipated increases, corresponding increases in the amount of wood-waste were expected to provide necessary fuel supplies to support a national program that increases the domestic energy generation, replacing imported natural gas and heavy oil.

In 2005, Belarus used 32,000 million terajoules (TJ) of wood and wood waste for fuel. The majority of this is for residential households (23,000 TJ), a lesser amount is used in small boiler houses (7,000 TJ) and the remainder is used within the wood processing industries (in the form of offcuts and sawdust).

In 2002, Belarus had approximately 2,000 boiler houses sized from 0.5 to 10MW and fired by fossil fuel that were technically and economically suitable for conversion to wood biomass. These conversions would consume approximately 6 million cubic meters of wood-waste and displace imported fossil fuels from Russia. Further evaluation through the Project's GIS shows the actual number of boiler houses (between 0,3 and 10 MW) for conversion is higher and represents a significant part of 6,000 boiler houses available.

Harvesting of wood is mainly done by "Lespromhozes" which belong to the "Bellesbumprom", a state owned forestry enterprise. Almost all wood residues produced during harvesting and forest thinning are left in the forest, and are frequently burned directly in the forest. A main source of waste wood is the Belarussian Wood and Paper Concern ("Bellesbumprom"), which covers about 40% of all wood processed in Belarus. The main wood processing and logging Concern's "Bellesbumprom" activities are carried out in 58 large enterprises spread over the entire Republic, but concentrated in the Minsk and Gomel oblasts. In 2000, 540 thousand out of 780 thousand cubic metres of wood waste were used (330 thousand m³ used for production of wood chipboards, fibre boards, and 210 thousand m³ as fuel for boilers) leaving 240 thousand m³ unused. Sawdust was only used as fuel at 6 enterprises; at other enterprises, it is landfilled, where it generates GHG emissions, or given to farmers for use as floor covering in animal enclosures or supplied for alcohol production.

Other supply lines for fuel wood in Belarus include the "Oblast Fuel Enterprise", with one situated in each oblast ("Obltop"). Every "Obltop" manages approximately 20 "Raitop" or "Gortop", located in regional centres. These regional fuel enterprises are operated both by the regional administration and by the corresponding "Obltop". Regional fuel enterprises have 1 or 2 teams of workers that harvest wood and transport fuel wood to end users (i.e. general population, commercial and state institutions). There are approximately 120 regional enterprises that supply 450 thousand m³ of compressed wood (in the form of logs), comprising 10% of total firewood consumption (about 4,200 thousand m³ of compressed wood in year 2000.). "Obltop" and "Raitop" are also responsible for supplying peat and coal. The Obltop, on a tender basis, purchases coal and the supplier then delivers coal to each Raitop. The Raitop is responsible for selling this coal to end users in their region.

however, represents less than 1% of the country's total forest cover. The planned volume of uncontaminated wood cut for 2001 was 10.8 million cubic meters made up of 5.8 million cubic metres as timber for export or processing, and 5 million cubic meters as firewood in logs.

There are also 88 Forest Enterprises (“Leskhoz”) operated by the Ministry of Forestry, involved with both harvesting and thinning of forests; harvesting occupies only about 10% of their business and the rest is from thinning. Each Leskhoz supplies fuel wood usually in the form of logs.

1.2 Government Initiatives Supporting Biomass Energy

Prior to the commencement of the Project, Belarus had undertaken a number of institutional and policy changes to implement its goals of reducing its dependence on imported energy sources:

- ⇒ In 1993, the government established a State Committee on Energy Efficiency and Control in 1993, renamed in 2001 as the Committee on Energy Efficiency, and again in 2006 to its current name, Department of Energy Efficiency (DEE). The mandate of DEE tasks is to:
 - promote state policy in the efficient use of fuel and energy resources;
 - develop technical regulations, standardisation of energy consuming technologies used in Belarus, supervise the production of energy consuming and energy producing equipment to state standards, and establish regulations dedicated to efficient use of fuel and energy resources;
 - take part in state supervision of detailed technical design both for new construction and modernisation of existing sites to become more energy efficiency;
 - provide state supervision for the efficient use of fuel and energy resources
 - provide oversight for the state program of energy savings in regions, districts, cities, towns, municipalities and enterprises;
 - establish necessary financial and legal measures to support projects in energy saving;
 - introduce renewable energy sources;
 - provide information to support energy saving initiatives; and
 - institute a system of training and continuing staff education.

DEE has seven subsidiary enterprises and six engineering consulting companies. The DEE is now under the State Committee for Standardization who reports directly to the Council of Ministers;

- ⇒ A special inter-agency Committee of Experts was created in 1998 by a Decree of the Council of Ministers to promote energy efficiency and co-ordinate efficient use of local energy sources, including wood and wood waste. This committee is headed by the chairman of the DEE and includes members of all key sectoral ministries, regional departments, scientific institutions and state enterprises;
- ⇒ Between 1996 and 2000, USD 370 million was invested in energy saving activities under the National Programme on Energy Saving. The bulk of this investment was on the installation of metering devices, design of new energy saving materials and technologies, boiler rehabilitation, and replacement of old heat boilers with more efficient ones, all to reduce fossil fuel consumption;

- ⇒ The DEE has been carrying out educational, awareness raising and research projects related to the promotion of domestic renewable energy generation, energy efficiency and energy saving;
- ⇒ The GoB has been setting targets to increase generation of at least 25% of electricity and heat from local fuels and alternative energy sources in Belarus up to 2012 (approved by Ordinance 1680 of the Council of Ministers of the Republic of Belarus on December 30, 2004). Much of this would be met by developing wood biomass in a sustainable manner throughout Belarus.

1.2.1 Improvements for Attracting Foreign Investment

Belarus currently maintains features of a planned economy with the government controlling key factors of production and economic decisions. Although inflation was rapidly decreasing from 251% in 1999 to approximately 100% in 2000 to around 22% in 2003, other investment barriers in Belarus in 2003 remained¹⁸ including:

- A relatively high tax burden used by government to support certain companies and employment as well as social programmes;
- Uncertainty over the protection of property rights and an unfavourable business environment that only served to increase business development costs;

Belarus has recognized the need to attract foreign expertise and technologies to meet national goals of increasing biomass fuel usage for heat and energy generation. Changes were required to gradually reduce direct government participation, strengthen market-based approaches to boost investor confidence, and move towards a legal and regulatory basis more suitable for a competitive market structure. Since 2004, GoB has responded with a number of measures to attract foreign investments including:

- A Presidential Order to make Belarus more attractive for foreign investors;
- Raising awareness of GoB officers to be more supportive of foreign resources to assist in biomass development;
- Official recognition of the need for foreign technology investments Through the “State Integrated Program of Modernization of Belarusian Energy System Generation Facilities and Increase of Domestic Fuel and Energy Resources Use, 2006-2010” (approved by President’s Decree #399 dated August 25, 2005);
- Selective engagement policies to bring in foreign investors; and
- Drafting of annual Presidential Decrees for exempting import duties on specialized equipment including biomass-fired boilers.

¹⁸ Belarus: In-Depth Review of the Investment Climate and Market Structure in the Energy Sector, Energy Charter Secretariat, 2007, http://www.encharter.org/fileadmin/user_upload/document/Belarus_ICMS_2007_ENG.pdf

1.2.2 Assistance of the Donor Community

Other donor agencies that have provided support for GoB initiatives for developing biomass energy and energy efficiency include:

- ⇒ *The United Nations Economic Commission for Europe (UNECE)*. UNECE were a strong and long-term supporter of this Project and played an important part in encouraging Belarus' ratification of the UNFCCC in 2000. The UNECE was also instrumental in the development of this Project as well as the Energy Efficiency 21 Project, which aims to assist Belarus in meeting international environmental treaty obligations under the UNFCCC through the development of energy efficiency investment projects;
- ⇒ *World Bank*. The "Social Infrastructure Retrofitting Project" (BY-7056) was started in 2002. To date, the project had invested approximately USD 7 million for boiler replacement or conversion from oil and coal to gas and wood fuel (about 30 small size units). Recently, the project was extended until 2010 with an additional USD 7.5 million targeted for conversion of small and medium sized boiler houses to biomass. This project also provided technical assistance in analysing tariffs and subsidies and developing recommendations for change.

1.2.3 Issues Prior to Commencement of Project

In 2002 prior to the commencement of the Project, the Government of Belarus were faced with a number of challenges related to increasing domestic biomass energy generation¹⁹:

- Lack of incentives for enterprise managers to convert to biomass fuel. These managers had relied on financing from government grants to maintain hot water and heating. Government grants were provided to enterprises irrespective of their fiscal performance;
- Selection resulting from the competitive bidding process of least-cost boiler technologies, and not those that provided the best thermal efficiency;
- Lack of a developed market for foreign technologies that were viewed as being more efficient; and
- Lack of fiscal resources to finance the government's intended goals of increased domestic biomass energy generation.

These were the primary issues that provided the initial impetus for the formation of the Project.

¹⁹ Personal communication with Viktor Fedoseev, Project Expert and former Deputy Chairman of the Committee of Energy Efficiency in 2000 – 2004.

1.3 Project Objectives and Expected Results

The development **goal** in 2003 of the UNDP-GEF Project “Belarus: Biomass Energy for Heating and Hot Water Supply” was to reduce GHG emissions of Belarus by removing barriers to economically feasible wood and wood waste utilization for heat, hot water and power supply.

To achieve this goal, the Project was designed with a number of barrier-removal **objectives**:

- Objective 1: Strengthen institutional capacity to support biomass energy projects;
- Objective 2: Establish a track record for investments in sustainable biomass energy projects, including both fuel supply and demand. This would include developing demonstration sites using specific technologies (foreign or domestic) that incinerate firewood for heat and power generation, as well as advanced technologies to collect and process logging waste to supply wood fuel to the boiler plants;
- Objective 3: Develop straightforward financial “starter” mechanisms in a challenging investment climate that will allow continued financing for biomass energy projects. This would include the formation of a revolving fund mechanism that would support biomass financing needs for the next 21 years; and
- Objective 4: Overcome negative perceptions of biomass energy and provide public and private investors with much-needed market information.

The expected **results** for the Project include:

- Substantial progress towards elimination of barriers to widespread use of wood waste for fuel in Belarus;
- Six investment projects (five demand-side and one supply-side) being implemented;
- Replication mechanisms in place through awareness-raising activities, investment-friendly policies, the availability of decision making tools, and finances through a revolving fund;
- Close working relationship with an institute as an exit strategy after the completion of the project.

Section 2 provides the assessment on the achievements of project objectives and outcomes.

1.4 Final Evaluation

1.4.1 Purpose of the Evaluation

For all UNDP projects funded by GEF, a final evaluation (FE) is required after completion of a project to provide a comprehensive and systematic account of the performance of the completed project by evaluating its design, process of

implementation and achievements vis-à-vis GEF project objectives and any agreed changes during project implementation. As such, the FE for this Project will serve to:

- promote accountability and transparency, and to assess and disclose levels of project accomplishments;
- synthesize lessons that may help improve the selection, design and implementation of future GEF activities;
- provide feedback on issues that are recurrent across the portfolio and need attention, and on improvements regarding previously identified issues; and,
- contribute to the GEF Evaluation Office databases for aggregation, analysis and reporting on effectiveness of GEF operations in achieving global environmental benefits and on the quality of monitoring and evaluation across the GEF system.

This Final Evaluation was prepared to:

- ⇒ be undertaken independent of project management to ensure independent quality assurance;
- ⇒ apply UNDP norms and standards for evaluations;
- ⇒ assess achievements of outputs and outcomes, likelihood of the sustainability of outcomes; and if the project met the minimum M&E requirements;
- ⇒ report basic data of the evaluation and the project as well as provide lessons from the Project on broader applicability.

An evaluation team was fielded to Minsk for the 23 June – July 4 2008 period. The Terms of Reference (ToRs) for the Final Evaluation are contained in Appendix A.

1.4.2 Key Issues to be Addressed

Key issues addressed on this FE include:

- The appropriateness of the project concept and design in the context of the current events in Belarus;
- Implementation of the Project in the context of relevance, efficiency and effectiveness of the activities; and
- Project impacts based on current outputs and outcomes and the likelihood of sustaining project results.

1.4.3 Evaluation Methodology and Structure of the Evaluation

The methodology adopted for this evaluation includes:

- Review of project documentation (i.e. project documents, APRs, meeting minutes of Steering and Advisory Committees) and pertinent background information;
- Interviews with key project personnel including the Project Manager, technical advisors (domestic and international), demonstration project proponents, investors and relevant UNDP staff;
- Interview with relevant stakeholders from Government (e.g. Committee on Energy Efficiency, Ministry of Economy); and
- Field visits to selected project sites and interviews with beneficiaries.

A full list of documents reviewed and people interviewed is given in Annex B. A detailed itinerary of the Mission is shown in Appendix C. The Evaluation Mission for the UNDP-GEF project was comprised of one International Expert and one National Expert.

This evaluation report is presented as follows:

- An overview of project achievements from the commencement of operations in September 2003;
- An assessment of project results based on project objectives and outcomes through relevance, effectiveness and efficiency criteria;
- Assessment of sustainability of Project outcomes;
- Assessment of the replication or catalytic effect of the Project;
- Assessment of monitoring and evaluation systems;
- Assessment of progress that affected Project outcomes; and
- Lessons learned and recommendations.

This evaluation report is designed to meet GEF's "Guidelines for Implementing and Executing Agencies to Conduct Terminal Evaluations" of May 7, 2007:

[http://www.undp.org/gef/05/documents/me/Policies_and_Guidelines-Terminal Eval Guidelines.pdf](http://www.undp.org/gef/05/documents/me/Policies_and_Guidelines-Terminal_Eval_Guidelines.pdf)

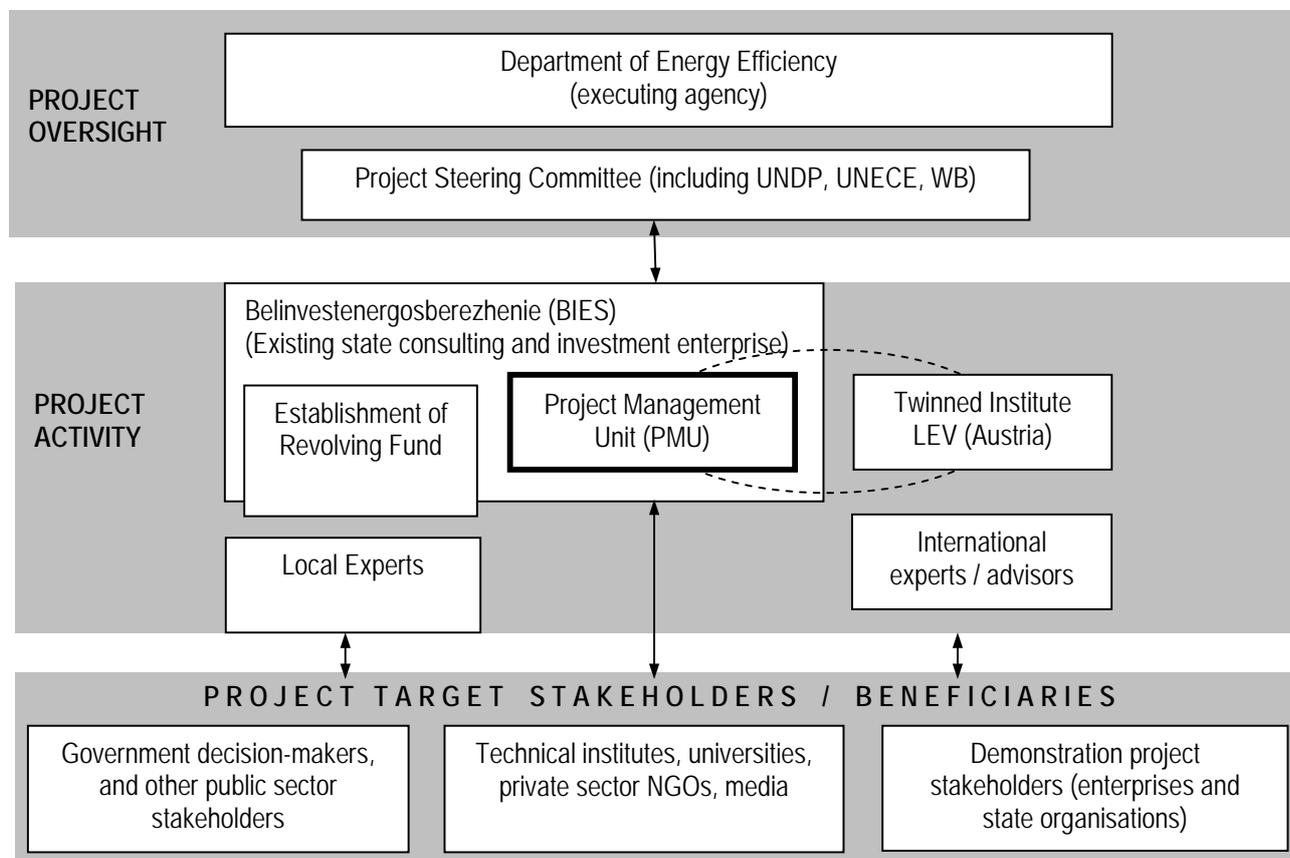
The Evaluation also meets conditions set by the UNDP Guideline for Evaluators, June 2002:

[http://www.undp.org/gef/05/documents/me/UNDP ME Handbook.pdf](http://www.undp.org/gef/05/documents/me/UNDP_ME_Handbook.pdf)

1.5 Project Implementation Arrangements

The project organization chart is shown on Figure 1. The original 2003 Project design allocated UNDP-GEF funds to provide for:

- development of institutional capacity through study tours, training, strategic planning, and the development and use of decision making tools;
- development of technical capacity through the development of demonstration projects for boiler house conversion to wood and wood supply;
- development of financial capacity through the development of pipeline projects and a functioning revolving fund;
- raising awareness of the Project amongst policy makers, stakeholders and the general public; and
- monitoring and evaluation support.

Figure 1: Project Organization Chart (modified from 2003 Prodoc)

The main stakeholders on the Project include:

- Council of Ministers;
- Department of Energy Efficiency and oblast branches;
- Ministry of Forestry;
- Ministry of Natural Resources and Environment;
- Ministry of Economy;
- Ministry of Housing and Public Utilities;
- Committee on State Control;
- State-owned energy company “Belenergo”;
- Representatives of Municipalities from the cities of Uzda, Mosty, Orekhovsk and Vileika;
- State-owned pulp and paper company “Bellesbumprom”; and
- Representatives of all potential investment sites.

The executing agency for this Project has been the Department of Energy Efficiency (DEE) of the Republic of Belarus. The DEE was created in 2006 from the Committee of Energy Efficiency. The DEE reports to the State Committee for Standardization subordinated directly to the Council of Ministers, and have worked closely with the

Ministry of Natural Resources and Environmental Protection, which is designated as the government implementing agency under the UNFCCC. The mandate of DEE is to promote energy efficiency and to monitor compliance with energy efficiency targets for national agencies, regions, districts, cities, towns, municipalities and enterprises. To support this mandate, they operate branches in each of the 6 oblasts throughout Belarus.

The Project Management Unit (PMU) was established within the state enterprise “Belinvestenergosberezhenie” (BIES). PMU functions included oversight management of all project activities including revolving fund activities established within BIES or a branch under the organisation under DEE’s supervision.

2. ASSESSMENT OF PROJECT RESULTS

Project results are assessed in this section against project objectives and outcomes. The assessment is based on relevance, effectiveness and efficiency criteria.

2.1 Overview of Project Achievements and Results

The Project has achieved all its objectives as set out in the Prodoc of 2003. Moreover, the Project has been instrumental in removing a significant number of barriers to biomass investments in Belarus. As a consequence, the Project has achieved a portion of its targets for GHG emission reductions, catalyzed further GHG reductions through financing biomass conversions from the revolving fund, and met a demand for technical assistance to project proponents.

Expected results for the Project (as stated in Section 1.3) or “intended Project outcomes” have been achieved including:

- Substantial progress towards barrier removal for widespread use of wood biomass for fuel in Belarus;
- Implementation of five biomass energy investment projects including one biomass supply-side demonstration project, and four demand-side (3 CHPs and one heat only) demonstration projects;
- Replication of biomass investment projects throughout Belarus with supporting mechanisms in place including awareness-raising activities, investment-friendly policies, and availability of decision making tools and finances through a revolving fund;
- A working relationship with an institute was established during the implementation of the Project. The existence of this working relationship after the completion of the Project, however, is uncertain.

2.2 Assessment of Project Results

Each outcome was evaluated against individual criterion of:

- *Relevance* – the extent to which the outcome is suited to local and national development priorities and organizational policies, including changes over time;
- *Effectiveness* – the extent to which an objective has been achieved or how likely it is to be achieved; and
- *Efficiency* – the extent to which results have been delivered with the least costly resources possible.

The Project outcomes were rated based on the following scale:

- *Highly Satisfactory (HS)*: The project has no shortcomings in the achievement of its objectives;
- *Satisfactory (S)*: The project has minor shortcomings in the achievement of its objectives;

- *Moderately Satisfactory (MS)*: The project has moderate shortcomings in the achievement of its objectives;
- *Moderately Unsatisfactory (MU)*: The project has significant shortcomings in the achievement of its objectives;
- *Unsatisfactory (U)*: The project has major shortcomings in the achievement of its objectives;
- *Highly Unsatisfactory (HU)*: The project has severe shortcomings in the achievement of its objectives.

In addition, the Evaluation team has provided an assessment (wherever appropriate) on Project impacts, positive or negative, and possible long-term effects of the outcomes or outputs.

2.2.1 Global Environmental Objectives: Reduce GHG Emissions and Fossil Fuel Consumption

Intended GHG Outcome:

⇒ CO₂ emissions are reduced by an accumulated total of 720,000 tonnes at the demonstration sites up to 2015 (10 years) and 1.08 million tonnes in 15 years

Actual GHG Outcome:

⇒ The forecast CO₂ emissions reductions are 693,000 tonnes up to 2015 (10 years) and 1.116 million tonnes up to 2020 (15 years)

Rating: relevance: HS
 effectiveness: HS
 efficiency: S
 overall rating: HS

The impact of this outcome is very positive and provides an excellent basis for sustained decreases in GHG emissions and fossil fuel consumption in Belarus.

GHG emission reduction impacts have been calculated for the Project on the basis of methodologies suggested by the “Manual for Calculating GHG Benefits of GEF Projects: Energy Efficiency and Renewable Energy Projects”, April 16, 2008, GEF/C.33/Inf.18²⁰. For actual GHG emissions for the Project including demonstration projects, two CDM Executive Board methodologies were used:

- ACM0006 for the Conversion of Biomass to Electricity (applicable to all demonstration projects except Volat-1); and
- ACM0036 for fuel switch from fossil fuels to biomass residues for boilers for heat generation.

²⁰ Available at:
[http://gefweb.org/uploadedFiles/Documents/Council_Documents__\(PDF_DOC\)/GEF_33/C.33.Inf.18%20Climate%20Manual.pdf](http://gefweb.org/uploadedFiles/Documents/Council_Documents__(PDF_DOC)/GEF_33/C.33.Inf.18%20Climate%20Manual.pdf)

Other important assumptions in the calculation of the Project's GHG reductions include:

- the GHG emissions factor of 0.546 tCO₂/MWh for the Belarusian electric grid²¹, 0.203 tCO₂/MWh for natural gas to biomass conversions, and 0.272 tCO₂/MWh for mazut to biomass conversions;
- service life of a biomass boiler and power generation unit being 20 years;
- a 10-year period (2005 to 2015) for revolving fund finance for direct post project emissions;
- a 10-year influence period after the 2008 completion of project as recommended by GEF guidelines. Hence, only GHG emissions up to and including 2018 were credited to GEF;
- The GEF causality factor for indirect GHG emission reductions at 0.8 given the Project is under the strong influence of a state-planned economy which has had a very strong and positive impact on catalyzing the growth of biomass energy in Belarus.

Table 1 summarizes these GHG reductions resulting from the Project.

Table 1: Summary of CO₂ Reductions Resulting from the Project

<i>Total direct emission reduction, t CO₂</i> ²²	101,210
<i>Total direct post-project emission reduction, t CO₂</i> ²³	2,125,335 4,014,602
<i>Indirect emission reduction, t CO₂</i> ²⁴	8,146,494
TOTAL EMISSION REDUCTIONS DUE TO UNDP-GEF PROJECT, t CO ₂	12,10,373,03 9

2.2.2 Immediate Objective: Sustained Use of Biomass is Promoted and Increased in Belarus

Intended Outcome 1:

⇒ By the end of the project the biomass used per year for district heating is increased to 280,000 m³ of wood chips (loose) or 35,000 tonnes coal equivalent

Actual Outcome 1:

⇒ Increased use of wood biomass for district heating. Over 155,065 m³ (loose) was used during the first half of 2008. Projected over the entire 2008, an estimated 310,000 m³ (loose) of biomass is likely to be used annually in the four demonstration projects in Uzda, Mosty, Vileika and Orekhovsk, meeting the 280,000 m³ target

²¹ Table 21 from Regional Guide for Baltic Sea Region "BASREC" on procedures of joint implementation, Institute on Energy Cooperation in the Region of Baltic Sea, 3d edition, 2007.

²² These GHG reductions from the demonstration projects operating to the end of the Project. GHG reductions on GEF spreadsheet are 339,242 tonnes and represent the GHG reductions had the demonstration projects been fully operational over the 5-year project period.

²³ These are GHG reductions generated from investments supported by the revolving funds that continue operating after the end of the project. The GEF default value for RF operation after the completion of the Project is 7 years. This was assumed in the GHG reduction calculation.

²⁴ A top-down approach assumed with a high causality factor (0.8) assumed due to centrally planned economy of Belarus and significant impacts from Project activities.

Rating: *relevance: HS*
 effectiveness: HS
 efficiency: S
 overall rating: HS

Intended Outcome 2:

⇒ By the end of the project, 5 demand sites are operating clean and efficient biomass district heating units, and one fuel delivery mechanism is being successfully demonstrated.

Actual Outcome 2:

⇒ Four demand sites are operating clean and efficient biomass district heating units with one fuel delivery mechanism being successfully demonstrated.

Rating: *relevance: HS*
 effectiveness: S
 efficiency: S
 overall rating: S

Figure 2 shows the location of the five demonstration projects:

- The Volat-1 site in Uzda (Site 3) is a demonstration of a heat and hot water plant in operation since October 2004;
- The State forestry enterprise "Vileiskiy Leskhoz" (Site 5) is a demonstration project that supplies wood chips to the Vileika demonstration CHP (Site 1);
- The Mostovdrev demonstration CHP in Mosty (Site 4); and
- BelGRES demonstration CHP in Orekhovsk (Site 2).

All demonstration projects (with the exception of Volat-1) started operations in 2007. Originally, 6 demonstration projects were planned. However, there were implementation issues with some of the original project sites including:

- Olekhnovichi poultry farm mini-CHP - poor management and financial issues;
- the biomass supply unit at JSC Molodechnoles - poor management and financial issues;
- Farinovo site (boiler house) - decision by the IKEA Corporation not to build a wood processing facility in Farinovo; and
- Vileika Stroidental - the company chose not to wait for the start of the Project, and instead, financed and implemented their own biomass boiler conversion.

Three of these demonstration sites were replaced with the Vileika CHP, Vileika Forestry Enterprise (in December 2004 by the Project Coordinating Committee) and the Mostovdrev CHP in Mosty.

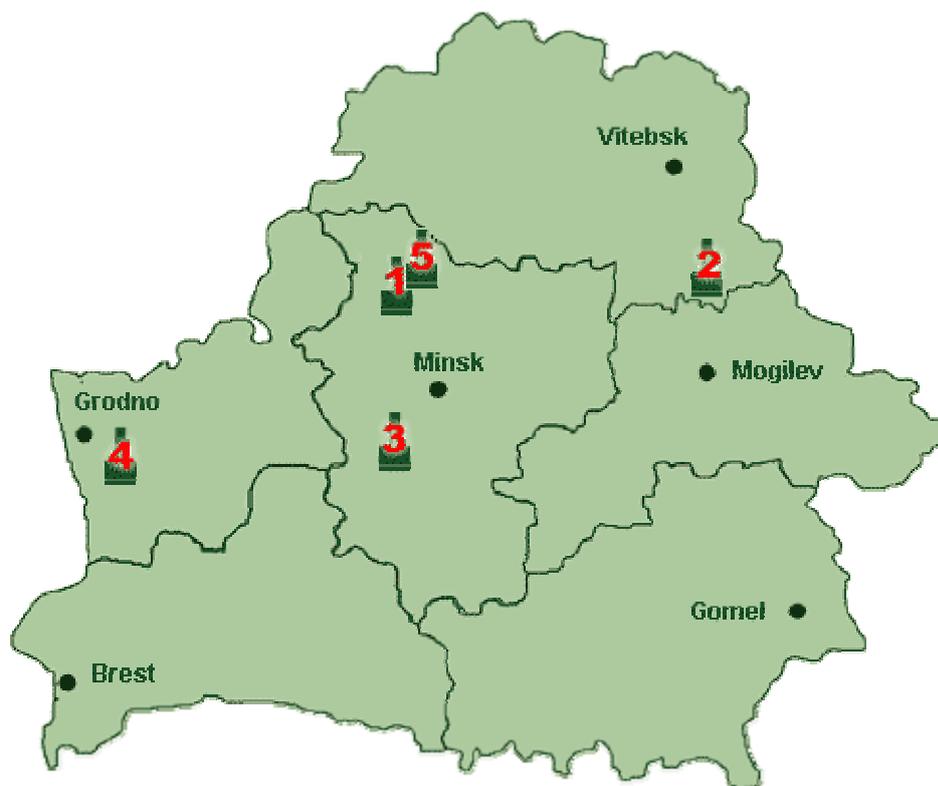


Figure 2: Location of Demonstration Projects

Intended Outcome 3:

⇒ By the end of the project, the Government is in a position to identify the most cost-effective boiler conversion sites and biomass fuel delivery mechanisms and has developed a plan for implementation.

Actual Outcome 3:

⇒ The Government of Belarus through its strong participation on technical knowledge transfers through the Project, is able to identify the most cost effective boiler conversion sites through databases and GIS developed by the Project. Moreover, they have a national plan in place to implement a large-scale program for biomass conversions in Belarus and with committed over USD 80 million in funding in 2007 for bioenergy projects from the budget and innovation funds.

Rating: relevance: HS
 effectiveness: HS
 efficiency: S
 overall rating: HS

The national plan is entitled “The National Plan (Strategy) for Ensuring Sustainable Development and Efficient Use of Wood Fuel for Energy Supply (Heat and Electricity

Production) in the Republic of Belarus for 2006-2012”, and was approved by the decision of the Board, Energy Efficiency Department of the State Committee on Standardization of the Republic of Belarus October 10, 2007, protocol Nr.4. This plan would be implemented through the “State Integrated Program of Modernization of Belarusian Energy System Generation Facilities and Increase of Domestic Fuel and Energy Resources Use, 2006-2010” which was approved by President’s Decree #399 dated August 25, 2005. The Program was updated and extended until 2011 and approved by President’s Decree #575 dated 15.11.2007.

Intended Outcome 4:

⇒ By the end of the project, the DEE has allocated additional funding to the conversion of boilers to biomass fuels.

Actual Outcome 4:

⇒ Additional funding of USD 5.95 million was allocated by the DEE (formerly the Committee for Energy Efficiency) over 2004-2008 period to Project investment sites to make up for the higher investment costs than originally projected in the approved project document, and to the Revolving Fund to match GEF’s contribution

Rating: relevance: HS
 effectiveness: HS
 efficiency: HS
 overall rating: HS

2.2.3 Objective 1: Strengthen Institutional Capacity

Intended Outcome 5:

⇒ By the end of month 6, a twinning arrangement (TA) has been established and is functioning.

Actual Outcome 5:

⇒ A twinning arrangement between BIES and LEV (Austria) has been established in 2005.

Rating: relevance: S
 effectiveness: HS
 efficiency: HS
 overall rating: HS

LEV (LandesEnergieVerein Steiermark) is an agency dedicated to the increasing energy efficiency and the use of domestic and renewable sources of energy through development of regional policies, environment protection and supporting long term effectiveness. The Agency is an interface between administration, policy, research and the energy consumers. Its activities comprise the technical and organizational support of energy projects, awareness raising (exhibitions, publications, conferences), training (expert training, promotion of research), European co-operation (participation in EU-

research and development projects), and energy counselling. A twinning arrangement was relevant to provide Belarus with the necessary linkages and networks to foreign expertise.

Since 2005 when the twinning arrangement was signed, LEV has provided valuable linkages with GoB personnel and Belarusian project proponents to biomass industry leaders in Europe. These contacts have led to contacts with a number of technical institutes, equipment suppliers and consulting engineers specializing in biomass energy projects. This outcome can be closely linked to the improvement of knowledge in Belarus on biomass energy projects with all Project stakeholders, and to a large extent, the high quality of demonstration projects in Belarus.

There has been increasing regional interest in Belarus' biomass program since the start of the Project in 2005 resulting from the presence of foreign equipment suppliers and technical expertise. This includes companies and expertise from Austria, Sweden, Finland, Germany and other regional countries. As such, the importance of the twinning arrangement envisaged at the commencement of the Project is somewhat diminished as a number of these countries have provided such expertise resulting from the study tours and to support the sale of foreign equipment such as boilers and wood chippers. In addition, the emergence of NEFCO as a financing partner will likely result in the development of a relationship with Belarus similar to that of LEV.

Intended Outcome 6:

⇒ The national capacity to monitor boiler emissions and measure wood fuel quality will be increased by the end of year 3.

Actual Outcome 6:

⇒ A modern mobile monitoring facility has been equipped with modern equipment.

Rating: *relevance:* *HS*
 effectiveness: *S*
 efficiency: *MS*
 overall rating: *S*

Certification of the foreign monitoring equipment has now been completed in Belarus, providing the DEE with the necessary equipment to monitor emissions from biomass projects including PM_{2.5}, PM₁₀, NO_x, SO_x, and CO, as well as testing fuel stock for calorific values. Equipment includes:

- The Gravimat isokinetic sampler that was used at Volat-1 and Mostovdrev sites for monitoring particulate emissions;
- Parr 6200 calorimeter to be used for providing calorific values of fuel stock to CHPs;
- The Testo-350 portable gas analyzer that was used for monitoring of CO, NO_x emissions from boilers at Volat-1 and Mostovdrev sites.

Country certification of the new equipment was completed in May 2008; hence, the Project has not had an opportunity to use this equipment to take stack emission

measurements on old and new boilers. The equipment has been transferred to BIES which has a separate unit specialised in energy audits and energy monitoring. Three specialists of this unit were trained to use this equipment, and were involved in its certification and measuring emissions at project demonstration sites.

Intended Outcome 7:

⇒ **By the end of year 3, a GIS system with relevant biomass planning data is functioning**

Actual Outcome 7:

⇒ *A GIS for planning of biomass conversion projects was established in Year 4*

*Rating: relevance: HS
 effectiveness: HS
 efficiency: S
 overall rating: HS*

The GIS provides key information to the DEE and other relevant government ministries for holistic planning and feasibility studies of biomass projects. This has improved institutional capacity to approve feasible projects and increase the use of domestic fuels. The GIS was formulated on a MapInfo platform with supporting technical data including forest resources, town locations, roads, forest enterprises, topography, and environmental information. Each of the 88 forest districts or subdivisions in Belarus are divided in to 1.0 ha blocks that allow the planner to optimize boiler locations with respect to fuel sources. A database containing more than 6,000 boiler house locations (classified as <0.5 MW and >0.5 MW) can be overlaid onto the GIS to determine wood types and wood waste available within a certain radius. The GIS is regularly updated with new data layers added whenever necessary.

The impact of the GIS has been significant. The DEE and other ministries have found the GIS to be highly effective in planning potential CHP projects. The DEE has been appointed for promotion of biomass use. The BIES will be responsible for further GIS update and use jointly with the DEE for biomass resources planning.

Intended Outcome 8:

⇒ **By the end of the project, a concrete and realistic plan for continuation and scaling up results is developed and disseminated, and next steps identified.**

Actual Outcome 8:

⇒ *A national plan for scaling up of biomass has been drafted and disseminated amongst stakeholders in December 2006, and approved by the DEE in October 2007*

*Rating: relevance: HS
 effectiveness: HS
 efficiency: HS
 overall rating: HS*

The strategy entitled “National Plan (Strategy) for Ensuring Sustainable Development and Efficient Use of Wood Fuel for Energy Supply (Heat and Electricity Production) in the Republic of Belarus for 2006-2012” is a thorough document that:

- provides an analysis of the current energy profile of Belarus;
- analyses current available wood reserves in Belarus;
- provides an overview of the strategy that calls for improvements to economic development in wood harvesting, improving legislation and regulatory frameworks, developing and improving financial mechanisms, reducing wood production costs through large-scale production lines, improving tariffs and policies, promotion of research and development to improve current practices, training, sustaining international cooperation, implementing Joint Implementation (JI) projects, and using GIS to ensure proper project designs;
- details a program of organizational and technical measures to promote increased use of wood biomass for fuel including a pipeline of biomass projects to 2012.

2.2.4 Objective 2: Establish Track Record for Sustainable Biomass Energy Investments

Intended Outcome 9:

⇒ By the end of year 4, five demand-side projects are operating as designed.

Actual Outcome 9:

⇒ Four demand-side investment projects are operating as designed

Rating: relevance: HS
 effectiveness: S
 efficiency: S
 overall rating: S

Three of the demo projects are related to heat and power generation (Mostovdrev CHP, Vileika CHP and BelGRES CHP) with one demo project on heat generation only (Volat-1). These four well-managed demonstration projects provide a good track record of implementation and are serving as model operations for future biomass projects and training platforms to demonstrate best practices for planning, design, construction and operations of such projects. The Project provided valuable technical assistance for the feasibility studies that assisted in the selection of cost effective and appropriate technologies. International Project experts provided technical oversight of these studies and technology selections. Lower ratings were given due to the fact only 4 out of 5 demand-side projects were implemented and that the 3 CHP demonstrations were not operational until Year 4 of the project. As such, there was less than one year to collect operational and GHG data on these projects.

Intended Outcome 10:

⇒ Total fuel savings, from all demonstration projects of approximately 35,000 tonnes coal equivalent per year and emission reductions of 72,000 tonnes per year is achieved from year 4.

Actual Outcome 10:

⇒ Fuel savings from four demonstration projects is 26,536 tce with annual emissions of 60,743 tonnes CO₂eq in Year 4

Rating: *relevance:* *HS*
 effectiveness: *S*
 efficiency: *MS*
 overall rating: *MS*

The fuel savings from the four demand-side projects are important in demonstrating that biomass energy projects are highly relevant in displacing imported fossil fuels. A satisfactory rating was given due to the late start-up of three of the four demonstration projects in Year 4; only one of the demonstration projects, Volat-1, has been in operation for over 2 years since 2004. CO₂ reduction targets in the Prodoc would have been attained if the demonstration projects had been started earlier. Their late completion date is the result of a cancellation of other CHP projects as detailed in Section 6.6. Project proponents, however, have been satisfied with the fuel savings of the demonstration projects. The feasibility studies for all demonstration projects were prepared using UNDP project resources (PMU, international and local consultants) to identify appropriate technologies and designs that would maximize fuel savings.

Intended Outcome 11:

⇒ By the end of year 3 the 'biomass fuel supply' project is operating efficiently and cost effectively according to design parameters.

Actual Outcome 11:

⇒ In Year 4, a biomass fuel supply project is operating efficiently and cost effectively in Vileika

Rating: *relevance:* *HS*
 effectiveness: *S*
 efficiency: *S*
 overall rating: *HS*

The State forestry enterprise "Vileiskiy Leskhoz" has provided a demonstration of a wood fuel supply chain operation in Belarus. The Project provided assistance in identifying the German made "Jenz Hem 420" chipping machine for the Vileiskiy Leskhoz. The demonstration of this type of enterprise appears to have catalyzed the growth in the number of wood chip suppliers to the Vileika CHP; there are now three wood chip suppliers to the Vileika CHP.

Although Vileiskiy Leskhoz exists as a cost effective operation, its viability solely as a wood chip supplier to the Vileika CHP facility is in doubt. The entrepreneur cited additional capital and operational costs that prevent a decent rate of return on the wood chip for CHP investment alone. These costs include constructing wood chip transfer points, upgrading the main storage area in Vileika to comply with fire safety standards, and rising fuel costs. Although the price of wood chips was raised by the Ministry of Economy by 11% in July 2008, the new price may not be sufficient to ensure the rate of return sought by this entrepreneur for CHP wood chip supply. To increase the viability of this operation, Vileiskiy Leskhoz has had success finding buyers of their wood chips in Lithuania at higher prices, and has managed to sustain the enterprise in its current form. The evaluator also surmises that Vileiskiy Leskhoz's competitors may have learned from the demonstration on how to further reduce operating costs to provide the Vileika CHP with lower prices for wood chips.

Intended Outcome 12:

⇒ Reduction in long-term fuel preparation and delivery costs for the wood harvesting company of over 20% as a result of the techniques implemented in the project

Actual Outcome 12:

⇒ *Actual costs for wood fuel preparations have been reduced by 30 to 50% depending on the wood harvesting technology*

Rating: *relevance:* *HS*
 effectiveness: *HS*
 efficiency: *S*
 overall rating: *HS*

The Project provided assistance to State forestry enterprise "Vileiskiy Leskhoz" and the BelGRES demonstration projects in the identification of appropriate and cost effective wood harvesting methods.

Before the Project, there was no biomass CHP in Vileisky. As such, there is no baseline on which to measure reductions in the cost of wood fuel preparations. The Project did provide assistance in identifying the "Jenz Hem 420" chipping machine for the Vileiskiy Leskhoz. However, Vileiskiy Leskhoz is actively seeking measures to reduce operating costs to compete with other wood fuel suppliers to the Vileika CHP. One of these measures includes minimizing storage of wood chips at transfer points and the main storage area in Vileika.

Prior to the Project, older chipping machines at BelGRES produced limited volumes of wood chips that were insufficient for a CHP operation. The Project provided technical assistance to BelGRES to identify the "Amkodor", a locally manufactured machine that is capable of producing over 50,000 m³ (loose) of wood chips for a CHP operation. This machine also provided a good comparison to the foreign-made Jenz Hem 420 wood chipping machine in use at Vileiskiy Leskhoz. Production costs for biomass at Vileika and BelGRES was USD 85-90 per 1 tce, much lower in comparison to the USD 130 per 1 tce biomass supply for the Osipovichy CHP, a location where the Project was not involved.

2.2.5 Objective 3: Develop Mechanisms for Continued Finance for Biomass Energy Projects

Intended Outcome 13:

⇒ Investment briefs on 5 to 10 replication projects are available in the second half of year 3 of the project

Actual Outcome 13:

⇒ Investment briefs for 12 projects were available at the end of the Project

Rating: relevance: HS
 effectiveness: S
 efficiency: S
 overall rating: HS

This outcome is reflective of the high demand for biomass energy projects that is in line with Belarus' strategy to increase the generation of domestic sources of energy to 25% by 2012. Many of these investment briefs have been or are going to be used for securing finance from the various sources in Belarus including Innovation Funds and the Project's RF.

The investment briefs were prepared by the Belarusian Thermal Engineering Institute; the quality of these briefs is to the feasibility study level as they provide technical details of the biomass conversion, and the business plan for financing and implementing the biomass projects. Completed project investment briefs where RF financing is requested includes the Beresino oil fired boiler house, the Starye Dorogy oil fired boiler house (undergoing international competitive bidding, and the Bobruisk wood processing company (under loan negotiation). Other investment briefs not requesting RF finance includes the Vitebskdrev CHP and Petrikov CHP (under implementation).

Intended Outcome 14:

⇒ Non-DEE funding sources for the replication projects identified and expressions of interest received from the relevant organizations.

Actual Outcome 14:

⇒ Non-DEE funding sources for replication projects has been identified

Rating: relevance: HS
 effectiveness: HS
 efficiency: HS
 overall rating: HS

Several non-DEE resources were identified for financing replication projects. This includes RF-financed projects such as Pinskdev CHP (equity finance for USD 4.5 million), and the Bobruisk boiler house (equity finance for USD 0.3 million). There are also a number of other projects with equity finance in the pipeline under discussion (as of June 2008) for RF funding including Petrikov CHP (USD 4.2 million) and the Pruzhany CHP (USD 12 million). State budget resources are being considered for Beresino and

Starye Dorogi, both under Minsk Region communal utilities. In all cases, Project technical assistance was used to identify the best boiler technologies.

Intended Outcome 15:

⇒ The government will leverage a certain percentage of its current funding for energy projects through the revolving fund mechanism

Actual Outcome 15:

⇒ The Government of Belarus has transferred USD 1.54 million to match the GEF revolving loan funds:

Rating: *relevance:* *HS*
 effectiveness: *S*
 efficiency: *S*
 overall rating: *S*

The matching funds demonstrate commitment by the GoB towards sustained growth of biomass energy projects and further adds to revolving fund resources. Matching funds were committed in two tranches, first tranche in 2006 (USD 0.84 million) and the second tranche in November 2007 (USD 0.70 million) near the completion of the Project. The matching funds from the GoB have yet to be used for biomass projects (as of June 2008).

Intended Outcome 16:

⇒ The revolving fund will be established and will be operating effectively by the end of the project.

Actual Outcome 16:

⇒ A revolving fund has been established that has a charter incorporating international best practices for revolving funds.

Rating: *relevance:* *HS*
 effectiveness: *MS*
 efficiency: *MS*
 overall rating: *MS*

Initial management for the RF was undertaken by “Belinvestenergosberezhenie” (BIES), the existing state energy investment enterprise under the DEE and designated as a republican unitary enterprise (RUE) that allows an organization to generate profits under the GoB.

Early in the operation of the RF, a number of problems were experienced including delays in the repayment of the first loan to the Volat-1 demonstration project in 2004²⁵.

²⁵ Prior to drafting of the RF charter, USD 130,000 was loaned to Volat-1 at 0% interest rate in 2004 for the installation of their biomass boiler. The grace period for payment of the loan was originally one year with an extension of an additional year based on the request from Volat-1 and an extension approval by the Project Steering Committee. However, due to financial problems and pressure from UNDP and DEE to initiate repayments, Volat-1 did not start paying back the principal until

The first version of the RF charter was completed in 2005. An evaluation of the RF performance was conducted in August 2007²⁶ that outlined a number of issues related to the sustainability of the RF in its 2007 form including:

- Lack of proper risk evaluations of borrowers;
- Lending at interest rates that do not adequately cover administrative costs and inflation; and
- Constraints in taking legal action against defaulters.

In response to this RF evaluation, a second charter was completed by DEE and BIES in January 2008. Based on recommendations from UNDP's financial auditor, a third charter was prepared in April 2008. This version of the charter was reviewed and further amended with the assistance of NEFCO in September 2008 to ensure the charter met international best practices for revolving funds including:

- a definition of the RF as a distinct non-profit fund within the RUE;
- a rating system to evaluate creditworthiness of borrowers;
- definition of RF loan interest rates and repayment terms;
- avoidance of transactions by BIES that would place it in a conflict of interest with its borrowers;
- legal and operational procedures for loan approvals and recovery of bad loans; and
- a system for loan monitoring.

With the NEFCO changes made to the April 2008 RF charter, prospects for the RF to sustain financing over the next 21 years are improved which are further discussed in Section 3.1.

2.2.6 Objective 4: Overcome Negative Perceptions of Biomass Energy Projects

Intended Outcome 17:

⇒ Surveys at the end of Years 2 and 4 on participants in the study tours (ST) via reports and questionnaires show growing interest in the use of biomass in Belarus.

Actual Outcome 17:

⇒ Survey in Year 4 of the Project indicated excellent reviews of the study tours and positive impressions of opportunities in biomass energy development:

Rating: *relevance:* *HS*
 effectiveness: *HS*
 efficiency: *HS*
 overall rating: *HS*

2007. The repayment problems were related to a BIES conflict of interest; BIES had served a dual role to Volat-1: acting as RF loan manager to track down unpaid loans and as World Bank project manager responsible for payment to Volat for procured goods. Repayment of the loan was made in 2007 and 2008 after court action was taken against Volat-1. Their current remaining debt is USD 60,000.

²⁶ Financial evaluation report by Paul Backer, August 2007

The study tours were cost-effective and were conducted during Project implementation to improve quality of biomass projects development within the timeframe of the UNDP Project. The study tours targeted senior to mid-level policy makers and were essential in overcoming technical barriers and in facilitating knowledge transfers from biomass projects in developed countries. Knowledge transferred included best practices in developing, implementing and operating biomass energy projects from both the supply and demand sides. Study tours were made to the Czech Republic, Austria, Finland and Sweden.

A survey of participants confirmed that the study tours had a significant impact on their knowledge of biomass energy development. The evaluation team also heard similar sentiments from a number of GoB personnel interviewed including the Ministry of Forestry and the Ministry of Housing and Public Utilities. A total of 48 specialists and managers participated in the STs that brought participants to examples of various biomass projects (for heating, hot water and power generation), wood fuel suppliers and equipment suppliers. More than 90% of them responded to the questionnaire prepared by the project team, and mentioned that their knowledge about biomass energy projects was essentially improved. All participants have shared their experience and knowledge with colleagues and trainees in workshops and lectures in Belarus targeting a wide range of audiences and benefiting more than 1,000 persons. At least 6 comprehensive articles by ST participants were published in the national press as a result of the STs which publicly confirmed this. ST participants also gave lectures for students of the State Technological University and trainees from in-country training courses. Six analytical articles related to the ST experience were published in central newspapers and magazines that can be found on the Project website.

Intended Outcome 18:

⇒ Information leaflets, brochures and videos are published and distributed to target audiences each year

Actual Outcome 18:

⇒ A number of brochures, leaflets and guidebooks have been published and disseminated through the Project's website

Rating: *relevance:* *HS*
 effectiveness: *HS*
 efficiency: *HS*
 overall rating: *HS*

The published material covers a wide range of relevant topics to assist biomass project developers in Belarus that includes design, finance and implementation of biomass energy projects. This includes a “best practices” guidebook on biomass combustion and forest fuel supply (i.e. combustion characteristics of wood, industrial biomass combustion concepts, power generation and emissions) to fuel supply (i.e. identifying forest fuel sources, energy wood harvesting machines, wood harvesting methods, fuel production logistics, quality control, cost factors, and wood prices).

All published material are available on the Project's website (www.bioenergy.by) providing all stakeholders with easy access to information. There has been a steady stream of publications since 2004 being made available to all stakeholders on the Project website.

Intended Outcome 19:

⇒ The project is mentioned at the Council of Ministers (CoM) at least 3 times a year, and regularly in the press.

Actual Outcome 19:

⇒ *Since its Inception, the Project has been mentioned to the Council of Ministers on a consistent basis*

Rating: relevance: HS
 effectiveness: HS
 efficiency: HS
 overall rating: HS

The National Project Director is the Deputy Chairman of the State Committee for Standardization and regularly attends meetings with the Council of Ministers. As such, he has regularly reported Project progress to the CoM, and used the Project effectively to guide the GoB towards its goals of increasing the share of biomass generation in Belarus.

Intended Outcome 20:

⇒ By the end of the project, demand for biomass boiler installations has increased

Actual Outcome 20:

⇒ *Demand for biomass boilers has increased dramatically at the end of the project*

Rating: relevance: HS
 effectiveness: HS
 efficiency: HS
 overall rating: HS

In 2007, one large-size and 390 small and medium-size boilers with total capacity 221 MW were converted to biomass. At the end of the Project, there was demand for 308 boilers (total capacity 356 MW) to be converted to biomass. The demand for biomass boiler installations can be attributed to the success of the demonstration projects and the MoHPU program that converted a large number of small and medium-sized units to biomass. These boiler houses were fuelled by mazut, gas or coal prior to 2003, and then converted in 2003 - 2004 to wood logs using thermally inefficient technologies.

The Project provided technical assistance after 2004 to MoHPU to improve the process of conversion, to dissuade the use low efficiency boiler units (below 80% efficiency) and to follow to European standards (using 80% efficiency as the minimum efficiency). As a consequence, MoHPU has changed its approach to biomass conversion since 2006

using only boilers with high thermal efficiency. In 2006 and 2007, more than 350 new boilers (average size of 1.2 MW) with improved thermal efficiency were commissioned at a cost of USD30 million. The high emission reduction numbers for this Project are due to the Project linkage to the MoHPU biomass boiler conversion program.

The success of the demonstration projects at Uzda (Volat-1), Mosty (Mostovdrev CHP), Vileika (Vileika CHP) and Orekhovsk (BelGRES CHP) also contributed to demand for biomass boiler installations and CHP. There are currently another 12 CHP projects being planned or implemented at the time of the final evaluation mission.

2.2.7 Overall Evaluation of Project

The overall rating of the project results is S. This is based on the Project achieving all of its intended outcomes including strengthening institutional capacity to support the development of biomass energy projects in Belarus, demonstrating biomass supply and demand-side projects, setting up of a revolving fund to finance biomass energy projects and raising awareness of biomass energy projects in Belarus.

3. SUSTAINABILITY OF PROJECT OUTCOMES

In assessing Project sustainability, we asked “how likely will the Project outcomes be sustained beyond Project termination?” Sustainability of these objectives was evaluated in the dimensions of financial resources, socio-political risks, institutional framework and governance, and environmental factors, using a simple ranking scheme:

- *Likely (L)*: very likely to continue and resources in place;
- *Moderately Likely (ML)*: model is viable, but funding or resources may not be in place;
- *Moderately Unlikely (MU)*: model is not viable or needs changing; and/or resources not in place; and
- *Unlikely (U)*: model is not viable and resources are not in place.

The overall sustainability rating for the Project is ML (moderately sustainable). There are moderate sustainability issues for the Project with:

- Actual Outcome 5: Twinning arrangement between BIES and LEV. This is related to the availability of financial resources to maintain this arrangement in the post-project scenario, and the competition from other similar agencies to promote their technical expertise and products;
- Actual Outcome 11: The Vileika biomass fuel supply project whose profitability is constrained by government-regulated pricing of wood chips. As such, Vileika is required to diversify its client base beyond the CHP to increase the profitability of the chip production operation;
- Actual Outcomes 15 and 16: Establishment of and GoB contribution to the revolving fund. An issue lies with the future use of the RF considering its small proportion of financing to biomass energy and supply projects (4 to 21% of the total cost for past demo projects has been financed by the RF).

The evaluation for sustainability is shown on Table 2. The Table provides a rating of the project design and viability going forward, including availability of budget and resources for continuation. An elaboration of the sustainability of the RF and the enhancement of financing mechanisms through Joint Implementation are covered in Sections 3.1 and 3.2 respectively.

Table 2: Assessment of Sustainability of Outcomes

Actual Outcomes (as of October 2008)	Assessment of Sustainability	Dimensions of Sustainability
Immediate Objective Sustainable use of biomass as an energy source is promoted and increased in Belarus		
<p><i>Actual Outcome 1: Increased use of wood biomass for district heating.</i> Over 155,065 m³ (loose) was used during the first half of 2008. Projected over the entire 2008, 310,000 m³ (loose) of biomass is likely to be used annually in the four demonstration projects in Uzda, Mosty, Vileika and Orekhovsk, exceeding the 280,000 m³ target</p>	<ul style="list-style-type: none"> • <i>Financial Resources:</i> There have no issues regarding available finances to fuel and operate biomass boilers. With regards to wood chip supply, there are no reports of shortages notwithstanding the State price of wood chips. In July 2008, the price of wood chips (for heat and power generation) was raised 11% to ensure price competitiveness with higher wood chip prices being paid by the pulp and paper industry in neighboring countries; • <i>Socio-Political Risks:</i> The reduction of imported fossil fuel usage and the increase in domestic energy generation is a national priority. Local communities are very supportive of new biomass projects as a means to reduce the cost of their boiler operations; • <i>Institutional Framework and Governance:</i> The reduction of imported fossil fuel usage and the increase in domestic energy generation is a national priority. The GoB has demonstrated their willingness to resolve any problems or issues related to achieving this objective that includes their :National Plan (Strategy) for Ensuring Sustainable Development and Efficient Use of Wood Fuel for Energy Supply (Heat and Electricity Production) in the Republic of Belarus for 2006-2012”; • <i>Environmental Factors:</i> GoB has provisions to ensure that the increase of wood biomass for heating is done in a sustainable manner that ensures Belarus has its critical areas covered by forested areas (see Environmental Factors for Actual Outcome 11) <p style="text-align: right;"><i>Overall Rating</i></p>	<p>L</p> <p>L</p> <p>L</p> <p>L</p> <p>L</p>
<p><i>Actual Outcome 2: Five demonstration sites are in operation.</i> These sites are well managed and successfully demonstrating fuel delivery mechanisms and efficient heat generation from biomass boilers</p>	<ul style="list-style-type: none"> • <i>Financial Resources:</i> All 4 demonstration sites for biomass heat generation are operating with adequate rates of return. The demonstration project for CHP wood chip fuel delivery, “Vileiskiy Leskhoz”, is undertaking measures to ensure profitability through sale of wood chips to non-CHP clients who will pay market prices for wood chips. • <i>Socio-Political Risks:</i> Local communities are very supportive of new biomass projects and thus would not jeopardize their operations; • <i>Institutional Framework and Governance:</i> Adequate technical support has been provided to demonstration plants reducing the risk of prolonged closure. Stakeholders 	<p>L</p> <p>L</p> <p>L</p>

Table 2: Assessment of Sustainability of Outcomes

Actual Outcomes (as of October 2008)	Assessment of Sustainability	Dimensions of Sustainability
	have strong attachment to projects; <ul style="list-style-type: none"> <i>Environmental Factors:</i> No environmental risks with these projects <p style="text-align: right;"><i>Overall Rating</i></p>	L L
<p><i>Actual Outcome 3: The Government of Belarus is able to identify the most cost effective boiler conversion sites through databases and GIS developed by the Project. They also have a national plan in place to implement a large-scale program for biomass conversions in Belarus.</i></p>	<ul style="list-style-type: none"> <i>Financial Resources:</i> The GoB has committed over USD 80 million in funding in 2007 for bioenergy projects from the budget and innovation funds. <i>Socio-Political Risks:</i> This outcome supports a national priority; hence, no identifiable risks; <i>Institutional Framework and Governance:</i> In part due to the Project's capacity building activities, the GoB provides strong support for the continuation of Project activities for biomass boiler conversions; <i>Environmental Factors:</i> Outcome will be sustained due to Belarus' commitments to the Kyoto Protocol <p style="text-align: right;"><i>Overall Rating</i></p>	L L L L
<p><i>Actual Outcome 4: A total of USD 5.95 million has been allocated by the Committee for Energy Efficiency (now under the name of the Department for EE of the State Standardization Committee) for the 2004-2008 period to make up for the higher investment costs at project sites than originally projected in the approved project document, and to the Revolving Fund to match GEF's contribution</i></p>	<ul style="list-style-type: none"> <i>Financial Resources:</i> GoB has committed funding in place for this national priority. <i>Socio-Political Risks:</i> This outcome supports a national priority; hence, no identifiable risks; <i>Institutional Framework and Governance:</i> The DEE has assumed the role of management and disbursement of biomass development funds. <i>Environmental Factors:</i> No identifiable environmental risks. <p style="text-align: right;"><i>Overall Rating</i></p>	L L L L
<p>Objective 1: Strengthen institutional capacity to support biomass energy projects</p>		
<p><i>Outcome 5: A twinning arrangement between BIES and LEV (Austria) has been established</i></p>	<ul style="list-style-type: none"> <i>Financial Resources:</i> While a relationship has been developed, financial resources to continue this relationship have not yet been identified. BIES has indicated that there are intentions to allocate financial resources to continue this relationship; <i>Socio-Political Risks:</i> The collaborative relationship between BIES and LEV was excellent and is likely to be sustained especially if financial resources are available. There is competition, however, from other countries especially with the emergence of NEFCO and the window of opportunity for Belarus to access Scandinavian expertise; <i>Institutional Framework and Governance:</i> The GoB is very supportive of this arrangement as LEV are viewed as a window of it supports foreign investment towards 	ML L ML

Table 2: Assessment of Sustainability of Outcomes

Actual Outcomes (as of October 2008)	Assessment of Sustainability	Dimensions of Sustainability
	<p>a national priority. They are also open to similar arrangements with other institutions;</p> <ul style="list-style-type: none"> • <i>Environmental Factors:</i> No identifiable environmental risks <p style="text-align: right;"><i>Overall Rating</i></p>	<p>L</p> <p>ML</p>
<p><u><i>Outcome 6: A modern mobile emissions monitoring facility has been equipped with modern equipment.</i></u></p>	<ul style="list-style-type: none"> • <i>Financial Resources:</i> Arrangements are complete to have BIES operate and maintain the equipment on a commercial basis; • <i>Socio-Political Risks:</i> Equipment has been certified by the Institute of Metrology. At the time of evaluation, there is DEE willingness to sustain the use of this monitoring facility; • <i>Institutional Framework and Governance:</i> BIES will undertake the role of ensuring the continued use of this equipment; • <i>Environmental Factors:</i> Equipment is essential in monitoring environmental quality. <p style="text-align: right;"><i>Overall Rating</i></p>	<p>L</p> <p>L</p> <p>L</p> <p>L</p> <p>L</p>
<p><u><i>Outcome 7: A GIS system for planning of biomass conversion projects was established</i></u></p>	<ul style="list-style-type: none"> • <i>Financial Resources:</i> Financing for GIS use and maintenance is included in the energy efficiency program budget for 2009. BIES is currently the caretaker of the GIS and have re-hired a GIS specialist; • <i>Socio-Political Risks:</i> The use of the GIS is expected to be very high. The GIS is regarded by several Ministries as essential for the planning of forest harvests and biomass energy projects; • <i>Institutional Framework and Governance:</i> The GoB strongly supports the use of GIS for the holistic planning of biomass projects. The DEE will have a contractual arrangement with BIES to manage the GIS and its databases after completion of the Project; • <i>Environmental Factors:</i> The GIS is viewed by the DEE and the Ministry of Forests as an essential tool in the holistic and sustainable planning of forest harvests for biomass energy projects <p style="text-align: right;"><i>Overall Rating</i></p>	<p>L</p> <p>L</p> <p>L</p> <p>L</p> <p>L</p>
<p><u><i>Outcome 8: A national strategy for scaling up of biomass has been drafted and approved by the DEE in October 2007</i></u></p>	<ul style="list-style-type: none"> • <i>Financial Resources:</i> The GoB have allocated in 2007 about USD 80 million to support the national strategy; • <i>Socio-Political Risks:</i> Little or no risks as the plan was developed in consultation with a wide range of stakeholders in October 2006; • <i>Institutional Framework and Governance:</i> Given the strategy is a national priority, there is supporting institutional framework through the DEE and the Council of 	<p>L</p> <p>L</p> <p>L</p>

Table 2: Assessment of Sustainability of Outcomes

Actual Outcomes (as of October 2008)	Assessment of Sustainability	Dimensions of Sustainability
	<p>Ministers to smoothly implement the strategy. This includes resources to acquire the requisite technical expertise if appropriate;</p> <ul style="list-style-type: none"> • <i>Environmental Factors:</i> The strategy will support sustainable harvesting of forests in Belarus <p style="text-align: right;"><i>Overall Rating</i></p>	<p>L</p> <p>L</p>
<p>Objective 2: Establish a track record for investments in sustainable biomass</p>		
<p><u>Outcome 9: At the end of Year 4, four demand-side investment projects are operating as designed</u></p>	<ul style="list-style-type: none"> • <i>Financial Resources:</i> All sites operating with good rates of return; • <i>Socio-Political Risks:</i> Stakeholders have strong attachment to Project and thus would not jeopardize its operations; • <i>Institutional Framework and Governance:</i> Administrators, managers and specialists have frequently visited the projects for demonstration and training purposes. Technical support from equipment suppliers (foreign and domestic) has been good minimizing past CHP closures to 15 days; • <i>Environmental Factors:</i> CHP projects are equipped with flue gas cleaning systems to remove particulate emissions. <p style="text-align: right;"><i>Overall Rating</i></p>	<p>L</p> <p>L</p> <p>L</p> <p>L</p> <p>L</p>
<p><u>Outcome 10: Fuel savings from the four demonstration projects is 26,539 tce with annual emissions of 60,743 tonnes CO₂eq.</u> This is in comparison to the 35,000 tce and 72,000 tonnes in the 2003 log frame</p>	<ul style="list-style-type: none"> • <i>Financial Resources:</i> Projects have good rate of return based on fuel savings and displacement of expensive fossil fuels; • <i>Socio-Political Risks:</i> Local communities are very supportive of fuel savings from new biomass project, and would maintain current trends in fuel consumption of the projects; • <i>Institutional Framework and Governance:</i> GoB support is very strong for demonstrations that reduce fossil fuel consumption. DEE support is expected to be strong in a post-project environment; • <i>Environmental Factors:</i> The reduction of CO₂ emissions supports Belarus' commitment and compliance to Kyoto Protocol to which it is a signatory <p style="text-align: right;"><i>Overall Rating</i></p>	<p>L</p> <p>L</p> <p>L</p> <p>L</p> <p>L</p>
<p><u>Outcome 11: A biomass fuel supply project is operating efficiently and cost effectively in Vileika</u></p>	<ul style="list-style-type: none"> • <i>Financial Resources:</i> The Vileika Leskhoz FS supplies wood chips at unsustainable rates set by the Ministry of Economy. To maintain its cost effectiveness, Vileika Leskhoz has been selling a portion of its wood chips at a higher price to clients in Lithuania; this allows Leskhoz to cover losses from wood waste processing through 	<p>ML</p>

Table 2: Assessment of Sustainability of Outcomes

Actual Outcomes (as of October 2008)	Assessment of Sustainability	Dimensions of Sustainability
	<p>profits from merchantable wood sales.</p> <ul style="list-style-type: none"> • <i>Socio-Political Risks:</i> Little or no risks as the local communities are very supportive of the importance of wood chip supplies to the Vileika CHP. Moreover, the Vileika Leskhoz FS catalyzed the formation of two other wood chip suppliers to the Vileika CHP; • <i>Institutional Framework and Governance:</i> The GoB through the Ministry of Forests and Ministry of Economy has provided the institutional support to ensure a sustainable supply of wood chips (through the GIS and their forest harvest plans) and a review of wood chip supply prices to CHPs that ensure prices are competitive; • <i>Environmental Factors:</i> All forest harvesting is regulated for sustainability through a requirement that all forest institutions need to be certified in accordance to European rules (with institutes such as the Forest Stewardship Council). Furthermore, the GoB sanctioned "State Integrated Program of Modernization of Belarusian Energy System Generation Facilities and Increase of Domestic Fuel and Energy Resources Use, 2006-2010" and was approved by President's Decree #399 dated August 25, 2005, with further updating of the Program and extension until 2011 and approved by President's Decree #575 dated 15.11.2007. The Decree recognizes sustainability through regulating the harvesting rate of forests in a manner that ensures an uninterrupted supply of wood for CHPs; hence, the Strategy specifically mentions limiting the size of CHPs to meet this sustainability aspect. <p style="text-align: right;"><i>Overall Rating</i></p>	<p style="text-align: center;">L</p> <p style="text-align: center;">L</p> <p style="text-align: center;">L</p> <p style="text-align: center;">ML</p>
<p><u><i>Outcome 12: Actual costs for wood fuel preparations have been reduced by 30 to 50% depending on the wood harvesting technology</i></u></p>	<ul style="list-style-type: none"> • <i>Financial Resources:</i> Financial resources are available from the RF to procure equipment for efficient production of wood chips to biomass boiler plants; hence, no financial risks identified; • <i>Socio-Political Risks:</i> All CHP operators recognize the importance of reducing these costs as it would impact their profitability, and their effectiveness in delivering heat and hot water to their communities; • <i>Institutional Framework and Governance:</i> BIES has the capacity to link project proponents with technical assistance to identify cost reduction opportunities including identification of appropriate wood chipping equipment; • <i>Environmental Factors:</i> CHPs are planned in an area with a sustainable and uninterrupted wood supply to a CHP. Forest harvest planning by the MoF guides the CHPs to source their wood fuel away from protected areas under the "Forestry Fund" and at sources less than 30 km from the CHP to reduce excessive transport costs. 	<p style="text-align: center;">L</p> <p style="text-align: center;">L</p> <p style="text-align: center;">L</p> <p style="text-align: center;">L</p>

Table 2: Assessment of Sustainability of Outcomes

Actual Outcomes (as of October 2008)	Assessment of Sustainability	Dimensions of Sustainability
	<i>Overall Rating</i>	L
Objective 3: Develop mechanisms for continued financing for biomass energy projects.		
<u>Outcome 13: Investment briefs for 12 projects were available at the end of the Project</u>	<ul style="list-style-type: none"> • <u>Financial Resources:</u> A number of project proponents have used their own financial resources to recruit technical professionals who have experience in preparing investment briefs; • <u>Socio-Political Risks:</u> There is strong support from local community and government stakeholders for biomass conversion projects as this supports a national priority of reducing imported fossil fuel consumption; • <u>Institutional Framework and Governance:</u> BIES is positioned to facilitate linkages between project proponents and technical experts who have previously prepared investment briefs for the Project; • <u>Environmental Factors:</u> Investment briefs have identified environmental risks, if any. <p style="text-align: right;"><i>Overall Rating</i></p>	L L L L L
<u>Outcome 14: Non-DEE funding sources for replication projects have been identified</u>	<ul style="list-style-type: none"> • <u>Financial Resources:</u> There are several sources of non-DEE funding available for the biomass conversions from budget, Innovation Fund or foreign investors; • <u>Socio-Political Risks:</u> Since biomass conversions support a national priority to reduce fossil fuel consumption, there will be strong support from GoB for any funding towards this goal; • <u>Institutional Framework and Governance:</u> The GoB has committed a significant portion of the budget and "Innovation Fund" to biomass energy projects, and provided policies to encourage foreign investment in biomass projects. There is also a large government program within MoHPU to convert heating and hot water boilers to biomass for public housing; Over 350 boiler houses were converted to biomass in 2006-2007. Over 200 boiler houses are going to be converted in 2008. • <u>Environmental Factors:</u> No identifiable environmental risks. <p style="text-align: right;"><i>Overall Rating</i></p>	L L L L L
<u>Outcome 15: The Government of Belarus has transferred USD 1.54 million to match the GEF revolving loan funds</u>	<ul style="list-style-type: none"> • <u>Financial Resources:</u> The GoB has the financial commitment to support renewable energy development and energy efficiency initiatives through the setup of its own RF. A fourth RF charter that was drafted with assistance from NEFCO in September 2008, provides clarification on loan approval procedures, terms and conditions for loans, and penalties against loan defaulters. This mitigates previous RF risks, and improves the financial sustainability of the RF; 	L

Table 2: Assessment of Sustainability of Outcomes

Actual Outcomes (as of October 2008)	Assessment of Sustainability	Dimensions of Sustainability
	<ul style="list-style-type: none"> • <u>Socio-Political Risks</u>: There is strong political support to successfully manage an RF as it will likely catalyze co-financing from foreign sources such as NEFCO. However, most of these RF funds are used for energy efficiency projects generating GHG emissions reductions. There is also the additional risk that project proponents would be too reliant on state budgets or other lower interest rate loans to fund biomass conversions. The actual finance from the RF for the demonstrations projects was 4 to 5% of all financing required for CHP projects (see Project Profiles in Appendix D); • <u>Institutional Framework and Governance</u>: BIES is the agency tasked with managing the RF; • <u>Environmental Factors</u>: No identifiable environmental risks. <p style="text-align: right;"><i>Overall Rating</i></p>	<p style="text-align: center;">ML</p> <p style="text-align: center;">L</p> <p style="text-align: center;">L</p> <p style="text-align: center;">ML</p>
<p><u>Outcome 16: A revolving fund has been established with the assistance of NEFCO that has a charter incorporating best international practices</u></p>	<ul style="list-style-type: none"> • <u>Financial Resources</u>: The September 2008 version of the charter with inputs from NEFCO on best international practices, reduces the risk of depleting capital from the RF; • <u>Socio-Political Risks</u>: The charter in this form also provides a form of incentive for BIES to ensure that the RF is operational as it is attracting co-finances from NEFCO for biomass projects, thus increasing resources for biomass conversions. Similar to Outcome 15, there is a risk that the RF would not be used for finance in favor of lower cost loans or state budget grants or financing; • <u>Institutional Framework and Governance</u>: As result of the decision to include the RF in the RUE, the RF was never formed as an independent legal entity which under a 2005 charter would have been unsustainable. The new April 2008 charter with NEFCO inputs, does restrict BIES activities with borrowers that may place BIES in a potential conflict of interest. BIES may require TS or oversight to manage the RF in accordance with new September 2008 charter • <u>Environmental Factors</u>: No identifiable environmental factors <p style="text-align: right;"><i>Overall Rating</i></p>	<p style="text-align: center;">L</p> <p style="text-align: center;">ML</p> <p style="text-align: center;">ML</p> <p style="text-align: center;">L</p> <p style="text-align: center;">ML</p>
<p>Objective 4: Overcome negative perceptions of biomass energy and provide market information to public and private investors</p>		
<p><u>Outcome 17: Surveys in Years 2 and 4 of the</u></p>	<ul style="list-style-type: none"> • <u>Financial Resources</u>: No financial risks identified; 	<p style="text-align: center;">L</p>

Table 2: Assessment of Sustainability of Outcomes

Actual Outcomes (as of October 2008)	Assessment of Sustainability	Dimensions of Sustainability
<u>Project indicated excellent reviews of the study tours and positive impressions of opportunities in biomass energy development</u>	<ul style="list-style-type: none"> • <u>Socio-Political Risks:</u> With the GoB officers highlighting the national importance of biomass energy projects and their impact on reducing consumption of costly imported fossil fuels, positive perceptions of biomass projects will be sustained; • <u>Institutional Framework and Governance:</u> The GoB have supporting strategies and legislation in place to maintain positive impressions and the importance on biomass energy development for Belarus including National Programs dedicated to use of biomass as fuel for heat and power production; • <u>Environmental Factors:</u> No identifiable environmental risks. <p style="text-align: right;"><u>Overall Rating</u></p>	L L
<u>Outcome 18: A number of brochures, leaflets and guidebooks have been published and disseminated through the Project website.</u>	<ul style="list-style-type: none"> • <u>Financial Resources:</u> New publications are likely not required for the short term after the Project. This is due to the high quality of the current set of publications. Financial resources are in place for the DEE and BIES to continue the publication of new materials including the national magazine "Energy Efficiency", a special periodical on promotion of EE and renewable energy technologies. DEE and BIES are also committed to maintaining the Project website (www.bioenergy.by). • <u>Socio-Political Risks:</u> No social or political risks identified as this program supports a national priority; • <u>Institutional Framework and Governance:</u> BIES will provide all support for updating publications for biomass energy development as this would promote the use of the BIES-managed RF; • <u>Environmental Factors:</u> No identifiable environmental risks. <p style="text-align: right;"><u>Overall Rating</u></p>	L L L
<u>Outcome 19: Since its Inception, the Project has been mentioned to the Council of Ministers on a consistent basis</u>	<ul style="list-style-type: none"> • <u>Financial Resources:</u> No identifiable financial risks; • <u>Socio-Political Risks:</u> Biomass conversions are a national priority driven by the Council of Ministers to whom the NPD for the Project meets on a regular basis; hence, support for biomass project will be sustained; • <u>Institutional Framework and Governance:</u> Promotion of biomass will be sustained by the DEE; • <u>Environmental Factors:</u> No identifiable environmental risks. <p style="text-align: right;"><u>Overall Rating</u></p>	L L L
<u>Outcome 20: Demand for biomass boilers has</u>	<ul style="list-style-type: none"> • <u>Financial Resources:</u> There are a number of financial resources available for biomass 	L

Table 2: Assessment of Sustainability of Outcomes

Actual Outcomes (as of October 2008)	Assessment of Sustainability	Dimensions of Sustainability
<i>increased dramatically at the end of the project</i>	<p>energy projects (Foreign and domestic), including GoB USD 80 million allocation, SoE equity and foreign investment. This includes the current RF that would be used as co-financing with NEFCO funds for biomass conversions;</p> <ul style="list-style-type: none"> • <i>Socio-Political Risks:</i> No social or political risks identified as biomass conversion projects are a national priority; • <i>Institutional Framework and Governance:</i> The “National Plan (Strategy) for Ensuring Sustainable Development and Efficient Use of Wood Fuel for Energy Supply (Heat and Electricity Production) in the Republic of Belarus for 2006-2012” is in place as well as institutional framework to encourage foreign investment; • <i>Environmental Factors:</i> No identifiable environmental risks as these projects enhance Belarus compliance to Kyoto. <p style="text-align: right;"><i>Overall Rating</i></p>	<p>L</p> <p>L</p> <p>L</p> <p>L</p>
Overall Project Sustainability:		ML

3.1 Revolving Fund Sustainability

Several GoB personnel expressed their positive opinion to the Evaluator that the RF financial instrument was an attractive mechanism designed to “stretch” the value of funds invested in biomass energy projects through repayment of loans as opposed to past practices of government grants²⁷. However, throughout much of the Project’s duration, there were concerns over its development and ultimately, its sustainability after the completion of the Project.

First disbursements of the RF were issued prior to any charter being prepared for the RF. The Volat-1 loan conditions were 0% interest in 2004 for finance over 5 years with a grace period of 12 months. The same loan conditions were also provided to the Mostovdrev CHP in 2005. After the first charter was issued in 2005, the Project changed the conditions of RF finance to mirror lending conditions of a legal revolving fund.

Subsequent loans were disbursed to other project proponents with an interest rate up to 6%; the rate and loan terms for each loan agreement were agreed upon by the Commission established by the DEE. GEF funds for the RF were placed into a special bank account managed by Priorbank, one of Belarus’ largest commercial banks and related to the Reinfaisen Bank (Austria). The Belarusian contribution to the fund was placed in a ruble account at “Belinvestbank”, one of Belarus’ largest banks.

Concerns over RF sustainability were expressed in July 2007 on the management of the RF²⁸. The audit stated a number of concerns including:

- Legal status of the RF [Belinvestbank](#) account was not in line with a “Fund”²⁹;
- The RF lacks legal standing. As such, the RF had limited (no legal) recourse in recovering bad loans through the BIES (legal recovery of loans required BIES to file a legal claim);
- The non-profit RF was being managed by a profit driven RUE (BIES), a situation divergent from international best practices for non-profit fund administration;
- The prevailing interest rate of the RF was 6%, which is half the commercial rate for loans denominated in Belarusian rubles. International best practices call for interest rate charges that would cover operation costs and a cushion against failure to repay (this also applies to non-commercial lenders);
- RF operations were co-mingled with other RUE (BIES) commercial activity (including World Bank loans) leading to conflict of interest scenarios. One of the defaulting RF borrowers, Volat-1, attempted to justify its failure to repay the RF by the failure of BIES to repay a debt (for the purchase of windows) to the Volat-1 enterprise;
- The “RF operational experience indicates a material likelihood of the RF being unable to remain a viable financial entity”. As such, the RF in its state in 2007 would not be able to sustain its full lending obligations for 21 years as defined in the Prodoc.

²⁷ Personal communication with Project Manager and Ms Tamara Ostrovskaya, Ministry of Economy

²⁸ Report from Paul Backer, August 2007

²⁹ In Belarus, a “Fund” is a legal entity with a Board of Trustees that represent the interests of a non-profit and non-commercial organization. However, the RF funds with the Belinvestbank account were secure since the account had a “protected special bank account” status to avoid use of funds for other than the RF purposes

The financial audit suggested the RF be managed as a “subsidiary” to the DEE to achieve the necessary separation and legal identity. This separation and transferral of assets to another account, however, would have been administratively onerous and required considerable extra costs. To address these concerns, BIES with Project assistance, drafted a third charter in April 2008 to the RF charter to improve its sustainability prospects. This version of the charter includes:

- a definition of the RF as a distinct non-profit fund within the RUE;
- a rating system to evaluate creditworthiness of borrowers;
- legal and operational procedures for loan approvals and recovery of bad loans; and
- a system for loan monitoring.

The third charter was reviewed by the Nordic Environmental Finance Corporation (NEFCO) during a meeting in Helsinki with BIES in mid-September 2008. NEFCO provided comments on the third charter that bring it in line with best international practices for revolving funds. Charter clarifications and changes made by NEFCO for BIES in September 2008 included:

- provision of strategic goals of the fund (2008-2012 to reduce GHG emissions by minimum 100,000 tonnes);
- clearly defined rules regarding the management of the accounts and use of the loans;
- a firm payback period (maximum 5 years);
- fixed interest rates of 8.25% that cannot be negotiated with the borrower;
- stronger and well-defined penalties and actions to be taken against defaulters;
- a system for rating borrowers developed by DICSA, the financial auditor for the Project;
- clear roles of the head of the loan office; and
- simplified and strengthened loan consideration procedures.

NEFCO have expressed an interest in cooperating with BIES in setting up a facility for financing biomass projects as well as other projects related to cleaner production and energy saving projects in Belarus. The cooperation can be characterized as follows:

- launching a revolving fund on a pilot scale in Belarus;
- assuming the pilot is successful, BIES would assist NEFCO with the identification and monitoring and evaluation of projects;
- BIES would be able to leverage RF finance of the identified projects with NEFCO finance provided the projects had a 25% rate of return and positive environmental benefits (for any size of project).

To this end, if approved, the revised September 2008 RF charter will improve prospects for sustainable financing of biomass projects through a combination of the BIES RF and the NEFCO Clean Production and Energy Savings Credit Scheme. However, for BIES to be able to manage the RF under the new charter, it should seek technical assistance or oversight that their operations confirm to best international practices stated in the new charter.

3.2 Enhancing Financial Sustainability Through JI

Belarus recognizes the benefits of Joint Implementation (JI) programs as a means of increasing finances available for the growth of domestic renewable energy sources including biomass energy projects. Though Belarus has acceded to the Kyoto Protocol (KP) on August 26, 2005 and is an Annex 1 party to the UNFCCC, it is unable to engage in international emissions trading (IET) or project based activities through the Joint Implementation (JI) mechanism. The primary reason for this is that Belarus was not party to the UNFCCC at the time the KP was adopted in 1997, and was left out of the assigning of emission reduction targets. As such, it has an emission reduction target of 92% (against the baseline of 1990) under Annex B of the KP. The respective amendment to the KP, however, still needs to be ratified by 75% of countries parties to the KP. To date, only 5 countries have ratified this amendment.

Recognizing the complexity of the approval process, the Ministry of Natural Resources and Environmental Protection (MoNREP) have dedicated resources to position Belarus for engagement in JI and IET, along with voluntary emission reduction projects³⁰. Their current efforts include:

- legislation of a transparent voluntary emissions reduction (VER) market in Belarus, strengthening their preparedness for emissions trading;
- conducting meetings with over 100 potential partners in the VER market to set strategic and operational GHG reduction targets;
- setting up of a national registry system for GHG emission reductions in a manner where they can be reported to the UNFCCC;
- formation of a Designated National Authority to review and endorse JI and VER projects; and
- identification of a pipeline of eligible projects that includes a number of biomass conversion projects.

There are also ongoing discussions amongst government stakeholders led by MoNREP on the best use of carbon revenues. Suggestions range from community investments to reducing debt service charges to borrowers to capitalization of revolving funds.

In conclusion, the sustainability of the development of biomass energy projects will be enhanced by the efforts by the GoB to generate revenue from the carbon market through JI and IET.

³⁰ Pers. Communication with GEF Focal Point and First Deputy Minister of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus

4. REPLICABILITY OR CATALYTIC ROLE

This Project deserves significant credit for catalyzing the development of biomass energy projects for hot water, heating and power generation in Belarus:

- One of the results of the Project's PDF B phase was the issuance of Government Decree #1820 "On Additional Measures to Ensure Cost-Effective and Efficient Use of Fuel and Energy..." dated December 27, 2002 that targets wider use of wood waste as a national strategy. Institutional measures in the Decree were intended to give strong support to wider conversion of boiler houses from fossil to renewable fuels;
- Notwithstanding the country's strong drivenness for the increase of biomass energy projects, there was little in the way of biomass energy investment prior to the completion of the first demonstration project at Volat-1 in 2004. The completion and operation of the Volat-1 project demonstrated to many stakeholders that domestically available biomass was a viable fuel alternative for Belarus. Furthermore, Volat-1 demonstrated that modern boiler technologies can be successfully implemented in Belarus through the inputs of foreign institutions and companies;
- The Vileika Leskhoz project provided a successful demonstration of setting up and operating a wood fuel supply service to a CHP project, in particular, the Vileika CHP demonstration project. This fuel supply demonstration catalyzed the formation of more than 10 similar wood chip supply units in Belarus; the Vileika experience was recognised at the Government level as excellent exemplary demonstration of biomass supply and combustion technologies and was recommended for replication within Belarus;
- The Project's technical assistance to the MoHPU on the design and selection of energy efficient boilers was catalytic in the rapid replication of over 350 MoHPU boiler houses throughout Belarus since 2005. The energy savings and CO₂ emissions reductions from this assistance are significant;
- The Project's role in the setup of a revolving fund has catalyzed the interest of a foreign institute, NEFCO, in providing financing instruments for the development of biomass energy projects. This source of finance will only enhance the sustainability of the biomass energy development in Belarus.

5. ASSESSMENT OF MONITORING & EVALUATION SYSTEMS

5.1 M&E During Project Implementation

The 2003 Prodoc contains a reasonably detailed M&E plan that was considered acceptable for that time. Since 2003, GEFs M&E requirements have become more specific with the independence of the GEF Monitoring and Evaluation Unit that reports directly to GEF Council. The main reporting tool for this Project was a combined APR/PIR report.

While these reports provided clear and concise reports of Project progress and issues, there were subtle changes in reporting from year to year on the indicators for project objectives. These changes were made necessary due to a need to simplify and reduce the number of indicators, and to retrofit the log-frame to GEF changes to “outcome” reporting.

Improvements that could have been made to the Project’s M&E system include:

- Consistent format for reporting project performance with the correct usage of terms “indicators”, “outcomes” and “outputs” in the Project log-frame. Log-frame can be an effective tool for monitoring project progress;
- The inputs of an M&E specialist. While the Project had thorough M&E reports, M&E reporting quality would have been more consistent with the inputs of an M&E specialist on the PMU.

Ratings of the Project’s Monitoring and Evaluation system³¹ are as follows:

- Quality of M&E design – MS. This is mainly due to the fact system was designed in 2003;
- Quality of M&E implementation – S.

5.2 Monitoring Long Term Changes

The Project has also generated data related to increases in the numbers of biomass boiler houses and CHP projects, contributing to the development of a long term monitoring system. Due to the strong drivenness of the Government of Belarus on this Project to reduce its dependence on imported fossil fuels, the monitoring system is housed within BIES to complement their other activities. The monitoring system includes:

³¹ HS or Highly Satisfactory: There were no shortcomings in the project M&E system;

S or Satisfactory: There were minor shortcomings in the project M&E system,

MS or Moderately Satisfactory: There were moderate shortcomings in the project M&E system;

MU or Moderately Unsatisfactory: There were significant shortcomings in the project M&E system;

U or Unsatisfactory: There were major shortcomings in the project M&E system; HU or Highly Unsatisfactory: The Project had no M&E system.

- management of the RF and other accounts that finance renewable energy developments and energy efficiency initiatives;
- energy audits and feasibility studies;
- development of PINs and PDDs for JI projects; and
- GIS and its databases on boiler houses that are continually updated. This would include all biomass projects with or without RF financing. Data of these projects is reported annually by the six DEE Oblast branches.

6. ASSESSMENT OF PROCESSES AFFECTING ATTAINMENT OF PROJECT RESULTS

6.1 Preparation and Readiness

The Project designs from the PDF B Phase were well prepared, comprehensive and easy to understand. The roles and responsibilities of all government institutions were clear with counterpart funding and enabling legislation to meet project objectives.

6.2 Country Ownership and Drivenness

To a significant extent, Project results have been attained with strong ownership and drivenness of the Belarusian government. Evidence supporting this statement includes:

- a number of Government decrees issued after the commencement of the PDF B phase of the project including:
 - Government Decree #1820 “On Additional Measures to Ensure Cost-Effective and Efficient Use of Fuel and Energy...” dated December 27, 2002 that targets wider use of wood waste as a national strategy. Institutional measures in the Decree were intended to give strong support to wider conversion of boiler houses from fossil to renewable fuels;
 - an order issued December 2004 by the Council of Ministers to the Committee for EE, Ministries of Justice, Economy and Financing to prepare formal documents (draft regulations) for the Revolving Fund set up, including Government’s contribution to the RF;
- the GoB maintaining its financial commitment by transferring government funds (USD 1.54 million) in 2006 and 2008 to match the GEF contribution to the RF;
- approval by President (Decree #575 dated 15.11.2007) “State Integrated Program of Modernization of Belarusian Energy System Generation Facilities, Energy Efficiency and Increase of Share of Domestic Fuel and Energy Resources Use till 2011”. This document charts the government strategy of developing biomass energy projects after the completion of the Project.

6.3 Stakeholder Involvement

With Belarus having a centrally planned economy, stakeholder involvement of relevant government personnel has been a key to the success of the Project. This included MoNREP, MoF, MoE, DEE, MoHPU, CoM and a number of stakeholders from private enterprises and relevant technical institutes throughout Belarus who were consulted throughout the development and implementation of the Project. Early Project efforts on stakeholder involvement focused on government officers with study tours and technical sessions. These efforts were sustained throughout the entire duration of the Project with workshops and informal meetings concluding with the final Project Workshop of April 2008.

Awareness raising activities also provided the Project with the necessary outreach to project proponents in outlying areas from Minsk to inform them of the Project's available expertise and technical and financial assistance mechanisms. The Evaluation Team met a number of these project proponents in Uzda, Mosty, Vileika and Orekhovsk, many of whom seemed to be well entrenched into their communities. Project involvement in these regions has provided beneficiary communities with reliable sources hot water and heating using local wood biomass as a fuel. This has indirectly led to community economic benefits such as steady employment, community centers for recreation and sport, and greenhouses for fresh produce.

6.4 Financial Planning

Overall financial controls of the Project were adequate. Table 4 presents an overview of expenditures of the GEF contribution to the budget. Expenditures until the end of September 2008 were an estimated USD 3.12 million out of a total budget of USD 3.129 million. The falling value of the US dollar during the term of the Project could have negatively affected budget expenditures such as the cost of technical assistance (e.g. recruitment of a local expert assumed as USD 500 per month in the 2003 budget, has risen to over USD 1,000 per month) or the rising cost of construction materials for biomass plants that already escalated in absolute terms due to rising demand for concrete and steel.

The Evaluators conclude that management of the original budget allocations of 2003 has been satisfactory in achieving the Project objectives. The budget had been used mainly for capitalizing a revolving fund and provision of technical assistance. The revolving fund has been providing loans, notwithstanding the decreased value of the US dollar, to provide financing for the 5 demonstration projects. The aforementioned rising costs have been offset by government grants (from the Innovation Fund) and an increase in project proponent equity. This has been reflected in the Project exceeding its co-financing objectives by a factor of nearly 4.0 from 2003 estimates. Co-financing is summarized on Table 5.

6.5 Supervision and Backstopping by UNDP

Review of the Project APRs/PIRs reveals satisfactory supervision and backstopping efforts by UNDP Belarus and the UNDP-GEF Regional office in Bratislava. UNDP deserves significant credit for the successfully setup of the revolving fund. The establishment of the RF was delayed until Year 3 (2006) of the Project, and sustainability issues were not resolved until the end of the Project in September 2008. Furthermore, there were difficulties with the terms of the first loans for the Volat-1 demonstration project at a 0% interest rate, a rate that would have depleted its funds if the similar loans were extended to other borrowers. The added attention by UNDP throughout the Project duration was critical in resolving the Project RF financing issues.

Table 4: Project Expenditures (in USD as of October 22, 2008)

Project expenses	2003	2004	2005	2006	2007	2008	unspent 2008	2003-2008
Foreign personnel, consultants	-	55,500	108,679	66,083	73,094	41,610	8,250	353,216
National experts and consultants	13,594	81,780	114,399	118,924	132,858	55,297	3,500	516,072
Demonstration sites financing using the RF loans	-	530,000	350,000	660,000	-	-		1,540,000
Procurement of equipment for laboratory of monitoring and project GIS	3,466	35,560	107,785	3,998	28,425	13,087		192,321
Procurement of services in Belarus*		15,772	51,537	6,878	31,489	20,586		126,262
Project conferences, seminars, round tables	1,889	3,112	10,933	18,516	8,639	11,656		54,745
Study tours abroad and training seminars and sites visits in Belarus	-	25,296	80,459	50,796	40,883	33,930		231,364
Other	2,381	38,150	17,146	16,459	13,752	8,326	14,526	110,740
Total	21,330	785,170	840,938	941,654	329,14	184,492	26,276	3,129,000

* Includes contracts with local institutions (issuing of books, guides, brochures, video clips)

Table 5: Co-Financing and Leveraged Resources

Co financing (Type/ Source)	IA own Financing (mil USD)		Multi-lateral Agencies (Non- GEF) (mil USD)		Bi-laterals Donors (mil USD)		Central Government (mil USD)		Local Government (mil USD)		Private Sector (mil USD)		NGOs (mil USD)		Total Financing (mil USD)		Total Disbursement (mil USD)	
	Pro- posed	Actual	Pro- posed	Actual	Pro- posed	Actual	Pro- posed	Actual	Pro- posed	Actual	Pro- posed	Actual	Pro- posed	Actual	Pro- posed	Actual	Pro- posed	Actual
Grant							2.130	5.950*	1.560	8,36							3.69	14.31
Credits																		
Loans									0,63		2,44							3.07
Equity									1.510	0.220	0.290						0,22	1.8
In-kind							0.09	0.09*	1.590	0.300							1.68	0.39
Non-grant Instruments*																		
Other Types*																		
TOTAL							2.22	6.040	3.15	10.8	0.220	2.73					5.59	19.57

* Resources from the Department of Energy Efficiency

6.6 Co-Financing, Delays and Project Outcomes and Sustainability

The Project exceeded its co-financing objectives by a factor of nearly 4.0 from 2003 estimates. The additional finance was mainly government grants and equity finance for the conversion of boilers to domestic biomass fuels as the Project raised investor confidence through successful demonstrations. The co-financing has also had a direct effect on achieving the intended Project outcomes and spurring sustained growth of biomass energy projects in Belarus. The Project has also facilitated an investment environment that is friendly to foreign investment. The infusion of foreign funds into the Belarusian biomass energy sector should further contribute to its sustained growth.

The main Project delays were experienced in the implementation of demonstration projects. Delays were related to:

- the poor management and financial condition of two original demonstration sites, the mini CHP at the Olekhnovichi poultry farm and the biomass supply [unit](#) at JSC Molodechnoles. These demonstration sites were replaced by the Vileika CHP and Vileika Forestry Enterprise in December 2004 by the Project Coordinating Committee; and
- the decision by IKEA company not to build a wood processing facility in Farinovo. As such, the Farinovo site (boiler house) was dropped as a demonstration project and replaced with the Mostovdrev CHP in Mosty City;
- the unexpected addition of VAT charges and subsequent delays in the delivery of a Russian sourced steam turbine for the Mostovdrev CHP.

These delays did affect the intended Outcome 10 of 35,000 tce energy saved and 72,000 tonnes CO₂eq. reduced; actual reductions were 26,536 tce and 60,743 tonnes CO₂eq. However, the demonstrations were successful and the delays have not affected the positive evaluation of the sustainability of the biomass conversions.

7. LESSONS AND RECOMMENDATIONS

7.1 Lessons Learned

Project Design:

- Project success was based on relevance to national goals and government policy and strong government support at all levels of government. This Project received strong support from the Prime Minister's office to the Council of Ministers due to the acute need for foreign experience to facilitate urgently needed bioenergy project investments. As such, the Project benefited from this support to be able to achieve most of its objectives and intended outcomes.

Project Implementation:

- Demonstration sites programs are best implemented in increasing order of complexity. The Volat-1 demonstration was the least complex of the demonstration projects with only a heating and hot water component, and was implemented within an 8-month period in 2004. This provided the required quick response by the Project to demonstrate the viability of biomass energy projects in Belarus. In hindsight, if the Project had started with the Mostovdrev CHP, delays would have been experienced in the delivery of the steam turbine, possibly changing the perception of implementing biomass projects. Depending on the country, a poor demonstration can adversely impact the rate of adoption of a new technology;
- Project implementers need to manage the expectations of stakeholders in terms of realistic time periods on realizing benefits from GEF financing instruments. In the case of this Project, two years were required from the PDF B Phase to transfer GEF funds for financing a demonstration project. The two years would have involved the approval of the full project, Inception Mission and then project implementation to setup the Project's revolving fund. As such, Project implementers should be familiar with the approval process for the use of GEF financing instruments, and provide the stakeholder with the option of seeking another source of project financing. This was the case with the Vileika Stroidetal demonstration site where the site owner completed boiler conversions to biomass before the arrival of the GEF funds;
- Project implementation success is dependent on the stability of the government stakeholders involved with the Project. Top level decision makers and key technical specialists who took part in first study tour were dedicated to biomass production and related transportation issues. Many of these study tour participants are still involved today with biomass projects. In comparison, similar projects in other countries have not had the successes of this Project due to the frequent movement of government officers within their civil service. As a consequence of these movements, corporate memory of their project activities is lost within a short period of time, and project resources are

used to familiarize new officers with the project;

- Introduction of a new financial mechanism such as a revolving fund requires detailed and thorough preparations including existing legislation of host country on revolving funds and regulations governing sustainable use of the RF. While the experience of other countries in the setup of an RF may be useful, it cannot replace the effort required to understand host country legalities and nuances that ensure the outcome of a functional RF;
- Probabilities of project success are enhanced with additional sources of funding. In the case of this Project, the devalued US dollar and the doubling of the cost of equipment, construction materials and labour since project commencement, were threats to achieving original project objectives of 6 demonstration projects:
 - shortfalls in Project accounts were guaranteed by government who raised their planned contribution of USD 2.1 million to USD 5.8 million USD;
 - site owners raised their equity from USD 3.37 million to an estimated USD 13.0 million;
 - successful Project outcomes have garnered the interest of the Nordic Environmental Finance Corporation to co-finance biomass energy projects with revolving fund.

7.2 Recommendations

These recommendations have been generated from the lessons learned on the Project, and are intended to assist the GEF and future designers of similar projects in improving project preparations as well as implementation aspects of the projects:

- Greater scrutiny over project preparations should be made as these greatly affect the outcomes of projects: realistic schedules, absorptive capacities of stakeholders. These project preparation reviews should be done by qualified personnel from the Country Office;
- Future projects incorporating revolving funds or other GEF non-grant instruments new to the country should place the appropriate efforts in understanding the legal nuances of the host country and merging international best practices with local practices to increase the probabilities of an outcome of a functional RF. Effort should be invested early in a project or during project preparations to better assess these details.

The Evaluation Team also recommends a number of options specific to this Project to maximize leverage for the GEF revolving fund capital. These recommendations are provided with the assumptions with the knowledge that:

- ⇒ the GoB urgently wants to accelerate and optimize the growth of biomass use for energy generation in Belarus;

- ⇒ a revolving fund mechanism is recognized by the GoB as an excellent financial instrument for Belarus to leverage finances from foreign and domestic sources. Consistent with the Prodoc, the GoB has the intention of designing and operating an RF to sustain itself for a period of 21 years;
- ⇒ there are recognized difficulties in harmonizing international best practices with state-operated “funds”.

Specific recommendations include:

- Operate the RF under the NEFCO revised charter of September 2008 with fund replenishment being guaranteed by the Department of Energy Efficiency. Important reasons for this recommendation includes:
 - The NEFCO revised charter provides measures reducing the risk of RF depletion through set interest rates and loan terms, systems for evaluating borrowers and defined procedures and penalties for defaulters. However, as the RF policy is to keep interest rates lower than commercial rates, fund replenishment by DEE would need to be guaranteed to maintain the original fund levels of USD 1.54 million. While this does not promote growth of capital within the fund, this mechanism would assure that the fund does not decline over a 21-year period;
 - It would positively respond to NEFCO’s offer to cooperate and even co-finance biomass energy and other clean energy production projects. This would provide Belarus with an alternative source of funding for biomass conversions from a foreign donor.
- Explore and implement strategies to increase the reliance of project stakeholders on financing biomass energy projects through the RF. Currently, the proportion of RF finance to other sources of financing is in the order of 5% to 25% for biomass energy projects. Presumably, project proponents are financing through funds with lower interest rates of even grants. The GoB with NEFCO or other foreign institutes should explore the feasibility of additional incentives that would make RF funds more competitive with other funding sources. One of these incentives may be the lowering of interest rates in compensation for the generation of carbon credits from ERUs or VERs. Discussions with NEFCO on this possibility will be required to determine the significance of ERUs or VER credits and the extent of interest rate reduction;
- BIES should seek technical assistance to manage their RF under the new charter. Technical assistance would be required to enable fund managers to use Project-purchased software to evaluate creditworthiness; to strengthen RF management on best practices for lending and collection of loans; build capacity for clear and segregated financial RF accounting; legal analysis, and train staff to ensure repayments, and other fund management issues.

Appendix A –Terms of Reference for Final Evaluation

Position title	International Expert for Terminal Evaluation of UNDP/GEF Biomass Project
Position Level (according to pay range)	International SSA-B
Duration of contract	June 16, 2008 – July 25, 2008
Objectives of work	Perform Terminal evaluation (TE) of the UNDP/GEF biomass project #11748 in accordance with the attached terms of reference
Duties	<ul style="list-style-type: none"> • Lead and manage the evaluation mission; • Design the detailed evaluation methodology and plan; • Conduct desk-reviews, interviews and site-visits in order to obtain objective and verifiable data to substantive evaluation ratings and assessments; • Verify the GHG emission reductions achieved through the project-supported investments (using an internationally-accepted methodology); • Assess the functioning and sustainability of the Revolving Fund set up by the project; • Assess sustainability and replicability of the project-supported biomass investments, including company, technology, financial flows, etc.; • Draft the evaluation report and share with the key stakeholders for comments; • Finalize the evaluation report based on the inputs and comments from the key stakeholders.
Expected Results	TE report prepared in line with UNDP/GEF requirements and the attached terms of reference and finalized by July 25, 2008
Schedule of work	30 working days total (including 2 days for unforeseen work by agreement with UNDP), mission to Belarus – June 22-July 4, 2008
Qualifications required	<ul style="list-style-type: none"> • Advanced university degree in business, economics or energy/environment related area; • Extensive (at least 10 years) experience and proven track record with project development and/or policy advice in the field of renewable energy and/or energy efficiency; • Proven track record in monitoring and evaluations of renewable energy and/or energy efficiency projects, including evaluation of renewable or energy efficiency investment projects (relevant experience in the CIS region would be an asset); • Knowledge and proven ability to apply internationally accepted GHG emission reduction estimation methodologies (e.g. CDM or GEF); • Excellent analytical and drafting skills; • Knowledge of the relevant policies of the GEF; • Prior experience with UNDP would be an asset; • Proficiency in English (knowledge of Russian would be an asset).
Special Terms	<ul style="list-style-type: none"> • Final TE report to be submitted no later than July 25, 2008 • 2 working days for unforeseen work payable only upon agreement with UNDP that additional time is required
Duty Station	Surrey, British Columbia, Canada
Funding Source	Project 00011748
Supervisor	Project manager, Vladimir Voitekhovitch

Appendix B – List of Persons Interviewed and Documents Reviewed

<i>Minsk</i>			
#	Respondent's name	Respondent's position	Organization
1	Vladimir Voitekhovich	Project manager	“Belinvestenergozberezhenie” (BIES) and project staff
2	Tatiana Pushkina	Project Assistant	
3	Vikor Fedoseev	Project expert	
4	Andrey Lednitsky	Project expert	
5	Dmitry Suvorov	Project expert (Geographic Information System)	
6	Irina Ananich	Project expert (Revolving Fund)	
7	Dmitry Goloubovsky	Programme Officer	UNDP
8	Valentina Stalykho	Programme Manager, M&E focal point	
9	Yuri Nazarov	Deputy Minister	Ministry of Forestry of Belarus
10	Leonid Shenets	Head of the Department (Project Coordinator)	Department of Energy Efficiency
11	Ivan Belchik	Head and Coordinator of International Cooperation and Technical Assistance	Ministry of Economy of Belarus
12	Tamara Ostrovskaya	Head of Fuel and Energy Complex Department	
13	Svetlana Babintseva	Director	“Dicsa” Ltd.
14	Alexander Apatsky	Deputy Minister (GEF Focal Point in Belarus)	Ministry of Natural Resources and Environment
15	Anatoly Shagun	Head of Department of Communal Services and Energy	Ministry of Housing and Public Utilities of Belarus
16	Andrea Klammer	LEV Twinning Coordinator	LandesEnergieVerein Steiermark (LEV), Austria

<i>Field visits, demonstration sites, etc.</i>			
#	Respondent's name	Respondent's position	Organization/ location
1	Igor Petkevich	Director	Volat – 1, private company, Uzda, Minsk region
2	Sergei Ososov	General Director	JSC “Mostovdrev”, Mosty, Grodno region
3	V.Patonich	Energy Manager	
4	Pavel Kosiak	Director	Vileyka Forestry, Vileyka, Minsk region
5	Vladimir Polochansky	Director	Vileyka CHP, Vileyka, Minsk region

6	Gennady Gan	Director	BelGRES, Orekhovsk, Vitebsk region
7	Andrey.Vladykin	Head of technical department of BelGRES	

Total number of respondents involved: **22**

Documents reviewed for this evaluation includes:

- 1) Decree # 91 issued on May 31, 2006 by the Ministry of Economy Decree (electricity tariffs for independent electricity suppliers of the Belarusian State Energy Corporation “BelEnerg”).
- 2) Ministry of Utilities and Communal Services reports for 2006-2008 on boilers on local fuels.
- 3) “Dicsa-Audit” Ltd. audit report of the Revolving Fund issued on July 9, 2007.
- 4) Mid-term evaluation report by Paul Backer;
- 5) All APR/PIR reports;
- 6) All Tripartite / Project Steering Committee Meeting Reports;
- 7) 2008 Revised RF Charter Documents;
- 8) UNDP Project Document for “Biomass Energy for Hot Water and Heating for Belarus”, September 2003;
- 9) World Bank Report, “Belarus: Addressing Challenges in the Energy Sector”, Infrastructure Department Europe and Central Asia, June 2006;
- 10) UNDP Report, “Opportunities for Biomass Programmes: Experiences and Lessons Learned by UNDP in Europe and the CIS”, Ecoharmony, UK, March 2006;
- 11) UNDP Report, “Mid-Term Evaluation Report for Biomass Energy for Hot Water and Heating for Belarus”, April 2006:

Appendix C – Mission Itinerary

The evaluation mission, composed of an international consultant Mr Roland Wong and a national consultant Mr Alexei Golontsov, started in Minsk on 23 July, 2008. A series of meetings, discussions and interviews were conducted with national-level and local-level stakeholders involving “Belinvestenergozberezhnie” (**BIES** – an entity responsible for implementation of UNDP/GEF project), Belarusian Ministries, and UNDP officers. Field visits to see five demonstration sites established by the Project were made. During the field visits, the sites were evaluated from technological, socio-economic impact, environmental and sustainability perspectives.

During the two weeks in Minsk and on field trips, the evaluation mission collected initial feedback from major stakeholders in accordance with the objectives of the evaluation and obtained data relevant for making judgments regarding Project success and lessons learned.

<i>June 22, 2008 (Sunday)</i>			
#	Activity	Stakeholder involved	Place
1	Arrival of Roland Wong at Airport Minsk-2		Minsk
<i>June 23, 2008 (Monday)</i>			
#	Activity	Stakeholder involved	Place
1	Discussion of mission schedule at UNDP office with Vladimir Voitekhovich (Project Manager) and Dmitry Goloubovski (UNDP Programme Manager)	UNDP, PMU/BIES	Minsk
2	Further discussion of project results with Vladimir Voitekhovich, Tatiana Pushkina (Project Assistant)	BIES	
<i>June 24, 2008 (Tuesday)</i>			
#	Activity	Stakeholder involved	Place
1	Field visit to Volat -1 demonstration site in the town of Uzda with 2 – 1.0 MW with Dr. Igor Petkevich	Volat – 1, demonstration site	Uzda, Minsk region
2	Meeting with Yuri Nazarov, Deputy Minister for the Ministry of Forestry	Ministry of Forestry of Belarus	Minsk
3	Meeting with Leonid Shenets (Project Coordinator) for the Department of Energy Efficiency	Department of Energy Efficiency of State Committee on Standardization of Belarus	

June 25, 2008 (Wednesday)			
#	Activity	Stakeholder involved	Place
1	Meeting with Viktor Fedoseev (Project Expert and Founder)	Project staff	Minsk
	Meeting with Ivan Belchik (Head and Coordinator of International Cooperation and Technical Assistance) and Tamara Ostrovskaya (Head of Fuel and Energy Complex Department)	Ministry of Economy of Belarus	Minsk
	Meeting with Svetlana Babintseva, Director of “Dicsa” Ltd. (auditors and legal advisors for the Revolving Fund)	“Dicsa” Ltd.	
June 26, 2008 (Thursday)			
#	Activity	Stakeholder involved	Place
1	Field visit to JSC Mostovdrev, 15 MW CHP, in the town of Mosty, 250 km west of Minsk. Meetings with Sergei.Ososoov (General Director) and V.Patonich (Deputy Energy Manager)	“Mostovdrev” JSV, demonstration site	Mosty, Grodno region
June 27, 2008 (Friday)			
#	Activity	Stakeholder involved	Place
1	Field visit to the town of Vileika, Vileika Forestry, a biomass supply site, 110 km north of Minsk. Meeting with Pavel Kosiak (Director)	Vileika Forestry, demonstration site	Vileika, Minsk region
2	Field visit to Vileika, 2.4 MW CHP. Meeting with Vladimir Polochansky (Director)	Vileika CHP, demonstration site	
June 28, 2008 (Saturday)			
#	Activity	Stakeholder involved	Place
1	Meeting with Alexander Apatsky (GEF Focal Point in Belarus) at the Ministry of Natural Resources and Environment. Biomass Energy Project. Belarus and Kyoto Protocol.	Ministry of Natural Resources and Environment of Belarus.	Minsk
2	Meeting with Anatoly Shagun (Head of Communal Services and Energy Department at MoHPU)	Ministry of Housing and Public Utilities of Belarus	
3	Further discussion with Mr. Voitekhovich, Tatiana Pushkina (Project Assistant)	BIES	
4	Work on final evaluation report		

<i>June 29, 2008 (Sunday)</i>			
#	Activity	Stakeholder involved	Place
1	Work on final evaluation report		Minsk
<i>June 30, 2008 (Monday)</i>			
#	Activity	Stakeholder involved	Place
1	Meeting with Valentina Stalykho, UNDP M&E focal point	UNDP	Minsk
2	Meeting with Dmitry Goloubovski, UNDP Programme Manager	UNDP	Minsk
3	Work on final evaluation report		Minsk
<i>July 1, 2008 (Tuesday)</i>			
#	Activity	Stakeholder involved	Place
1	Visit to the town of Orekhovsk, BelGRES demonstration site (biomass production unit). CHP 1,5 MW – 300 km east of Minsk. Meeting with Gennady Gan (Director), Andrey Vladykin (Head of Technical Department of BelGRES), and Andrey Lednitsky (Project Expert)	BelGRES, demonstration site	Orekhovsk, Vitebsk region
<i>July 2, 2008 (Wednesday)</i>			
#	Activity	Stakeholder involved	Place
1	Meeting with Irina Ananich (former manager of the Revolving Fund)	Project staff	Minsk
2	Meeting with Dmitry Suvorov (former specialist of the Geographic Information system)		
3	Additional meeting with Leonid Shenets (Project Coordinator) for the Department of Energy Efficiency	Department of Energy Efficiency of State Committee on Standardization of Belarus	
4	Work on final evaluation report		
<i>July 3, 2008 (Thursday)</i>			
#	Activity	Stakeholder involved	Place
1	Work on final evaluation report		Minsk
<i>July 4, 2008 (Friday)</i>			
#	Activity	Stakeholder involved	Place

1	Departure of Roland Wong from Minsk		Minsk
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Total number of meetings conducted: **20**

Appendix D – Demonstration Project Profiles

Project 1: Demonstration of A Wood Supply Company to Supply Wood Biomass to the Vileika Combined Heat and Power Plant in Vileika (Minsk Oblast)

Owner: State Forestry Institution "Vileiskiy Leskhoz"
Pavel Kosjak, Director

Project sponsor: Committee for Energy Efficiency
Minsk oblast department, Georgiy Kirilchik

Overview of Baseline Scenario:

There was no wood chip production for heat and energy production at Vileika prior to the Project.

Overview of Demonstration Project Intervention:

Overview:

The State Forestry Institution (SFI) "Vileiskiy Leskhoz" focuses on wood harvesting and forest management and has established a department or branch responsible for the collection, processing, storage, and distribution of forest wood residues left over from harvesting, forest thinning and other forest management activities.

The department was setup to operate on a commercial basis selling wood chips initially to the Vileika city boiler house that was being supported by Project loans. The Project technically supported Vileiskiy Leskhoz advising on the procurement of all equipment, design and construction of infrastructure related to the production of wood chips and transport of wood chips to consumers. This included mobile wood chipping equipment, motor vehicle, tractors, loaders, lorries and facilities to store wood chips. The company was setup to produce about 150,000 m³ of loose wood chips per year and transporting them to local boiler houses.

Benefits:

- Forest residues left over from harvesting and forest management activities were previously left in the forest to decay. These residues are now collected, processed into chips and delivered to boiler houses. Current estimates on forest residues lost during harvesting in Belarus is 3 million m³, growing to a projected 4.5 million m³ by 2015.
- Employment creation.
- CO₂ reduction through displacement of fossil fuels.

Selection of Technology:

- Wood-chipping machinery were selected by local Project experts with oversight provided through the project's foreign biomass expert. Approval of the purchase was granted by the Client "Vileiskiy Leskhoz" who borrowed money from the Revolving Fund to purchase wood processing equipment.

Cost Breakdown of Boiler Equipment:

Project revolving funds were used to finance purchase of the wood chipping and transportation machines to supply wood biomass to the Vileika CHP plant. A breakdown of the cost of this equipment is provided below:

Description	Model Number	Quantity	Cost (USD)
Set of loading and transportation machines purchased by the company	Tracks, Loaders	1	\$276,000
Wood chipping machine with diesel engine	HEM-420D	2	\$500,695
Tractor for chipping machine transportation	MTZ-A221	2	\$62,350
Front loader	Amcodor 342C-03	1	\$60,930
Track for wood chips transportation	MAZ 543302-222	2	\$84,580
Motor vehicle used for loading and transportation of forest residues from the forest	MPT 461.1	5	\$208,435
Trailer for wood chips transportation between storage and CHP	PS-30	1	\$12,480
Tractor for trailer	MTZ-82	1	\$11,550
Main wood waste storage of the CHP	storage	1	\$308,980
Total			Total: \$1,526,000

Actual Profitability:

The following tables show 2007 and 2008 revenues from the sale of wood chips do not adequately cover production and transportation costs. The main reasons for this include the set price for wood chips (for energy purposes) by the Ministry for Economy of USD 10.50 per m³ loose. At this price, estimated losses incurred are USD 0.30 per 1.0 m³ loose (USD10.80 – 10.50 = USD 0.30 per m³ loose). In July 2008, the price limit was increased by 6.5% to USD 11.20 per m³ loose. This price increase, however, is not sufficient to overcome these losses.

Vileiskiy Leskhoz is producing wood chips from forest residues and fire wood alongside its harvesting of merchantable wood. Since merchantable wood is very profitable, Vileiskiy Leskhoz is able to offset the high cost of wood chip production using revenues from the merchantable wood. Before Vileiskiy Leskhoz produced wood chips, forest residues were collected and burnt in the forest, the cost of which was also offset by the sale of merchantable wood price. However, Vileiskiy Leskhoz is now more profitable with the production and sale of wood chips to biomass power producers. It is worth noting that several European countries have similar issues with the high cost of producing wood chips for energy which they offset through the sale of merchantable wood.

Estimated Vileiskiy Leskhoz FS Demo Project Net Revenue:

Type of Revenue	Estimated Cost or Revenue in USD				Remarks
	2005	2006	2007	2008 (6 months)	
Revenue from wood chip sales	0	0	\$638,453*	\$551,954*	\$10.5/m ³ *(loose)

Vileiskiy Leskhoz Finance and Estimated Operational Costs:

Type of Cost or Revenue	Estimated Costs in USD				Remarks
	2005	2006	2007	2008 (6 months)	
Wood Chipping and Transportation Machines		\$1,516,000			
<i>Project Finance:</i>					
Revolving fund finance requested		\$360,000			
Other financing		\$880,000			
Owner Equity		\$276,000			
<i>Operational Costs:</i>					
Debt Servicing + principal payback (actual on USD 360,000)			\$10,800 + 0	\$10,800+ \$45,000	3% interest rate plus principal paid back over a 5-year period with one year grace period
Debt Servicing + principal payback (govt. fixed rates on USD 360,000)			0 + 0	0 + \$45,000	0% interest rate plus principal paid back over a 5-year period
Debt Servicing + principal payback (commercial rates on USD 360,000)			\$43,200 + 0	\$21,600 + \$45,000	12% interest rate plus principal paid back over a 5-year period
Cost of biomass production, including chipping and transportation tom CHP	0	0	\$656,694*	\$567,724*	Specific cost 10.8/m ³ * loose This specific cost includes among other expenses, debt services of the Revolving Fund loan

Project 2: BELGRES Combined Heat and Power Plant in Orekhovsk (Vitebsk Oblast)

Owner: Republic Unitary Enterprise “Vitebskenergo”, Vitebsk
Gan Gennadiy V., Director

Project sponsor: Department for Energy Efficiency (Vitebsk Oblast Department)
V.G. Khron, Department Head

Overview of Baseline Scenario:

Heat and Energy Production:	<ul style="list-style-type: none"> • Capacity installed is 3 units x 52.0 MW thermal, and 1x 6,0 MW electric • Surplus steam used for producing 6.0 MW of electricity during 3 winter months, a time when there is sufficient steam to run the turbine
Type of boilers used:	<ul style="list-style-type: none"> • Three gas fired units (BKZ-75-33-400 - 75 tons of steam per hour at 33 Bars pressure and 400°C temperature). During the winter, one unit is in operation with the other 2 units in reserve.
Main end users/customers:	Apartment buildings, communal services, green houses, industries
Legal status of owner/sponsor	Republic Unitary Enterprise (state owned)

Overview of Demonstration Project Intervention:

Overview:

- Demonstration project was intended to increase the overall capacity of the plant to use wood fuel through:
 - Increasing the capacity of wood chipping machines to process and deliver 40,000 m³ (solid) of wood annually to cover a portion of the CHP demand for biomass. A mobile wood chipper was purchased to increase the production of wood chips for wood fuel. Special machines were purchased for Vitebsk Oblast for cleaning of vegetation from transmission right-of-ways, collection and transportation of the resulting forest residues and chips.
 - The installation of a biomass fired unit (KE-22-24-300) generating 22 tons of steam per hour at 24 Bar pressure and 300 C temperature (16 MW thermal) to operate for the entire year. While the biomass unit displaces the use of natural gas, it requires the use of both peat and wood as a fuel where peat is not considered as biomass in the emission reduction calculation. The current ratio of wood biomass to peat is now between 70:30 and 60:40 depending on equipment operation. Designed ratio of biomass to peat was between 30-70 and 40-60 (without project intervention – procurement of biomass transportation and processing equipment) Besides, with the increasing efficiency of the wood chipping process at BelGRES, the current wood fuel consumed being equivalent to 62,816 m³ (loose) will increase to 100,000 m³ (loose) within the next year;
 - the installation of a 1.5 MW steam turbine for generation of electricity based on the use of surplus steam from the 16 MW (thermal) biomass boiler, and steam from the gas-fired boiler. Electricity from this 1.5 MW turbine is thus produced year-round, displacing fossil-fuel generated grid electricity.

Benefits:

- The biomass combustor displaces 26,254 MWh of natural gas in the second half of 2007 and 28,420 MWh in the first half of 2008 through:
 - The use of wood chips (62,816 m³ (loose) or 6173 tce) for heating; and
 - Displacement of natural gas (1,38 million m³ of natural gas or 1577 tce) with biomass to generate 4,975 MWh of electricity through a 1.5 MW steam turbine;
- CO₂ emission reduction of 12,606 tons CO₂eq in the second half of 2007 and first half of 2008 (based on CDM methodology ACM0006 V6.1, Scenario 17)
- New jobs;
- Replication of CHP facilities throughout Belarus.

Selection of Technology:

- Wood chipping technology was selected by Project local experts with oversight provided through the project's foreign biomass expert. Approval of the purchase was granted by the Client "Vitebskenergo" who borrowed money from the Revolving Fund to purchase this equipment.
- The biomass combustor (the biomass-fired boiler and back pressure turbine) were procured simultaneously through international competitive bidding with the assistance of Project personnel (local and foreign). The tenders specified expected performance of the biomass combustor to be installed. The project manager and local boiler expert were the members of tendering commission.

Cost Breakdown of Wood Chipping and Transport Equipment:

Project revolving funds were used to finance 30% of the purchase of wood chipping technology and the transport of the wood chips to the CHP plant. A breakdown of the cost of this equipment is provided below:

Equipment Type	Model Number	Quantity	Cost (USD)
CHP Equipment (including biomass boiler and steam turbine)	KE-22-24-300 (biomass fired unit) 1.5 MW Steam Turbine PGT-1,5	1	\$5,500,000
Set of equipment for cleaning vegetation from power transmission right-of-ways	Stihl 036	20	\$10,000
	Other		\$10,000
Collection and transportation of forest residues	MPT-461.1	3	\$75,000
Chipping of forest residues	MTZ-1221	1	\$35,000
	"Amcodor" 2902	1	\$310,000
Transportation of wood logs and wood chips	MAZ-543302-222 MAZ-630308-226	3	\$190,000
	SAT-105	2	\$44,000
Wood chips intermediate storage and stationary wood chipping machine		1	\$376,000
Total:			\$6,550,000

Assessment of Financial Viability:

Based on revenues from heat sales and projected savings from the reduced use of natural gas, this demonstration project is financially viable. Net profit from 6 months in 2008 is $(\$916,545 + \$423,552 - \$283,143 - \$18,700 - \$77,500 = \$960,854)$.

Estimated over an entire year, net profit is estimated to be \$1.50 million. Specific energy consumption by BelGRES project and revenues from heat and electricity sales less operational costs are shown on the following tables.

Overview of BelGRES Energy Consumption:

Fuel/Emission	Estimated Annual Consumption				Unit price in USD
	2005	2006	2007	2008 (6 month)	
Gas consumption.	14,545 thousand m ³	15,203 th. m ³	9,019 th.m3	3,331 th.m3	\$176/1000 m ³
Mazut consumption	0	0	0	0	
Peat consumption	0	0	8,164 tonnes	4,203 tonnes	\$25/tonne
Wood biomass consumption	0	0	35,850 m ³ (loose)	26,966 m ³ (loose)	\$10.50/m ³ (loose)

Overview of BelGRES Energy Production:

Energy Type Produced	Estimated Annual Production				Unit price in USD
	2005	2006	2007	2008 (6 months)	
Heat production	109,790 MWh	114,727 MWh	41,210 MWh (nat.gas) 26,254 MWh (wood) 23,685 MWh (peat)	8,296 MWh (nat.gas) 28,420 MWh (wood) 17,550 MWh (peat)	\$51.43/MWh
Electricity production	0	0	1,666 MWh (biomass)	3,309 MWh	\$128/MWh

Estimated BelGRES Demo Project Net Revenue:

Revenue Description	Estimated Cost or Revenue in USD				Remarks
	2005	2006	2007	2008 (6 months)	
Revenue from heat sales (generated only by wood)	0	0	\$1,350,240	\$1,461,641	\$51.43/MWh
Revenue from electricity sales (generated by new CHP)	0	0	\$ 213,120	\$423,552	\$128/MWh
Profit from natural gas savings due to replacement by wood			\$846,692 Derived from 26,254 MWh*0.1075*300	\$916,545 =28,420MWh*0,1075*300	0.1075 – conversion factor from MWh to m ³ of nat.gas

BelGRES Finance and Estimated Operational Costs:

Cost Description	Estimated Costs in USD				Remarks
	2005	2006	2007	2008 (6 months)	
<i>Project Cost:</i>					
Equipment for wood chipping and delivery of fuel to CHP plant			\$1,050,500		This equipment was 30% financed by the revolving fund and 70% owner equity
CHP equipment (biogasifier and steam turbine)			\$5,500,000		
<i>Project Finance:</i>					
Revolving fund finance requested			\$310,000		Finance towards purchase of wood chipping equipment and delivery of wood fuel to CHP
Other financing			\$5,500,000		
Owner Equity			\$740,500		
<i>Operational Costs:</i>					
Actual Debt Service + principal payback (on USD 310,000)				\$18,700+\$77,500	Terms are 6% interest rate plus principal paid back over a 4-year period (with no grace period)
Debt Service + principal payback (assuming commercial rates of 12% on USD 310,000)				\$37,400+\$77,500	Assumes 12% interest rate plus principal paid back over 4 years without grace period
Cost of wood chips	0	0	\$376,425	\$283,143	Assumes USD 10.5 m ³ (loose)
Cost of natural gas (if priced at EU natural gas price of USD 300 per 1000 m ³)	\$4,363,500	\$4,560,900	\$2,705,700	\$1,055,100	

Project 3: Heat-only Boiler in City of Uzda

Owner: Private wood processing enterprise "VOLAT-1", producing wooden frame windows and doors
Igor Petkevich, director

Project sponsor: Committee for Energy Efficiency (Minsk oblast department)
G.I.Kirilchik, Head of Department

Overview of Baseline Scenario:

Heat Production:	<ul style="list-style-type: none"> Capacity installed is 700.0 kW thermal
Type of boilers used:	<ul style="list-style-type: none"> Seven electric boilers 100 kW each with water accumulator tank
Main end users/customers:	Production premises, technological equipment, office building
Legal status of owner/sponsor	Private company, biggest in Uzda city (270 workers)

Overview of Project Intervention:

Overview:

A new wood fired heat only 2.0 MW (2 boilers 1 MW each) thermal capacity boiler house will be installed in a separate building instead of existing electrical boilers installed inside production premises. District heating piping (outside laying 150 meters long) to connect boiler house to production shops will be installed. The new wood fired boiler house will have a higher capacity than the old one because of growing demand for production (additional wood processing equipment and shops to be installed in the coming years – currently production growth is limited due to high expenses for heat supply which is produced by electrical boilers). Due to saving reasons temperature comfort in shops and in office is also limited.

Benefits:

- o Year round heat and hot water for technology and sanitary needs
- o Natural gas savings at power plant due to electricity savings amounting to 1000 tce / yr
- o Improved temperature comfort
- o CO₂ emission reduction of 2 000 tonnes / yr
- o New jobs
- o Connection to biomass fired boiler house a kindergarten and hostel. Kindergarten is supplied with heat for free. Gas fired boiler in kindergarten shut down.

Selection of Technology:

The biomass boiler house was procured through international competitive bidding with the assistance of Project personnel (local and foreign). The tenders specified expected performance of the biomass combustor to be installed. The project manager and local boiler expert were the members of tendering commission.

Cost Breakdown of Boiler Equipment:

Project revolving funds were used to finance \$130 000 of the Volat-1 boiler house. A breakdown of the cost of this equipment is provided below:

Description	Model Number	Quantity	Cost (USD)
Two wood fired water boiler units 1MW thermal capacity each with automatic control system and supporting equipment, wood waste storage, flue gases cleaning system, construction works		1	\$320,480
Drying kilns		2	\$90,000
Boiler house building	-	1	\$62,000
District heating system		1	\$89,000
Design	-	1	\$40,000
		Total:	\$601,480

Overview of Volat-1 Energy Consumption:

Fuel/Emission	Estimated Annual Consumption				Unit price in USD
	2005	2006	2007	2008 (6 month)	
Wood biomass consumption	5,079 m ³ (loose)	4,700 m ³ (loose)	4,684 m ³ (loose)	3,214 m ³ (loose)	\$0.50/m ³ (loose)

Overview of BelGRES Energy Production:

Energy Type/Emission	Estimated Annual Production				Unit price in USD
	2005	2006	2007	2008 (based on 6 months production)	
Heat production	3,657MWh	3,384 MWh	3,373 MWh	4,628 MWh	\$20.5/MWh

Estimated Volat-1 Demo Project Net Revenue:

Type of Revenue	Estimated Cost or Revenue in USD				Remarks
	2005	2006	2007	2008 (6 months)	
Revenue from electricity savings in case of using wood instead of electricity in old electric boilers	\$468,096	\$433,152	\$ 431,744	\$296,192	\$128/MWh

Volat-1 Finance and Estimated Operational Costs:

Type of Cost or Revenue	Estimated Costs in USD					Remarks
	2004	2005	2006	2007	2008 (6 months)	
Complete boiler house, district heating system, drying kilns	\$601,480					
<i>Project Finance:</i>						
Revolving fund finance requested	\$130,000					• Finance towards purchase of boiler house equipment
Other financing	\$190,000					
Owner Equity	\$281,480					
<i>Operational Costs:</i>						
Actual Debt Servicing + Principal Payback (based on USD 130,000)				\$36,000	\$34,000	<ul style="list-style-type: none"> • 0% interest rate plus principal paid back over a 4-year period with a one-year grace period • 2007 payment in 2007 was one year late
Debt Servicing + principal payback (commercial rates on USD 130,000)	\$15,600	\$15,600	\$15,600	\$36,000+\$15,600	\$34,000 + \$7,800	<ul style="list-style-type: none"> • 12% interest rate plus principal paid back over a 4-year period with a one-year grace period
Cost of wood chips		\$2,540	\$2,350	\$2,342	\$1,607	Assumes USD 0.5 m ³ (loose)
Cost of electricity used for heat generation in case biomass boilers were not installed	\$128,768 in 4 th quarter	\$468,096	\$433,152	\$ 431,744	\$296,192	\$128 per MWh of electricity consumed

Project 4: Combined Heat and Power Plant in Mostovdrev (Grodno Oblast)

Owner: Joint Stock Co “Mostovdrev”
Alexander Onischenko Director

Project sponsor: Committee for Energy Efficiency, Grodno oblast department
A.D. Bulava, Head of Department

Overview of Baseline Scenario:

Heat Production:	<ul style="list-style-type: none"> Capacity installed 115 MW thermal. Capacity in operation 46.0 MW thermal,
Type of boilers used:	<ul style="list-style-type: none"> Gas fired steam boiler DE/25 –2units – 2x19 MW thermal, Gas fired water boilers DKVR/20/13-2 units – 2x15 MW thermal Gas fired water boiler PTVM-30 – 1 unit – 1x 35 MW thermal Wood fired boilers Tampella – 2 units low efficiency obsolete boilers (produced in 1947) 2x6MW thermal
Main end users/customers:	JSC Mostovdrev for heating, and Mosty City apartment buildings and communal utilities
Legal status of owner/sponsor	Joint stock company

Overview of Demonstration Project Intervention:

Overview:

JSC Mostovdrev replaced a DE 25/14 gas fired steam boiler (19 MW) with a CHP operation consisting of a new automatically operated wood fired superheated 17 MW steam high pressure boiler and a 2.5 MW turbine to produce electricity using high pressure (primary) steam.

Back pressure steam partly goes to the JSC Mostovdrev enterprise for wood processing and partly to the steam-water heat exchanger that supplies heat to the Mosty City district heating system. During the summer, the heat is used for domestic hot water, and in winter, for both domestic hot water and heating. The electricity produced by the 2.5 MW back pressure turbine is being used to partially satisfy the power demand of the JSC Mostovdrev.

This demonstration project was designed to:

- reduce natural gas consumption;
- use the wood waste generated by JSC Mostovdrev operations (instead of using it in the obsolete and 33% less efficient “Tampella” boilers); and
- supply domestic hot water to citizens throughout the year. Before CHP construction, domestic hot water was switched off from April until October to save fuel.

Benefits:

- Reduced consumption of natural gas fuel
- Displacement of fossil fuel generated electricity with renewable biomass energy from back pressure turbine to partially cover power load of JSC Mostovdrev
- Creation of new jobs
- CO₂ reduction

Selection of Technology:

- Wood-fired boilers were selected by Project local experts with oversight provided through the project's foreign biomass expert. Approval of the purchase was granted by the Client "Mostovdrev" who borrowed money from the Revolving Fund to purchase these boilers and back pressure turbine.
- The biomass combustor (the biomass-fired boiler and back pressure turbine) were procured simultaneously through international competitive bidding with the assistance of Project personnel (local and foreign). The tenders specified expected performance of the biomass combustor to be installed. The project manager and local boiler expert were the members of tendering commission.

Cost Breakdown of Boiler Equipment:

Project revolving funds were used to finance construction of the Mostovdrev CHP plant. A breakdown of the cost of this equipment is provided below:

Description	Model Number	Quantity	Cost (USD)
Wood fired steam boiler (17 MW) with air pre-heater, economizer, automatic control system	1 boiler KE-22-24-370	1	\$1,800,000
Steam back pressure turbine (2.5 MW)	2,5 MW electric	1	\$410,000
Reconstruction of boiler house and turbine shops, construction of wood fuel storage	-	1	\$2,100,000
Design	-	1	\$650,000
Works and construction materials.	-	1	\$2,165,000

Total: \$7,125,000

Actual Profitability:

Based on revenues from heat sales and projected savings from the reduced use of natural gas, this demonstration project is financially viable. Net profit from 6 months in 2008 is $(\$900,581/2 + \$336,896 - \$136,000 - \$26,873 = \$624,314$. Estimated over an entire year, net profit is estimated to be \$1.50 million. Specific energy consumption by Mostovdrev JSC and revenues from heat and electricity sales less operational costs are shown on the following tables..

Overview of Mostovdrev CHP Energy Consumption:

Fuel/Emission	Estimated Annual Consumption				Unit price in USD
	2005	2006	2007	2008 (6 month)	
Gas consumption.	10,826 thousand m ³	11,474 thousand m ³	9,089 th.m3	4,100 th.m3	\$176/1000 m ³
Mazut consumption	0	0	0	0	
Wood biomass consumption	88,846 m3 loose	62,999 m3 loose	76,780 m ³ (loose)	53,745 m ³ (loose)	\$0.50/m ³ (loose)

Overview of Mostovdrev CHP Energy Production:

Energy Type/Emission	Estimated Annual Production				Unit price in USD
	2005	2006	2007	2008 (6 months)	
Heat production	87,64 MWh (nat.gas) 53,147 MWh (wood)	93,47 MWh (nat gas) 35,830 MWh (wood)	69,619 MWh (nat.gas) 43,938 MWh (wood)	32,392 MWh (nat.gas) 36,115 MWh (wood)	\$37.8/MWh
Electricity production	0	0	345 MWh (biomass)	2,632 MWh (biomass)	\$128/MWh

Estimated Mostovdrev CHP Demo Project Net Revenue:

Type of Revenue	Estimated Cost or Revenue in USD				Remarks
	2005	2006	2007	2008 (6 months)	
Revenue from heat sales (generated only by wood)	\$2,008,957	\$1,353,240	\$1,660,856	\$1,365,147	\$37.8/MWh
Revenue from electricity sales (generated by new CHP)	0	0	\$ 44,160	\$336,896	\$128/MWh
Profit from natural gas savings, due to increased use of biomass in 2008 and correspondingly increased replacement of natural gas with biomass				\$900,581 Derived from(36,115*2 – 44,305)*0.1075*300/0.85	44,305 MWh – average annual production of heat by wood for 2005-2007

Mostovdrev CHP Finance and Estimated Operational Costs:

Type of Cost or Revenue	Estimated Costs in USD				Remarks
	2005	2006	2007	2008 (6 months)	
1 Wood fired steam boiler of 17 MW with automatic control system		\$1,800,000			
Steam turbine		\$410,000			
<i>Other equipment, buildings, construction works, services</i>		\$3,815,000	\$1,100,000		
<i>Project Finance:</i>					
Revolving fund finance requested	\$400,000				Request made in 2005 to start construction
Owner Equity + Bank loans		\$2,761,000	\$730,000		
Department for EE		\$2,864,000	\$370,000		
Bank loans					
<i>Operational Costs:</i>					
Actual debt servicing + principal payback (on USD400,000)		0	\$136,000	\$136,000	0% interest rate plus principal paid back over a 5-year period
Debt Servicing + principal payback (assuming commercial rates of 12% on USD 400,000)	\$48,000	\$48,000+\$100,000	\$36,000+\$100,000	\$24,000+\$100,000	12% interest rate plus principal paid back over a 4-year period
Actual cost of wood chips	\$49,423	\$31,500	\$43,890	\$26,873	Purchase from wood waste generated within plant at low cost \$0.50 per m ³ loose
Cost of natural gas used at EU natural gas price of USD 300 per 1000 m ³	\$3,247,800	\$3,442,200	\$2,726,700	\$1,230,000	

Project 5: Vileika Combined Heat and Power Plant in Vileika (Minsk Oblast)

Owner: Republic Unitary Enterprise “Minskenergo”, Minsk Oblast
Vasily Babey, General Director

Project sponsor: Committee for Energy Efficiency (Minsk Oblast department)
G.I.Kirilchik, Head of Department

Overview of Baseline Scenario:

Heat and Energy Production:	<ul style="list-style-type: none"> Capacity installed 123 MW thermal Capacity in operation 47,5 MW thermal
Type of boilers used:	<ul style="list-style-type: none"> Three gas fired water boilers PTVM-30 M – 30Gcal per hour (34.5 MW) thermal capacity. During the winter, one unit is in operation and 2 units are in reserve Three mazut fired steam boilers DKVR-10/13 – 10 tons of saturated steam per hour at 13 Bar (6.5 MW thermal capacity). Depending on load, 1 to 2 boilers are in operation for the entire year
Main end users/customers:	Apartment buildings, communal services, industries
Legal status of owner/sponsor	Republic Unitary Enterprise (state owned)

Overview of Demonstration Project Intervention:

Overview:

- Demonstration project was intended to increase overall capacity of the Vileika boiler plant to use wood fuel supplied by the Project-supported Vileiskiy Leskhoz FS through:
 - shutting down the three mazut boilers and a portion of the natural gas boilers;
 - replacing these boilers with one wood fired boiler unit (KE-22-25-370) that generates 22 tons of superheated steam per hour at 25 Bar pressure and 370 C temperature (17 MW thermal). Heat is used for district heating and hot water supplies for Vileisky City;
 - the installation of a 2.4 MW back pressure steam turbine using surplus steam from the 17 MW wood fired boiler, to produce electricity to be sold to the grid at permitted government tariff.

Benefits:

- Oil fuel savings of 5047 tons/year (7210 tce)
- Gas savings 4,926,000 m³ (5,630 tce) annually based on 2007-2008 data
- Total fuel savings of 12,840 tce (7210+ 5630)
- Electricity savings of 1792 tce/yr
- CO₂ emission reduction of 32,664 tonnes / yr
- SO₂ emission reduction of 145 tonnes / yr
- New jobs
- Replication of CHP facilities throughout Belarus.

Selection of Technology:

- Wood-fired boilers were selected by local Project experts with oversight provided by the Project's foreign biomass expert. Approval of the purchase was granted by the Client "Minskenergo" who requested loan finance from the Revolving Fund for the boiler and steam turbine.
- The biomass combustor (the biomass-fired boiler and back pressure turbine) were procured simultaneously through international competitive bidding with the assistance of Project personnel (local and foreign). The tenders specified expected performance of the biomass combustor to be installed. The project manager and local boiler expert were the members of tendering commission. Biomass fired boiler was supplied by Lithuanian company "Axis Industries", steam turbine was supplied by Saint Petersburg turbine plant (Russia).

Cost Breakdown of Boiler Equipment:

Project revolving funds were used to finance \$350,000 of the Vileika CHP plant. A breakdown of the cost of this equipment is provided below:

Description	Model Number	Quantity	Cost (USD)
One wood fired boiler unit 22 tons of superheated steam per hour at 25 Bar pressure and 370 C temperature (17 MW thermal)	KE-22-25-370	1	\$2,180,000
Back pressure turbine 2,4 MW	PTGU 2400	1	\$670,000
Boiler house building and wood waste storage	-	1	\$1,882,000
Accumulating tanks		2	\$ 556,000
Water treatment system		1	\$189,000
District heating system		1	\$480,000
Design	-	1	\$772,000
Construction works and materials	-	1	\$2,260,000
		Total:	\$8,989,000

Assessment of Financial Viability:

Based on revenues from heat and electricity sales, projected savings from the replacement of mazut and the reduced use of natural gas less cost of wood chips, debt servicing and operations, this demonstration project is financially viable. Net profit from 6 months in 2008 is \$738,900 + \$504,700 + \$428,544 – \$4,500 - \$56,000 - \$609,782 = \$1,001,862. Estimated over an entire year, net profit is estimated to be \$2.0 million. Specific energy consumption by BelGRES project and revenues from heat and electricity sales less operational costs are shown on the following tables.

Overview of Vileika CHP Energy Consumption:

Fuel/Emission	Estimated Annual Consumption				Unit price in USD
	2005	2006	2007	2008 (6 month)	
Gas consumption.	16 626 thousand m ³	14 153 thousand m ³	15 733 th.m3	5 726 th.m3	\$176/1000 m ³
Mazut consumption	3 554 tones	6 855 tones	132	0	\$200/ton
Wood biomass consumption	0	0	60805 ³ (loose)	58074 m ³ (loose)	\$10.50/m ³ (loose)

Overview of Vileika CHP Energy Production:

Energy Type	Estimated Annual Production				Unit price in USD
	2005	2006	2007	2008 (6 months)	
Heat production	179,176 MWh	191,512 MWh	136,187 MWh (nat.gas) 46,589 MWh (wood – Q2 to Q4 only)	49,186 MWh (nat.gas) 44,427 MWh (wood)	\$44.5/MWh
Electricity production	0	0	2,620 MWh (biomass)	3,348 MWh	\$128/MWh

Estimated Vileika CHP Demo Project Net Revenue:

Revenue Description	Estimated Cost or Revenue in USD				Remarks
	2005	2006	2007	2008 (6 months)	
Direct saving due to reduction of natural gas consumption				\$738,900	
Direct savings due to reduction of mazut consumption			\$1,009,400	\$504,700	
Revenue from heat sales (generated only by wood)	0	0	\$2,073,210	\$1,977,002	\$44.5/MWh
Revenue from electricity sales (generated by new CHP)	0	0	\$ 335,360	\$428,544	\$128/MWh

Vileika CHP Finance and Estimated Operational Costs:

Cost Description	Estimated Costs in USD				Remarks
	2005	2006	2007	2008 (6 months)	
2 Wood fired boilers 8,4 MW each, 14 Bar with automatic control system, 12 tons of steam/hour, 14 Bar, 250°C		\$2,180,000			
Back pressure turbine (1.5 MW)		\$670,000			
<i>Project Finance:</i>					
Revolving fund finance requested	\$350 000				
Other financing		\$5,789,000			
Owner Equity		\$2,850,000			
<i>Operational Costs:</i>					
Actual debt service + principal payback (actual on USD 350,000)			\$10,500+\$49,000	\$4,500+\$56,000	3% interest rate plus principal paid back over a 4-year period with a 12-month grace period
Debt service + principal payback (assuming 0% interest on USD 350,000)			0+\$49,000	0+\$56,000	0% interest rate plus principal paid back over a 4-year period
Debt service + principal payback (assuming 12% commercial rates on USD 350,000)			\$42,000+\$49,000	\$21,000+\$56,000	12% interest rate plus principal paid back over a 4-year period
Cost of wood chips	0	0	\$638,453	\$609,782	Purchase from several suppliers including Vileika Leshoz FS that has had support of Project. Cost assumed at USD 10.5 m ³ (loose)
Cost of natural gas (if priced at EU natural gas price of USD 300 per 1000 m ³)	\$4,987,800	\$4,245,900	\$4,719,900	\$1,717,800	