Republic of Moldova

TECHNOLOGY NEEDS ASSESSMENT FOR CLIMATE CHANGE MITIGATION

REPORT III

TECHNOLOGY ACTION PLAN

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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

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LIST OF ABBREVIATIONS

ACSA	National Agency for Rural Development (Moldova)
AIT	Asian Institute of Technology
ANRE	National Energy for Energy Regulation (Moldova)
AP	Action Plan
BLS	Base Line Scenario
CCPP	Combined Cycle Power Plant
CDM	Clean Development Mechanism
CH4	Methane
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”
DH	District Heating
E5P	The Eastern Europe Energy Efficiency and Environment Partnership
EBRD	European Bank for Reconstruction and Development
EEA	Energy Efficiency Agency (Moldova)
EIA	Environmental Impact Assessment
ESCO	Energy Service Companies
EU	European Union
GAZPROM	Russian gas company
GD	Government Decree
Gg	10^9 gram
GHG	Greenhouse Gases
G-MSW	Gasification of Municipal Solid Waste for electricity heat/ production
GOST	From Russian: State Standards
HAS	High Alternative Scenario
HEV	Hybrid electric vehicles

HVL	High Voltage Line
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)
LPA	Logical Problem Analysis
MAFI	Ministry of Agriculture and Food Industry
MCh	Municipality Chisinau
MCDA	Multi-Criteria Decision Analysis
MDL	Moldova currency, Lei
ME	Ministry of Economy
MEn	Ministry of Environment
MF	Ministry of Finance
MoSEFF	Moldova Sustainable Energy Financing Facility
MSW	Municipality Solid Waste
MTRI	Ministry of Transport and Road Infrastructure
MTV	Mini tillage, with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer
MW	10^6 Watt
NAMA	National Appropriate Mitigation Actions
NGO	Non Government Organization
NTV	No tillage, with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer
O&M	Operation and Maintenance
OECD	Organisation for Economic Co-operation and Development
PFS	Policy Fact Sheet
PP	Power Plant

PPP	Photovoltaic Power plant
R&D	Research and Development
RES	Renewable Energy Sources
RM	Republic of Moldova
SC	Commercial Society
SNC	Second National Communication (Moldova)
tce	Tonne coal equivalent
Thc	Heat capacity duration time
TNA	Technology Needs Assessment
toe	tone oil equivalent
TPP	Transnistria Power Plant
UNDP	United Nation Development Programme
UNEP	United Nation Environment Programme
UNFCCC	United Nation Framework Convention on Climate Change
USA	United States of America
VAT	Value Added Tax
WB	World Bank
WF	Wind Farm
WTE	Waste to Energy Technology

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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 Şalaru

Minister of Environment of the Republic of Moldova

March 2013

EXECUTIVE SUMMARY

This Report is the third out of four reports prepared for Technology Needs Assessment and Technology Action Plan for Mitigation, and will be presented by the Republic of Moldova as part of the TNA Project outcomes. Its purpose is to present the action plan which is the results of the 'political process', which has led to a selection of one option for groups of measures described in the barrier analyses and enabling framework report (Report II), a plan that is oriented to contribute in reaching country Copenhagen Accord commitment: to reduce by at least 25% greenhouse gas emissions from all primary energy sources by 2020, compared to 1990 levels (LEDS, 2012).

Based on Technology Need Assessment report (Report I) and Barrier Analysis and Enabling Framework report (Report II) the following technologies are subject for Action Plan development:

- Energy Sector
  - Electricity Supply: combined heat and power plants based on internal combustion engines of up to 500kW (ICE CHP).
  - Heat Supply: gasification of municipal solid waste for electricity heat/ production (G-MSW).
- Transport: hybrid electric vehicles (HEV). A hybrid car combines an internal combustion engine with technologies used in full electric vehicles. Agriculture Sector
  - No till soil cultivation system with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer.
  - Mini-Till soil cultivation system with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer.
  - Classic tillage, including a vetch field (two yields per year – autumn and spring), as a „green fertilizer field" into a 5-fields crop rotation.

The elaboration of Action Plan have been done in consultation with stakeholders, representatives from Ministries of Environment, Agriculture, Economy, research institutions, business and academia. The Working group has received guidance from UNEP Riso Center Country Coordinator, Asian Institute of Technology (AIT). The group has applied methodological guidance provided during TNA workshop in Bangkok (21-24 February, 2012) and following the methodological sources: TNA and TAP Report Template for Mitigation/Adaptation Version 2, 16 February 2012, and UNDP Handbook *Technology Needs Assessment for Climate Change* (UNDPH 2010).

The elaboration of Technology Action Plan for Energy sector starts with Energy sector description. The last is distinguished by very low security of supply – circa 95% of energy carriers are imported- and high energy intensity – three times exceed West European one. To overcome these challenges Moldova has voiced its commitment to adopt 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. In this respect, concrete targets are established by National Energy Strategy up to 2030 (MES 2030) and other policy instruments. 650MW of CHP and 400MW of renewable sources should be built by 2020, energy intensity decreasing by 20%.

The way the R. of Moldova has chosen to overcome its key Energy sector challenges are in compliance with established country sustainable environment goals. According to SNC HAS, up to 1450.9 Gg CO2eq emissions should be reduced in Energy sector by 2020. Three abovementioned technologies will cover 33% of this target, by 2020 being built 15 MW of ICE CHP, 30MW of G-MSW and replaced by HEV 1000 of vehicles. In supporting to reach these goals the following policies to promote Energy sector technologies are established:

1. Cogeneration Power Plant, including ICE CHP, promotion.

2. Renewable electricity production promotion, including gasification of municipal solid waste for electricity heat/ production (G-MSW).

3. Efficient car promotion, including Hybrid Electric Vehicles (HEV).

The main policy instruments that sustain these policies implementation are:

Policy 1: Low Emissions Development Strategy to the Year 2020 (LEDS, 2012); Energy Strategy to the year 2030 (NES 2012); Electricity Act (EA, 2010);

Policy 2: Low Emissions Development Strategy to the Year 2020 (LEDS, 2012); National Waste Management Strategy for the period 2012-2025 (NWMS 2012); Energy Strategy to the year 2030 (NES 2012); Law on Renewables (LRE 2007);

Policy 3: Low Emissions Development Strategy to the Year 2020 (LEDS, 2012); Land Transport Infrastructure Strategy; Law on Energy Efficiency (EEL 2010); Moldova 2020: National Development Strategy (Moldova 2020).

Further general barriers for all three technologies are identified, among which are: High costs; Incomplete legal and regulatory framework; Not enough Energy Efficiency Agency capacity; Inadequate information on new technologies. After specific measures are summarised, Action Plan (AP) for ICE CHP, G-MSW and HEV technologies diffusion is elaborated in this report.

AP development for ICE CHP diffusion begins with short technology description. 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 h 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.

In the R. of Moldova a favourable Enabling Framework is created to diffuse efficient PPs like ICE CHP is. In particular, Energy Efficiency Fund (EEF 2010) was created to support energy efficiency; liberalized electricity market is launched; investments are protected by law, etc.

However, there are multiple barriers of meeting the specified targets and milestones for transfer and diffusion of ICE CHP technology. Among the most important are: There are not identified the concrete locations where ICE CHP technology is feasible; There are no Feed-in tariffs approved for the energy produced at new CHPs; Cost allocation for heat and power is not transparent, etc. In order to overcome the barriers to the ICE CHP diffusion a detailed AP is developed, the main actions being the following:

In terms of 2013-2014, Ministry of Economy will apply to donor countries to get a technical assistance on ICE CHP project identification for municipalities' centralized heating; promote a Government Decree exempting from import duties the ICE CHP installations bought from abroad.

During 2013-2016, Energy Efficiency Agency will introduce a system of energy audit framework in order to identify the private and public enterprise where ICE CHP is feasible; encourage the appropriate private and public enterprises to build ICE CHP, having a support from Energy Efficiency Fund (EEF 2012), EBRD support through MoSEFF II Project (MoSEFFII 2012) and banks; disseminate the advantages of ICE CHP project.

By 2014-205, National Energy Regulatory Agency will approve Feed-in tariffs for CHP with the efficiency higher that 75%; remove cross subsidies used for price calculation at existing CHP.

Ministry of Environment will develop a framework in order to share social responsibility on GHG emissions harmful impact. The right population attitude to climate change problems will boost incentive to energy efficient best technologies implementation.

The detailed AP contains financing needed to fulfil each action, information on why the action is needed, how the measures will be carried out, etc.

AP development for G-MSW diffusion. G-MSW is a chemical process of solid waste that generates a gaseous, fuel-rich product. This product can then be combusted in a boiler, producing steam for power generation. There are more than 140 gasification plants currently in operation worldwide comprising more than 420 gasifiers (Gasification 2011). No waste processing technologies have been used in Moldova up to now.

In the R. of Moldova a favourable Enabling Framework is created to diffuse renewable energy sources, including G-MSW. In particular: G-MSW project is eligible for Energy Efficiency Fund (EEF 2010) created; renewable electricity is mandatory bought on the market and that assure income planned by investor; Energy Strategy target of 400 MW renewable sources be built by 2020 favours the implementation of G-MSW, etc.

However, there are barriers of meeting the specified targets and milestones for transfer and diffusion of G-MSW technology. Among the most important are: there has been no thorough analysis conducted on the costs and benefits of implementing G-MSW facilities across various regions in the country, and any existing technical knowledge is purely theoretical; there are no Feed-in tariffs for the energy produced at renewable sources; under-developed waste management policy and regulatory framework. The most vulnerable aspects of the waste management system are an un-reformed institutional framework and lack of investments in waste services and equipment; high risk perception of the technology; unknown composition of input waste, its calorific value, etc.

In order to overcome the barriers to the G-MSW diffusion a detailed AP is developed, the main actions being the following:

During 2013-2015, Ministry of Economy will: apply to donor countries to get an assistance to carry out a prefeasibility study on technology promotion in the municipality Chisinau. Because the investment is quite high (around US$126 million) such a study is needed first before proceed to launch a bid for Chisinau G-MSW plant construction; exempt from import duties the G-MSW

installations bought from abroad. An appropriate Government decision should be published in this respect, in order to increase project feasibility and attract foreign investments into the project.

During 2013-2018, Ministry of Environment will determine the composition and caloric value of input waste; develop mechanisms necessary to support an integrated waste management system of waste recycling and energy recovery across the country.

By 2015, Municipality of Chisinau will develop and publish the MCh Council Decision on public authority responsibility for waste collection and transportation in G-MSW project. The financing of G-MSW project must be analyzed across the entire value chain and waste collection and transportation costs are significant.

By 2015, National Energy Regulatory Agency will approve Feed-in tariffs for energy produced at new G-MSW PP.

The detailed AP presented into the report contains other aspects, like financing needed to fulfil each action, information on why the action is needed, how the measures will be carried out, etc.

AP development for HEV diffusion. When used in urban traffic, regenerative braking and electric motors of a hybrid car moving at a speed of 30-40 km / h produces lower CO2 emissions by 33-40% compared to a car using conventional fossil fuels. The fuel saving can reach 30% at modern HEV technologies (UNEP HEV 2012). More than 5.8 million hybrid electric vehicles have been sold worldwide by the end of October 2012 (HEV 2012). No HEV is met in Moldova.

The following Enabling Framework to diffuse HEV technology exists in Moldova already:

Energy Efficiency Fund (EEF 2010) is operating and HEV projects are eligible for this Fund. The existing Methodology for the calculation and regulation of tariffs and services provided by the passenger transport companies assures income predictability for transport companies; National Development Strategy Moldova 2030 has established a target for 2020: to reduce Energy Intensity by 10% that favours HEV promotion (MES 2030).

In the same time, there are barriers of meeting the specified targets and milestones for transfer and diffusion of HEV technology. Among the most important are: Low profitability in passenger transport sector. The current Methodology for the calculation and regulation of tariffs and services provided by the passenger transport companies operating in the capital is based on a fixed annual profit rate of 10%. This profitability is too low to attract more diversified investments in the passenger transport sector; high perceived risk due to unclear vehicle efficiency and CO2 emissions standards; unknown technology and its impact on environment. Market dominaits by conventional technologies. The lack of efficiency standards in the sector, coupled with unclear environmental targets for transport operation, will continue to favour use of traditional vehicles that can also be purchased at a much lower cost.

In order to overcome the barriers to the ICE CHP diffusion the following planned actions should be undertaken:

By 2014, Ministry of Transport and Road Infrastructure together with Municipality authorities will remove profitability constrains of 10% set in the transport tariff methodology;

By 2016, Ministry of Transport and Road Infrastructure will develop and approve low emission development strategy in the transport sector;

During 2013-2015, Ministry of Environment will create together with MTRI a stronger framework for carbon pricing. The establishment of a carbon pricing framework will lead to greater financing opportunities in the form of emission trading on international markets or emission credit to attract financing by international organizations;

Starting with 2013, Energy Efficiency Agency will enlarge the forms of information on HEV advantages.

More detailed Action Plan on HEV diffusion along with the priority of measures is presented in the text.

The development of Technology Action Plan for Agriculture sector has the same structure as for Energy sector. Agriculture sector plays a central role in the country economy. Lately the contribution of the agricultural sector in the GDP ranged between 14.5 – 22.4 percent, plant production contributing by 67.7% and animal production by 32.3% (NS 2011). At present the soil for plant production have lost around 2.1% of humus that is equivalent to 1.2% of carbon (48.8 t/he). That has led to preponderance low value of crops, -from one site, from other - around 85.2 million tons of carbon has been lost or 312 million tons of CO2 have been emitted in atmosphere. In another words, from all the Moldova soils tilled, around 2.55 million tones of CO2 pollute air annually.

In order to overcome soil degradation conservative technologies should be implemented, including NTV, MTV, CTV. The Program for Soil Fertility Conservation and Enhancement 2011-2020 (Fertility 2011) establishes the following overall objectives: 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 mil. hectares. These actions are in compliance with country goals to reduce GHG. According to SNC HAS, up to 323.3 Gg CO2eq emissions should be reduced in Agriculture sector by 2020. All three technologies are viewed as key contributors to the realization of the strategic objectives proposed. Although a more wide-spread adoption of these technologies is hampered by land fragmentation issues, the target is to achieve their diffusion over a total area of 600,000 hectares, which constitutes 36% of total arable land. This overall target was established at working group consultation meeting. 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. The technologies selected share the same barriers as they represent three possible land cultivation techniques that can reduce GHG emissions and minimise 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.

In supporting to reach abovementioned goals the policy "Create a balanced humus concentration in the soil" is established, being guided by a set of policy instruments, including: National Strategy for Sustainable Development of the Agro-Industrial Complex 2008-2015; The Program for Soil Fertility Conservation and Enhancement 2011-2020; The Concept on the System of Subsidies Applied to Agricultural Producers 2008-2015.

However, existing enable framework is not enough developed to assure successful technology implementation. There are a lot of barriers that need to be removed, among which should be marked: Reduced availability of financial resources. High cost of financing; High transaction costs; Low performance due to land fragmentation; Insufficient advisory services in agriculture; Inadequate laboratory facilities; Under-developed educational and research institutions; Lack of a centralized system on soil quality. To overcome these barriers the appropriate measures are identified, they being reflected in the Action Plan devoted to defuse NTV, MTV and CTV technologies. It comprises the following main actions:

Ministry of Agriculture and Food Industry will: promote actions to consolidate very fragmented agriculture land, during 2013-2018. This measure is of priority number one; Starting with 2013-2016, put in practice a subvention scheme for the purchase of equipment for conservative technologies to cover up to 20-30% of total investors costs in conservative agriculture; during 2013-2016, realise the reduction of transaction costs associated with land sale-purchase and lease contracts; during 2013-2015, improve local crediting conditions, together with banks; starting with 2013, carry out information and awareness raising campaigns, trainings; starting with 2013, to promote stronger stakeholder cooperation and foster a culture of participation; during 2013-2020, improve soil testing laboratory infrastructure. To increase the number of laboratories in the strategic rural points; during 2013-2020, improve the national system of pedologic research, together with research Agriculture research institutions; apply a single land tax instead of at least six existing taxes; starting with 2014, establish and maintain a centralized database on soil quality. To designate an institution for creation a centralized database on soil quality.

During 2013-2016, Land Relation and Cadaster Agency (LRCA) will contribute to reduce transaction costs associated with land sale-purchase and lease contracts.

National Agency for Rural Development (ACSA) should have a more large financial support from country budget.

The detailed AP contains financing needed to fulfil each action, information on why the action is needed, how the measures will be carried out, etc.

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. 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.

The final chapter of the report is devoted to Crosscutting issues. There are some common enabling policies and actions which can help addressing the common barriers they met to their diffusion of both Energy and Agriculture sectors. Access to affordable finance and in amounts needed for start investments or larger capital expenditures remain a constraint across both Energy and Agriculture sectors. In response to poor access to finances and investment capital as a measure was proposed to seek investments form to regional and global funding organisations.

1. TECHNOLOGY ACTION PLAN FOR ENERGY SECTOR

1.1 Actions at Energy Sector level

1.1.1 Energy Sector description

The Energy sector is the key branch of national economy and that oblige to make energy supply reliable at any time perspective. Unfortunately, The Republic of Moldova Energy sector cannot be mark as one secure, as:

a) It has insignificant reserves of solid fuels, petroleum and gas, and a low hydroelectric potential. This has led to a high dependence on energy imports (mainly from Russia and Ukraine) – with import levels varying within the 2000-2007 time series between 94% and 98% of total consumption (UNECFE, 2009);
b) 50% of energy balance is covered by natural gas that come from one source (GAZPROM, Russia) through gas pipelines that pass one country only (Ukraine);
c) More than 70% of electricity needed on right bank of river Nistru territory is provided outside this territory and through Transnistria secessionism territory (Taranu 2012);
d) Energy equipment is depreciated at the level of 70-75%, power sources being totally depreciated;
e) Energy efficiency is low, energy intensity exceeding the EU one by more than three time (MES 2030);
f) Being declared as the poorest European country the R. of Moldova experiences lack of own funds to develop the sector.

Faced with serious energy security challenges, Moldova has voiced its commitment to adopt a development trajectory that will hence forth be guided by principles of demand satisfaction from own power sources, energy efficiency, renewable energy sources development and environmental sustainability.

Additionally, in agreeing to join the Energy Community, Moldova has taken on a legally binding obligation to implement the relevant energy acquis communautaire (COM 2007), including to reduce by at least 25% greenhouse gas emissions from all primary energy sources by 2020, compared to 1990 levels (LEDS, 2012); to develop technologies in areas including renewable energy, energy conservation, low-energy buildings, clean coal and carbon capture (Moldova 2020, 2012).

More specifically, it is planned (MES 2030):

- To build 1050 MW new power capacity, including 650 MW of cogeneration power plant and 400 MW of renewable PP;
- To diversify natural gas sources by construction of gas pipeline Ungheni (Moldova)-Iasi (Romania) by 2014;
- To consolidate the role of electricity transition country by construction of HVL 400kV Suceava (Romania)-Balţi (Moldova) and HVL Straseni (Moldova)-Iasi (Romania);
- By 2020: to decrease energy intensity by 20%; to produce 20% of energy from RES, including 10% of electricity and 10% of energy (biofuel) for all forms of transport.
- To create an effective electricity and gas market where the competition will be considered the only way to get the cheapest energy carriers.

- To assure a modern institutional framework by implementation of Energy Community Package III.
- To join to ENTSO-E no later than 2020.

The way the R. of Moldova has chosen to overcome its key Energy sector challenges are in compliance with established country sustainable environment goals. According to Base Line Scenario (BLS) of Moldova Second National Communication, Energy sector is responsible for 65% (2005) of country total CO2 emissions (SNC, 2009), keeping about the same share during the years up to 2030. In order to fulfil Copenhagen Accord commitment (CA 2010) on climate change the following objectives are formulated for GHG emission reduction (Table 1.1.1-1):

Table 1.1.1-1 Projections of GHG emissions reduction in the RM, Gg CO2 eq

Sectors		**2005**	**2010**	**2015**	**2020**
Energy sector Emissions	BLS	7724.8	10271.9	12335.3	14442.8
	IAS	7724.8	9875.9	11786.7	14147.2
	HAS	7724.8	9425.8	11049.6	12991.9
Energy sector GHG emission reduction target	IAS	0	396	548.6	**295.6**
	HAS	0	846.1	1285.7	**1450.9**
Waste sector Emissions*	BLS	1400	1540.4	1836.6	2244.8
	IAS	1400	1422.6	1637.5	1866.5
	HAS	1400	1281.1	1495	1672.9
Waste sector GHG emission reduction target	IAS	0	117.8	199.1	**378.3**
	HAS	0	259.3	341.6	**571.9**

*) Along with Energy sector the GHG emission reduction targets for Waste sector are presented here as, in order to increase country energy security, electricity production from waste is forecasted in the R. of Moldova

As it is seen from the Table 1.1.1-1, according to SNC HAS, up to 1450.9 Gg CO2eq emissions should be reduced in Energy sector by 2020. This goal is forecasted be achieved by implementing performed technologies at **supply and demand side**. In order to realise this objectives the appropriate policy instruments has been developed lately. Starting with 2007 the most energy normative acts have been renewed and now the country is in the process of their realisation, having important foreign financial support (WB, EBRD, EU, USA, etc.)

In the long run the environmental objectives will be achieved through implementation of European standards and decreasing the discharge of emissions into the environment, implementation of EU legislation according to the Energy Community Treaty.

The same priority policies and targets are met in The Law on renewable energy (LRE 2007), Energy Efficiency Law (EEL 2010) and National Program for Energy Efficiency for the period 2011-2020 (NPEE 2011).

TNA Project is one that comes with its contribution in this process, providing a great opportunity for the Republic of Moldova to perform country-driven barriers analysis to transfer and diffusion of

energy efficient and thus environmentally sound technologies and combine sustainable practices with mitigation measures to climate change.

Based on the Multi-Criteria Decision Analysis (MCDA) applied in the first – Technology Needs Assessment – report, the following Energy sector technologies were selected for further examination of barriers and enabling framework:

- Electricity Supply: combined heat and power plants based on internal combustion engines of up to 500kW (ICE CHP)
- Heat Supply: gasification of municipal solid waste for electricity heat/ production (G-MSW)
- Transport: hybrid electric vehicles (HEV)

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

The Working group has received guidance from UNEP Riso Center Country Coordinator, Asian Institute of Technology (AIT). The group have applied methodological guidance provided during TNA workshop in Bangkok (21-24 February, 2012) and following the methodological sources: *Overcoming barriers to the transfer and diffusion of Climate Technologies (Boldt, J.,I. Nygaard, U.E. Hansen, S.Traep. UNEP RIso Centre, 2012),* UNDP Handbook *Technology Needs Assessment for Climate Change* (UNDPH 2010), Climate TechWiki website (TechWiki 2012), *Supplemental Cost-Benefit Economic Analysis Guide* (T.J. Conway,2009).

The above mentioned technologies refer to both energy supply (ICE CHP and G-MSW) and fuel demand in Transport (HEV). Technology profile in the domain where ICE CHP, G-MSW, HEV are planned to be diffused, along with existing policies and measures related to the sector's development and technology deployment are presented in the table 1.1.1-2. The targets of examined new technologies diffusion are to:

a) Build 15 MW of ICE CHP by 2020, increasing in such manner energy security and decreasing GHG emissions; The experience gained during projects implementation will serve as a jumping-off place for more ICE CHPs promotion after 2020
b) Build 30 MW of G-MSW in Chisinau by 2018-2019 years. The expected amount of electricity delivered into the grid will constitute 165.836 million kWh and this amount equals to ≈ 3,8 % of the projected country electricity demand for the year 2020. G-MSW built will contribute to energy security improvement and GHG emissions reduction. The experience gained during project implementation in Chisinau will serve as a jumping-off place for promotion of G-MSW PP to other cities after 2020. Total amount of waste stocked at all country landfills constitutes 669,013 tone/year, including 372,780 tone/year in Chisinau.
c) Implement HEV technology in 4 urban areas (Chisinau, Balti, Tighina and Tiraspol) for passenger transportation. A total number of 3000 vehicles is estimated be replaced during the following 15 years. Successful implementation of HEV technology in urban passenger transport sector can serve as an incentive for farther implementation of this technology for urban delivery trucks and other urban areas of passenger transportation.

Table1.1.1-2 Policies to promote new Energy sector technologies

Main Policy instruments applied	When enacted and revised	Main content	Current technology Profile
Name of Policy: **Cogeneration Power Plant, including ICE CHP, promotion**			
Low Emissions Development Strategy to the Year 2020	Draft	The general objective of the Strategy is "to provide a general policy framework focused on national sustainable development, that is likely to lead to low greenhouse gas emissions and will help to reach and, if possible, to increase the level of the Republic of Moldova's reduction commitment under the Copenhagen Accord", which it associated with on January 29th 2010. The Strategy stipulates sectorial GHG emissions reduction targets by 2020, the concrete measures that should be applied to reach country CO2 reduction goal. The Strategy breaks down the list of mitigation measures into three categories: (1) autonomous measures to be implemented without international assistance; (2) supported measures to be implemented with international donor assistance; (3) measures financed with the help of carbon markets. The need of investments per each measure and responsible entity for measure realization is also provided.	Combined heat and power plants based on internal combustion engines (ICE CHP) technology is widely spread in the world. For example, in UK there are 1,438 CHP schemes in operation. Of these, 328 are in the industrial sectors and 1,110 are in commercial, public administration, residential, transport and agriculture sectors. ICE CHP capacity is in range of 70kWe-1,500kWe with an electricity efficiency of 25-40%. The heat produced is usually hot water, rather than steam, and they generally produce 1-2 units of heat for each unit of electricity, with the ratio of heat to power generally decreasing with size (Carbontrast 2010). 4500 h of high and constant heat demand is needed to make CHP economical. CHP technology is promoted by all R. of Moldova energy policy instruments. At the moment, around 25% of electricity needed on right bank of country territory is covered by three CHP located here: **CHP-1** with a capacity of 66MW, 42MW of which are built in 1959-1961; 12MW - in 1995; 12MW-in 2001. The overall efficiency is 62-73% during the lasts 5 years. **CHP-2** with a capacity of 240MW built during 1976-1980, the overall efficiency being 69-71% during the last five years. **CHP-Nord** with a capacity of 24MW, of which 12MW built in 1995 and 12MW in 2005; All three CHP above mentioned are regulated. From the data above is seen that the main CHP capacity is outdated and the

Main Policy instruments applied	When enacted and revised	Main content	Current technology Profile
Energy Strategy to the year 2020	Published in September 2007	The Energy Strategy was developed to support the implementation of the Government's objectives for economic development and growth and of the Plan of Actions "Moldova-European Union," and to harmonize the country's legal framework to the acquis communautaire in energy. Its three strategic objectives are: security of energy supply; promoting energy and economic efficiency, and liberalization of the energy market and restructuring of the power industry. The Strategy recognizes the impact that the energy sector has on the environment, and as such puts a great emphasis on promoting energy efficiency projects, including by diversifying the sources of renewable energy. In this context, the Strategy foresees an increase in the share of renewable energy sources in the country's energy balance to up to 20% by 2020. The Strategy stipulates the activities aimed at attracting investments in the energy sector	efficiency is low. And what is more, because of heat demand lack the capacity at CHP-2 is used at the level of 65% only (ANRE 2011). According to the draft of Energy Strategy up to 2030, by 2020 650MW of CHP should be built. The main requirement such target be achieved is the presence of heat demand. For the conditions of the Republic of Moldova, feasible heat demand can be met mainly at industrial and service provider's level and less for householders. The estimation maid by the experts of working group showed that the CHP capacity at these sites rare will exceed 1 MW, the most applicable being 500kW. The total capacity of ICE CHP should reach 15MW by 2020. There are several small CHP operating on country territory. One of 400kW built by State University, where heat is used for own building and a student pool heating. No energy is delivered into the public grid. Another small CHP of 170MW is built at Chisinau Yeast Plant. All the energy is used for own technology process.
Law on Energy Efficiency	Published in September 2010	The Law transposes the EU Directive 2006/32/CE of April 5, 2006 on the efficiency of energy end-use and energy services. It regulates activities aimed at decreasing energy intensity in the national economy and at reducing the negative impact of the energy sector on the environment. The Law established the Agency for Energy Efficiency as the institution in charge of promotion and monitoring of energy efficiency and use of renewable energy sources. The Law strengthens the framework for the ESCOs operation, energy performance contracts, energy consumption metering, etc; provides for financial support in the form of loans or guarantees from the Energy Efficiency Fund to economic agents whose activities/projects increase energy efficiency; requires adoption of minimum energy	

Main Policy instruments applied	When enacted and revised	Main content	Current technology Profile
		performance standards; provides for the adoption the "National Energy Efficiency Program to the Year 2020" and "National Energy Efficiency Action Plans" every other 3 years at the national level.	
Electricity Act	Published in February 2010	The purpose of the Law is to establish the legal framework for an efficient functioning, regulation and gradual opening up of the energy market to activities specific to the power sector and heat generation at cogeneration plants. The Law clarifies the scope of regulation by the Government, local public administration authorities, and specifically by the National Agency for Energy Regulation (ANRE). The Law establishes ANRE as the authority in charge of regulating the power market, lists its responsibilities, and the administrative and financial framework supporting its activities. In particular, the Law regulates the following aspects of the market: license issuance, amendment, suspension, withdrawal; electricity generation, transmission, distribution, supply, and power system operation; regulation of relationships among market participants; tariff regulation; protection of consumer interests.	
Name of Policy: **Renewable electricity production promotion, including gasification of municipal solid waste for electricity heat/ production (G-MSW)**			
Low Emissions Development Strategy to the Year 2020	Draft	See above	There are more than 140 gasification plants currently in operation worldwide comprising more than 420 gasifiers. Most of these gasifiers use coal feedstocks. Worldwide gasification capacity is expected to increase 80% by 2015 with most of that increase occurring in China (Gasification Technologies Council 2008).
National Waste Management	Draft	The Strategy sets the ground for the elaboration of the legal and normative framework required (1) to regulate the	

Main Policy instruments applied	When enacted and revised	Main content	Current technology Profile
Strategy for the period 2012-2025		various waste flows and recycling operations, waste valorification and elimination, (2) to create an efficient institutional system for waste management and monitoring, (3) to ensure enforcement of environmental legislation, and (4) to attract investments in the waste sector. The Strategy emphasises the creation of a sustainable waste management sector in the country based on the following principles: prevention, re-use and recycling, energy recovery from waste, and elimination. Economic instruments will be elaborated in order to encourage reflection of waste management costs in the price of products, and to ensure an equitable distribution of costs between producers and waste generators. Total investments required in the national waste management system over the period 2011-2025 are estimated at EUR 375-470 million.	Biomass gasification and incineration are proven commercial technologies worldwide for both conventional biomass and MSW. However, these applications are generally limited to firing boilers for process heat and electricity generation. The process scale for these applications is case specific ranging anywhere from a few to several hundred dry tons/day with applications for power generation generally in the larger sizes. There have been some demonstration-scale efforts with conventional biomass feedstocks 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 this time (Cobb 2007). Four commercial gasifiers were identified that process MSW.
Energy Strategy to the year 2020	Published in September 2007	See above	
Law on Renewables	Published in August 2007	The Law regulates activities in the renewable energy sector, stipulating renewable energy targets of 6% until 2010, and an obligation for reaching 20% share of energy from renewable sources by 2020. The scope of the Law is to: set out state policy principles and objectives relating to renewable energy sources; identify the financial resources and mechanism required to support the implementation of renewable energy sources, including support schemes based on approved tariffs for 15 years and certification schemes on guarantees of origin issued by grid operators; establish the economic and organisational measures necessary to incentivise the use of energy from renewable sources. In	According to the National Energy Strategy, 400 MW of renewable electricity sources should be built by 2020 (MES 2030). The preference will be given to waste RES as it overcome very important waste environment problem existing in some cities, especially in municipality Chisinau at present. No waste processing technologies have been used in Moldova up to now. By 2018-2019 30 MW of G-MSW should be built in Chisinau, processing 372,780 tone waste per year.

Main Policy instruments applied	When enacted and revised	Main content	Current technology Profile
		terms of institutional framework, the Law provides for the establishment of the Agency for Energy Efficiency (through the restructuring of the former Agency for Energy Conservation) as the state authority in the renewable energy sector. An Energy Efficiency Fund is also established, aimed to support the implementation of energy efficiency projects through a range of financing mechanisms, such as loans, investment guarantees etc. The Law establishes the National Agency for Energy Regulation as the authority in charge of regulating the renewable energy market, including approving tariffs for renewable energy and biofuels, developing draft contracts for renewable energy and biofuels trade, and issue-ing licenses for the production of electricity from renewable energy and biofuels.	
Name of Policy: **Efficient car promotion, including Hybrid Electric Vehicles (HEV)**			
Low Emissions Development Strategy to the Year 2020	Draft	See above	More than 5.8 million hybrid electric vehicles have been sold worldwide by the end of October 2012 (HEV 2012). HEVs typically achieve better fuel economy and have lower fuel costs than similar conventional vehicles. For example, the 2012 Honda Civic Hybrid has an EPA combined city-and-highway fuel economy estimate of 6l/100km, while the estimate for the conventional 2012 Civic (four cylinder, automatic) is 9l/100km (USD Energy 2012). The fuel saving can reach 30% at modern HEV technologies (UNEP HEV 2012). Present technologies applied in Moldova Transport sector correspond to ones known at the world level, those obsolete predominating. No electric or hybrid electric
Land Transport Infrastructure Strategy	Published in February 2008	The Strategy's main objective is to establish an efficient transport system and improve road infrastructure to help reduce fuel consumption in the transport sector. The three key priority directions are infrastructure rehabilitation, infrastructure development, and institutional framework strengthening. In terms of impact on the environment, this will be determined by the interventions proposed as part the Road Sector Program Support project.	
Law on Energy Efficiency	Published in September	See above	

Main Policy instruments applied	When enacted and revised	Main content	Current technology Profile
	2010		transport is used at the moment. The share of road vehicles using compressed natural gas and liquefied petroleum gas as fuel is in increasing process. Bio-fuels (ethanol and biodiesel) utilization is on incipient stage. There is no vehicles production in the country. All the vehicles needed are from the import. Limited age for imported road vehicles is established at the level of 10 years. During the following 15 years around 3000 vehicles should be replaced by HEV.
Moldova 2020: National Development Strategy	Approved in 2012	"Moldova 2020" is the development strategy underpinning the Government's economic growth and poverty reduction objectives to the year 2020. Among 7 Strategy's priorities is to reduce energy consumption by increasing energy efficiency and use of renewable energy sources.	

1.1.2 General barriers and proposed measures

The economic-financial analysis made by the working group showed that all three technologies mentioned above for promotion in Moldova Energy sector are feasible. However, there are a lot of barriers that impede their implementation. Some of them are common for all technologies selected, i.e. ICE CHP, G-MSW and HEVs. They are summarized in the Table 1.1.2-1 along with the measures identified to overcome them. The barrier number one is the lack of Feed-in tariffs for energy produced by new generating sources and reasonable fares for public transport. Without overcoming these barriers the investors will not come in Moldova to enter into energy supply and passenger transport market. Once these barriers are overcome the new investment climate will be favourable for investments in similar new renewable passenger transport technologies. In parallel with overcoming the barrier number one, the capacity of Energy Efficiency Agency should be improved in order it be capable to enlarge the form of information on ICE CHP, G-MSW and HEVs advantages, in such manner attracting investors' interests in renewable energy supply and more efficient passenger transport business.

Table1.1.2-1 Energy sector General barriers and measures for new technologies promotion

Domain	General barriers	General measures
Economic and Financial	High costs	To support the technologies from Energy Efficiency Fund
Policy, Legal and Regulatory	Incomplete legal and regulatory framework	To approve Feed-in tariff for electricity produced from renewable sources, CHP and remove profitability constrains set in the transport tariff methodology
Institutional Capacity	Not enough Energy Efficiency Agency capacity	To increase Energy Efficiency Agency capacity to promote ICE CHP, G-MSW, HEV
Information and Awareness	Inadequate information on new technologies	To enlarge the forms of information on ICE CHP, G-MSW and HEVs advantages

Along with Energy sector general measures there are specific measures to promote the selected technologies. They are summarized in the Table 1.1.2-2.

Table1.1.2-2Specific measures to overcome the technologies barriers

Domain	ICE CHP	G-MSW	HEV
Economic and Financial	To exempt from import duties ICE CHP installations	To exempt from import duties G-MSW installations	Use of economic instruments to incentivise use of cleaner cars
	To Provide restructuring of the district heating systems: To optimize the structure of existing CHPs and Heat Plants, developing heat sources closer to consumers		
Policy, Legal and Regulatory	To approve regulatory framework: CHP-produced electricity should be qualified for sale under regulated tariffs if the energy is destined for householders and is produced at the efficiency higher than 80%.	To implement international standards for waste classification	Remove profitability constrains set in the transport tariff methodology
	Electricity produced in excess at enterprises and service providers should have a mandatory be purchased in the market at the price regulated	To improve network of facilities for waste disposal, recycling, processing and treatment	To develop and approve low emission development strategy in the transport sector
	For the entities with energy consumption of 200 t.o.e/year and more energy audit should be a mandatory	To improve waste collection and transportation system	Implementation of market based instruments, emission limits and technology standards, emission trading or emission credits
Information and Awareness		To promote programs of awareness building campaigns and educational measures: environmental impact of the solid waste, the technologies that could be implemented to increase sustainability in the waste sector	More commitment towards improving environmental performance of vehicle fleet management
		To revise and supplement the set of statistical tools in order to ensure that the data provided on waste generation and flow is accurate	

1.2 Action Plan for Technology combined heat and power plants based on internal combustion engines of up to 500kW (ICE CHP)

1.2.1 About ICE CHP technology

Cogeneration – also known as Combined Heat and Power Plant (CHP) – is the simultaneous generation of heat and power. CHP involves using residual energy in power production to generate heat for industrial processes and district heating, providing significantly higher system efficiencies. The electricity generated by the cogeneration plant is normally used locally, which results in negligible transmission and distribution losses. While it can comprise a range of technologies, it will always include an electricity generator and a heat recovery system. The total energy efficiency of CHP technologies is estimated at 80-85% compared to 35-42% on average from conventional power generation (where 65-58% of the energy potential is released as waste heat), or 55% from the more recent combined cycle power generation (IEA 2012).

The specific CHP technology that has been selected as part of the TNA is based on internal combustion engines of at most 500kW (ICE CHP). The market potential in Moldova up to 2020 is estimated at the level of at least 15 MW, with an economic and technical life-time of 20-25 years. In Moldova it is expected that CHPs will be owned by either private suppliers of non-regulated CHP energy, or private or municipal suppliers of regulated CHP energy. The consumer base is also rather diverse and can include residential households (heat consumers mainly), domestic and non-domestic users of electricity, and industrial and service providers (who can be non-regulated CHP owners at the same time). The total amount of investments needed to implement ICE CHP project constitutes around 17.25 million US$.

Combined heat and power plants based on internal combustion engines (ICE CHP) technology is widely spread in the world. For example, in UK there are 1,438 CHP schemes in operation. Of these, 328 are in the industrial sectors and 1,110 are in commercial, public administration, residential, transport and agriculture sectors.

ICE CHP capacity is in range of 70kWe-1,500kWe with an electricity efficiency of 25-40%. The heat produced is usually hot water, rather than steam, and they generally produce 1-2 units of heat for each unit of electricity, with the ratio of heat to power generally decreasing with size(Carbontrast 2010). 4500 h of high and constant heat demand is needed to make CHP economical.

The main reasons ICE CHP technology was identified as one priority measure for Moldova energy sector are as following:

- In order to increase energy security, 650MW CHP should be built in the country up to 2020 (MES 2030). The main requirement such target be achieved is the presence of heat demand. For the conditions of the Republic of Moldova, distinguished by relatively mild winters and long warm summers, feasible heat demand can be met mainly at decentralized heat consumers. The estimation maid by the experts of working group showed that the CHP capacity at these sites rare will exceed 1 MW, the most applicable being 500kW;

- 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;
- Distributed heat and electricity production lead to energy losses decreasing;
- Internal Rate of Return is quite attractive and it is in range of 18-20%, calculated for the first 10 years;
- Relatively short construction time is required as ICE CHP is produced in an aggregated module.

1.2.2 Targets for technology transfer and diffusion

There is no enough country experience on promoting ICE CHPs. Their successful dissemination requires following preliminary step, started in 2013-2014 and ending in 2020. During this period around 15 MW of ICE CHP should be built.

By 2020 the final objectives that will be achieved by implementing ICE CHP, including GHG emission reduction, correspond to those from the Table 1.1.-2. If 15MW of such power plant is built by this year, the contribution of ICE CHP projects to GHG emission reduction target, established by SNC for Energy sector High Alternative Scenario (HAS), will constitute 1,6% or 7,7% if it is refers to Intermediate Alternative Scenario target.

Table1.2.2-1CO2 emissions reduction from ICE CHP implementation

Items	units	ICE CHP for residential householders	ICE CHP for industrial and service providers	TOTAL	The contribution to GHG emission reduction established by SNC HAS, %
CO2 reduction of 500kW ICE CHP	tCO2	278.20	852	1130	
Potential for ICE CHP implementation, including:	MW	1	13	14	
by 2015	MW		1	1	
by 2020	MW	1	13	14	
CO2 reduction, including	tCO2	556	23,859	**24,415**	
by 2015	tCO2		1,704	**1,704**	0.1
by 2020	tCO2	556	22,155	**22,711**	1.0

Based on the experience gained, new targets for ICE CHP dissemination will be established for the years after 2020.

1.2.3 Barriers to the ICE CHP diffusion

In the R. of Moldova a favourable Enabling Framework is created to diffuse efficient PPs like ICE CHP is. In particular:

- The existing in Moldova legal framework permits foreign investors to invest on the country territory, they having internationally recognised level of protection (LEP, 2004);

- Energy Efficiency Fund (EEF 2010) and EEF Regulation (EEFR, 2012) have been approved and published. ICE CHP projects are eligible for this Fund. The sum allocated from the state budget to the EEF is increasing from year to year;
- Moldova is a full member of Energy Community and that assures the investors the country will follow EU acquis;
- MoSEFF Project launched for Moldova by EBRD permit to get up to 2 million Euro credit with up to 20% grant for realisation of energy efficient projects. A ICE CHP of 500kW needs less than 1 million Euro and is eligible for MoSEFF fund;
- 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 installations too;
- Moldova has taken a commitment to reduce by 25% GHG emissions reduction by 2020 as a signatory to the Copenhagen Accord (CA 2010). This target encourage the promotion of energy efficiency measures, including ICE CHP technology;
- Starting with 2013 the electricity market is liberalized for economic agents (EA, 2010). Liberalised market will favour not regulated ICE CHP to sell the excess of electricity to the power market, making PP more feasible economically;
- Additional amendments required by Energy Community has been introduced in the new draft of Electricity Act (it will be approved and published in early 2013), in order to make new PPs access to the grid more favourable;
- Energy Strategy target of 650 MW CHP be built by 2020 favours the implementation of ICE CHP.

However, there are multiple barriers of meeting the specified targets and milestones for transfer and diffusion of ICE CHP technology. Among the most important are:

- There is not identified the concrete location where ICE CHP technology is feasible, i.e. where heat demand exceed as higher as 4500 h/year of installed heat capacity use;
- There are no Feed-in tariffs approved for the energy produced at new CHPs, if the energy is delivered for public needs. Lack of such tariffs introduces an uncertainty for investors to return their investments;
- Inadequate sharing of project experience. Knowledge on the implementation of small capacity ICE CHP projects in Moldova is very limited. Sharing of experience around planning and pricing, risk identification and mitigation, implementation and operation is generally limited;
- Cost allocation for heat and power is not transparent. 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 cannot compete with one generated at existing CHPs, leading to energy market distortion and having an negative impact on ICE CHP diffusion;
- Unclear framework for negotiating the price for surplus of non-regulated electricity. There is no clear framework governing the process and principles for the sale of excess non-regulated electricity on the electricity market. Although this is an issue affecting all producers of non-regulated electricity, it is a particular challenge for ICE CHP projects, which rely on the sale of all electricity produced to be able to recover the considerable costs involved;
- Inadequate information on the implementation of ICE CHP projects. The knowledge on this project has remained concentrated within a small group of local experts, which has slowed the uptake of energy efficiency projects by other potential beneficiaries in the country. Additionally, this has also implied that search for foreign consultancy services has been

mainly left with the interested parties on their own, who, without necessarily having enough knowledge about the economics of similar projects implemented elsewhere, cannot make an accurate assessment of the provided results;

- Environmental management is not seen as a shared social responsibility. Due to other more urgent economic priorities, environmental management has only recently started to be acknowledged as a real problem with potential impact on the quality of life in Moldova. Reliance on external technical assistance, which created the image of the environment being mostly a concern of development partners or rich countries, has contributed to the general attitude of indifference regarding sustainability matters. Industry-wise, energy efficiency is still not a matter of great concern although a change in attitude is slowly occurring.

1.2.4 Proposed action plans for ICE CHP Technology

In order to overcome the barriers to the ICE CHP diffusion the following planned actions should be undertaken:

- The Ministry of Economy will:

  a) by 2013-2014, apply to donor countries to get a technical assistance on ICE CHP project identification for municipalities' centralized heating. There is not identified the concrete location where ICE CHP technology is feasible, i.e. where heat demand exceed as higher as 4500 h/year of installed heat capacity use. In the frame of The Eastern Europe Energy Efficiency and Environment Partnership (the "E5P"), EBRD is actively looking to identify one or a number of bankable district heating projects in Moldova, either as one or a number of stand-alone projects, or as a programme comprising demonstration projects in 2-3 cities;

  b) continue to develop a legal framework to attract foreign investments in efficient power plant development, including in ICE CHP. The country is poor. There is small chance for local investments.;

  c) by 2014, promote a Government Decree exempting from import duties the ICE CHP installations bought from abroad, in order to assure the project feasibility.

- Energy Efficiency Agency (EEA) will:

  a) introduce, during 2013-2015, a system of energy audit framework in order to identify the private and public enterprise where ICE CHP is feasible, as there is not identified the concrete location where ICE CHP technology is feasible, i.e. where heat demand exceed as higher as 4500 h/year of installed heat capacity use;

  b) during 2013-2016, encourage the appropriate private and public enterprises to build ICE CHP, having a support from Energy Efficiency Fund (EEF 2012), EBRD support through MoSEFF II Project (MoSEFFII 2012) and banks;

  c) disseminate the advantages of ICE CHP project. Knowledge on ICE CHP projects in Moldova is very limited.

- National Energy Regulatory Agency will:

  a) by 2015, create a regulatory framework to facilitate ICE CHP development through assuring regulated tariffs for such PPs, if the energy is destined for public purposes. Lack of Feed-in tariffs introduces an uncertainty for investors to return their investments;

b) by 2014, create a framework for negotiating the price for surplus of non-regulated electricity, in order to assure ICE CHP project increased feasibility;

c) by 2014, allocate correctly the costs for heat and electricity at existing regulated CHP, otherwise the price for heat at ICE CHP cannot compete with one generated at existing CHPs.

- Ministry of Environment will develop a framework in order to share social responsibility on GHG emissions harmful impact. The right population attitude to climate change problems will boost incentive to energy efficient best technologies implementation.

More detailed Action Plan on ICE CHP diffusion along with the priority of measures is presented in the Table 1.2.4-1.

Table1.2.4-1 Action Plan on ICE CHP diffusion

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
Legislation and regulation: legislation, standards and labeling	To develop a legal framework to attract foreign investments in efficient power plant development, including in ICE CHP	The country is poor. There is small chance for local investments	Ministry of Economy	ME will: a) include the realization of action in its plan of activity; b)apply to donor countries to get a technical assistance	2013-2014	2000US$-domestic, 10000US$-foreign assistance	A technical assistance obtained to develop a legal framework to attract investments in ICE CHP would be considered as indicator of success	ME will verify the action implementation on regular bases during the years	3
	To identify the concrete locations where ICE CHP is feasible	There is not identified the concrete location where ICE CHP technology is feasible, i.e. where heat demand exceed as higher as 4500 h/year of installed heat capacity use	Ministry of Economy and Energy Efficiency Agency	ME will apply to donor countries to get a technical assistance. EEA will include the realization of action in its plan of activity	2013-2015	5000US$-domestic, 15000US$-foreign assistance	The location for ICE CHP construction identified would be an indicator of success	ME will verify the action implementation on regular bases during the years	1

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
	To approve Feed-in tariffs for energy produced at new CHP, if the energy is destined for public purposes	Lack of Feed-in tariffs introduces an uncertainty for investors to return their investments	National Energy Regulatory Agency	To elaborate, approve and publish	2013-2015	2000US$-domestic, 5000US$-foreign assistance	Approved Feed-in tariff would be an indicator of success	The action should be written into ME plan and monitored respectively	1
	To allocate correctly the costs for heat and electricity at existing regulated CHP	The price for heat at ICE CHP cannot compete with one generated at existing CHPs	ANRE	To undertake a commitment	2013-2014	No costs	Excluded cross-subsidies at CHP energy price calculation would be an indicator of success	EEA will monitor the Action implementation	3
	To create a framework for negotiating the price for surplus of non-regulated electricity	To increase the project feasibility	ANRE	The Market Rules should be amended respectively	2013-2014	Low costs	Market rules amended would be an indicator of success	EEA will monitor the Action implementation	3

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
Financial incentives	To exempt from import duties the ICE CHP installations bought from abroad	To assure the project feasibility	ME	Publishing a Government Decree	2013-2015	Low costs	A respective GD published would be an indicator of success	ME will verify the action implementation on regular bases during the years	2
Information and awareness raising	To share the ICE CHP experience	Knowledge on ICE CHP projects in Moldova is very limited	EEA	Seminars, EEA site, mass media	2013-2018	2000US$-domestic, 8000US$-foreign assistance	The appropriate knowledge disseminated would be an indicator of success	EEA will verify the action implementation on regular bases during the years	3
	To share social responsibility on GHG emissions harmful impact	To enforce incentive to energy efficient best technologies implementation	Ministry of Environment	By introducing the appropriate subject in the schools, organizing seminars, using its web site and mass media	2013-2020	5000US$-domestic	More initiative in the domain of energy efficiency would be an indicator of success	MEn will verify the action implementation on regular bases during the years	3

1.3 Action Plan for Technology Gasification of municipal solid waste for electricity heat/ production (G-MSW)

1.3.1 About G-MSW technology

Within MSW gasification, two processes must take place in order to produce a useable fuel gas (Klein, 2002). First, through pyrolysis the volatile components of the fuel are released at temperatures below 600°C. As a side benefit from this process, char is produced which consists mainly of fixed carbon and ash. Second, the carbon remaining after pyrolysis is either reacted with steam or hydrogen or combusted with air or pure oxygen at temperatures between 760 and 1,650° C under high pressure. Gasification with air results in a nitrogen-rich, low-Btu fuel gas. Gasification with pure oxygen results in a higher quality mixture of CO and hydrogen and virtually no nitrogen. Gasification with steam is generally called 'reforming' and results in a hydrogen- and CO2-rich 'synthetic' gas (syngas). Cleaned from contaminants, the syngas can be combusted in a boiler, producing steam for power generation (ClimateTechWiki/msw 2012).

On average, conventional waste-to-energy plants that use mass-burn incineration can convert one ton of MSW to about 550 kWh of electricity. With gasification technology, one ton of MSW can be used to produce up to 1,000 kWh of electricity, a much more efficient and cleaner way to utilize this source of energy (Gasification 2011).

There are more than 140 gasification plants currently in operation worldwide comprising more than 420 gasifiers. Most of these gasifiers use coal feedstocks. Worldwide gasification capacity is expected to increase 80% by 2015 with most of that increase occurring in China (Gasification 2011).

Biomass gasification and incineration are proven commercial technologies worldwide for both conventional biomass and MSW. However, these applications are generally limited to firing boilers for process heat and electricity generation.

The process scale for these applications is case specific ranging anywhere from a few to several hundred dry tons/day with applications for power generation generally in the larger sizes.

As it was mentioned above a G-MSW PP of 30 MW capacity is planned to be built in Chisinau by 2018-2019 years. The load factor of the plant will be at the level of 0,74, corresponded to 6503 hours per year of nominal capacity used. The power plant will have 3 units of 10 MW each. The period of construction is 2 years. The specific investments is 4200 $/kW (Ecomagazin 2008) applied to installed capacity. The low calorific value of the waste is 1100 kcal/kg and it is much lower than one assuring a stable burning. In order to overcome this problem, some quantity of natural gas is used for technological process. Around 15 % of the electricity produced is used for own consumption. The expected amount of electricity delivered into the grid constitutes 165.836 million kWh and this amount equals to ≈ 3,85 % of the projected electricity demand of the Republic of Moldova for the year 2015.

The main reasons G-MSW technology was identified as one priority measure for Moldova energy sector are as following:

- In order to increase energy security, 400MW renewable electricity sources should be built in the country up to 2020 (MES 2030). It is expected the preference will be given to renewable sources based on municipalities' wastes, not to Wind Farms (WF) and Photovoltaic PPs (PPP), because:

a) WF&PPPs require the availability of traditional sources power that will replace WF&PPP capacity when the wind (solar) is lack. As such source the most recommendable for Moldova would be combine cycle PP (CCPP). But the tandem CCPP+WF lead to electricity price increasing by circa 24% in comparison with the traditional power sources development option, energy security does not having much to gain (IC 2012).

b) The municipalities' wastes storage at landfills has become a real problem for Moldova lately, because of population protests against environment pollution these landfills provoke around. The local authorities are in searching a solution the wastes be treated, not land filled.

- The R. of Moldova has insignificant reserves of solid fuels, petroleum and gas, and a low hydroelectric potential that make it dependent on 94-98% from the energy come from abroad. That obliges to use broadly all possible internal energy sources;
- Internal Rate of Return is relatively attractive, equal to 15%, calculated for the first 10 years;

1.3.2 Targets for technology transfer and diffusion

Annually the municipality services of Moldova record around 1,143-1,266 thousands m^3 of Municipal Solid Waste (MSW) transported to the landfills (Tugui 2006), 56% of which belongs to municipality Chisinau. The utilization of this waste for energy need is planned to be done in stepwise manner.The utilization of MSW for energy generation is mostly advanced for Municipality Chisinau. Several projects have been discussed until now (In 2006 Mayoralty of municipality Chisinau has signed a preliminary Incineration contract with the Italian company STR Engineering Consulting Ltd, and other in 2009 with STR Engineering Consulting Ltd), but not for one it has been reached a construction decision. The promotion of gasification of municipal solid waste for electricity heat/ production (G-MSW) is seen as realistic new chance to overcome the very urgent waste problem for Municipality Chisinau. The experts analysis demonstrated that the capacity of the plant is estimated be at the level of 30MW. If the plant is built and operate at this capacity by 2020, it will assure significant CO2 emission reduction, at the level of around 445.9 thousands t CO_2/year, including:

a) 369 thousand tCO2eq avoided at landfills, representing 98% of GHG emission reduction target established for Waste sector by 2020, according to HAS of SNC;
b) 105 thousands tCO2 emission reductions as the consequence of 166GWh electricity displacement at fossil fuel operating Transnistria PP. This reduction cover 11% of the appropriate GHG emission reduction target established for Energy sector for 2020, according to HAS of SNC.

Based on the experience gained, new targets for ICE CHP dissemination will be established for the years after 2020 having in mind the available country MSW potential.

1.3.3 Barriers to the G-MSW diffusion

In the R. of Moldova a favourable Enabling Framework is created to diffuse renewable energy sources, including G-MSW. In particular:

- The existing in Moldova legal framework permits foreign investors to invest on the country territory, they having internationally recognised level of protection (LEP, 2004);
- Energy Efficiency Fund (EEF 2010) and EEF Regulation (EEFR, 2012) have been approved and published. G-MSW project is eligible for this Fund. The sum allocated from the state budget to the EEF is increasing from year to year;
- Moldova is a full member of Energy Community and that assures the investors the country will follow EU acquis;
- 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 installations too;
- Moldova has taken a commitment to reduce by 25% GHG emissions reduction by 2020 as a signatory to the Copenhagen Accord. This target encourage the promotion of renewable sources, including G-MSW technology;
- For renewable sources, including for the energy sources based on waste, the electricity produced is mandatory bought on the market and that assure planned by investor income.
- Additional amendments required by Energy Community has been introduced in the new draft of Electricity Act (it will be approved and published in 2013), in order to make new PPs access to the grid more favourable;
- Energy Strategy target of 400 MW renewable sources be built by 2020 favours the implementation of G-MSW.

However, there are multiple barriers of meeting the specified targets and milestones for transfer and diffusion of G-MSW technology. Among the most important are:

- High transaction costs. Due to the lack of any practical experience of local consultants with implementing G-MSW technologies in Moldova, but also given that this technology is still only gaining momentum on the international market, it is expected that the cost of project design and feasibility studies will be high. There has been no thorough analysis conducted on the costs and benefits of implementing G-MSW facilities across various regions in the country, and any existing technical knowledge is purely theoretical.
- There are no Feed-in tariffs for the energy produced at renewable sources. Lack of such tariffs introduces an uncertainty for investors to return their investments. Instead of Feed-in tariffs a Methodology for calculation of renewable tariffs is published in 2009 (RESMT, 2009). However, the art. 14 of the Methodology permit ANRE to establish a tariff based on world benchmark, exposing the future investors to very high financial risk;
- Insufficient financing along the value chain in the waste management sector. It is expected that projects for Gasification of Municipal Solid Waste for Electricity and Heat production will require involvement of the local public authorities responsible for waste collection and

transportation. The financing of G-MSW projects therefore cannot be viewed in isolation and must be analysed across the entire value chain. The financial ability of local authorities to provide such services in a reliable way must be considered in addition to the cost of financing of the G-MSW project itself.

- Under-developed waste management policy and regulatory framework. The most vulnerable aspects of the waste management system are an un-reformed institutional framework and lack of investments in waste services and equipment. Although environmental protection is regulated by about 35 legislative acts and over 50 Government Decisions (LEDS 2012), the legal framework of waste management is still under-developed. The current framework is lacking the mechanisms necessary to support an integrated waste management system of waste recycling and energy recovery across the country. While the EU legislation recognizes that waste management is preferably dealt with at the regional level, no such principle has yet been incorporated in Moldova's legislation. At present, separation of solid waste is done only rarely, mostly due to high up-front and operating costs of specialized treatment facilities. International categorization of the waste has not yet been introduced.
- High risk perception of the technology. Given the numerous unknowns around the specifics of G-MSW projects in Moldova, there is a high risk perception associated with the implementation of this technology. These unknowns include the scale at which the technical design of the gasification process will need to be tailored to match the local waste composition, how the optimum site locations will be determined so as to minimize costs of access to heat distribution grids as well as waste deposits, and how a reliable end-to-end value chain can be ensured given the currently under-developed waste management infrastructure.
- Unknown composition of input waste. The technical design of the G-MSW facility is largely driven by the composition of the input solid waste. It is therefore possible that the design of such facilities in Moldova can differ substantially from the ones already implemented in other countries. However, data on the composition and distribution of waste across the country is very poor. What is known is that different types of waste, including biodegradable and non-recyclable are predominantly deposited in bulk. This will not only make the separation of waste difficult, but will also complicate the assessment of the feasibility of G-MSW projects in Moldova, and of how the technical designs will need to be tailored to the waste composition and prevalence that is specific to the country.

1.3.4 Proposed action plans for G-MSW Technology

Due to the fact that G-MSW technology is still in its early stages of development on the international market, knowledge transfer on G-MSW technologies from foreign experts to local stakeholders has been very limited. From international experience, an already known barrier is the complexity of determining MSW throughput and modelling economies of scale (Jenkins2007). This – coupled with the low awareness of costs and benefits of such advanced technology options among urban dwellers, policymakers and businesses –creates a stall condition for the uptake of G-MSW technology. That is why, in order the project has a successful implementation start a clear vision on main real economic and technical features of Chisinau G-MSW PP should be formed first. This is a priority number one. In the range of the same priority are both the realizations of measure leading to publishing of Feed-in

tariff for the energy produced at G-MSW PP and determination of effective Municipality of Chisinau waste calorific value, changeable during the year.

In order to overcome the underlined barriers and other of importance ones described above, in the process of G-MSW technology diffusion the following planned actions should be undertaken:

- The Ministry of Economy will:
  a) during 2013-2015, carry out, together with MCh, a thorough analysis of the costs and benefits of implementing G-MSW in municipality Chisinau. Because the investment is quite high (around US$126 million) a prefeasibility study is needed first before proceed to launch a bid for Chisinau G-MSW plant construction. In order to reach the goal ME and MCh will apply to donor countries to get an appropriate technical assistance;
  b) by 2015, Develop, together with MCh, a legal framework to attract foreign investments in G-MSW PP construction. The country is poor. There is no chance to invest about US$126 million by local investors;
  c) by 2015, exempt from import duties the G-MSW installations bought from abroad. An appropriate Government decision should be published in this respect, in order to increase project feasibility and attract foreign investments into the project.
- Ministry of Environment will:
  a) by 2015, determine, together with MCh, the composition of input waste. The technical design of the G-MSW facility is largely driven by the composition of the input solid waste and that oblige to have the effective calorific value of waste foreseen for gasification.
  b) during 2013-2015, develop a mechanisms necessary to support an integrated waste management system of waste recycling and energy recovery across the country. In order to increase G-MSW plant efficiency the separation of solid waste is needed and international categorization of the waste need to be introduced.
  c) during 2013-2018, disseminate information on G-MSW PP advantages. The knowledge on G-MSW projects is very limited in Moldova.
- By 2015, Municipality of Chisinau will develop and publish the MCh Council Decision on public authority responsibility for waste collection and transportation in G-MSW project. The financing of G-MSW project must be analyzed across the entire value chain and waste collection and transportation costs are significant.
- By 2015, National Energy Regulatory Agency will approve Feed-in tariffs for energy produced at new G-MSW PP. Lack of Feed-in tariffs introduces a big uncertainty for investors to return their investments and that cannot favour at all their involvement in the country renewable sources development.

More detailed Action Plan on G-MSW technology diffusion along with the predetermined level of measures priority is presented in the Table 1.3.4-1.

Table1.3.4-1 Action Plan on G-MSW technology diffusion

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
Legislation and regulation	To develop a legal framework to attract foreign investments in G-MSW PP construction	The country is poor. There is small chance to invest about US$126 million by local investors	Ministry of Economy, Municipality Chisinau (MCh)	ME and MCh will: a) include the realization of action in its plan of activity; b)apply to donor countries to get a technical assistance	2013-2015	2000US$-domestic, 30000US$-foreign assistance	The donors technical assistance obtained would be considered as indicator of success	ME will verify the action implementation on regular bases during the years	3
	To approve Feed-in tariffs for energy produced at new G-MSW	Lack of Feed-in tariffs introduces an uncertainty for investors to return their investments	National Energy Regulatory Agency	To elaborate, approve and publish Feed-in tariff	2013-2015	2000US$-domestic, 5000US$-foreign assistance	Approved Feed-in tariff would be an indicator of success	The action should be written into ME plan and monitored respectively	1
	To carry out a thorough analysis on the costs and benefits of implementing G-MSW in municipality Chisinau	Because the investments is quite high a prefeasibility study is needed first before proceed to launch a bid for Chisinau G-MSW plant construction	Ministry of Economy and Municipality Chisinau	ME and MCh will apply to donor countries to get a technical assistance in the form of performing the feasibility study.	2013-2015	10000US$-domestic, 100000US$-foreign assistance	A prefeasibility study done would be an indicator of success	ME and MCh will verify the action implementation on regular bases during the years	1

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
	To develop and publish the MCh Council Decision on public authority responsibility for waste collection and transportation in G-MSW project	The financing of G-MSW project must be analyzed across the entire value chain	MCh	To develop and publish an appropriate decision which will stipulate financial allocation for Action implementation	2013-2015	100000US$-domestic	Published Decision of MCh Council would be an indicator of success	Men and MCh will verify the action implementation on regular bases during the years	3
Financial incentives	To exempt from import duties the G-MSW installations bought from abroad	To assure the project feasibility	ME	Publishing a Government Decree	2013-2015	Low costs	An appropriate GD published would be an indicator of success	ME will verify the action implementation on regular bases during the years	2
Information and awareness raising	To disseminate information on G-MSW PP advantages	Knowledge on G-MSW projects is very limited in Moldova	MEn	Seminars, MEn site, mass media	2013-2018	2000US$-domestic, 8000US$-foreign assistance	More local authorities initiative to process the cities' waste would be an indicator of success	MEn will verify the action implementation on regular bases during the years	3

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
Mechanism and institutional arrangement	To develop a mechanisms necessary to support an integrated waste management system of waste recycling and energy recovery across the country	In order to increase G-MSW plant efficiency the separation of solid waste is needed and international categorization of the waste need to be introduced	MEn	MEn will apply to donor countries to get an appropriate technical assistance	2013-2015	3000US$-domestic, 80000US$-foreign assistance	An integrated waste management system approved would be an indicator of success	MEn will verify the action implementation on regular bases during the years	3
Support to R&D	To determine the composition of input waste	The technical design of the G-MSW facility is largely driven by the composition of the input solid waste	MEn and MCh	To order an appropriate study to R&D institutions	2013-2015	20000US$-domestic, 50000-foreign assistance	The composition of input waste determined will avoid risk of project implementation	Men and MCh will verify the action implementation on regular bases during the years	1

1.4 Action Plan for Technology hybrid electric vehicles (HEV)

1.4.1 About HEV technology

One approach to lowering the CO2 emission from traffic is the hybridization of vehicles. A hybrid vehicle uses two or more distinct power sources, i.e. hybrid electric vehicles (HEVs) combine an internal combustion engine and one or more electric motors. Vehicles employed in urban areas like small passenger cars, local delivery trucks and city busses benefit from hybridization and show substantially lower CO2 emissions, ranging from 23 to 43% depending on the traffic dynamics. For passenger cars there are various levels of hybridization possible all giving rise to various amount of CO2 emission reductions at different costs. Small passenger cars benefit the most from strong downsizing in combination with micro hybridization. Cars running most of their kilometers on motorways do not benefit from hybridization mostly because on motorways vehicles drive at more or less constant speeds. Hybrid vehicles are still more expensive than traditional vehicles using an internal combustion engine. They have the advantage of higher fuel efficiency and reduced CO2 emissions without additional infrastructure requirements. (ClimaTetechWiki 2012)

Although the purchase cost of a hybrid bus can be 30% higher than that of traditional non hybrid bus, the total operation costs are approximately 15% lower. For passenger cars, micro hybridization is the cheapest solution to benefit from fuel saving technologies, with full hybridization being the most expensive.

Hybrid electric vehicles (HEVs) do not show significant improvements in fuel consumption when driven on highways. However, when used in urban traffic, regenerative braking and electric motors of a hybrid car moving at a speed of 30-40 km / h produces lower CO2 emissions by 33-40% compared to a car using conventional fossil fuels (liquefied petroleum gas, diesel oil, gasoline). Additionally, research has shown that, depending on the traffic dynamics, hybrid buses have 23 – 43% lower CO_2 emission and 18-39% lower NO_x emissions compared to similar new non hybrid buses using diesel engines (ClimaTetechWiki 2012).

In the context of Moldova, the potential is to replace about 3,000 buses with HEVs by 2030, with a passenger flow of 1.118 mln passengers – km (MD Statistica 2011). The estimation made by the experts of working group the HEV technology is supposed to be implemented in 4 urban areas (Chisinau, Balti, Tighina and Tiraspol) for passenger transportation. The total investments needed are equal to US$255,6 million versus US$196,6 million if conventional vehicles are used.

The main reasons HEV technology was identified as one priority measure for Moldova energy sector are as following:

- Transport sector is responsible for 14% of country total GHG emissions (SNC 2009) and HEV assure 33% reduction of fuel consumption, when the price for fuel continues to rise;
- HEV technology win more and more market in the world demonstrating its viability (USD Energy 2011);

- Reduced noise emissions resulting from substantial use of the electric motor at idling and low speeds;
- Hybrid technology for buses has seen increased attention since recent battery developments decreased battery weight significantly;
- IRR calculated for 10 years of operation is ranged between 14% and 22% being attractive for investments.

1.4.2 Targets for technology transfer and diffusion

At present there is no hybrid electric vehicles registered in the R. of Moldova. According to HEV project this technology will be implemented for 274 buses and 2684 minibuses during 15 years, starting with 2015, replacing each year around 200 vehicles. By 2020 about 1000 HEV will serve country passengers, their total number reaching 3000 HEV by 2030. As a consequence fuel saving and CO2 emission reduction will be recorded as it is shown from the Table 1.4.2-1.

Table1.4.2-1 Targets for HEV transfer and diffusion

Type of vehicle	Energy savings, TJ/year		GHG emission reduction, tCO2/year	
	2020	2030	2020	2030
Bus	25	75	1893	5679
Minibus	91	274	6892	20676
Total	117	350	8785	26354

The total GHG emission reduction reached by 2020 and 2030 corresponds respectively to 3% and 1,8% of GHG emission target established by SNC for Intermediate Alternative Scenario.

1.4.3 Barriers to the HEV diffusion

In the R. of Moldova a favourable Enabling Framework is created to diffuse HEV technology. In particular:

- The existing in Moldova legal framework permits foreign investors to invest on the country territory, they having internationally recognised level of protection (LEP, 2004);
- Energy Efficiency Fund (EEF 2010) and EEF Regulation (EEFR, 2012) have been approved and published. HEV projects are eligible for this Fund. 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 realisation of energy efficient projects.
- Moldova has taken a commitment to reduce by 25% GHG emissions reduction by 2020 as a signatory to the Copenhagen Accord. This target encourage the promotion of energy efficiency measures, including HEV technology;
- The existing Methodology for the calculation and regulation of tariffs and services provided by the passenger transport companies assures income predictability for transport companies;

- National Development Strategy Moldova 2030 has established a target for 2020: to reduce Energy Intensity by 10% that favours HEV promotion (MES 2030).

However, there are multiple barriers of meeting the specified targets and milestones for transfer and diffusion of HEV technology. Among the most important are:

- Low profitability in passenger transport sector. The current Methodology for the calculation and regulation of tariffs and services provided by the passenger transport companies operating in the capital – which has the most concentrated transport network in the country – is based on a fixed annual profit rate of 10% being set for these transport companies (excluding those that benefit from state budget allocations). Considering the high costs of crediting in the country, this profitability is too low to attract more diversified investments in the passenger transport sector. This, together with the difficulty with which transport tariffs are typically adjusted, constitutes a clear barrier to the diffusion of the HEV technology in the sector;
- Incomplete legal framework. While the Land Transport Infrastructure Strategy currently in force emphasises infrastructure rehabilitation and development as key priorities in the sector, it also recognizes that environmental improvements brought on by the implementation of strategy objectives will be limited to the resulting positive externalities. Generally, the current legal framework in the transport sector does not clearly establish environmental sustainability as a primary objective, and as a result does not provide for any specific incentives or support for the implementation of transport technologies conducive to emissions reductions in the sector;
- High perceived risk due to unclear vehicle efficiency standards. On the supply side, another barrier to improving vehicle efficiency is the perceived commercial risk of investing in low-carbon emitting technologies, particularly due to the lack of clear regulatory signals in the form of vehicle efficiency standards. Although over the last few years there has been a gradual introduction of European vehicle emission standards, enforcement of EURO standards is still an issue, as a large part of the transport fleet fails to comply with the laxer GOST standards inherited from the Soviet system;
- Inadequate institutional framework. Integration of environmental considerations into the transport sector has been very slow due to under-developed institutional structures. These are struggling to establish a more coordinated sectorial approach and to define a strategic vision of the sector based on sustainability principles, and have a weak understanding of the potential role of policy instruments. The current mandates of municipalities to introduce fare structures create another barrier to the establishment of an improved management of public transport;
- Unknown technology and its impact on environment. Knowledge about HEV technologies is reduced, given that they are still in the first stage of commercialization on international markets. Yet, advisory services relating to the diffusion of HEVs particularly as passenger cars will be essential given the range of costs associated with the different types of possible hybridization (micro- to full-hybridization);

- Market domination by conventional technologies. The transport sector in Moldova is entirely dependent on fossil fuels. The lack of efficiency standards in the sector, coupled with unclear environmental targets for transport operation, will continue to favour use of traditional vehicles that can also be purchased at a much lower cost.

1.4.4 Proposed action plans for HEV Technology

In order to overcome the barriers to the HEV diffusion the following planned actions should be undertaken:

- Ministry of Transport and Road Infrastructure will:
  a) during 2013-2014 (together with Municipality authorities), remove profitability constrains set in the transport tariff methodology. By using a fixed rate of 10% profitability in the calculation of the passenger transport tariffs, public authorities are implicitly limiting the ability of transport agents to finance their operations through loans which are expensive. Instead, transport tariff regulation should be formulated in a way that is agnostic of available sources of finance – own capital or credit – and tariffs should be set at a level that would allow transport operators to better manage their options for raising capital. A proposed measure is to raise the profitability levels set in the Methodology from 10% to 14-15%;
  b) by 2016, develop and approve low emission development strategy in the transport sector. The lack of a strategic program is incongruous against the over-arching GHG emissions targets embraced by the country.
- Ministry of Environment will:
  a) during 2013-2015, create together with MTRI a stronger framework for carbon pricing. The transport sector generates significant externalities that are not fully reflected in prices. Yet, a robust carbon pricing framework, apart from raising awareness about the environmental cost of transport activities, will also deliver certainty to businesses in the sector about the required standards and the investments costs necessary to ensure compliance. A joint implementation of market-based instruments (such as eco-taxes), emission limits and technology standards can achieve a fuller internalization of environmental externalities. In this way, an efficient implementation of the 'polluter pays' and 'user pays' principles is also ensured. Finally, the establishment of a carbon pricing framework in the transport sector will also lead to greater financing opportunities in the form of emission trading on international markets or emission credit to attract financing by international organizations;
  b) starting with 2015, use of economic instruments to incentivize use of cleaner cars. The regulatory framework in the transport sector must provide clear signals regarding compliance with higher environmental standards. As such, ecological taxation should be considered as way to promote ecologically sustainable activities in the transport sector, while minimizing the incidence of command and control approaches. Such instruments can include vehicle taxes based on emission-tax deductions on cleaner cars,

differentiation in car registration taxes to encourage buyers to opt for cleaner car models, lower annual circulation taxes for the use of battery vehicles.

- Starting with 2013, Energy Efficiency Agency will enlarge the forms of information on HEV advantages. Information provided by authorities in the transport sector on CO2 emission performance of vehicles should be more actively disseminated. Public authorities should show more commitment towards improving the environmental performance of the vehicle fleet. Emission parameters must be included in vehicle maintenance requirements, and monitored through periodic technical inspections. All of these activities should be carried out within a wider program of gaining public support for the new policies.

More detailed Action Plan on HEV diffusion along with the priority of measures is presented in the Table 1.4.4-1.

Table1.4.4-1 Action Plan on HEV diffusion

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
Legislation and regulation	Remove profitability constrains set in the transport tariff methodology	There is no ability of transport agents to finance their operations through loans which are expensive	Ministry of Transport and Road Infrastructure, Municipality Authorities (MA)	To raise the profitability levels from 10% to 14-15%.	2013-2014	5000US$-domestic	Published Methodology with a level of 14-15% profitability	MTRI and MA will verify the action implementation on regular bases during the years	1
	To develop and approve low emission development strategy in the transport sector	The lack of a strategic program is incongruous against the over-arching GHG emissions targets embraced by the country	Ministry of Transport and Road Infrastructure	By attracting governmental institutions and the academic environment, ensuring public consultations	2013-2016	2000US$-domestic, 8000US$-foreign assistance	Publisht Strategy	MTRI will verify the action implementation on regular bases during the years	2
	Create a stronger framework for carbon pricing	Greater financing opportunities in the form of emission trading on international markets or emission credit to attract financing by international organizations	MEn and MTRI	Implementation of market-based instruments (such as eco-taxes), emission limits and technology standards	2013-2015	2000US$-domestic, 8000US$-foreign assistance	Published eco-taxes, emission limits, technology standards	Men and MTRI will verify the action implementation on regular bases during the years	1

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
Financial incentives	Use of economic instruments to incentivize use of cleaner cars	Ecological taxation should be considered as way to promote ecologically sustainable activities in the transport sector	MEn	By applying vehicle taxes based on emission-tax deductions on cleaner cars, differentiation in car registration taxes to encourage buyers to opt for cleaner car models, lower annual circulation taxes for the use of battery vehicles	2015-2030	10000US$-domestic	The number of HEV entering into the passenger transport market	The action should be included into MEn plan and monitored respectively	2
Information and awareness raising	To enlarge the forms of information on HEV advantages	Knowledge on HEV is very limited in Moldova	EEA	Seminars, EEA site, mass media	2013-2020	2000US$-domestic, 8000US$-foreign assistance	More HEV on trafic	The action should be included into EEA plan and monitored respectively	2

2. TECHNOLOGY ACTION PLAN FOR AGRICULTURE SECTOR

2.1 Actions at Agriculture Sector level

2.1.1 Agriculture Sector description

Agricultural sector plays a central role in the country economy. Lately the contribution of the agricultural sector in the GDP ranged between 14.5 – 22.4 percent, plant production contributing by 67,7% and animal production by 32,3% (NS 2011).

The principal production means of the agricultural sector in the Republic of Moldova are preponderantly privately owned agricultural lands, which by January 1, 2009 accounted for 1,984,550 thousand hectare (SNC 2009). The destination of this category of lands is production of agricultural commodities. The share of privately owned agricultural lands is 85 %.

More than half of population (59.0%) lives in rural areas, and circa 40.7 % of the total employed population are employed in agriculture.

It is well known that plant production is a source of feed and raw material for animal production and process industry and thus it is of crucial branch for national economy. In one's turn, plant production depends on soil quality, climate conditions and technologies applied for plant cultivation. 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. From other site, excessive fragmentation of privately owned agricultural lands in Moldova does not permit to apply best plant production agro technics.

As to the soil quality, taking into consideration both the dynamic of the land tilled and the types of agricultural methods used in Moldova, 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.

At present the tilled soils (1.82 million hectares) have lost around 2.1% of humus in the 0-30cm of soil layer that is equivalent to 1.2% of carbon (48.8 t/he), according to direct calculation method. That has led to preponderance low value of crops, -from one site, from other - around 85.2 million tons of carbon has been lost or 312 million tons of CO2 have been emitted in atmosphere. 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. In absolute value, from all the Moldova soils tilled, around 2.55 million tones of CO2 pollute air annually.

Only a balanced humus concentration in the soil can exclude its further degradation and GHG emissions from it. To reach this goal 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. The analyses of possible GHG emission reduction solutions applied to the agricultural soils identify the following measures in this respect:

1. The replacement of deep tilling by one superficial.
2. Predominate straw cereals growing in the crop rotation.
3. Utilization of agriculture organic wastes as fertilizer
4. Utilization of other measures leading to humus increasing in the soil

The overall targets for improvement of soil conditions derive from a number of national and sectoral policies, strategies and development plans.

The National Strategy for Sustainable Development of the Agro-Industrial Complex 2008-2015 (NSSDA 2008) is the main document for strategic coordination of political, social and economic development goals in agriculture and food processing. The general objective is to promote sustainable growth in these sectors, support their adaptation to market economy, and ensure a consequent improvement in the quality of life in rural areas by increasing the productivity and competitiveness of the sector. Among the priority is the measures contributing to diminishing agriculture's vulnerability related to risk factors and environmental protection, erosion combating.

The Program for Soil Fertility Conservation and Enhancement 2011-2020 (Fertility 2011) establishes the following overall objectives:

- by 2013 to create the technical-scientific knowledge base, in order to support soil improvement works; to subsequently maintain the knowledge base up to date;
- by end of 2013 to create the informational system on soil quality; to subsequently maintain the system up to date;
- 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 Concept on the System of Subsidies Applied to Agricultural Producers 2008-2015 (Subsidies 2008) was elaborated in response to the inefficiency and lack of transparency in the previous system of subsidy allocation to agricultural producers. The Concept's main objectives are to:

- elaborate a single system of subsidies for agricultural producers, aligned to approved policy priorities in agriculture;
- establish priority sectors in agriculture that are eligible for subsidies;
- increase efficiency of subsidy allocation;
- determine key mandatory criteria for subsidy eligibility;
- create the institutional system required for managing and monitoring subsidy funds allocation.

The way the R. of Moldova has chosen to overcome its key Agriculture sector challenges are in compliance with established country sustainable environment goals. According to Base Line Scenario (BLS) of Moldova Second National Communication, Agriculture sector is responsible for 18% (2005) of country total CO2 emissions (SNC, 2009), decreasing to 16% by 2030. In order to fulfil Copenhagen Accord commitment (CA 2010) on climate change the following objectives are formulated for GHG emission reduction in this sector (Table 2.1.1-1):

Table2.1.1-1 Projections of GHG emissions reduction for Agriculture sector, Gg CO2 eq

Sectors		2005	2010	2015	2020
Agriculture sector, Emissions	BLS	2127.8	2653.7	3157.8	3728
	IAS	2127.8	2636.4	3077.3	3594
	HAS	2127.8	2603.8	2995.7	3404.7
Agriculture sector GHG emission redaction target	IAS	0	17.3	80.5	**134**
	HAS	0	49.9	162.1	**323.3**

As it is seen from the Table 2.1.1-1, according to SNC HAS, up to 323.3 Gg CO2eq emissions should be reduced in Agriculture sector by 2020.

TNA Project is one that comes with its contribution in this process, providing a great opportunity for the Republic of Moldova to perform country-driven barriers analysis to transfer and diffusion of efficient soil tillage and thus environmentally sound technologies and combine sustainable practices with mitigation measures to climate change.

In the final stage of Technology Needs Assessment Project the working group of Mitigation component has prioritized 3 top technologies of Agriculture sector with highest potential on GHG reduction and capability for technology transfer and diffusion:

- No tillage, with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer (NTV);
- Mini tillage, with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer (MTV);
- Classic tillage, using a vetch field with two yearly yields (autumn and spring) as a „green fertilizer field" (CTV).

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

The Working group has received guidance from UNEP Riso Center Country Coordinator, Asian Institute of Technology (AIT). The group have applied methodological guidance provided during TNA workshop in Bangkok (21-24 February, 2012) and following the methodological sources: *Overcoming barriers to the transfer and diffusion of Climate Technologies (Boldt, J.,I. Nygaard, U.E. Hansen, S.Traep. UNEP RIso Centre, 2012),* UNDP Handbook *Technology Needs Assessment for Climate Change*(UNDPH 2010), Climate TechWiki website(TechWiki 2012), *Supplemental Cost-Benefit Economic Analysis Guide* (T.J. Conway, 2009).

Technology profile in the domain where NTV, MTV and CTV are planned to be diffused, along with existing policies and measures related to the sector's development and technology deployment are presented in the table 2.1.1-2. All three technologies are viewed as key contributors to the realization of the strategic objectives proposed. Although a more wide-spread adoption of these technologies is

hampered by land fragmentation issues, the target is to achieve their diffusion over a total area of 600,000 hectares, which constitutes 36% of total arable land. This overall target was established at working group consultation meeting. 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. The technologies selected share the same barriers as they represent three possible land cultivation techniques that can reduce GHG emissions and minimise 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. 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.

Table2.1.1-2 Policies to promote advanced Agriculture sector technologies

Main Policy instruments applied (Government Decisions)	When enacted and revised	Main content	Current technology Profile
Name of Policy: **Create a balanced humus concentration in the soil**			
National Strategy for Sustainable Development of the Agro-Industrial Complex 2008-2015	In effect starting with 21.03.2008	The Strategy is the main document for strategic coordination of political, social and economic development goals in agriculture and food processing. The general objective is to promote sustainable growth in these sectors, support their adaptation to market economy, and ensure a consequent improvement in the quality of life in rural areas by increasing the productivity and competitiveness of the sector. Among the priority is the measures contributing to diminishing agriculture's vulnerability related to risk factors and environmental protection, erosion combating. Total cost estimated at MDL 9,4482 mln (approx €608 mln), which will be covered over 2008-2015: • state budget: MDL 1,511 mln (approx €97 mln) • private investment: MDL 2067.5 mln (approx €132.5 mln) • investment projects (including grants): MDL 952.1 mln (approx €61 mln) • funding to be further raised: MDL 4957.6 mln (approx €318 mln) New institutions created: • Centre for Legislation Harmonization • Centre for Information and Marketing in Agriculture • Agency for Payments and Interventions in Agriculture • Further restructuring through merging of several Agencies subordinate to the Ministry	In the R. of Moldova different technologies for soil tillage are used. According to the MAFI*, on around of 30% of arable lands Classic tillage (ploughing the soil, several subsequent cultivations and crop establishment with seed drills) is applied. No-conventional tillage is spread on remaining part of arable land. Among them No-till Mini-till technologies are used on about 44 000 he, including No-till – on 18000 he, i.e. totally on around 2,4% of arable land. On only around 30% of land previous crop residues are incorporated into the soil or on its surface. Crop rotation is not

Main Policy instruments applied (Government Decisions)	When enacted and revised	Main content	Current technology Profile
The Program for Soil Fertility Conservation and Enhancement 2011-2020	In effect starting with 26.08.2008	The Program will be implemented over the period 2011-2020, in three phases each of 3 years in duration. The overall objectives of the Program are: • by 2013 to create the technical-scientific knowledge base, in order to support soil improvement works; to subsequently maintain the knowledge base up to date • by end of 2013 to create the informational system on soil quality; to subsequently maintain the system up to date • 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. Funded by the state budget, grants, and economic agents in the agricultural sector. The cost of works are established annually. Total estimated cost for 2011-2013 is MDL 54 mln (approx €3.5 mln).	applied on regular bases. As to fertilizers applied, insufficient quantity of mineral one is used – in average 20kg/he, rare - organic, if the last is available in the region, their quantity being insignificant - in average 10kg/he. Hairy Vetch for Cover Cropping in Organic Farming is not used at all in the R. of Moldova. Globally, the no-tillage technology is being applied on over 100 Million ha under the most diverse climate and soil conditions (Derpsch, et al., 2010)
The Concept on the System of Subsidies Applied to Agricultural Producers 2008-2015	In effect starting with 17.12.2007	The Concept was elaborated in response to the inefficiency and lack of transparency in the previous system of subsidy allocation to agricultural producers. The Concept's main objectives are to: • elaborate a single system of subsidies for agricultural producers, aligned to approved policy priorities in agriculture • establish priority sectors in agriculture that are eligible for subsidies • increase efficiency of subsidy allocation • determine key mandatory criteria for subsidy eligibility • create the institutional system required for managing and monitoring subsidy funds allocation Subsidies are approved through the Law on state budget on an annual basis.	

Note: No official statistic data on type of tillage technology used is available in R. of Moldova.

2.1.2 General barriers and proposed measures

As it was mentioned above the technologies selected share the same barriers as they represent three possible land cultivation techniques that can reduce GHG emissions and minimise 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. That is why general barriers and proposed measures of the technologies considered correspond to ones specific. In the Table 2.1.2-2 the measures to overcome selected agriculture technologies barriers are presented.

Table2.1.2-1 Agriculture sector barriers and measures for NTV, MTV, CTV promotion

Domain	Barriers	Measures
Economic and Financial	Reduced availability of financial resources. High cost of financing	To improve local crediting conditions: to review different options for how the risk premium attached to agricultural projects can be under-written so that end-user interest rates are reduced. Additionally, a grace period of 3-5 years should also be considered, which will allow credit beneficiaries to better align their credit payment schedule with the life-cycles of conservative technologies. To incentivize conservative agriculture: exemption of duties on imported equipment and other tax rebates, long term commitment to the sector and providing support to map investment possibilities.
Policy and Regulation	High transaction costs	To reduce transaction costs associated with land sale-purchase and lease contracts: 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.
	Slow implementation of programs promoting conservative agriculture	To boost the implementation of policies and action plans promoting conservative agriculture: The Government should elaborate the Program for conservation agriculture, as it has indicated in its Plan of activities for 2012.
	Low performance due to land fragmentation	To promote land consolidation. The regulatory framework should be conducive to the establishment of economic mechanisms that incentivize single-party land ownership over areas of more than 200-400 hectares. Agricultural policy should encourage long-term leasing and strive to reduce transaction costs for selling and buying land, should support a wider coverage of mortgage lending schemes, and should strengthen the institutional capacity through the provision of tools and research support during the process of land consolidation.
Network and Institutional	Low stakeholder cooperation. Lack of cooperation along the value chain.	Promote stronger stakeholder cooperation and foster a culture of participation
	Insufficient advisory services in agriculture	Strengthen advisory services to help promote sustainable practices. To develop the network of local consulting services in agriculture. The projects aimed at developing local consulting services should also include diffusion of environmental specific knowledge, and extending organizational capacity to meet demand for advisory services specific to the implementation of sustainable

Domain	Barriers	Measures
		technologies in agriculture, including conservative.
	Inadequate laboratory facilities	To improve laboratory infrastructure. A widespread soil analysis should be carried out to determine fertilizer requirements – it is hoped that during this process a better understanding of opportunities to use green fertilizers will also be gained.
Social, Information and Awareness	Inadequate sharing of project experience. Poor dissemination of information. High risk perception of technology	To carry out information and awareness raising campaigns, trainings
	Under-developed educational and research institutions	To improve the national system of pedologic research. Implementation and enforcement of the single tax on land relies on a solid information system on soil quality and on improved capacities to carry out pedologic research.
	Lack of a centralized system on soil quality	To establish and maintain a centralized database on soil quality. The roll-out of this system should be accompanied by a plan of training and professional development of staff in the agricultural sector, and a campaign to raise general awareness about the system and its purpose.

2.2 Action Plan for Agriculture NTV, MTV, CTV Technologies

As it was mentioned above, during the barrier analysis, it became clear that technologies selected in the agricultural sector 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. As a consequence, the identified measures are also shared and together can be used as the enabling framework and Action Plan necessary to support the transfer and diffusion of the selected conservative technologies in agriculture: NTV, MTV and CTV. 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.

The main reasons why NTV, MTV and CTV technologies were identified as ones priority measure 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 due to:

- Gradual restoration of the humus content, favourable structure and fertility of the soil arable layer;
- Decrease 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 favour reduction of leaks and accumulation of water from precipitations in the soil);
- Establishment of a positive balance of humus and carbon in soil, total reduction of GHG emissions from agricultural soils.
- Increase of soils productivity by 30-40 percent.
- Low pay-back period, 2-3 years are needed to return the investments made.

2.2.1 About NTV technology

The no-till soil cultivation system means that the sowing is done directly on the stubble field or field containing vegetal waste of the previous crop. This prevents excessive ploughing – characteristic of existing soil cultivation techniques – which causes soil degradation through de-humification, increased compaction and erosion. The no-till system significantly reduces soil erosion, conserves soil nutrients and reduces equipment, energy and fertilizer use.

The use of vetch as green fertilizer is essential as it provides replacement for the otherwise chemical fertilizers. The no-till technology also requires the use of a sowing machine with cutters, which can be combined with corrugated disc type blades and chisel type blades. As it is not produced locally in Moldova, this equipment will have to be imported. The no-till technology is profitable if implemented

on large-scale farms, of at least 200-400 hectares. Each land plot of this minimum size must be managed by a single operator who can control the cultivation life-cycle.

Overall for Moldova, as it was mentioned above, the target is to diffuse the technology over 200,000 hectares of land – mainly in the South of the country – over a period of 10 years (20,000 ha annually) using 5-field crop rotation. The estimated benefit as a result of improved crop yield is 47Euro /he/year in the first year (2014), reaching 255 Euro/he/year while the reduction of CO2 is estimated at 2.54t/ha/year.

2.2.2 About MTV technology

The mini-till system consists of returning crop residue back into the soil and partially preserving vegetal waste as mulch, which serves as source of energy for the living organisms in earth. In this way, biodiversity and a balanced ecosystem are maintained.

Use of vetch as green fertilizer is proposed as an improvement to the mini-till cultivation system so as to counteract the reduction of organic matter in soil that has been caused by existing cultivation techniques. Implementation of this technology will require a joint use of drill tillage with light discs and a common sowing machine, or a combined tillage and sowing machine.

Overall for Moldova, the target is to diffuse the technology over 200,000 hectares of land over a period of 10 years (20,000 ha annually) using 5-field crop rotation. The estimated benefit as a result of improved crop yield is 47Euro /he/year in the first year (2014), reaching 255 Euro/he/year while the reduction of CO2 is estimated at 2.54t/ha/year.

2.2.3 About CTV technology

The specific classic-till farming technology that has been selected as part of the TNA is classic tillage using a vetch field with two yearly yields (autumn and spring) as a „green fertilizer field" into a 5-fields crop rotation, with two crops of vetch incorporated in soil as green fertilizer on each field once every 5 years. This method of classic tillage is particularly intended for cases where soil cultivation techniques cannot be replaced with conservative technologies such as due to crop specifics (such as sugar beet, legumes etc.). Classic tillage through the use of green fertilizer fields improves the humus content and carbon balance in soil, stops land degradation and increases the soil's resistance to pollution and draught.

A vetch seeds production facility is required to implement this technology. The vetch is sown on the „occupied field" and incorporated in soil twice a year – about 20t/ha of organic matter – which keeps a good balance of nitrogen and carbon over the next 4 years when the field is used for cultivation of main crops.

Overall for Moldova, the target is to diffuse the technology over 200,000 hectares of land over a period of 10 years (20,000 ha annually) using 5-field crop rotation.

The estimated benefit as a result of improved crop yield is (-60) Euro /he/year in the first year (2014), reaching 192 Euro/he/year, NPV for 5 years being 21.82 million Euro, while the reduction of CO2 is estimated at 2.03t/ha/year.

2.2.4 Targets for technology transfer and diffusion

The Second National Communication (SNC 2009) sets the target for the Agricultural sector to reduce GHG emissions by 162 th tCO2 by 2015 and 323 th tCO2 by 2020, according to High Alternative Scenario. The three technologies considered are viewed as key contributors to the realization of the strategic objectives proposed. Although a more wide-spread adoption of these technologies is hampered by land fragmentation issues, the target is to achieve their diffusion over a total area of 600,000 hectares, which constitutes 36% of total arable land. This overall target was established at working group consultation meeting. 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.

The following CO2 emission reduction (Table 2.2.4-1) will be achieved by 2015 and 2020 if the technologies are implemented at the magnitude described above:

Table2.2.4-1 Contribution of NTV, MTV and CTV in reaching GNG emission reduction targets

Technology	**units**	**2015**	**2020**
No-till+vetch	th tCO2	10	193
Mini-till+vetch	th tCO2	10	193
Classic+vetch	th tCO2	8	154
TOTAL	th tCO2	**28**	**540**
Target of CO2 reduction in Agriculture sector according to SNC	th tCO2	**162**	**323**
Contribution of NTV, MTV and CTV in reaching GNG emission reduction targets	th tCO2	**28.4**	**540.4**
	% from target	**17.5**	**167.1**

As it is seen from the Table 2.2.4-1, by 2020 the implementation of the technologies will assure a much higher CO2 reduction, than it was planned by SNC for agriculture sector. 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 Third National Communication that is in the process of elaboration at present.

Based on the experience gained, new targets for NTV, MTV and CTV dissemination will be established for the years after 2020.

2.2.5 Barriers to the NTV, MTV and CTV diffusion

In the R. of Moldova a partly favourable Enabling Framework is created to diffuse Soil Fertility Conservation technologies like NTV, MTV and CTV are. In particular:

- The existing in Moldova legal framework permits foreign investors to invest on the country territory, they having internationally recognised level of protection (LEP, 2004);

- Moldova has taken a commitment to reduce by 25% GHG emissions reduction by 2020 as a signatory to the Copenhagen Accord. This target encourage the promotion of soil conservative measures, including NTV, MTV and CTV technology;
- The Program for Soil Fertility Conservation and Enhancement 2011-2020 foreseen to implement works of soil conservation and fertility improvement on an area of 1.7 mln hectares by 2020;
- Soil protection measures in the frame of Agriculture practices are established by Government Decree (SPM 2008).
- Land property regime, land state cadastre and land monitoring regulation is approved by the Parliament (LPR 1993)
- Land Relation and Cadastre Agency is operating in the R. of Moldova, one of the main duty being the formulation and realisation of the country single land relation development concept, Restoring fertility and quality of soil.
- Other around fourteen normative acts are put in effect to support the promotion of soil conservation while keeping high crop productivity on arable land.

However, there are multiple barriers of meeting the specified targets and milestones for transfer and diffusion of NTV, MTV and CTV technology. Among the most important are:

- Excessive land fragmentation leading to low performance. Land ownership in Moldova is highly polarized, with few large corporate farms and many small and fragmented family farms created as a result of the land reform that took place in the decade following the country's independence. Most of the contracts for land lease by peasant farms and corporate agricultural units are signed for no more than 3 years, which creates little incentives for leaseholders to invest additional capital in soil-fertility improving technologies that typically have a long life-cycle.
- Lack of economic incentives. Starting with 2012 subventions for the purchase of pesticides and fertilizers have been removed from the annual program of subventions by the state. The Ministry of Agriculture and Food Industry 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 – a scheme that could potentially be rolled out through donor-financed programs - however such discussions are in very early stages.

  Furthermore, the recent decision to increase the VAT rate applied on agricultural products – from 8 to 20% – will have a negative impact on the overall capitalization of the agricultural sector and is likely to cause a reduction in the number of economic agents involved in the sector.
- High cost of financing. Access to credit in Moldova is expensive and difficult, and long-term loans for agriculture are scarce.
- Slow implementation of programs promoting conservative agriculture. While the Strategy for Sustainable Development of the Agro-Industrial Complex adopted in 2008 recognizes reduction of tillage and of GHG emissions in agriculture as key priorities in the sector,

adoption of a targeted plan of actions promoting the use conservative technologies across the country has been slow.

- Not clear land management standards. Inadequate balance between land ownership rights and obligations. Currently, land relations in the Republic of Moldova are regulated by a large number of legal acts – laws, by-laws, programs, strategies, and action plans of central and local public authorities – which creates an environment where coordination and correlation of legal objectives and priorities is difficult to achieve.
- Low stakeholder cooperation. Lack of cooperation along the value chain. Although at present there are associations to support farmers, producers, processors, and other actors in the agro-industrial complex, the influence that these groups have on the actual operations of the various players within the sector is not significant.
- Insufficient advisory services in agriculture. Development of agricultural advisory services is often viewed as a lower priority given the primary focus on production. Programs to improve soil management through good agricultural practices exist, but their funding and coverage remains limited.
- Inadequate laboratory facilities. 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.
- Inadequate sharing of project experience. Poor dissemination of information. High risk perception of technology. Local authorities are not always up to date with the existing legal framework in agriculture, including programs and strategies in force. It is often the case that they do not have enough capacity to adequately cover their land management functions, have limited knowledge about the use of modern technologies in agriculture, and have insufficient means to disseminate information or provide any servicers to farmers.
- Under-developed educational and research institutions. Despite the generally high level of education in Moldova, the number and quality of professional qualifications held by the rural population continues to decline. The number of researchers employed by scientific institutions in the agricultural sector has also been on the decline, mostly due to inadequate funding of such organizations. As a result, the current system of research and innovation in the country does not correspond to modern market needs and service standards.
- Lack of a centralized system on soil quality. Availability of accurate and comprehensive data on soil quality is a key pre-condition for the elaboration of a broad, complete and strategic legal framework governing land management in the country. In Moldova, mostly due to limited financial resources, a centralized database on soil quality has not yet been established, although works to this end have commenced and are in early stages.

2.2.6 Proposed action plans for NTV, MTV and CTV technologies

In order to overcome the barriers to the NTV, MTV and CTV diffusion the following planned actions should be undertaken:

- Ministry of Agriculture and Food Industry will:
  a) during 2013-2018, promote actions to consolidate very fragmented agriculture land. The measures applied in this direction should be considered of priority number one. The regulatory framework should be conducive to the establishment of economic mechanisms that incentivize single-party land ownership over areas of more than 200-400 hectares. Agricultural policy should encourage long-term leasing and strive to reduce transaction costs for selling and buying land, should support a wider coverage of mortgage lending schemes, and should strengthen the institutional capacity through the provision of tools and research support during the process of land consolidation.
  b) Incentivize conservative agriculture. Starting with 2013-2016 put in practice a subvention scheme for the purchase of equipment for conservative technologies to cover up to 20-30% of total investors costs in conservative agriculture. This measure is considered of priority number one.
  c) during 2013-2016, realise the reduction of transaction costs associated with land sale-purchase and lease contracts. To replace 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.
  d) during 2013-2014, boost the implementation of policies and action plans promoting conservative agriculture. To elaborate the Program for promoting conservation agriculture.
  e) during 2013-2015, improve local crediting conditions, together with banks. To review different options for how the risk premium attached to agricultural projects can be under-written so that end-user interest rates are reduced; a grace period of 3-5 years for credits should be considered.
  f) starting with 2013, carry out information and awareness raising campaigns, trainings. 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.
  g) starting with 2013, to promote stronger stakeholder cooperation and foster a culture of participation. An adequate level of financial support is channelled through national strategy budgets towards strengthening institutional capacities of local authorities so that they can take on greater responsibilities for environmental protection. To assure a Public-private dialogue, to establish a road-map that will build trust among the various players along the value chain of agricultural production.
  h) during 2013-2020, improve soil testing laboratory infrastructure. To increase the number of laboratories in the strategic rural points.

i) during 2013-2020, improve the national system of pedologic research, together with research Agriculture research institutions. To apply a single land tax instead of at least six existing taxes. To elaborate the digital country-wide pedological map.

j) starting with 2014, establish and maintain a centralized database on soil quality, together with research Agriculture research institutions. To designate an institution for creation a centralized database on soil quality. The appropriate fund should be allocated.

- During 2013-2016, Land Relation and Cadaster Agency (LRCA) will contribute to reduce transaction costs associated with land sale-purchase and lease contracts. To replace 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.
- National Agency for Rural Development (ACSA) should have a more large financial support from country budget; ACSA will apply to donor support as well. ACSA hasn't enough financing to provide support for increasing innovation and productivity on small and medium farms throughout Moldova.

More detailed Action Plan on NTV, MTV and CTV diffusion along with the priority of measures is presented in the Table 2.2.6-1.

Table2.2.6-1 Action Plan on NTV, MTV and CTV diffusion

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
Legislation and regulation: legislation, standards and labelling	To reduce transaction costs associated with land sale-purchase and lease contracts	The costs associated with land sale-purchase and lease contracts are high in both terms: financial and time consuming	Land Relation and Cadastre Agency (LRCA)	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.	2013-2016	2000US$-domestic, 30000US$-foreign assistance	Published new fees will be an indicator of success	LRCA will verify the action implementation on regular bases during the years	2
	To boost the implementation of policies and action plans promoting conservative agriculture	The adoption of a targeted plan of actions promoting the use conservative technologies across the country is slow	MAFI	To elaborate the Program for promoting conservation agriculture	2013-2014	5000US$-domestic, 100000US$-foreign assistance	Approved Program will be an indicator of success	MAFI will verify the action implementation on regular bases during the years	2
	To promote land	In order to achieve economies of scale and higher returns,	MAFI	The regulatory framework should be conducive to the	2013-2018	10000US$-domestic, 200000US$-	First single-party land ownership	MAFI will verify the action	1

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
	consolidation	conservative technologies in agriculture must be implemented on large plots of land. Land ownership in Moldova however is highly polarized, with few large corporate farms and many small and fragmented family farms.		establishment of economic mechanisms that incentivize single-party land ownership over areas of more than 200-400 hectares. Agricultural policy should encourage long-term leasing and strive to reduce transaction costs for selling and buying land, should support a wider coverage of mortgage lending schemes, and should strengthen the institutional capacity through the provision of tools and research support during the process of land consolidation.		foreign assistance	over areas of more than 200-400 he would be an indicator of success. If the land is not consolidated conservative agriculture will be inefficient	implementation on regular bases during the years	

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
Financial incentives	To improve local crediting conditions	Access to credits in Moldova is expensive and difficult, and long-term loans for agriculture are scarce	MAFI together with banks	To review different options for how the risk premium attached to agricultural projects can be under-written so that end-user interest rates are reduced; a grace period of 3-5 years for credits should be considered	2013-2015	2000US$-domestic, 5000US$-foreign assistance	An appropriate agreement signed between MAFI and banks would be an indicator of success	MAFI will verify the action implementation on regular bases during the years	2
	To incentivize conservative agriculture	Starting with 2012 subventions for the purchase of pesticides and fertilizers have been removed. VAT rate applied on agricultural products has been increased from 8 to 20%, having a negative impact on the overall capitalization of the agricultural sector. MAFI has been considering the elaboration of a	MAFI	As soon as possible to put in practice a subvention scheme for the purchase of equipment for conservative technologies to cover up to 20-30% of total investors costs in conservative agriculture.	2013-2016	10000US$-domestic, 50000US$-foreign assistance for the elaboration and approve the scheme. The subventions will require annually around 1.63 - 2.45 million Euro during 10 years	The Parliament decision on subvention scheme of conservative agriculture will be the indicator of success	MAFI will verify the action implementation on regular bases during the years	1

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
		subvention scheme for the purchase of equipment for conservative technologies to cover up to 20-30% of total cost. But up to now no changes have been produced on this policy.							
Information and awareness raising	To carry out information and awareness raising campaigns, trainings	High risk perception of conservative technologies. The knowledge gained through project implementation is not widely shared. Local authorities are not always up to date with the existing legal framework in agriculture, including programs and strategies in force	MAFI	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.	2013-2020	50000US$- domestic, 100000US$ - foreign assistance	The program for dissemination information elaborated and approved, and subsidies allocated for acquisition of consultancy services would be an indicator of success	MAFI will verify the action implementation on regular bases during the years	2

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
Mechanism and institutional arrangement	To promote stronger stakeholder cooperation and foster a culture of participation	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	MAFI	An adequate level of financial support is channelled through national strategy budgets towards strengthening institutional capacities of local authorities so that they can take on greater responsibilities for environmental protection. To assure a Public-private dialogue, to establish a road-map that will build trust among the various players along the value chain of agricultural production.	2013-2018	40000US$-domestic, 100000US$-foreign assistance	An established road-map that will build trust among the various players along the value chain of agricultural production would be the first indicator of success.	MAFI will verify the action implementation on regular bases during the years	2

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
	To strengthen advisory services to help promote sustainable practices	National Agency for Rural Development (ACSA) hasn't enough financing to provide support for increasing innovation and productivity on small and medium farms throughout Moldova	ACSA	1. Enlarge financial support from country budget; 2. To apply to donor support.	2013-2015	10000US$- domestic, 100000US$- foreign assistance	ACSA Financial assurance would be an indicator of success	MAFI and ACSA will verify the action implementation on regular bases during the years	3
	To improve laboratory infrastructure	Access to soil and other testing facilities is limited in Moldova. The technical equipment used in the existing laboratories is generally obsolete. This further inhibits the ability to analyze various organic micro-polluters in water, air and soil.	MAFI	To increase the number of laboratories in the strategic rural points	2013-2020	50000US$- domestic per laboratory	The new laboratory created would be an indicator of success	MAFI will verify the action implementation on regular bases during the years	2

Domain	Action	Why the measure/action is needed	Who (government agency, private sector etc.)	How should they do it?	When (0-5 years, 5-10 years, or 10-20 years)	How much the measure/action will cost, how can it be funded (domestic funding, or international funding)	Indicators of success, risks	Monitoring, reporting and verification for measure	Priority
Support to R&D	To improve the national system of pedologic research	A solid information system on soil quality and on improved capacities is needed in order successfully promote conservative technologies.	MAFI together with Agriculture research institutions	To apply a single land tax instead of at least six existing taxes. To elaborate the digital country-wide pedological map.	2013-2020	100000US$-domestic, 100000-foreign assistance	A single land tax and digital country-wide pedological map developed would be an indicator of success.	MAFI and Agriculture research institutions will verify the action implementation on regular bases during the years	3
	To establish and maintain a centralized database on soil quality	Availability of accurate and comprehensive data on soil quality is a key pre-condition for the elaboration of a broad, complete and strategic legal framework governing land management in the country. In Moldova, a centralized database on soil quality has not yet been established, although works to this end have commenced and are in early stages.	MAFI together with Agriculture research institutions	To designate an institution for creation a centralized database on soil quality. The appropriate fund should be allocated	Starting with 2014 and maintain permanently	100000US$-domestic, annually; 100000-foreign assistance at the first stage	The institution designated and the appropriate fund allocated would be an indicator of success	MAFI will verify the action implementation on regular bases during the years	3

3. CROSSCUTTING ISSUES

Despite the difference between sectors' technologies considered there are some common enabling policies and actions which can help addressing the common barriers they met to their diffusion. They are presented in the Table 3-1 below:

Table 3-2.2.6-1Common enabling policies and actions to technology diffusion

No	Enabling environment	Comments	Supported entities
1	Protection of foreign investments	The existing in Moldova legal framework permit foreign investors to invest in the R.ofMoldova without significant risks. Common barrier: Risks for investments	ME
2	To improve local crediting conditions	Access to credits in Moldova is expensive and difficult, and long-term loans are scarce. This is a common barrier for all technologies implementation	ME, MTRI, MAFI
3	Past exemption from import duty on energy technologies	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 all other imported installations that lead to important economy development. Common barriers are: High up-front costs, High cost of financing, Investment incentives not clearly defined	ME, MTRI, MAFI
4	Moldova has submitted a target of 25% GHG emissions reduction by 2020 as a signatory to the Copenhagen Accord	The target is fixed into the draft of LEDS. In order to reach the goal the second legal framework should be developed and put in effect. Common barrier: Second environment legal framework is underdeveloped.	ME, MTRI, MAFI

Access to affordable finance and in amounts needed for start investments or larger capital expenditures remain a constraint across both Energy and Agriculture sectors. This issue is difficult to solve applying measures based on internal budgetary resources and in conditions where private sector is weak in addressing country's sustainable development needs. In response to poor access to finances and investment capital as a measure was proposed to seek investments form to regional and global funding organisations. Governmental commitment toward implementation of international programmes on climate change is of great support for all sectors of Moldova's economy. By another hand, some of sector's level problems (managerial) could be solved locally, with national or even community supports, as these opportunities are not well explored.

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Annex I. List of stakeholders involved and their contacts

Table AI-1 Experts involved in the Technology Action Plan 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, Power generation technologies. Responsible for Barrier Analysis and Enabling Framework identification of the technologies: 1. Electricity Supply: combined heat and power plants based on internal combustion engines of up to 500kW (ICE CHP) 2. Heat Supply: gasification of municipal solid waste for electricity heat/ production (G-MSW)	Phone: 373 22 852 934 andrei_sula@yahoo.com
3	Codreanu Sergiu	Engineer, ICS RED Union Fenosa S.A.	Transport sector technologies. Responsible for Barrier Analysis and Enabling Framework identification of the technology: 3. Hybrid electric vehicles (HEV)	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 Barrier Analysis and Enabling Framework identification of the technology: 1. No till soil cultivation system with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer 2. Mini-Till soil cultivation system with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer 3. Classic tillage, including a vetch field (two yields per year – autumn and spring), as a „green fertilizer field” into a 5-fields crop rotation	Phone: 373 79 462 471 vcerbari@gmail.com

TableAI-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	1. Electricity Supply: combined heat and power plants based on internal combustion engines of up to 500kW (ICE CHP) 2. Heat Supply: gasification of municipal solid waste for electricity heat/ production (G-MSW)	Meetings	Phone: +373 22 234 628
2	Moraru Marcelina	Ministry of Transport and Road Infrastructure, Director of the Department for International Relations and European Integration	Hybrid electric vehicles (HEV)	Meetings	Phone: +373 22 820 710
3	Mihai Suvac	Ministry of Agriculture and Food Processing, Director of the Department for Production Policies and Quality Regulation of Vegetable Products	1. No till soil cultivation system with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer 2. Mini-Till soil cultivation system with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer 3. Classic tillage, including a vetch field (two yields per year – autumn and spring), as a „green fertilizer field" into a 5-fields crop rotation.	Meetings	Phone: +373 22 211 575