IMPLEMENTATION COMPLETION MEMORANDUM (ICM)

Revised Template version May 2007

A. BASIC TRUST FUND INFORMATION

TF Name: Biogas Generation from Animal Manure – Pilot Project
TF Number: 099602
Task Team Leader Name/TF Managing Unit: Sandra Broka/GFA05
TF Amount*:* *USD 980,000*
Recipient of TF funds: Government of Republic Moldova, Ministry of Environment, Consolidated Environment Project Implementation Unit
Type of TF: Free Standing
Single/Multi Donor: Single donor
Donor Name: World Bank
TF Program Source Code: N/A
Purpose of TF: Provide Technical Assistance, Training, and Investment Grants
TF Approval/IBTF Clearance Date: July 6, 2011
TF Activation Date: July 6, 2011
TF Closing Date: June 30, 2015
Date of ICM Submission to TFO: May 26, 2016
Cost and Financing Table:

Co financier	Original	Actual
GEF	980,000	980,000
IBRD/IDA	-	-
Recipient	248,600	67,700
Other	-	-
	1,288,600	1,047,700

Rating Summary

Category	Rating
Overall TF Outcome	Moderately Satisfactory
Overall Risk to Development Outcome	Moderate
Bank Performance	Moderately Satisfactory
Recipient Performance	Moderately Satisfactory

B. TRUST FUND DEVELOPMENT OBJECTIVES AND DESIGN

Original (and Revised) Trust Fund Development Objectives

The ***overall project objective*** was to promote the transfer of a new environmentally sustainable renewable energy technology through piloting the use of animal manure for biogas-based heating and electricity production at the farm level.

The ***global environment objective*** was to contribute to the reduction of GHG emissions through the adoption of on-grid renewable energy supplies.

The objectives were to be addressed through support in five focus areas: (i) Contribute to the creation of a legal framework for the use of bio-digesters in Moldova; (ii) Build farmer capacity on environmentally sound manure management systems to reduce climate change effects; (iii) Build local capacity to further scale-up the use of new technologies, in particular, bio-digesters;(iv) Implement a comprehensive pilot program by installing a wide range of digesters; (v) Improve operational efficiency in the animal farming sub-sector.

Original (and Revised) Trust Fund Activities/Components

The project had the following main components:

Component 1: Enabling legislative and policy environment (Total cost - $88,900 of which GEF $80,000), including: (i) certification and licensing of bio-digesters for use in Moldova and with provision of the necessary supporting legal framework; and (ii) cooperation with the country's energy regulator to review options and develop the relevant legislation provisions for allowing smaller electricity producers to sell surplus electricity into the national grid.

Component 2: Technical assistance, capacity building and awareness raising on sound animal waste management, and animal manure-based bio-digester and electricity generation technologies (Total - $691,600 of which GEF $610,000). By mobilizing international expertise and best-practice transfer, the project was to provide: (i) training of farmers in sound manure management practices; (ii) training of a number of local engineers in the installation and operation of bio-digesters in order to be able to work independently in scaling up the generation of biogas and electricity after the project closes; (iii) training of participating farmers in the proper operation of bio-digesters; and (iv) broader awareness-raising in the livestock production community through a series of seminars and demonstration activities, to disseminate information on the benefits of biogas and electricity generation from animal manure. The component would also support a feasibility study to replicate and expand the use of bio-digester technology in the country's animal farms. Finally, to reduce investment costs bio-digesters were to be manufactured locally to ensure affordability and accessibility of bio-digesters to a wider farmer population. The project was to support local manufacturers with knowledge transfer and capacity building in various bio-digester and co-generation equipment technologies.

Component 3: Bio-digester Investment Grants (Total - US$667,000 of which GEF US$200,000). The project was to fund pilot bio-digesters/co-generation systems in two livestock cattle farms where the small carbon emissions reductions prevent them from obtaining co-financing investment from the carbon funds. This was meant to complement parallel developments on poultry and swine farms under the Moldova Bio-energy project. Investment grants were to help leverage commercial loans under the IDA-supported RISP II project. Bio-digester investments included the equipment to use the gas produced for heat of electricity generation or both.

Component 4: Project Management (Total US$112,500 of which GEF US$90,000). The Carbon Finance Unit (CFU) under the Ministry of Environment was to be responsible for the technical implementation of the project. The CFU was selected as implementing agency based on the complementarity of this GEF with the follow on carbon finance project. Technical implementation of the GEF project would have permitted the CFU to obtain knowledge of bio-digester technology and become a contact point for farmers interested in adopting the new technology. Procurement and financial management functions were to be performed by the Water Supply and Sanitation Project Implementation Unit (WSSPIU) which had prior experience and a solid track record in carrying out these functions for the project. Environmental Safeguards activities were to be carried out by a part-time environmental specialist.

Output/outcome Indicators

Project outcomes were to be measured by the following outcome indicators:

- Development of market for bio-digester technologies for cattle farms encouraged, with an additional two farms installing bio-digesters.
- Legal and regulatory framework established.
- Energy produced from biogas units (kWh).

These indicators where then underpinned by a series of intermediate indicators as follows:

- Bio-digesters licensed for use in Moldova
- At least 1,500 farmers trained in sustainable manure management practices
- At least 10% of farmers who participated in awareness raising activities are using improved manure management practices
- At least one local producer of bio-digesters identified and has started production of the equipment
- Bio-digesters installed on at least two cattle farms, using grant financing
- Improved operating efficiency of the participating farms by at least 5% as a result of introduction of the new bio-digester technology.
- Improved global and local air quality, by achieving at least 103,130t/CO2 GHG emission reductions through operation of bio-digesters on the two pilot farms during investment lifetime

The indicators provided a reasonable basis for the assessment of the project performance, however two main issues where identified: (a) some indicators were too ambitious and (b) the hierarchy of indicators had some flaws. The requirement as intermediate indicator to build two bio-digester installations to meet the primary PDO indicator was too ambitious especially given the lack of knowhow and the estimated but previously untested cost structure in the country for such installations. While technology transfer can have huge benefits, complex specialized installations such as these in all likelihood involve first some component manufacturing before the experience is gained to design and build fully functional systems. In addition, given the large number of manufacturers of such equipment throughout the EU countries benefitting from favourable renewable energy policies, it was overly optimistic to assume significant local manufacturing uptake without clear demand in the local market. The indicators focused to a large part on quantitative outputs which would serve as catalysts that would lead to adoption and build on the achievements of the project. As such the indicators were too interdependent, if one indicator could not be met a string of other indicators would be missed as well. More independent indicators to measure intermediate performance could have limited the risk in not meeting certain project outputs and outcomes. In addition, the intermediary indicator on the impact on the air quality may have been more appropriate as an outcome indicator.

Other Significant Changes in Trust Fund Design

Implementing Agency: Due to internal difficulties in the CFU related to cost of running the office and the challenges to mobilize carbon financing combined with the low prices per carbon unit, the Ministry of Environment pulled back its support for implementation through the CFU. In its place the Consolidated Environmental Project Implementation Unit (CEPIU) under the Ministry of Environment was established that would also be responsible for project implementation, including financial management and procurement. CEPIU also ensured monitoring and evaluation of project activities.

Extension of the Closing Date: On March 12, 2014, the Ministry of Environment requested an extension of the project closing date until June 30, 2015 to enable: (i) the installation of a pilot biodigester in Bardar, one of the sites, (ii) significant advancement of design works at the other sites, as well as (iii) for monitoring of impact of the project activities to ensure reporting on the agreed indicators. The Bank approved this request considering that: (i) an investor in Bardar village, Ialoveni district, interested and capable to make the investment in a pilot bio-digester had been identified by CEPIU; (ii) the technical designs for the pilot bio-digester in Bardar were ready and approved by the authorities, and some of the auxiliary construction works had been contracted; (iii) the investor had identified the necessary funding, including from a commercial bank, the Biogas project and the National Ecological Fund.

Reallocations of funds: ANRE had been receiving support from the Swedish International Development Agency (SIDA) to improve regulations for calculation of feed-in tariffs for supply of energy from renewable energy investments. Therefore, no further assistance from the project was required. The funds in the amount of US$80,000

initially allocated for this purpose under Component 1 were reallocated for use in training of stakeholders including farmers, and the manufacturing industry under Component 2.

C. OUTCOME

Relevance of TF Objectives, Design and Implementation

Relevance of Objectives. Moldova is small, landlocked and one of the poorest countries in Europe with GDP per capita significantly below the average for Central European countries. At the time of the grant proposal the country imported both primary energy resources (natural gas, petroleum products and coal) and electricity. Nearly half of the energy imported is natural gas and about a quarter are liquid fuels, the rest is mainly represented by electricity and coal. Over 70% of the energy resources are used for electricity and heat production. During the last decade, only about 4% of the energy consumed came from national sources. The remaining 96% of energy was imported: natural gas from Russia, electricity from Ukraine, Romania and Transnistria.

Moldova has no oil and natural gas reserves. A small coal industry produces low-grade bituminous coal. The majority of the population lives in rural communities, where living conditions are especially difficult in the cold winter months. In rural areas, traditionally, coal and firewood are used for heating. Energy prices at the time of project preparation had taken a sharp upswing leaving many Moldovans with the choice of buying food and other life necessities vs heating their homes. As such, developing alternative energy production was a very sensible objective that was supported by Moldova's new Energy Strategy which had identified a wide range of renewable energy options including solar, wind, biogas, as well as hydropower. Given this, the overall project objectives are assessed as very relevant. However, the GEO may have been overambitious by talking about reducing GHG emissions (other than through the pilots, i.e. on a small scale).

Project Design. The grant activities were to overcome a number of barriers and challenges that prevented the emergence of renewable energy production leading to an increased share of locally produced renewable energy. The project was prepared in the wake of the GEF-financed Agricultural Pollution Control Project (P107995) that had promoted better manure management practices notably with the construction of manure platforms and slurry pits to reduce surface water contamination. The lessons drawn informed the design of this project to a significant extent, especially as it relates to the need to train farmers in better manure management practices.

The project design took a comprehensive approach that involved support to develop a more effective regulatory environment to help facilitate investments in biogas production, providing information and training to regulators and officials as well as to farmers on manure management, as well as to engineers who would later engage in the design and manufacturing of bio digesters. Two pilot sites would also serve as demonstration sites to increase interest amongst larger livestock farms in the technology that would then be replicated and ideally, at least partially be manufactured locally.

While originally the objective was the production of biogas that could be used for heat and/or converted to electricity, ultimately the focus was on electricity generation and supplying the power grid. Since these were pilots possibly more efforts could have been spent on investigating gas production which after scrubbing could have been sold in compressed bottles to retailers or even generation for any district heating systems. The economics of such arrangements could possibly have been more favourable and could have provided a platform for public private partnership between local government and private farms in energy production.

The project efforts were to lead to the emergence of at least one Moldovan manufacturer of such equipment or componentry in Moldova, which was a very challenging assumption, given the lack of knowledge in the field and the relatively modest manufacturing capacity in the country overall. The expected eventual component manufacture would likely emerge from enough demand for such installations. The initial introduction of new technology is typically based on imported installations that provide for proven designs that eventually are, or parts thereof are copied as demand for such installations grows and if local manufacturing can be more effective and efficient than the imported systems. It is, therefore, concluded, that relevance of design was substantial.

Implementation. The project experienced an initial delay of about 6 months, related to the transfer of the project implementation responsibilities to the then newly created CEPIU. The CEPIU was created following the unavailability of the support from the Carbon Fund on the initiative of the Ministry of Environment.

An extensive effort was undertaken to try to find the optimal sites for the pilot biodigesters so as to have the largest demonstration impact possible. Detailed feasibility studies were prepared for the six most likely sites for installation of biodigesters. This also included working closely with SIDA which had financed some pre-feasibility studies in Bardar. Simultaneously, an extensive information campaign was launched to promote the concept of biogas generated from animal waste including TV information clips, a series of brochures for farmers related to manure management and biogas/co-generation possibilities. In parallel, training courses were developed to be delivered to various stakeholders including local administrations, farmers as well as manufacturing engineers.

The demand for larger systems than intended at project design as well as generally weak financial capacity of the farms that had been identified as potential sites for pilot investments delayed the selection of sites. One site (with independently raised investor funding) benefitted from the technical assistance on biodigester construction and operation. Other than this, there were numerous enthusiastic attempts that faltered on the ability of mobilizing the investment resources to build the facilities. In part to be able to provide support to a larger number of initiatives, the Government decided and the Bank agreed to re-orient the approach by providing support to the design of biodigesters (six were completed by the end of the project) rather than investing in their construction.

When the opportunity presented that one of the investors in the project sites would be able to secure the necessary funding, and some of the preparatory works (building of the

access route and laying of water pipeline) was started, the Government of Moldova requested that the project would be extended by 12 months in March 2014, to allow the construction of a bio-digester under the project as originally envisaged in the project design. Unfortunately, in spite of this closing date extension the investor was not ultimately able to secure all the funding required for the biodigester construction, and works on the site stalled. Thus, none of the envisaged pilot bio-digesters ultimately benefitted from financing for construction made available under the grant, and grant resources went exclusively to the preparation of designs. Shifting the focus and resources towards providing TA and design support was a wise decision as is allowed support to projects that had resources already mobilized and had better chances for success. Given that these sites have mostly been engaged with foreign technology, however, local manufacturers have not been able to benefit and gain much experience from the project.

Achievement of TF Development Objective

The project's development objective was to promote the transfer of a new environmentally sustainable renewable energy technology through piloting the use of animal manure for biogas-based heating and electricity production at the farm level. It was to be achieved by: (i) removing barriers to enable the use of biogas renewable energy technology in the country; (ii) building farmer capacity in environmentally sound manure management systems to reduce environmental pollution; and (iii) reducing greenhouse gas (GHG) emissions to help address climate change effects by using a viable alternative to fossil fuels. Overall, the objective is considered not achieved in full, therefore the project is proposed to be rated Moderately Satisfactory. Further analysis focuses on achievement of the specific outcome indicators.

As it relates to the stated outcome indicator ***"developing a market for bio-digester technologies for cattle farms, with an additional two farms installing biodigesters"***, this is considered to be ***partially achieved and rated moderately satisfactory***. While the overall market development activities were comprehensive, covering a full review of the legal and regulatory framework, awareness raising and significant outreach to the potential investors, farmers, industry specialists and government representatives, the grants to support actual investments in two sites were not used in the originally intended manner, i.e., to support physical investment into the project sites. One biodigester was established and operation initiated with the technical assistance from the project (it was subsequently used under the project for demonstration and training purposes), and high quality technical designs were financed for six more sites. The lack of physical investment into the biodigester under the project were due to: (i) the demand by larger farms for larger digesters than envisaged at design to take advantage of economies of scale during operations, (ii) the preference for high-end Western European equipment vs less sophisticated designs as envisaged at project appraisal and, (iii) the financial crisis which led to a drying up of the credit market across Europe.

While biodigesters were not built with the project financing, the project through its training awareness at the level of public, farm and potential manufacturing base has proven to be a catalyst for the technology with some 6 projects supplied with designs and

two larger digesters being built. The technology transfer towards local manufacturing was not achieved, or at least not in the manner that the project intended. While individual componentry manufacturing seems to generate some interest, it is likely only to take off along with demand for more digesters. However, given Moldova's lack of energy alternatives and dependency on imports, biogas from farm manure along with other organic waste generated on farms have reasonable prospects on larger farms[1]. As such, given the interest that the project has generated, the achievement of the first objective of the grant is ***rated moderately satisfactory.***

With regards to the second indicator to have a functional "***Legal and regulatory framework established",*** the project substantially achieved its objectives. Only limited input was needed to the permit process for the construction of digesters and regulation for feed-in of electricity, since the review of the existing legal and regulatory framework did no show major deficiencies. More input was provided at the policy level which, along with other energy related initiatives supported by the donor community, led to the adoption of an the an updated Energy Strategy until 2030, a National Plan for Energy Efficiency in 2011, and a National Energy Efficiency Action Plan for 2013 to 2015. Due to the less intensive input required, resources were refocused to support TA in the private sector among farmers and potential manufacturers. As such this ***indicator has been met in a satisfactory manner***.

Due to the challenges related to building bio-digesters under the project, to date there is no production of biogas as direct investment by the project. However, an existing installation in Firladeni, to which the project provided technical advice is currently operational, producing some 2,520,000 kW/h thus the indicator defined as ***Energy produced from biogas units (kWh)*** has been met, however not as direct consequence of investment in construction but from TA support. Given that another 1MW bio-digester is under contract for construction, it can be assumed that within a year to 18 months, if the system runs at full capacity another 8,640,000kW/h will be generated per year. While the achievement of the indicator cannot be directly related to investments conducted under the project but with good prospects for a significant increase in production over the foreseeable future, the achievement of this ***indicator is rated moderately satisfactory.***

As it relates to the outcomes of the GEF objective ***"improved global air quality, by achieving 103,130t t/CO_2 of emission reductions through operation of biodigesters on the two pilot farms during investment lifetime",*** the Firladeni plant that is operational is expected to contribute to a reduction of some 3,603 tons of CO_2 per year which over a 15 year period would amount to some 54,045 tons of CO_2, or about half of what envisaged at project design. However, with the coming on line of the large 1MWunit on the cattle farm of Radoaia within a year that amount would increase to over 15,000 tons of CO2 per year or roughly 240,000 tons CO_2 over the life of the two installations. As such the achievement against the GEF ***objective is rated moderately unsatisfactory.***

[1] Some of these observations are made based on the report "Marktuebersicht von biogas kleinanlagen in Europa" Report number BEF2-15001-DE published June15, 2015, co-financed by the Intelligent Energy Europe Program of the European Union.

A number of intermediate indicators related to dissemination of good manure management practices as part of this project were fully met. Information related to the intermediate indicator related to improvements of operating efficiency has not been collected.

Detailed component outputs:

Component 1: The output of this component was fully attained according to the requirement of the Project Documents. Upon review of the regulatory framework it was concluded that, no special license is needed to put a bio-digester into operation in Moldova. While subject to general construction rule, each site planned for a bio-digester would have to obtain a construction permit based on the technical project (including technical design).

Support to the national energy regulator (ANRE). During the implementation of this component, it was found that there is adequate legislation in force in Moldova, which allows sale of electricity generated from renewable resources into the grid, including the electricity generated through biogas production, as well as imperative legal provisions, which in certain conditions, could legally force the energy distribution companies to buy such energy from renewable sources. The funds in the amount of US$80,000 initially allocated for this purpose were reallocated for use under Component 2 (?).

***Component 2*:** The output of this Component was fully attained according to the requirement of the Project Documents.

Training manuals and hand-outs (brochures) in sustainable manure management practices, biogas generation from animal manure for generation of biogas, and installation, operation and maintenance of bio-digesters were prepared under the project. The following modules were developed: “Manure management”, “Biogas production and energy generation from manure”, “Mechanization and automation within biogas technologies and energy generation”.

An information campaign was held throughout the country. The project formally trained a total of 8,536 persons, including 5,828 farmers, 884 rayon and local administration representatives, 774 specialists (including, engineers, agricultural and food processing sector specialists), 669 rural entrepreneurs and 381 consultants. The feedback from the farmers who benefitted from the training was very positive: 100% of respondents thought that the training was good.

The project also developed, printed and disseminated thousands of brochures on four different topics: “Composting of manure and other organic residues”, “Manure storage and handling”, “Alternative systems for manure treating” and “Environmental protection thought integrated management of biodegradable waste”. Furthermore, two brochures on biogas potential were developed on the main topics of: “Biogas production from animal manure” and “The use of biogas for heat and energy production”. Half of those materials were distributed to farmers all over the country, and the rest to the Technical University

of Moldova (Power and Electrical Energy Faculty), Ministry of Environment, Ministry of Agriculture and Food Industry, interested people and decision makers.

Follow-up work on adoption of improved manure management practices. The project documents contain an indicator that at least 10% of beneficiaries trained under the project had to adopt, during the lifetime of the project, some improved manure management practices. ACSA continued working with farmers and households throughout 2013, and in total (since the work with farmers under the project started) reached 18,017 participants from farms and households through 1,840 events, including 10,843 participants through 579 workshops, 2,269 participants through 250 round tables, and 4,905 participants through 1,011 site visits.

A survey was conducted in 2014 and the following country-wide results of the survey include:

- Agrochemical soil tests which determine the appropriate use of the fertilizer remain at a low level of use. Only 955 farms and households (5.3% of the total trainees) do such tests, covering a total of 17,052 Ha of agricultural land.
- Use of platforms for collection and storage of manure and waste: 2,742 households and farms (15.2% of the total number of trainees) and 240 communities throughout the country. The total volume of manure collected and stored is almost 3.4 million cubic meters.
- Compost production: 2,924 households and farms (16.2% of the total) with a total of 34,554 cubic meters.
- Application of recommended doses of organic fertilizer: 4,793 households (26.6% of the total) on a total of 19,800 ha of agricultural land.

In total, an estimated 11,400 households and farms (63.4% of the total number of trainees) have applied one or more improved agricultural or manure management practice.

Training of engineers and farmers in biogas and electricity generation from animal manure. The Local Consultant developed a workshop for engineers that include participants from all over the country. In the structure of the group were included 14 engineers, 5 energy professionals, 2 bioenergy workers, 5 farm owners, 3 consultants specializing in energy and an expert in the field. This training was divided in two parts, the theoretical part was held by experts in biogas generation and manure management, and practical part took place at the biogas station from Firladeni village, Hincesti district.

A workshop was held for decisions makers and the relevant government agencies that was attended by 30 participants. It included the department heads from: Ministry of Environment, Ministry of Agriculture and Food Industry, Ministry of Economy, State Ecological Inspection, National Agency for Energy Regulation, Energy Efficiency Agency, State Construction Inspection, State Labor Inspection and National Public health Center, representatives from Technical University and farmers that have a small improvised biogas station at home. This training was divided in two parts, the theoretical

part was held by experts in biogas generation and manure management, and practical part took place at the biogas station from Firladeni village, Hincesti district.

Work with the potential manufacturers of bio-digester components. As a result of the preliminary selection (which was advertised through printed mass media), six local equipment and machinery manufacturers expressed interest to participate in the project activities. Three manufacturers participated in the initial training seminar, and two participated in the study tour for bio-digester manufacturers to Slovakia. While certain parts of the bio-digester installations (such as construction of fermenter and pre-treatment and post-treatment basins, pipes, electric control panel, electricity/water/heating systems and others) can be manufactured in Moldova, no such manufacturing has yet begun due to weak demand.

A feasibility study for biogas investment potential was carried out in collaboration with the Energy Efficiency Agency (EEA) under the Ministry of Economy. The study was co-financed by the EEA and the Biogas project. The study covered the prospects for scaling up bio-digester investments in Moldova, both animal manure in combination with other types of feedstock suitable for this purpose. The findings confirmed a significant potential in scaling up bio-digestion technology to improve manure management practices in the country, and sale of electricity into the grid. The study also reviewed some potential financing methodologies (including sale of carbon benefits), and took an in-depth look at thirty farms representing cattle, swine and poultry producers of the country.

***Component 3*:** Two farms, one in Singerei and the other in Calarasi were selected as the potential demonstration sites. Both these sites were planning to install relatively large bio-digesters, 1MW each, with the total project cost of about EUR 2.5 million. The technical designs were prepared by a local design company, and parts of the bio-digester are expected to be manufactured locally. However, lack of borrowing capacity prevented construction. Four more sites - in Bardar, Anini, Hincesti and Orhei were identified to which support with system design was provided.

The summary of the current status of the sites is as follows:

- Site A: Cattle farm at Radoaia. The investor opted for a 1MW biogas installation, with the total cost of approx. EUR 2.5 million. The feedstock was to be a combination of animal manure and energy crops. The technical design was financed 100% from the project. At project closing, the investor had all the technical documents and permits in place, and had contracted a construction company.
- Site B: Cattle farm at Niscani. The investor was reviewing various options for the size of the bio-digester (between 600 kW and 1MW). Ultimately, the design was scaled down to 450kW. The technical design was financed 100% from the project. At project closing, the investor had all the technical documents and permits in place.
- Site C: Pig farm at Bardar. The investor made some preparatory work for the construction, such as the gas and water supply pipelines installed and the access

route built. However, the construction of the bio-digester has not started yet since the investor is still waiting for the grant funding from the Ecological Fund. The technical design was financed 65% from the project. The total capacity of the biogas station is 350kW. At project closing, the investor had all the technical documents and permits in place, and had contracted a construction company.

- Site D: Cattle farm at Anini. The total capacity of the biogas station is 200kW. The technical design was financed 100% from the project. At project closing, the investor had all the technical documents and permits in place.
- Site E: Pig farm at Hincesti. The total capacity of the biogas station is 350kW. The technical design was financed 100% from the project. At project closing, the investor had all the technical documents and permits in place.
- Site F: Poultry farm at Orhei. The total capacity of the biogas station is 350kW. The technical design was financed 100% from the project. At project closing, the investor had all the technical documents and permits in place.

***Component 4*:** Project management for the most part has been satisfactory and the PIU has made enormous efforts in order to get the various activities under the project delivered. At closure all outputs with the exception of the co-financing of construction of the two facilities had been delivered.

Efficiency

This was a very small grant amounting to less than US$1.0 million US$ for a pilot project to advance knowledge awareness and promote the potential of biogas/co-generation installations on livestock farms. For the most part grant resources were used in an efficient manner. For instance, a much greater number of individuals were trained under the project than estimated at project preparation within the allocated funds. The support to technical design appears to have been quite efficient as well. Designs where prepared for investments in digesters totalling between US$5.0 to 7.0 million, at a relatively modest design cost of 10 percent of investment, these expenditures alone would have amounted to anywhere between US$500,000 and US$700,000 of the grant amount.

The design of components and activities was generally appropriate for achieving project objectives albeit more modestly than envisaged in some cases. The project piloted a new approach that involved a significant learning curve for project stakeholders and participants. The beneficiaries that were selected for the project (large energy producers with potential but with no financing capacity) differed a lot from the originally envisaged beneficiaries (relatively small-scale farmers willing to resolve the manure issues). Because of the financial crisis and falling financial capacity of the potential project beneficiaries, the project had to reallocate the grants for technical design project. In view of the above, the Closing date of the project was extended from June 30, 2014 to June 30, 2015. Most scheduled work for the final year was completed and satisfactory.

Economic/financial rate of return calculation. At appraisal, the financial sustainability of the entire project was expected to be low, since, being a market-creation project with substantial capacity building and technical assistance activities, the project's IRR would

be negative. However, by providing technical assistance to local manufacturers the project was expected help to identify designs that will be attractive and more affordable to farmers and provide a basis for building a biodigester manufacturing business in the country for wider market outreach. While the objective of the work on legislation of the renewable market is to develop an attractive outlet for the biogas generated thereby providing an incentive to farmers to invest in biogas generation as part of developing a more efficient and financially sustainable agriculture. Therefore, "with project" and "without project" expected IRR was calculated for the two specific beneficiary sites, yielding an incremental improvement in the two IRRs of over 10% in the "with project" scenario. At closing, however, there was no attempt to calculate the economic and financial ratios. Given the extensive technical assistance provided by the project with no immediate income generation during the project period, the IRR for the project would be negative. The specific financial analysis of the sites was also not carried out, since the project did not provide a full package of support (technical assistance + investment), but only the technical assistance.

Development Impacts, including those that are Unintended/Unrelated to TF Objectives

The Project fully supported Moldova's strategy and policies with regards to renewable energy in general, and biogas utilization in particular. The overall target for renewable energy consumption in 2020 has been set by the "Energy Strategy up to 2030", thus harmonizing the provisions of the in force legislation in the Republic of Moldova, as 20% Renewable Energy Sources (RES) contribution to the energy consumption, the sectorial targets being set equal with 10% RES in electricity (RES-E) and 10% RES in transport (RES-T), thus resulting in 27% for heating and cooling (RES-H&C).

The Republic of Moldova aims at strengthening its own generation capacity to become a competitive electricity generation platform within the framework of the regional electricity flows. It represents one of the specific objectives of the country´s "Energy Strategy up to 2030".

The Project outcomes are fully supportive of the general country policies in the RES sector:

- Adjustment of the national legislative framework to the rules and standards of the European Union – Component 1;
- Promotion of energy from renewable sources, energy efficiency and energy savings through the application of support schemes and measures compliant with the national legislation – Component 1 & 3;
- Priority network access for electricity from renewable – Component 2;
- Ensuring access to the information on generation and utilization of energy from renewable sources and energy efficiency for legal entities and natural persons – Component 2.

The relevance of the Project can also be viewed through the country objectives in the renewable sector:

- Diversification of indigenous primary energy resources;
- Achieving at least 20% share of renewable energy in the gross final consumption of energy in 2020;
- Promoting and encouraging energy efficiency, energy savings, cogeneration use and district heating and cooling, as well as increasing share of energy from renewable sources;
- Encouraging the international scientific and technical collaboration and implementation of international technical and scientific progress in the renewable energy field;
- Ensuring communication and public awareness in the field of energy from renewable sources.

Overall TF Outcome

Overall, the grant objectives may have been too ambitious for the amount of the financing received from the GEF, as the project aimed to address all aspects related to introduction of a new technology. However, given that this project was presented as a pilot, such comprehensive approach to facilitating this technology may have been necessary, as short of the physical investments in the biodigester sites, the project implemented very well all other aspects of this market promotion attempt. The work on the legal and regulatory framework, as well as the knowledge dissemination activities have provided a solid basis for future investment in this sub-sector of agriculture. The team should also be commended for reacting proactively to the difficulties presented by the inability of the biodigester investors to secure the necessary funds, by focusing on the financing of designs with companies that had better access to credit and would install larger systems with better economies of scale. This hampered the uptake of local manufacturers since much fewer such larger system will likely be built and demand for smaller systems is not likely to develop as was expected under the project. In spite of the failure to actually finance construction of two biodigesters as envisaged in the project design, the project created enough interest that several companies are now taking steps to become manure based energy producers. As such, in spite of its shortcomings, the overall outcome rating of the grant is ***Moderately Satisfactory.***

D. Risk to Development Outcome
Follow-On Results and/or Investment Activities

*Activity/Investment:*___X__ Recipient/Other Investment; _____ Grant Project/Program; _____ Bank Project; _____ IFC Financial Project/Activity, Other (explain)

Replicability

The Project's objective was to test the transfer of a known technology to a new environment while simultaneously address a real need for more local renewable energy generation. Technology transfer is always a risky proposition because one never has all the variables that are necessary to be able gauge whether a market will take off or not. In Western Europe biodigesters seem to work when they are fully integrated into the

operation of the farm not as a profit center as such but as an integral part of farm operations. In Moldova case, there are approximately 400 animal farms that could be potential users and operators of a biodigester. Given the clarity of the legal and regulatory framework, and the extensive knowledge transfer under the project, availability of financing is the only "missing link". To facilitate replication, in particular in countries that prefer focusing on more advanced technologies, more grant support (a higher share of the investment as a grant) would be required to help offset the relatively high start-up costs. It might also not only require the involvement of the private sector, but possibly also involve research institutions and local government who could possibly benefit from such systems and share some of the investment risks, which was impossible in the Moldova case due to the extremely small budgets of the local authorities. In terms of local manufacturing of biodigesters, which would reduce the costs of biodigester installations, the starting point could be manufacturing of standardized parts that benefits from a cost advantage due to proximity to the buidigester investors, through association with more established producers (i.e., manufacturing under a license). This approach was very much intended in Moldova, where an agreement was reached during the project implementation with one of the local manufacturers of equipment to produce a simpler and more affordable biodigesters. However, the lack of financial capacity of the biodigester investor deemed the arrangement unfeasible.

The project activities have contributed to raising awareness in the energy and agricultural sectors of the country, which has brought more knowledge of the constraints that affect the emergence of a more widespread adoption of this technology.

Overall Risk to Development Outcome

The grant primarily provided for TA support, provide awareness and develop knowledge as such it never presented a major risk in achieving its outcomes. The information acquired through the grant implementation provides a basis for further development of the subsector. However, one substantive risks for replication of the technology in the future is the financial capacity of investors in biodigesters to raise necessary funding. As such risk to grant outcome are considered ***moderate***.

E. PERFORMANCE

Bank

Grant approval (MS): The preparation of the grant involved significant consultations and research into the topic to help minimize the risks related to the grant. A thorough analysis of the proposed project was prepared. While the team should be commended for the comprehensive design, it should also be noted that the design was too ambitious for the amount of funds granted from the GEF. As such the Bank performance at approval was ***moderately satisfactory***.

Supervision (S): The project was supervised effectively and regularly with significant emphasis on financial management and procurement. Possibly more technical staff on the team with more experience in engineering and technical aspects could have helped in

providing technical proposals to overcome some of the cost related challenges. However, it should also be acknowledged that this was largely off-set by the international technical consulting company hired under the project. The project supervision also suffered from an unrealistically small supervision budget which meant that supervision really could only be performed whenever the team was already in the region in order to share travel costs and expenditures. Nonetheless, the team was pro-active realised the need to change course and adapt to the situation on the ground to optimise the impact, as such supervision was ***satisfactory.***

General performance: The Bank performance is rated **Moderately Satisfactory** on balance.

Recipient (for Recipient-executed TFs only)

Recipient performance is rated **Moderately Satisfactory** as it did successfully complete most project activities and demonstrated a lot of diligence in trying to get grant objectives achieved and activities delivered. More attention should have been given by the PIU to the option of using less sophisticated and less expensive technology so that overall costs of such facilities could have been brought down and adoption of this technology could have been more widespread.

F. LESSONS LEARNED / RECOMMENDATIONS

- A grant of this nature providing substantial assistance in TA to public and private stakeholders helps with raising awareness and possibly realization of the opportunities as well as the limitations in the transfer of this new technology.

- Grant financing dependent on another grant for financing investments presents considerable implementation risks since the failure of approval of one grant make the other grant considerably more challenging.

- The smaller actors in the private sector are not able to bear the risk of introducing a new technology if it implies significant up front investments.

G. ICM PROCESSING AND COMMENTS

Preparation
TTL at Approval: Sandra Broka, Sr. Agriculture Economist TTL at Closing: Sandra Broka, Sr. Agriculture Economist Comment of TTL at Closing: N/a Prepared by (if other than TTL): Daniel Gerber, Sr. Agricultural Specialist Date Submitted to Approving Manager: April 24, 2016
Approval
Manager:

Date Approved by Manager:
Manager's Comment:

3. TFO Evaluation of ICM Quality
TFO Reviewer:
TFO Rating on the Quality of ICM *(Satisfactory or Unsatisfactory):*
Comment and Justification for Rating Given by TFO: