PROMITHEAS – 4

Knowledge transfer and research needs for preparing mitigation/adaptation policy portfolios

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Evaluation of Mitigation / Adaptation policy portfolios for Moldova

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

Abbreviation	Full name
ANCE	National Agency for Energy Conservation
ANRE	National Agency for Regulation of Energy
BAT	Best Available Technologies
BAU	Busines As Usual
CDM	Clean Development Mechanism
CERs	Certified Emission Reductions
CHP	Combined Heat and Power
CCS	Carbon Capture and Storage
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EE	Energy Efficiency
EEA	European Environmental Agency
EEF	Energy Efficiency Fund
ENPI	European Neighboring Policy Instrument
ERUs	Emission Reduction Units
ESCO	Energy Services Company
EU	European Union
FNC	First National Communication
GHG	Greenhouse Gas
GWP	Global Warming Potential
HPP	Hydro Power Plants
IEA	International Energy Agency
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Chang
MIEPO	Moldovan Investment and Export Promotion Organization
MoE	Ministry of Energy
NC	National Communication
NDS	National Development Strategy
NEEP	National Energy Efficiency Program
NEU	Northern Europe
RES	Renewable Energy Sources
SEM	Southern Europe and Mediterranean
SNC	Second National Communication
TPP	Thermal Power Plant
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

ASSESSMENT OF THE THREE DEVELOPED SCENARIOS FOR MOLDOVA, THROUGH THE MULTI - CRITERIA METHOD AMS

General comments

Each scenario will be assessed for its performance under the criteria/sub-criteria of the AMS method which is the combination of three standard multi-criteria methods: the Analytical Hierarchy Process (AHP), the Multi-Attribute Utility Theory (MAUT) and the Simple Multi-Attribute Ranking Technique (SMART) (P.Konidari and D.Mavrakis, 2007; 2006). AMS is developed for evaluating climate policy instruments (PI) or relevant Policy Mixes (PM) and with suitable modification for evaluating their interactions as well.

Required data

The LEAP provides the following outcomes for all three scenarios:

Table 1: Total emissions for the country.

Scenario	Total GHG emissions (in $MtCO_2eq$)		
	2000	**2020**	**2050**
BAU	7,953	10,838	25,549
Opt	7,953	8,741	23,128
Pes	7,953	9,181	23,964

Table 2: Emissions per sector for the country.

Scenario	GHG emissions (in $MtCO_2eq$)		
	2000	**2020**	**2050**
Households			
BAU	1,022	2,228	4,653
OPT	1,022	1,664	3,786
PES	1,022	2,158	4,690
Agriculture			
BAU	0,207	0,167	0,260
OPT	0,207	0,159	0,288
PES	0,207	0,151	0,203
Non Specified			
BAU	0,211	0,487	0,666
OPT	0,211	0,398	0,578
PES	0,211	0,443	0,622
Industry			
BAU	0,257	0,373	0,781
OPT	0,257	0,346	1,078
PES	0,257	0,321	0,606
Transport			
BAU	0,485	1,610	5,223
OPT	0,485	1,379	4,840
PES	0,485	1,501	5,058
Electricity generation			
BAU	1,502	1,829	1,910
OPT	1,502	0,703	1,557
PES	1,502	0,475	1,136
Heat Production			
BAU	0,483	0,528	1,320
OPT	0,483	0,291	0,266
PES	0,483	0,679	0,910

Table 3: Other environmental effects for the country under each scenario

Scenario	Million Metric Tonnes CO_2 eq		
	2000	2020	2050
Environmental effects (Carbon Monoxide (CO)- Nitrogen Oxides (NOx)- Non Methane Volatile Organic Compounds- Sulfur Dioxide)			
BAU	0,102	0,280	0,843
OPT	0,102	0,827	2,560
PES	0,102	0,521	1,250

Table 4: Water Use.

Scenario	Billion m^3		
	2000	**2020**	**2050**
Agriculture			
BAU	0,107	0,071	0,038
OPT	0,107	0,092	0,133
PES	0,107	0,092	0,120

Assignment of grades

The software ClimAMS-2012 is used for the evaluation of the scenarios (Figure 43).

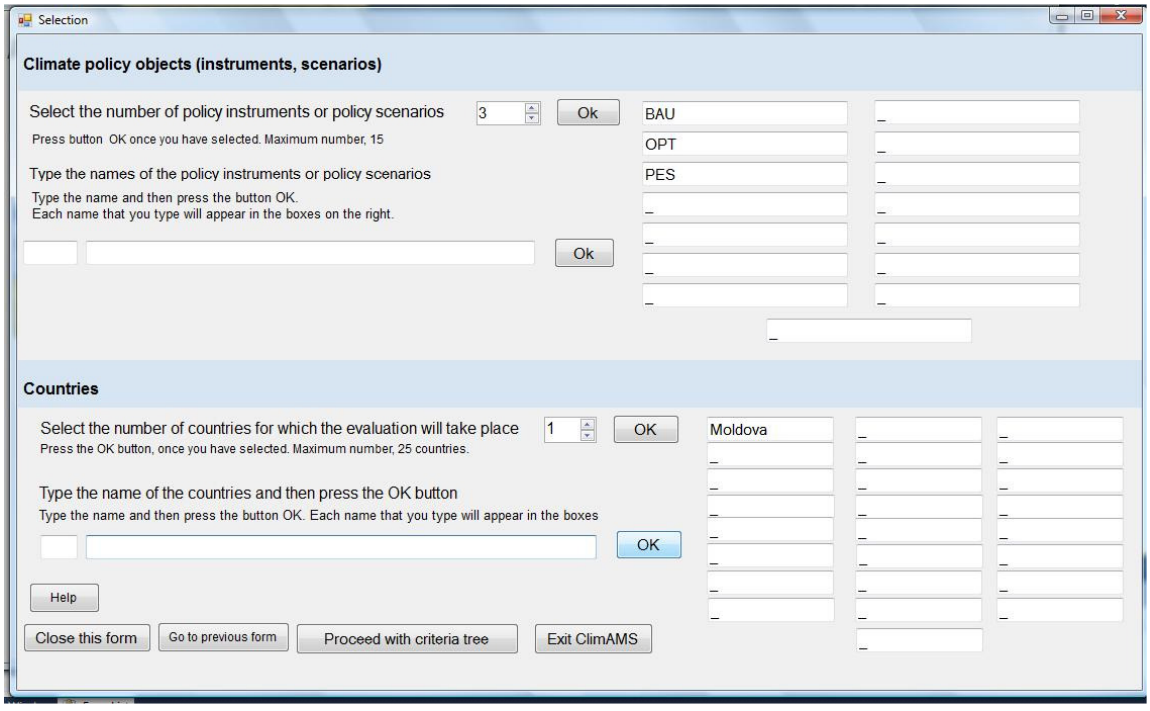

Figure 1: ClimAMS-2012.

Criterion 1: Environmental performance

Direct contribution to GHG emission reductions: For this sub-criterion, the outcome of LEAP for the total expected GHG emissions in year 2020 are used (Table 3). The scenario with the fewer amounts of emissions has the best performance for this sub-criterion.

Indirect environmental effects: The total amount of the total environmental effects provided by LEAP (Table 5) is used to assess the sub-criterion.

As a next step, the 2020 data is entered in ClimAMS (with negative value) to calculate respectively the direct effect on GHG emissions and indirect environmental effects.

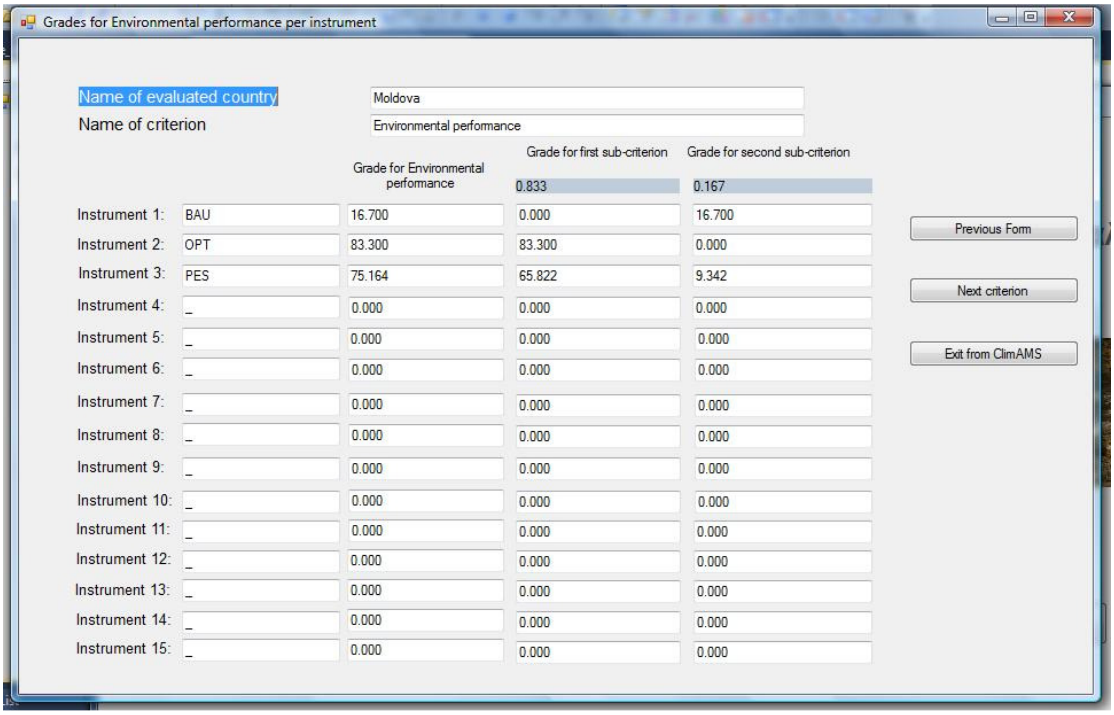

Figure 2: Grades for Environmental performance.

Criterion 2: Political acceptability

Each scenario is evaluated against each of the five sub-criteria of this criterion.
For ***cost efficiency*:** For the first sub-criterion the mean CEI for each sector was calculated depending on the policy instruments that were under each scenario. Each value was multiplied with the respective amount of GHG emission reductions that were estimated by LEAP outcomes. The reductions were calculated against those of the BAU scenario for each sector.

Concerning adaptation, due to no available data these were not calculated for Moldova. Additionally, there were no specific measures for the described sectors in the respective previous session about the adaptation needs of the country that could be taken into consideration. The total values are inserted in ClimAMS, but as positive ones.

The policy portfolio with the lowest total cost is the one with the best performance for year 2020.

Table 5: Mean CEI for each sector depending on the policy instruments of the BAU scenario.

Mitigation					
Scen.	**Sector**	**Technological options**	**Policy instrument**	**CEI**	**Mean CEI**
BAU	Buildings	-	-	-	-
	Industry	-	-	-	-
	Transport	-	-	-	-
	Energy	Promotion of RES technologies	Regulation standards (Methodology - Guarantees of origin) (Regulation – ANRE Decisions No. 321/2009 and No. 330/2009)	-0,75	(-0.75-0,25-0,75)/3= -0,583
		Promotion of RES technologies	Subsidy (Feed-in-tariffs) (Law No. 160-XVI, 2007)	-0,25	
		Energy management	Performance standards (energy certificates,) (Law No. 142/2010)	-0,75	

Table 6: Mean CEI for each sector depending on the selected policy instruments of the OPT scenario.

Mitigation					
Scen.	**Sector**	**Technological options**	**Policy instrument**	**CEI**	**Mean CEI**
OPT	Buildings	Energy management	Performance standards (Draft Law – Road map – incorporating Directives for labeling)	-5,75	(-5,75-2,5-2,5-0,25)/4 = -2,75
		Energy efficient lighting	Performance standards (Incorporating Directive 98/11/EC)	-2,5	
		Energy efficient appliances	Performance standards (Incorporating Directives for home appliances)	-2,5	
		Energy management	Behavior change - Proposed	-0,25	
	Industry (also for non-specified)	Best Available Technologies for restricting air pollution	Technological or design standards (incorporating Directive 2001/80/EC)	+1,25	(+1,25-0,25-1,25-0)/4 = -0,063
		Promotion of RES and EE technologies	Tradable permits – Proposed	-0,25	
		Energy efficient technologies	Voluntary agreements (Proposed)	0	
		Energy efficient technologies	Regulatory standards (White certificates) (Proposed)	-1,25	
	Transport	Energy efficiency	Performance standards (transport management, speed limits) – Planned - Proposed	+0,5	(+0,5+0,25-1,75-0,25-0,25)/5 = -0,4
		Energy efficiency	Fuel switch (promotion of biofuels)	+0,25	
		Energy efficient vehicles	Technological standards (standards for CO2 emissions, vehicle labeling, fuel efficiency) - Proposed	-1,75	
		Energy efficiency	Behavior change - Proposed	-0,25	
		Energy efficient vehicles	Financial policy instruments (Subsidy) – Proposed	-0,25	
	Energy	Promotion of RES technologies	Regulation standards (Methodology - Guarantees of origin – free zones) (Regulation – ANRE Decisions No. 321/2009 and No. 330/2009)	-0,75	(-0,75-0,25-0,75+1,25-0,25)/5= -0,15
		Promotion of RES technologies	Subsidy (Feed-in-tariffs) (Law No. 160-XVI, 2007)	-0,25	
		Energy management	Performance standards (energy certificates) (Law No. 142/2010)	-0,75	
		Best Available Technologies for restricting air pollution	Technological or design standards (incorporating Directive 2001/80/EC)	+1,25	
		Promotion of RES and EE technologies	Tradable permits – Proposed	-0,25	
Adaptation					
	Agriculture	Irrigation systems, plantations	Subsidy - Proposed	+0,5	(0,5-1/6)/2 = 0.167
			Awareness	-1/6	

	Water management		Land management	-1/6	-1/6
	Forestry		Land management	+0,5	+0,5

Table 7: Mean CEI for each sector depending on the selected policy instruments of the PES scenario.

Mitigation					
Scen.	**Sector**	**Technological options**	**Policy instrument**	**CEI**	**Mean CEI**
PES	Buildings	Energy management	Performance standards (Draft Law – Road map – incorporating Directives for labeling)	-5,75	(-5,75-2,5-2,5)/3 = -3,583
		Energy efficient lighting	Performance standards (Incorporating Directive 98/11/EC)	-2,5	
		Energy efficient appliances	Performance standards (Incorporating Directives for home appliances)	-2,5	
	Industry	Best Available Technologies for restricting air pollution	Technological or design standards (incorporating Directive 2001/80/EC)	+1,25	+1,25
	Transport	Energy efficiency	Fuel switch (promotion of biofuels)	+0,25	+0,25
	Energy	Promotion of RES technologies	Regulation standards (Methodology - Guarantees of origin – free zones) (Regulation – ANRE Decisions No. 321/2009 and No. 330/2009)	-0,75	(-0,75-0,25-0,75+1,25-0,25)/5= -0,15
		Promotion of RES technologies	Subsidy (Feed-in-tariffs) (Law No. 160-XVI, 2007)	-0,25	
		Energy management	Performance standards (energy certificates) (Law No. 142/2010)	-0,75	
		Best Available Technologies for restricting air pollution	Technological or design standards (incorporating Directive 2001/80/EC)	+1,25	
		Promotion of RES and EE technologies	Tradable permits – Proposed	-0,25	
Adaptation					
	-	-	-	-	-

Table 8: Overall cost efficiency for the three scenarios.

Scen.	Mitigation/Adaptation Cost										Total
	Buildings		Non-specified		Industry		Transport		Energy		
	M	A	M	A	M	A	M	A	M	A	
BAU	0	0	0	0	0	0	0	0	0	0	0
OPT	-1,551	0	-0,006	0	-0,002	0	-0,092	0	-0,205	0	-1,853
PES	-0,251	0	+0,055	0	+0,065	0	+0,027	0	-0,203	0	-0,307

For *"**dynamic cost efficiency**"* – renewable energy technologies and energy efficient appliances and equipment are encouraged mainly in the OPT scenario. The other two scenarios perform badly in this sub-criterion since there are no policy instruments to promote these technologies. Additionally, no research efforts for other RES technologies are promoted in any scenario. The assigned grades: BAU – 4, OPT – 5 PES – 4.

For *"**competitiveness**"* - The Republic of Moldova has a relatively small and open economy (OECD, 2011). Although legislation related to investment policy is up to standard and refers to national treatment of foreign investors, the latter still face heavy restrictions in specific areas such as the acquisition of agricultural land (OECD, 2011). A more favorable business environment is created in the OPT scenario due to the incorporation of a considerable number of EU Directives for energy efficiency and renewable energy sources into national legislation. OPT through emission trading attempts to support investments for RES and EE technologies. However, without defined priorities for CDM projects and more incentives foreign private investors are not encouraged. Without policy instruments for the agricultural sector so as to face climate change impacts, there will be a need to restrict production or change types of products.

The competitiveness of the country in attracting investments for RES was very low in 2012 – not included within the 40 most competitive countries of the world (Ernest & Young, 2012).

The assigned grades are: BAU – 4, OPT – 5 PES – 4.

For *"**equity**"*- Taking into consideration the need to compare the scenarios under a regional level the ratio GHG emission reductions in $MtCO_2eq$ to capita is calculated for each scenario. The larger the ratio is the fairer is the scenario in sharing the burden among the sectors. In the Opt scenario almost all sectors participate in contributing to emission reductions.

Table 9: Equity measurement.

Scenario	Total amount of 2020 GHG emissions ($MtCO_2eq$)	Reductions compared to BAU	Population in 2020 (in million)	Ratio reductions tCO_2eq per capita
BAU	10,838	0	3,352	0
OPT	8,741	1,960	3,352	0,626
PES	9,181	1,299	3,352	0,494

For *"**flexibility**"* - The scenarios are compared towards the incentives and the options that they offer to target groups. The Opt scenario offers more options (subsidies and feed-in-tariffs) compared to the other two ones. So, BAU – 4, Opt – 5, Pes – 4.

For *"**stringency for non-compliance**"* - the scenarios do not foresee penalties, fees on any other sanctions. So, all are assigned with 4.

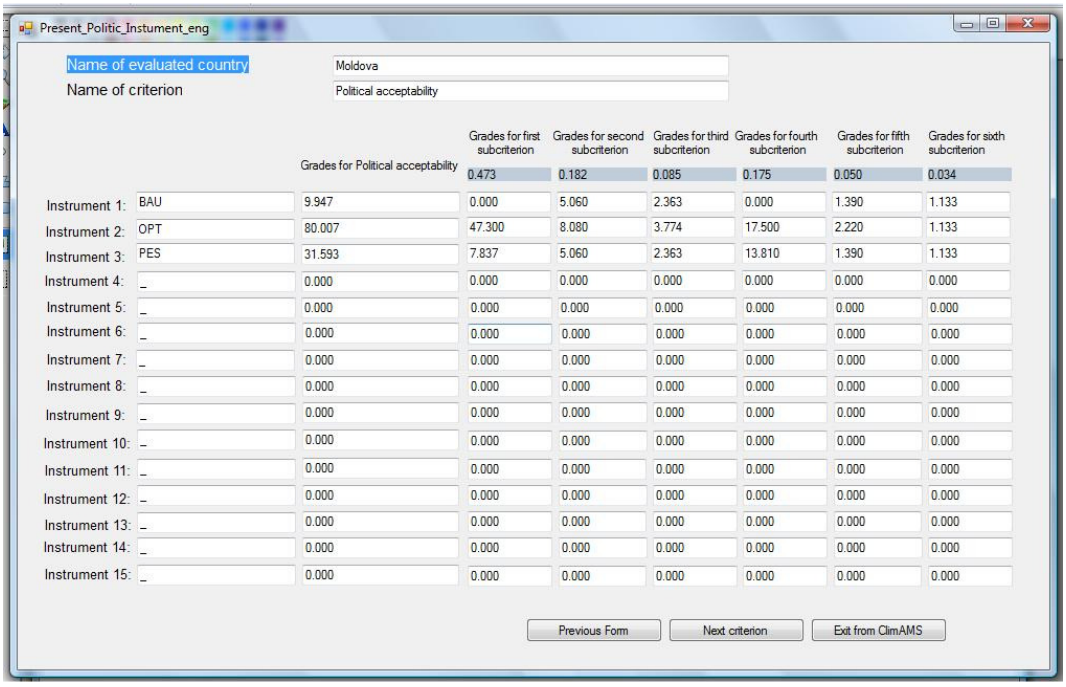

Figure 3: Grades for political acceptability.

Criterion 3: Feasibility of Implementation

The scenarios were evaluated against 3 sub-criteria.

For the "***implementation network capacity***", the scenarios have a poor performance. There is limited number of official reports regarding climate change policy issues for the country. The reports are not updated. The web-sites are not user friendly and the information is not directly accessible. In most of them there is no English version to facilitate foreign researchers. Users need to devote time is searching for the necessary information. The Climate Change Office under the Ministry of Environment and the Designated national Authority for CDM do not have their own web-sites.

The following entities form the Moldovian implementation network:

- Ministry of Economy and Trade[1];
- Ministry of Agriculture and Food Industry[2];
- Ministry of Environment[3];
- ANRE[4]
- Forestry Agency "Moldsilva"[5].

For implementing a stricter national climate policy the implementation network needs to be reinforced, educated and to increase its capacity building. The assigned grades are: BAU – 4, OPT – 3, PES – 3.

For "***administrative feasibility***", the scenarios have a poor performance. The existing policy portfolio is not characterized by readiness in achieving its tasks. First National Communication under the UNFCCC (2000), Second National Communication under the UNFCCC (2009), Third National Communication under the UNFCCC (under development),

[1] http://www.mec.gov.md/
[2] http://www.maia.gov.md/index.php?l=en
[3] http://www.mediu.gov.md/index.php/en/
[4] http://www.anre.md/index.php?vers=3
[5] http://www.moldsilva.gov.md/index.php?l=en

National Inventory Report for the period 1990-2005 (2009). The preparation of a National Action Plan for Renewable Energy Sources is also delayed. The problems presented in the session about the "Main characteristics of the BAU scenario" reflect also the poor performance of current policy portfolio in this sub-criterion. The assigned grades are: BAU – 4, OPT – 4, PES – 4.

For "***financial feasibility***", the scenarios have again poor performance. The country has limited financial sources to implement any of the three policy portfolios. The OPT scenario due to possible revenues from the sold CERs from CDM projects may be used for the necessary subsidies in the transport sector. The grades are: BAU – 3, Opt – 5 and Pes – 4.

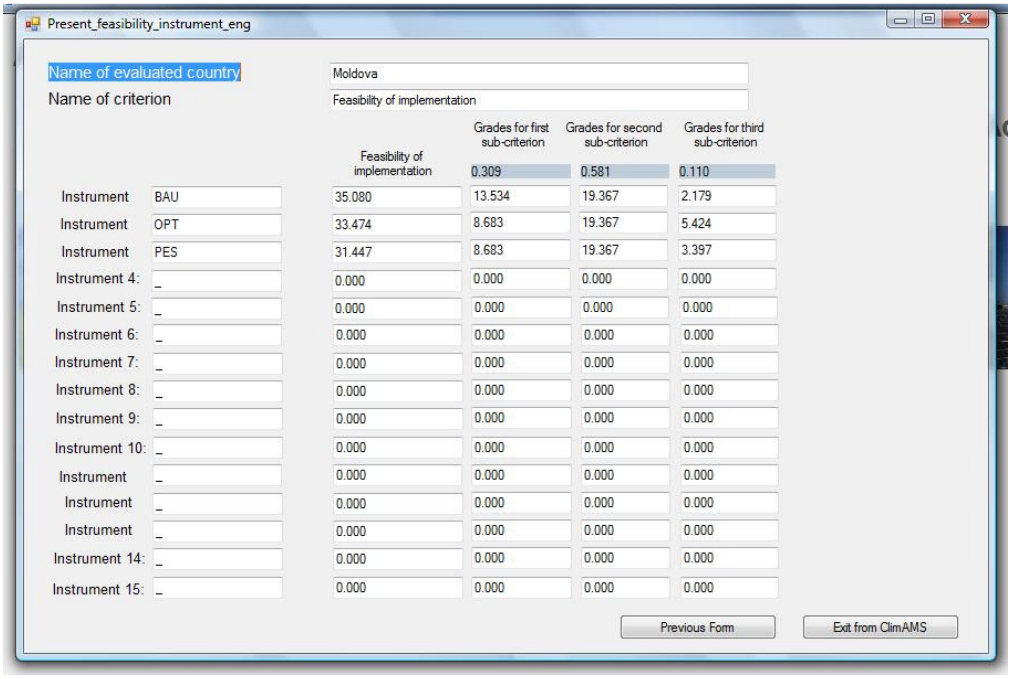

Figure 4: Grades for Feasibility of implementation.

Results

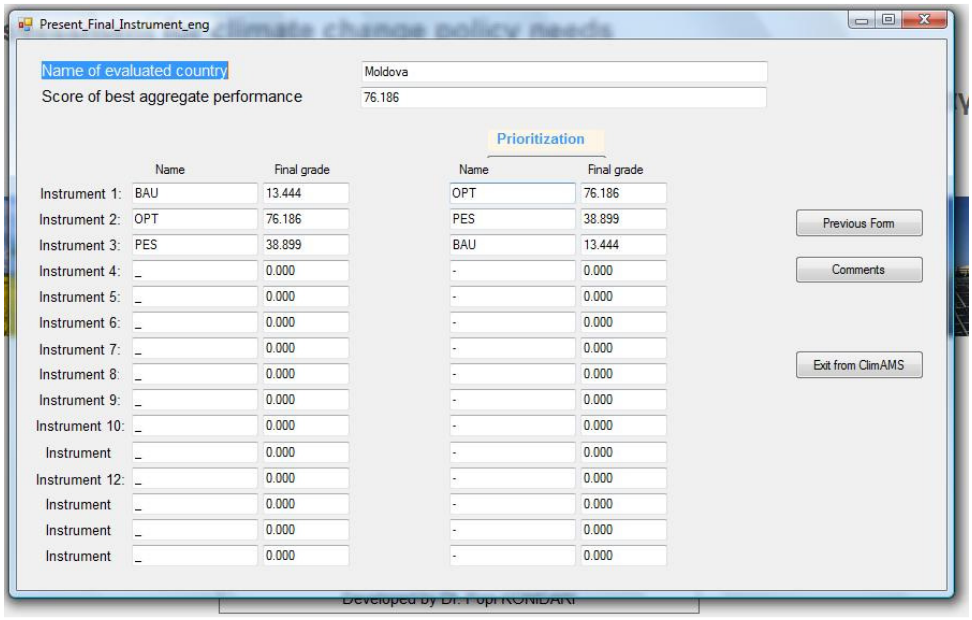

Figure 5: Score of best aggregate performance.

Table 10: AMS results for each scenario.

Criteria	Scenarios		
	BAU	**OPT**	**PES**
Direct contribution to GHG emission reductions (0,833)	0	83,300	65,822
Indirect environmental effects (0,167)	16,700	0	9,342
Environmental performance (0,168) - A	**16,700**	**83,300**	**75,164**
Cost efficiency (0,474)	0	47,300	7,837
Dynamic cost efficiency (0,183)	5,060	8,080	5,060
Competitiveness (0,085)	2,363	3,774	2,363
Equity (0,175)	0	17,500	13,810
Flexibility (0,051)	1,390	2,220	1,390
Stringency for non-compliance (0,032)	1,133	1,133	1,133
Political acceptability (0,738) - B	**9,947**	**80,007**	**31,593**
Implementation network capacity (0,309)	13,534	8,683	8,683
Administrative feasibility (0,581)	19,367	19,367	19,367
Financial feasibility (0,110)	2,179	5,424	3,397
Feasibility of implementation (0,094) - C	**35,080**	**33,474**	**31,447**
Total (A+B+C)	**13,444**	**76,186**	**38,899**

Comments

The results for each scenario are presented in the Table 12. The final grades demonstrate which of the three M/A policy portfolios has the better performance in responding to the climate change policy needs of the country taking into consideration the national framework.

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Konidari P. and Mavrakis D., 2007. A multi-criteria evaluation method for climate change mitigation policy instruments, Energy Policy 35, pp. 6235–6257

OECD, 2011. Competitiveness and Private Sector Development – Republic of Moldova – Fostering SME Development. Available at: http://www.mec.gov.md/docs_news/competitiveness-and-private-sector-development-republic-of-moldova-2011.pdf

CONCLUSIONS

This report concerns the development and assessment of three (3) climate change mitigation and adaptation policy scenarios for Moldova. Each of them is characterized by a different policy portfolio and is named after it as Business As Usual (BAU), Optimistic (OPT) and Pessimistic (PES).

All scenarios of this report take into consideration the following national objectives: i) 20% share of RES in the total energy mix by 2020 and ii) 20% reduction of the total primary energy consumption by 2020, compared to that of year 2009. As a non-Annex I Party, Moldova has no commitment to reduce its GHG emissions under the Kyoto Protocol. However, the country has set a voluntary target under the Copenhagen Accord which is to reduce by 25% its total GHG emissions by 2020 compared to those of the base year 1990. According to the data provided by the UNFCCC database for the GHG emissions of Moldova, the country has already reduced its national emissions considerably. More specifically the GHG emissions of year 2005 are reduced by approximately 72% compared to those of the base year 1990.

BAU scenario

The BAU scenario concerns the time evolution of the already implemented mitigation and adaptation policy instruments (set into force before 31 December 2010) in Moldova until the year 2050 and serves as the reference against which the outcomes of the other scenarios are compared.

The currently implemented Moldavian mitigation policy has three main components: i) penetration of RES in the national energy mix, ii) support to increase energy efficiency; iii) GHG emission reductions through CDM. Concerning the adaptation policy, there are no relevant implemented policy instruments.

According to the outcomes of the model Long range Energy Alternatives Planning System (LEAP) for the BAU scenario in 2020 the GHG emissions are approximately 11MtCO_2eq[6]. The share of RES in the total energy mix by 2020 is 5% and the total primary energy consumption increases by 43% compared to that of year 2009[7].

OPT scenario

The OPT scenario concerns the time evolution of an enhanced Mitigation/Adaptation policy portfolio that Moldova will implement during the time interval 2011 - 2050. This enhanced policy portfolio takes into account the policy instruments adopted after 1st January 2011 as well as plans of the country and supports: i) the introduction of efficient technologies in almost all sectors targeting to the maximum reduction of GHG emissions through the maximum exploitation of the potential of the country in energy efficiency and renewable energy sources and ii) the necessary infrastructure for the adaptation of the country towards the minimum – in size and extent - expected climate change impacts.

The policy portfolio of this scenario includes thirteen (13) EU Directives[8] whose majority will be incorporated into the national legislation within the next five years and will reinforce the implementation of the aforementioned policy components in BAU. The adaptation policy instruments will meet adaptation needs in the agricultural sector and in water and forest management.

[6] GHG emission sources which are taken into consideration in this study do not include land use change and forestry, waste management and the whole spectrum of industrial processes due to missing data. They are mostly those related to the mitigation policy measures which are implemented.
[7] Based on the relevant outcomes of the LEAP model and the available historical data.
[8] Directives 2001/77EC, 2003/30/EC, 2009/28/EC, 2010/30/EC/94/2/EC, 95/12/EC, 95/13/EC, 96/60/EC, 97/17/EC, 98/11/EC, 2002/31/EC, 2012/40/EC, 2007/60/EC.

Based on the outcomes of the LEAP model the OPT scenario overcomes by 2% the set target for the RES share in the total energy mix by 2020. In this scenario the total primary energy consumption is reduced only by 4% compared to that of year 2009. This low percentage is atttributed to the following reasons: i) there is limited information within the country regarding energy efficient technologies and practices that does not allow the achievement of the required amount of energy savings; ii) aged equipment and infrastructure are responsible for losses and without the necessary amount of investments there will be gradually higher losses; iii) there are not yet official reports concerning the estimation of the potential in energy savings per sector and activity. The GHG emissions in 2020 are 8,7MtCO_2eq, which is less compared to those of the BAU scenario.

PES scenario

The PES scenario concerns the time evolution of a Mitigation/Adaptation policy portfolio that the country will implement up to 2050 without exploiting fully the national potential in energy efficiency and renewable energy sources and by facing the worse expected impacts of climate change, taking into account the policy instruments adopted after 1st January 2011.

This scenario assumes less ambitious mitigation policy by limiting the possible technological options only to a selected number of sectors with the highest energy efficiency potential and the most promising for the country types of RES. The scenario considers the implementation of all policy instruments approved (existing or planned), but no additional ones apart from those in line with the EU climate change policy and the national priorities. Despite the huge needs of adaptation (driven by the high global GHG emission levels and the related temperature changes), there are no planned adaptation policy instruments.

The outcomes of LEAP for this scenario provide a 13% share of RES in the total energy mix of year 2020, a 13% increase in the total primary energy consumption compared to year 2009 and GHG emissions are 9,6MtCO_2eq (more than OPT, less than BAU).

Assessment outcomes[9]

Using the multicriteria method AMS, the three (3) policy portfolios were assessed against their environmental performance (amount of GHG emissions and secondary environmental effects), political acceptability (attitude of the involved entities (target groups) towards the relevant policy portfolio) and feasibility of implementation (applicability of the policy portfolio from the point of the governmental and national pertinent entities).

The BAU scenario drives to the largest amount of GHG emissions and to the lowest indirect environmental effects. On the contrary the OPT scenario demonstrates lower GHG emissions and higher indirect environmental effects due to the higher shares of biomass and biofuels in the total energy mix of this scenario.

The OPT scenario has the best performance in political acceptability since it is the most cost effective for the target groups (residential, industrial, energy and transport sectors) compared to the other two policy portfolios. It offers a fair distribution of the "climate change" burden among the respective sectors. Moreover, OPT and partially PES encourage the introduction of innovative technologies, such as solar, biomas, biogas, but do not promote research. In BAU, innovations are not encouraged.

The implementation network (the governmental and national entities that will implement the policy instruments) does not provide the relevant information for climate change policy issues in none of the three policy portfolios. It is copying with the currently implemented policy portfolio, but it fails to respond properly in the cases of OPT and PES. This is justified by the fact that BAU includes a limited number and relatively simple policy instruments, but the other two scenarios have a larger number of policy instruments, the majority of which require a more capable implementation network.

[9] The assessment outcomes depend on the level of expertise of the person who makes the assessment as well as the degree of justification concerning the sub-criteria.

Given the above, the Mitigation/Adaptation policy portfolio which characterizes the Optimistic scenario is the one that reaches sufficiently the targets of the climate change policy of Moldova. Nevertheless, the success of this policy portfolio requires the demonstrated effectiveness of the implementation network and a more stringent frame for non-compliance.

In this report, the component of adaptation in climate change policy is not fully developed since the country hasn't set an adequate framework to reduce its vulnerability to climate change. Moreover, the design and assessment of relevant policy instruments require data related to the frequency of extreme events, water resources and use, low-income groups, biodiversity, the health sector, etc., which are not available at the moment.

Concluding, the scenarios of this report were developed under the same assumptions for the evolution of GDP and population for the period 2011-2050. In order to perceive the performance and applicability of the three (3) policy portfolios, the report should include six (6) more scenarios with the combinations "low population growth – high GDP growth" and "high population growth-low GDP growth", according to the socioeconomic frameworks presented in the IPCC pathways (new generation of IPCC scenarios).