Republic of Moldova

TECHNOLOGY NEEDS ASSESSMENT FOR CLIMATE CHANGE MITIGATION

REPORT IV

PROJECT IDEAS

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AIT Asian Institute of Technology

Preface

The Republic of Moldova has signed the United Nations Framework Convention on Climate Change (UNFCCC) on June 12, 1992, ratified it on March 16, 1995 and for our country the Convention entered into force on September 7, 1995. On January 28, 2011 the Republic of Moldova has associated with the Copenhagen Agreement of the United Nations Framework on Climate Change. Under this Agreement, our country has set a new target aimed at Greenhouse Gas (GHG) emissions reduction, specifying " reduction of total national levels of GHG emissions by not less than 25% by 2020 compared to the reference year (1990). Hereby, it is determined that this target shall be achieved by implementing global economic mechanisms focused on mitigating climate change in accordance with UNFCCC principles and decisions."

The recent and underway policies of the Republic of Moldova on climate change mitigation are aimed at promoting energy efficiency and renewable energy sources in all sectors of the national economy, systematic afforestation activities and rational land management, promoting innovative approaches and environmentally friendly technologies and exploring carbon financing mechanisms.

In conformity with the general objective of the Convention, which sets as a target the maximum global average temperature growth until 2100 by no more than 20C, the Republic of Moldova has decided to undertake a transition to a low GHG emissions development path. The first step in this direction was made in 2011 when development of the Low-Emission Development Strategy and Climate Change Adaptation Strategy started. Approval of these strategies is planned for 2013, which will allow access to the long-term financing mechanisms under the Convention to implement the so-called Nationally Appropriate Mitigation Actions (NAMA) and adaptation measures. Technology needs assessment in the context of climate change mitigation and adaptation is a crucial first step in achieving the objectives of these strategies. Methodological aspects of evaluation and identification of appropriate technologies in climate change mitigation and adaptation revealed during the TNA will serve as a starting point in promoting them nationwide. In the future the Republic of Moldova will address climate change issues so, that they can be included in all national and sector development policies and strategies of the country. This status will allow our country to get integrated in the global process of climate change mitigation and adaptation to this phenomenon at the national level.

Disclaimer

This document is an output of the Technology Needs Assessment project, funded by the Global Environment Facility (GEF) and implemented by the United Nations Environment Programme (UNEP) and the UNEP-Risoe Centre (URC) in collaboration with the Regional Centre Asian Institute of Technology, Bangkok for the benefit of the participating countries. The present report is the output of a fully country-led process and the views and information contained herein are a product of the National TNA team, led by the Climate Change Office (CCO) of the Ministry of Environment of the Republic of Moldova

LIST OF ABBREVIATIONS

AAPI	Agriculture Agency for Payments and Intervention
ACSA	National Agency for Rural Development (Moldova)
AIT	Asian Institute of Technology
ALRC	Agency for Land Relations and Cadastre
ANRE	National Energy for Energy Regulation (Moldova)
CDM	Clean Development Mechanism
CHP	Combined Heat and Power Plant, Cogeneration Power Plant
CTV	Classic tillage, using a vetch field with two yearly yields (autumn and spring) as a „green fertilizer field"
EBRD	European Bank for Reconstruction and Development
EEA	Energy Efficiency Agency (Moldova)
GD	Government Decree
GHG	Greenhouse Gases
G-MSW	Gasification of Municipal Solid Waste for electricity heat/ production
HAS	High Alternative Scenario
IAS	Intermediate Alternative Scenario
ICE CHP	Combined Heat and Power Plants based on internal combustion engines
IRR	Internal Rate of Return
LEDS	Low Emission Development Strategy (Moldova)
MAFI	Ministry of Agriculture and Food Industry
MCh	Municipality Chisinau
ME	Ministry of Economy
MEn	Ministry of Environment
MoSEFF	Moldova Sustainable Energy Financing Facility
MRV	Measuring, Reporting and Verification
MSW	Municipality Solid Waste
MTV	Mini tillage, with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer
NAMA	National Appropriate Mitigation Actions
NTT	NTV, MTV and CTV technologies, alltogether
NTV	No tillage, with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer
OM	Official Monitor
O&M	Operation and Maintenance
PP	Power Plant
R&D	Research and Development
RM	Republic of Moldova
SNC	Second National Communication (Moldova)
Thc	Heat capacity duration time
TNA	Technology Needs Assessment
UNFCCC	United Nation Framework Convention on Climate Change

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FOREWORD

I am proud to provide a foreword to this report, which is one of the outputs of the 'Technology Needs Assessment' (TNA) conducted in the Republic of Moldova. The TNA process was coordinated by the Ministry of Environment through Climate Change Office (CCO), who, with the help of local experts, conducted a thorough stakeholder consultation and analysis of the technical and policy options for increasing the use of low-carbon and climate-resilient technologies in the Republic of Moldova.

Following methodological and technical assistance provided by the UNEP Risø Centre, the CCO facilitated a stakeholder-led Multi Criteria Analysis for the prioritisation of both mitigation and adaptation-side technologies. This was followed by stakeholder consultations regarding the most important barriers to the uptake of these technologies, and what can be done to overcome them.

The TNA process has finalised with Technology Action Plans (TAPs) that provide a clear and realistic road map to reforming market incentives and attracting investment in specific technologies. As such, these documents allow us to facilitate the transfer of key climate technologies that also serve to drive economic growth and development. Above all, the TAPs offer practical solutions for the sustainable development of the country's agricultural sector, upon which we depend heavily for our income and livelihoods.

Gheorghe Șalaru
Minister of Environment of the Republic of Moldova
March 2013

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 sighed. 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 stakholers	2018-2019	Contracts for selling electricity, heat, recycled material, GHG emission reduction if it is the case

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.

2.2. Implementation of conservative technologies, with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer

2.2.1. Introduction/Background

Project implementation is the R. of Moldova, Agricultural soils. The following main challenges the project seeks to address:

a) To stop degradation and erosion of agricultural soils. Arable agriculture in Moldova mostly uses conventional land and crop management technology, such as ploughing the soil, several subsequent cultivations and crop establishment with seed drills. While such techniques have worked, they are no longer sustainable due to the negative impact they have had on the soil quality, damaging effects being soil erosion, loss of organic matter, soil compaction and other. During 1990-2010 years, when the transition from the planned to market based economy was promoted, the negative soil balance was recorded with up to 0.6-0.7 t of carbon/he losses;

b) To maintain and increase agricultural crop while climate is changing. During the last period high frequency of extreme natural phenomena and exceptional situations in Moldova agricultural sector (heavy rains, hail, freezing, floods, droughts) have been recorded and that has made very instable plant production during the years;

c) To fulfill country commitment on GHG emission reduction, established in Annex II of Copenhagen Accord. Nowadays, according to the calculations made, from the 0-30cm of soil layer 0.65 tone of humus/he or 0.38 tone of carbon/he is lost each year, equivalent to 1.4 tone of CO2/he emissions in atmosphere.

To reach these goals friendly practices to the soils should be applied, they leading to organic substance stocking in the soil, finally contributing to enough humus creation in the land. Three technology have been selected by working group for further promotion, as ones distinguished by reaching progressive soil conservative effects, namely:

- 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 main reasons why NTV, MTV and CTV technologies were identified as ones priority measures for Moldova Agriculture sector are derived from the fact that they ensure long term maintenance of soils fertility – the main production means of the country, and protect the farmlands from desertification. These technologies share the same barriers as they represent three possible land cultivation techniques that can reduce GHG emissions and minimize the degradation of soil quality. All the technologies apply vetch as a „green fertilizer field" into a 5 fields crop rotation; they differ mainly by the depth of tillage applied and

degree of agriculture waste conservation into the soil. The farmers' choice of one of the technology depends on their local tradition, machinery availability and level of precipitation. For example, in the country south part droughts predominate, NTV being the most recommended technology.

2.2.2. Objectives

- The target is to achieve the diffusion of NTV, MTV and CTV technologies over a total area of 600,000 hectares, which constitutes 36% of total country arable land. It is forecasted 200,000 hectares be involved per each of three technologies, 20,000 hectares each year, during 10 years, starting with 2014 year. As a consequence a positive balance of humus and carbon, and nitrogen fixation in soil will be created as a result of systemic use of green fertilizer (autumn vetch of *Violeta* variety and spring vetch of *Moldavscaia 82* variety), leading to reducing practically total CO2 and N2O emissions from soils.

2.2.3. What are the outputs and are they measurable?

- Carbon conservation and humus increasing in the soil. The share of carbon in the soil can be measured by applying all known methods of laboratory analysis (ERASC 2002).
- Agricultural crop per hectare. Their quantity will be determined by scales and then compared to the crop obtained at the same lands in the past.
- GHG emission abatement. CO2 emission reduction will be calculated based on the appropriate UNFCCC CDM Methodologies.

2.2.4. Relationship to the country's sustainable development priorities

- NTV, MTV and CTV promotion are supported by many country's policy instruments, including:
  - Program for Soil Fertility Conservation and Enhancement 2011-2020 (Fertility 2011);
  - Low Emission Reduction Development Strategy of The Republic of Moldova to 2020 (LEDS, 2012);
  - National Strategy for Republic of Moldova Agro-industrial complex sustainable development (2008-2015) (NSSDA 2008);
  - Soil protection measures in the frame of Agriculture practices (SPM 2008).

- According to (Fertility 2011) the following overall objectives to soils improvement are established:
  - By end of 2020 to stop the active degradation of 887,000 hectares of arable land;
  - By 2020 to implement works of soil conservation and fertility improvement on an area of 1.7 mln. hectares.
- The key Agriculture sector objectives are in compliance with established country sustainable environment goals. According to SNC HAS, up to 323.3 Gg CO2eq emissions should be reduced in Agriculture sector by 2020. That is why, NTV, MTV and CTV are included in the list of LEDS NAMAs and are viewed as priority solution to reach the LEDS target.

2.2.5. Project Deliverables

- Main deliverables are (Rusu 2005, Cerbari 2012):
- crop increasing by up to 35%, it being of high quality;
- decreasing by up to 80-90% nitrogen fertilizer needed annually;
- up to 30% decreasing of fuel used by tillage machinery;
- restoration of the humus content, favorable structure and fertility of the soil arable layer;
- decreasing of non-productive losses of water from soil due to mulching which contributes to combating pedological drought;
- partial or total stop of the soil erosion (the stubble field and mulching favoure reduction of leaks and accumulation of water from precipitations in the soil);
- establishment of a positive balance of humus and carbon in soil, with no GHG emissions from agricultural soils.
- Main beneficiaries: rural population – their welfare will increase, labour migrants will return to their native villages and exodus will decrease; the country in the whole – the GDP will increase.
- Main benefits: crop yield increase of 1.0 t/ha (wheat); fodder production/quality increase; farm income increase; reduced labour and energy inputs; national institution strengthening; soil cover improvement (residues, early seeding); increase in soil moisture; increase in soil fertility; soil loss reduction; increase in soil organic matter; biodiversity enhancement; flexible labour inputs: seeding is independent of rain onset; fewer tractor passes in field; reduced downstream flooding, etc (WOCAT 2007). More specifically:
  - By 2020 the implementation of abovementioned conservative technologies will assure 540.4 GgCO2/year emission reduction, much higher than it was planned by SNC for agriculture sector (323.3 Gg CO2eq). That is explained by both the progressive technologies' evolution and increased farmers' awareness to implement such technologies. The new target of GHG emission reduction will be reflected in the country Third National Communication that is in the process of elaboration now;
  - Relatively stable agriculture production, it being less vulnerable to climate change, leading finally to country economic growth. Lately the contribution of the agricultural sector in the R. of Moldova GDP ranged between 14.5 – 22.4 percent, plant production contributing by 67,7% (NS 2011);
  - Stabilization of economic, ecological and social situation in rural areas. Because of high land fragmentation, low land productivity and income received the exodus of population out of the countryside has begun around fifteen years ago and is continuing up to now;
  - Reduced labour input.
- The project promotion will lead to:
  - Land consolidation. In order to achieve economies of scale and higher returns, conservative technologies in agriculture must be implemented on large plots of land. Land ownership in Moldova is highly polarized, with few large corporate farms and many small and fragmented family farms;
  - Stronger stakeholder cooperation. The level of collaboration between non-governmental organizations and public authorities in the sector is generally inadequate, which leads to a

poor understanding of local needs and opportunities for implementing conservative technologies.

- Vetch production in Moldova could be launched, vetch seeds cultivated serving not only for country own use, but for export as well.

2.2.6. Project Scope and Possible Implementation

- The Project Scope refers to soil conservation, aiming to restore the humus content, favorable structure and fertility of the soil arable layer, exclude soil erosion. And thus, the project is one sustainable.
- As it was mentioned above, overall for Moldova, the target is to diffuse each of three technologies over 200,000 hectares of land over a period of 10 years (20,000 ha annually each) using 5-field crop rotation. The estimated benefit as a result of improved crop yield is 47Euro /he/year (NTV, MTV) and -60 Euro/he/year (CTV) in the first year, reaching 255 Euro/he/year (NTV, MTV) and 192 Euro/he/year (CTV) in the 10th year, while CO2 reduction is estimated at the level of 2.54t/ha/year and 2.03t/ha/year respectively. NPV for the first 5 years is US$38,3million and US$21.82 million for (NTV, MTV) and (CTV) respectively, without carbon trading. So that the project is quite feasible.
- As soon as the project is implemented and experience is gained, NTV, MTV and CTV could be spread over other arable land of the R. of Moldova, the total area of which is around 1.83 million hectares at present.
- Totally on around 2,4% of country arable land NTV and MTV is used, but Hairy Vetch for Cover Cropping in Organic Farming is not used at all in the R. of Moldova.

2.2.7. Project activities

- The project should start with Land consolidation. In Moldova there are few large corporate farms and many small and fragmented family farms.
- The necessary agricultural equipment for direct sowing farming should be bought, including:
  - seed drills for direct seeding;
  - special tractors;
  - herbicide sprayers;
  - seed and fertilizer drill systems;
  - combine harvesters and other machinery required by the technology.
- On site the following activities are foreseen (WOCAT 2007):
  - Stubble maintenance (no grazing, only partial straw removal after harvest);
  - Direct seeding/fertilizer (N/P) banding using no-till drill (early November);
  - Chemical weed control (December/January);
  - Nitrogen fertilization (March);
  - Harvest (May: after 6 months crop period;
  - Leave fields to fallow for 18 months; apply herbicides if needed.

- As it was specified above, a total of 200 000 hectares of agricultural soils will be allocated to be used per each of NTV, MTV and CTV technologies, annually 3x20 000 new agriculture surface being attracted in this process. In the first year, per each technology, 1/5 of the area, i.e. 4000 he, is sown with vetch seed and this area ensure a higher harvest only in the second year. In the second year another new 1/5 area is sown with vetch seed, etc. After five years a new rotation will follow. On the lands where the vetch is not sown the vegetable residues remained on the ground.

2.2.8. Timelines

- The project is planned for 10 years implementation. Each year 20,000 hectares per each of NTV, MTV and CTV will be attracted into the project realization.
- Land consolidation, equipment acquisition and staff training will require additional 2 years before on site tillage will start.

2.2.9. Budget/Resource requirements

- US$8.2 million investments are required to attract into the project 3x20,000 hectare of lands each year during 10 years, including:
  - US$2.4 million per each of NTV and MTV technology
  - US$3.4 million for CTV
- US$17.6 million O&M costs, including for seeds acquisition, are needed, in the first year. In the 10th year O&M costs will rise up to US$175.5 million as 600,000 hectare will be attracted into the project. Respectively, O&M cost for separate technologies will be:
  - US$5.5 million in the first year and US$54.8 million in the 10th year for each of NTV and MTV technology
  - US$6.6 million in the first year and US$65.9 million in the 10th year for CTV technology
- Only in the first year for all technologies and partially in the second year for CVT technology the income obtained from project activity will not be enough to cover both investments and O&M costs above specified. After 1-2 years the benefit becomes positive. Such results are obtained if the following grains are in the 5 years crop rotation agrotechnique and the harvest is sold on the market at 2012 prices: Vetch (is used for own needs only), Maize, Winter wheat, Peas, Sunflower.
- The farmers launching the project are eligible to get subsidies from state budget, according to Government Decree (Subsidies 2007). In 2012 400 million Lei (around US$33million) were allocated from the state budget as subsidies to agriculture farmers.
- Ministry of Agriculture and Food Infrastructure has been considering the elaboration of a subvention scheme for the purchase of equipment for conservative technologies to cover up to 20-30% of total cost. But up to now no concrete decision has been published.
- As vetch fertilizer is not used in Moldova, an appropriate consulting agency should be hired before the project starts.

- NTV and MTV technologies are used on around of 44000 hectares in Moldova. Respective cooperation agreements should be established with the appropriate farmers in order to make project implementation with fewer mistakes.
- An active partnership should be established with local authorities in order to have support on the stage of Land consolidation and further project development

2.2.10. Measurement/Evaluation

- The factors to evaluate and monitor are:
  - Content of humus (organic carbon) in the soil. That is the key parameter that should be evaluated and monitored. It will be measured annually after the September harvesting, hiring in this respect a R&D institution;
  - Time schedule implementation;
  - Type and quantity of herbicides used;
  - Weather data;
  - Quality and quantity of grains sown and harvested;
  - The number of effective hectares of land attracted in the project per each of technology, i.e. NTV, MTV and CTV;
  - Effective quantity of crop harvested at the lands with and without vetch fertilizer;
  - The quantity of GHG emission reduction, calculated based on humus structure (organic carbon) and methodologies approved in the frame of UNFCCC;
  - Economic data: investments, O&M costs, Income.

  All this factors should be subject of comparison with the ones predicted or planned by the project, in order to identify why they are different and what should be done to reach the performance of best practices.
- According to LEDS, NTV, MTV and CTV refer 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 (LEDS 2020).

2.2.11. Possible Complications/Challenges

- Because the use of vetch as organic fertilizer is a new approach to maintain and increase the agricultural crop, the local farmers may manifest a reluctance to promote NTV, MTV and CTV with vetch application. There is a resistance to change due to strong reliance on traditional cultivation techniques and skeptical appreciation of practices that defy the familiar. Information and awareness raising campaigns, trainings are needed to overcome this challenge. Programs to improve soil management through good agricultural practices exist, but their funding and coverage remains limited.

- Land consolidation could meet difficulties. Some of land owners may impose not reasonable conditions at the stage of signing leasing contract, leading to resource spending and delay in the project starting.
- Most individual farmers have little business management experience and have had limited exposure to modern technologies that can be employed to increase the efficiency of land works and improve production processes in agriculture. Managers of corporate farms also have insufficient knowledge in areas such as corporate administration, demand forecast, financial management, procurement and marketing.
- The lack of labour opportunities in rural areas has led to a massive labour migration out of the countryside. Most of the migrating population has been young people, and specialists with medium and high level of education.
- Access to soil and other testing facilities is limited in Moldova. Although there are some soil testing laboratories across the country, these are not strategically placed, which limits the farmers' ability to determine the proper mix of fertilizers required for their soil.
- Weaknesses and how to overcome (WOCAT 2007):
  - High level of management is required. Training of land users is needed;
  - Sensitive to nitrogen level management. Soil tests/application of azote according to needs of crops under NTV, MTV and CTV technologies (NTT) is a mandatory;
  - High disease and pest prevalence if crop residues are not well managed. Resistant varieties and early seeding of diverse crops is required;
  - Reduced availability of straw (fodder). Crop optimization/livestock integration is needed: straw production under NTT is higher but farmers have to be convinced to remove only part it; use fodder crops in rotation is required;
  - Unforeseen environmental risks: e.g. soil or ground water contamination with herbicides/phosphate;
  - Weed control in NTT is critical: weed infestation if not well managed; high cost of herbicides. Measures to overcome: environment-friendly herbicides application, crop diversification; hand weeding;

2.2.12. Responsibilities and Coordination

The actions needed to undertake, the responsible stakeholder, the stakeholders attracted, when and how the measures should be promoted is reflected in the Table 2.2.12-1.

Table 2.2.12-1. Responsibilities and Coordination

Action	Responsible stakeholder	Stakeholders attracted	When?	How?
Information and awareness raising campaigns, trainings	MAFI	ACSA, AAPI, Farmers	2013-2020	A program for disseminating information and raising awareness about conservative agriculture should be elaborated, approved and promoted. To apply Subsidies for the acquisition of services of training to farmers and enterprise managers.
To promote land consolidation	MAFI	ALRC, Farmers	2013-2018	Incentivize single-party land ownership over areas of more than 200-400 hectares; encourage long-term leasing and strive to

Action	Responsible stakeholder	Stakeholders attracted	When?	How?
				reduce transaction costs for selling and buying land.
To reduce transaction costs associated with land sale-purchase and lease contracts	LRCA	MAFI	2013-2016	Replacing the minimum notary fee with a pro rata fee, simplifying the ownership-transfer procedures, allowing consolidation of multiple small contracts in fewer bulk transactions to reduce total fees
To boost the implementation of policies and action plans promoting conservative agriculture	MAFI	AAPI	2013-2014	To elaborate the Program for promoting conservation agriculture. Put in practice a subvention scheme
To promote stronger stakeholder cooperation and foster a culture of participation	MAFI	ACSA, AAPI, Farmers, Local Authorities	2013-2018	Financial support to strengthen institutional capacities of local authorities so that they can take on greater responsibilities for environmental protection. Public-private dialogue, to establish a road-map that will build trust among the various players along the value chain of agricultural production.
To strengthen advisory services to help promote sustainable practices	ACSA	MAFI	2013-2015	To enlarge financial support from country budget; To apply to donor support.
To improve laboratory infrastructure	MAFI		2013-2020	To increase the number of laboratories in the strategic rural points
To improve the national system of pedologic research	MAFI	Agriculture research institutions	2013-2020	To apply a single land tax instead of at least six existing taxes. To elaborate the digital country-wide pedological map
To establish and maintain a centralized database on soil quality	MAFI	Agriculture research institutions	Starting with 2014 and maintain permanently	To designate an institution for creation a centralized database on soil quality. The appropriate fund should be allocated
To apply to donors support for NTT promotion	MAFI	Farmers, AAPI, MEn	2014-2020	To prepare concrete formal requests and apply to donors.
To get financing, including from donors	MAFI	Farmers, AAPI	2014-2020	Investment contract signing
NTT machinery acquisition	Farmers	AAPI	2014-2020	Negotiation with NTT machinery producers
NTT on site implementation	Farmers	Local authorities	2014-2024	NTT agro technique application

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ANNEXES

Annex I. List of stakeholders involved and their contacts

Table AI.2.2.12-1.Experts involved in the Project Idea development

No	Expert name	Position, title, Institution	Area of expertise	Contact data
1	Comendant Ion	Ph.D, Research Coordinator, Institute of Power Engineering ASM	Team Leader of Mitigation Team under the TNA Project, Power System, Energy Efficiency, Renewable Energy Sources economic analysis, Climate Change, Energy Regulations, Tariffs	Phone: 373 69 217 004 icomendant@gmail.com
2	Sula Andrei	Engineer, National Agency for Energy Regulation	Power sources development, Energy Regulations, Economic analysis. Responsible for Project Idea of G_MSW and ICE CHP	Phone: 373 22 852 934 andrei_sula@yahoo.com
3	Codreanu Sergiu	Engineer, ICS RED Union Fenosa S.A.	Energy Regulations, Economic analysis, Tariffs Responsible for Project Idea of G_MSW and ICE CHP	Phone: 373 22 431 441 2serco@gmail.com
4	Cerbari Valerian	Professor, Doctor Habilitatus, pedologist, Head of Pedology Laboratory, Institute of Pedology, Agrochemistry and Soil Protection "N. Dimo"	Soil resources, needs for land use systems improving and sustainable use of soil resources; assessing the GHG emissions from arable soils; soil quality monitoring, soil processing technologies, etc. Responsible for Project Idea of NTV, MTV and CTV	Phone: 373 79 462 471 vcerbari@gmail.com

Table AI.2.2.12-2. Ministries involved in the Technology Action Plan development

No	Name	Ministry, Position, title, Institution	Area of expertise	Approach of consultation	Contact data
1	Lesnic Valentin	Ministry of Economy, Department Director of Electricity Sector and Cooperation of Power Systems	ICE CHP, G-MSW	Meetings	Phone: +373 22 234 628
2	Mihai Suvac	Ministry of Agriculture and Food Processing, Director of the Department for Production Policies and Quality Regulation of Vegetable Products	NTV, MTV and M	Meetings	Phone: +373 22 211 575