1.3. The construction of Internal Combustion Engine Combined Heat and Power Plants (ICE CHP) of 500 kW electrical output for electricity and heat production

1.3.1. Introduction/Background

The project will be implemented in the Republic of Moldova. The concrete locations - is subject of energy audit studies at the sites with heat demand concentration. The following main issues the project seeks to address:

a) To produce electricity and heat at the prices less than existing on site;
b) To improve country's energy security as it imports more than 95% of primary energy resources;
c) To fulfill country commitment on GHG emission reduction, established in Annex II of Copenhagen Accord, as less fuel will be used for the same energy demand satisfaction.

CHP involves using residual energy in power production to generate heat for industrial processes and district heating, providing significantly higher system efficiencies, reaching 80-85%. The heat produced by ICE CHP is usually hot water, rather than steam. 4500 hours of high and constant heat demand is needed to make CHP economical. ICE CHP is widely spread in the world. Only two small CHP are built in R. of Moldova.

ICE CHP at the capacity of 500 kW has been chosen by the working group for further promotion as there are not foreseen the sites with higher concentrated heat demand on the country territory

1.3.2. Objectives

- To increase efficiency of heat and electricity production.
- To build around 30 ICE CHPs, each of the capacity of about 500 kW, totally 15 MW, including:
  - 1MW for residential householders. It is planned several blocks be disconnected from centralized heating system and connected to locally build ICE CHP. Such strategy is adequate for many country's cities where a radical restructuring of heating system is needed due to very inefficient of existent centralized heating systems;
  - 14 MW for industrial and service providers agents (agriculture product processing enterprises, dairy products factories, hotels, campuses, etc.).

1.3.3. What are the outputs and are they measurable?

- Electricity and Heat delivered to either public distribution grid or to consumer's internal network. These outputs will be measured by the meters installed at ICE CHP and reflected in the electricity balance published by System Operator on its web site or, if electricity&heat is not delivered to public grid, the values are reported to the National Bureau of Statistics, further being reflected in the country Energy Balance.

- GHG emissions reduction. They will be determined, not measured, based on UNFCCC CDM Methodologies and available Grid Emission Factor calculation Procedure developed already for Moldova power system case.
- Fuel saved, i.e. natural gas. The values are determined by calculations. Gas burned and measured at ICE CHP is compared with appropriate base lines data.

1.3.4. Relationship to the country's sustainable development priorities

- ICE CHPs promotion is supported by many country policy instruments, including:
  - National Development Strategy "Moldova 2020" (Moldova 2020);
  - Energy Efficiency Law (EEL 2010);
  - Low Emission Reduction Development Strategy (LEDS 2020);
  - Moldova Energy Strategy up to 2030;
  - National Energy Efficiency Program for the period 2011-2020 (EEP 2011);
  - The draft of the Law on thermal energy that will transpose the European Union Directive on promoting of high efficient cogeneration technologies.

- Moldova Energy sector is distinguished by very low security of supply – circa 95% of energy carriers are imported - and by very high energy intensity – three times exceed West European one. To overcome these challenges Moldova has adopted a development trajectory that will henceforth be guided by principles of demand satisfaction from own power sources, energy efficiency, renewable energy sources development and environmental sustainability. According to the policy instruments abovementioned 650 MW of cogeneration power plants should be built and 20% of GHG emissions less produced in comparison with Base Line Scenario should be reached by 2020. As CHP source, ICE CHP examined will contribute to accomplish these targets. ICE CHP is one of national LEDS NAMAs and is viewed as a preferable solution to overcome country energy security.

1.3.5. Project Deliverables

- Main deliverables are: electricity and heat to satisfy energy demands at the prices lower than applied at sites before.
- 15MW of new power capacity and about 75GWh of distributed electricity generation will be involved in the country energy balance, diminishing by around 2,7% electricity imported and thus increasing country energy security.
- Around 67,5GWh of heat generation will satisfy the costumers demand at a quality higher that it was before ICE CHP is put in operation.
- New jobs will be created, at least 1-2 at each ICE CHP, totally around 30-60 units.
- Main beneficiaries:
  - business entities where ICE CHPs are installed, including: agriculture product processing enterprises, dairy products factories, hotels, campuses, etc;
  - householders for which ICE CHP becomes heat source;

  - country in the whole as energy security becomes higher;
  - climate in the whole as less GHG emissions will be recorded.
- Main benefits:
  - The consumers' bills for heat and electricity consumed from ICE CHP will be less by up to 20% for residential householders and by up to 15% for industrial and service providers, depending on all country electricity price evolution;
  - Around 13,6 million m3 of natural gas will be saved and 22,7 GgCO2 emissions reduced annually, contributing to cover 7,7% of SNC Intermediate Alternative Scenario target for 2020.
- Based on the experience gained, the knowledge accumulated and new technology diffusion reached new targets for ICE CHP dissemination will be established for the years after 2020.
- There are 14 centralized heating systems in Moldova (ANRE 2011) that need to be restructured because of their high energy inefficiency. The construction of ICE CHP could serve as one optimal solution in the process of these systems rehabilitation;

1.3.6. Project Scope and Possible Implementation

- The project refers to energy efficiency improvement actions, by applying cogeneration principle of heat and electricity production, involving either outside investors or the owners of industrial and service enterprises, campuses, etc.
- IRR for the first 10 years is 23% if ICE CHP is implemented to cover householders' heat and electricity demand and, it is equal to 18% if ICE CHP is built at industrial and service providers' sites, i.e. the project is feasible for Moldova business environment, where EBRD established the least IRR of 10% in their energy efficiency projects (MoSEFFII 2012). If higher load factor than 0,57 (5000 h per year) for electricity and 0,51 (4500 h per year) for heat could be reached, the higher feasibility level of the investments made in the project could be obtained.
- The potential for the project scaling up could be determined after the appropriate energy audits will be carried out at the sites established by Energy Efficiency Law (EEL 2010) and recently approved Energy Audit Regulation (EAR 2012). Energy Efficiency Agency will record all the audits and analyse them in order to elaborate respective recommendations on priority actions toward energy efficiency improvement, among which ICE CHP implementation is foreseen too.
- Usually ICE CHP is designed as aggregate facility of a certain capacity. So that the project implementation will not require much time at the stage of its construction and commissioning.

1.3.7. Project activities

- After the right sites for ICE CHP implementation is determined based on EEA respective energy audits analysis a prefeasibility study should be undertaken by future PP owner, in order to determine if the business is feasible. Concrete data from the site should be used.
- After prefeasibility study a feasibility study will be done to get more precise data, used for plant designing and equipment procurement as well.

- The contract on project implementation will be signed not before the actions reflected into the Table 1.3.12-1 are fulfilled.
- After the contract is signed the financial analysis will be done in order to determine the optimal schedule of financing as well as the financial viability of the project.
- As soon as the contract enters into force, the investor/company will proceed to:
  - land acquisition or rent;
  - obtain all necessary permits;
  - contacting with all local authorities, if needed;
  - sign agreements on electricity and heat selling;
  - procure the technology;
  - install and test the technology;
  - put into operation the ICE CHP;
  - analyze the real performances and compare with planned ones.

1.3.8. Project Timeline:

- Total time needed - 12 months, ±2months, including (Handbook 2007) :
  - site assessment, 2-3 months;
  - project design and fund obtaining, 3 months;
  - equipment procurement, 3 month;
  - equipment installation and commissioning, 3 months.

  After synchronization with the power system in the commissioning phase, there will be a 2-3 weeks operational phase with technology provider's technician on location to handle training and operational details that may arise.

1.3.9. Budget/Resource requirements

- Total investments needed to build ICE CHP of 500 kW is US$575,000.
- Annual operation and maintenance costs, excluding fuel, are in the rage of 84,000 US$;
- Feasibility study costs, including project design, are relatively high, reaching up to 10% from the total project cost. These high costs are particularly due to the fact that there is no wide-spread experience of implementing small-scale ICE CHPs in Moldova, and as a consequence, foreign consultancy – which is expensive - will need to be engaged in project initiation work.
- Total annual fuel cost is about 322,394 US$, at the price of natural gas of 506 US$/1000m3.
- It is expected that the ICE CHPs will be predominantly financed from external sources as the local capital market is under-developed. This will be done by attracting foreign private capital, using credit lines offered by international development banks, or applying for technical assistance from international donor organizations.
- ICE CHP project is eligible to Energy Efficiency Fund (EEF 2010). Such Fund is created in the R. of Moldova and is destined to finance measures leading to energy efficiency increasing and renewable sources involvement into the country energy balance. Most part of the money is allocated in form of grant. The sum allocated from the state budget to the EEF is increasing from

year to year For 2012 1.56 million Euros were allocated to this fund from the state budget, for 2013 – 5 million Euro (Allocations 2012).

- MoSEFF Project launched for Moldova by EBRD permit to get up to 2 million Euro credit with up to 20% grant for energy efficiency projects implementation, including ICE CHP (MoSEFFII 2012). I.e., this is other source of project financing.
- In the past the Government exempted from import duties the installation for construction of both Combined Cycle PP in Giurgiulesti and Coal PP in Ungheni. So that the same exemption could be applied for ICE CHP imported equipment too.
- Because of limited budget it is unlikely the cities' municipality would enter into a co-financing scheme. In the same time such collaboration could be successfully promoted with industry or service providers entities.

1.3.10. Measurement/Evaluation

- The expected year of commissioning the first ICE CHP of 500 kW is 2015-2016, or about one year after the date the project starts.
- The terms, including evaluation, of project implementation will be established in the contract between the site owner, as future beneficiary of heat and electricity, and the owner of the ICE CHP, the company which will be responsible for project implementation up to the phase of its operation, either based on donors' funds or its own sources. If the site owner is disposable to invest its own financial resources, then it will be the manager of the project and will have full responsibility for project implementation and evaluation.
- The factors to evaluate and monitor are:
  - Time schedule for project implementation;
  - Effective financial resources spent versus planned;
  - Plant effective capacity. It is measured by the amount of electricity and heat produced hourly;
  - The amount of fuel used versus projected. Plant efficiency;
  - The quantity of GHG emission reduction, calculated based on the amount of fuel savings and approved UNFCCC methodologies.
- According to LEDS, ICE CHP refers to NAMAs supported internationally. Such mitigation action requires international measuring, reporting and verification (MRV), the guidelines for which are yet to be developed. MRV framework of the measure and its effectiveness would likely require a greenhouse gas emission output indicator and can be expected to follow the approaches currently used in the CDM.
- The success of project implementation depends much on the key actions viewed be effectively finalized before launching the project. The list of such main measures and required deadlines of their implementation are shown in the Table 1.3.12-1. Any delay in resolving these issues in time would lead to the appropriate postpone of ICE CHP construction starting date.

1.3.11. Possible Complications/Challenges

- ICE CHP performance depends much on heat load factor. It should be no less than 0.514 (4500h) at any time horizon of planned plant operation period. That requires very attentive identification of heat demand evolution in the medium and long run at the stage of prefeasibility study. If in the future heat load factor will record less value than abovementioned the investments made could not be returned.
- Feed-in tariffs for electricity produced at small CHP could not be approved at the stage of taking decision to build ICE CHP. That will rise the risk the project be feasible.
- Lack of government decision to exempt from import duties the ICE CHP equipment bought from abroad. That will lead to increase the price of electricity and heat produced.
- There is no clear framework governing the process and principles for the sale of excess non-regulated electricity on the electricity market. That may negatively influence the project return of investments.
- At present for existing regulated CHPs the costs for electricity price calculation are increased in favour to heat price. As a consequence, the price for heat at ICE CHP could not compete with one generated at existing CHPs, having an negative impact on ICE CHP diffusion;

1.3.12. Responsibilities and Coordination

The actions needed to undertake to implement the project, the responsible stakeholders, the stakeholders attracted, when and how the measures should be promoted are reflected in the Table 1.2.12-1.

Table 1.3.12-1. Responsibilities and Coordination

Action	Responsible stakeholder	Stakeholders attracted	When?	How?
To identify the concrete locations where ICE CHP is feasible	EEA	Energy audit companies, energy consumers	2013-2020	Energy audits carrying out. Donors support is needed.
To approve Feed-in tariffs for energy produced at new CHP, if the energy is destined for public purposes	ANRE	EEA	2014-2015	Feed-in tariffs published.
To allocate correctly the costs for heat and electricity at existing regulated CHP	ANRE	EEA	2014-2015	CHP energy price calculation spreadsheet published on ANRE web site
To exempt from import duties the ICE CHP installations bought from abroad	ME	EEA	2014-2015	Published Government decision
Prefeasibility study and Road map	Future ICE CHP owner	EEA, municipalities, energy consumers	2014-2020	Study and developed Road map
Request to Donors to invest in ICE CHP	ME	MEn, EEA	2014-2016	Government official Request. Investments allocation
Prefeasibility study and Contracts negotiation	ICE CHP owner	EEA, municipalities,	2015-2020	Sign the contracts

Action	Responsible stakeholder	Stakeholders attracted	When?	How?
		energy consumers		
ICE CHP designing and construction	ICE CHP owner	Design and Construct agents	2015-2020	Commissioning during 2016-2020, total 30 ICE CHP
To sign contracts for ICE CHP output selling	ICE CHP owner	Electricity and Heat Buyers	2016-2020	Contracts for selling electricity, heat and GHG emission reduction if it is the case

2. PROJECT IDEAS FOR AGRICULTURE SECTOR

2.1. Brief summary of the Project Ideas for Agriculture sector

The project idea described below is concrete actions supporting the realisation of the overall target indicated in the Technology Action Plans (Report III of TNA project, implemented through the UNEP Risø Centre (URC)) for Agriculture sector and refers to the following technologies:

- Conservative technologies implementation, with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer, comprising three technologies:
  - No till soil cultivation system with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer (NTV);
  - Mini-Till soil cultivation system with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer (MTV);
  - Classic tillage, including a vetch field (two yields per year – autumn and spring), as a „green fertilizer field" into a 5-fields crop rotation (CTV).

The technologies have been selected and further examined in consultation with stakeholders, representatives from Ministries of Environment, Ministry of Agriculture and Food Infrastructure, research institutions, business, academia. The stakeholders were part of national Working group assigned to Agriculture sector.

The technology idea for these technologies has been developed following guidance from UNEP Riso Center Country Coordinator, Asian Institute of Technology (AIT), namely: methodological guidance provided during TNA workshop in Bangkok (21-24 February, 2012).

The Republic of Moldova is seeking the ways to halt its soil degradation. The most feasible way in which this can be achieved is through the promotion and diffusion of best technologies such as those specified above. But a simple identification of such technologies is a not sufficient criterion to ensure their implementation. Attracting investors' interest and supporting their motivation to progress with a project idea is essential for a successful project launch. It is therefore important that during the early stages of a project, investors are able to access relevant project-related information, including a brief description of the project's main economic and technical features, country legal and regulatory environment, existing barriers and activities planned to overcome those, challenges, opportunities for project extension and scale-up, etc.
In this context, the project ideas presented below are developed in response to the needs identified above and as such provide a first step for the attraction of investor interest in the transfer, diffusion and deployment of agriculture soils mitigation technologies.