Republic of Moldova

TECHNOLOGY NEEDS ASSESSMENT FOR CLIMATE CHANGE MITIGATION

REPORT II

BARRIER ANALYSIS AND ENABLING FRAMEWORK

December, 2012

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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)
BLS	Base Line Scenario
CCPP	Combined Cycle Power Plant
CDM	Clean Development Mechanism
CH4	Methane
CHP	Combined Heat and Power Plant, Cogeneration Power Plant
DH	District Heating
E5P	The Eastern Europe Energy Efficiency and Environment Partnership
EBRD	European Bank for Reconstruction and Development
EEA	Energy Efficiency Agency (Moldova)
EECCA	Eastern Europe, Caucasus and Central Asia
EIA	Environmental Impact Assessment
ESCO	Energy Service Companies
EU	European Union
GD	Government Decree
Gg	$!0^9$ 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
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
MCDA	Multi-Criteria Decision Analysis
ME	Ministry of Economy
MEn	Ministry of Environment
MF	Ministry of Finance
MoSEFF	Moldova Sustainable Energy Financing Facility
MTRI	Ministry of Transport and Road Infrastructure
MW	10^6 Watt
NAMA	National Appropriate Mitigation Actions
NGO	Non Government Organization
O&M	Operation and Maintenance

OECD	Organisation for Economic Co-operation and Development
PFS	Policy Fact Sheet
pkm	Passengers*km
PP	Power Plant
PPP	Photovoltaic Power plant
R&D	Research and Development
RES	Renewable Energy Sources
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 Șalaru

Minister of Environment of the Republic of Moldova

March 2013

EXECUTIVE SUMMARY

This Report is the second 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 two-fold: to first identify barriers and measures addressing barriers to the transfer and diffusion of each selected technology, and based on these findings to establish an enabling framework for technologies of the same sector.

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

- 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)
- 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

Project activities were implemented in consultation with stakeholders, representatives from Ministries of Environment, Agriculture, Economy, research institutions, business, academia, NGOs. The stakeholders were part of national teams divided into two working groups assigned to Energy and Agriculture sectors.

During the implementation of this phase, the groups have received guidance from UNEP Riso Center Country Coordinator, Asian Institute of Technology (AIT). The groups 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)*[1], UNDP Handbook *Technology Needs Assessment for Climate Change*[2], Climate TechWiki website,[3] *Supplemental Cost-Benefit Economic Analysis Guide (T.J. Conway)*[4].

The barrier analysis process started with a re-affirmation of Moldova's development and climate change mitigation priorities, followed by a review of the specific sub-sectorial objectives that are required to meet the national targets. A natural extension of this thought process was to simultaneously contextualize the proposed sub-sectorial objectives against the backdrop of enabling factors that are currently present or missing in Moldova. In this way,

[1] Overcoming barriers to the transfer and diffusion of Climate Technologies (Bodt, J.,I. Nygaard, U.E. Hansen, S.Traep. UNEP RIso Center), (2012)
[2] UNFCCC/UNDP. Technology Needs Assessment for Climate Change. Handbook, 2010
[3] http://tech-action.org/guidebooks.htm
[4] Supplemental Cost-Benefit Economic Analysis Guide (T.J. Conway) (2009)

preliminary targets have been identified first. Sectorial development policies, development plans and programs, each technology characteristics have been considered in setting targets to transfer of technologies for energy savings and renewable electricity production increasing.

Market mapping techniques were used from the early stages of the barrier analysis process which involved several consultations among stakeholders. The resulting market maps for each technology continued to be refined throughout the consultations and served as a key input in the detailed categorization of barriers and the later identification of cross-technology linkages.

In order to understand the core problems in technology transfer, the working group of each sector has applied **Logical Problem Analysis (LPA)**. The cause/effect relations were organized in **Problem tree**, having the main problem put as starter problem, causes at the bottom of the tree and their effects in the upper part of the diagram. Using LPA the working groups were able to bring together the key elements of problems, apply logical analysis of interrelated elements, and identify linkages between problem elements and external factors. Thus, the Problem trees were used for understanding the causal relations of barriers, their linkages.

The next step of the Project was the identification of measures supporting technology transfer as actions that could be taken to enhance technology transfer. The process of identification and description of measures to overcome barriers was done by working groups of both Energy and Agriculture sectors in the same context as barrier analysis, applying the Logical Problem Analysis. Applying LPA, the working groups have considered the circumstances these opportunities could be reached and set objectives for each technology, organizing them into the **Objective Tree**. Proposed measures were discussed according to their economic profile and incentives used. The implementation of each analysed technology falls under jurisdiction of several normative acts of the Republic of Moldova and the working groups have discussed the political environment and functioning regulations influencing technology transfer. Among listed policies and regulations the groups have identified the policy directly impacting technology implementation. In this respect the crucial policy instruments were described in the form of **Policy Fact Sheets**.

The political path impacting technology implementation under a specified policy and regulatory acts is influenced by economic-financial conditions. These conditions have been analyzed applying economic-financial analysis. To make it more qualified each of technology was modeled into the Excel format, it permitting to identify the conditions when the technology becomes feasible and what should be undertaken the project be more attractive for investors. GHG emissions reduction per each of technology and its contribution to reach country target in this respect are reflected in these models too. The analysis made proved that all the technologies are feasible for country business environment. However, some modifications of existing normative acts should be undertaken in order the projects be profitable.

Market analysis was performed by Mitigation national teams using market mapping approach. This approach helped to visualize commercial and institutional environment for each technology market. The whole system was considered in the context of its three main components: Enable business environment; Market chain actors and linkages and Service providers. 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 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, the identified measures are also shared and together can be used as the enabling framework necessary to support the transfer and diffusion of the selected conservative technologies in agriculture. From the long lists of barriers and measures per each technology it has been identified the short ones, they encompassing the most crucial of barriers and measures. They are reflected in the tables below.

Table 1. Identified barriers to technology transfer in the Energy Sector

Domain	ICE CHP	G-MSW	HEV
Economic and Financial	High transaction costs Reduced availability of financial resources High cost of financing Investment incentives not clearly defined	High up-front costs High operational and maintenance costs Insufficient financing along the value chain in the waste management sector	Inappropriate incentives. Low profitability in the passenger transport sector
Market Failure and Imperfection	Inadequate sharing of project experience		
Policy, Legal and Regulatory	Incomplete legal and regulatory framework Uncertain incentives for private investors	Incomplete legal framework to support renewable energy projects Under-developed waste management policy and regulatory framework Inadequate enforcement of waste management regulations	Incomplete legal framework in the transport sector Lack of low emission development strategy in the transport sector
Institutional Capacity	Slow development of institutional capacity in energy efficiency		Inadequate institutional framework
Information and Awareness	Inadequate information on the implementation of small scale ICE CHP projects	Inadequate waste-related information High risk perception of the technology	Unknown technology and its impact on environment
Technical Issues		Unknown composition of input waste	

Table 2. Proposed measures to overcome barriers to technology transfer in the Energy Sector

Domain	ICE CHP	G-MSW	HEV
Economic and Financial	To exempt from import duties ICE CHP installations To support ICE CHP construction from Energy Efficiency Fund To Provide restructuring of the district heating systems: To optimize the structure of existing CHPs and Heat Plants, developing heat sources closer to consumers	To exempt from import duties G-MSW installations To support G-MSW construction from Energy Efficiency Fund	Use of economic instruments to incentivise use of cleaner cars To support HEV from Energy Efficiency Fund
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% Electricity produced in excess at enterprises and service providers should have a mandatory be purchased in the market at the price regulated For the entities with energy consumption of 200 t.o.e/year and more energy audit should be a mandatory	To approve Feed-in tariff for electricity produced from waste To implement international standards for waste classification To improve network of facilities for waste disposal, recycling, processing and treatment To improve waste collection and transportation system	Remove profitability constrains set in the transport tariff methodology To develop and approve low emission development strategy in the transport sector Implementation of market based instruments, emission limits and technology standards, emission trading or emission credits
Institutional Capacity	To increase Energy Efficiency Agency capacity to promote more successfully ICSE CHP	To increase Energy Efficiency Agency capacity to G-MSW technologies	To increase Energy Efficiency Agency capacity to promote more successfully HEV
Information and Awareness	To enlarge the forms of information on CHP advantages	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 To revise and supplement the set of statistical tools in order to ensure that the data provided on waste generation and flow is accurate	To enlarge the forms of information on HEV advantages: best practices in transport planning and clean technology implementation in other countries More commitment towards improving environmental performance of vehicle fleet management

The next two tables provide a summary of the barriers and measures identified for the diffusion of the selected technologies in Agriculture.

Table 3. Identified barriers to technology transfer in the Agriculture Sector:

Domain	No Tillage	Mini Tillage	Classic Tillage
Economic and Financial	High-up front costs High operation costs Reduced availability of financial resources	High-up front costs High operation costs Reduced availability of financial resources	High-up front costs High operation costs Reduced availability of financial resources
Market Failure and Imperfection	Low performance due to land fragmentation Price distortions and dysfunctional value chain	Low performance due to land fragmentation Price distortions and dysfunctional value chain	Low performance due to land fragmentation Price distortions and dysfunctional value chain
Policy, Legal and Regulatory	Lack of economic incentives Slow implementation of promoting conservative agriculture	Lack of economic incentives Slow implementation of promoting conservative agriculture	Lack of economic incentives Slow implementation of promoting conservative agriculture
Network Failures	Low stakeholder cooperation	Low stakeholder cooperation	Low stakeholder cooperation
Human Skills	Inadequate business management skills	Inadequate business management skills	Inadequate business management skills
Information and Awareness	Poor dissemination of information Insufficient advisory services in agriculture Lack of a centralized system on soil quality	Poor dissemination of information Insufficient advisory services in agriculture Lack of a centralized system on soil quality	Poor dissemination of information Insufficient advisory services in agriculture Lack of a centralized system on soil quality

Table 4. Proposed measures to overcome barriers to technology transfer in the Agriculture Sector

Domain	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
Economic and Financial	Developing a system of economic incentives for agricultural enterprises that use and promote green fertilizers To reduce/to avoid taxes on profit for farmers investing in good agricultural practices, including procurement of equipment. To release subsides for farmers implementing climate technologies	Developing a system of economic incentives for agricultural enterprises that use and promote green fertilizers To reduce/to avoid taxes on profit for farmers investing in good agricultural practices, including procurement of equipment. To release subsides for farmers implementing climate technologies	Developing a system of economic incentives for agricultural enterprises that use and promote green fertilizers To reduce/to avoid taxes on profit for farmers investing in good agricultural practices, including procurement of equipment. To release subsides for farmers implementing climate technologies
Institutional capacity	Cadastre Agency intensifying of land consolidation process Improve R&D system in soil science.	Cadastre Agency intensifying of land consolidation process Improve R&D system in soil science.	Cadastre Agency intensifying of land consolidation process Improve R&D system in soil science.
Network working	Assure an efficient coordination between main actors of organic and green fertilizers chain	Assure an efficient coordination between main actors of organic and green fertilizers chain	Assure an efficient coordination between main actors of organic and green fertilizers chain
Policy, legal and regulatory	Provisions of soil management responsibilities in the Law on the Land Code and in the Law of the Republic of Moldova on Environmental Protection Establish clear land management standards Increase accountability of farmers for long-term maintenance of soil quality	Provisions of soil management responsibilities in the Law on the Land Code and in the Law of the Republic of Moldova on Environmental Protection Establish clear land management standards Increase accountability of farmers for long-term maintenance of soil quality	Provisions of soil management responsibilities in the Law on the Land Code and in the Law of the Republic of Moldova on Environmental Protection Establish clear land management standards Increase accountability of farmers for long-term maintenance of soil quality
Information and awareness	Make the agricultural businesses aware about the environmentally friendly practices.	Make the agricultural businesses aware about the environmentally friendly practices.	Make the agricultural businesses aware about the environmentally friendly practices.
Human skills	Promote Programmes for providing awareness raising campaigns, training and education on soil management.	Promote Programmes for providing awareness raising campaigns, training and education on soil management.	Promote Programmes for providing awareness raising campaigns, training and education on soil management.

If all technologies are implemented at the capacity forecasted in the report they could contribute to cover 43% of country GHG reduction target established by Second National Communication in its High Alternative Scenario for 2020. The details are shown in the Table 5 below.

Table 5. Contribution of considered technologies to reach country GHG emission reduction targets by 2020

Items	Energy sector			Agriculture sector			TOTAL
	ICE CHP	G-MSW	HEV	No Tillage	Mini Tillage	Classic Tillage	
Implementation capacity by 2020	15MW	30MW	3,000 vehicols	140,000 he	140,000 he	140,000 he	
GHG emission reduction expected by 2020, th tCO2	24	474	26	193	193	154	1,065
Country GHG emission reduction target according to SNC HAS, th tCO2							2,456
Contribution of considered technologies to reach country GHG emission reduction targets by 2020, %							**43**

1 ENERGY SECTOR

1.1 Preliminary Targets for Technology Transfer and Diffusion

Faced with serious energy security challenges due to an almost full dependence on imported energy (96%), 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.

Additionally, in agreeing to join the Energy Community, Moldova has taken on a legally binding obligation to implement the relevant energy acquis communautaire, key elements of which include[5]:

- A cut of at least 20% in greenhouse gas emissions from all primary energy sources by 2020 (compared to 1990 levels), while pushing for an international agreement to succeed the Kyoto Protocol aimed at achieving a 30% cut by all developed nations by 2020.
- A cut of up to 95% in carbon emissions from primary energy sources by 2050, compared to 1990 levels.
- A minimum target of 10% for the use of biofuels by 2020.
- That the energy supply and generation activities of energy companies should be 'unbundled' from their distribution networks to further increase market competition.
- Improving energy relations with the EU's neighbours, including Russia.
- The development of a European Strategic Energy Technology Plan to develop technologies in areas including renewable energy, energy conservation, low-energy buildings, 4th generation nuclear power, clean coal and carbon capture.

These goals are ambitious and over-arching, and will clearly require contribution from each energy sub-sector.

The overall targets of energy security improvement derive from a number of national and sectorial policies, strategies and development programs.

According to the draft of Energy Strategy of the Republic of Moldova till 2030[6] the energy security will be achieved through a large range of measures, including the implementation of energy efficient technologies that have a low impact on environment as combined cycle and cogeneration, attraction of private investments in the rehabilitation and construction of energy facilities, use of own energy resources to satisfy the demand, including renewable energy sources and promotion of an energy efficiency policy at customers' level. The Strategy establishes specific targets in this respect. The objectives of the state in the field of renewable energy are to diversify the domestic energy sources, to cover 20 % of energy demand from renewable energy sources by 2020, including 10% generation of renewable electricity, to increase by 20 % the energy efficiency in comparison with the level obtained in 2009.

[5] An Energy Policy for Europe, Communication from the Commission to the European Council and the European Parliament COM(2007) 1 final
[6] http://particip.gov.md/proiectview.php?l=ro&idd=444

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[7], Energy Efficiency Law[8] and National Program for Energy Efficiency[9] for the period 2011-2020

In the range of objectives in the field of land transport[10] it is mentioned development of more efficient urban transport systems and minimization of negative environmental impact.

National Energy Strategy 2030[11] establishes the implementation of advanced technologies of fuel use as well.

Energy Security target was the country main objective starting with Moldova Independence from 1991. Up to 2005 a lot of normative acts were approved in this respect[12]. Unfortunately all these actions have had a low influence on reaching the pre-established goals. Starting with 2007 abovementioned 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.) 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. The technologies examined will contribute to fulfilment of Moldova GHG emissions reduction targets the country undertaken in the frame of UNFCCC Copenhagen Accord. These targets correspond to those reflected in the Second National Communication under UNFCCC and presented in the Table 1.1-1 below.

Table 1.1-1. Moldova GHG emissions reduction targets, Gg CO2 eq

Sectors	Scenario	2015	2020
Energy	BLS[1]	12,335	14,443
	HAS[2]	11,050	12,992
GHG emission reduction target		**1,286**	**1,451**
Waste	BLS	1,837	2,245
	HAS	1,495	1,673
GHG emission redaction target		**342**	**572**

[1]BLS-Base Line Scenrio
[2]HAS-High Alternative Scenario

Preliminary targets for technology "Combined heat and power plants based on internal combustion engines of up to 500kW (ICE CHP)"

According to the draft of National Energy Strategy up to 2030, 1050 MW of new capacities should be built in Moldova by 2020, including 650 MW of cogeneration power plants. The main requirement such target be achieved is the presence of heat demand. For the conditions of the Republic of Moldova, where the climate is moderately

[7] The Law on renewable energy nr. 160 adopted on July 12, 2007 (Published in the Official Monitor of the Republic of Moldova on August 17, 2007)
[8] Energy Efficiency Law, nr 142 of July 2, 2010 (Published in the Official Monitor of the Republic of Moldova on September 3, 2010).
[9] National Energy Efficiency Program for the period 2011-202, adopted by the Government Resolution nr. 833 of November 10, 2011 (Published in the Official Monitor on November 11, 2011).
[10] Land Transport Infrastructure Strategy
[11] Energy Strategy for 2030, http://particip.gov.md/proiectview.php?l=ro&idd=444
[12]Energy Conservation Law no 1136 from 13.07.2000; Energy Strategy 2000-2010; Energy Conservation Program for 2003-2010. GD no 1078 from 2003; Regulation on Energy Conservation Fund Creation. GD no 1528 from 26.11.02. http://lex.justice.md/

continental, characterized with relatively mild winters with little snow, long warm summers and low humidity, 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.

There is no country experience until now on promoting such kind of power plants. Their successful dissemination requires following preliminary step, started in 2013-2014 and ending in 2020. During this period around 15000 MW of ICE CHP should be built. In order to reach this goal:

- The Ministry of Economy will apply to donor countries to get a technical assistance on ICE CHP project identification for municipalities' centralized heating. 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.
- Energy Efficiency Agency (EEA) will introduce a system of energy audit framework in order to identify the private and public enterprise where ICE CHP is feasible.
- The appropriate private and public enterprise will be encouraged by EEA to build ICE CHP, having a support from Energy Efficiency Fund[13], EBRD support through MoSEFF II Project[14] and banks
- Ministry of Economy will continue to develop a legal framework to attract foreign investments in efficient power plant development, including in ICE CHP
- National Energy Regulatory Agency will create a regulatory framework to facilitate ICE CHP development through assuring regulated tariffs for such PPs, if the energy is destined for public purposes.

By 2020 the final objectives that will be achieved by implementing ICE CHP, including GHG emission reduction, are shown in the Table 1.1.-2. 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% by 2020 if 15MW of such power plant is built by this year. In the Intermediate Alternative Scenario target the same contribution will be equivalent to 7,7%.

Table 1.1-2. CO2 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

[13] Government Decree no 401 from 12.06.12, Official Monitor from 22.06.12
[14] http://www.ebrd.com/pages/project/psd/2012/43067.shtml

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

Preliminary targets for technology Gasification of municipal solid waste for electricity heat/ production (G-MSW)"

In per capita terms, the Moldovan municipal sector generates about 29%[15] more waste than the European average. At the same time, an integrated waste management system does not exist in the country. This does not only mean lost opportunity for energy recovery from waste and CH4 removal, but it also implies rising health risks to the local population as a result of growing landfills and decomposing waste.

Annually the municipality services of Moldova record around of 1,143-1,266 thousands m^3 of Municipal Solid Waste (MSW) transported to the landfills[16] (Annex III).

As it was specified above, according to the draft of National Energy Strategy up to 2030, 10% of electricity demand from 2020 should be covered from the renewable sources, including from MSW. The utilization of MSW for electricity production is mostly advanced for Municipality Chisinau. Several projects have been discussed until now, 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 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 SNC.

In order the plant be built by 2020, the following preliminary targets for this technology are established:

- The Ministry of Economy and Municipality of Chisinau will apply to donor countries to get a technical assistance on best G-MSW project identification. 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.
- Starting with 2013 Energy Efficiency Agency (EEA) will promote the best practices implementation of G-MSW through the country municipalities.
- The appropriate private and public enterprise will be encouraged by EEA to build G-MSW, having a financial support from Energy Efficiency Fund[17], EBRD support through MoSEFF II Project[18] and external donors.
- Ministry of Economy will continue to develop a legal framework to attract foreign investments in renewable power plant development, including in G-MSW.

[15] National Report for UN CSD 2012 Rio+ 20 http://www.uncsd2012.org/content/documents/782Moldova_Report_RIO20_ENG_12-06-2012_final.pdf
[16] Gheorghe Duca, Tatiana Tugui. Managementul deseurilor. Chisinau, 2006, 248 pages.
17 Government Decree no 401 from 12.06.12, Official Monitor from 22.06.12
[18] http://www.ebrd.com/pages/project/psd/2012/43067.shtml

- By 2013-2014 National Energy Regulatory Agency will establish Feed-in tariffs for G-MSW, as existing renewable Tariff methodology in effect do not incentive the investor to enter into a renewable PP generation business.

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.

Preliminary targets for "Hybrid electric vehicles (HEV)" technology

The transport sector in Moldova accounts for about 14%[19] of total energy consumption and is entirely dependent on fossil fuel. A constantly growing demand for transport coupled with a prevalent use of outdated vehicles means that the transport sector is increasingly becoming one the biggest polluters in the country.

According to the draft of Energy Strategy of the Republic of Moldova till 2030[20] the energy security will be achieved through a large range of measures, including applied to transport sector, all leading to increase by 20 % the energy efficiency in comparison with the level obtained in 2009. The promotion of HEV project is seen as realistic chance to overcome high fuel specific consumption in the country transport sector. 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. A total number of 3000 vehicles is forecasted be replaced with new ones in these urban areas, including buses and minibuses. If HEV technology is implemented at full planned capacity GHG emissions will be reduced by 26,300 tons per year, equivalent to 1.8% of GHG emission reduction target established for Energy sector by 2020, according to SNC High Alternative Scenario or 8.8% of SNC IAS.

Responsible entities for implementing the HEV technology are local public authorities with corresponding support came from the Ministry of Transport and Road Infrastructure.

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.

The three technologies selected in the energy sector –cogeneration based on internal combustion engine, gasification of solid municipal waste for electricity/heat production, and hybrid electric vehicles – are believed not only to help contribute to an increase in energy efficiency levels in Moldova, but also – through their successful implementation – to spur an extended portfolio of investments in renewables and energy efficiency projects in the years to come. These technologies have been selected based on MCDA in the first part of TNA and Technology Action Plans for Climate Change project.

[19] Low Emissions Development Strategy of the Republic of Moldova to the Year 2020 (Draft) http://clima.md/lib.php?l=ro&idc=236&
[20] http://particip.gov.md/proiectview.php?l=ro&idd=444

1.2 Barrier Analysis and Possible Enabling Measures for ICE CHP of at Most 500kW

1.2.1 General Description

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[21].

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 is estimated at the level of at least 15 MW, with an economic and technical life-time of 15-20 and 20-25 years respectively[22]. 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).

1.2.2 Identification of Barriers

The Mitigation working group (experts and consultants) has considered the technology market characteristics and classified Combined heat and power plants based on internal combustion engines of up to 500kW (ICE CHP) as *capital good* due to a limited number of potential sites/consumers, relatively large capital investment, simpler market chain (the country hasn't technology providers), demand is profit-driven. The identification of barriers has done in a stepwise manner, based on methodological approaches from above mentioned guides. The working group has identified the barriers to promote ICE CHP, put efforts to understand why despite the advantages such power plant is not implemented in the country.

The working group has used **Market Mapping techniques** as a tool of barriers identification and analysis of challenges the future owner of ICE CHP should pass the plant be implemented and sell electricity and heat to consumers. The working group has identified a significant number of barriers that impede this scope be achieved, decomposed them and made specific for each main market actor.

This step was followed by screening of barriers according to their significance to technology transfer and their ranking based on 1-5 scale. A close work with stakeholders' representatives was done in order to reach common agreement on

[21] http://iea-etsap.org/web/Supply.asp
[22] www.energymanagertraining.com/CHPMaterial/12-V-EDUCOGEN_Cogen_Guide.pdf; climatetechwiki.org

significance of a particular barrier. After the comprehensive understanding achieved, the experts came up with the List of key barriers that represent the list of essential barriers after non-essential being removed.

Another tool used in the barriers analysis by working group was **Logical Problem Analysis (LPA**) for analysing casual relations and core problems in technology transfer. The participants have arranged the problems into hierarchy of causes and effects having as central starting problem a generic problem for technology transfer. **The LPA Problem Tree** emphasised the main links between causes and effects and organised them into logical inter-relations, addressed the basic issues and highlighted linkages with external factors. On the Problem Tree diagram the causes are shown below the starter problem and effects above. The LPA Problem Tree for this and other considered technologies are included in the Annex I.

The results of barriers identification exercise are provided in the Long List of Barriers for this technology – Table 1.2.2-1.

Table 1.2.2-1. Long List of Barriers to technology transfer for ICE CHP technology.

Main market actors	**Barriers identified**		
	Broad categories of barriers	**Barriers within category**	**Elements of barriers**
Future electricity and heat generators (owners)	Economic and financial	High up-front costs	- Low scale projects - Import of technology (it lacks in country) add taxies
		High operation and maintenance costs	- Small scale installations - Use of foreign skilled staff at initial stage - Imported spare parts
		High transaction costs	- Economies of scale only at high investment level - Market size small - Missing or under-developed supply channels
		Reduced availability of financial resources	- Scarcity of cheap capital - Undeveloped capital market - Lack of venture capital - Lack of access to cheap capital
		High cost of financing	- Undeveloped capital market - Lack of venture capital result in high interest rates levied by commercial banks for loans
		Investment incentives not clearly defined	- Insufficient incentives to develop climate friendly technologies - Non-consideration of externalities by the power producers - No tax incentives on climate friendly technologies
		Low affordability of consumers to pay for energy	Moldova is considered the poorest country in Europe. This severely limits consumer willingness and ability to pay for energy and heat consumption.
	Market failure, imperfection	Market control by dominant district heating companies	- existing district heating reject measures that diminish their income, i.e. heat decreasing
		Economies of scale only at high level of investment	- The larger the capacity means lower investments per unit of capacity, as well as lower operation and maintenance

Main market actors	Barriers identified		
	Broad categories of barriers	**Barriers within category**	**Elements of barriers**
			costs - depends on the heat demand during the year all round
		Inadequate sharing of project experience	- Insufficient operation of the Energy Efficiency Agency as it is at the initial stage of its operation - lack of energy audit companies and the framework for energy audit demand
		Cost allocation for heat and power is not transparent	- The allocation of costs between the two energy forms should be performed according to the approved methodology for tariff calculation
		Lack of supply market for equipment and spare parts	- Problems in import of technology or equipment - Missing or under-developed supply channels
	Policy, legal and regulatory	Incomplete legal and regulatory framework	- No legal framework on thermal energy that would incorporate the provisions regarding the promotion of small scale high efficient technologies
		Uncertain incentives for private investors	- Insufficient incentives to develop climate friendly technologies
		Unclear framework for negotiating the price for surplus non-regulated electricity	- The suppliers are not obliged to purchase the surplus of electricity that may be delivered into the electric networks
	Institutional and organizational capacity	Slow development of institutional capacity in energy efficiency	-Not yet enough experience of Energy Efficiency -Lack of sufficient financing
		Limited availability of technical and business management skills	- Lack of local skilled specialists for design, construction, operation and maintenance of the technology - no demand in the specialist on technology
	Social, Information and awareness	Environmental management not seen as a shared social responsibility	- Non-consideration of externalities (negative externalities (pollution, damage from this) from conventional energy is considered in pricing - positive impacts of climate technologies not valued
		Inadequate information on the implementation of small scale ICE CHP projects	-Poor dissemination of information to technology users -Poor infrastructure for communication of small-scale project support
Ministry of Economy	Institutional and organizational capacity	Limited capacity to promote efficient development of energy sector, including on supply and demand level	- No financial resources available to hire high qualified specialists - Lack of enough options on how to develop energy sector
	Social, Information and awareness	Environmental management not seen as a shared social responsibility	- Non-consideration of externalities (negative externalities (pollution, damage from this) from conventional energy is considered in pricing

Main market actors	Barriers identified		
	Broad categories of barriers	**Barriers within category**	**Elements of barriers**
			- positive impacts of climate technologies not valued
Energy Efficiency Agency	Market failure, imperfection	Inadequate sharing of project experience	- Insufficient operation of the Energy Efficiency Agency as it is at the initial stage of its operation - lack of energy audit companies and the framework for energy audit demand
	Policy, legal and regulatory	Incomplete legal and regulatory framework	- No legal framework on thermal energy that would incorporate the provisions regarding the promotion of small scale high efficient technologies
	Institutional and organizational capacity	Slow development of institutional capacity in energy efficiency	-Not yet enough experience of Energy Efficiency - Lack of sufficient financing
	Social, Information and awareness	Environmental management not seen as a shared social responsibility	- Non-consideration of externalities (negative externalities (pollution, damage from this) from conventional energy is considered in pricing - positive impacts of climate technologies not valued
Local public administration	Policy, legal and regulatory	Incomplete legal and regulatory framework	- No legal framework on thermal energy that would incorporate the provisions regarding the promotion of small scale high efficient technologies
	Institutional and organizational capacity	Low public administration capacity in energy efficiency	-Not enough staff allocation for Energy Efficiency - Lack of sufficient financing

1.2.2.1 Economic and Financial

The crucial element that determines the success of any project promotion is the assurance the project is financially feasible. In order to identify the economic-financial characteristics of 500kW ICE CHP an appropriate model in Excel format was developed. It covers two projects:

a) ICE CHP replaces centralized heat and electricity supply for residential householders, i.e. several blocks are disconnected from centralized heating system and are connected to locally build ICE CHP. Such strategy is adequate for many country's cities where a radical restructuring of heating system is needed due to very inefficient of existent centralized heating systems. Base Line for this case reflect the existing, or future, prices for centralized electricity and heat provided

b) ICE CHP for industrial and service providers (agriculture product processing enterprises, dairy products factories, hotels, campuses, etc). Base Line for this case reflects the separate production of heat,- by boiler houses, and electricity, - by a condensing PP with the efficiency of 37%, the one that is located in Transnistria, not recognized secessionist territory, and which cover more than 70% of power demand of Moldova territory located on right bank of river Nistru.

The scope of the model elaborated was to determine, first of all, the conditions when IRR reach the value corresponded to country risk rate. As a minimum value was taken an IRR no less than 10%, the rate accepted in the energy efficiency projects promoted by EBRD in the Republic of Moldova (MoSEFF Project[23]).

Using the Excel tool elaborated, the analysis demonstrated that the most sensible parameters that influence projects feasibility, i.e. internal rate of return (IRR), are both the price for electricity and Heat capacity duration time (Thc). Thc should not be less than 4500h/year. As to the electricity tariff, acceptable IRR is obtained when the tariff applied at 0.4 kV voltage level reaches 2 lei/kWh (around 16.3 UScent/kWh). It is expected such value will be in effect in 2013 or 2014. For such value of the electricity tariff, the consumer expenditure for heat and electricity came from ICE CHP is less by 21% than in the case of Base Line-residential householders and by 17,6% in the case of Base Line - industrial and service providers. In the first case IRR for 10 years is 23%, for the second – 18%, i.e. the projects are feasible.

The first project – for residential householders- is planned to be implemented at the capacity of 1MW by 2020, total investments required being 1,15 million US$.

The second project – for industrial entities and service providers- is planned to be implemented at the capacity of 14MW by 2020, total investments required being 16,1 million US$. More detailed information about the projects examined is presented in the Annex III.

The first project assure a reduction of 556 tCO2/year by 2020, due to grid electricity and heat losses reduction, while the realization of the second project lead to 23,859 tCO2/year reduction by the same year due to: a) a higher implementation rate and, b) higher energy efficiency at CHP than separate production of electricity and heat, power losses saving into the grid contributing as well.

In other words, if ICE CHP projects are implemented at a total capacity of 15 MW by 2020 that will lead to cover 1.6% of Energy sector HAS emission reduction target established by SNC for 2020, or 7.7% of IAS target for the same year.

The experience gained during projects implementation will serve as a jumping-off place for more ICE CHPs promotion after 2020.

1.2.2.1.1 High up-front costs

High up-front costs, including for buying new equipment and spare parts, are one of the major barriers to implementing energy efficiency projects in Moldova. Investment costs in a small scale ICE CHPs are typically in the range of 1150 $/kW[24] and depend on site-specific parameters. Upfront costs of this size are generally viewed as very high relative to alternative technologies, such as the combined cycle power plant for which the typical cost is of 650$/kW[3].

[23] http://www.moseff.org/

[24] http://iea-etsap.org/web/ThanksDl.asp?file=E04

1.2.2.1.2 High operation and maintenance costs

Fixed operation and maintenance costs for ICE CHP are also relatively high. The O&M cost for an IEC CHP in Moldova are estimated to be in the range of 168$/kW per year[25]. This is higher than the O&M costs for a natural gas combined cycle power plant (24$/kW/year), and three to four times as high as those of a Gas Turbine CHP (40-50$/kW per year).

1.2.2.1.3 High transaction costs

The cost of feasibility studies, including project design, for implementing ICE CHPs is relatively high, and can constitute 10% of the total project cost. These high costs are particularly due to the fact that there is no wide-spread experience of implementing small-scale ICE CHPs in Moldova, and as a consequence, foreign consultancy – which is expensive - will need to be engaged in project initiation work.

1.2.2.1.4 Reduced availability of financial resources

It is expected that the selected technologies will be predominantly financed from external sources as the local capital market is under-developed. This will be done by attracting foreign private capital, using credit lines offered by international development banks, or applying for technical assistance from international donor organizations.

Availability of local capital to finance technology costs is inadequate overall, which generally limits the interest of private agents to invest in energy efficiency projects. It is of no surprise therefore to observe that at the moment private investment in sustainable technologies is very limited in Moldova.

Although energy efficiency projects with support from international development organizations have been implemented in Moldova, none included the construction of an ICE CHP (although some projects promoted the principle of cogeneration through the use of biomass). At the same time, some recent initiatives are being tailored to offer targeted financing for energy efficiency through cogeneration regardless of whether renewable or non-renewable sources are used.

For example, starting with September 2012, small capacity ICE CHP become eligible for crediting through the EBRD Moldovan Sustainable Energy Financing Facility (MoSEFF), which includes a 5-20% grant component. The support has been extended for another three years, and it is envisaged that about 1 million Euro could be used to finance small-scale CHP projects. Despite this opportunity however, there is high risk that very few, if any at all, applications for residential ICE CHP financing will be submitted within the available time-frame considering the effort-intensive nature of project preparatory work (which includes obtaining authorisations from municipalities for selling ICE CHP-generated thermal energy etc.).

A vicious circle is therefore created, whereby it becomes difficult to quickly act upon financing opportunities when they do become available and initiate project design work without having a certain view of financial options in the medium to longer term.

[25] http://www.energymanagertraining.com/CHPMaterial/12-V-EDUCOGEN_Cogen_Guide.pdf

1.2.2.1.5 High cost of financing

Cost of financing in Moldova is high due to its rating as a high risk country. According to Moody's latest report in March 2012, "Moldova's B3 government bond rating and stable outlook reflect Moldova's very low economic resilience and moderate level of government financial robustness."[26]

The high risk premium translate into high interests rates and collateral being set by the local banks, which in their turn discourage potential energy saving beneficiaries from applying for credits to finance energy efficiency projects.

The high risk premium also constrains the pay-back period for which external investors are willing to sign up for. Consequently, foreign investors are typically reluctant to invest in projects where recovery of investment costs is over a period of more than 5-7 years.

1.2.2.1.6 Investment incentives not clearly defined

Although the Energy Strategy of the Republic of Moldova for the period until year 2020 stipulates that a set of incentives will be adopted to promote investments in energy efficiency projects, such as relating to pricing methodologies and taxation of energy projects, no such incentive has been specifically established yet.

In the particular context of ICE CHP projects, considering the high implementation costs, a guarantee by law that all of the ICE CHP-generated electricity will be purchased for distribution within the national grid is essential. In terms of the thermal energy produced, the institutionalization of 'take or pay' contracts – including with the municipalities in case of residential ICE CHPs – is also important.

Additionally, in order to alleviate the high up-front investment costs, an exemption from duties on imported equipment should also be considered, as it had been done for the construction of Orhei coal PP and Cahul combined cycle PP on natural gas.

1.2.2.1.7 Low affordability of consumers

Low affordability of the average consumer to pay for the energy used is one of the main barriers in the reduction of GHG emissions in Moldova. Most of the measures aimed at GHG emission reduction require significant investments which inevitably translate into higher prices for the energy consumed.

1.2.2.2 Market Failure and Imperfection

1.2.2.2.1 Market control by dominant district heating companies

As a key legacy of the Soviet planned system, the centralized district heating (DH) system in Moldova is the primary source of thermal energy supply to residential buildings. A major institutional change in the sector occurred in 2000, when the mandate to approve end-user heat tariffs was transferred to local public administration authorities along with

[26] Moody's issues annual credit report on Moldova. http://www.moodys.com/research/Moodys-issues-annual-credit-report-on-Moldova--PR_242020

the transfer of ownership from the two state-owned DH companies (one supplying to the capital, the other – to the rest of the country).

Yet, setting of heat tariffs by local public administration authorities has remained a highly politicized process, mainly due to the DH companies not being able to raise tariffs to reflect their cost-recovery levels. In 2010, this problem was rectified by transferring the role of evaluating and approving end-user tariffs for heat supplied through district heating systems from local public administration authorities to the National Agency for Energy Regulation. However, a much more comprehensive restructuring program is required to address the structural inefficiencies of the old centralized municipal DH systems.

With this experience in mind, potential investors in ICE CHPs projects are cautious of any backlash from DH companies that may – in the absence of a clear restructuring plan – oppose cogeneration projects by invoking the impact that these would have on the tariffs set by DH companies to their remaining consumers. In particular, in order to achieve cost recovery from supplying heat in a fixed supply infrastructure but to a smaller demand base due to loss of market share to ICE CHP projects, the DH companies will demand an increase in the tariffs applied to their remaining consumers.

1.2.2.2.2 Economies of scale only at high level of investment

Economies of scale for ICE CHP projects can only be achieved if significant upfront investment can be secured. This is explained by the following factors:

- Implementation of residential ICE CHPs requires that service contracts are signed by each individual household. Transaction costs are substantially reduced when contract signing is done in an one-off process
- High upfront investments are required to ensure that CHPs can achieve the minimum heat load threshold of 4,500h in yearly consumption (ie a minimum energy efficiency factor of 75%). In this case, the electricity produced by CHPs for domestic consumption can become regulated, and thereby benefit from the Regulator's guarantee that all energy will be bought on the market.
- Savings on ICE CHP energy distribution are greater the more geographically concentrated the heat load is. Therefore, scenarios on the optimum clustering of buildings and project scaling should be thoroughly analysed at the project design phase.

1.2.2.2.3 Inadequate sharing of project experience

Knowledge on the implementation of small capacity ICE CHP projects in Moldova is very limited. Most of the small-scale cogeneration projects implemented so far are using biomass as input material, whereas the three state-owned CHPs are operating based on large-scale cogeneration technologies. Sharing of experience around planning and pricing, risk identification and mitigation, implementation and operation is generally limited.

1.2.2.2.4 Cost allocation for heat and power is not transparent

Currently, tariff calculation for energy includes cross-subsidization between electricity and heat costs (with heat costs being subsidised). Clearly, this creates an environment where the real competitiveness of CHPs – through their more efficient heat production – cannot be harnessed. Yet, it is essential that investors are given the right signals about fairness of competition on the market.

1.2.2.2.5 Lack of supply market for equipment and spare parts

The supply market of equipment and spare parts required for ICE CHP has not been thoroughly studied, however it is expected that most of the technical material will be imported. Some challenges may be faced in the transportation of equipment due to long supply routes. Due to the lack of a local distribution network of ICE CHP equipment, an on-site facility for storing spare parts may need to be considered to avoid potential delays from import.

1.2.2.2.6 Inefficient district heating system

While the current legislation provides that meters for thermal energy must be installed at each block of flats by the energy suppliers themselves, metering per individual households cannot be achieved on a wide scale due to the implementation in series of the current district heating system. This constitutes one of the major barriers to the implementation of ICE CHP projects.

While the redesign of the heating system across a complex of blocks implementing ICE CHP will undoubtedly introduce additional project costs, this in fact is not the greater concern. The bigger barrier is the human factor, and particularly resistance to continual change and disquiet caused to households as a result of the need to sign various individual agreements. This factor may be further exacerbated by any block-level restructuring that may have been completed beforehand by public authorities.

1.2.2.3 Policy, Legal and Regulatory

1.2.2.3.1 Incomplete legal and regulatory framework

Up until 2009, the evolution of Moldova's energy sector was highly symptomatic of the absence of any political will to promote energy efficiency projects in the country.

After a radical change in the make-up of ruling political parties, energy security through energy efficiency has finally been recognized by the Government of Moldova as one of the primary objectives in the country's development plans to the year 2020. This, together with the target embraced under the Copenhagen Accord of reducing GHG emissions by 25% by 2020 compared to the 1990 baseline, has inevitably placed the role of renewable energy sources at the fore-front of all energy efficiency strategies approved or being drafted to cover all sectors in the economy.

Despite this, the absence of secondary legislation and specific plans of actions to support the implementation of strategic objectives is notable. For instance, while the Electricity Act and the Natural Gas Act provide possibilities to include in the tariff calculation all reasonable costs recorded along the chain from generation to supply, no specific steps have yet been made to account for the costs of carrying out GHG emission reduction activities, as no normative acts have yet been approved to support this.

The National Program for Energy Efficiency (approved through the Government's Decision from 10.11.2011) further provides that the Agency for Energy Efficiency shall establish energy efficiency indicators and benchmarks, will align existing indicators to those of the European Union, and will establish national reference values of the efficiency of separate production of electricity and thermal energy, which could serve as an impetus to reduce losses including through an extended adoption of energy efficiency technologies. Due to the delayed establishment of AEE, however, very little progress has been done to this end. Among other specific objectives of the Program are to retrofit heat plants into cogeneration plants, and to review the Concept for the renovation of the republican heat supply system so

as to give priority to cogeneration technologies; however no feasibility studies to support these objectives have yet been initiated.

1.2.2.3.2 Uncertain incentives for private investors

While the Law on Renewable Energy provides guarantees that all electricity produced from renewable energy sources will purchased for further distribution in the national grid, similar guarantees provided for electricity produced through cogeneration are not as broad. In particular, according to the Electricity Act (nr. 124 from 23.12.2009), only electricity produced by CHPs that deliver heat into the district heating system may benefit from the provision of priority dispatch of electricity produced by CHPs. Yet, investors require guarantees that all electricity produced by CHPs will be bought by suppliers.

In order to alleviate investors' uncertainties around cost recovery, the option of implementing feed-in-tariffs has also been put forward – a methodology promoted by EU Directives and extensively used in EU countries. However, and as expected, discussions around the benefits of this methodology have not been straightforward. The energy regulatory body has raised concerns about the risks associated with the introduction of feed-in-tariffs in Moldova without a thorough assessment of various variables specific to the local market before a viable feed-in-tariff methodology can be enforced.

1.2.2.3.3 Unclear framework for negotiating the price for surplus 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. The issue is very complex, as it requires consideration of aspects like the need to align surplus ICE CHP electricity with the buyer's demand curve, or to reconcile the energy sold by the ICE CHP with the minimum volume of electricity that the buyer must purchase from a third supplier based on take-or-pay contracts between the two.

1.2.2.4 Institutional and Organisational

1.2.2.4.1 Slow development of institutional capacity in energy efficiency

Establishment and strengthening of the institutional framework required to support the implementation of the existing legal framework on energy efficiency has been slow. For example, the Law on Renewable Energy 2007 provides that an Energy Efficiency Fund shall be established with a key role in managing financial resources to support implementation of energy efficiency and renewable energy projects. However, although the Fund was legally created in 2007, its activity only started in 2012 and is currently in early stages.

Additionally, while the Law on Energy Efficiency 2010 promotes the creation of energy service companies (ESCOs) – which could facilitate the implementation of ICE CHPs projects through provision of audit and construction services, as well as through knowledge sharing – the number of ESCOs that have so far been established is rather low. The main reason continually cited for this – despite the Energy Strategy stating that incentives will be given for commercial banks to invest in energy efficiency projects – is the lack of start-up capital from financial institutions, which are unfamiliar with the business models of ESCOs.

1.2.2.4.2 Limited availability of technical and business management skills

Given that energy efficiency objectives, including through the use of renewable energy, have only in recently been recognized as nationally strategic, technical experience required to prepare and start projects in this domain although continues to be accumulated, still remains limited. Domain-specific business management expertise is also inadequate and there is limited institutional framework available to provide business management consultancy. Certainly, these barriers can be overcome through targeted trainings of local personnel, and engagement of foreign consultants particularly in the initiation phases of the project, however this will clearly imply higher transaction costs for projects.

1.2.2.5 Social, Information and Awareness

1.2.2.5.1 Environmental management 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. Consumer-wise, the still relatively low prices on energy create few incentives for final energy users to become more frugal in their energy use and invest in energy efficient appliances.

1.2.2.5.2 Inadequate information on the implementation of small scale ICE CHP projects

Although there is some experience with implementing cogeneration projects in Moldova, it is either from large scale projects at the three state-owned cogeneration plants, or small scale using biomass to generate bio-gas for the subsequent production of electricity. Although dissemination of information to support implementation of energy efficiency projects is in the responsibility of the Agency for Energy Efficiency, due to the slow institutional establishment of AEE information sharing has been inadequate. This has led to the fact that knowledge on energy efficiency projects 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.

Table 1.2.2-2. List of barriers for ICE CHP technology and hierarchy classification

No	Barriers identified	Rank (1-5)	Classification of the barriers
1.	High up-front costs	4	Economic and financial
2	High operation and maintenance costs	3	Economic and financial
3	High transaction costs	5	Economic and financial
4.	Reduced availability of financial resources	5	Economic and financial
5	High cost of financing	5	Economic and financial
6.	Investment incentives not clearly defined	5	Economic and financial
7.	Low affordability of consumers to pay for energy	3	Economic and financial
8.	Market control by dominant district heating companies	3	Market failure, imperfection

9.	Economies of scale only at high level of investment	2	Market failure, imperfection
10.	Inadequate sharing of project experience	5	Market failure, imperfection
11.	Cost allocation for heat and power is not transparent	2	Market failure, imperfection
12.	Lack of supply market for equipment and spare parts	3	Market failure, imperfection
13.	Incomplete legal and regulatory framework	5	Policy, legal and regulatory
14.	Uncertain incentives for private investors	5	Policy, legal and regulatory
15.	Unclear framework for negotiating the price for surplus non-regulated electricity	3	Policy, legal and regulatory
16.	Slow development of institutional capacity in energy efficiency	5	Institutional and organizational capacity
17.	Limited availability of technical and business management skills	3	Institutional and organizational capacity
18.	Environmental management not seen as a shared social responsibility	3	Social, Information and awareness
19.	Inadequate information on the implementation of small scale ICE CHP projects	5	Social, Information and awareness

Table 1.2.2-3. The List of Key Barrier to ICE CHP

Key barriers identified	Classification of the barriers
High transaction costs	Economic and financial
Reduced availability of financial resources	Economic and financial
High cost of financing	Economic and financial
Investment incentives not clearly defined	Economic and financial
Inadequate sharing of project experience	Market failure, imperfection
Slow development of institutional capacity in energy efficiency	Institutional and organizational capacity
Incomplete legal and regulatory framework	Policy, legal and regulatory
Uncertain incentives for private investors	Policy, legal and regulatory
Inadequate information on the implementation of small scale ICE CHP projects	Social, Information and awareness

1.2.3 Identified Measures

Having established a thorough understanding of the barriers, the next step for the working group has been to identify of measures needed to overcome the barriers established and to improve each technology performances. In this respect, at the very beginning, the working group has discussed the impact of policy options on technology. **Logical Problem Analysis** was used as a tool to identify the measures to overcome the barriers. The experts have prepared sector specific information, policy documents, and other useful information for discussions during the meetings with stakeholders. The working group discused the measures in the context the barriers were addressed, grouping by the same criteria as barriers. The problems were reformulating into positive statements of future situation, arranging measures and results into **Objective tree** as logically organised presentation of objectives. The Objective tree of this and other technologies are presented in the Annex I. The measures were assessed according to their economic profile and incentives used. The results are presented in the tables below.

The combined heat and power plants **based on internal combustion engines of up to 500kW (ICE CHP)** technology has been supported by the study of policy enabling environment. Developed **Policy Fact Sheet (PFS**) of this technology is presented in the Annex II. According to the investigations done by experts the implementation of

the technology falls under the jurisdiction of several laws promoting energy efficiency, open power electricity market, renewable energy among which the most important are:

- Low Emissions Development Strategy to the Year 2020[27];
- Energy Strategy to the year 2020[28]
- Law on Energy Efficiency[29]
- Electricity Act[30]

Working groups has considered that the highest impact with direct effect on technology implementation has the Electricity Act and Law on Energy Efficiency. The related regulatory acts complement the main law, contributing to a policy and regulatory path for implementing the technology.

The experts have undertaken a ***cost-effective analysis*** of the political path supported by the specific law that shall ensure the successful implementation of the technology and obtaining the best financial results. The scenario includes long-term operation of small cogeneration power plants that lead to energy savings at location where electricity and heat are or planned to be consumed from the centralised grid. This technology is aimed to produce electricity and heat in an efficient cogeneration regime with an overall efficiency higher than 80%.

The table below provides a summary of the measures identified:

Table 1.2.3-1. Identified measures to overcome barriers to technology transfer for ICE CHP technology

Barriers identified	Measures identified to overcome the barriers
Economic and financial	- To exempt from import duties ICE CHP installations - To support ICE CHP construction from Energy Efficiency Fund - To encourage use the EBRD Fund for energy Efficiency in Moldova (MoSEFF II) - To Provide restructuring of the district heating systems: To optimize the structure of existing CHPs and Heat Plants, developing heat sources closer to consumers
Market imperfection	- To reflect a transparent allocation of heat and power costs
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% - Electricity produced in excess at enterprises and service providers should have a mandatory status be purchased in the market at the price regulated. - For the entities with energy consumption of 200 t.o.e/year and more energy audit should be a mandatory
Institutional capacity	- To increase Energy Efficiency Agency capacity to promote more successfully ICE CHP
Information and awareness	To enlarge the forms of information on CHP advantages

[27] Low Emissions Development Strategy to the Year 2030. Draft
[28] Energy Strategy to the year 2020. http://lex.justice.md/
[29] Law on Energy Efficiency. http://lex.justice.md/
[30] Electricity Act. http://lex.justice.md/

Table 1.2.3-2. Categories of measures and incentives for ICE CHP.

No	Financial measures and responsible entity	Non-financial measures and responsible entity and responsible entity	Complementary measures and responsible entity	Incentives and responsible entity
1	To Provide restructuring of the district heating systems: To optimize the structure of existing CHPs and Heat Plants, developing heat sources closer to consumers (ME)	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% (ANRE)	To increase Energy Efficiency Agency capacity to promote more successfully ICE CHP (ME)	To exempt from import duties ICE CHP installations (ME)
2		Electricity produced in excess at enterprises and service providers should have a mandatory be purchased in the market at the price regulated (ANRE)	To enlarge the forms of information on CHP advantages (EEA)	To support ICE CHP construction from Energy Efficiency Fund (EEA)
3		For the entities with energy consumption of 200 t.o.e/year and more energy audit should be a mandatory (ME)		To encourage use the EBRD Fund for energy Efficiency in Moldova (MoSEFF II) (EEA)
4.		Reflect a transparent allocation of heat and power costs (ANRE)		

Table 1.2.3-3. Final List of measures to overcome technology barriers for ICE CHP technology

No.	Measures
1.	To exempt from import duties ICE CHP installations
2.	To support ICE CHP construction from Energy Efficiency Fund
3.	To encourage use the EBRD Fund for energy Efficiency in Moldova (MoSEFF II)
4.	To Provide restructuring of the district heating systems: To optimize the structure of existing CHPs and Heat Plants, developing heat sources closer to consumers
5.	To reflect a transparent allocation of heat and power costs
6.	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%
7.	Electricity produced in excess at enterprises and service providers should have a mandatory be purchased in the market at the price regulated
8.	For the entities with energy consumption of 200 t.o.e/year and more energy audit should be a mandatory
9.	To increase Energy Efficiency Agency capacity to promote more successfully ICSE CHP
10.	To enlarge the forms of information on CHP advantages

1.2.3.1 Economic and Financial

1.2.3.1.1 Provide restructuring of the district heating systems

Given the sensitivity of the process by which end-user tariffs have been set for the thermal energy supplied by existing district heat suppliers, the success of the ICE CHP projects will also depend on how well their implementation can be aligned to the plans of DH restructuring in Chisinau, which are currently in early stages. In order to reduce barriers of entry of CHPs into the heat supply market – barriers that may be caused by a resulting hike in end-user tariffs for the heat supplied by existing DH companies – the Government should first carry out a study on the sensitivity of the tariff value to the dislocation of the end-user base, and with the findings at hand, approve a plan of state support during the DH restructuring phase in order to ease the impact on end users, especially the most vulnerable ones.

1.2.3.2 Market Improvements

1.2.3.2.1 Implement reforms in the district heating system

Although the need for a sweeping reform in the district heat supply system has been touted for years, progress on ground has been very slow. In order to improve payment collection, the restructuring plan that is currently being discussed will ensure that heat meters are installed at all residential blocks serviced through the centralized heating system. Yet, a complete overhaul of the system whereby heat supply and consumption can be controlled for each flat individually is unlikely due to the immense costs involved. Clearly, the costs associated with the re-design of the heat supply systems in residential blocks in order to ensure monitoring per individual flats will need to be borne by the CHP projects themselves (and recouped through the final price on energy). However, it is important that incentives for energy efficiency projects are considered wherever possible. As such, as part of the district heating reform, the Government should strongly promote cogeneration as a priority technology that will help the sector's transition towards higher energy efficiency, and ensure that an optimal allocation can be reached between centralized and decentralized heat supply.

1.2.3.3 Policy and Regulatory

1.2.3.3.1 Improve the legal framework to include clear incentives for CHP-generated energy

Private investors will participate in financing ICE CHP projects only if they have confidence that their cost recovery projections will be met. As these projections are highly dependent on forecasts of energy sale and price, it is critical that the legal framework is improved to clearly stipulate the conditions for when CHP-produced electricity can qualify for sale under regulated tariffs. Additionally, in the face of strong competition from cheap electricity produced by conventional technologies, the framework of guarantees provided for renewable energy should be extended to include incentives for CHP-generated electricity too, such as by clearly giving it priority over fossil fuel-based electricity for distribution in the national grid, and by considering agreements of long-term uptake of small-scale CHP electricity. In Moldova there are no sites where significant concentrated of heat demand is recorded and that do not favour the construction of big cogeneration power plant on country territory. In the same time the construction of mini and small

CHP requires much more specific investments and that often impede to have feasible projects. The investment costs of a gas-engine CHP plant are in the range of $850–1950/kWe, the higher value corresponding to a CHP with lower capacity[31]. In order to overcome the barrier of high investments the appropriate incentives should be promoted respectively. In the range of such are the following: a) The Government should consider fiscal concessions for the import of technical equipment and spare parts, and VAT exemptions on the end-user tariff for the energy produced through cogeneration. The exemption from import duties for CHP installations is a measure that have been already used by the Government for promoting some PP in the past; b) financial support through National Energy Efficiency Fund, created in 2012[32]; c) financial support through MoSEFF project launched by EBRD for The R. of Moldova[33]. For the loan up to 2 million Euro a grant of 20% can be obtained as on site co-generation belong to Best available techniques (BAT) and it is considered eligible for loan and the appropriate fee request.

1.2.3.3.2 Energy audit Mandatory

As country experience has shown the reserves of energy efficiency is not known properly by local authorities, enterprises and service providers. In order to remove this gap Energy audit Mandatory should be promoted for all energy customers that consume more than 200 toe/year, - the value evaluated by working group. The energy saving potential knowledge will serve to EEA and customers to promote more efficiently energy efficiency measures.

1.2.3.3.3 Reflect a transparent allocation of heat and power costs

Cross-subsidies between heat and electricity should be removed from energy tariff calculation. Elaboration of cost-reflective tariff methodologies is essential for ensuring a functional and competitive energy market that will promote energy efficiency and will improve quality of energy services.

1.3 Barrier Analysis and Enabling Measures for G-MSW technology for Electricity/Heat Production

1.3.1 General Description

Gasification of municipal solid waste (G-MSW) is a chemical process that generates a gaseous, fuel-rich product. This product can then be combusted in a boiler, producing steam for power generation. Gasification is a more complex process than waste incineration, but the reactors used for both processes are quite similar. Similar to Waste to Energy Technology (WTE)[34], the waste gasification technology has the benefit of reducing the volume of waste diverted to landfills by up to 95%. Consequently, methane emissions from landfills are mitigated. In addition to this, electricity

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[31] http://iea-etsap.org/web/ThanksDl.asp?file=E04

[32] http://search.conduit.com/results.aspx?q=fondul+de+eficienta+energetica+moldova&Suggest=&stype=Results&FollowOn=True&CUI=UN81354247732087974&SelfSearch=1&SearchType=SearchWeb&SearchSource=15&ctid=CT3072253&octid=CT3072253

[33] http://www.moseff.org/

[34] City of Amsterdam. Waste and Energy Company. Annual Report 2005. http://www.afvalenergiebedrijf.nl/bijlagen/82695%20aeb%20jrvslg%20eng%20klein_nw.pdf

produced from MSW gasification technology can lead to reduction of CO2 emissions as it can replace fossil-fuel based electricity production capacity. [35]

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[36].

1.3.2 Identification of Barriers

The Mitigation working group (experts and consultants) has considered the technology market characteristics and classified Gasification of municipal solid waste for electricity heat/ production (G-MSW) as *capital good* due to a limited number of potential sites/consumers, relatively large capital investment, simpler market chain (the country hasn't technology providers), demand is profit-driven. The identification of barriers has done in a stepwise manner, based on methodological approaches from above mentioned guides. The working group has identified the barriers to promote G-MSW, put efforts to understand why municipality wastes are not processed, they are led to landfills.

The working group has used **Market Mapping techniques** as a tool of barriers identification and analysis of challenges the future owner of ICE CHP should pass the plant be implemented and sell electricity and heat to consumers. The working group has identified a significant number of barriers that impede this scope be achieved, decomposed them and made specific for each main market actor. This step was followed by screening of barriers according to their significance to technology transfer and their ranking based on 1-5 scale. A close work with stakeholders' representatives was done in order to reach common agreement on significance of a particular barrier. After the comprehensive understanding achieved, the experts came up with the List of key barriers that represent the list of essential barriers after non-essential being removed.

Another tool used in the barriers analysis by working group was **Logical Problem Analysis (LPA)** for analysing casual relations and core problems in technology transfer. The participants have arranged the problems into hierarchy of causes and effects having as central starting problem a generic problem for technology transfer. **The LPA Problem Tree** emphasised the main links between causes and effects and organised them into logical inter-relations, addressed the basic issues and highlighted linkages with external factors. On the Problem Tree diagram the causes are shown below the starter problem and effects above. The LPA Problem Tree for this and other considered technologies are included in the Annex I.

The results of barriers identification exercise are provided in the Long List of Barriers for this technology – Table 1.3.2-1

Table 1.3.2-1. Long List of Barriers to technology transfer for G-MSW technology.

Main market actors	Barriers identified		
	Broad categories of barriers	Barriers within category	Elements of barriers
Private or public	Economic and financial	High up-front costs	- Very high per unit investment costs - Low scale projects

[35] http://climatetechwiki.org/technology/msw
[36] http://www.gasification.org/uploads/downloads/GTC_Waste_to_Energy.pdf

Main market actors	Barriers identified		
	Broad categories of barriers	**Barriers within category**	**Elements of barriers**
Investors in G-MSW			- Import of technology (it lacks in country) add taxies
		High operation and maintenance costs	- technology is very complex - the necessity to pre-process of MSW - Use of foreign skilled staff at initial stage - Imported spare parts
		High transaction costs	- Economies of scale is manifested mainly at high investment level - Market size small - Missing or under-developed supply channels
		Insufficient financing along the value chain in the waste management sector	- Scarcity of cheap capital - Undeveloped capital market - Lack of venture capital - Lack of access to cheap capital - Budget constraints of the local public administration authorities
	Policy, legal and regulatory	Incomplete legal framework to support renewable energy projects	- the secondary legislation is still incomplete (standards, …) - lack of Feed-in tariffs, instead Renewable Tariff methodology calculation is in effect with big uncertainty on future tariff for RES energy
		Under-developed waste management policy and regulatory framework	- Lack of a strong driver to invest in waste management systems - Un-reformed institutional framework - lack of the mechanisms necessary to support an integrated waste management system of waste recycling and energy recovery across the country - no existing legal act regulates environmental permitting of waste incinerators or lays down any emission limit values - international waste categorization standards has not yet been introduced
		Inadequate enforcement of waste management regulations	- The Law on Environmental Protection is not respected: economic agents have not introduced technologies that minimize waste generation, kept a register of generated wastes and process recyclable waste on site or in specialized enter - the waste service agreements have generally not been well defined - compliance with environmental standards is not enough monitored
	Network Failures	Weak participatory governance in the waste management sector	-no clear roles and responsibilities defined for actors in the sector - no public participation in the decision-making process in the waste sector
		Lack of inter-municipal	-Lack of studies on how to reach inter-municipal agreements

Main market actors	Barriers identified		
	Broad categories of barriers	**Barriers within category**	**Elements of barriers**
		agreements	
	Institutional and organizational capacity	Limited institutional capacity in the waste management sector	- Missing of the infrastructure for planning and implementing an integrated waste management system at both national and regional levels
		Under-developed waste management system	- Waste disposal services cover only 60-90% of all municipal waste generators in urban sector and 10-20% in rural sector.
	Social, Information and awareness	Inadequate waste-related information	- detailed information, both on the situation on the ground and policy actions, is particularly hard to come by in Moldova - not known waste caloric value - potential mitigation costs that the waste sector can offer are not known
		Unknown technology	-Limited knowledge transfer on G-MSW technologies - complexity of determining MSW throughput and modelling economies of scale
		High risk perception of the technology	-No one G-MSW project is implemented on country territory - No reliable characteristics on G-MSW power plant
	Technical	Unknown composition of input waste	- Data on the composition and distribution of waste across the country is very poor -The designing of G-MSW is exposed to very high risk as waste composition is not known
		Limited knowledge of the technological process	-No knowledge on solid waste gasification, composition of waste material, the composition of gas emitted after waste gasification, how the residue waste will be disposed of is not clear
		Inadequate waste management facilities	- Separation of waste services are under-developed or missing in localities across Moldova - existing waste storage facilities are not operated in accordance with environmental standards
		Heat distribution network constraints	- G-MSW power plant could generate the heat in a limited number of cities where distribution network exists
Local public administration	Economic and financial	Insufficient financing along the value chain in the waste management sector	- Scarcity of cheap capital - Undeveloped capital market - Lack of venture capital - Lack of access to cheap capital - Budget constraints of the local public administration authorities
	Policy, legal and regulatory	Under-developed waste management policy and regulatory framework	- Un-reformed institutional framework - lack of the mechanisms necessary to support an integrated waste management system of waste recycling and energy recovery across the country - no existing legal act regulates environmental permitting of waste incinerators or lays down any emission limit values - international waste categorization standards has not yet been introduced
	Network	Weak participatory	-no clear roles and responsibilities defined for actors in the

Main market actors	Barriers identified		
	Broad categories of barriers	**Barriers within category**	**Elements of barriers**
	Failures	governance in the waste management sector	sector - no public participation in the decision-making process in the waste sector
	Institutional and organizational capacity	Limited institutional capacity in the waste management sector	- Missing of the infrastructure for planning and implementing an integrated waste management system at both national and regional levels
		Under-developed waste management system	-- Waste disposal services cover only 60-90% of all municipal waste generators in urban sector and 10-20% in rural sector.
	Social, Information and awareness	Inadequate waste-related information	- not known waste caloric value - potential mitigation costs that the waste sector can offer are not know
		Unknown technology	- Limited knowledge transfer on G-MSW technologies
Ministry of Environment	Institutional and organizational capacity	Limited capacity to promote efficient waste management system	- No financial resources available to hire high qualified specialists - Lack of knowledge how to develop a successful waste management system

1.3.2.1 Economic and Financial

The crucial element that determines the success of any project promotion is the assurance the project is financially feasible. In order to identify the economic-financial characteristics of G-MSW power plant an appropriate model in Excel format was developed.

The first G-MSW project is planned to be built in Chisinau, the capital of the R. of Moldova. All the municipality wastes will be treated at one plant, located in the area of the city. The capacity of the plant is determined based on the caloric value of the wastes, their daily quantity processed and the load factor for electricity produced. The value obtained is 30 MW at generator bas-bar, the load factor of the plant is 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 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 destined 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.

Because of high value of investments needed for plant construction, around US$126 million, it is unlikely believe this project could be put in operation earlier than 2017-2018.

IRR is equal to 15% for the first 10 years, being negative for the first 5 years as rate of return taken into consideration is fix at the level of 14%, i.e. payback period is around 7 years. The calculation is made in the concept the electricity is sold only, the price for electricity being not lower than 27 cent$/kWh, while the highest price for power generated is around 15 cent$/kWh among the operated local PPs at present. No doubt the price for electricity and payback period could be much lower if both the heat produced by the plant and CO2 reduction could be realized at the market. For

example, if expected GHG reduction (474 thousands tone of CO2) is sold on carbon market at a price of 10 $/tCO2 IRR reaches 17%, payback period being around 6 years. So that the economic-financial parameters can be improved and that should demonstrate a more detailed feasibility study, that will take into consideration the possibility to sell the heat produced by G-MSW plant. Of course, other factors as higher load factor, higher waste caloric value, less specific investments may improve in edition G-MSW plant commercial offer.

From climate change point of view, the G-MSW project is very attractive by its potential to reduce GHG emissions. The effects come from two sources. From one site, 369,418 tCO2 reductions is obtained from future CH4 emissions avoided at landfill and, from another site, 105,000 tCO2 reduction due to the displacement of electricity produced at Transnistria PP that operates on natural gas.

The abovementioned project will contribute to reaching the National Low Emission Development Strategy (LEDS) goal, contributing to cover 98% of emission reduction target established for Waste sector, and 11% for Energy sector, all referring to most optimistic scenario, i.e. HAS, according to SNC.

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.

1.3.2.1.1 High up-front costs

High up-front costs, and access to finance these costs, are one of the major barriers to the implementation of the Gasification of Municipal Solid Waste (G-MSW) for electricity production in Moldova (G-MSW)). Investment costs in G-MSW projects are typically around 4200 $/kW, but can grow significantly higher depending on the country – and site – specific parameters. Such upfront costs are generally viewed as very high relative to alternative technologies (the typical cost for combined cycle power plants is of 650$/kW), and are higher than the up-front costs for the implementation of ICE CHPs.

The indicative costs above are based on the assumption that waste collection points have been set up within the required perimeter of the G-MSW facility. The optimal locations for implementing G-MSW facilities in Moldova have not been studied in depth, however waste management is a well-known problem in the country and it is possible that the local infrastructure may fall short of the G-MSW operational requirements, in which case additional costs may be required up-front.

1.3.2.1.2 High operational and maintenance costs

Operational and maintenance costs for the implementation of G-MSW facilities are estimated to be in the range of 520$/kW[37] per year, which is significantly higher than O&M costs for a natural gas combined cycle power plant (24$/kW/year), and more than three time as high as those of a Gas Turbine CHP (168$/kW/year).

Together with the high up-front costs, the G-MSW technology is too costly relative to the separate production of electricity and heat by conventional technologies. Compared to the combustion-based MSW technology, G-MSW

[37] Avraam Karagiannidis. Thermal treatment of waste in Greece. Laboratory of Heat transfer and environment engineering. 2008

generates more electricity and has a lower up-front cost. However, the maintenance cost of the gasification system is higher, resulting in a slightly higher overall cost per tonne of waste treated in comparison to WTE facilities[38].

1.3.2.1.3 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. Furthermore, how the landfill waste composition in Moldova differs from that in countries where G-MSW technologies have already been implemented is unknown. As such, before any G-MSW project design can commence, an initial study on waste composition and landfill concentration across the country will need to be carried at length, given that such information is currently missing. Based on such information, an analysis of feasible scenarios of CO2 abatement through gasification of municipal solid waste will need to be undertaken and reflected in the Environmental Impact Assessment. EIA is a document required by the Law on Ecological Expertise and must be prepared by the project proponents at their own expenses and submitted to the relevant environmental and local authorities for approval.

1.3.2.1.4 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 be financed by local and/or foreign investors, and will also 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. In particular, given that G-MSW projects rely on functional local waste management services, such as collection, separation, and transportation, which are typically run by local authorities, the financial ability of local authorities to provide such services in a reliable way must but be considered in addition to the cost of financing of the G-MSW project itself.

Yet insufficient financing by the state for increasing the quality and efficiency of the waste management services is a well-known constraint. While the sector has started to attract some private operators, service levels are not well defined and compliance with environmental standards is not thoroughly monitored and enforced.

In terms of private capital, foreign private investment in sustainable waste management technologies is currently non-existent. At the same time, local businesses – despite the aggravation of the waste management situation in the country – remain sceptical in front of such technically complex initiatives particularly due to the uncertainty of project cost forecasts and the project's financial viability altogether.

[38] Source: http://climatetechwiki.org/technology/msw citing Klein, A., 2002. Gasification: An Alternative Process for Energy Recovery and Disposal of Municipal Solid Wastes, Earth Engineering Center, Colombia University

1.3.2.2 Policy, Legal and Regulatory

1.3.2.2.1 Incomplete legal framework to support renewable energy projects

Although significant progress has been made recently in the promotion of renewable energy sources through various legal acts and development strategies, the secondary legislation required to support the proposed objectives is still incomplete. For instance, while the Law on Renewable Energy stipulates the obligation to follow technical standards on the production, storage, transportation and consumption of renewable energy and fuel, the exact standards have not yet been clearly specified. Also, although the need for a standardized template of a Contract to sell electricity produced from renewable energy sources has been voiced on numerous occasions, this has not yet been elaborated by ANRE.

1.3.2.2.2 Uncertain incentives for private investors

The Law on Renewable Energy provides that the tariffs on renewable energy shall be approved on annual basis based on the production type and production capacity of facilities, on the forecasts of volumes that will be generated and supplied, and on the period of supply of renewable energy. Additionally, it also stipulates that upon setting these tariffs, the National Agency for Energy Regulation will also take into account prices on the international market.

While the latter stipulation can be appreciated as an end objective of Moldova's alignment to the energy acquis communautaire, it should be dealt with carefully in the early stages of the alignment process given the immense discrepancy between the economic realities of Moldova and those of the EU countries. In fact, potential private investors in G-MSW may view this statement as counter-incentivizing as it creates an uncertain context for subsequent tariff renegotiation, thereby reducing investor confidence in cost recovery projections.

1.3.2.2.3 Under-developed waste management policy and regulatory framework

Until recently, Moldova has lacked a strong driver to invest in waste management systems, mostly due to other economic development priorities. As expected, this has led to an aggravation of the waste situation in the country, with municipal landfills growing in size without any remedial plans in sight.

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[39], the legal framework of waste management is still under-developed, and has not been shaped to comprehensively address implications on the state of the environment.

In particular, 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

[39] Low Emissions Development Strategy of the Republic of Moldova to the Year 2020 (Draft) http://clima.md/lib.php?l=ro&idc=236&

specialized treatment facilities. Also, no existing legal act regulates environmental permitting of waste incinerators or lays down any emission limit values.

Furthermore, the current definition and categorization of waste is based on the old Soviet standards – international categorization has not yet been introduced. According to the Law on Environmental Protection 1993, wastes are grouped into three main categories: solid and non-hazardous waste, toxic (hazardous) waste and nuclear waste. However, a comprehensive list of wastes falling into each of these categories is still missing.

1.3.2.2.4 Inadequate enforcement of waste management regulations

Enforcement of the existing waste regulations has been generally lax, which has generated an overall attitude of doubt that a modernized waste management system in theory will also translate into a reformed value chain in practice. For example, the Law on Environmental Protection 1993 requires that economic agents introduce technologies that minimize waste generation, keep a register of generated wastes and process recyclable waste on site or in specialized enterprises. However, judging by the rising incidence and size of waste dumps across the country, it is clear that this requirement has not been sufficiently enforced, the small size of penalties being one of the reasons. Additionally, while the Law on Industrial and Domestic Wastes 1997 stipulates that permits must be issued for waste storage and disposal, in practice the State Environment Inspectorate issues very few if any at all. At the same time, it must be acknowledged that over the last few years some improvements have started to take place, such as a growing interest of private operators to provide services in the waste management sector. However, the service level agreements have generally not been well defined, and compliance with environmental standards has not been thoroughly monitored.

1.3.2.3 Network Failures

1.3.2.3.1 Weak participatory governance in the waste management sector

The current participatory and governance framework in the waste management sector in Moldova is under-developed, with no clear roles and responsibilities defined for actors in the sector, including state institutions, associations, the private sector, and the civil society. Participation by the general public in the decision-making process in the waste sector, as well as in the waste management process itself such as by cooperating to increase the quality of waste management services, is practically absent.

1.3.2.3.2 Lack of inter-municipal agreements

Large-scale G-MSW Electricity/Heat production relies on the availability and access to a relatively large volume of input waste, which will require sourcing from multiple locations. This is likely to require some municipalities to join together – via inter-municipal agreements for example – to obtain cost-effective disposal systems, however the possibility and constraints to reach such agreements in Moldova have not yet been thoroughly studied.

1.3.2.4 Institutional and Organisational Capacity

1.3.2.4.1 Limited institutional capacity to promote renewable energy projects

Limited institutional capacity to promote RES technologies is one of the main barriers to their implementation in Moldova. Although the Law on Renewable Energy from 2007 established the Agency for Energy Efficiency as the

authority in the renewable energy sector, its institutional set-up has been a very slow process. This has resulted in an inadequate appreciation of R&D in climate change mitigation, and in an insufficient dissemination of information on the benefits from using renewable energy sources and on potential project opportunities in this domain.

1.3.2.4.2 Limited institutional capacity in the waste management sector

The institutional capacity to promote sustainable waste management technologies in Moldova is under-developed. The infrastructure required for planning and implementing an integrated waste management system at both national and regional levels is currently missing. The limitations faced by local public authorities in their ability to fulfil their waste-management-related duties are also apparent. For example, although by law local public authorities are responsible for carrying out regular studies of waste composition, these have been produced only intermittently. Furthermore, the information on waste volume and composition that does get collected is still recorded based on Soviet standards, and therefore is not aligned to the European waste classification requirements. Yet, an effective waste management plan cannot be drafted without an accurate ex ante understanding of the morphological composition of municipal solid waste.

1.3.2.4.3 Under-developed waste management system

Most of the challenges currently faced by the waste management sector in Moldova are due to lack of investments in the modernization of the sector over the last decade. As a result, waste collection services are unreliable, the roads for accessing waste dumps are in a very bad shape, separation of municipal waste is not taking place, and compliance with environmental standards is not thoroughly monitored and enforced.

Although specialised waste disposal services exist in all municipalities and small cities, these cover only 60-90% of all municipal waste generators. In rural areas however the coverage of such services is much smaller (10-20%)[40], and waste disposal is typically undertaken by the waste generators themselves. Furthermore, due to limitations in the technical capacity for waste collection, reuse and recycling, most of the generated waste is landfilled in bulk, which creates a lost opportunity to generate value from waste recycling and energy recovery. It is no surprise therefore, that the industry of waste recovery and recycling accounted for only 0.1 per cent of the gross value added generated by the Moldovan economy in 2010[41].

1.3.2.5 Information and Awareness

1.3.2.5.1 Inadequate waste-related information

Waste management is an area where detailed information, both on the situation on the ground and policy actions, is particularly hard to come by in Moldova. Inadequate information means that the extent and nature of the challenge posed by waste has not been fully diagnosed, and potential mitigation costs that the waste sector can offer are not known. For example, the rates of daily waste generation per person calculated based on the available information on

[40] National Waste Management Strategy for the Period 2012-2015 (Draft) http://particip.gov.md/proiectview.php?l=ro&idd=114
[41] National Report for UN CSD 2012 Rio+ 20 http://www.uncsd2012.org/content/documents/782Moldova_Report_RIO20_ENG_12-06-2012_final.pdf

population and size of solid waste landfills give too widely ranging city-specific numbers. This can only be explained by the fact that activities of unauthorized waste disposal – which are unaccounted for in the calculations – are rather wide-spread. Since waste disposal is not fully controlled, the calorific value of waste may differ in reality. Furthermore, although some waste treatment and processing facilities exist in the country, the information on volumes of recycled waste is nowhere recorded. Also, to trace the flow of hazardous waste generated in Moldova is practically impossible due to the fact that it is disposed of together with the municipal solid waste; as such, calculations predominantly include numbers on hazardous industrial waste only.

1.3.2.5.2 Unknown technology

Given that the G-MSW technology is still in its early stages of development on the international market, very little is known of its potential applicability in Moldova. 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[42]. For this reason, municipalities tend to be hesitant to seriously consider implementation of G-MSW projects. 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.

1.3.2.5.3 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. The high risk perception barrier can be alleviated through a successful implementation of one or several pilot projects, small or large scale.

1.3.2.6 Technical

1.3.2.6.1 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.

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[42] Source: http://climatetechwiki.org/technology/msw citing Jenkins, S.D., 2007. Conversion technologies: A new alternative for MSW management, Earthscan.

1.3.2.6.2 Limited knowledge of the technological process

There is limited knowledge available in the country on how the G-MSW technology works and how it will need to be adapted to local conditions. More is known about wood gasification processes, but very little has been studied on the gasification of solid waste. This is further complicated by the fact that the technical design of a G-MSW facility depends on the composition of waste material, which upon gasification can emit various types of gases that must be either cleansed and re-absorbed or extracted. Additionally, how the residue waste will be disposed of is not clear, as well as what happens to the residue gases that cannot be re-absorbed into the gasification process. In case residue gases do get emitted into the atmosphere, the methodology for calculating the impact of such emissions for various types of gases will need to be further established.

1.3.2.6.3 Inadequate waste management facilities

Separation of waste that may damage or compromise the G-MSW technical process is a key step in the project's life-cycle. Currently however, such services are under-developed or altogether missing in localities across Moldova. For example, the infrastructure for managing non-hazardous waste, such as construction materials, livestock manure, and street waste is entirely missing. Also, existing waste storage facilities are not operated in accordance with environmental standards.

1.3.2.6.4 Heat distribution network constraints

In Moldova, heat distribution networks exist only in cities, while in rural areas heat demand is predominantly satisfied by each household individually. Access of G-MSW facilities to the existing heat network will therefore be constrained by the proximity of technology sites to urban areas. This may become an implementation barrier for G-MSW projects depending on the types of gas emitted and residue waste, which may require that sites be located at a minimum distance away from any residential areas.

Table 1.3.2-2. List of barriers for G-MSW technology and hierarchy classification

No	Barriers identified	Rank (1-5)	Classification of the barriers
1.	High up-front costs	5	Economic and financial
2	High operation and maintenance costs	5	Economic and financial
3	High transaction costs	4	Economic and financial
4.	Insufficient financing along the value chain in the waste management sector	5	Economic and financial
5	Incomplete legal framework to support renewable energy projects	5	Policy, legal and regulatory
6.	Under-developed waste management policy and regulatory framework	5	Policy, legal and regulatory
7.	Inadequate enforcement of waste management regulations	5	Policy, legal and regulatory
8.	Weak participatory governance in the waste management sector	4	Network Failures
9.	Lack of inter-municipal agreements	3	Network Failures
10.	Limited institutional capacity in the waste management sector	4	Institutional and organizational capacity
11.	Under-developed waste management system	4	Institutional and organizational capacity
12.	Inadequate waste-related information	5	Social, Information and awareness

13.	Unknown technology	3	Social, Information and awareness
14.	High risk perception of the technology	5	Social, Information and awareness
15.	Unknown composition of input waste	5	Technical
16.	Limited knowledge of the technological process	3	Technical
17.	Inadequate waste management facilities	3	Technical
18.	Heat distribution network constraints	3	Technical

Table 1.3.2-3. The List of Key Barrier to G-MSW

Key barriers identified	Classification of the barriers
High up-front costs	Economic and financial
High operation and maintenance costs	Economic and financial
Insufficient financing along the value chain in the waste management sector	Economic and financial
Incomplete legal framework to support renewable energy projects	Policy, legal and regulatory
Under-developed waste management policy and regulatory framework	Policy, legal and regulatory
Inadequate enforcement of waste management regulations	Policy, legal and regulatory
Inadequate waste-related information	Social, Information and awareness
High risk perception of the technology	Social, Information and awareness
Unknown composition of input waste	Technical

1.3.3 Identified Measures

Having established a thorough understanding of the barriers, the next step for the working group have been to identify of measures needed to overcome the barriers established and to improve each technology performances. In this respect, at the very beginning, the working group has discussed the impact of policy options on technology. **Logical Problem Analysis** was used as a tool to identify the measures to overcome the barriers. The experts have prepared sector specific information, policy documents, and other useful information for discussions during the meetings with stakeholders. The working group discussed the measures in the context the barriers were addressed, grouping by the same criteria as barriers. The problems were reformulating into positive statements of future situation, arranging measures and results into **Objective tree** as logically organised presentation of objectives. The Objective tree of this and other technologies are presented in the Annex I. The measures were assessed according to their economic profile and incentives used. The results are presented in the tables below.

The gasification of municipal solid waste for electricity heat/ production (G-MSW) technology has been supported by the study of policy enabling environment. Developed **Policy Fact Sheet (PFS**) of this technology with compressed information about policy framework is presented in the Annex II. According to the investigations done by experts the implementation of the technology falls under the jurisdiction of several laws promoting GHG reduction, waste management system, renewable energy among which the most important are:

- Low Emissions Development Strategy to the Year 2020[43];

[43] Low Emissions Development Strategy to the Year 2020. Draft

- National Waste Management Strategy[44]
- Energy Strategy to the year 2020[45]
- Law on Renewables[46]

Working groups has considered that the highest impact with direct effect on technology implementation has the National Waste Management Strategy and Law on Renewables. The related regulatory acts complement the main law, contributing to a policy and regulatory path for implementing the technology.

The experts have undertaken a ***cost-effective analysis*** of the political path supported by the specific law that shall ensure the successful implementation of the technology and obtaining the best financial results. The scenario includes long-term operation of G-MSW technology that lead to significant GHG emissions reduction, country energy security increasing and overcoming of municipalities' waste problems. This technology is aimed to produce electricity but will be feasible to generate heat too if near to power plant the demand for heat exists or access to heat distribution network is available.

The table below provides a summary of the measures identified.

Table 1.3.3-1. Identified measures to overcome barriers to technology transfer for G-MSW technology.

Barriers identified	Measures identified to overcome the barriers
Economic and financial	- To exempt from import duties G-MSW installations - To support G-MSW construction from Energy Efficiency Fund - To encourage use the EBRD Fund for energy Efficiency in Moldova (MoSEFF II) - exemption or reduction of VAT on the energy produced through waste processing technologies
Policy, legal and regulatory	- To approve Feed-in tariff for electricity produced from waste. - To improve waste collection and transportation system - To implement international standards for waste classification - To improve network of facilities for waste disposal, recycling, processing and treatment - Inter-municipal agreements to establish disposal and processing facilities that handle multiple municipalities - To determine and apply stronger administrative fines for environmental offences - To define more clearly the roles and responsibilities for waste management across relevant agencies, with guidance being provided from central authorities to municipalities as required
Institutional capacity	- To increase Energy Efficiency Agency capacity to G-MSW technologies
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 - To revise and supplement the set of statistical tools in order to ensure that the data provided on waste generation and flow is accurate

[44] Draft. http://particip.gov.md/proiectview.php?l=ro&idd=114
[45] Energy Strategy to the year 2020. http://lex.justice.md
[46] http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=324901

Table 1.3.3-2. Categories of measures and incentives for G-MSW.

No	Financial measures and responsible entity	Non-financial measures and responsible entity and responsible entity	Complementary measures and responsible entity	Incentives and responsible entity
1		To approve Feed-in tariff for electricity produced from waste (ANRE)	To improve network of facilities for waste disposal, recycling, processing and treatment (MEn)	To exempt from import duties G-MSW installations (ME)
2		To improve waste collection and transportation system (MEn)	Inter-municipal agreements to establish disposal and processing facilities that handle multiple municipalities (MEn)	To support G-MSW construction from Energy Efficiency Fund (EEA)
3		To implement international standards for waste classification (MEn)	To determine and apply stronger administrative fines for environmental offences (MEn)	To encourage use the EBRD Fund for energy Efficiency in Moldova (MoSEFF II) (EEA)
4.		To increase Energy Efficiency Agency capacity to G-MSW technologies (ME)	To define more clearly the roles and responsibilities for waste management across relevant agencies, with guidance being provided from central authorities to municipalities as required (MEn)	VAT exemption or reduction on the energy produced through waste processing technologies (ME)
5.		To revise and supplement the set of statistical tools in order to ensure that the data provided on waste generation and flow is accurate (MEn)	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 (MEn, EEA)	

Table 1.3.3-3. Final List of measures to overcome technology barriers for G-MSW technology

No	Measures
1.	- To exempt from import duties G-MSW installations
2.	- To support G-MSW construction from Energy Efficiency Fund
3.	- To encourage use the EBRD Fund for energy Efficiency in Moldova (MoSEFF II)
4.	- VAT exemption or reduction on the energy produced through waste processing technologies
5.	- To approve Feed-in tariff for electricity produced from waste
6.	- To improve waste collection and transportation system
7.	- To implement international standards for waste classification
8.	- To revise and supplement the set of statistical tools in order to ensure that the data provided on waste generation and flow is accurate
9.	- To increase Energy Efficiency Agency capacity to G-MSW technolo
10.	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

1.3.3.1 Economic and Financial

1.3.3.1.1 Implement economic instruments to reflect real cost of waste management

The financing system in the waste sector must be revised in order to improve the quality and reliability of waste management services provided by local authorities. Fees and charges for these services should be progressively revised in order to apply the 'polluter pays principle' for internalizing environmental costs, and cover the private good aspect of waste management. To this end, the waste flow, particularly, waste origination, should be thoroughly studied, in order to ensure that internalization of environmental costs is applied in an equitable way across contributors.

1.3.3.1.2 Establish incentives to increase efficiency in the waste sector

Given the significant under-investment in the waste management sector over the last decade in Moldova, the Government should consider a program of medium-term incentives to promote a radical change in waste services and standards compliance, and to promote an environmentally-friendly waste management technologies. These incentives can include fiscal stimulus for industrial production based on waste recycling and reuse, lower service charges for enterprises showing a good track of waste reduction, exemption of import duties on biomass and biogas equipment and components, VAT exemption on local production of such equipment, and VAT exemption on the heat produced through waste processing technologies.

1.3.3.2 Policy, Regulatory and Institutional

1.3.3.2.1 Establish guarantees for energy produced from waste

As part of the process of aligning the national legislation to the energy acquis communautaire, Moldova is currently elaborating the legal framework necessary for the implementation of feed-in-tariff schemes. It is expected that initially the maximum power limit allowed to be covered by feed-in-tariffs will be relatively low, which is to allow for a gradual accommodation of the resulting increase in energy tariffs. However, although it is likely that the power of a large-scale G-MSW facility will be within the threshold allowed, this does not provide a sufficient guarantee that the generated electricity will be covered by the feed-in-tariff scheme due to possible dislocation of eligible electricity by that produced from other renewable sources such as wind. It is therefore necessary that the legislation provides a clear priority to energy produced from waste over that originating from other renewable sources, particularly given the wide-ranging social benefits that an improved waste management system can bring, and also the greater reliability that the waste-based energy can provide thereby addressing the energy security challenges faced by the country.

1.3.3.2.2 Implement the legal framework required to modernise the waste management system

A National Waste Management Strategy to the Year 2020 is currently being drafted and is expected to be approved by end of year. During this process, it is important that the objectives in the waste strategy are aligned to those set out in the Low Emissions Development Strategy to the Year 2020, which is also in draft, in order to ensure that the new waste management framework is governed by principles of environmental sustainability in addition to those of economic efficiency. In particular, the new legal framework in the waste sector must be conducive – inter alia –

towards a wider establishment of services of waste separation at origin or at transfer stations (in rural areas where selective pre-collection of waste is difficult); an improved waste collection and transportation system; an improved network of facilities for waste disposal, recycling, processing and treatment; realization of economies of scale at waste disposal through inter-municipal agreements to establish disposal and processing facilities that handle multiple municipalities; and implementation of international standards for waste classification.

1.3.3.2.3 Ensure better enforcement of compliance to waste standards

It is essential that the plan of actions for the implementation of the new waste management strategy is supported by an effective enforcement framework. The size of fines for environmental offences is currently too low to create any deterrent effect and should therefore be revised to induce compliance. A useful report in this respect is the methodological guidance prepared by the OECD in 2009 at the request of environmental authorities in EECCA countries[47], and which discusses the administrative enforcement tools that can be improved without compromising proportionality and fairness of penalties applied. Compliance with the obligatory standards stipulated in the landfill management license should also be stronger enforced particularly in municipalities where the situation has become critical due to the growing incidence of unauthorized waste disposal.

1.3.3.2.4 Improve coordination among public agencies

Measures needed to ensure the financial stability of environmental services, including waste management, may collide with other strategic priorities established by different ministries. It is therefore essential that a cross-ministerial dialogue is maintained and strengthened in order to avoid a single-minded orientation of the legislation, with various acts specifying their own implementation regimes. Roles and responsibilities for waste management should also be clearly defined across relevant agencies, with guidance being provided from central authorities to municipalities as required.

1.3.3.3 Information and Awareness

1.3.3.3.1 Increase public awareness

Waste generation patterns are highly determined by people's attitude towards waste management. In Moldova, increasing the efficiency and reducing the environmental impact of the solid waste management system is not seen as a shared responsibility, yet the success of the waste reform will be greatly determined by user cooperation too. As such, programs of awareness building campaigns and educational measures need to be elaborated and followed through to positively influence the public's participation. The programs should also raise awareness about the impact waste has on the environment, and about technologies that could be implemented to increase sustainability in the waste sector. Furthermore, to strengthen the sense of inclusivity, programs should further invite participation from community members in various field activities, such as separation and collection of recyclable waste, and ensure that results are published so that changes and benefits are made known to the wider public.

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[47] Determination and Application of Administrative Fines for Environmental Offences: Guidance for Environmental Enforcement Authorities in EECCA Countries, OECD 2009 http://www.oecd.org/env/environmentinemergingandtransitioneconomies/42356640.pdf

1.3.3.3.2 Improve the waste management information system

The national waste management information system must be improved across all of its stages, including data collection, validation and reporting. The set of statistical tools used should be revised and supplemented to ensure that the data provided on waste generation and flow is accurate. By having a reliable source of information on municipal solid waste, it will be possible to assess the country's potential for energy recovery from waste, together with the mitigation costs that the MSW sector can offer.

1.4 Barrier Analysis and Possible Enabling Measures for Hybrid Electric Vehicles

1.4.1 General Description

The most energy efficient vehicle available today is the electric vehicle. However, commercialization of full electric vehicles is still hampered by high purchase prices, short driving ranges and long recharging times. These facts have led to the construction of hybrid vehicles. A hybrid car combines an internal combustion engine with technologies used in full electric vehicles. They have the advantage of higher fuel efficiency and reduced CO2 emissions without additional infrastructure requirements.

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. [48]

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[49].

1.4.2 Identification of Barriers

The Mitigation working group (experts and consultants) has considered the technology market characteristics and classified Hybrid electric vehicles (HEV) as consumer goods due to a high number of potential consumers; interaction with existing markets and requiring distribution, maintenance and installer networks in the supply chain; large and complicated supply chains with many actors, including producers, assemblers, importers, wholesalers, retailers and end consumers; barriers may exist in all steps in the supply chain; demand depends on consumer awareness and

[48] Source: http://climatetechwiki.org/technology/hev
[49] Source: http://www.statistica.md/category.php?l=ro&idc=138&

preferences and on commercial marketing and promotional efforts. The identification of barriers has done in a stepwise manner, based on methodological approaches from above mentioned guides. The working group has identified the barriers to promote HEV, put efforts to understand why despite the advantages such vehicle has not implemented in the country.

The working group has used **Market Mapping techniques** as a tool of barriers identification and analysis of challenges the HEV could met in its promoting. The working group has identified a significant number of barriers that impede this scope be achieved, decomposed them and made specific for each main market actor. This step was followed by screening of barriers according to their significance to technology transfer and their ranking based on 1-5 scale. A close work with stakeholders' representatives was done in order to reach common agreement on significance of a particular barrier. After the comprehensive understanding achieved, the experts came up with the List of key barriers that represent the list of essential barriers after non-essential being removed.

Another tool used in the barriers analysis by working group was **Logical Problem Analysis (LPA**) for analysing casual relations and core problems in technology transfer. The participants have arranged the problems into hierarchy of causes and effects having as central starting problem a generic problem for technology transfer. **The LPA Problem Tree** emphasised the main links between causes and effects and organised them into logical inter-relations, addressed the basic issues and highlighted linkages with external factors. On the Problem Tree diagram the causes are shown below the starter problem and effects above. The LPA Problem Tree for this and other considered technologies are included in the Annex I.

The results of barriers identification exercise are provided in the tables of this sub-chapter.

Table 1.4.2-1. Long List of Barriers to technology transfer for HEV technology.

No	Actors on the market	Identified barriers		
		Wide categories of barriers	Barriers within the category	Barrier elements
1	Ministry of Transport and Road Infrastructure	Market failure	Poor articulated demand	- Lack of clear regulatory signals regarding emissions
			Market domination by conventional technologies	- Unclear environmental targets for transport operations
		Policy, legal and regulatory	Incomplete legal framework	- Environmental improvements limited to the resulting positive externalities - Absence of laws and bylaws on climate technologies - Lack of government faith in climate technologies - Inadequate or unwieldy regulations for climate technologies - Lack of coherent economic policies - Lack of low emission development strategy in the transport sector
			High perceived risk due to unclear vehicle efficiency standards	- Lack of clear regulatory signals - Enforcement of EURO emission standards is still an issue
		Institutional and informational	Inadequate institutional framework	- Underdeveloped institutional structures - Inadequate coordinated sector approach - Inadequate definition of strategic vision based on sustainability principles - Weak understanding of potential role of policy instruments

No	Actors on the market	Identified barriers		
		Wide categories of barriers	Barriers within the category	Barrier elements
2	Municipalities (local public authorities)	Economic and Financial	Low profitability in passenger transport sector	- To low profit rate to attract investments - Difficult tariffs adjustment
		Market failure	Poor road infrastructure	- Insufficient investments
		Institutional and informational	Inadequate economic instruments to influence transport investments	- Heavily subsidized sector - Still limited use of economic instruments
			Inadequate institutional framework	- Political uncertainty
			Weak institutional capacity	- Limited capacity to solicit innovative ideas to encourage low carbon technologies
3	Municipal transport companies	Economic and Financial	High-up front costs	- Higher purchase cost of new technology - Scarcity of cheap capital - Low affordability of population
			Inappropriate incentives	- Insufficient incentives to apply climate change technologies - Non-consideration of external costs axes on climate change technologies
		Market failure	Poor market infrastructure	- Limited familiarity with new technologies - Missing supply channels for equipment and spare parts
			Poor road infrastructure	- Increased maintenance costs - Decline in lifetime of new technology
		Institutional and informational	Weak institutional capacity	- Limited ability to absorb new techniques and information
			Unknown technology	- Limited practical experience of local experts - First stage of commercialisation of HEV technology
4	Energy Efficiency Agency	Market failure	Market domination by conventional technologies	- Lack of efficiency standards

1.4.2.1 Economic and Financial

The crucial element that determines the success of any project promotion is the assurance the project is financially feasible. In order to identify the economic-financial characteristics of HEV technology an appropriate model in Excel format was developed. The details are presented in the Annex III.

According to the evaluation made by the experts of working group the HEV technology is supposed to be implemented in 4 urban areas (Chişinău, Bălţi, Tighina and Tiraspol) of passenger transportation. For mentioned cities it was estimated a total number of 3000 vehicles, including buses and minibuses. The Excel model elaborated includes both these types of vehicles. Assuming that conventional (Base Line Scenario) and HEV technologies cover the same passenger transport activity, the analysis is done for marginal contribution only.

Three economical-financial indicators were determined: Net Present Value, Internal Rate of Return and Pay-Back Period. They are presented in the Table 1.4.2-2.

As it is seen from the Table 2.4.2-1, HEV technology is feasible, IRR recording 22% for Bus and 14% for Minibus, payback period being 6.1 and 7.2 years respectively.

Table 1.4.2-2. Main economic and financial parameters of HEV technology

Items	units	Bus	Minibus
Number of vehicles		274	2,684
1. Marginal capital investments, $	US$	-39,000	-18,000
2. Annual marginal costs[1], $	US$	6,945	2,544
3. Total, $	US$	-32,055	-15,456
NPV, $	US$/vehicle	16.216	2.567
IRR, %	%	22%	14%
PB, yr	years	6.1	7.2

[1] Starting from the second year annual costs are increased by CPI=5,0%/year.

The analysis made demonstrated that the highest influence on HEV technology have additional investments, distance traveled (km/yr) and fuel price. Considering the same additional investments and fuel price, the annual traveled distance for buses should be at least 40 thousand km/year for Buss and 49 thousand km/year for Minibuses. Lower additional investments and higher fuel price make the project more attractive.

HEV technology implementation in four country's cities, i.e. Chisinau, Bălți, Tighina and Tiraspol, will contribute to GHG emissions reduction by 26,300 tones per year, equivalent to 1.8% of GHG emission reduction target established for Energy sector by 2020, according to SNC High Alternative Scenario or 8.8% of SNC IAS.

Successful implementation of HEV technology in the abovementioned urban passenger transport sector shall serve as an incentive for farther implementation of this technology for urban delivery trucks and other vehicles destined for passenger transportation.

1.4.2.1.1 High up-front costs

High purchase cost of hybrid vehicles is one of the greatest barriers to the diffusion of this technology in Moldova. Despite the advantage of higher fuel efficiency from the use of HEVs compared to traditional vehicles based on internal combustion engine, the need to secure upfront funding to cover the high costs makes them unaffordable to both public authorities and individual consumers.

1.4.2.1.2 Low profitability in the 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 wider sand 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.

1.4.2.1.3 Low affordability of the population

Due to a generally low affordability of the local population, the high up-front costs of hybrid passenger cars are a great deterrent to the purchase of HEVs for individual consumption. Similarly, private economic agents running private fleets of micro-buses – which are heavily used for public transportation in Moldova – will find purchase costs too high given the relatively low profitability in the public transport sector.

1.4.2.2 Market failure

1.4.2.2.1 Poor road infrastructure

Insufficient investments in the road infrastructure of Moldova have resulted in an increasing deterioration of the quality of roads across the country. This in turn has caused vehicle operation and maintenance costs to go up and vehicle life-time to go down. Although no new infrastructure is required to operate HEVs, ensuring that HEV life-time is not shortened – including due to poor roads – is essential to gaining the net cost benefit that is accrued as a result of lower operating costs over the technology's life-time.

1.4.2.2.2 Poor market infrastructure

The local demand for HEVs is poorly articulated due to limited familiarity with the technology, but also due to a lack of clear regulatory signals regarding emissions reduction in the transport sector. The supply channel for imported equipment and spare parts is missing.

1.4.2.2.3 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. Policy, Legal and Regulatory

1.4.2.2.4 Incomplete legal framework in the transport sector

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.

1.4.2.2.5 Inadequate economic instruments to influence transport investments

Public transport operations used to be state-owned and heavily subsidised, however with their transfer to municipalities commensurate financial resources have not been ensured. The use of economic instruments to influence transport demand, modal share and fuel choice is still limited. Attracting investments in public transport appears to be even more difficult than in roads infrastructure.

1.4.2.2.6 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.

1.4.2.3 Institutional and Informational

1.4.2.3.1 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.

1.4.2.3.2 Weak institutional capacity

Public authorities have limited institutional capacity to solicit innovative ideas and to encourage potential entrepreneurs in the transport sector. Generally, the inefficiency of public administration in the transport sector greatly affects the sector's development and prospects of adopting low carbon technologies, including HEVs. Municipal public transport companies have a limited ability to absorb new techniques and information on alternative technologies, mainly due to under-staffing and under-funding.

1.4.2.3.3 Unknown technology

The practical experience of local experts with the implementation of low carbon emitting technologies in the transport sector is limited. Knowledge about HEV technologies in particular is even more 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).

Table 1.4.2-3. List of barriers for HEV technology transfer and hierarchy classification

No	Barriers identified	Rank (1-5)	Classification of the barriers
1.	High-up front costs	4	Economic and Financial
	High fuel consumption	4	Economic and Financial
2	Inappropriate incentives	5	Economic and Financial
3	Low profitability in passenger transport sector	5	Economic and Financial
4.	Incomplete legal framework (profitability constraints set in the transport tariff Methodology)	5	Policy, legal and regulatory
5.	Lack of low emission development strategy in the transport sector	5	Policy, legal and regulatory
6	High perceived risk due to unclear vehicle efficiency standards	4	Policy, legal and regulatory
7.	Inadequate institutional framework	5	Institutional and informational
8.	Inadequate economic instruments to influence transport investments	4	Institutional and informational
9.	Weak institutional capacity	3	Institutional and informational
10.	Unknown technology and its impact on environment	5	Institutional and informational
11.	Poor market infrastructure	3	Market failure
12.	Poor road infrastructure	4	Market failure
13.	Market domination by conventional technologies	4	Market failure

Table 1.4.2-4. The List of Key Barrier to HEV transfer

Key barriers identified	Classification of the barriers
Inappropriate incentives	Economic and Financial
Low profitability in passenger transport sector	Economic and Financial
Incomplete legal framework (profitability constraints set in the transport tariff Methodology)	Policy, legal and regulatory
Lack of low emission development strategy in the transport sector	Policy, legal and regulatory
Inadequate institutional framework	Institutional and informational
Unknown technology and its impact on environment	Institutional and informational

1.4.3 Identified Measures

Having established a thorough understanding of the barriers, the next step for the working group has been to identify of measures needed to overcome the barriers established and to improve each technology performances. In this respect, at the very beginning, the working group has discussed the impact of policy options on technology. **Logical Problem Analysis** was used as a tool to identify the measures to overcome the barriers. The experts have prepared sector specific information, policy documents, and other useful information for discussions during the meetings with stakeholders. The working group discussed the measures in the context the barriers were addressed, grouping by the same criteria as barriers. The problems were reformulating into positive statements of future situation, arranging measures and results into **Objective tree** as logically organised presentation of objectives. The Objective tree of this and other technologies are presented in the Annex I.

The measures were assessed according to their economic profile and incentives used. HEV technology has been supported by the study of policy enabling environment. Developed **Policy Fact Sheet (PFS) referred** to this technology is presented in the Annex II According to the investigations done by experts the implementation of the technology falls under the jurisdiction of several laws promoting energy efficiency and CO2 reduction:

- Low Emissions Development Strategy to the Year 2020[50];
- Land Transport Infrastructure Strategy[51]
- Law on Energy Efficiency[52]
- Moldova 2020: National Development Strategy[53]

Working groups has considered that the highest impact with direct effect on technology implementation has Land Transport Infrastructure Strategy and Law on Energy Efficiency. The related regulatory acts complement the main law, contributing to a policy and regulatory path for implementing the technology.

The experts have undertaken a ***cost-effective analysis*** of the political path supported by the specific law that shall ensure the successful implementation of the technology and obtaining the best financial results. The scenario includes long-term operation of HEV that lead to fuel savings and other beneficial for vehicle owner. This technology is aimed

[50] Low Emissions Development Strategy to the Year 2020. Draft
[51] Land Transport Infrastructure Strategy. http://lex.justice.md/
[52] Law on Energy Efficiency. http://lex.justice.md/
[53] Moldova 2020: National Development Strategy. http://lex.justice.md/

to reduce fuel consumption by 8 thousand tons of fuel and more than 26 thousand tons of CO2 per year, equivalent to 1.8% of GHG emission reduction target established for Energy sector by 2020, according to SNC High Alternative Scenario or 8.8% of SNC IAS.

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.

The table below provides a summary of the measures identified.

Table 1.4.3-1. Identified measures to overcome barriers to technology transfer for HEV technology.

Barriers identified	Measures identified to overcome the barriers
Economic and financial	- Use of economic instruments to incentivise use of cleaner cars - To support HEV from Energy Efficiency Fund - To encourage use the EBRD Fund for energy Efficiency in Moldova (MoSEFF II)
Policy, legal and regulatory	- Remove profitability constrains set in the transport tariff methodology - To develop and approve low emission development strategy in the transport sector - Implementation of market based instruments, emission limits and technology standards, emission trading or emission credits
Institutional capacity	- To increase Energy Efficiency Agency capacity to promote more successfully HEV
Information and awareness	- To enlarge the forms of information on HEV advantages: best practices in transport planning and clean technology implementation in other countries - More commitment towards improving environmental performance of vehicle fleet management

Table 1.4.3-2. Categories of measures and incentives for HEV technology.

No	Financial measures and responsible entity	Non-financial measures and responsible entity and responsible entity	Complementary measures and responsible entity	Incentives and responsible entity
1		Remove profitability constrains set in the transport tariff methodology (MT)	To increase Energy Efficiency Agency capacity to promote more successfully HEV (ME)	Use of economic instruments to incentivise use of cleaner cars (ME)
2			To enlarge the forms of information on HEV advantages (EEA)	To support HEV implementation from Energy Efficiency Fund (EEA)
3			To develop and approve low emission development strategy in the transport sector (MT)	To encourage use the EBRD Fund for energy Efficiency in Moldova (MoSEFF II) (EEA)
4.			Implementation of market based instruments, emission limits and technology standards, emission trading or emission credits (MEn, EEA)	

Table 1.4.3-3. Final List of measures to overcome technology barriers for HEV technology

No.	Measures
1.	Use of economic instruments to incentivise use of cleaner cars
2.	To support HEV implementation from Energy Efficiency Fund
3.	To encourage use the EBRD Fund for energy Efficiency in Moldova (MoSEFF II)
4.	Remove profitability constrains set in the transport tariff methodology
5.	To increase Energy Efficiency Agency capacity to promote more successfully HEV
6.	To enlarge the forms of information on HEV advantages
7.	To develop and approve low emission development strategy in the transport sector
8.	Implementation of market based instruments, emission limits and technology standards, emission trading or emission credits
9.	To undertake more commitment towards improving environmental performance of vehicle fleet management

1.4.3.1 Economic and Financial

1.4.3.1.1 Use economic instruments to incentivise 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.

1.4.3.2 Policy and Regulatory

1.4.3.2.1 Remove profitability constraints 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%.

1.4.3.2.2 Elaborate and implement a low emission development strategy in the transport sector

The lack of a strategic program with clear objectives for a low emission development of the transport sector is incongruous against the over-arching GHG emissions targets embraced by the country. As such, the Ministry of Transport and Road Infrastructure, in collaboration with other governmental institutions and the academic environment, should mobilize the necessary resources to develop such a policy document in the near future, while also ensuring that public consultations are followed through.

1.4.3.2.3 Create 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.

1.4.3.3 Institutional and Informational

1.4.3.3.1 Increase awareness about vehicle environmental impact by enforcing technical standards

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.

1.4.3.3.2 Strengthen institutional capacity in the transport sector

The lack of vehicle efficiency standards and urban planning capacity are clear barriers to the adoption of cleaner technologies in the transport sector of Moldova. In this context, sharing of best practices in transport planning and clean technology implementation in other countries will be of great assistance to public authorities in Moldova. Greater financial support should also be targeted to accelerate development of efficiency standards and low emission strategies in the transport sector.

1.5 Linkages of the Barriers Identified

During the barrier analysis, it has become clear that many of the challenges identified are shared by all three selected technologies in the energy sector. A joined up view of these barriers is useful as it puts their root causes in greater perspective, and provides an opportunity to review the recommended measures so as to link them for an optimised effect.

In order to understand the core problems in technology transfer, the working group has performed **Logical Problem Analysis (LPA)**. The LPA diagrams were elaborated by experts in consultation with stakeholders. The cause/effects relations were organised in **Problem tree**, having the main problem put as starter problem and causes and effects identified and analysed. Using LPA the working groups was able to bring together the key elements of problems, use logical analysis of inter-related elements, and identify linkages between problem elements. Thus, the problem trees were used for understanding the casual relations of barriers, their linkages.

Problem Tree of considered technology is provided in the Annex I.

1.5.1 Economic and Financing

The R. of Moldova is considered the poorest country in the Europe[54]. The population capacity to pay for electricity, heat ant transport service is very low. Therefore, common barrier for all three energy technologies is the scarcity of money. All three energy improvement technologies require "up-front" investment, that increase much price for electricity, heat and transport services.

Even some local investors are able to invest in energy sector, their financial capacity is too low to enter into a promotion of medium or large energy projects oriented to mitigate climate change, particularly with long-term returns. Currently in Moldova private banks are not willing to invest in environmental technologies mainly because they are concerned about the risk-adjusted financial return. There are no incentives that would stimulate capital investment in such technologies. Many investors are not convinced, that climate change technologies is a good investment. Unfortunately Government also is not investing nor has little implication in such type of financing that contributes to the undeveloped market.

1.5.2 Policy and regulations

In the whole, the policy and regulatory framework in Moldova is supportive to implementation of energy efficient technologies, while in reality they are not in force or has little effect.

Energy Strategy up to 2020 in effect, the draft of Energy Strategy up to 2030, Law on Renewables and Energy Efficiency Law are in favor to implement broadly cogeneration PPs and renewables. But there is no one second regulation that would regulate price for new built CHP. As to the tariff for renewable electricity the "Methodology for the determination, approval and application of tariffs for electricity produced from renewable energy sources and bio-fuel" in effect leave to Regulator the right to establish a tariff based of west benchmark (art. 14 of the Methodology) after the plant is built, i.e. the investor do not know before begin to build a renewable power plant the tariff for energy this source will produce.

An addition common barrier for all energy technologies considered is lack of shared social responsibility for environment. There is no secondary regulatory framework that would regulate the incentive to decrease GHG emissions.

1.5.3 Provision of Information and Education

It was mentioned, that local government representatives, local private service providers and transport companies cannot make good decisions about the implementation of energy efficient technologies due to lack of appropriate information about these technologies, their beneficial impact on fuel consumption, price energy and services provided, etc. Respective institutions and agencies do not transit the information to users, thus create relationship between information and institutional barriers.

[54] http://voices.yahoo.com/the-poorest-country-europe-discovered-10996310.html

In Moldova the information about successful projects in energy efficiency is not disseminated properly yet, the replications of successful ideas need be developed more. Lack of information interrelates with little market transparency.

1.6 Enabling Framework for Overcoming the Barriers in the Energy Sector

While the previous sections have focused on providing an over-arching view of barriers specific to each of the selected technologies in the energy sector, this chapter will use the information obtained – including on the linkages of identified barriers – to suggest an enabling framework that will support technology diffusion in the sector as a whole.

Enabling environment was analysed as part of Market mapping technique.

Proposed energy technologies aim to be implemented at the national level starting with pilot projects with following replication. For this reason the enabling environment analysis of each technology considers regulatory, financial, economic, other components. A particular attention was given to enabling policy environment for commitment to environment requirements at the local as well as national governments.

Components and their constituents of enabling environment with commentary for each of it, service providers and provided services of each Energy sector technologies, i.e. ICE CHP, G-MSW and HEV, are analysed in the Tables 1.6-1, 1.6-2, 1.6-3, 1.6-4, 1.6-5 and 1.6-6 below. They have been analysed in a more aggregated and conceptual version into the Market Map provided in the Annex I.

Table 1.6-1. Enabling business environment for ICE CHP technology

No	Enabling environment	Comments	Supported entities
1	Tariff calculation Framework	In order ICE CHP be feasible Regulated tariffs for distributed CHP should be developed and published, if electricity and heat are destined for public needs.	ANRE
2	Protection of foreign investments	The existing in Moldova legal framework permit foreign investors to invest in the R. of Moldova without significant risks[55].	ME
3	Energy Efficiency Fund Regulation	The Regulation ensures a transparent allocation of financial means for the best energy efficiency projects entered into the bid. The future ICE CHP investors should apply to the Fund	EEA, future ICE CHP investors
4	Energy Community Framework	Moldova is a full member of Energy Community and that permit to assure the investors the country will follow EU acquis.	ME
5	BERD Energy efficiency	MoSEFF Project launched for Moldova by EBRD permit	EBRD

[55] Law on the entrepreneur's investments activity protection. http://lex.justice.md/?search=true

	Programs	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.	
6	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 ICE CHP imported installations	ME
7	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. ICE CHP Project should be included in LEDS as NAMA	MEn
8	Power Market liberalization starting with 2013	Liberalised market may favour not regulated ICE CHP excess electricity be sold on the market, making PP more feasible economically.	ANRE
9	PPs connection to the grid Favorable framework	Additional amendments required by Energy Community has be introduced in the new draft of Electricity Act, in order to make new PPs access to the grid more favourable	ME
10	650 MW of CHP should be built by 2020	This target encourage the investments into distribution ICE CHP	ME

Table 1.6-2. Service providers and services provision of ICE CHP technology.

No.	Service providers	Services provided
1.	Ministry of Economy (ME)	1. Ensures foreign technical assistance for: a) identifying the best practices of ICE CHP; b) economic, financial, technical and other aspect consultancy on technology implementation 2. Supports EEA in increasing their capacity, including of Energy Efficiency Fund 3. At the request of Foreign Investors Association supports promoting reasonable legal modifications in order to have successful technologies implementation and operation 4. Strengthen the regional and ministerial business consultancy centres for private and municipality energy efficient technologies investors
2.	Energy Efficiency Agency (EEA)	1. Establish the framework for mandatory energy audits in order to identify the sites and best ways of technologies implementation Largely disseminates the information on best energy efficient technologies
3.	Local public administration	Participates in the coordination of ICE CHP (for city householders) technologies implementation
4.	National Agency for Energy Regulation (ANRE)	Assures a regulatory framework for ICE CHP and G-MSW on electricity and heat market
5	Donors' Technical Assistance	Contributes to: a) identifying the best practices of ICE CHP; b) economic, financial, technical and other aspect consultancy on technology implementation
6	Energy Audit Entities	Identifies the sites, reasonability and best ways of technologies implementation
7	CHP O&M Service	Provides O&M services to CHP at the request, in such way O&M costs are becoming

	companies	less.
8	Mass Media	Ensures the dissemination of best energy efficiency and environmentally friendly technologies
9	Power System Operator	Realises the transport of electricity produced by ICE CHP to customers based on load curve negotiated between generator and consumers.
10	Business advisory services, including legal	Provides the consulting on how to overcome any business and legal issues in the process of initiating, construction and operating of PP, taking into consideration local business environment
11	Banks, Ministry of Finance	Proposes Loans with low interest rates and longer grace period for energy efficient projects
12	CHP design entities	Provides the design services for investors in CHP
13	Electricity and Heat Grid	Ensures the distribution of electricity and heat to customers
14	Natural Gas Supplier	Provides natural gas to CHP according to the regulations and tariffs approved by ANRE

Table 1.6-3. Enabling business environment for G-MSW technology

No	Enabling environment	Comments	Supported entities
1	Tariff calculation Framework	In order G-MSW be feasible Feed-in tariffs for renewable electricity should be developed and published	ANRE
2	Protection of foreign investments	The existing in Moldova legal framework permit foreign investors to invest in the R. of Moldova without significant risks[56].	ME
3	Energy Efficiency Fund Regulation	The Regulation ensures a transparent allocation of financial means for the best energy efficiency projects entered into the bid. The future G-MSW investors should apply to the Fund	EEA, future ICE CHP investors
	Energy Strategy: 10% renewable electricity by 2020	The target encourage to build G-MSW	ME, G-MSW PP investors
	Renewable Energy Law	Establishes the fundamental legal framework on renewable sources promotion	ME
	Population against waste landfills	There are a lot of protests from the village Tantareni against stoking Chisinau city wastes into landfill located to village living area. That enforce G-MSW PP building as soon as possible	Municipality Chisinau
	Possible external funding schemes	For Chisinau G-MSW PP construction around of 126 million US$ are needed, the sum that could be allocated through external funding schemes, including Donors participation	Municipality Chisinau
4	Energy Community Framework	Moldova is a full member of Energy Community and that permit to assure the investors the country will follow EU acquis.	ME

[56] Law on the entrepreneur's investments activity protection. http://lex.justice.md/?search=true

5	BERD Energy efficiency Programs	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. G-MSW PP investor is eligible for 2 million loan, the total investment in this technology is much higher than the limited sum.	EBRD
6	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 G-MSW PP imported installations too	ME
7	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. G-MSW Project should be included in LEDS as NAMA	MEn
8	Power Market liberalization starting with 2013	G-MSW PP is planned to be regulated and all the electricity generated by it will be sold on the electricity market as mandatory.	ANRE
9	PPs connection to the grid Favorable framework	Additional amendments required by Energy Community has be introduced in the new draft of Electricity Act, in order to make new PPs access to the grid more favourable	ME
10	400MW of renewable power capacity should be built by 2020	This target encourage the investments into G-MSW	ME

Table 1.6-4. Service providers and services provision of G-MSW technology.

No	Service providers	Services provided
1.	Ministry of Environment (MEn)	1. Ensures foreign technical assistance for: a) identifying the best practices of G-MSW; b) economic, financial, technical and other aspect consultancy on technology implementation 2. Supports EEA in increasing their capacity, including of Energy Efficiency Fund 3. At the request of Foreign Investors Association supports promoting reasonable legal modifications in order to have successful technologies implementation and operation 4. Strengthen the regional and ministerial business consultancy centres for private and municipality energy efficient technologies investors
2.	Energy Efficiency Agency (EEA)	Largely disseminates the information on best G-MSW technologies
3.	Local public administration	Participates in the coordination and implementation of G-MSW PP
4.	National Agency for Energy Regulation (ANRE)	Assures a regulatory framework for G-MSW PP at renewable electricity market
5	Donors' Technical Assistance	Contributes to: a) identifying the best practices of G-MSW; b) economic, financial, technical and other aspect consultancy on technology implementation
7	G-MSW O&M Service companies	Provides O&M services to G-MSW PP at the request, in such way O&M costs are becoming less.
8	Mass Media	Ensures the dissemination of best energy efficiency and environmentally friendly

		technologies, including G-MSW
9	Power System Operator	Operates the electricity produced by G-MSW in the power system based on load curve declared.
10	Business advisory services, including legal	Provides the consulting on how to overcome any business and legal issues in the process of initiating, construction and operating of PP, taking into consideration local business environment
11	Banks, Ministry of Finance	Proposes Loans with low interest rates and longer grace period for energy efficient projects
12	G-MSW design entities	Provides the design services for investors in G-MSW PP
13	Electricity and Heat Grid	Ensures the distribution of electricity and heat to customers

Table 1.6-5. Enabling business environment for HEV technology

No	Enabling environment	Comments	Supported entities
1	Methodology for the calculation and regulation of tariffs and services provided by the passenger transport companies[57]	The modification of the Methodology in order to stimulate HEV implementation	MTRI
2	Protection of foreign investments	The existing in Moldova legal framework permit foreign investors to invest in the R. of Moldova without significant risks[58].	ME
3	Energy Efficiency Fund Regulation	The Regulation ensures a transparent allocation of financial means for the best energy efficiency projects entered into the bid. The future HEV investors should apply to the Fund	EEA, future HEV investors
4	Moldova 2020: To reduce Energy Intensity by 10% (2020)	The target encourage to implement HEV	MTRI, HEV investors
5	Possible external funding schemes	For Chisinau G-MSW PP construction around of 250 million US$ are needed, the sum that could be allocated through external funding schemes, including Donors participation	MTRI
6	BERD Energy efficiency Programs	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. HEV investors are eligible for 2 million loan, the total investment in this technology is much higher than the limited sum.	EBRD
7	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 HEVs imported as they provide important fuel savings	ME

[57] GD no 1167 from 29.10.2007. Official Monitor no 171-174 from 02.11.2007. http://lex.justice.md/?search=true

[58] Law on the entrepreneur's investments activity protection. http://lex.justice.md/?search=true

8	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. HEV Project should be included in LEDS as NAMA	MEn
9	Liberalized fuel and technology market	Ensures transparent and competitive prices for fuel and energy efficient technologies, including determined prices for HEV technology	MTRI
10	Regulated rate of return on vehicle fuel prices	ANRE has established a limited 10% profit for care fuels. Because of keen competition the real profit do not exceed 2% of the total fuel sales. These ensures not over dimensioned prices for fuels.	ANRE
11	Increasing recognition by authorities of transport pollution issues	Because of increasing road traffic the authorities are in favour to support energy efficient vehicles.	MTRI

Table 1.6-6. Service providers and services provision of HEV technology

No	Service providers	Services provided
1	Ministry of Transport and Road Infrastructure	1. Ensures foreign technical assistance for economic, financial, technical and other aspect consultancy on technology implementation 2. Supports EEA in increasing their capacity, including of Energy Efficiency Fund 3. At the request of Foreign Investors Association supports promoting reasonable legal modifications in order to have successful HEV technologies implementation 4. Strengthen the regional and ministerial business consultancy centres for private and municipality HEV technologies investors
2	Energy Efficiency Agency (EEA)	Largely disseminates the information on HEV technologies
3	Local public administration	Participates in the coordination and implementation of HEV
4	Donors' Technical Assistance	Contributes to: a) identifying the best HEV options; b) economic, financial, technical and other aspect consultancy on technology implementation
5	Vehicles reparation and spare parts companies	Provides reparation and spare parts services. Because some parts of HEV are new in the country the appropriate actions should be undertaken by MTRI to prevent their lack at the stage of HEV penetration in the country
6	Mass Media, NGOs	Ensures the dissemination of best energy efficiency and environmentally friendly technologies, including HEV
7	Business advisory services, including legal	Provides the consulting on how to overcome any business and legal issues in the process of HEV promoting, taking into consideration local business environment
8	International Investments Banks, Fund, etc.	Proposes Loans with low interest rates and longer grace period for energy efficient projects, including HEV
9	Feasibility studies providers	Provides the prefeasibility studies the HEV investor before launch the business
10	Awareness and staff training services	Provides training for HEV drivers. The lasts will need to be familiar with their car in order to ensure its efficient exploitation.
11	Insurance services	Car insurance is a mandatory in R. of Moldova. This service reduces the transport company's costs for car reparation.
12	National Institute for Standardization and Metrology	Provides homologation of HEV technology as the law requires.

2 AGRICULTURAL SECTOR

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;
- Mini tillage, with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer;
- Classic tillage, using a vetch field with two yearly yields (autumn and spring) as a „green fertilizer field".

These technologies were subject to barrier analysis and enabling framework during the second phase of TNA Project. Due to the reason that barrier analysis of a particular technology is an investigation work performed mainly by experts in consultancy with stakeholders' representatives monitored by the team leader, the TNA Committee has decided to organise this process within working group. The Mitigation working group has met in several working meetings and has an intensive electronic correspondence, many individual meetings between experts and team leader. After discussing technologies characteristics, the working group has categorized them as *consumer good* despite the circumstances that the Government can influence the adoption of these practices through various ways, which classifies it as one of the main actor of the market chain of these technologies, as in case of public goods. It was considered, that the development of "green market" and access to sustainable practices in Moldova have to be largely diffused and available for large number of market players, including private business from private market actors, NGOs, research institutions, etc. This approach will promote rural entrepreneurship and economic diversification.

The technologies examined will contribute to fulfilment of Moldova GHG emissions reduction targets the country undertaken in the frame of UNFCCC Copenhagen Accord. These targets correspond to those reflected in the Second National Communication under UNFCCC and presented in the Table below.

Table 2-1. Moldova Agriculture GHG emission reduction target according to SNC HAS

Sector		**2015**	**2020**
Agriculture	BLS	3158	3728
	HAS	2996	3405
GHG emission redaction target		**162**	**323**

2.1 Preliminary targets

Arable agriculture in Moldova mostly uses conventional land and crop management technology, such as ploughing the soil, several subsequent cultivations and crop establishment with seed drills. While such techniques have worked, they are no longer sustainable due to the negative impact they have had on the soil quality. Apart from soil erosion, loss of organic matter, soil compaction and other damaging effects caused, wide-spread conventional agriculture is also not in line with Moldova's trajectory towards a low-carbon development. With this in mind, the Program for Soil Fertility Conservation and Enhancement 2011-2020[59] highlights reduction of GHG emissions in agriculture through sustainable

[59] http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=339882

agricultural works, including optimized crop structure and reduction of tillage, as one of its primary objectives. Furthermore, the Second National Communication[60] 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 described further below 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. For all of them more specific preliminary targets are as follow:

- Creating prerequisites for implementing sustainable agriculture practices on an area of 200,000 ha by introducing a "field of vetch as green manure (2 yields per year)" in a 5 field crop rotation.
- Improving the soil quality on an area of 200,000 ha, 20 thousand ha annually, by creating a positive balance of humus and carbon, and nitrogen fixation in soil as a result of systemic use of green fertilizer (autumn vetch of *Violeta* variety and spring vetch of *Moldavscaia 82* variety) on an area of 200,000 ha of arable lands.
- Restore the ecological balance in the existing agricultural systems on an area of 200,000 ha by reducing practically total CO2 and N2O emissions from soils as a result of biological fixation of carbon and nitrogen by the leguminous crop used as green fertilizer.
- Increase production capacity of the soils on an area of 200,000 ha as a result of improving physical, chemical and biological characteristics of degraded soils, as a result of systemic use of green fertilizer.

In order to determine economic, financial and GHG emission reduction characteristics of the technologies considered an appropriate Excel model was elaborated (see Annex III). Based on the results obtained the following CO2 emission reduction will be achieved by 2015 and 2020 if the technologies are implemented at the magnitude described above:

Table 2.1-1. Contribution of No-till, Mini-till and Classic tillage with vetch 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 No-till, Mini-till and Classic tillage with vetch in reaching GNG emission reduction targets	th tCO2	**28.4**	**540.4**
	% from target	**17.5**	**167.1**

[60] www.clima.md

As it is seen from the Table 2.1-1 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.

TNA Project provides a great opportunity for The Republic of Moldova to perform country-driven barriers analysis to transfer and diffusion of abovementioned technologies and combine sustainable practices with mitigation measures to climate change

2.2 Barrier Analysis and Possible Enabling Measures

2.2.1 General Description

2.2.1.1 No tillage, with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer

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.

2.2.1.2 Mini tillage, with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer

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.

2.2.1.3 Classic tillage, using a vetch field with two yearly yields (autumn and spring) as a „green fertilizer field”

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.

2.2.1.4 Identification of Barriers

The difference between three examined technologies is in the type of tillage used: no tillage, mini tillage and classic tillage, but the core element that make them equivalent is vetch as green fertiliser applied, using the same 5-field crop rotation. I.e. the three selected technologies in agriculture share the same challenges. This permitted the barrier analysis be conducted using a joint view on technologies, which has also helped identify barrier linkages as part of the analysis process. As such, the chapters below have been formulated in a way that unifies cross-cutting issues in a consolidated description that remains relevant to each of the three technologies. The analysis provided is the product of several consultations between the stakeholders, which started with an initial discussion of the market map across all the three dimensions – enabling framework, market participants and service providers. The market map continued to be refined during subsequent consultations, which has also helped ironing out the final list of applicable barriers.

The Mitigation working group (experts and consultants) has considered the technology market characteristics and classified all three technologies above as *consumer goods* due to a a high number of potential consumers; interaction with existing markets and requiring distribution, maintenance and installer networks in the supply chain; large and complicated supply chains with many actors, including producers, assemblers, importers, wholesalers, retailers and end consumers; barriers may exist in all steps in the supply chain; demand depends on consumer awareness and preferences. The identification of barriers has done in a stepwise manner, based on methodological approaches from above mentioned guides. The working group has identified the barriers to promote abovementioned technologies, put efforts to understand why despite the advantages the farmers rarely apply sustainable agricultural practices in Moldova.

The working group has used **Market Mapping techniques** as a tool of barriers identification and analysis of challenges the farmers have to overcome to ensure a soil conservation system. The working group has identified a significant number of barriers that impede this scope be achieved, decomposed them and made specific for each main market actor. This step was followed by screening of barriers according to their significance to technology transfer and their ranking based on 1-5 scale. A close work with stakeholders' representatives was done in order to reach common agreement on significance of a particular barrier. After the comprehensive understanding achieved, the experts came up with the List of key barriers that represent the list of essential barriers after non-essential being removed.

Another tool used in the barriers analysis by working group was **Logical Problem Analysis (LPA**) for analysing casual relations and core problems in technology transfer. The participants have arranged the problems into hierarchy of causes and effects having as central starting problem a generic problem for technology transfer. **The LPA Problem Tree** emphasised the main links between causes and effects and organised them into logical inter-relations, addressed the basic issues and highlighted linkages with external factors. On the Problem Tree diagram the causes are shown below the starter problem and effects above. The LPA Problem Tree for this and other considered technologies are included in the Annex I.

The results of barriers identification exercise are provided in the tables of this sub-chapter.

Table 2.2.2-1. Long List of Barriers to technology transfer for Agriculture technologies.

Actors on the market	Identified barriers		
	Wide categories of barriers	**Barriers within the category**	**Barrier elements**
Ministry of Agriculture and Food Industry	Economic and financial	Lack of financial possibility to create a fund for stimulation of agricultural businesses which use green fertilizer	- There are no resources to create the fund because of low profitability of agriculture
	Market failures and Imperfection	Undeveloped market	- Price distortions and dysfunctional value chain. The absence of market price for environmental benefits from soil improvement works.
		Low performance due to land fragmentation	- Land ownership in Moldova is highly polarized, with few large corporate farms and many small and fragmented family farms
		Inadequate road access	- Insufficient investments in Moldova's road infrastructure have resulted in the deterioration of existing roads but also in a limited expansion of the national road coverage
	Legal	Unconditional terms of leasing agricultural lands	- Lack in the Land Code of provisions about the leasor's responsibility for the quality of the leased soil, in the chapter on lease of agricultural lands
		Lack of seeds	- Local seed producers are not protected

Actors on the market	Identified barriers		
	Wide categories of barriers	**Barriers within the category**	**Barrier elements**
Ministry of Agriculture and Food Industry	Regulatory	Excessive fragmentation of land	- The process of agricultural lands consolidation is too slow
	Network Failures	Low stakeholder cooperation	- Extremely large number of agricultural businesses, dominance of subsistence rather than market agriculture.
		Lack of cooperation along the value chain	- Lack of trust among industry players due to delays in payments and in honouring obligations
	Human Skills	Under-developed educational and research institutions	- The number and quality of professional qualifications held by the rural population continues to decline. - Exodus of population - The existing educational and research system is not adequate
		Skills loss due to exodus of population	- Young agricultural entrepreneurs who could become industry leaders through the promotion of modern technologies and strategies are missing. - No clear strategy for how to deal with the labour shortage and how to support farmers and other businesses in this process
	Social, Cultural and Behavioural	Resistance to change	- Strong reliance on traditional cultivation techniques - Accustomed to fields free of stubble and residue - Accustomed use agro-chemicals, not herbicides
		Choices determined by short-term priorities	"Food security at any cost"
	Institutional and organizational capacity	Lack of expertise in organizing and promoting market agriculture.	- Insufficient training of specialists in the domain.
	Information and Awareness	Insufficient advisory services	- National Agency for Rural Development (ACSA) lacks financing - Agriculture sustainability is seen as low priority
		Lack of a centralized system on soil quality	- Complete and Strategic legal framework governing land management in the country cannot be elaborated
		High risk perception of technology	- Long term benefit is a concern versus small term

Actors on the market	Identified barriers		
	Wide categories of barriers	**Barriers within the category**	**Barrier elements**
	Technical	Weak institutional and organizational capacity of the government, professionals and businesses in agriculture, lack of standards and codes, poor quality products, lack of operation and maintenance, inadequate laboratory facilities.	- Poor performance in standardization of agricultural products, poor quality control of agricultural products. - Access to soil and other testing facilities is limited
Local public administration	Regulatory	Lack of legislation that would require the local public administration to be accountable for the soils condition.	- The Regulations on municipality activity does not feature the obligation for maintaining soil quality.
		Lack of interest from the mayors in promoting green technologies.	- The promotion of green technologies is not a mandatory and staffed
	Information and awareness	Lack of skilled local agricultural specialists.	- Lack of local extension centres.
Agriculture Private enterprises	Economic and financial	1. Inadequate pricing of agricultural products and equipment 2. High operation costs 3. Reduced availability of financial resources 4. High cost of financing	Lack of policies protecting and supporting domestic producers.
	Policy, Legal	Lack of economic incentives	- No support through Program for Soil Conservation 2011-2020 - Starting with 2012 subventions for the purchase of pesticides and fertilizers have been removed from the annual program of subventions by the state - VAT increase from 8% to 20% for agriculture products
	Human skills	Lack of interest from businesses for improving the quality of the soil.	- There is no mechanism to assess the soil quality before and after lease.
		Inadequate business management skills	- Managers of corporate farms have insufficient knowledge in areas of corporate administration, demand forecast, financial management, procurement and marketing
	Information and awareness	Insufficient knowledge among agricultural businesses	- Lack of training centres for agricultural enterprises staff
		Poor knowledge among rural population about the significance of soils in sustainable agriculture.	- Lack of locale extension centres

Because all three technologies considered in the Agriculture sector refer to soil practices, and they differ by the machinery applied and methods of soil tillage only, generic barriers have common elements and that permit to consider explanatory details of barriers to one technology, they being applied to other two ones as well.

2.2.2.1. Economic and Financial

The crucial element that determines the success of any project promotion is the assurance the project is financially feasible. In order to identify the economic-financial characteristics of HEV technology two models in Excel format was developed: one for No-till&Mini-till soil cultivation systems with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer and, another model - for Classic tillage, including a vetch field, as a „green fertilizer field" into a 5-fields crop rotation. The details are presented in the Annex III.

A. Economic- financial analysis of No- till and Mini-till soil cultivation systems with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer

Due to the fact that No-till and Mini-till soil cultivation systems practically have the same economic-financial features, the analysis is done for No-till technology only. As input data, those reflected in the appropriate TFSs have been used along with the specific technical and economic data of soil processing available from Moldova specialized agriculture enterprise SC "Pashcani Technological and Experimental Station"

A total of 200 000 hectares of agricultural soils will be allocated to be used per each of abovementioned technologies, annually 20 000 new agriculture surface being attracted in this process. The model elaborated takes into consideration that in the first year 1/5 of the area, i.e. 4000 he, is sown with vetch seed and this area ensure a higher harvest only in the second and the following years. Other four fields are sown with the following grains, respectively: Maize, Winter wheat, Peas, Sunflower. In the third year 2/5 of the area, i.e. 8000 he, is sown with vetch seed, etc. Other four areas in the first year, three area in the second year, two areas in the third year, etc., are distinguished by lower harvest, corresponded to one grown on the area where classic tillage is applied. After five years a new rotation will follow. This aspect is shown in the Annex III where input data for calculations is presented as well.

During 10 years, each year, a sum of 2,4 million Euro investments should be spent to implement No-till technology on the area of 20 000 hectares. The same sum and the same area – should be involved to implement Mini-till technology. Operating costs for one technology start with 5,5 million in the first year for 20 000 hectares and reach 54,8 million Euro in the Year 10 for 200 000 hectares. Benefits calculated showed that this business is quite profitable. Less than two years are needed to return the investments made. Payback period would be even less if CO2 reduction is sold on carbon market. In the second year 10 160 tCO2 reduction will be recorded, it increasing up to 406 400 tCO2 in the Year 10. The same figures correspond to Mini-till technology.

B. Economic- financial analysis of Classic tillage, including a vetch field (two yields per year – autumn and spring), as a „green fertilizer field" into a 5-fields crop rotation

As input data for the Excel model developed, those reflected in the appropriate TFS from Report I have been used along with the specific technical and economic data of soil processing available from Moldova specialized agriculture enterprise SC "Pashcani Technological and Experimental Station"

A total of 200 000 hectares of agricultural soils will be allocated to be used per this technology, annually 20 000 new agriculture surface being attracted in this process. The model take into consideration that in the first year 1/5 of the area, i.e. 4000 he, is sown with vetch seed and this area ensure a higher harvest only in the second and the following years. Other four fields are sown with the following grains, respectively: Maize, Winter wheat, Peas, Sunflower. In the third year 2/5 of the area, i.e. 8000 he, is sown with vetch seed, etc. Other four areas in the first year, three area in the second year, two areas in the third year, etc., are distinguished by lower harvest, corresponded to one grown on the

area where classic tillage without vetch field is applied. After five years a new rotation will follow. This aspect is shown in the Annex III where input data for calculations is presented as well.

During 10 years, each year, a sum of 3,4 million Euro investments should be spent to implement Classic tillage with vetch technology on the area of 20 000 hectares. Operating costs for one technology start with 6,6 million in the first year for 20 000 hectares and reach 65,9 million Euro in the Year 10 for 200 000 hectares. Benefits calculated showed that this business is one profitable. Less than three years are needed to return the investments made. Payback period would be even less if CO2 reduction is sold on carbon market. In the second year 8 120 tCO2 reduction will be recorded, it increasing up to 324 800 tCO2 in the Year 10.

Below the identified Economic and Financial barriers foreseen in the process of three Agricultural soil technologies implementation are described in more detailed manner

2.2.2.1.1. High up-front costs

High up-front costs are one of the major barriers to the implementation of conservative technologies in agriculture, particularly given the low profitability and relatively low revenues generated by businesses in the sector. High up-front costs are mostly driven by the cost of equipment (purchase or rent), but also by the crediting requirements for down-payment and collateral which are particularly onerous in Moldova. It is estimated that the minimum investment costs to implement the no-till technology on a farm land area of 400 hectares are of around USD 340,000, to implement mini-till on the same plot size – USD 92,000, and GFF classic tillage – USD 7,600 (the latter includes only costs of additional equipment required for GFF classic tillage).

2.2.2.1.2. High operation costs

Operation and maintenance costs associated with conservative technologies in agriculture are also high. Annual maintenance costs for the no-till, mini-till and GFF classic tillage technologies for an area of 400 ha are valued at USD225,000, USD154,000, and USD 68,000 respectively (the last number includes only additional costs required to implement GFF classic tillage).

2.2.2.1.3. Reduced availability of financial resources

Reduced availability of capital and inadequate access to affordable financing constitute one of the greatest barriers in the implementation of GHG emissions mitigation measures in the agricultural sector of the Republic of Moldova. State support in agriculture is provided in two ways – monetary subventions from the state budget, and non-monetary means (mostly to help mitigate the impact of natural calamities) – however, on balance, the extent of support is limited compared to that in other countries. As such, financing the implementation of conservative technologies in agriculture is expected to be in the full responsibility of economic agents operating in the sector.

The share of credits provided by local commercial banks to businesses in the agricultural sector has been low compared to other industries. Additionally, where loan schemes are offered by banks for investment projects in agriculture, their value is too small relative to the implementation costs of conservative technologies.

Generally, capital investments and foreign investments in the Moldovan agriculture have been very modest. In 2009, agriculture benefited from only 8.4% of capital investments, while foreign investments constituted only 1.5% of total investments in the sector.[61]

International financial institutions have recently increased their participation in agricultural projects, through the provision of grants, technical assistance, bank loan guarantees, and loans at lower interest rates. Effort so far has been particularly concentrated on projects aimed to improve the overall competitiveness of agricultural products, by developing and strengthening the sector's value chains and extending access to export markets. Although specific focus on emissions mitigation projects in agriculture has been growing, the impact from the implementation of such projects has predominantly remained localized due to limited financing. Improving soil fertility through a country-wide adoption of conservative technologies has not yet been thoroughly explored for potential donor assistance.

Furthermore, the expiry of the Kyoto Protocol at the end of 2012 implies that participation of private investors in CDM projects is likely to decline until a post-Kyoto framework is instituted. Clearly, the policy uncertainty around trading of emissions reduction certificates will affect investor willingness to develop new projects in particular.

2.2.2.1.4. High cost of financing

Access to credit in Moldova is expensive and difficult, and long-term loans for agriculture are scarce. Land, which is often the only valuable asset, is not accepted as collateral, and the collateral that is accepted is usually significantly undervalued.[62] The high interest rate on loans provided by local commercial banks reflect the country's risk rating, the cost recovery risks characteristic of investments in an agriculture that is highly vulnerable to weather changes, but also the margin applied by banks for operating credits provided by international funds.

2.2.2.2. Market Failure and Imperfection

2.2.2.2.1. Low performance due to land fragmentation

In order to achieve economies of scale and higher returns, conservative technologies in agriculture must be implemented on large plots of land. Land ownership in Moldova however 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. Land fragmentation also implies a smaller size of land individually owned by farmers (particularly in the Central and Southern parts of the country), which in turn results in a lower revenue generating potential that limits the affordability of new equipment.

[61] Stratan A., Moroz V., Ignat A., Country's Food Security Assurance: Urgent Measures and Sustainable Policies. ftp://www.ipe.ro/RePEc/iag/iag_pdf/AERD1102_163-170.pdf

[62] Value Chain Analysis and Market Study in the Fruit and Vegetable Sector in Moldova, Final Report: Analysis of HVA Constraints, Opportunities and Requirements, Millennium Challenge Corporation, 13 March 2009. http://s3.amazonaws.com/zanran_storage/moldova.usaid.gov/ContentPages/45224507.pdf

2.2.2.2.2. Price distortions and dysfunctional value chain

Market infrastructure in the agricultural sector in Moldova is under-developed which negatively affects business profitability in the sector. There is a high disequilibrium between the price of agricultural products sold by agricultural producers to merchants, and that at which products are sold to end users on local markets. This greatly diminishes the revenue generating potential of primary agriculture. Implementation of integrated vertical value chains in agriculture is practically absent. On one hand, this is explained by the economic risks associated with the high susceptibility of agricultural yield to climate phenomena. On the other, this has also been due to the lack of an over-arching marketing framework connecting agricultural producers, processors, sellers and consumers, which could help uncover strategic opportunities that would otherwise remain unknown and therefore untapped.

2.2.2.2.3. Inadequate road access

Insufficient investments in Moldova's road infrastructure have resulted in the deterioration of existing roads but also in a limited expansion of the national road coverage. As a consequence, it is not uncommon to see land areas located far away from rural settlements left as fallow ground due to lack of road access.

2.2.2.3. Policy, Legal and Regulatory

2.2.1.4.1 Lack of economic incentives

Without any financial incentives and support, economic agents in the agricultural sector in Moldova cannot afford the cost of equipment and herbicides required for conservative technologies. Yet, while the Program for Soil Conservation 2011-2020 provides that one of the key objectives in the agricultural sector is to stop soil degradation through soil conservation works, it is expected that works through the implementation of conservative technologies will be entirely financed by the economic agents in agriculture, with no support currently being allocated through the Program's action plan. Additionally, 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. Despite the proviso whereby agricultural producers will be able to claim partial VAT reimbursement within a period of 30 days, the cash-flow constraints faced by agricultural producers due to the seasonal character of agricultural works will make higher VAT payments extremely difficult, thereby putting even greater pressure on any capital reserves made for investment projects.

2.2.2.3.1. 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. Although the elaboration of the Program for promoting conservation agriculture was initially included in the Government's Plan of activities for the

year 2011, this has been delayed to be completed by end of 2012. Additionally, while the Medium-Term Expenditure Framework for 2012-2014 reflects the Program's elaboration as an activity to be funded, how the implementation-related expenditures will be covered is not clear, which creates the risk that policy execution will lag policy adoption.

2.2.2.3.2. Inadequate balance between land ownership rights and obligations

Although the land reform on the 90's has radically changed the structure of land ownership away from Soviet cooperatives, and has increased the number of participants in land relations, it did not also create the necessary conditions for ensuring a sustainable use of land. In the transition from a planned to a market economy, this can only be achieved through a national commitment to integrate agriculture policies within a wider national strategy for the protection of land, based on principles of environmental impact mitigation. However 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.

Furthermore, there is an incongruity between the civil rights and land legislations, both of which currently regulate land relations and land ownership. While the Civil Code establishes the freedom of actions over one's property, which can include deterioration, the land legislation does not provide for such freedom over the use of land as it views land as an immovable good of special purpose that besides having the title of private property is also a constituent part of the country's natural patrimony. As such, a land owner is responsible for ensuring that land resources are used in a rational manner and that soil fertility is maintained. However, due to the disjointed nature of the current legislation but also due to the limited institutional capacity of local authorities, this obligation is not fully enforced.

2.2.2.4. Network Failures

2.2.2.4.1. Low stakeholder cooperation

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. 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. This is a lot explained by the low efficiency levels of the institutional arrangements today, some of which are still reminiscent of the Soviet era. For example, the culture of participation involving the various stakeholders in the industry, including public authorities, is fragmented although there are signs of effort being made towards ensuring a more joined-up collaboration. Another explanation is that because the local innovation business is in its early stages and given the known financial limitations, the overall demand by the industry for state-of-the-art and innovative techniques and approaches have still not reached a critical mass.

2.2.2.4.2. Lack of cooperation along the value chain

Lack of cooperation among producers and processors is common in the agricultural production sector of Moldova. Although most recognize the need for a better collaboration, farmers find it difficult to join efforts that would help them source industry know-how, develop marketing strategies, acquire input materials etc.[63] Based on various studies carried out, the inaptness of the value chain is mostly explained by the lack of trust that exists among industry players due to delays in payments and in honouring obligations. This in turn attenuates the farmers' need to mobilize their efforts together.

2.2.2.5. Human Skills

2.2.2.5.1. 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 situation is explained by various factors, including the exodus of population which is discussed further below. However the lack of high-skilled labour force in the agro-industrial sector also suggests that the existing educational system is not aligned to the emerging needs in the industry. Generally, the prestige of agricultural professions has sharply diminished, with the number of graduates from agricultural specialties taking only a very small share of the total. Additionally, the lacklustre demand from prospective students has also led some agricultural colleges and vocational schools to reduce their activities, which in its turn creates a vicious circle that exacerbates the general trend.

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.

2.2.2.5.2. Inadequate business management skills

Most individual farmers have little business management experience and have had limited exposure to modern technologies that can be employed to increase the efficiency of land works and improve production processes in agriculture. Managers of corporate farms also have insufficient knowledge in areas such as corporate administration, demand forecast, financial management, procurement and marketing. Oftentimes, management activity is mostly driven by the need to meet production and sales targets, which are not necessarily always adjusted to real market demand both in terms of volume and diversity. Apart from giving the tools necessary to make sound operational decisions, business management knowledge is also useful to be able to take advantage of state subvention programs, as these typically require submission of viable business plans.

[63] Value Chain Analysis and Market Study in the Fruit and Vegetable Sector in Moldova, Final Report: Analysis of HVA Constraints, Opportunities and Requirements, Millennium Challenge Corporation, 13 March 2009.
http://s3.amazonaws.com/zanran_storage/moldova.usaid.gov/ContentPages/45224507.pdf

2.2.2.5.3. Skills loss due to exodus of population

The lack of labour opportunities in rural areas has led to a massive labour migration out of the countryside. Most of the migrating population have been young people, and specialists with medium and high level of education. As a result, young agricultural entrepreneurs who could become industry leaders through the promotion of modern technologies and strategies are missing. The resulting shortage of skilled and unskilled labour has forced farmers to cut back on the size of acreage farmed, and in some instances to abandon the areas altogether leaving the land fallow. There is currently no clear strategy for how to deal with the labour shortage and how to support farmers and other businesses in this process.

2.2.2.6. Social, Cultural and Behavioural

2.2.2.6.1. Resistance to change, lack of faith in technology

One of the major barriers to the implementation of GHG emissions mitigation measures in agriculture is resistance to change due to strong reliance on traditional cultivation techniques and sceptical appreciation of practices that defy the familiar. A small-scale project piloting the implementation of conservation tillage in Moldova some time ago exemplifies this best.[64] During the project, for example, local farmers showed resistance to the introduction of no-tillage practices because they had been accustomed to fields free of stubble and residue. Further reluctance was also caused by the negative association between the uses of herbicides in the proportion recommended by the project with the excessive use of agro-chemicals during the Soviet era, which had a harmful effect on overall soil fertility. Additionally, the conservation tillage machinery was viewed as too heavy and large, with doubts being raised as to whether it could create adequate seedbeds and avoid soil compaction.

2.2.2.6.2. Choices determined by short-term priorities

Another barrier to the implementation of sustainable policies in agriculture is the short-term survival decisions – such as "food security at any cost" – which cause environmental degradation through their lack of recognition of long-term effects. Subsistence production is another side-effect, with limited investments being made in an agricultural infrastructure that can otherwise achieve increase in yields without harming the quality of soil.

2.2.2.7. Information and Awareness

2.2.2.7.1. Inadequate sharing of project experience

Although several projects advancing the use of environmentally-friendly technologies – including conservative technologies - have been implemented with donor support, scaling up remains a challenge. Predominantly, the linkages created as a result of past project implementation have not been sufficiently capitalized and knowledge gained through project implementation has not been widely shared. In some cases for instance, land plots used in pilot

[64] Low Emissions Development Strategy of the Republic of Moldova to the Year 2020 (Draft) referencing the USAID Conservation Tillage Project. http://clima.md/lib.php?l=ro&idc=236&

projects have been left abandoned after project closure, mostly due to the limited resources available to agricultural households to cover the full maintenance costs.

2.2.2.7.2. Poor dissemination of information

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. As a result, the level of awareness of the local population about sustainable technologies in agriculture, their benefits and available financing opportunities, is generally low.

2.2.2.7.3. Insufficient advisory services in agriculture

Development of agricultural advisory services across the country has still a long way to go, especially in land management and agricultural sustainability, which are 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.

The National Agency for Rural Development (ACSA) – an advisory service system – was established in 2001 with assistance from the World Bank to provide support for increasing innovation and productivity on small and medium farms throughout Moldova. Continuity of ACSA's programs however is not without uncertainty as it is highly sensitive to the funding provided by the Government and the World Bank.

2.2.2.7.4. 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.

2.2.2.7.5. High risk perception of technology

Risk attitudes are another important barrier to the implementation of GHG emissions mitigation measures in agriculture. As mentioned before, long-term benefits from the implementation of sustainable technologies are highly discounted in favour of small-term concerns with ensuring adequate yields and volumes of production. As such, implementation of conservative technologies is viewed as a risk that can disrupt the familiar crop life-cycle, which is also highly susceptible to weather changes. Lack of information about and low awareness of the benefits that conservative technologies can bring, coupled with the known financial impediments, exacerbate the perception that implementation of such technologies comes at a high risk.

2.2.2.8. Technical

2.2.2.8.1. 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. Generally, soil monitoring activities are not carried out on a regular basis by the relevant institutions. Participation of laboratories in national and international inter-laboratory comparisons is limited, which additionally undermines the quality assurance roles. Also, the technical equipment used in the existing laboratories is generally obsolete. This further inhibits the ability to analyse various organic micro-polluters in water, air and soil.

2.2.2.8.2. Lack of special green fertilizer

While the technical equipment required for the implementation of conservative technologies can be rather easily obtained on the market, creating fields of vetch for subsequent use as green fertilizers will be more difficult. Yet, given the reduction of organic matter in soil as a result of soil degrading agricultural works, the use of vetch as green fertilizer will be a key success factor in the implementation of the selected conservative technologies.

Table 2.2.2-2. List of barriers for Agriculture sector's technologies transfer and hierarchy classification

No	Barriers identified	Rank (1-5)	Classification of the barriers
1	High up-front and operation costs	5	Economic and financial
2	Reduced availability of financial resources	5	Economic and financial
3	High cost of financing	4	Economic and financial
4	Low performance due to land fragmentation	5	Market failures and Imperfection
5	Price distortions and dysfunctional value chain	5	Market failures and Imperfection
6	Inadequate road access	3	Market failures and Imperfection
7	Lack of economic incentives	5	Policy, Legal and Regulatory
8	Slow implementation of programs promoting conservative agriculture	5	Policy, Legal and Regulatory
9	Inadequate balance between land ownership rights and obligations	4	Policy, Legal and Regulatory
10	Low stakeholder cooperation	5	Network Failures
11	Lack of cooperation along the value chain	3	Network Failures
12	Under-developed educational and research institutions	4	Human Skills
13	Inadequate business management skills	5	Human Skills
14	Skills loss due to exodus of population	4	Human Skills
15	Resistance to change, lack of faith in technology	5	Social, Cultural and Behavioural
16	Choices determined by short-term priorities	4	Social, Cultural and Behavioural
17	Inadequate sharing of project experience	4	Information and Awareness
18	Poor dissemination of information	5	Information and Awareness
19	Insufficient advisory services in agriculture	5	Information and Awareness
20.	Lack of a centralized system on soil quality	5	Information and Awareness
21.	High risk perception of technology	4	Information and Awareness
22.	Inadequate laboratory facilities	3	Technical
23.	Lack of special green fertilizer	4	Technical

Table 2.2.2-3. The List of Key Barrier to Agriculture technologies transfer

Key barriers identified	Classification of the barriers
High up-front and operation costs	Economic and financial
Reduced availability of financial resources	Economic and financial
Low performance due to land fragmentation	Market failures and Imperfection
Price distortions and dysfunctional value chain	Market failures and Imperfection
Lack of economic incentives	Policy, Legal and Regulatory
Slow implementation of programs promoting conservative agriculture	Policy, Legal and Regulatory
Low stakeholder cooperation	Network Failures
Inadequate business management skills	Human Skills
Poor dissemination of information	Information and Awareness
Insufficient advisory services in agriculture	Information and Awareness
Lack of a centralized system on soil quality	Information and Awareness

2.2.3. Identified Measures

The three selected technologies in agriculture share the same barriers, so it follows that the measures are also shared. **Logical Problem Analysis** was used as a tool to identify the measures to overcome the barriers.

The problems were reformulating into positive statements of future situation, arranging measures and results into **Objective tree** as logically organised presentation of objectives. The Objective tree of this and other technologies are presented in the Annex I.

The measures were assessed according to their economic profile and incentives used. The results are presented in the tables below.

Three technologies considered have been supported by the study of policy enabling environment. According to the investigations done by experts the implementation of the technology falls under the jurisdiction of several laws, among which the most important are:

- National Strategy for sustainable development of agro-industrial complex of the Republic of Moldova [65];
- Program for Soil Fertility Conservation and Enhancement 2011-2020[66].
- The Concept on the System of Subsidies Applied to Agricultural Producers 2008-2015[67].

Working groups has considered that the highest impact with direct effect on technology implementation has the national policy on soil conservation "Program for Soil Fertility Conservation and Enhancement 2011-2020". The related regulatory acts complement the main law, contributing to a policy and regulatory path for technology transfer.

This technologies scenario combined two purposes of vetch production: vetch plants as crop for seeds collection and as green fertilizer as its main purpose. The experts have provided cost-effective analysis based on 5 year crop rotation, which can be run repeatedly until soil quality improved. **Financial-economic analysis** of technology implementation

[65] National Strategy for sustainable development of agroindustrial complex of Republic of Moldova (2008-2015), www.maia.gov.md
[66] Program for Soil Fertility Conservation and Enhancement 2011-2020, www.maia.gov.md.
[67] The Concept on the System of Subsidies Applied to Agricultural Producers 2008-2015 www.maia.gov.md

under specified policy and regulatory acts for this technology along with developed **Policy Fact Sheet** of appropriate normative acts for three technology examined are provided in the Annex II.

By this virtue, the list of proposed measures can be used as the enabling framework necessary to support the transfer and diffusion of the selected conservative technologies.

The table below provides a summary of the measures identified:

Table 2.2.3-1. Categories of measures and incentives

No	Financial measures	Non-financial measures	Complementary measures	Incentives
1	Create a fund for stimulating agriculturall businesses to use green fertilizers, on the account of ecologic grants.	Provision in the Land Code of the chapter on the possibility of long-term land lease and the lessor's responsibility for protection of the soil quality.	Develop an agronomic advisory service within municipalities.	Develop a system of economic incentives at the state level for agricultural businesses which use green fertilizers.
2	Financial contribution of MAFI in reanimating the process of vetch seeds production on the basis of local varieties	Improving lease requirements in agriculture, raising agricultural land lessors' responsibility for maintaining soil quality in the farming process.	Organize permanent extension and training centers for the relevant specialists in this area besides research institutes and departments specialized in agricultural issues in universities and agricultural colleges, etc. Improve the national soil research system and create control service.	
3		Intensification by the Land Relationships and Cadastre Agency of land consolidation processes.	Building awareness of agricultural businesses about environment friendly agricultural practices by organizing thematic seminars during the cold season	Low interest loans and longer grace period

Table 2.2.3-2. Final List of measures to overcome technology barriers for Agriculture technologies considered

No.	Measures
1.	Developing a system of economic incentives for agricultural enterprises that use and promote green fertilizers.
2.	To reduce/to avoid taxes for profit for farmers investing in good agricultural practices, including procurement of equipment.
3.	To release subsides for farmers implementing climate technologies
4.	Increase accountability of farmers for long-term maintenance of soil quality
5.	Provisions of soil management responsibilities in the Law on the Land Code and in the Law of the Republic of Moldova on Environmental Protection.
6.	Cadastre Agency intensifying of land consolidation process
7.	Establish clear land management standards
8.	Improve R&D system in soil science.
9.	Assure an efficient coordination between main actors of organic and green fertilizers chain
10.	Promote Programmes for providing awareness raising campaigns, training and education on soil management.
11.	Make the agricultural businesses aware about the environmentally friendly practices.

2.2.3.1. Economic and Financial

2.2.3.1.1. Improve local crediting conditions

The high costs of equipment, fuel, herbicides and other fertilizers make conservative technologies unaffordable. The crediting schemes for implementing sustainable technologies in agriculture must be adjusted so they are better aligned with the revenue generating capacities of economic agents in agriculture. The Government together with the local banks should 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.

2.2.3.1.2. Create incentives to attract investment

In order to minimize the trade-offs being made in agriculture between productivity and mitigation especially in the early stages of transition to a lower emissions economy, a framework of adequate incentives for sustainable technologies must be in place. As such, policies for agricultural subsidies must put emphasis on organic agriculture and particularly that which minimizes GHG emissions in the process. Approved policy instruments and public expenditures should discourage unsustainable behaviour and provide targeted, time-limited, subsidies for the adoption of greener technologies. Incentives to attract investments in the implementation of conservative technologies could range from fiscal such as exemption of duties on imported equipment and other tax rebates, to institutional including long term commitment to the sector and providing support to map investment possibilities.

2.2.3.1.3. Assess opportunities to attract donor support

As described in the Low Emissions Development Strategy of Moldova (LEDS - currently in draft), tillage and reduced tillage are included in the list of supported measures that can be implemented with international donor assistance as part of the country's program of Nationally Appropriate Mitigation Actions (NAMAs). Although adopting an optimal portfolio of NAMAs based on a viable LEDS is still work in progress, it is important that domain experts, technology users and other stakeholders are involved early in such policy discussions. Among other benefits, this will help assess the real financing needs required to ensure participation of a critical mass of economic agents that will further advance the uptake of conservative technologies in agriculture. The financing gap that will be uncovered in this way will hopefully lead to the consideration of broader financing schemes that will help prevent isolated project implementation left with too few resources to attempt scaling-up.

2.2.3.2. Policy and Regulation

2.2.3.2.1. Reduce transaction costs of land lease and sale-purchase

Transaction costs associated with land sale-purchase and lease contracts should be reduced through various mechanisms, including: 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. At the same time however, given that territorial cadastral offices heavily rely on fee revenues to cover their operational costs,

such reforms should be implemented with care as part of wider land consolidation programs – including with support from international donors – that can provide alternatives for the financing gaps.

2.2.3.2.2. Implement policies and action plans promoting conservative agriculture

While the Government has recognized implementation of conservative technologies as one of the most efficient measures to achieve reduction of GHG emissions in agriculture, adoption of a targeted program to support diffusion of such technologies has been delayed. In this context, the Government must follow through its commitment to elaborate the Program for conservation agriculture by end of year, as it has indicated in its Plan of activities for 2012. In addition to this, however, it must also ensure that a plan of actions supporting the implementation of the Program is subsequently created in a timely manner, with a clear mapping of expenditures to available sources of funding.

2.2.3.2.3. Promote land consolidation

The extent to which land consolidation can be achieved will have a great impact on how widely conservative technologies will be adopted in Moldova. It is therefore critical that the regulatory framework is conducive to the establishment of economic mechanisms that incentivize single-party land ownership over areas of more than 200-400 hectares. As such, agricultural policy should encourage long-term leasing and strive to reduce transaction costs for selling and buying land as discussed above, 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.

2.2.3.3. Network and Institutional

2.2.3.3.1. Promote stronger stakeholder cooperation and foster a culture of participation

The local population and local authorities must be more actively involved in all aspects relating to land management and adoption of sustainable technologies in agriculture. Some activities have been carried out in this respect; however their reach has been limited mostly due to lack of funding. It is therefore important that 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. An inclusive public-private dialogue will not only foster a stronger culture of participation to address the impact of traditional agricultural works on the environment, but will also help establish a road-map that will build trust among the various players along the value chain of agricultural production.

2.2.3.3.2. Strengthen advisory services to help promote sustainable practices

It is not doubt that while decisions to pursue investment projects and commercial opportunities rest with farmers and rural entrepreneurs, access to technical knowledge and business advice increases their chances of success. It is therefore essential that opportunities are created to further develop the network of local consulting services in agriculture, but to also extend the domain areas they can advise on. While a great emphasis is being placed on strengthening consulting services that can support commercially productive partnerships, it is also important that the provided business advice is contextualized within the wider national objectives to reduce the environmental impact of soil works and agricultural production. As such, projects aimed at developing local consulting services should also

include diffusion of environmental specific knowledge, and extending organisational capacity to meet demand for advisory services specific to the implementation of sustainable technologies in agriculture, including conservative.

2.2.3.3.3. Support R&D and innovation activities

In order to strengthen the level of cooperation between research institutions and the agricultural community, greater investments should be allocated to ensure that institutions are provided with state-of-the-art agricultural equipment and that laboratories are endowed with modern testing facilities. In this way, a more reliable environment will be created to help validate various assumptions on soil quality and tillage techniques that are most optimal for a given location based on the specific structure of soil.

2.2.3.4. Social, Information and Awareness

2.2.3.4.1. Implement pilot projects

Demonstrations and pilot projects are essential for diffusing conservative technologies in agriculture in Moldova. As such, special sites should be assigned for testing, demonstrating, improving and adjusting technologies to local conditions in various pedo-climateric areas. In this way, farmers will learn how to transition away from conventional to conservation agriculture, and research institutions will be able to assess the impact of conservative technologies on environment, using the methodology for calculating GHG emissions reductions that has already been elaborated. Some technical assistance may also be required to co-finance the investment and advisory costs for the pioneering farmers.

2.2.3.4.2. Carry out information and awareness raising campaigns, trainings

A wide adoption of sustainable technologies in agriculture will only be possible if environmental management is seen as a shared social responsibility. A program for disseminating information and raising awareness about conservative agriculture should therefore be elaborated to target the general public but also public authorities, for whom domain-specific training should be planned in addition. Access of rural communities to information, consultancy services and specific training should be particularly improved. Subsidies for the acquisition of services of training to farmers and enterprise managers on the implementation of conservative technologies in agriculture should also be considered.

2.2.3.4.3. Improve the national system of pedologic research

A single tax on land – based on soil fertility factors and on the productivity of agricultural production – is currently being considered for implementation in Moldova. This is aimed to replace at least six other taxes (income tax, current land tax, tax on immovable property, road tax and other local taxes) in an effort to simplify the taxation mechanisms affecting economic agents in agriculture. Implementation and enforcement of the single tax however relies on a solid information system on soil quality and on improved capacities to carry out pedologic research. It is therefore important that local authorities are provided with sufficient funds to support such activities, including elaboration of digital country-wide pedological maps. Indirectly, this will also support diffusion of conservative technologies across the country, as it requires a good understanding of the actual soil composition, levels of fertility and degradation.

2.2.3.5. Technical

2.2.3.5.1. Establish clear land management standards

Standards and norms governing the use of agricultural lands should be clearly established and better enforced. In this way, private owners will be responsible for ensuring that their activities do not cause soil degradation through reckless use of land. An established framework of accountability for soil quality will also create greater incentives for the adoption of conservative technologies in agriculture.

2.2.3.5.2. Establish and maintain a centralized database on soil quality

The Ministry of Agriculture and Food Industry, together with the Agency for Land Relations and Cadastre, should mobilize efforts to help advance the establishment of a centralized database on soil quality, which will include chemical, physical, and biological indices, and measurements of soil fertility. 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.

2.2.3.5.3. 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. Action plans based on the results of such analysis should include the elaboration and implementation of plans that will aim to expand access of farmers to testing laboratories across the country.

2.3 Linkages of the barriers identified

In order to understand the core problems in technology transfer, the working group has performed **Logical Problem Analysis (LPA)**. The LPA diagrams were elaborated by experts in consultation with stakeholders. The cause/effects relations were organised in **Problem tree**, having the main problem put as starter problem and causes and effects identified and analysed. Using LPA the working groups was able to bring together the key elements of problems, use logical analysis of inter-related elements, and identify linkages between problem elements. Thus, the problem trees were used for understanding the casual relations of barriers, their linkages. Problem Tree of considered technology is provided in the Annex I.

2.3.1 Economic and Financing

Low income population prevails in the rural area, where agriculture is a dominant means of livelihood. Therefore, common barrier for all three soil technologies is the scarcity of money. All three soil improvement technologies require “up-front” investment.

In Moldova farmers are categorized as low income population and small business entrepreneurs. They are unable to purchase equipment needed for implementing the technologies because they do not have access to the private or government investment funds necessary to purchases the equipment. Currently in Moldova private banks are not willing to invest in environmental technologies mainly because they are concerned about the risk-adjusted financial return.

Unfortunately Government also is not investing nor has little implication in such type of financing that contributes to the undeveloped market.

Individual and institutional investors also have reserves in investing in environmental technologies particularly with long-term returns. There are no incentives that would stimulate capital investment in such technologies. Many investors are not convinced, that climate change technologies is a good investment.

2.3.2 Institutional barriers

The working group has mentioned weak interaction between economic actors, which creates logistic and institutional barriers. Poor communication and non-sharing the information between market players may lead to market failure. The lack of participatory arrangements that fully engage all the involved actors is a significant barrier.

A significant institutional barrier was considered the multi institutional management of soil sustainable practices in Moldova. Cadastre Agency manages the land and regulates legal relations of land, but practically is not responsible for the sustainable use of land and soil. While Ministry of Agriculture manages the land use, but lack of leverage legal, economic and control functions and cannot sufficiently influence the sustainable use of agricultural land, protect and improve the soil. Ministry of Environment is empowered with control of the ecological and soil pollution, but, for various reasons, is not able to cover the necessary control throughout the country.

Lack of real coordination between research institutions in agriculture and soil areas and institutions design and implement soil improvement measures.

2.3.3 Policy and regulations

In the whole, the policy and regulatory framework in Moldova is supportive to implementation of soil improvements technologies, while in reality they are not in force or has little effect.

The experts have mentioned that in the area of land resources management and protection of the soil cover, the key issue is delineation of specific legislation and civic land. Lack of interrelation between land legislation and civic legislation is based on different principles of regulation: the civic - the principle of freedom of action to the property owner that belongs, including its deterioration, while land legislation does not provide for such freedoms to earth, considering land as real estate of a special type, which is private, but is also a resource for living, natural wealth of the nation. So landowner is obliged to protect this wealth, rational use and keep it for meeting the nutritional requirements of recent population and future generations. Unfortunately, although there are provisions in the land law in Moldova obligation to maintain long-term soil quality favorable condition is not respected by most businesses in agriculture.

2.3.4 Provision of Information and Education

It was mentioned, that farmers or even local government representatives cannot make good decisions about the employment of soil conservation or soil improvement technologies due to lack of appropriate information about these technologies, their beneficial impact on water relations, nutrient retention, cycling capacity, etc. Respective institutions and agencies do not transit the information to users, thus create relationship between information and institutional barriers.

In Moldova the information about successful projects in soil improvement is not disseminated, there are not replications of successful ideas. Lack of information interrelates with little market transparency.

2.4 Enabling framework for overcoming the barriers in Agriculture sector

Enabling environment was analysed as part of Market mapping technique.

Proposed technologies for soil conservation and soil improvement aim to be implemented at the national level starting with pilot projects with following replication. For this reason the enabling environment analysis of each technology considers regulatory, financial, economic, other components. A particular attention was given to enabling policy environment for commitment to environment- friendly agricultural practices both at the local as well as national governments.

Components and their constituents of enabling environment with commentary to each of it, service providers and provided services of soil technologies considered are analysed in the tables bellow. They have been analysed in a more aggregated and conceptual version into Market Map provided in the Annex I.

Table 2.4.1. Enabling business environment of agriculture technologies considered.

No	Enabling environment	Comments	Responsible entity
1	Amendments in the Land Code regarding responsibility of agricultural lessors for the soil quality.	Making the long term land lease rules and the monitoring of the quality of leased soils more specific.	MAFI
2	Consolidation of agricultural lands into agricultural exploitations larger than 400ha managed by one operator.	Sustainable profitable agriculture is only possible in big farms.	Local authorities
3	Developing an indigenous seed pool for autumn and spring vetch	Restoring the seed pool of this crop, which was destroyed during the land reform	MAFI, Local authorities, Vetch seed producers and Traders
4	Setting up a financial incentives fund for farmers implementing technologies which ensure soil protection.	Stimulate implementation of environment friendly agricultural technologies	MAFI, MF
5	Improving the land lease system by taking into account of the interests of owners, leasers, soil protection needs	Development of legal prerequisites for rational farming of lands leased by agricultural businesses	MAFI
6	Organization and management by the Ministry of Agriculture and Food Industry, relevant bodies of the local public administration of the process of technology implementation	Administrative and organizational support in the process of technology implementation	MAFI
7	Improving the soils quality control and monitoring system	It is necessary to improve the national soil research system and to create control service	MAFI
8	Support from the state in ensuring the equipment necessary to implement the technology	Low interest loans and longer grace period	MAFI, Co/owners of agricultural machinery
9	Introducing diversified crop rotation where the share of weeding crops does not exceed 50 %	To protect the soil from erosion and improve the degraded lands	Local authorities

Table 2.4-2. Service providers and services provision of agriculture technologies considered.

No.	Service providers	Services provided
1	Ministry of Agriculture and Food Industry (MAFI), local public administration	Organizes and coordinates the large scale implementation of the technology, contributes to the restoration of the indigenous seed pool of autumn and spring vetch
2	MAFI and the subordinated research and education institutes	Develops informational marketing, organizes training of agricultural professionals
3	Ministry of Finance (MF) and MAFI	Protect the local agricultural producer on the market, create favourable conditions to sell the agricultural products
4	Ministry of Finance (MF) and MAFI	Create condition to subsidize the farmers by enabling low interest loans and grace period
5	MAFI, Associations of Agricultural Producers	Ensures quality of the products by monitoring the quality in specialized laboratories
6	MAFI, MF, specialized private enterprises	Strengthen the regional and ministerial business consultancy centres for agricultural producers
7	Companies /owners of specific machinery	Support in providing equipment
8	MAFI, subordinated research and education institutes, local public administration	Create awareness and training centres for agricultural professionals at local and national level.

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ANNEXES 1-4.

Annex I. Market Mapping, Problem trees and Objective trees

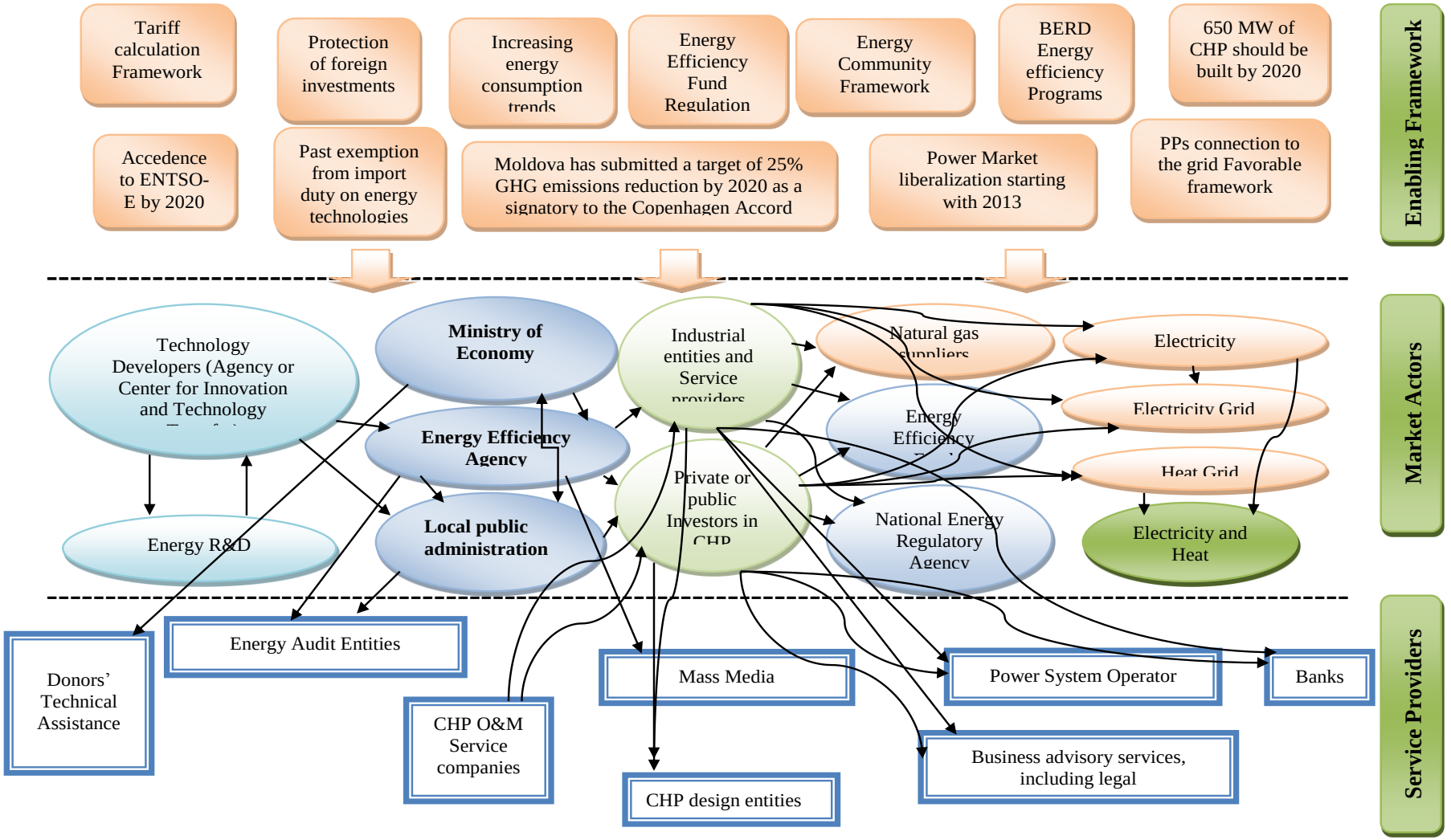

Fig. A1-1. Market Mapping of ICE CHP 500 kW

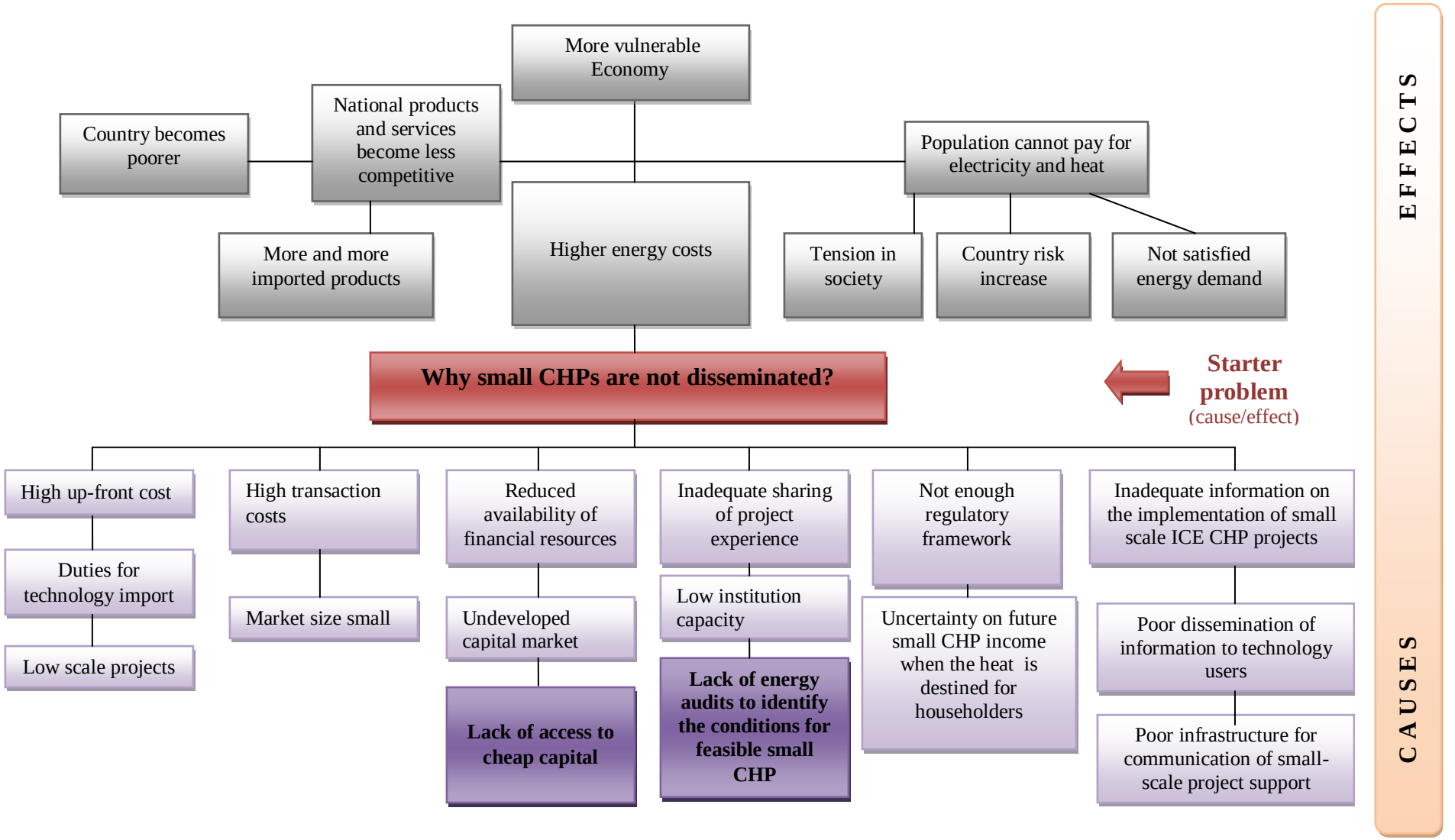

Fig. A1-2. Logical Problem Analysis of ICE CHP. Problem Tree

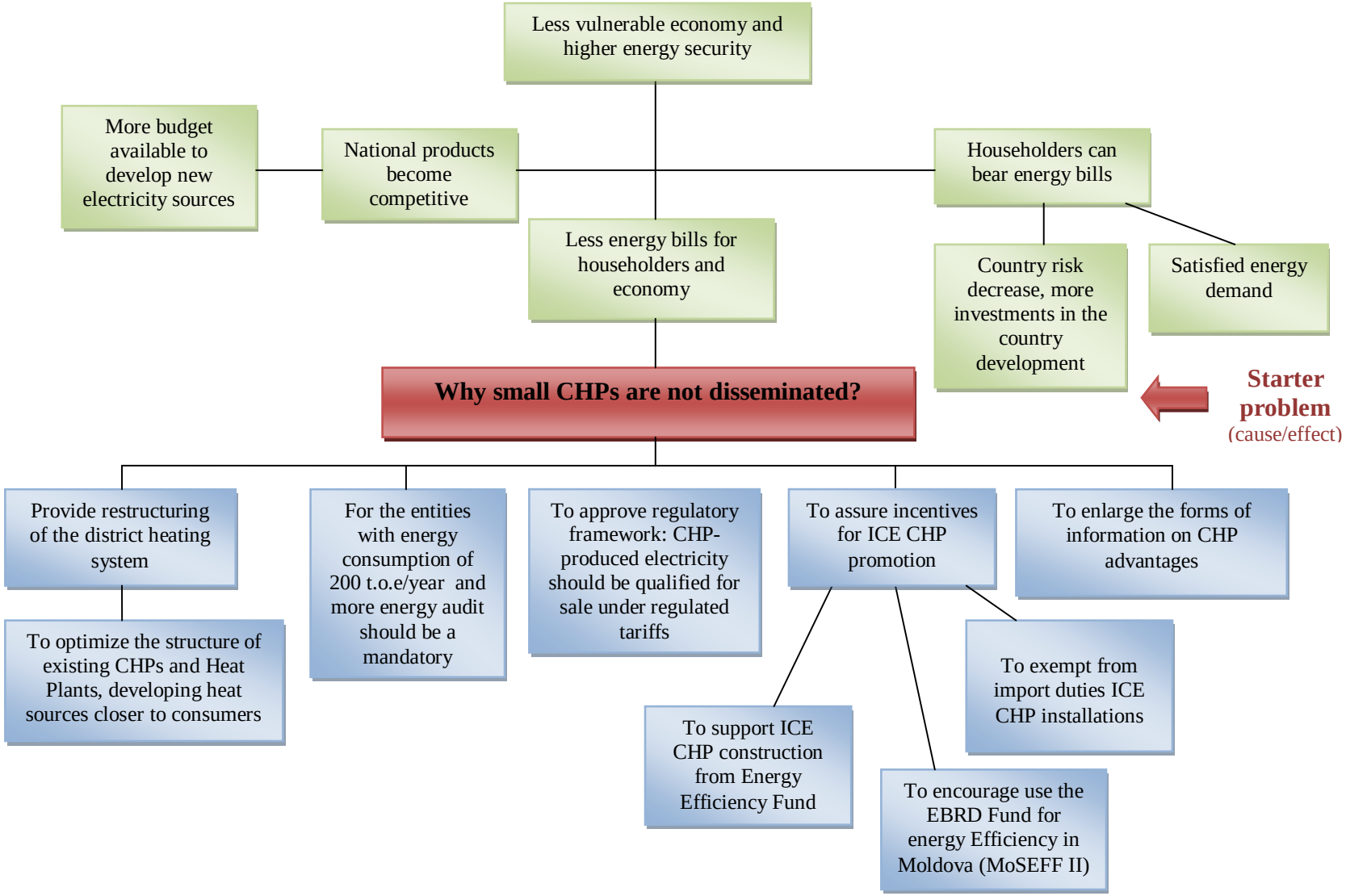

Fig. A1-3. Logical Problem Analysis of ICE CHP. Objective Tree

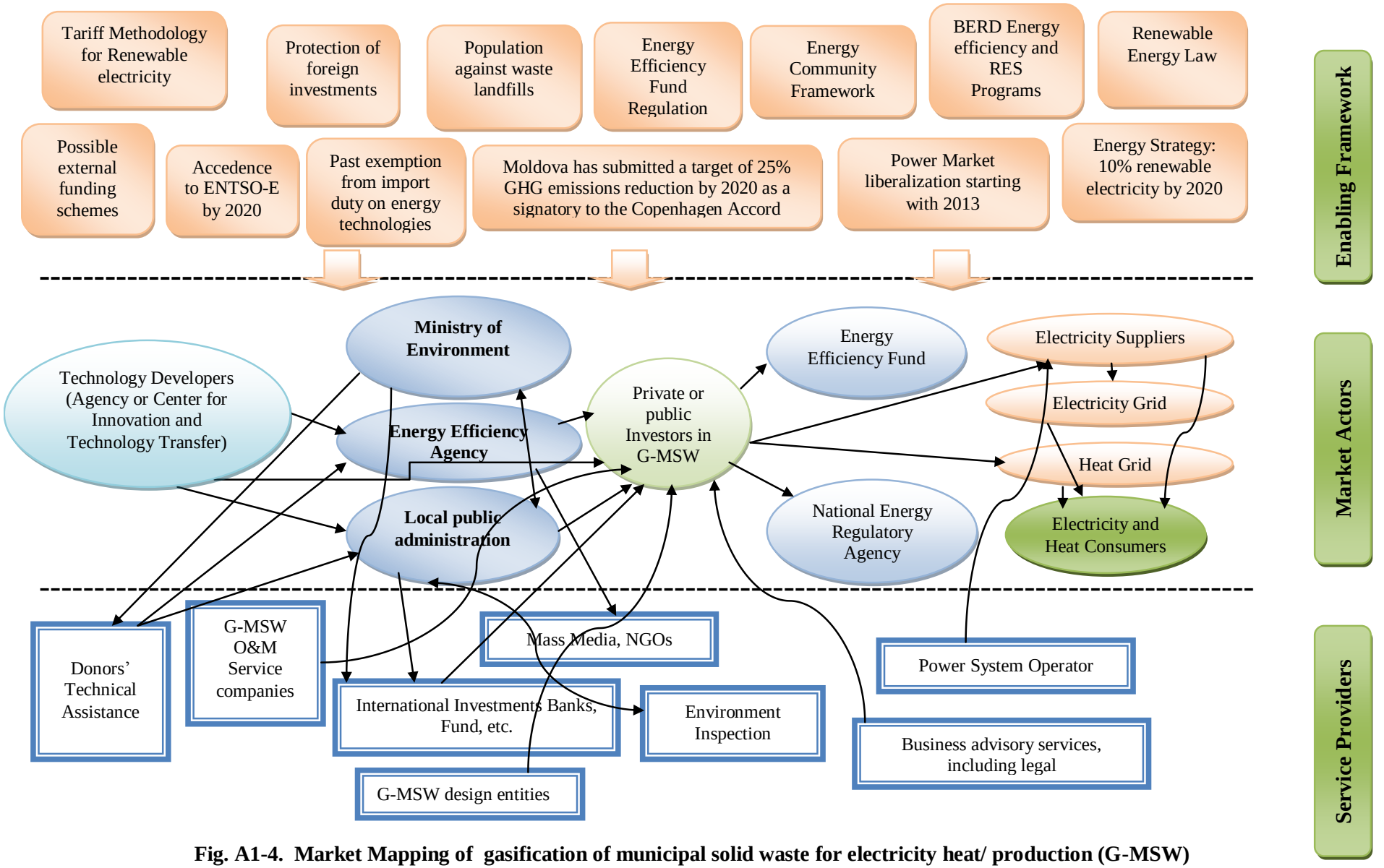

Fig. A1-4. Market Mapping of gasification of municipal solid waste for electricity heat/ production (G-MSW)

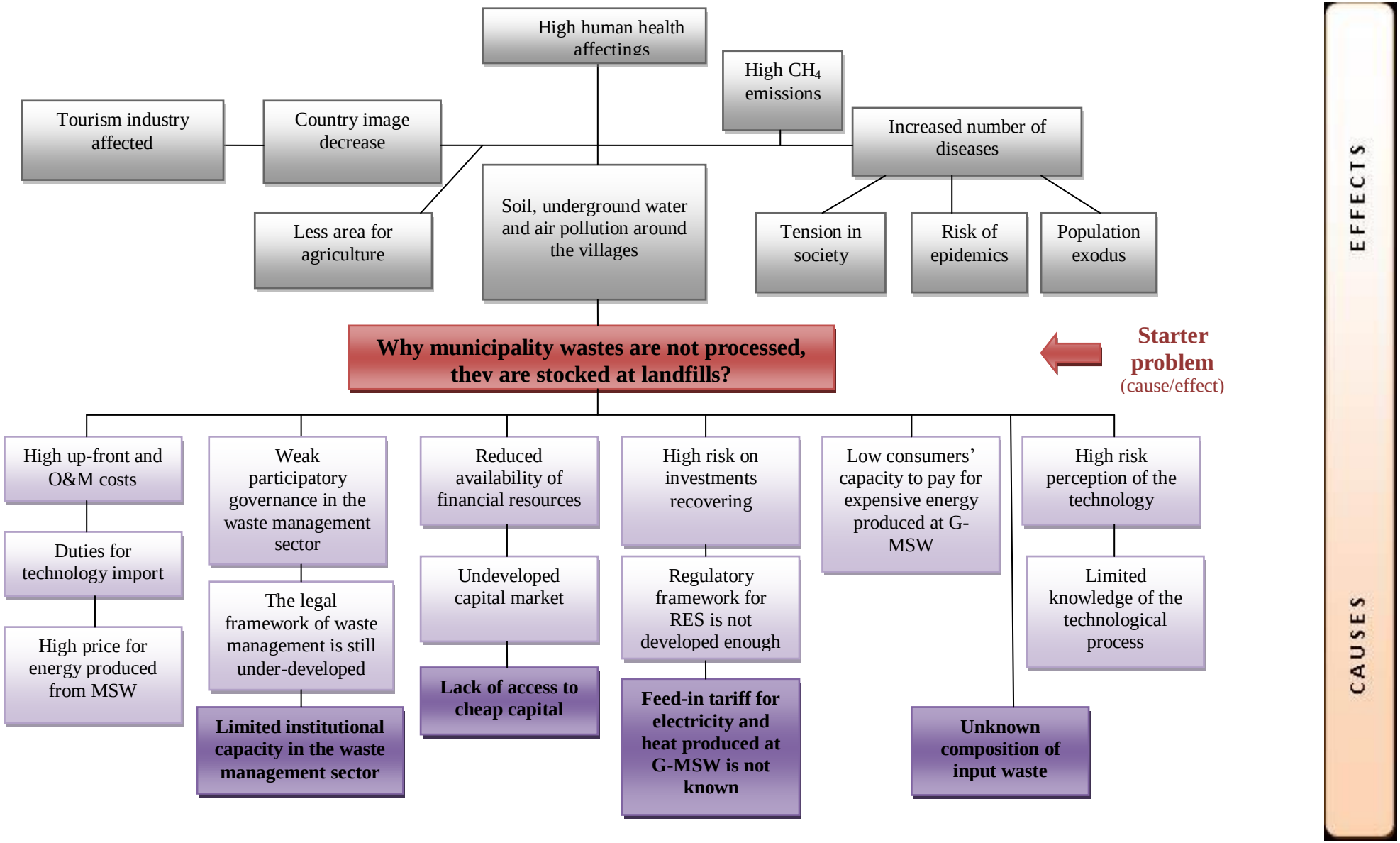

Fig. A1-5. Logical Problem Analysis of G-MSW. Problem Tree

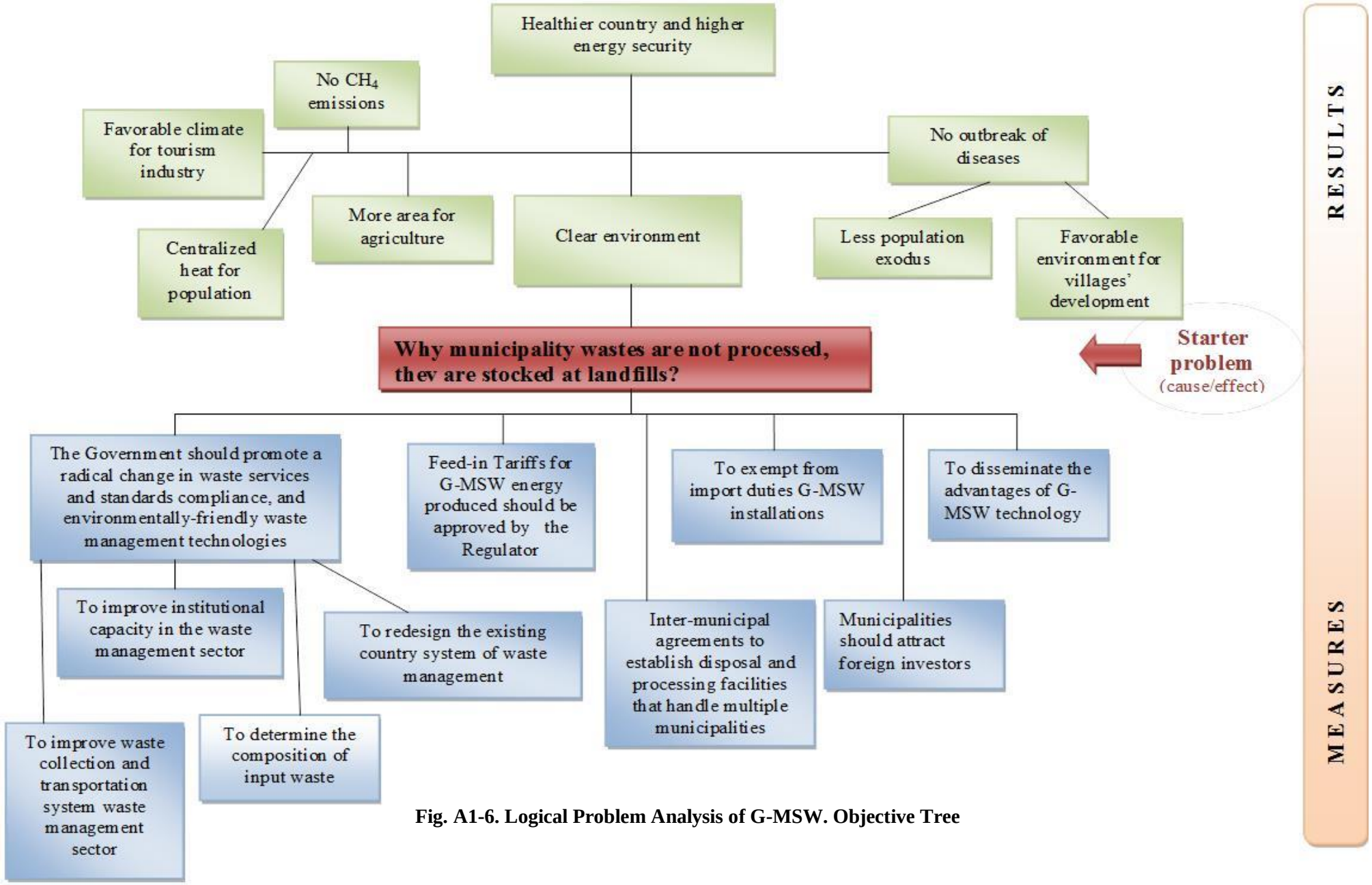

Fig. A1-6. Logical Problem Analysis of G-MSW. Objective Tree

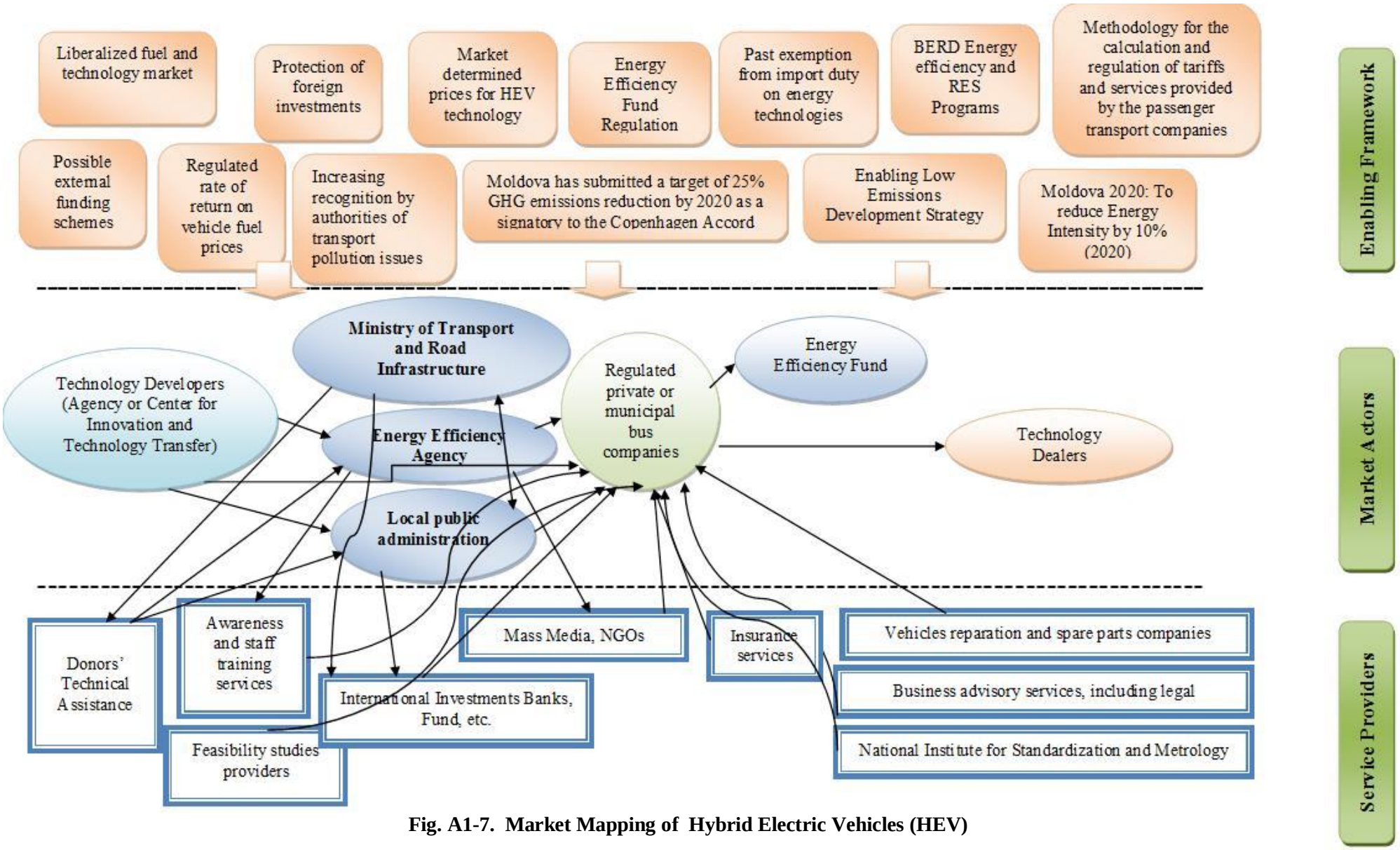

Fig. A1-7. Market Mapping of Hybrid Electric Vehicles (HEV)

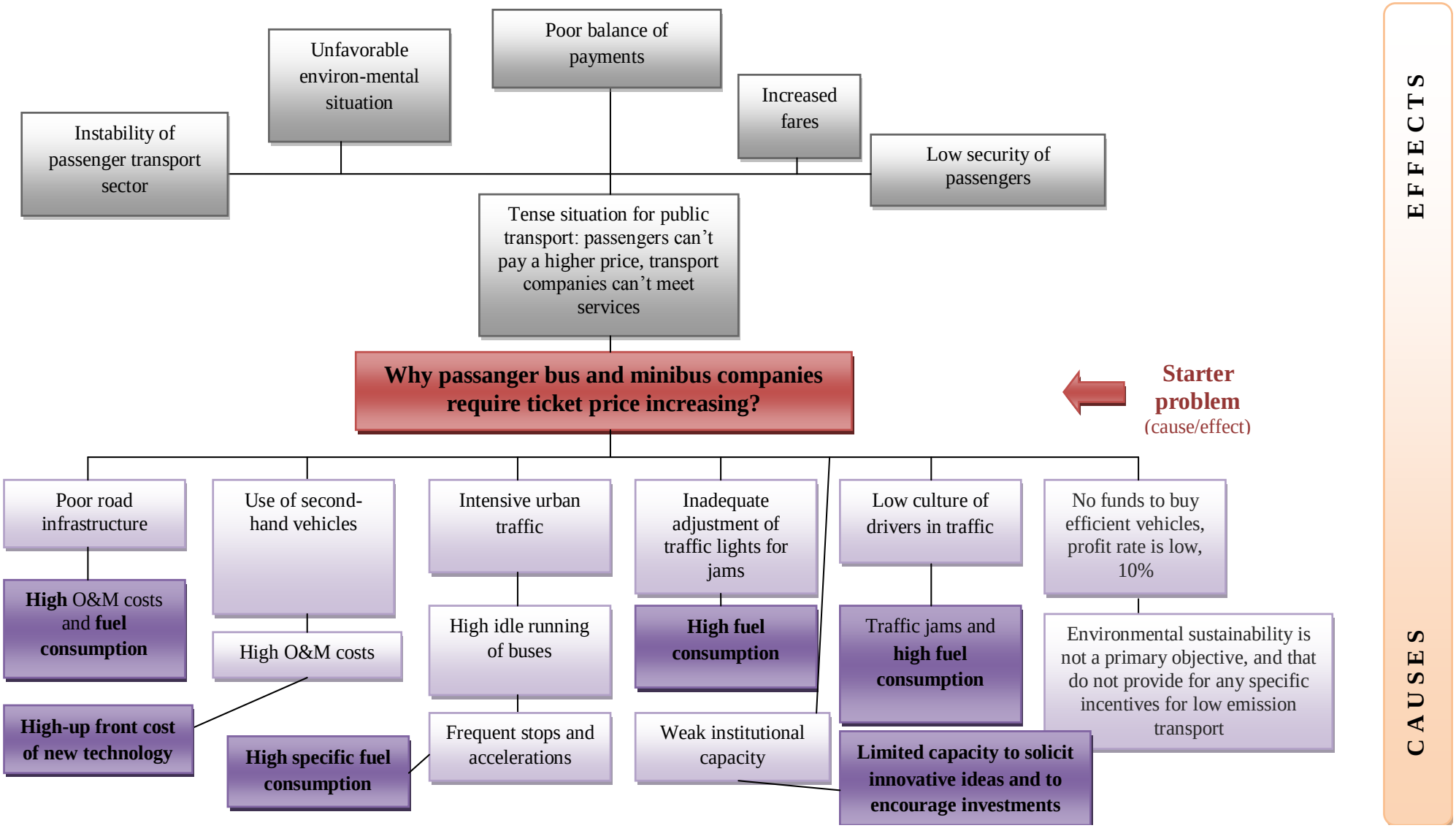

Fig. A1-8. Logical Problem Analysis of HEV. Problem Tree

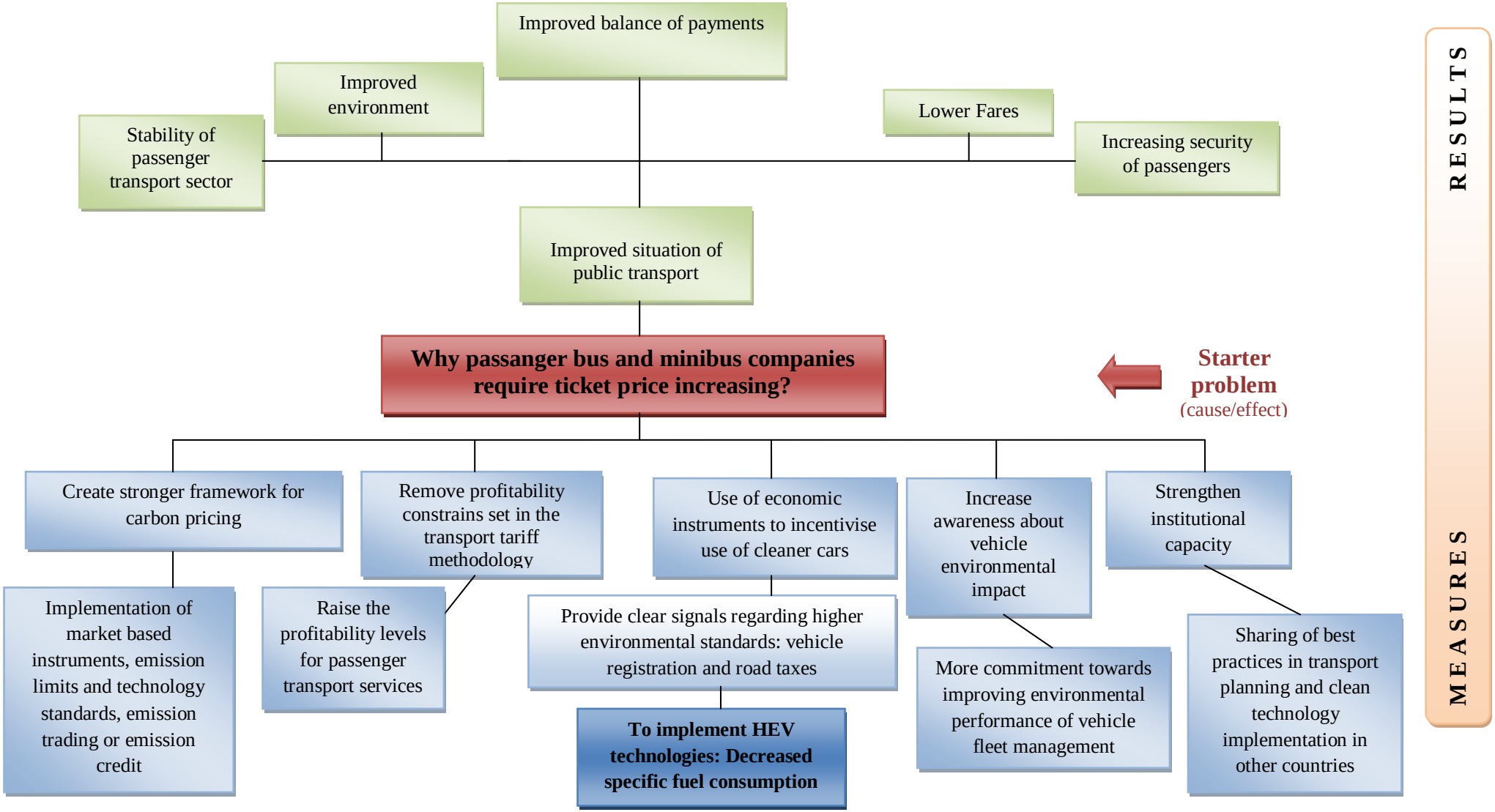

Fig. A1-9. Logical Problem Analysis of HEV. Objective Tree

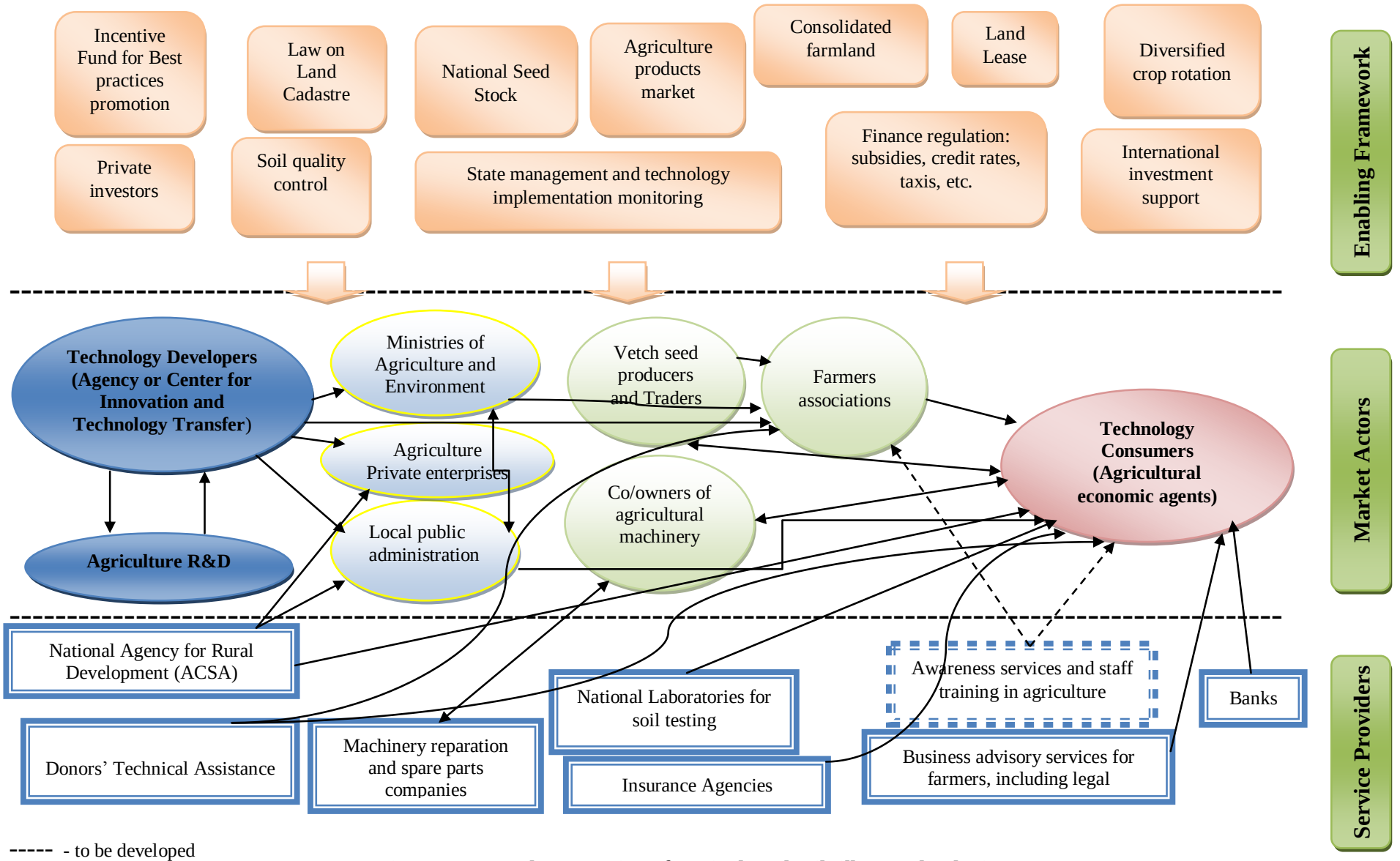

Fig. A1-10. Market Mapping of Agricultural soil tillage technologies

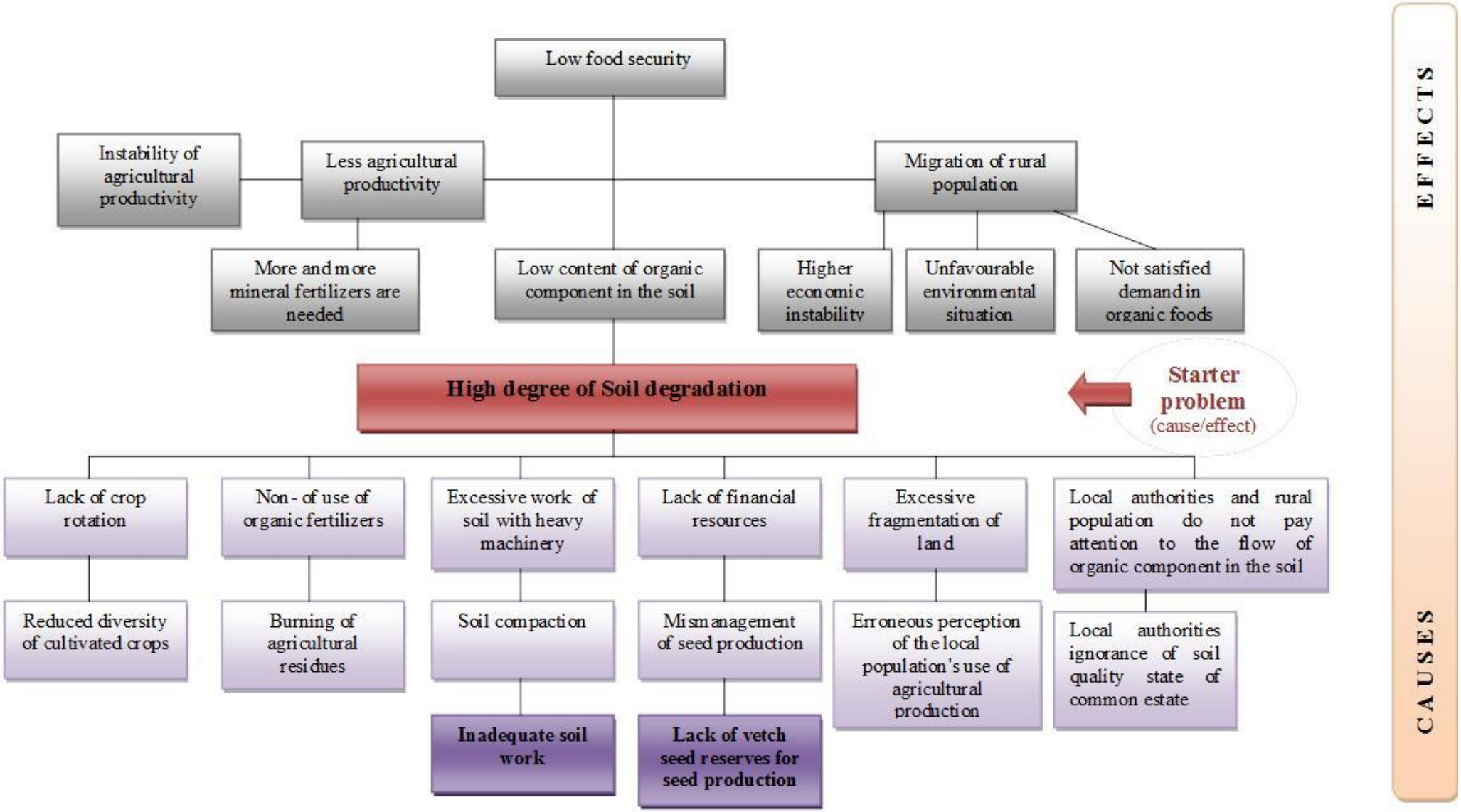

Fig. A1-11. Logical Problem Analysis of Agricultural technologies. Problem Tree

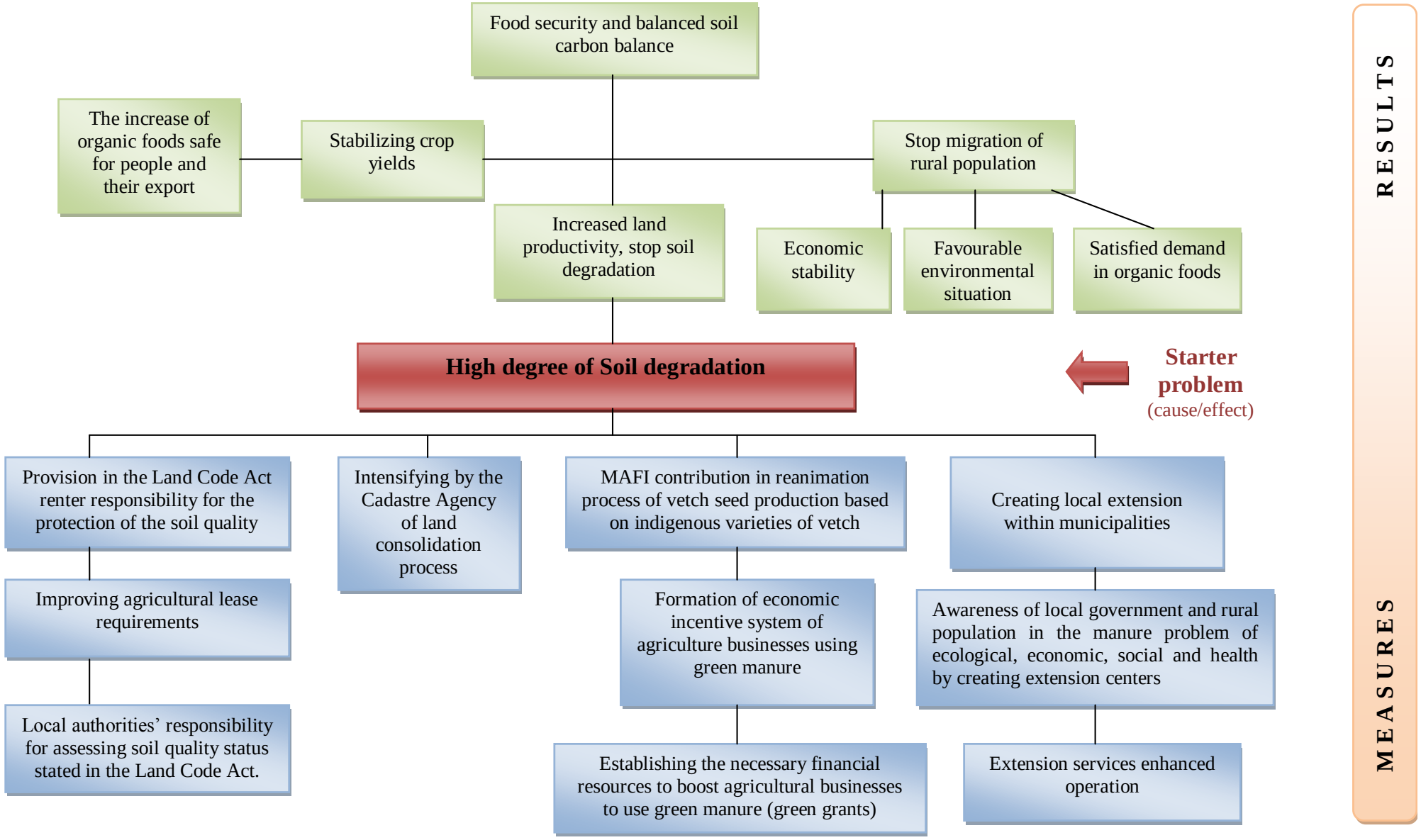

Fig. A1-12. Logical Problem Analysis of Agricultural technologies. Objective Tree

Annex II – Policy Fact Sheets

AII-1. General Developmental and Environmental Framework

POLICY:	**Low Emissions Development Strategy to the Year 2020**
Name of field:	**Content**
Date Effective:	Draft
Date Announced:	
Date Promulgated:	
Date Ended:	Draft
Unit:	CC, RE, EE
Country:	Moldova
Year:	2011
Policy Status:	Draft
Agency:	Ministry of Environment
Funding:	Exact cost and funding for mitigating activities is stipulated in relevant Laws. Overall, the Strategy breaks down the types of possible funding into 3 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.
Further Information:	http://clima.md/lib.php?l=ro&idc=236&
Enforcement:	Energy Efficiency Agency - implementation of LCSD technical tasks; coordination of international support The Climate Change Office of the Ministry of Environment - overall Strategy implementation The Financing Carbon Office of the Ministry of Environment - implementation of supported and credited mitigation measures
Penalty:	
Related Policies:	National Energy Strategy to the Year 2020 Law on Energy Efficiency Law on Renewable Energy The Road Transport Infrastructure Strategy for the Period 2008-2017 National Waste Management Strategy for the Period 2012-2025 (draft) National Strategy for Sustainable Development of the Agricultural Complex for the Period 2008-2015 Program for Soil Fertility Conservation and Enhancement for the Period 2011-2020
Policy Superseded by:	

Policy Supersedes:	
Stated Objective:	Low carbon development GHG emissions reduction
Evaluation:	
Policy Type:	Policy Processes - Enhancement of Existing Policy, Strategic Planning Regulatory Instruments - Assessment, Benchmarking, Standards Financial - Tax and Tax Incentives Incentives/Subsidies - Feed-in Tariffs, Third Party Financing
Policy Target:	Energy Biomass, Wind, Solar Cogeneration Waste management Agriculture Land Use Afforestation Environmental Management Buildings Transport
URL:	http://clima.md/lib.php?l=ro&idc=236&
Legal References:	
Description:	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. In this context, Republic of Moldova expressed its willingness to undertake mitigation measures focused on reducing its total national GHG emissions by 2020 with no less than 25% (twenty five percent) of the base year (1990) level. The Low Carbon Development Strategy has been elaborated to support achieving this goal through a transition to a low-carbon economic growth. First, the Strategy provides an evaluation of the existing legal framework and institutional capacity, an assessment of economic and non-financial barriers, and a description of climate change related projects implemented in Moldova with donor assistance in the following sectors: energy, industrial processing, transport, waste management, forestry and agriculture. Second, the Strategy proposes a series of policy measures and instruments that should be implemented in order to ensure energy efficiency in the mentioned sectors, and also sets out the framework required for the its implementation and assessment. In addition to this, the Strategy also 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 Strategy stipulates the following sectorial GHG reduction emissions targets by 2020: • Energy: by no less than 65% of the 1990 level, and no less than 10% of BAU level • Industry: by no less than 25% of the 1990 level, and no less than 15% of BAU level • Agriculture: by no less than 40% of the 1990 level, and no less than 20% of BAU level • Land Use, Land-Use Change, Forestry: by no less than 30% of the 1990 level, and no less than 15% of BAU level • Waste: by no less than 20% of BAU level Provided additional international support is available, more ambitious mitigation levels are also set out.

POLICY:	**Moldova 2020: National Development Strategy 2012-2020**
Name of field:	**Content**
Date Effective:	Draft, is currently being reviewed by the Parliament
Date Announced:	
Date Promulgated:	
Date Ended:	Draft
Unit:	CC, RE, EE
Country:	Moldova
Year:	2012
Policy Status:	Draft
Agency:	Ministry of Economy
Funding:	The Government's funding of Strategy activities will be aligned to the Medium Term Expenditure Frameworks - MTEF is a rolling 2-3 year process, revisited every year, aimed at reducing the imbalance between what is affordable and what is demanded, with adjustments taking place through policy changes.
Further Information:	index.php?action=view&view=doc&lang=1&id=342697
Enforcement:	National Council for Participation - will include representatives of the civil society and will undertake independent monitoring of the Strategy's implementation State Chancellery - will collect assessment reports from the public authorities responsible for implementing the Strategy's objectives
Penalty:	
Related Policies:	Medium Term Expenditure Frameworks http://www.mf.gov.md/en/middlecost/
Policy Superseded by:	
Policy Supersedes:	National Development Strategy 2008-2011
Stated Objective:	

Evaluation:	
Policy Type:	Policy Process - Enhancement of Existing Policy, Strategic Planning
Policy Target:	Economic development Poverty reduction Energy efficiency Renewable energy Regulatory reform Infrastructure investment Financial services reform
URL:	http://particip.gov.md/public/files/strategia/Moldova_2020_proiect.pdf
Legal References:	
Description:	"Moldova 2020," once approved by the Parliament, will be the development strategy underpinning the Government's economic growth and poverty reduction objectives to the year 2020. The Strategy's priorities are to: • align the educational system to the demands of the labour market • secure public investments in the national and local roads infrastructure • reduce the costs of finance by promoting competition in the financial services sector and developing instruments for managing financial risks • improve the business climate by streamlining the regulatory framework and promoting IT in the delivery of public services • reduce energy consumption by increasing energy efficiency and use of renewable energy sources • ensure financial sustainability of the pensions system • combat corruption and improve the efficiency of the judiciary system In terms of energy efficiency, the specific objectives set out by the Strategy are: • incentivize the use of energy produced from renewable sources to 10% in 2015 and 20% in 2020 as a share of GDP • increase the share of energy produced from renewable sources to 10% in 2020 .

AII-2. Energy Sector: Efficiency and Renewables

POLICY:	**Energy Strategy to the Year 2020**
Name of field:	**Content**
Date Effective:	07.09.2007
Date Announced:	
Date Promulgated:	
Date Ended:	
Unit:	RE, EE
Country:	Moldova
Year:	2007
Policy Status:	In force
Agency:	Ministry of Industry and Infrastructure
Funding:	
Further Information:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=325108
Enforcement:	Ministry of Environment (formerly Ministry of Ecology and Natural Resources) Ministry of Industry and Infrastructure Ministry of Transport and Roads Infrastructure Ministry of Economy and Commerce State Agency for Intellectual Property Energy Efficiency Agency (created through the break-up of the former National Agency for Energy Conservation) Academy of Sciences National Agency for Energy Regulation Ministry of Finances Ministry of Agriculture and Food Industry Ministry of Education and Youth National Institute of Standardization and Metrology Agency for Construction and Territorial Development Ministry of Justice Agency for Geology Ministry for Foreign Affairs and European Integration
Penalty:	
Related Policies:	Law on Joining the Energy Community Treaty nr 117-XVIII from 23.12.2009 Law on Energy Sector nr 1525-XIII from 19.02.1998 Law on Natural Gas nr 123-XVIII from 23.12.2009 Law on Energy Efficiency nr 142 from 02.07.2010

	Law on Renewable Energy nr 160 from 12.07.2007 European Union - Moldova Action Plan http://ec.europa.eu/world/enp/pdf/action_plans/moldova_enp_ap_final_en.pdf
Policy Superseded by:	
Policy Supersedes:	Energy Strategy to the Year 2010
Stated Objective:	
Evaluation:	
Policy Type:	Policy Process - Strategic Planning
Policy Target:	Biomass Wind Solar Energy security Cogeneration Liberalized energy market Energy sector Heat supply Natural gas supply Renewable energy
URL:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=325108
Legal References:	Government Resolution nr 958 from 21.08.2007
Description:	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. Among possible sources, it lists the energy potential of biomass (production of bio fuel from cereals, sugar sorghum and oily technical cultures - rape, sunflower, grape seeds from wine industry etc.), solar energy by conversion to electricity and heat, wind, hydropower, and, in the future, new sources of energy. The Strategy stipulates the following activities aimed at attracting investments in the energy sector: • promote rule of law and judicial reforms • implement new financing mechanisms based on offsetting (part of) the accumulated external debt with an equivalent of state investments in environment protection or development of renewable energy resources • promote private investments in CDM projects and subsequently enter bilateral

	agreements with EU to potentially qualify for the EU ETS • implement international methodologies for estimating the volume of investments necessary to achieve the strategic and specific objectives in the energy sector. • develop an informational system and a database for managing energy project financing • support reforms in the banking sector.

POLICY:	**Law on Renewables**
Name of field:	**Content**
Date Effective:	17.08.2007
Date Announced:	
Date Promulgated:	
Date Ended:	
Unit:	CC, RE, EE
Country:	Moldova
Year:	2007
Policy Status:	In force
Agency:	Agency for Energy Efficiency
Funding:	Funding approved annually through the state budget.
Further Information:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=324901
Enforcement:	Agency for Energy Efficiency - state authority in the renewable energy sector National Agency for Energy Regulation - regulation of energy market overall, including renewable energy
Penalty:	
Related Policies:	Regulation on the Organization and Functioning of the Energy Efficiency Fund 2012 http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=343683 Energy Strategy to the Year 2020 http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=325108 Regulation on the Organization and Functioning of the Agency for Energy Efficiency 2010 http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=337105 Law on Energy Efficiency http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=335818 Methodology for the determination, approval and application of tariffs for electric energy produced from renewable energy sources and bio-fuel 2009 http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=330868
Policy Superseded by:	
Policy Supersedes:	

Stated Objective:	
Evaluation:	
Policy Type:	Policy Processes - Institutional Creation
Policy Target:	Institutional capacity in renewable energy Renewable energy regulation
URL:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=324901
Legal References:	Law nr 160-XVI from 12.07.2007
Description:	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 • establish the means by which renewable energy sources are integrated into the national energy system • 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 • stipulate the mechanism by which information on activities in the renewable energy domain is made available • establish the economic and organisational measures necessary to incentivise the use of energy from renewable sources. In 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 further describes the framework regulating activities in the renewable energy sector, including use of technical equipment, authorisations, conditions for commercialising renewable energy and fuel, tariff setting, rights and obligations of economic agents, security requirements. 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.

POLICY:	Law on Energy Efficiency
Name of field:	**Content**
Date Effective:	03.09.2010
Date Announced:	
Date Promulgated:	
Date Ended:	
Unit:	CC, EE
Country:	Moldova
Year:	2010
Policy Status:	In force
Agency:	
Funding:	The Law establishes the means of financial support available in general for EE activities, including third party financing, loans or guarantees from the Energy Efficiency Fund, state budget financing, fiscal incentives in accordance with the Tax Law. The annual budget of the Agency for Energy Efficiency is estimated at MDL 800,000 (approx EUR 52,080) and will be financed from the state budget; the budget required to set up the Energy Efficiency Fund is estimated at EUR 4 mln and is to be covered by grants; the cost of implementing the National Program for Energy Efficiency is estimated at MDL 1,29 mln (approx EUR 8,4 mln).
Further Information:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=335818
Enforcement:	
Penalty:	
Related Policies:	Regulation on the Organization and Functioning of the Energy Efficiency Fund 2012 http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=343683 Energy Strategy to the Year 2020 http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=325108 Regulation on the Organization and Functioning of the Agency for Energy Efficiency 2010 http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=337105 National Program for Energy Efficiency 2011-2020 http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=340940 The Government's Activity Program "European Integration: Freedom, Democracy, Welfare 2011-2014" http://www.gov.md/doc.php?l=en&idc=445&id=3729
Policy Superseded by:	
Policy Supersedes:	
Stated Objective:	

Evaluation:	Ministry of Economy's Report on the monitoring of the implementation of the Law on Energy Efficiency http://old.mec.gov.md/node/21
Policy Type:	Policy Processes - Institutional Creation, Enhancement of Existing Policy
Policy Target:	Energy efficiency Institutional capacity in energy efficiency Regulation of EE activities
URL:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=335818
Legal References:	Law nr 142 from 02.07.2010
Description:	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. In particular, its scope covers the following areas to the extent they contribute to energy efficiency: energy suppliers, distributors, operators in the distribution grid, energy service suppliers, end users and armed forces as applicable. 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. Among its activities are: developing and maintaining energy efficiency indicators, establishing mechanisms for monitoring and tracking energy savings and energy intensity, authorizing of energy audits, disseminating information and undertaking education campaigns on energy efficiency. The Agency's budget is approved on annual basis and is financed from the state budget. The Law also: • strengthens the framework for the ESCOs operation, energy performance contracts, energy consumption metering, mandatory metrological recording of energy resources through the entire value chain (extraction, transformation, transmission, storage, distribution, consumption) • provides for financial support in the form of loans or guarantees from the Fund of Energy Efficiency to economic agents whose activities/projects increase energy efficiency • requires adoption of minimum energy 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

POLICY:	**Electricity Act**
Name of field:	**Content**
Date Effective:	12.02.2010
Date Announced:	
Date Promulgated:	

Date Ended:	In force
Unit:	EE
Country:	Moldova
Year:	2010
Policy Status:	In force
Agency:	National Agency for Energy Regulation (ANRE)
Funding:	ANRE establishes its budget in accordance with the Law on Energy Sector nr 1525-XIII from 19.02.1998
Further Information:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=333639
Enforcement:	National Agency for Energy Regulation
Penalty:	
Related Policies:	Methodology for the determination, approval and application of tariffs for electricity produced from renewable energy sources and bio-fuel 2009 http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=330868 Methodology for the determination, approval and application of tariffs for electricity, heat and of treated up water generation and the Methodology for the determination, approval and application of tariffs for heat supply to end users 2011 http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=340415
Policy Superseded by:	
Policy Supersedes:	
Stated Objective:	
Evaluation:	
Policy Type:	Policy Processes - Institutional Creation Regulatory Instruments - Mandates
Policy Target:	Power sector Power market Energy tariffs Energy regulation Electricity Heat Renewable Energy
URL:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=333639
Legal References:	Law nr 124 from 23.12.2009

Description:	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 further clarifies the scope of regulation by the Government in general, 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 • legal aspects relating to the use of property owned by third parties • electricity generation, transmission, distribution (including technical standards of and third party access to electricity distribution grids), supply, and power system operation • regulation of relationships among market participants, including recording consumption of and payment for electric energy • tariff regulation, specifying input parameters included in tariff calculation methodologies. The Law also stipulates that the methodology for calculating and applying regulated tariffs is elaborated and approved by ANRE for specific periods • protection of consumer interests.

POLICY:	**Law on Energy Sector**
Name of field:	**Content**
Date Effective:	04.06.1998
Date Announced:	
Date Promulgated:	
Date Ended:	In force
Unit:	EE
Country:	Moldova
Year:	1998
Policy Status:	In force
Agency:	National Agency for Energy Regulation (ANRE)
Funding:	NAER's budget is prepared and approved on an annual basis, in accordance with the Law on Energy.
Further Information:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=311606
Enforcement:	
Penalty:	

Related Policies:	Natural Gas Act 2009 Law on the Market of Oil Products 2001 Electricity Act 2010
Policy Superseded by:	
Policy Supersedes:	
Stated Objective:	
Evaluation:	
Policy Type:	Policy Processes - Institutional Creation Regulatory Instruments - Mandates, Monitoring
Policy Target:	Energy market regulation Institutional capacity in energy market Rights of consumers and suppliers Energy market competition
URL:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=311606
Legal References:	Nr.1525-XIII from 19.02.98
Description:	The Law establishes the legal framework for ensuring energy efficiency and security. The scope of the Law is to • regulate the organizational, economic and financial activities of energy companies, and their relations with regulatory authorities • establish the basic principles of the activities of energy producers, transmission companies, and energy suppliers, as well as the legal and economic relations between the suppliers and customers; • establish measures for ensuring fuel and energy at minimal prices and tariffs for consumers • determine key measures for ensuring a safe operation of energy facilities. The Law establishes the National Agency for Energy Regulation (ANRE) as the authority responsible for regulating and monitoring activities in the energy sector, clarifies the scope of ANRE's regulation and defines the process for setting and approving ANRE's budget. The Law also: • establishes that the types of ownership possible in the energy sector can be public or private • provides for limiting monopolistic activities and promoting competition in the energy sector • provides for the establishment of investment and special funds to support the development of the energy sector • establishes the scope of energy state supervision inspection • establishes provisions concerning energy metering • sets out the framework for ensuring security in the functioning of energy facilities.

POLICY:	Natural Gas Act
Name of field:	**Content**
Date Effective:	12.02.2010
Date Announced:	
Date Promulgated:	
Date Ended:	In force
Unit:	EE
Country:	Moldova
Year:	2009
Policy Status:	In force
Agency:	National Agency for Energy Regulation (ANRE)
Funding:	NAER's budget is prepared and approved on an annual basis, in accordance with the Law on Energy.
Further Information:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=333636
Enforcement:	
Penalty:	
Related Policies:	Law on Energy Sector 1998 The Government's Activity Program "European Integration: Freedom, Democracy, Welfare 2011-2014" http://www.gov.md/doc.php?l=en&idc=445&id=3729 Energy Strategy to the Year 2020
Policy Superseded by:	
Policy Supersedes:	
Stated Objective:	
Evaluation:	Annual Report on the Implementation of the Acquis Under the Treaty Establishing the Energy Community 2011 http://www.energy-community.org/pls/portal/docs/1146177.PDF Ministry of Economy's Report on the monitoring of the implementation of the Natural Gas Act http://old.mec.gov.md/node/2105
Policy Type:	Policy Processes - Institutional Creation Regulatory Instruments - Mandates, Monitoring
Policy Target:	Regulation of natural gas market Institutional capacity in the natural gas market
URL:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=333636
Legal References:	nr. 123-XVIII from 23.12.2009

Description:	The Act establishes the legal framework for regulating the functioning of the natural gas market. The Act covers • production, storage, transmission, distribution, supply of natural gases • import and export of natural gases • setting and approval of regulated tariffs for natural gases and tariffs for provided services • licensing of activities in the natural gas market, including types of licenses and procedures • legal aspects concerning the use of property owned by third parties • technical norms, including of transport and distribution networks • legal aspects concerning access by third parties to natural gas networks • security and reliability of natural gas supply to consumers • rights and obligations of market participants, including protection of end users rights. The Act further describes the responsibilities of the Government, local public administration authorities, and of the National Agency for Energy Regulation (ANRE) in the market - the law establishes ANRE as the independent authority responsible for regulating activities in the natural gas market, including approval of national transmission and distribution network tariffs.

POLICY:	**Methodology for the determination, approval and application of tariffs for electricity produced from renewable energy sources and bio-fuel**
Name of field:	**Content**
Date Effective:	27.02.2009
Date Announced:	
Date Promulgated:	
Date Ended:	In force
Unit:	RE, EE
Country:	Moldova
Year:	2009
Policy Status:	In force
Agency:	National Agency for Energy Regulation (ANRE)
Funding:	ANRE's budget is prepared and approved on an annual basis, in accordance with the Law on Energy Sector.
Further Information:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=330868
Enforcement:	
Penalty:	
Related Policies:	Law on Renewables 2007 National Accounting Standards
Policy Superseded by:	
Policy Supersedes:	
Stated Objective:	

Evaluation:	
Policy Type:	Regulatory Instruments - Benchmarking, Monitoring, Standards
Policy Target:	Biofuel Renewable energy Rate of return on investments Tariff calculation Depreciation
URL:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=330868
Legal References:	Government Resolution nr 231 from 22.01.2009
Description:	The Methodology is developed in accordance with the Law on Renewable Energy 2007 and the National Accounting Standards, and aims to establish a single methodology for the determination, approval and application of regulated tariffs for all producers of electric energy generated from renewable energy sources and biofuel. The Methodology is a key document for attracting investments in the development of renewable sources in the Republic of Moldova. In particular, the Methodology establishes • the structure and method used to determine regulated incomes and expenditures • the method used to calculate, approve and apply regulated tariffs • the method used to calculate the rate of return on investments • the procedure and method used to adjusted tariffs over the period of validity of this Methodology. The Methodology is based on the following principles: • to protect and enhance the state's energy security • to reduce the negative impact that the energy sector has on the environment • to cover the real costs incurred by companies as a result of their exploitation of production units and of carrying out regulated activity under normal circumstances • companies shall carry out an efficient and profitable activity that would allow them to recover their financial investments made into the development, modernization and reconstruction of production capacities. All reasonable costs borne by investors in renewables are recovered through the price of energy delivered to the grid. Furthermore, in order to incentivize investments in renewables the rate of return for the first 5 years is 1.5 times higher than the one applied to local distribution companies using the Weighted Average Cost of Capital methodology. The incentive coefficient is gradually reduced to 1.3 and 1.1 for each of the two subsequent 5-year periods. This Methodology is mandatory for renewable energy generation companies in case the capacity of the power plant of the producer is not less than 10 kW and the electricity generated is designed to be commercialized on power market and for all companies producing biofuel designed to be commercialized on the market of petroleum products. The Methodology is valid for a period of 15 years starting from the date it was published. The Methodology further stipulates that companies must present to NARE on annual basis, and by the end of the month of November, the calculation of tariffs for the following year made in accordance with the provisions of the Methodology. NARE shall

	subsequently examine the material presented by companies and, as appropriate, shall adjust, approve and publish new tariffs. The tariffs shall enter into force in January of the following year, and shall be valid for the entire calendar year. NARE has also the right to decline approving the proposed tariff where it considers that costs and incomes required by the company are unreasonable - in such cases, decisions will be accompanied by explanations providing guidance to companies.

POLICY:	**Protocol Concerning the Accession of the Republic of Moldova to the Energy Community Treaty**
Name of field:	**Content**
Date Effective:	22.01.2010
Date Announced:	
Date Promulgated:	
Date Ended:	In force
Unit:	RE, EE
Country:	Moldova
Year:	2009
Policy Status:	In force
Agency:	Ministry of Foreign Affairs and European Integration
Funding:	
Further Information:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=330868
Enforcement:	
Penalty:	
Related Policies:	Energy Strategy to the Year 2020 http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=325108 Report on the Implementation of the Activity Program of the Republic of Moldova "European Integration: Freedom, Democracy, Welfare 2011-2014" for the Period 2011-2012 http://moldovaportal.sites.mfa.gov.md/img/docs/raport-program-guvern-2011.pdf
Policy Superseded by:	
Policy Supersedes:	
Stated Objective:	
Evaluation:	Annual Report on the Implementation of the Acquis Under the Treaty Establishing the Energy Community 2011 http://www.energy-community.org/pls/portal/docs/1146177.PDF
Policy Type:	Policy Processes - Enhancement of Existing Policy

Policy Target:	Natural gas Electricity Infrastructure Sulphur content Combustion plants Wild birds Biofuels Renewable fuels
URL:	http://www.energy-community.org/pls/portal/docs/576178.PDF
Legal References:	Law nr 117-XVIII from 23.12.2009
Description:	The Law specifies the Agenda for implementing the Memorandum signed between the Republic of Moldova and the European Commission on April 29th 2009 on Moldova's accession to the Energy Community. The Agenda provides the schedule of EU Directives and Regulations that Moldova must implement as part of the accession process.

AII-3. Waste Sector

POLICY:	National Waste Management Strategy for the Period 2012-2025
Name of field:	**Content**
Date Effective:	Draft
Date Announced:	
Date Promulgated:	
Date Ended:	Draft
Unit:	RE
Country:	Moldova
Year:	Draft
Policy Status:	Draft
Agency:	
Funding:	• external sources - financial and technical assistance, including grants and credits from international financial organisations and bilateral donors; resources to support implementation of international agreements; foreign investments • internal sources (approx EUR 2.4 mln) - annual budget, National Fund for Ecology, individual contributions, and contributions by economic agents.
Further Information:	http://particip.gov.md/proiectview.php?l=ro&idd=114
Enforcement:	Ministry of Environment
Penalty:	
Related Policies:	Law on Renewables Low Emissions Development Strategy to the Year 2020
Policy Superseded by:	
Policy Supersedes:	
Stated Objective:	Establish a national integrated national waste management system
Evaluation:	
Policy Type:	Policy Processes - Enhancement of Existing Policy, Strategic Planning
Policy Target:	Regional planning of waste management Energy recovery from waste Biomass Waste management Environmental management
URL:	http://particip.gov.md/proiectview.php?l=ro&idd=114
Legal References:	

Description:	The Strategy's objective is to create the necessary framework for the elaboration and implementation of an integrated waste management system in the country. This includes elaboration of the legal and institutional framework required to support the gradual harmonization of local waste management practices with those used in the European Union. Overall, the Strategy sets the ground for the elaboration of the legal and normative framework required (1) to regulate the 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. All types of waste are covered by Strategy's provisions, including municipal and assimilable wastes, production wastes, and wastes generated from medical activities - waste categorization is made in accordance with EU Directives. 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 mln.

AII-4. Transport Sector

POLICY:	**Code on Road Transport**
Name of field:	**Content**
Date Effective:	01.10.1998
Date Announced:	
Date Promulgated:	
Date Ended:	in force
Unit:	CC
Country:	Moldova
Year:	1998
Policy Status:	in force
Agency:	Ministry of Transport and Road Infrastructure (previously Ministry of Transport and Communications)
Funding:	
Further Information:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=311547
Enforcement:	
Penalty:	
Related Policies:	Road Transport Infrastructure Strategy for 2008-2017 http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=326894 Technical Regulation on authorizations for motor vehicles and certification of component parts http://www.cccec.md/Sites/cccec_md/Uploads/ultima%20varianta%20omologare1.3EA8D9A62C194F65B0D574BCCE7BAE86.pdf Low Carbon Development Strategy to the Year 2020 http://clima.md/lib.php?l=ro&idc=236& Road Traffic Regulation http://lex.justice.md/md/331491/
Policy Superseded by:	
Policy Supersedes:	
Stated Objective:	
Evaluation:	
Policy Type:	Policy Processes - Institutional Creation
Policy Target:	Freigh transportation Passenger transportation Transport regulation Motor vehicles

	Technical standards
URL:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=311547
Legal References:	Law nr 116-XIV from 29.07.1998
Description:	The Code regulates activities in the automotive transport sector and establishes the rights, obligations and responsibilities of transport service providers and beneficiaries. The Law sets the legal basis for the elaboration of a number of separate Regulations in the transport sector, including • on the vehicular transportation of passengers and freight • on the transportation of hazardous materials • on road safety at institutions and organisations providing passenger and freight transport services • on authorizations for international road transportation • on transport and expedition services • on transportation by heavy-weight and large-scale vehicles • on road traffic. The Code does not explicitly stipulate technical requirements and standards for vehicles and mentions that these are established through separate policies on state standards and technical requirements as well as Regulations, such as the Road Traffic Regulation 2009 and draft Technical Regulation on authorizations for motor vehicles and certification of component parts.

POLICY:	**Land Transport Infrastructure Strategy for 2008-2017**
Name of field:	**Content**
Date Effective:	12.02.2008
Date Announced:	
Date Promulgated:	
Date Ended:	In force
Unit:	EE
Country:	Moldova
Year:	2008
Policy Status:	In force
Agency:	Ministry of Transport and Road Infrastructure (previously Ministry of Transport and Communications)
Funding:	The total cost of activities stipulated in the Strategy is of MLD 40,058 mln (USD 3,184 mln). The Strategy describes 3 scenarios of fund allocation per priority activities depending on the availability of funds. Sources of funding:

	Road Fund State Budget External funding - EU (through the New Neighbourhood Policy); Millennium Challenge Corporation; World Bank/IDA; EBRD and EBI
Further Information:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=326894
Enforcement:	
Penalty:	
Related Policies:	• Low Carbon Development Strategy to the Year 2020 http://clima.md/lib.php?l=ro&idc=236& • "Republic of Moldova-European Union Action" Plan, Road Sector Program Support project supported by the Financing Agreement between Moldovan and the International Association for Development • Law on Road Fund http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=312866
Policy Superseded by:	
Policy Supersedes:	
Stated Objective:	
Evaluation:	Foreign Aid in Road Infrastructure Sector
Policy Type:	Policy Processes - Strategic Planning, Enhancement of Existing Policy
Policy Target:	Road infrastructure Road rehabilitation Institutional capacity
URL:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=326894
Legal References:	Government Resolution nr 85 from 01.02.2008
Description:	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 Strategy is in line with the Government's priorities including as set out in the "Republic of Moldova-European" Action Plan, and its implementation is supported through the Financing Agreement (the Road Sector Program Support project) between the Republic of Moldova and the International Development Association. 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; at the same time, the Strategy recognizes that environmental improvements from implementing its objectives will be limited to positive externalities from rehabilitation works, such as determining the composition of dust, controlling the level of noise, evacuation of hazardous wastes etc. At the same time, the Strategy stipulates that any new infrastructure project must include an environmental impact assessment and public consultations.

	The Strategy also makes reference to the Law on the Road Fund of 1996, which established a Road Fund for channelling various road proceeds (taxes, fees etc.) to finance activities in the road sector. In order to ensure a more adequate financing of the Road Fund's budget, the Strategy proposes the following financial and operational amendments to the Road Fund Law and Tax Code: • financial: direct financing through payments by road users in the form of excise taxes on fuel (included in the price of fuel), as well as other road taxes • operational include: the Fund's resources to be used only for maintenance and rehabilitation of existing road infrastructure; contracts for road maintenance works to be allocated through tenders; to carry out regular financial and technical auditing of the Fund.

AII-5. Agricultural Sector

POLICY:	National Strategy for Sustainable Development of the Agro-Industrial Complex 2008-2015
Name of field:	**Content**
Date Effective:	21.03.2008
Date Announced:	
Date Promulgated:	Government Decision on 11.03.2011
Date Ended:	In force
Unit:	Climate Change
Country:	Moldova
Year:	2008
Policy Status:	In force
Agency:	Ministry of Agriculture and Food Industry (previously Ministry of Agriculture and Processing Industry)
Funding:	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)
Further Information:	http://www.maia.gov.md/doc.php?l=ro&idc=48&id=13472
Enforcement:	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
Penalty:	
Related Policies:	The Concept for the system of subsidies applied to agricultural producers 2008-2015 http://aipa.md/index.php/legislatie Land Code of the Republic of Moldova http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=313324
Policy Superseded by:	
Policy Supersedes:	Strategy for the Development of the Agricultural and Food Sectors 2006-2015
Stated Objective:	Promoting competitive and sustainable agriculture; Harmonization with EU legislation; Improving institutional capacity in agriculture

Evaluation:	Report on the Implementation of the Activity Program of the Republic of Moldova "European Integration: Freedom, Democracy, Welfare 2011-2014" for the Period 2011-2012 http://moldovaportal.sites.mfa.gov.md/img/docs/raport-program-guvern-2011.pdf
Policy Type:	Policy Processes - Strategic Planning
Policy Target:	Sustainable agriculture Competitive agriculture Soil conservation Institutional capacity in agriculture Innovation and R&D in agriculture
URL:	http://www.maia.gov.md/doc.php?l=ro&idc=48&id=13472
Legal References:	Government Decision nr 282 from 11.03.2011
Description:	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. The Strategy's Plan of Actions spans from 2008 to 2015 and includes the following priorities: • promote a well-reasoned and justified subsidizing policy, using clear and transparent mechanisms • promote modernization in the agricultural sector through land consolidation • reduce GHG emissions in agriculture through sustainable agriculture works such as optimized crop structure and reduction of tillage • combat land degradation and increase carbon sequestration through afforestation, creation of forest belts around agricultural lands and water basins, creation of new vineyards • promote agricultural entrepreneurship by implementing trade regulations that will support exports of and will optimize import demand for agricultural products • enhance the national structure of the value chain by targeting the production and sales of primary products and processing • create incentives to attract investments in agriculture • promote innovation and R&D in agriculture • streamline the regulatory framework and improve the institutional capacity • support the cooperation and integration of farmers with the manufacturing industry and marketing area through republican and regional associations. The performance indicators are: • food security • favourable business climate • improved institutional capacity • efficient use and conservation of natural resources • harmonization of legislation to that of EU

POLICY:	**The Concept on the System of Subsidies Applied to Agricultural Producers 2008-2015**
Name of field:	**Content**
Date Effective:	17.12.2007
Date Announced:	
Date Promulgated:	Government Decision on 28.11.2007
Date Ended:	In force
Unit:	Climate Change
Country:	Moldova
Year:	2007
Policy Status:	In force
Agency:	Ministry of Agriculture and Food Industry (previously Ministry of Agriculture and Processing Industry) Ministry of Economy and Commerce Ministry of Finance
Funding:	Subsidies are approved through the Law on state budget on an annual basis.
Further Information:	http://aipa.md/index.php/legislatie
Enforcement:	Agency for Payments and Interventions in Agriculture
Penalty:	
Related Policies:	National Strategy for Sustainable Development of the Agricultural Complex 2008-2015 http://www.maia.gov.md/doc.php?l=ro&idc=48&id=13472
Policy Superseded by:	
Policy Supersedes:	
Stated Objective:	Improve process for subsidizing agricultural producers
Evaluation:	
Policy Type:	Incentives/Subsidies - Preferential Loans, Rebates
Policy Target:	Competitive agriculture Food security Improved investment opportunities in agriculture Organic agricultural products Poverty reduction Modernized agriculture
URL:	http://aipa.md/index.php/legislatie
Legal References:	Government Decision nr 1305 on 28.11.2007

Description:	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

POLICY:	**Program for Soil Fertility Conservation and Enhancement 2011-2020**
Name of field:	**Content**
Date Effective:	26.08.2008
Date Announced:	
Date Promulgated:	Government Decision on 20.08.2011
Date Ended:	In force
Unit:	Climate Change
Country:	Moldova
Year:	2011
Policy Status:	In force
Agency:	Agency for Land Relations and Cadastre Ministry of Agriculture and Food Industry (previously Ministry of Agriculture and Processing Industry)
Funding:	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).
Further Information:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=339882
Enforcement:	• Ensuring scientific knowledge base - relevant institutions subordinate to the central public administration authorities • Informational system on soil quality - Ministry of Agriculture and Food Industry and Agency for Land Relations and Cadastre • Soil conservation works - Agency for Land Relations and Cadastre, and "Moldsilva" Agency • Activities for improving soil fertility - local public administration • Training, information awareness - Ministry of Agriculture and Food Industry, Ministry of Environment, Academy of Sciences

Penalty:	
Related Policies:	List of financial means necessary to carry out the Plan of Actions for the implementation of the Program for Soil Fertility Conservation and Enhancement 2011-2013 http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=343049 Land Code of the Republic of Moldova http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=313324
Policy Superseded by:	
Policy Supersedes:	
Stated Objective:	Improve soil fertility; Implement soil conservation technologies; Improve the knowledge base on soil conservation and fertility
Evaluation:	
Policy Type:	Policy Processes - Strategic Planning
Policy Target:	Soil fertility Soil regeneration Soil erosion
URL:	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=339882
Legal References:	Government Decision nr 626 from 20.08.2011
Description:	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. The first phase of the Program spans from 2011 to 2013 and includes the following specific objectives: • improve the technical-scientific, and normative knowledge base concerning research and soil-improvement works • create an informational system of soil quality; draw up digital maps on soil degradation • implement projects for improving soil quality, including through combatting erosion, implementing pedo-ameliorative works, land clearing from degraded perennial plantings, hydrological planning of land etc. • improve soil fertility through various works, including conservative technologies such as no-tillage.

Annex III Cost-benefit Analysis

AIII-1. Energy Sector

AIII-1.1. Economic- financial analysis of Combined heat and power plants based on internal combustion engines of up to 500kW (ICE CHP)

According to the draft of National Energy Strategy up to 2030, 1050 MW of new capacities should be built in Moldova by 2020, including 650 MW of cogeneration power plants. The main requirement such target be achieved is the presence of heat demand. For the conditions of the Republic of Moldova, where the climate is moderately continental, characterized with relatively mild winters with little snow, long warm summers and low humidity, 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.

In order to identify the economic-financial characteristics of 500kW ICE CHP an appropriate model in Excel format was developed. It covers two cases:

a) ICE CHP replaces centralized heat and electricity supply for residential householders, i.e. several blocks are disconnected from centralized heating system and are connected to locally build ICE CHP. Such strategy is adequate for many country's cities where a radical restructuring of heating system is needed due to very inefficient of existent centralized heating systems. Base Line Scenario for this case reflect the existing, or future prices for centralized electricity and heat provided
b) ICE CHP for industrial and service providers (agriculture product processing enterprises, dairy products factories, hotels, campuses, etc). Base Line Scenario for this case reflects the separate production of heat,- by boiler houses, and electricity, - by a condensing PP with the efficiency of 37%, the one that is located in Transnistria, not recognized secessionist territory. This plant cover more than 70% of power demand of Moldova territory located on right bank of river Nistru.

For the future ICE CHP's investor the main aspect that should be known beforehand is to have assurance the project is feasible. It can be such if, first, the consumers' expenditure for heat and electricity generated by ICE CHP is less than it is recorded before ICE CHP is put in operation. Second, the price for ICE CHP heat and electricity should assure an internal rate of return (IRR) corresponded to country recognized risk. EBRD applies for its energy efficiency projects in Moldova (MoSEFF Project) a rate of return equal to 10%. So that the scope of the model elaborated was to determine, first of all, the conditions when IRR reach this value. In the same time CO2 emission reduction was calculated for each case of ICE CHP implementation.

The calculations maid by using the model along with the input data applied are presented in the Tables AIII-1, AIII-2, AIII-3, AIII-4.

Table AIII-1. Economic and Financial evaluation of ICE CHP

Input data ICE CHP		
Power Capacity	kW	500
Heat Capacity	kW	500
Specific investments	$SUA/kW	1150
ICE CHP overall efficiency	%	80

Construction duration	years	1
ICE CHP duration life	years	15
Power capacity duration time	h/year	5000
Heat capacity duration time	h/year	4500
Gas price	Lei/th m3	6221
	$/tce	441
Exchange rate	Lei/$	12,3
Specific O&M costs, excluding fuel	$/(kW*year)	168
CO2 reduction	tCO2/year	400
Electricity grid losses	%	13
Centralized Heat grid losses	%	19
National Grid Emission Factor	tCO2/MWh	0.4
Heat Grid Emission Factor	tCO2/MWh	0.244
Natural gas emission factor	tCO2/thm3	1.876
ICE CHP Economic parameters calculation		
Total investments	$	575,000
Specific fuel consumption	gce/kWh	154
Electricity delivered	th kWh	2500
Heat delivered	th kWh	2250
Annual fuel consumption	tce	730
TOTAL O&M costs, excluding fuel	$/year	84,000
Fuel cost	$/year	322394
Annual depreciation	$/year	38333
Electricity and Heat production Total costs	$/year	444,728
Overall energy price without profit	UScent/kWh	9.36
Base Line: ICE CHP for residential householders		
Supplier Electricity Price	Lei/kWh	200
	UScent/kWh	16.26
Centralized Supplier Heat Price	Lei/Gcal	987.00
	UScent/kWh	6.,90
Cost of electricity and heat bought from the Supplier	$	561,748
Weighted average energy tariff	UScent/kWh	11.83
Electricity losses in the grid	th kWh	374
Heat losses in the grid	th kWh	528
CO2 emission reduction	**tCO2**	**278**
ICE CHP total cost decrease vs Base Line	**%**	**20.83**

Base Line: ICE CHP for industrial and service providers		
Boiler House Capacity	kW	500
Specific Boiler House investments	$/kW	60
Boiler House Efficiency	%	94
Boiler House O&M costs, % from investments	%	2
Boiler House duration life	years	10
Gas price	Lei/th m3	6221
	$/tce	441
Investments	$	30000
Depreciation	$	3000
Specific fuel consumption	gce/kWh	131
Annual fuel consumption	tce	294
Fuel consumption cost	$/year	129,969
Total O&M costs, including fuel	$/year	130,569
Total Costs	$/year	133,569
Total Costs, including for electricity	$/year	540,073
Fuel burned at PP with 37% efficiency	tce	955
Total fuel burned by separated PP and Boiler House	tce	1249
Fuel saved by ICE CHP	tce	519
	th m3	454
CO2 Emission reduction	**tCO2**	**852**
ICE CHP total cost decrease vs Base Line	**%**	**17.65**

Table AIII-2. Financial analysis of ICE CHP for residential householders

Items		Years	1	2	3	10	15	16
INVESTMENTS	th US$		575					
Total O&M costs including cost of fuel	th US$			406	406	406	406	406
TOTAL Costs	th US$		575	406	406	406	406	406
INCOME	th US$			562	562	562	562	562
BENEFIT	th US$		-575	155	155	155	155	155
IRR 5 years	%	3						
IRR 10 years	%	23						
IRR 15 years	%	26						

Table AIII-3. Financial analysis of ICE CHP for industrial and service providers

Items		Years	1	2	3	10	15	16
INVESTMENTS	th US$		575					
Total O&M costs including cost of fuel	th US$			406	406	406	406	406
TOTAL Costs	th US$		575	406	406	406	406	406
INCOME	th US$			540	540	540	540	540
BENEFIT	th US$		-575	134	134	134	134	134
IRR 5 years	%	-3						
IRR 10 years	%	18						
IRR 15 years	%	22						

Table AIII-4. CO2 reduction from ICE CHP implementation

Items	units	ICE CHP for residential householders	ICE CHP for industrial and service providers
CO2 reduction of 500kW ICE CHP	tCO2	278.20	852
Potential for ICE CHP implementation, including:	MW	1000.00	13000
by 2015	MW		1000
by 2020	MW	1000.00	13000
CO2 reduction, including	tCO2	556.41	23859
by 2015	tCO2		1704
by 2020	tCO2	556.41	22155

As the analysis demonstrated the most sensible parameters that influence IRR are both the price for electricity and Heat capacity duration time (Thc). Thc should not be less than 4500h/year. As to the electricity tariff, at the moment for the voltage level of 0.4 kV it is established a tariff of 1.58 Lei/kWh for the consumers served by ICS RED Union Fenosa S.A., a private regulated distribution company that cover around 70% of country electricity demand, and 1.73 Lei/kWh - for regulated state distribution companies. The share of generated electricity costs in the tariff is more than 70%. In the same time 70% of this electricity is coming from Transnistria PP (TPP) for which not recognized transnistria authority established a price for gas significantly lower (150 US$/th m3 instead of around 400 US$/th m3) than one fix for R. of Moldova by GAZPROM, the single provider of natural gas to the country. In the following years gas price for TPP will increase. A such perspective demonstrates the last (2012) decision of transnistria authority to increase the price for gas from 150 to 220 US$/th m3. So that it is expected the price for electricity applied to consumers connected to grid voltage of 0.4 kV will increase much higher than 2.00 Lei/kWh in the following years. In the calculation maid the electricity tariff of 2.00 Lei/kWh was considered. At such tariff, the consumers' expenditure for heat and electricity consumed from ICE CHP is less by 21% than in the case of Base Line Scenario corresponded to residential householders and by 17.6% in the case of Base Line Scenario, corresponded to industrial and service providers. In the first case IRR for 10 years is 23%. for the second – 18%, i.e. the projects are feasible.

The first project – for residential householders- is planned to be implemented at the total capacity of 1MW by 2020, total investments required being equal to 1.15 million US$.

The second project – for industrial entities and service providers- is planned to be implemented at the total capacity of 14MW by 2020, total investments required being 16.1 million US$.

The first project assure 556 tCO2/year reduction by 2020, due to grid electricity and heat losses reduction, while the realization of the second project lead to 23859 tCO2/year reduction by the same year due to: a) a higher implementation rate and, b) higher energy efficiency at CHP than separate production of electricity and heat, power losses saving into the grid contributing as well.

The abovementioned projects will contribute to reach the National Low Emission Development Strategy goal, fix for energy sector: to undertake mitigation measures focused on reducing GHG emissions by 2020 with no less than 25% of the base year (1990) level.

The experience gained during projects implementation will serve as a jumping-off place for more ICE CHP promotion after 2020.

In other words, if ICE CHP projects are implemented at a total capacity of 15 MW by 2020 that will lead to cover 1.6% of Energy sector HAS emission reduction target established by SNC for 2020, or 7.7% of IAS target for the same year.

AIII-1.2. Economic- financial analysis of Gasification of Municipal Solid Waste for electricity/heat generation (G-MSW PP)

According to the draft of National Energy Strategy up to 2030, 1050 MW of new capacities should be built in Moldova by 2020, including 400 MW of renewable electricity sources. 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 missing. 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 gain68.
b) The stocking of municipalities' wastes 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.

Among the known technologies for waste processing the treatment based on waste gasification gaining more and more field for implementation and it ensures much more energy generation than Waste to Energy Technologies[69]. The best scheme to realize such projects in Moldova is to attract investors to enter into such deal, not by involving local

1 [68] WIND FARM promotion IMPACT ON NATIONAL POWER SYSTEM DEVELOPMENT. INTERNATIONAL CONFERENCE

2 "ENERGY OF MOLDOVA – 2012. REGIONAL ASPECTS OF DEVELOPMENT" October 4-6, 2012 - Chisinau, R. of Moldova

[69] http://www.ewp.rpi.edu/hartford/~stephc/EP/Research/Plasma%20Cycle/Choy(2004)-Process%20design%20and%20feasibility%20study%20for%20small%20scale%20MSW%20gasification.pdf

authorities' financial means that are missing. For the future G-MSW investor the main aspect that should be known beforehand is to have assurance the project is feasible. In order to determine the parameters that make such a project attractive for investments an Excel model of G-MSW plant was elaborated.

The calculations maid by using the model along with the input data applied are presented in the Tables AIII-5, AIII-6, AIII-7, AIII-8.

The first G-MSW project is planned to be built in Chisinau, the capital of the R. of Moldova. All the municipality wastes will be treated at one plant, located in the area of the city. The capacity of the plant is determined based on the caloric value of the wastes, their daily quantity processed and the load factor for electricity produced. The value obtained is 30 MW at generator bas-bar, the load factor of the plant is 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[70] 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.

Because of high value of investments needed for plant construction, around US$126 million, it is unlikely believe this project could be put in operation earlier than 2017-2018.

Table AIII-5 Economic and Financial evaluation of G-MSW PP

Input data G-MSW PP		
Power Capacity	kW	30,000
Specifc investments	$SUA/kW	4200
G-MSW CHP overall efficiency	%	**25.68**
Construction duration	years	2
G-MSW PP duration life	years	30
Power capacity duration time	h/year	6503
Gas price	Lei/th m3	5835
	$/tce	414
Exchange rate	Lei/$	12.3
Specific O&M costs, excluding fuel	$/(kW*year)	520
CO2 reduction, including from:	tCO2/year	**474,227**
The future CH4 emissions missed at landfill	tCO2eq/year	369,418
The displacement of electricity produced at Transnistria PP	tCO2eq/year	104,809
Natural gas emission factor	tCO2/thm3	1,876
G-MSW PP Calculation parameters		
Total investments	Mil $	126

[70] http://www.ecomagazin.ro/americanii-si-italienii-fac-energie-din-deseurile-noastre/

Specific fuel consumption	gce/kWh	479
Quantity of wastes used annually	tones	372,665
Low calorific value of wastes	kcal/kg	1100
Quantity of natural gas used annually	mil m3	18.369
Low calorific value of natural gas	kcal/m3	7963
Electricity produced	mil kWh	195.1
Electricity for own use	%	15
Quantity of electricity delivered into the network	mill kWh	165.8
TOTAL O&M costs, excluding fuel	mil$/year	15.6
Fuel cost	mil$/year	8.71
Annual depreciation	mil$/year	4.2
Total electricity production costs	mil$/year	28.51
Overall energy price without profit	UScent/kWh	**17.19**

Table AIII-6. Financial analysis of G-MSW PP

Items		Years	1	2	3	10	15	16
INVESTMENTS	th US$		126000					
Total O&M costs including cost of fuel	th US$			23346	24186	30417	35105	36117
TOTAL Costs	th US$		126000	23346	24186	30417	35105	36117
INCOME	th US$			51867	52099	55181	59212	60232
BENEFIT	th US$		-126000	28520	27913	24764	24106	24115
IRR 5 years	%	-5						
IRR 10 years	%	15						
IRR 15 years	%	19						

Table AIII-7. CO2 emission reduction from G-MSW PP implementation, tCO2/year

Items	tCO2/year
CO2 reduction, including from:	**474,227**
The future CH4 emissions avoided at landfill	369,418
The displacement of electricity produced at Transnistria PP	104,809

IRR is equal to 15% for the first 10 years, being negative for the first 5 years as rate of return taken into consideration is fix at the level of 14%, i.e. payback period is around 7 years. The calculation is made in the concept the electricity is sold only. For the input data above considered the price for electricity is not lower than 27 cent$/kWh, while at present the highest price for power generated at local CHPs is around 15 cent$/kWh. No doubt the price for electricity and payback period could be much lower if both the heat produced by the plant and CO2 reduction could be realized at the local market. For example, if expected GHG reduction (474 thousands tone of CO2) is sold on carbon market at a price of 10 $/tCO2, IRR reaches 17%, payback period being around 6 years. So that the economic-financial

parameters can be improved and that should demonstrate a more detailed feasibility study, that will take into consideration the possibility to sell the heat produced by G-MSW plant as well. Of course, other factors as higher load factor, higher waste caloric value, less specific investments may improve in edition G-MSW plant commercial offer.

From climate change point of view, the G-MSW project is very attractive by its potential to reduce GHG emissions. The effects come from two sources. From one site, 369,418 tCO2 reductions is obtained from future CH4 emissions avoided at landfill and, from another site, 104,809 tCO2 reduction due to the displacement of electricity produced at Transnistria PP that operates on natural gas at an efficiency of 37%.

The abovementioned project will contribute to reaching the National Low Emission Development Strategy (LEDS) goal, contributing to cover 98% of emission reduction target established for Waste sector, and 11% for Energy sector, all referring to most optimistic scenario, i.e. HAS, according to SNC.

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. The appropriate reserves are shown in the Table AIII-8 below

Table AIII-8. Annual Generation of MSW in the Republic of Moldova, tones/year

Locality	Inhabitants	Tones/ year	Locality	Inhabitants	Tones/ year	Locality	Inhabitants	Tones/ year
Chisinau	785,087	372,708	Soroca	101,489	11,234	Teleneşti	74,916	7,233
Bălţi	148,114	20,073	Anenii Noi	83,105	8,386	Ungheni	117,219	13,957
Briceni	76,590	7,463	Călăraşi	79,604	7,884	Basarabeasca	29,500	2,135
Donduşeni	46,388	3,774	Criuleni	72,787	6,945	Cahul	123,808	15,176
Drochia	91,492	9,641	Dubăsari	35,211	2,655	Cantemir	63,406	5,733
Edineţ	83,884	8,499	Hînceşti	123,499	15,118	Căuşeni	92,904	9,859
Făleşti	93,600	9,968	Ialoveni	97,987	10,664	Cimişlia	62,903	5,670
Floreşti	91,492	9,641	Nisporeni	67,386	6,235	Leova	53,896	4,600
Glodeni	62,893	5,669	Orhei	125,915	15,576	Ştefan Vodă	72,498	6,906
Ocniţa	56,801	4,936	Rezina	53,200	4,521	Taraclia	44,609	3,587
Rîşcani	71,297	6,746	Străşeni	91,491	9,640	Găgăuzia	159,717	22,632
Sîngerei	93,906	10,016	Şoldăneşti	44,109	3,535			
TOTAL	**3,572,703 inhabitants**				**669,013 tones/year**			

AIII-1.3. Economic- financial analysis of hybrid electric vehicles (HEV)

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. A total number of 3000 vehicles is estimated be implemented in these urban areas, including buses and minibuses. General information on HEV promotion in four Moldova cities is presented in the Table AIII-9

Table AIII-9. General data on HEV promotion in Moldova cities

Urban areas	Vehicle category	Population	Vehicles	Activity	Conventional technology fuel consumption		HEV technology fuel consumption	
		10^3	units	10^6 pkm	10^ tones	TJ	10^ tones	TJ
Chisinau	minibuses	789.5	1,784	1,199	13	552	9	370
	buses		182	408	4	152	2	102
Balti	minibuses	148.9	336	226	2	104	2	70
	buses		34	77	1	29	0	19
Tiraspol	minibuses	148.9	336	226	2	104	2	70
	buses		34	77	1	29	0	19
Tighina	minibuses	100.5	227	153	2	70	1	47
	buses		23	52	0	19	0	13
TOTAL, including		**1,188**	**2,958**	**2,417**	**25**	**1,059**	**17**	**710**
	minibuses		2,684	1,804	20	831	13	557
	buses		274	613	5	228	4	153

In order to identify technical and economical characteristics of HEV project a corresponding Excel model was developed, separately for buses and minibuses options. As conventional and HEV technologies cover the same passenger transport activity, the analysis is done for marginal contribution only. The model below presents separate analysis for bus and minibus.

Table AIII-10. Bus: initial data1

Indicators	Conventional technology	HEV technology	Conventional-HEV (marginal contribution)
1. Investment2, $	**130,000**	**169,000**	**-39,000**
2. Lifetime, yr	10	10	-
2. Maintenance costs3, $/yr	**1,300**	**1,690**	**-390**
3. Distance travelled, km/yr	56.000	56.000	-
4. Fuel savings[4], %	0%	33%	-
4. Specific fuel consumption, liters/100 km	35.0	23.5	-
5. Fuel consumption, tones/yr	20	13	-
6. Fuel price, $/litter	1,1	1,1	-
7. Fuel cost, $/yr	**22,227**	**14,892**	**7,335**
8. Labour and other costs[5], $/yr	-	-	-

[1] Because HEV technology is supposed to ensure the same activity as conventional one, income figures were excluded.

[2] The purchase costs of a hybrid bus can be 30% higher than a comparable non hybrid bus (Chandler and Walkowics, 2006).

[3] Maintenance usually it is deemed to be 10% of total value of the investment.

[4] Depending on the traffic dynamics, the hybrid buses have 23 – 43% lower CO2 emission and 18-39% lower NOx emissions compared to similar new non hybrid diesel articulated buses.

[5] Both technologies have the same labour and other costs.

Table AIII-11. Minibus: initial data1

Indicators	Conventional technology	HEV technology	Conventional-HEV (marginal contribution)
1. Investment[2], $/unit	**60,000**	**78,000**	**-18,000**
2. Lifetime, yr	10	10	-
2. Maintenance costs[3], $/yr	**600**	**780**	**-180**
3. Distance travelled, km/yr	56.000	56.000	-
4. Fuel savings[4], %	0%	33%	-
4. Specific fuel consumption, liters/100 km	13.0	8.7	-
5. Fuel consumption, tones/yr	7	5	-
6. Fuel price, $/litter	1,1	1,1	-
7. Fuel cost, $/year	**8,255**	**5,531**	**2,724**
8. Labour and other costs[5], $/yr	-	-	-

[1] Because HEV technology is supposed to ensure the same activity as conventional one, income figures were excluded.

[2] The purchase costs of a hybrid bus can be 30% higher than a comparable non hybrid bus (Chandler and Walkowics, 2006).

[3] Maintenance usually it is deemed to be 10% of total value of the investment.

[4] Depending on the traffic dynamics, the hybrid buses have 23 – 43% lower CO2 emission and 18-39% lower NOx emissions compared to similar new non hybrid diesel articulated buses.

[5] Both technologies have the same labour and other costs.

Based on marginal contribution it was calculated three economical-financial indicators: Net Present Value, Internal Rate of Return and Pay-Back Period. The results obtained are presented in the Table AIII-12 and Table AIII-13.

Table AIII-12. Bus: Calculation of marginal contribution

Indicators	Yr 1	Yr 2	Yr 3	Yr 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
1. Capital investments, $	-39,000	0	0	0	0	0	0	0	0	0
2. Annual marginal costs[1], $	6.945	7.292	7.657	8.040	8.442	8.864	9.307	9.772	10.261	10.774
3. Total, $	-32.055	7.292	7.657	8.040	8.442	8.864	9.307	9.772	10.261	10.774
NPV, $	16,216									
IRR, %	22%									
PB, yr	6,1									

[1] Starting from the second year annual costs are increased by CPI=5,0%/yr.

Table AIII-13. Minibus: calculation of marginal contribution

Indicators	Yr 1	Yr 2	Yr 3	Yr 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
1. Capital investments, $	-18,000	0	0	0	0	0	0	0	0	0
2. Annual marginal costs[1], $	2.544	2.672	2.805	2.946	3.093	3.247	3.410	3.580	3.759	3.947
3. Total, $	-15.456	2.672	2.805	2.946	3.093	3.247	3.410	3.580	3.759	3.947
NPV, $	2,567									
IRR, %	14%									
PB, yr	7,2									

[1] Starting from the second year annual costs are increased by CPI=5,0%/yr.

The economic and financial indicators demonstrate that HEV technology is viable. The most sensible drivers that influence the viability of HEV technology are additional investments, distance traveled (km/yr) and fuel price. Considering the same additional investments and fuel price, the annual traveled distance for buses should be at least 40 thousand km/year, and 49 thousand km/year for minibuses. In case of lower additional investments and higher fuel price the project becomes more attractive.

HEV technology implementation in four country's cities, i.e. Chisinau, Bălţi, Tighina and Tiraspol, will contribute to GHG emissions reduction by 26,300 tones per year, equivalent to 1.8% of GHG emission reduction target established for Energy sector by 2020, according to SNC High Alternative Scenario or 8.8% of SNC IAS.

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.

AIII-2. Agriculture Sector

AIII-2.1. Economic- financial analysis of No- till and Mini-till soil cultivation systems with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer

Due to the fact that No-till and Mini-till soil cultivation systems practically have the same economic-financial features, the analysis below is done for No-till technology mostly. In order to assess economic-financial parameters of these technologies an Excel calculation model was elaborated. As input data, those reflected in the appropriate TFSs have been used along with the specific technical and economic data of soil processing available from Moldova specialized agriculture enterprise SC "Pashcani Technological and Experimental Station"

A total of 200 000 hectares of agricultural soils will be allocated to be used per each of abovementioned technologies, annually 20 000 new agriculture surface being attracted in this process. The model take into consideration that in the first year 1/5 of the area, i.e. 4000 he, is sown with vetch seed and this area ensure a higher harvest only in the second year. In the third year 2/5 of the area, i.e. 8000 he, is sown with vetch seed, etc. Other four areas in the first year, three area in the second year, two areas in the third year, etc., are distinguished by lower harvest, corresponded to one grown on the area where classic tillage is applied. After five years a new rotation will follow. This aspect is shown in the Table AIII-14 below where input data for calculations is presented as well.

Table AIII-14. Economic-Financial analysis. Input data for No till soil cultivation system with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer

Input data		units	General value	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Total aria additionally involved in new technology	he		20000	20000	20000	20000	20000	20000	20000	20000	20000	20000
	Years of crop rotation	years	5										
Area sown per each seed	Vetch	he		4000	8000	12000	16000	20000	24000	28000	32000	36000	40000
	Maize	he		4000	8000	12000	16000	20000	24000	28000	32000	36000	40000
	Winter wheat	he		4000	8000	12000	16000	20000	24000	28000	32000	36000	40000
	Peas	he		4000	8000	12000	16000	20000	24000	28000	32000	36000	40000
	Sunflower	he		4000	8000	12000	16000	20000	24000	28000	32000	36000	40000
Area passed vetch fertilizer	Vetch	he											
	Maize	he		0	1000	3000	6000	10000	14000	19000	25000	32000	40000
	Winter wheat	he		0	1000	3000	6000	10000	14000	19000	25000	32000	40000
	Peas	he		0	1000	3000	6000	10000	14000	19000	25000	32000	40000
	Sunflower	he		0	1000	3000	6000	10000	14000	19000	25000	32000	40000
Area not passed vetch fertilizer	Vetch	he											
	Maize	he		4000	7000	9000	10000	10000	10000	9000	7000	4000	0
	Winter wheat	he		4000	7000	9000	10000	10000	10000	9000	7000	4000	0
	Peas	he		4000	7000	9000	10000	10000	10000	9000	7000	4000	0
	Sunflower	he		4000	7000	9000	10000	10000	10000	9000	7000	4000	0
Seed price	Vetch	€/kg	0.8										
	Maize	€/kg	1.9										
	Winter wheat	€/kg	0.4										
	Peas	€/kg	12.7										

Input data		units	General value	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Sunflower	€/kg	3.2										
Sowing norm	Vetch	kg/he	185										
	Maize	kg/he	25										
	Winter wheat	kg/he	200										
	Peas	kg/he	10										
	Sunflower	kg/he	10										
	Price of Fuel and lubricants	€/l	1.0										
Norm of fuel consumption	Vetch	l/he	109.2										
	Maize	l/he	46.6										
	Winter wheat	l/he	48										
	Peas	l/he	48										
	Sunflower	l/he	46.6										
Machinery O&M costs	Vetch	€/he	27.5										
	Maize	€/he	15.7										
	Winter wheat	€/he	15.0										
	Peas	€/he	15.0										
	Sunflower	€/he	15.7										
General and Administrative costs	Vetch	€/he	34.1										
	Maize	€/he	22.6										
	Winter wheat	€/he	21.1										
	Peas	€/he	21.1										
	Sunflower	€/he	22.6										
icide , Mine l	Vetch	€/he	0.0										

Input data		units	General value	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Maize	€/he	107.6										
	Winter wheat	€/he	107.6										
	Peas	€/he	107.6										
	Sunflower	€/he	107.6										
Total operating costs	Vetch	€/he	314.1										
	Maize	€/he	241.1										
	Winter wheat	€/he	268.8										
	Peas	€/he	319.4										
	Sunflower	€/he	225.3										
Crop production on land passed new technology	Vetch	tone/he	0										
	Maize	tone/he	4										
	Winter wheat	tone/he	3.5										
	Peas	tone/he	2.7										
	Sunflower	tone/he	2										
Crop production on land not passed new technology	Vetch	tone/he	0										
	Maize	tone/he	3										
	Winter wheat	tone/he	2.5										
	Peas	tone/he	2										
	Sunflower	tone/he	1.5										
Selling Crop Price	Vetch	€/tone	759.5										
	Maize	€/tone	189.9										
	Winter wheat	€/tone	221.5										
	Peas	€/tone	253.2										

Input data		units	General value	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Sunflower	€/tone	379.7										
Income from Crop Selling harvested on vetch land	Vetch	€/he	0.0										
	Maize	€/he	759.5										
	Winter wheat	€/he	775.3										
	Peas	€/he	683.5										
	Sunflower	€/he	759.5										
Income from Crop Selling harvested on not vetch land	Vetch	€/he	0.0										
	Maize	€/he	569.6										
	Winter wheat	€/he	553.8										
	Peas	€/he	506.3										
	Sunflower	€/he	569.6										
	Exchange rate	Lei/€	15.8										
	CO2 reduction by technology	tCO2/he/year	2.54										
	CO2 criteria (1-CO2 reduction is sold; 0-Not)		0										
	CO2 reduction price on the market	€/tCO2	10										
	Discount rate	%	9%										
	Specific investments in the technology	€/he	119										

The calculation made permitted to obtain the following results presented in the Table AIII-15

Table AIII-15. Economic-Financial output for No till soil cultivation system with preliminary positive recovery of the post-arable layer and use of vetch as intermediary crop for green fertilizer

Input data		units	General value	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	CO2 reduction	**tCO2**		**0**	**10.160**	**30.480**	**60.960**	**101.600**	**142.240**	**193.040**	**254.000**	**325.120**	**406.400**
	Investments	**mil. €**		**2,4**	**2.4**	**2.4**	**2.4**	**2.4**	**2.4**	**2.4**	**2.4**	**2.4**	**2.4**
	Operating costs	**mil. €**		**5.5**	**11.0**	**16.4**	**21.9**	**27.4**	**32.9**	**38.3**	**43.8**	**49.3**	**54.8**
	TOTAL COSTS	mil. €		**7.9**	**13.3**	**18.8**	**24.3**	**29.8**	**35.2**	**40.7**	**46.2**	**51.7**	**57.1**
INCOME from grains sold	Vetch	mil. €		0	0	0	0	0	0	0	0	0	0
	Maiz	mil. €		2.3	4.7	7.4	10.3	13.3	16.3	19.6	23.0	26.6	30.4
	Winter	mil. €		2.2	4.7	7.3	10.2	13.3	16.4	19.7	23.3	27.0	31.0
	Peas	mil. €		2.0	4.2	6.6	9.2	11.9	14.6	17.5	20.6	23.9	27.3
	Sunflower	mil. €		2.3	4.7	7.4	10.3	13.3	16.3	19.6	23.0	26.6	30.4
	INCOME from CO2 reduction selling	mil. €		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL INCOME	mil. €		**8.8**	**18.4**	**28.7**	**39.9**	**51.8**	**63.7**	**76.4**	**89.8**	**104.1**	**119.1**
	BENEFITS	**mil. €**		**0.9**	**5.0**	**9.9**	**15.6**	**22.0**	**28.5**	**35.7**	**43.7**	**52.4**	**62.0**
	NPV 5years	**mil. €**	**$38.13**										

AIII-2.2. General analysis of costs and benefits of No-till (Mini-till) technology

During 10 years, each year, a sum of 2.4 million Euro investments should be spent to implement No-till technology on the area of 20 000 hectares. The same sum and the same area – should be involved to implement Mini-till technology. Operating costs for one technology start with 5,5 million in the first year for 20 000 hectares and reach 54.8 million Euro in the Year 10 for 200 000 hectares. Benefits calculated show that this business is quite profitable. Less than two years are needed to return the investments made. Payback period would be even less if CO2 reduction is sold on carbon market. In the second year 10 160 tCO2 reduction will be recorded, it increasing up to 406 400 tCO2 in the Year 10. The same figures correspond to Mini-till technology.

AIII-2.3. Economic- financial analysis of Classic tillage, including a vetch field (two yields per year – autumn and spring), as a „green fertilizer field" into a 5-fields crop rotation

In order to assess economic-financial parameters of this technologies an Excel calculation model was elaborated. As input data those reflected in the appropriate TFS have been used along with the specific technical and economic data of soil processing available from Moldova specialized agriculture enterprise SC "Pashcani Technological and Experimental Station"

A total of 200 000 hectares of agricultural soils will be allocated to be used per abovementioned technologies, annually 20 000 new agriculture surface being attracted in this process. The model take into consideration that in the first year 1/5 of the area, i.e. 4000 he , is sown with vetch seed and this area ensure a higher harvest only in the second year . In the third year 2/5 of the area, i.e. 8000 he, is sown with vetch seed, etc. Other four areas in the first year, three area in the second year, two areas in the third year, etc., are distinguished by lower harvest, corresponded to one grown on the area where classic tillage without vetch field is applied. After five years a new rotation will follow. This aspect is shown in the Table AIII-16 below where input data for calculations is presented as well.

Table AIII-16. Economic-Finantial analysis. Input data for Classic tillage, including a vetch field, as a „green fertilizer field" into a 5-fields crop rotation

Input data		units	General value	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Total aria additionally involved in new technology	he		20000	20000	20000	20000	20000	20000	20000	20000	20000	20000
	Years of crop rotation	years	5										
Area sown per each seed	Vetch	he		4000	8000	12000	16000	20000	24000	28000	32000	36000	40000
	Maize	he		4000	8000	12000	16000	20000	24000	28000	32000	36000	40000
	Winter wheat	he		4000	8000	12000	16000	20000	24000	28000	32000	36000	40000
	Peas	he		4000	8000	12000	16000	20000	24000	28000	32000	36000	40000
	Sunflower	he		4000	8000	12000	16000	20000	24000	28000	32000	36000	40000
Area passed vetch fertilizer	Vetch	he											
	Maize	he		0	1000	3000	6000	10000	14000	19000	25000	32000	40000
	Winter wheat	he		0	1000	3000	6000	10000	14000	19000	25000	32000	40000
	Peas	he		0	1000	3000	6000	10000	14000	19000	25000	32000	40000
	Sunflower	he		0	1000	3000	6000	10000	14000	19000	25000	32000	40000
Area not passed vetch fertilizer	Vetch	he											
	Maize	he		4000	7000	9000	10000	10000	10000	9000	7000	4000	0
	Winter wheat	he		4000	7000	9000	10000	10000	10000	9000	7000	4000	0
	Peas	he		4000	7000	9000	10000	10000	10000	9000	7000	4000	0
	Sunflower	he		4000	7000	9000	10000	10000	10000	9000	7000	4000	0
Seed price	Vetch	€/kg	0.8										
	Maize	€/kg	1.9										
	Winter	€/kg	0.4										
	Peas	€/kg	12.7										

Input data		units	General value	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Sunflower	€/kg	3.2										
Sowing norm	Vetch	kg/he	185										
	Maize	kg/he	25										
	Winter wheat	kg/he	200										
	Peas	kg/he	10										
	Sunflower	kg/he	10										
	Price of Fuel and lubricants	€/l	1.0										
Norm of fuel consumption	Vetch	l/he	109.2										
	Maize	l/he	94.4										
	Winter wheat	l/he	87.4										
	Peas	l/he	83										
	Sunflower	l/he	94.4										
Machinary O&M costs	Vetch	€/he	27.5										
	Maize	€/he	28.1										
	Winter wheat	€/he	24.4										
	Peas	€/he	23.3										
	Sunflower	€/he	28.1										
General and Administrative costs	Vetch	€/he	34.1										
	Maize	€/he	40.2										
	Winter wheat	€/he	35.0										
	Peas	€/he	34.2										
	Sunflower	€/he	40.2										
cide, Mine ral	Vetch	€/he	0.0										

Input data		units	General value	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Maize	€/he	107.6										
	Winter wheat	€/he	107.6										
	Peas	€/he	107.6										
	Sunflower	€/he	107.6										
Total operating costs	Vetch	€/he	**314.1**										
	Maize	€/he	**320.1**										
	Winter wheat	€/he	**332.6**										
	Peas	€/he	**376.9**										
	Sunflower	€/he	**304.3**										
Crop production on land passed new technology	Vetch	tone/he	0										
	Maize	tone/he	4										
	Winter wheat	tone/he	3.5										
	Peas	tone/he	2.7										
	Sunflower	tone/he	2										
Crop production on land not passed new technology	Vetch	tone/he	0										
	Maize	tone/he	3										
	Winter wheat	tone/he	2.5										
	Peas	tone/he	2										
	Sunflower	tone/he	1.5										
Selling Crop Price	Vetch	€/tone	759.5										
	Maize	€/tone	189.9										
	Winter wheat	€/tone	221.5										
	Peas	€/tone	253.2										

Input data		units	General value	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Sunflower	€/tone	379.7										
Income from Crop Selling harvested on vetch land	Vetch	€/he	0.0										
	Maize	€/he	759.5										
	Winter wheat	€/he	775.3										
	Peas	€/he	683.5										
	Sunflower	€/he	759.5										
Income from Crop Selling harvested on not vetch land	Vetch	€/he	0.0										
	Maize	€/he	569.6										
	Winter wheat	€/he	553.8										
	Peas	€/he	506.3										
	Sunflower	€/he	569.6										
	Exchange rate	Lei/€	15.8										
	CO2 reduction by technology	tCO2/he/year	2.03										
	CO2 criteria (1-CO2 reduction is sold; 0-Not)		0										
	CO2 reduction price on the market	€/tCO2	10										
	Discount rate	%	9%										
	Specific investments in the technology	€/he	170.6										

The calculation made permitted to receive the following results presented in the Table AIII-17.

Table AIII-17. Economic-Financial output for Classic tillage, including a vetch field, as a „green fertilizer field" into a 5-fields crop rotation

Input data		units	General value	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	CO2 reduction	**tCO2**		**0**	**8.120**	**24.360**	**48.720**	**81.200**	**113.680**	**154.280**	**203.000**	**259.840**	**324.800**
	Investments	**mil. €**		**3,4**	**3,4**	**3,4**	**3,4**	**3,4**	**3,4**	**3,4**	**3,4**	**3,4**	**3,4**
	Operating costs	**mil. €**		**6,6**	**13,2**	**19,8**	**26,4**	**33,0**	**39,6**	**46,1**	**52,7**	**59,3**	**65,9**
	TOTAL COSTS	mil. €		**10,0**	**16,6**	**23,2**	**29,8**	**36,4**	**43,0**	**49,6**	**56,1**	**62,7**	**69,3**
INCOME from grains sold	Vetch	mil. €		0	0	0	0	0	0	0	0	0	0
	Maiz	mil. €		2,3	4,7	7,4	10,3	13,3	16,3	19,6	23,0	26,6	30,4
	Winter	mil. €		2,2	4,7	7,3	10,2	13,3	16,4	19,7	23,3	27,0	31,0
	Peas	mil. €		2,0	4,2	6,6	9,2	11,9	14,6	17,5	20,6	23,9	27,3
	Sunflower	mil. €		2,3	4,7	7,4	10,3	13,3	16,3	19,6	23,0	26,6	30,4
	INCOME from CO2 reduction selling	mil. €		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	TOTAL INCOME	mil. €		**8,8**	**18,4**	**28,7**	**39,9**	**51,8**	**63,7**	**76,4**	**89,8**	**104,1**	**119,1**
	BENEFITS	**mil. €**		**-1,2**	**1,8**	**5,5**	**10,1**	**15,4**	**20,7**	**26,8**	**33,7**	**41,3**	**49,8**
	IRR 5 years	%	263%										
	IRR 6 years	%	268%										
	IRR 7 years	%	270%										
	IRR 8 years	%	270%										
	IRR 9 years	%	271%										
	IRR 10 years	%	271%										
	NPV 5years	mil. €	$21,82										

AIII-2.4. General analysis of costs and benefits of Classic tillage, including a vetch field, as a „green fertilizer field" into a 5-fields crop rotation

During 10 years, each year, a sum of 3,4 million Euro investments should be spent to implement Classic tillage with vetch technology on the area of 20 000 hectares. Operating costs for one technology start with 6,6 million in the first year for 20 000 hectares and reach 65,9 million Euro in the Year 10 for 200 000 hectares. Benefits calculated show that this business is one profitable. Less than three years are needed to return the investments made. Payback period would be even less if CO2 reduction is sold on carbon market. In the second year 8 120 tCO2 reduction will be recorded, it increasing up to 324 800 tCO2 in the Year 10.

AIII-2.5. Climate Change benefits from new three agriculture technologies considered

If starting with 2014 all three technologies are put in operation in the volume described above the following emission reduction will be recorded during 10 years

Table AIII-18. CO2 reduction if all new three soil technologies are implemented

Technology	**units**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
No-till	th tCO2	10	30	61	102	142	193	254	325	406
Mini-till	th tCO2	10	30	61	102	142	193	254	325	406
Classic+vetch	th tCO2	8	24	49	81	114	154	203	260	325
TOTAL	th tCO2	**28**	**85**	**171**	**284**	**398**	**540**	**711**	**910**	**1,138**
Target of CO2 reduction in Agriculture sector according to SNC	th tCO2	**162**					**323**			
Contribution of No-till, Mini-till and Classic tillage with vetch 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 AIII-18 by 2020 the implementation of the technologies will assure a much higher CO2 reduction, than it was planned by SNC for agriculture sector: 540,4 th tCO2 instead of 323 th tCO2 reduction planned. 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.

Annex IV List of stakeholders involved

The National TNA team includes a TNA Coordinator, a wide range of stakeholders to constitute the National TNA Committee and National Consultants/experts organized in workgroups. A National Steering Committee is envisaged as the top most decision making body of the TNA Project, comprising policy makers from relevant key ministries.

National Steering Committee is viewed as the top most decision making body of the project. The National Steering Committee is comprised of members responsible for policy making from relevant ministries as well as key stakeholders from the academia sector and civil society. The National Steering Committee provides political acceptance to the TNA process and is also responsible for appointment the National TNA Committee, as well as for the political acceptance for the Technology Action Plan (TAP).

AIV-1. Republic of Moldova National Steering Committee

1. **TNA Coordinator:**
   PhD Vasile SCORPAN
2. **Members of National Steering Committee:**

1) H.E. Gheorghe SALARU, Minister, Ministry of Environment; UNFCCC and GEF Focal Point, Head of National Steering Committee;
2) Mrs. Maria NAGORNII, Head of Direction, Direction Analysis, Monitoring and Policies Evaluation, Ministry of Environment, Steering Committee Member.
3) Mr. Pintilie PIRVAN, Head of Direction, Food Industry Direction, Ministry of Agriculture and Food Industry, Steering Committee Member.
4) PhD Vladimir BERZAN, Director, Institute of Power Engineering, Academy of Sciences of Moldova, Steering Committee Member.
5) Prof., PhD Petru TODOS, first vice-rector, vice-president of the Council of Administration of the Technical University of Moldova; Technical University of Moldova, Steering Committee Member.
6) Mr. Stefan LOZINSCHII, Director, Association of Environment Radio Journalists "ECOTERA" (NGO), Steering Committee Member.

3. **Members of National TNA Committee:**

1) Mrs. Galina PARSIAN, Deputy Head of Direction, Thermo Power Direction; Ministry of Economy,
2) Mrs. Tamara ROZNERITA, Deputy Head, Direction Ecological Agriculture, Renewable Energy and Irrigation, Ministry of Agriculture and Food Industry,
3) Mr. Sergiu BRUMA, Head of Direction, Direction of Technology Transfer, Agency of Innovation and Technology Transfer, Academy of Sciences of Moldova;
4) PhD Mihai TIRSU, Deputy-Director, Institute of Power Engineering, Academy of Sciences of Moldova;
5) Prof., PhD Dumitru UNGUREANU, vice-rector for practical instruction, social issues and relationships with technical colleges, Technical University of Moldova;
6) Prof., PhD Grigore MARIAN, State Agrarian University of Moldova, Faculty of Agricultural Engineering and Auto Transportation, Department of Machines Maintenance and Materials Engineering;
7) PhD. Andrei CHICIUC, Vice-director "Energie Plus" University Centre, Technical University of Moldova.
8) Prof., PhD Aurel GUTU, Technical University of Moldova
9) Prof., Grigore FRIPTULEAC, the State University of Medicine and Pharmaceuticals of Moldova "Nicolae Testimiteanu".

4. Institutions Overview

1) Ministry of Environment;
2) Ministry of Economy;
3) Ministry of Agriculture and Food Industry;
4) Agency of Innovation and Technology Transfer of the Academy of Sciences of Moldova;
5) Institute of Power Engineering of the Academy of Sciences of Moldova;
6) Institute of Agriculture Technics "MECAGRO" of the Academy of Sciences of Moldova;
7) Practical Scientific Institute of Plant Growing of the Academy of Sciences of Moldova;
8) Technical State University;
9) State Agrarian University of Moldova;
10) RED Union Fenosa S.A.;
11) MOLDAGROTEHNICA S.A.;

AIV-2. Stakeholders involved in Barrier Analysis and Enabling Framework identification

Table AIV-1. Experts involved in the Barrier Analysis and Enabling Framework identification

No	Expert name	Position, title, Institution	Area of expertise
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
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)
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)
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

Table AIV-2. Ministries involved in the Barrier Analysis and Enabling Framework identification

No	Name	Ministry, Position, title, Institution	Area of expertise	Approach of consultation
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
2	Moraru Marcelina	Ministry of Transport and Road Infrastructure, Director of the Department for International Relations and European Integration	Hybrid electric vehicles (HEV)	Meetings
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