

1. PROJECT IDEAS FOR ENERGY SECTOR

1.1. Brief summary of the Project Ideas for Energy sector

The project ideas described below are 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 Energy sector and refer to the following technologies:

- The construction of municipality solid waste gasification plant for electricity and heat production (GP-MSW);
- The construction of Internal Combustion Engine Combined Heat and Power Plants (ICE CHP) of 500 kW electrical output for electricity and heat production.

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

The technology ideas for these two technologies have 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 ways to enhance its economic development and improve its energy security, to which it has been highly vulnerable. 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 energy mitigation technologies.

1.2. The construction of municipality solid waste gasification plant for electricity and heat production (GP-MSW)

1.2.1. Introduction/Background

Project implementation location is municipality Chisinau, the R. of Moldova capital. There are three main problems the project seeks to address:

- a) To reduce the amount of waste sent to landfills. The municipalities' wastes storage at landfills has become a real problem for Moldova lately, because of population increasing protests against environment pollution these landfills provoke around. The local authorities are therefore searching for a sustainable alternative to landfilling municipal waste.
- b) To improve the country's energy security as it imports more than 95% of primary energy resources;
- c) To fulfill Moldova's commitment on GHG emission reduction, established in Annex II of Copenhagen Accord.

Waste gasification solution has been chosen by working group to treat the municipality wastes, having the following main reasons. Gasification of solid waste is a chemical process that generates a gaseous, fuel-rich product. This product can then be combusted in a boiler, producing steam for power generation. Gasification is a more complex process than waste incineration, but the reactors used for both processes are quite similar. With gasification technology, one tonne of MSW can be used to produce up to twice more electricity than with incineration technology.

1.2.2. Objectives

- To build a waste gasification plant with a generation capacity of 30MW that will process all of Chisinau's municipality solid wastes, i.e. around 372,708 tonnes per year.
- To minimise the environment pollution caused by landfilling solid waste.

1.2.3. What are the outputs and are they measurable?

- Electricity delivered to the grid. These outputs will be measured by the meters installed at GP-MSW and reflected in the electricity balance published by System Operator on its web site.
- 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.
- Heat delivered into centralised municipality grid. It will be measured by the meters installed at GP-MSW.
- Recycled materials. Their quantity will be determined by scales.

1.2.4. Relationship to the country's sustainable development priorities

- GP-MSW promotion is supported by many country policy instruments, including:
 - National Development Strategy “Moldova 2020” (Moldova 2020);
 - The Law on renewable energy (LRE 2007);
 - Energy Efficiency Law (EEL 2010);
 - Low Emission Reduction Development Strategy (LEDS 2020);
 - Moldova Energy Strategy up to 2030. Draft;
 - National Energy Efficiency Program for the period 2011-202 (EEP 2011);
 - National Waste Management Strategy for the period 2012-2025, Draft;

- 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 more than the average for West European. 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 400 MW of renewable sources should be built and 20% of GHG emissions less produced in comparison with Base Line Scenario should be reached by 2020. As renewable source, GP-MSW in municipality Chisinau will contribute to accomplish these targets.
- Chisinau GP-MSW is one of national LEDS NAMAs and is viewed as a preferable solution to overcome country municipalities’ solid waste problem.

1.2.5. Project Deliverables

- Main deliverables are: renewable electricity and heat for public needs; recycled materials (metal, glass, construction materials for roads)
- 30MW of new power capacity and 166GWh of electricity generation will be involved in the country energy balance, diminishing by around 6% electricity imported and thus increasing country energy security.
- At least 500 GWh residue energy of GP-MSW is available to be used for centralized heating annually. As existing in municipality Chisinau CHP-1 and CHP-2 have enough heat capacity reserves for centralized heating, below economic characteristics of Chisinau GP-MSW are calculated without involving GP-MSW in the heat production and supply. However, at the stage of carrying out GP-MSW feasibility study such opportunity should be taken into consideration as centralised heating system of municipality Chisinau needs be restructured because of its inefficiency, according to country Energy Strategy up to 2030.
- Recycled materials will be produced: metal, glass, road construction materials.
- New jobs will be created: 50 -according to (Chamco 2010), but can reach 350 according to (PIN China 2005).
- Main beneficiaries: villages’ people around existing landfill (Tintareni) - clean environment (air, soil, water), no more protest against waste storing; country in the whole -production of own electricity when no local conventional energy resources are available.
- Main benefits:
 - Annually 445.9 GgCO₂ emissions will be abated, including 369 GgCO₂eq avoided at landfills and 105 GgCO₂ emissions reductions as the consequence of 166GWh electricity displacement at fossil fuel power plants. The project realisation will lead to cover 2020 year country GHG emission reduction target by 18% and 51% of Intermediate and High Alternative scenarios objectives respectively;
 - Epidemiological situation around Chisinau municipality landfill (village Tantereni) will be improved (Tantareni 2010) ;
 - Reduced migration due to new job creation.

- The project is the first action in Moldova to treat solid waste, not to dispose it at landfills. Its successful implementation would lead to GP-MSW extension to other country's cities and to the neighbor countries (Ukraine, Romania) as well.

1.2.6. Project Scope and Possible Implementation

- The Project covers the area of Chisinau Municipality and refers to renewable sources.
- Private sector will be attracted in the project implementation.
- IRR is equal to 15%, calculated for the first 10 years and a load factor of 0,74 (6500h per year), the average price for electricity constituting no less than 27 UScents/kWh. If load factor is 0,91 (8000h/year) IRR reach 22% for the first 10 years, payback period being 4 years, price for electricity delivered into the grid – 23,4 UScents/kWh, in the conditions when only the electricity represents the commercial output, i.e. no heat and no CO2 abatement is sold on the market, and Municipalities do not pay to the plant operators/owners a tipping fee for each tone of MSW that they receive and handle per day. For example, the average tipping fee is around \$40 per tonne in the USA (Chamco 2010). For Chisinau GP-MSW it should be negotiated. As the plant is planned to work in three shifts a load factor of 0,91 is most likely be recorded effectively.
- Chisinau municipality generates around 56% of total MSW the country produces annually. So that after the experience is gained at GP-MSW in Moldova capital, such plant could be extended to other cities and in the neighbour countries where this technology is lack at the moment.
- Usually GP-MSW is designed as aggregate facility of a certain capacity. So that the project implementation could start with one unit, accumulate experience and then extend the project up to the full capacity (Chamco 2010).

1.2.7. Project activities

- Concrete future investor's activities oriented to build Chisinau GP-MSW will start after the appropriate contract is signed. A lot of actions should be carried out before the contract can be signed. They are reflected in the Table 1.2.13-1.
- After the contract enters into force, the investor/company selected will proceed to:
 - land acquisition or rent;
 - obtain all permits;
 - contacting with all local authorities;
 - award of contract;
 - build Chisinau GP-MSW;
 - sign contracts with Unique Regulated Electricity Operator, distribution or transport companies, and other entities on electricity, heat and recycling materials selling.

1.2.8. Project Timeline (Chamco 2010):

- The following timeline is to be expected:
 - Site assessment and engineering, 3-4 months (according to the specific conditions encountered);

- Procurement, 5-8 months (according to the specific units required);
 - Installation of the units, 6-9 months (according to conditions on the ground);
 - Commissioning, 3-5 months (according to the type of units specified).
- After synchronization with power system in the commissioning phase, there will be a 3-month operational phase with technology provider's technicians on location to handle training and operational details that may arise. Total time from award of contract to completed system is 17-26 months depending upon conditions encountered on the ground.

1.2.9. Facility Process Overview (Chamco 2010):

- MSW will arrive at the MSW processing facility location around the city. This facility can be located either at the generation facility or another location remote from the generation facility;
- Garbage will be dried and sorted. Recycling can be done at this stage;
- Garbage will be sized and processed into refuse derived fuel Briquette;
- The RDF will be used at Gasification units to produce Synthetic gas;
- Syngas directly will be used in to generate electricity and heat.

1.2.10. Budget/Resource requirements

- The total cost of the Sorting and Briquette making facilities, Gasification and Power Plants including: survey, feasibility study and planning, engineering, procurement, contracting, test, commission and training is approximately US\$126,000,000 per 30MW of power plant. The total costs will be \$102,000,000 if three shift regime is used at power plant. In this case power plant capacity will be at the level of 25MW (Ecomagazin 2008; Chamco 2010).
- Specific O&M costs (personnel, maintenance, residue processing, rent and leases, other operating expenses), excluding fuel, is 520 \$/kW*year (Amsterdam 2005), or totally \$12 - \$15 million/year corresponding to 8000-6500 operation hours per year respectively.
- GP-MSW project is eligible for Energy Efficiency Fund (EEF 2010). The sum allocated from the state budget to the EEF is increasing from year to year.
- MoSEFF Project launched for Moldova by EBRD permit to get up to 2 million Euro credit with up to 20% grant for renewable sources development (MoSEFFII 2012).
- 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 GP-MSW imported installations too.
- Because of limited budget it is unlikely the Chisinau municipality or Government would enter into a co-financing scheme.

1.2.11. Measurement/Evaluation

- The expected GP-MSW commissioning year is 2018-2019, as according to Energy Strategy 400MW of renewable sources should be built by 2020. Starting from the date of contract signing

three years are needed to build and put in operation the plant, i.e. in 2015-2016 the Contract should be signed. So that in 2014-2015 the bid for selection of best GP-MSW construction offer should be finished.

- The terms, including evaluation, of project implementation will be established in the Contract between investor and Municipality of Chisinau (MCh). As soon as the contract is signed there is a mutual motivation the terms be respected. From one site MCh is driven by the commitment to remove solid waste disposal, from another site,- the investor is interested to build the plant as soon as possible in order not to freeze the investments and to postpone the benefits from the plant operation.
- The factors to evaluate and monitor are:
 - Time schedule implementation;
 - Effective financial resources spent versus planned;
 - Plant effective capacity. It is measured by the amount of waste processed and the power delivered to the grid;
 - Electricity delivered to the grid. It is measured by the meters installed at the grid frontier
 - The number of employees hired at plant;
 - The effective composition and the caloric value of solid waste processed;
 - Plant efficiency;
 - The quantity of GHG emission reduction, calculated based on waste composition and methodologies approved in the frame of UNFCCC;
 - Heat energy delivered to the grid if such is planned to supply.
- According to LEDS, Chisinau GP-MSW 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 scheme.
- The success of project implementation depends much on the key actions viewed be effectively finalized before launching the bid for best GP-MSW offer. The list of such main measures and required deadlines of their implementation are shown in the Table 1.2.13-1.
Any delay in resolving these issues in time would lead to the appropriate postpone of GP-MSW construction starting date.

1.2.12. Possible Complications/Challenges

- Feed-in tariffs for electricity produced at renewable sources and affordable power to generate into the grid are not approved yet. That will introduce an uncertainty not compatible with investors' willing to enter into a bid for selecting the best GP-MSW offer.
- Solid waste effective composition and caloric value are not determined. It is not known how it is changing during the year too. That will impede to prepare the offers by investors.

- Lack of government decision to exempt from import duties the G-MSW installations bought from abroad. That will lead to increase the price for electricity produced, not in favour to consumers that are distinguished by very low capacity to pay for utilities.
- GP-MSW is relatively new technology, its performances depending on many local factors, as solid waste composition and its changing during the year, local staff aptitude to new technology, how the residue waste will be disposed, their recycling and selling challenges, unexpected plant hazard emissions and how they are regulated by national environment standards, the real syngas composition is not known and that can influence negatively the planned plant efficiency and operation costs, etc. That is why, it is recommended to build a small plant unit first (let's say of 4.4 MW (Chamco 2010)), increasing the capacity as soon as main issues are overcome.
- There have been some demonstration-scale efforts with conventional biomass feedstock to provide gas for a gas turbine, but inadequate reduction of tar levels in the product gas has proven to be a technical barrier at 2007 year stage (Cobb 2007)

1.2.13. Responsibilities and Coordination

The actions needed to undertake to implement the project, the responsible stakeholder, the stakeholders attracted, when and how the measures should be promoted are reflected in the Table 1.2.13-1.

Table 1.2.13-1. Responsibilities and Coordination

Action	Responsible stakeholder	Stakeholders attracted	When?	How?
To approve Feed-in tariff for electricity from MSW	ME	MEn, MCh, ANRE	2013-2014	To publish in OM
Solid waste composition and caloric value determination	MCh	MEn, R&D institutions	2013-2014	Study report
Prefeasibility study and Road map	MCh	MEn, Donor countries	2013-2014	Study and developed Road map
To exempt from import duties the G-MSW installations bought from abroad	ME	MCh, MEn	2014-2015	GD published in OM
Request to Donors to invest in GP-MSW	ME	MEn, MCh	2013-2014	Government official Request. Investments allocation
Launch and finish the bid	MCh	ME, MEn	2014-2015	Selection the best Offer (Company)
Contract negotiation	MCh	ME, MEn, Company selected	2015-2016	Sign the contract
MP-MSW designing and construction	Company selected	MCh, ME, MEn	2016-2019	Commissioning in 2019
To sign contracts for MP-MSW output selling	Company selected	MCh, Utilities, other market stakeholders	2018-2019	Contracts for selling electricity, heat, recycled material, GHG emission reduction if it is the case