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International Centre for Theoretical Physics**



2138-24

**Joint ICTP-IAEA Workshop on Vulnerability of Energy Systems to
Climate Change and Extreme Events**

19 - 23 April 2010

**Impacts of extreme weather events on energy infrastructure in the Republic of
Moldova**

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Workshop on Vulnerability of Energy Systems to Climate Change and Extreme Events.

Trieste, Italy 19-23 April 2010

Impacts of extreme weather events on energy infrastructure in the Republic of Moldova

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Republic of Moldova.



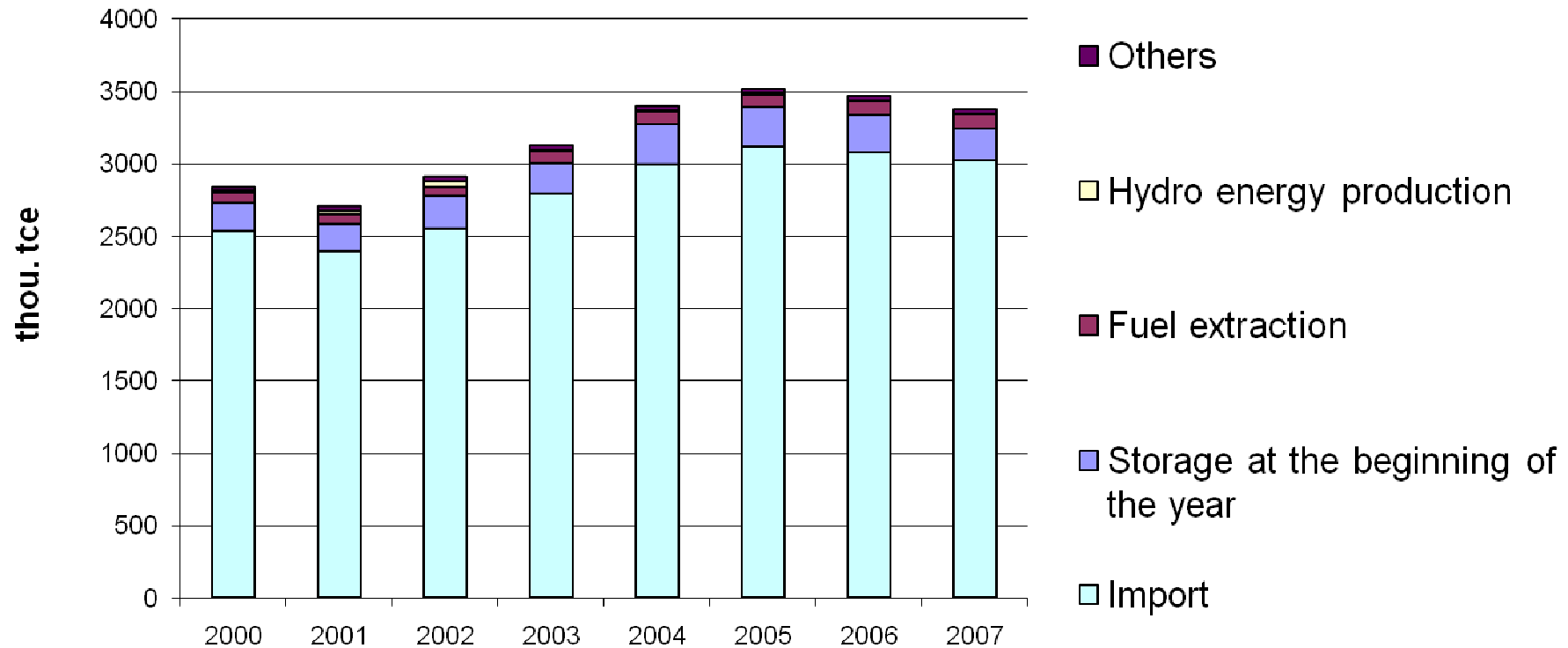
- Location: East Europe, northeast of Romania
- Total area: 33845 km²
- Population: 3.39 million
- Capital: **Chisinau**, 716 thousands inhabitants, area 120 km²
- Moldova has NO fossil fuels resources



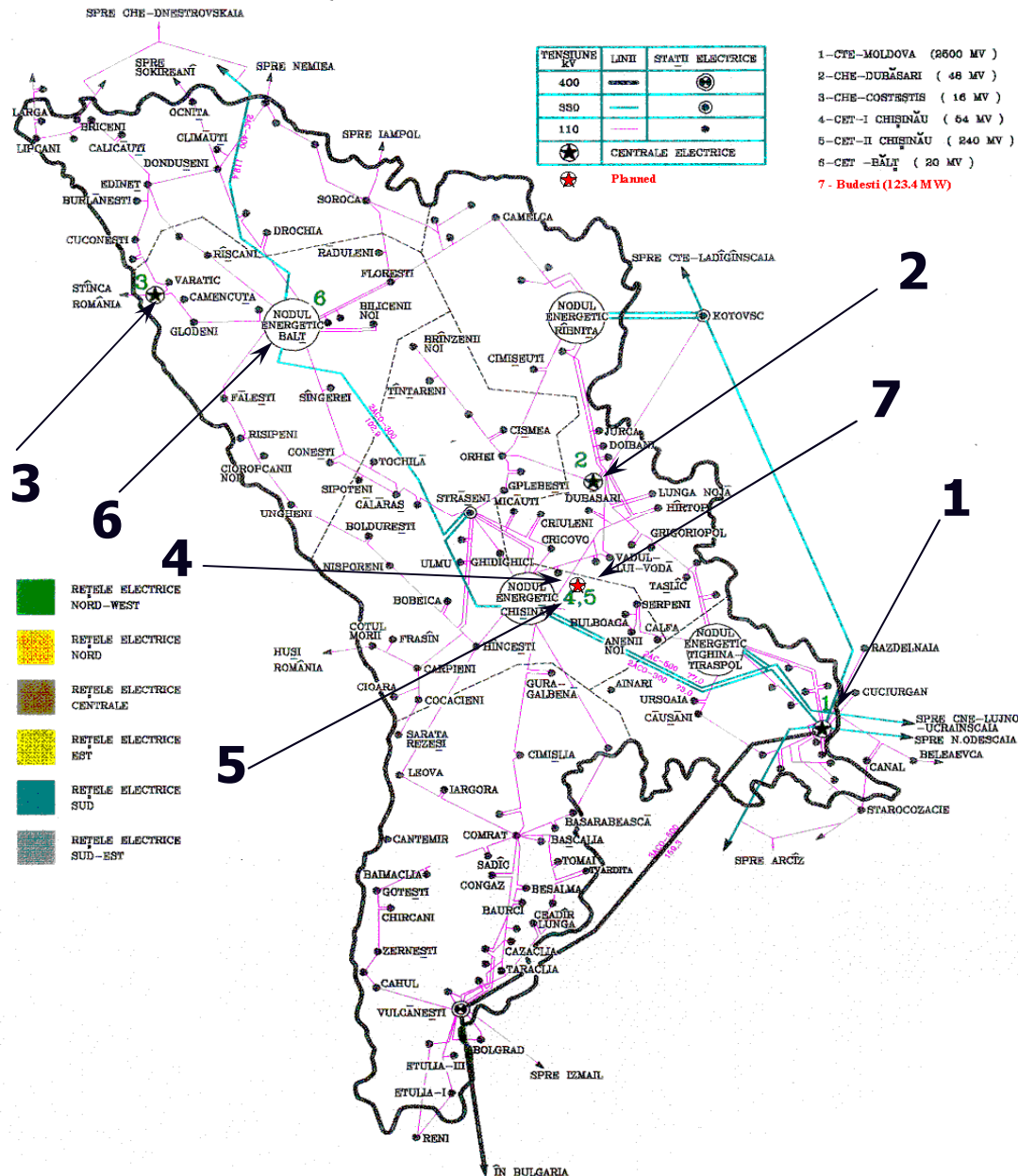
Major Trends and Current Situation in the Energy Sector



Energy and fuel supply



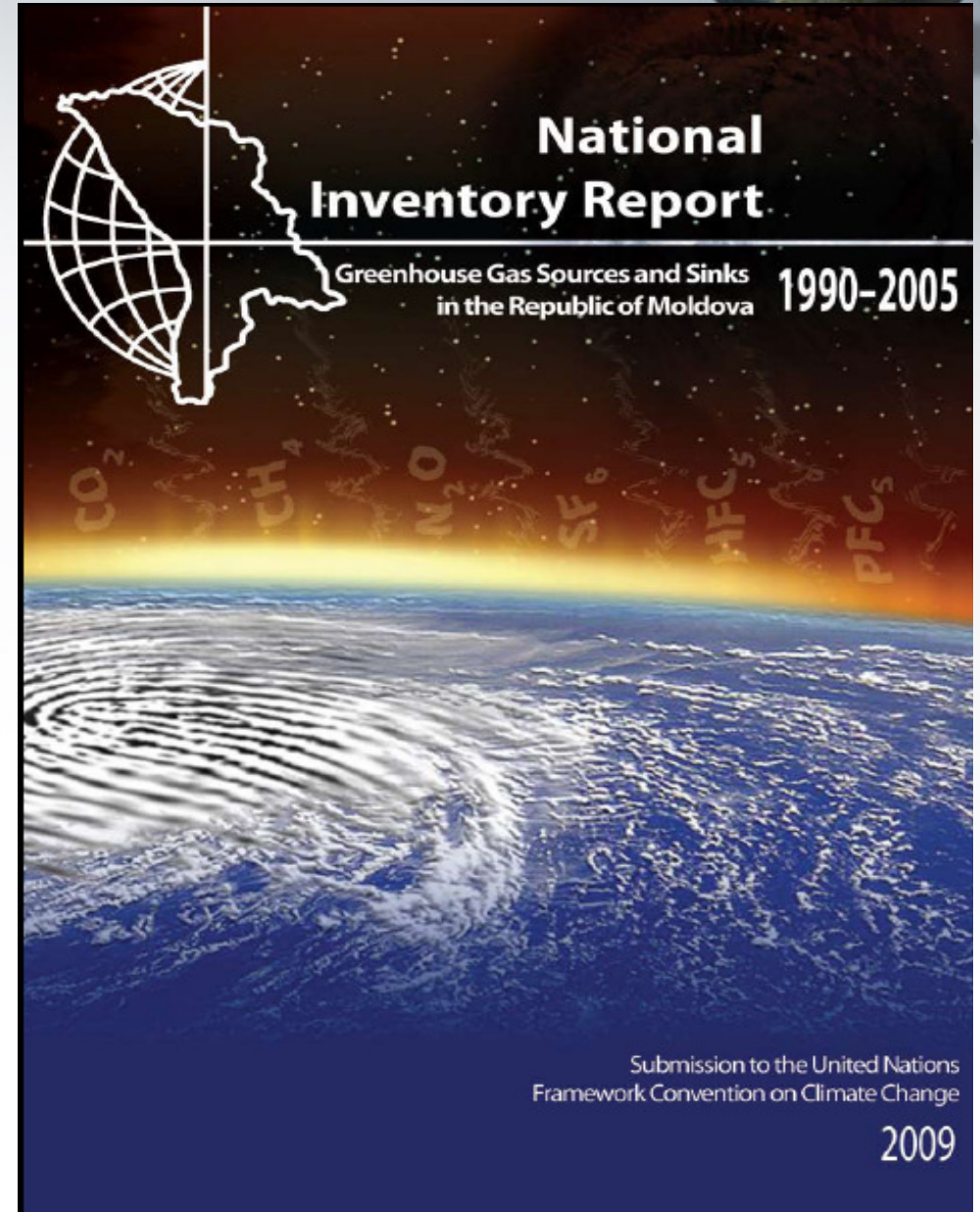
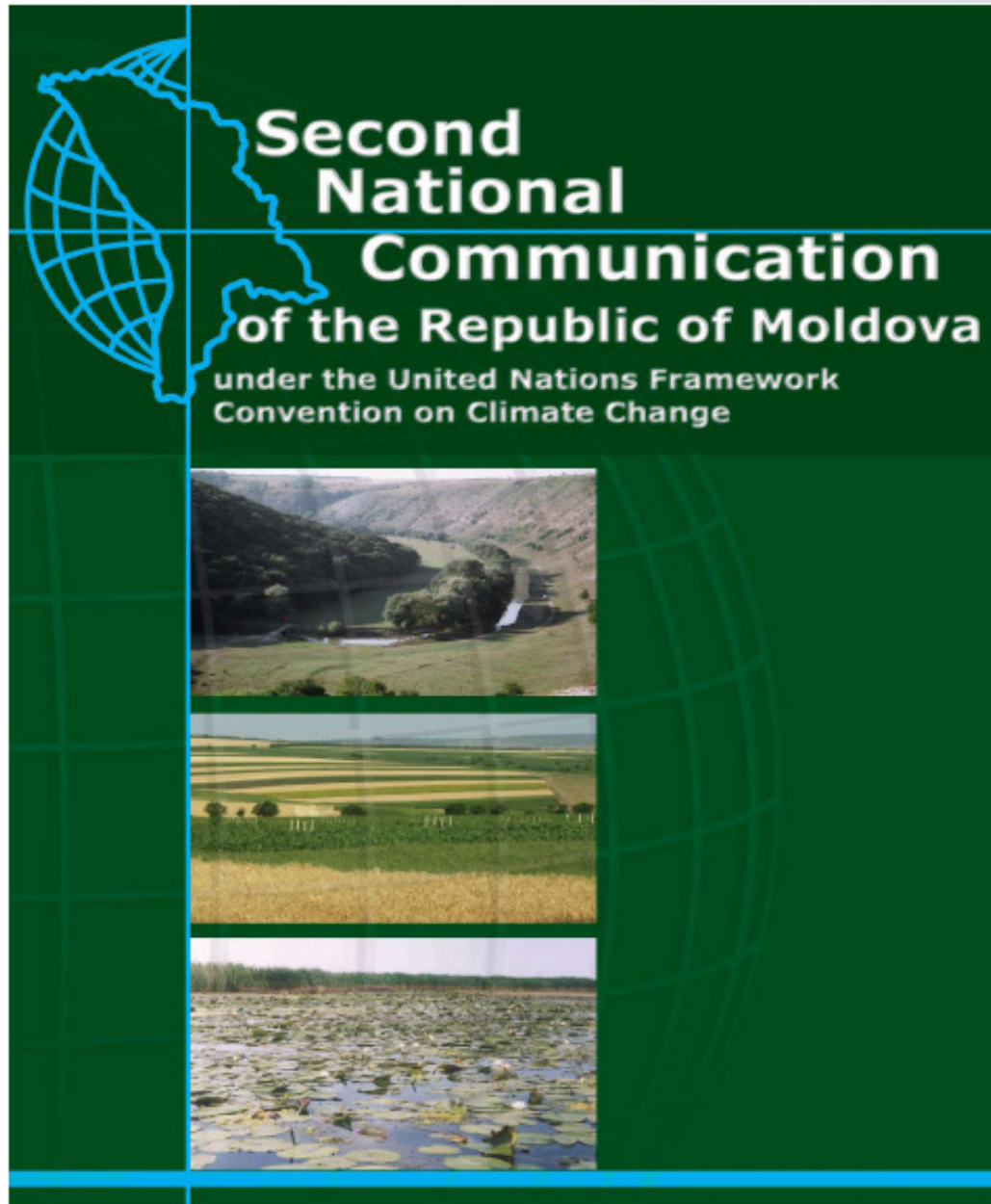
SCHEMA REȚELOR ELECTRICE 110-400 kV ALE SISTEMULUI ENERGETIC NAȚIONAL



ENERGY SYSTEM OF MOLDOVA

1. PP Moldova – 2500 MW
2. HPP Dubasari – 48 MW
3. HPP Costesti – 16 MW
4. CHP 1 Chisinau - 54 MW
5. CHP 2 Chisinau - 240 MW
6. CHP Balti – 20 MW

Documents that are representing the position of the Republic of Moldova in climate change and adaptation



Republic of Moldova and Copenhagen Accord



MINISTERUL MEDIULUI
AL REPUBLICII MOLDOVA



MINISTRY OF ENVIRONMENT
THE REPUBLIC OF MOLDOVA

Nr. 03-08/246

29 January 2010

Mr. Yvo de Boer
UNFCCC Executive Secretary
Haus Carstanjen
Martin-Luther-King-Straße 8
D-53175 Bonn
Germany

Subject: *Association of the Republic of Moldova to the Copenhagen Accord*

Dear Mr. de Boer

Taking note of the Copenhagen Accord and in accordance with the UNFCCC Executive Secretary's Notifications to Parties of 18 and 25 of January 2010,

Being guided by the principles and provisions of the Convention, the Republic of Moldova expresses its willingness to associate with the Accord.

Pursuant to paragraph 5 of the Copenhagen Accord on implementation the mitigation actions to combat climate change, the support of the Republic of Moldova on respective issue for the 2013-2020 period is presented in the Appendix II „Nationally appropriate mitigation actions of developing country Parties”.

Along with those exposed, we conclude that the Copenhagen Accord may serve as a basic framework for continuing the negotiation process on achieving the Convention's objectives on reducing the greenhouse gas emissions and maintaining the global climate system within its natural balance.

On behalf of the Government the Ministry of Environment of the Republic of Moldova avails itself of this opportunity to renew to the Secretariat of United Nations Framework Convention on Climate Change the assurance of its highest consideration.

Sincerely,

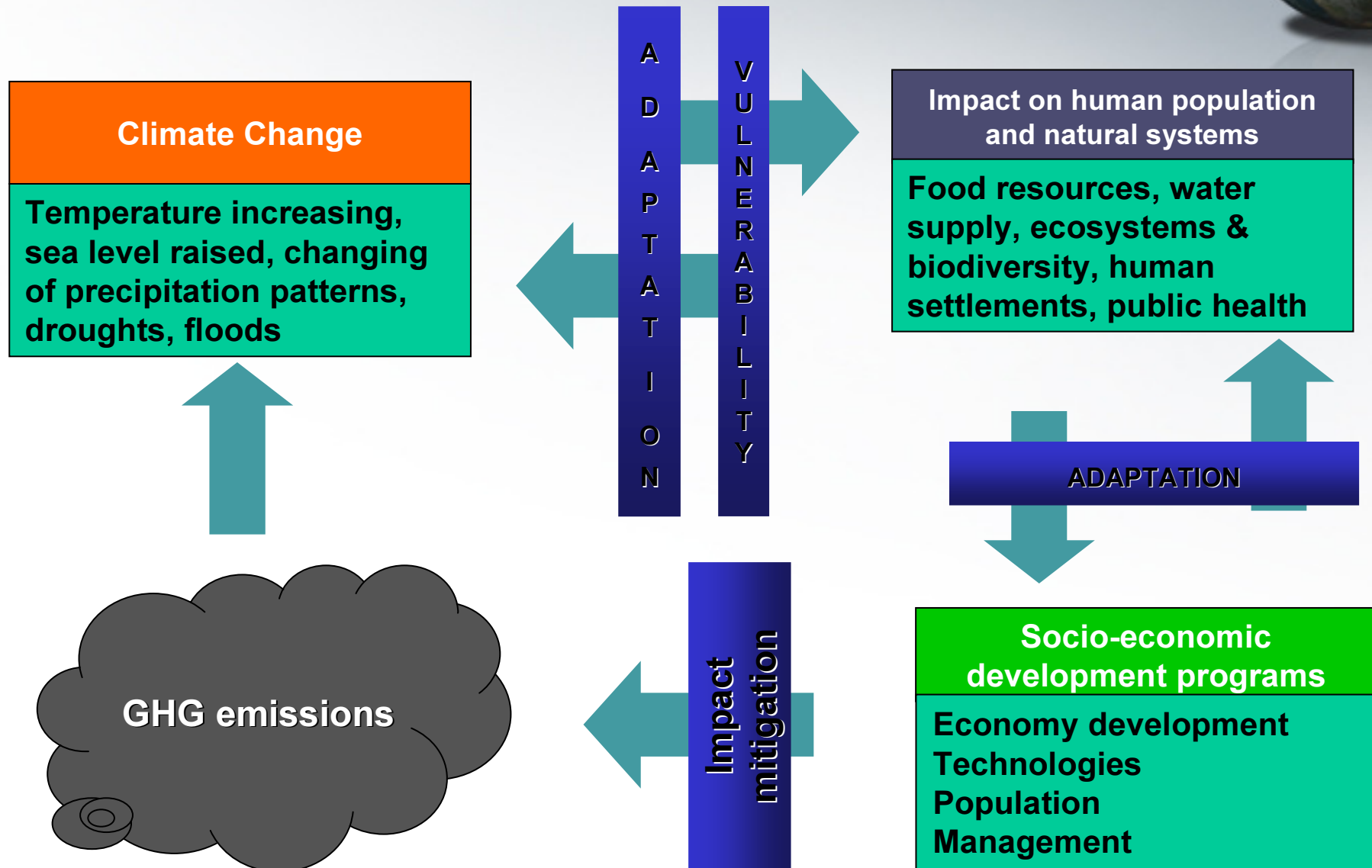
Gheorghe ȘALARI
Minister

APPENDIX II

Nationally appropriate mitigation actions of developing country Parties

Non Annex I	Actions
Republic of Moldova	A reduction of no less than 25% of the base year (1990) level total national GHG emissions have to be achieved by 2020 year through implementation of global economical mechanisms focused on the climate change mitigation, in accordance with the Convention's principles and provisions.

Strategy of assessment of vulnerability and adaptation on climate change.



Scenarios of power sources development



- **BLS - Base Line Scenario**
rehabilitation of CHP-1, CHP-2, CHP-North, without construction of other power plants (energy supply will be provided from imports gradually).
- **HAS - High Alternative Scenario**
energy supply from local sources combined with import. To get this scenario it was analyzed separately the following scenarios:
 - a) energy supply only from local sources
 - b) energy supply only from import
 - c) combined option a) and b) – resulted in HAS.
- **MRS - Medium Realistic Scenario**
intermediate scenario between HAS and BLS, lower efficiency of 42%

Scenarios of power sources development (cont.)



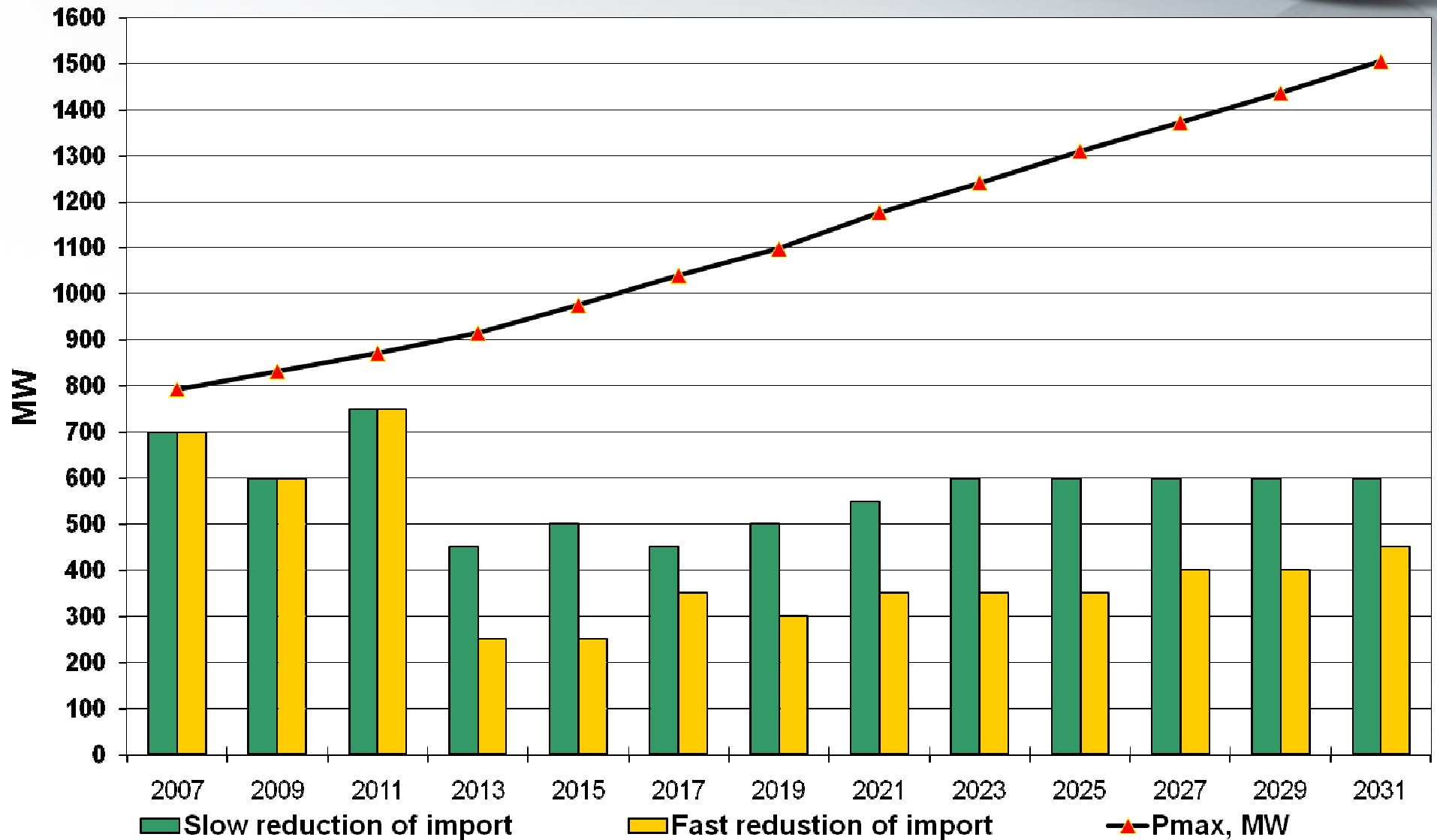
- **A – according to scenario “limited development of new capacities” from Energy Strategy till 2020**
operation of existing power plants for study period, and construction of mini-CHP of distributed generation of 179MW in 2020
- **B - according to scenario “moderate development of new capacities” from Energy Strategy till 2020**
operation of existing power plants for study period, and construction of mini-CHP of distributed generation of 179MW in 2020 and extension of CHP-1, CHP-2, CHP-North by 296 MW till 2020 (CHP-1 by 24 MW; CHP-North by 72 MW and CHP-2 by 200 MW during 2015 - 2020)
- **C - according to scenario “extended development of new capacities” from Energy Strategy till 2020**
the same as scenario B, but CHP-1 by 24 MW in 2010; CHP-North by 72 MW in 2015; CHP-2 by 200 MW in 2020.

Methodology

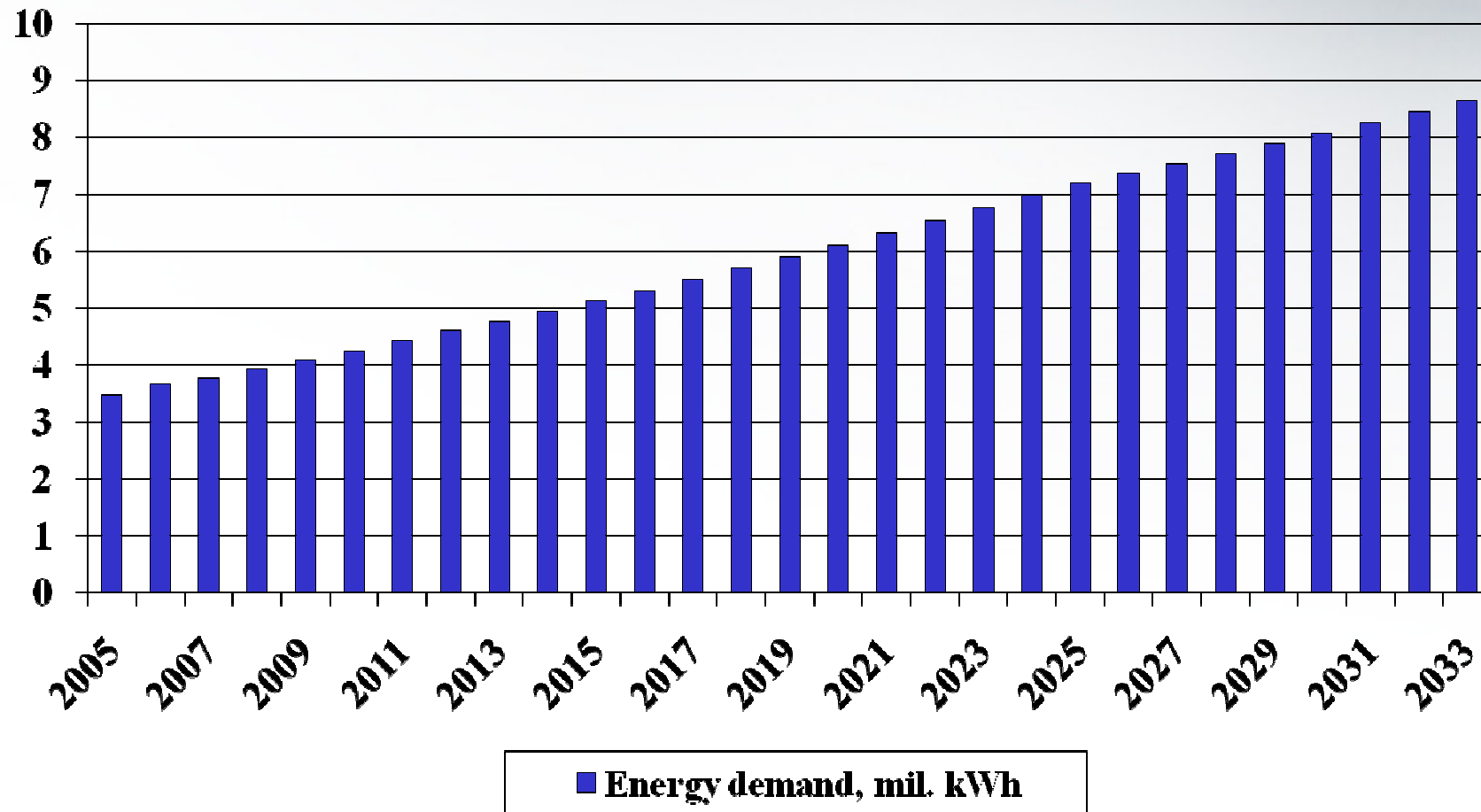


- Application of ENPEP program developed by IAEA: WASP, IMPACT, etc.
- with WASP are obtained the optimum scenarios of power sources development.
- Results from WASP are imported in IMPACTS and emissions are calculated.

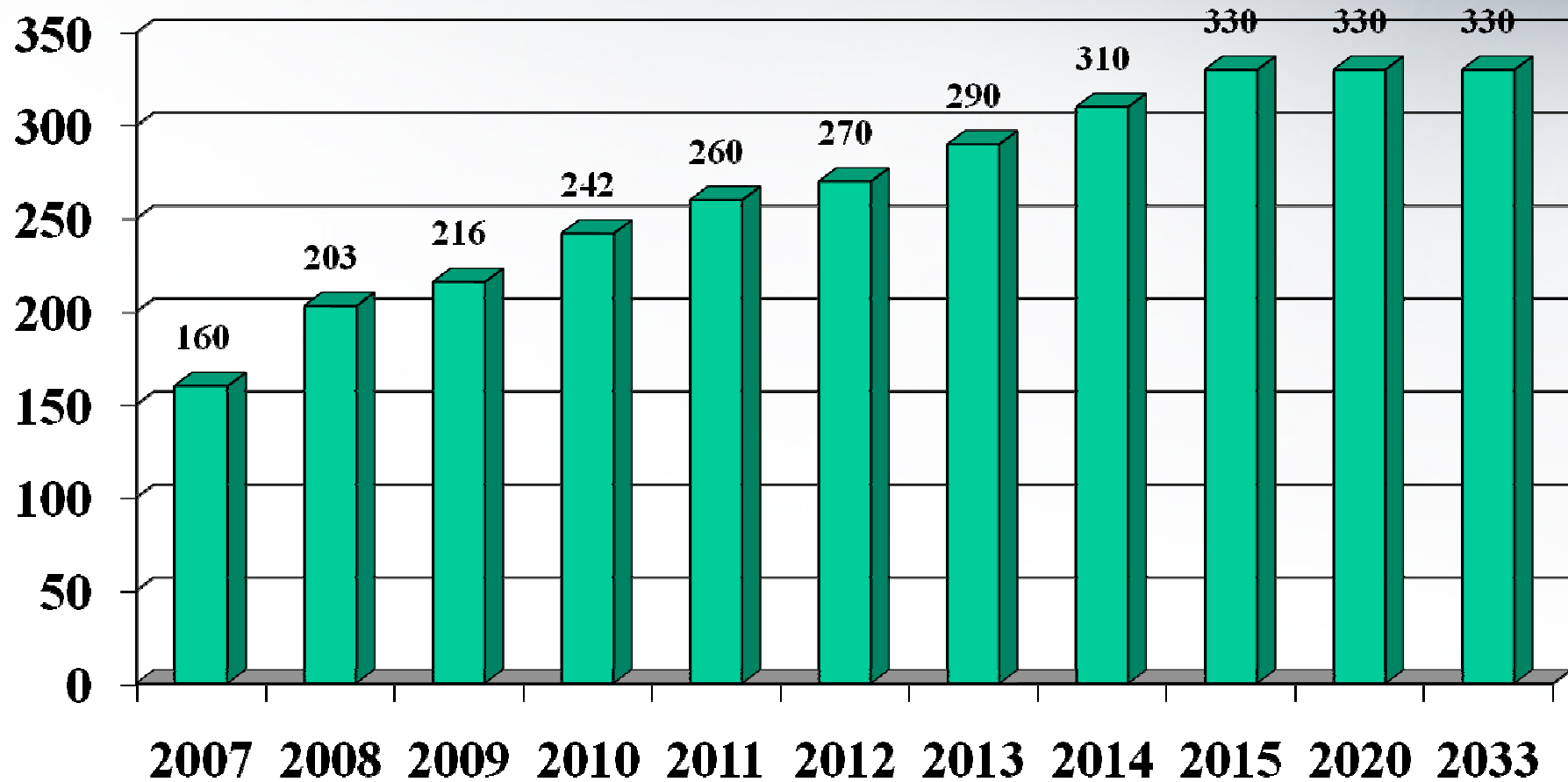
Power demand forecast



Energy demand forecast



Cost of Natural Gas, USD



Input data for calculations



Unit	Investment cost, \$/kW	P _{nom} , MW	Efficiency, %	Construction period, years	Life, years
GTRR, Gas turbines Rolls-Royce	500	51	35	2	25
CB1N, new unit at CHP-1	544	10	41	1	25
CB2N, new unit at CHP-Balti	495	37	36	2	25
CCSS, combined cycle	738	100	52	3	25
CCWE, combined cycle Westinghouse Electric	715	179	52	3	25
CETS, mini CHP	1041	5	45	1	25
CETM, combined cycle Check	870	135	52	2	25
CC2M, combined cycle ABB	704	202	52	3	25
GCAR, coal PP	1732	180	36	5	30
Nuclear unit	1500-2000	700	42	6	30

Results



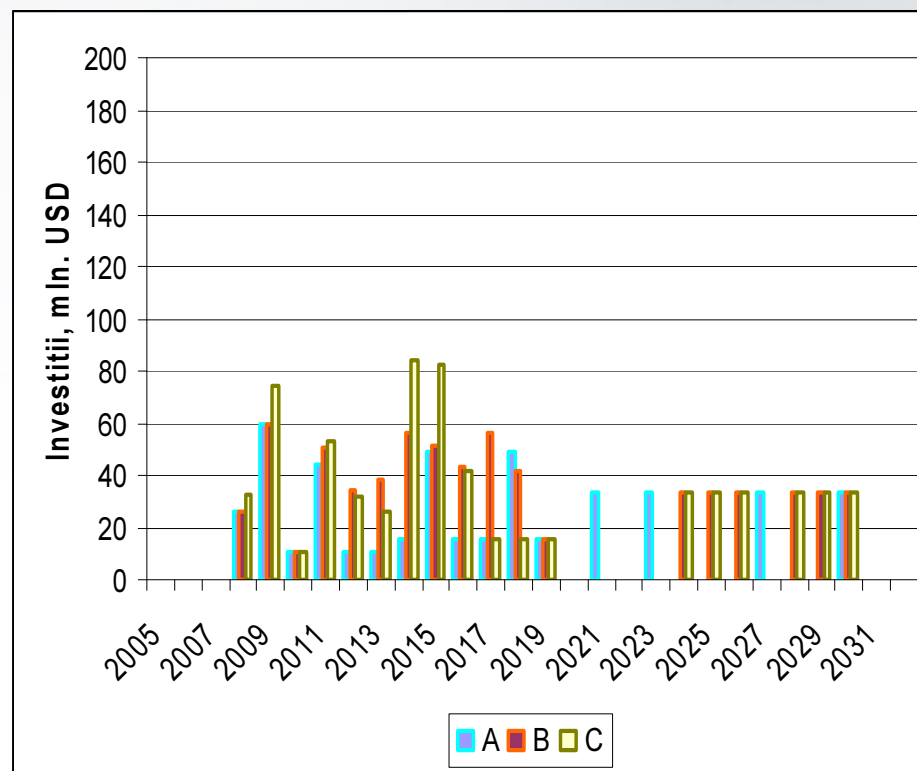
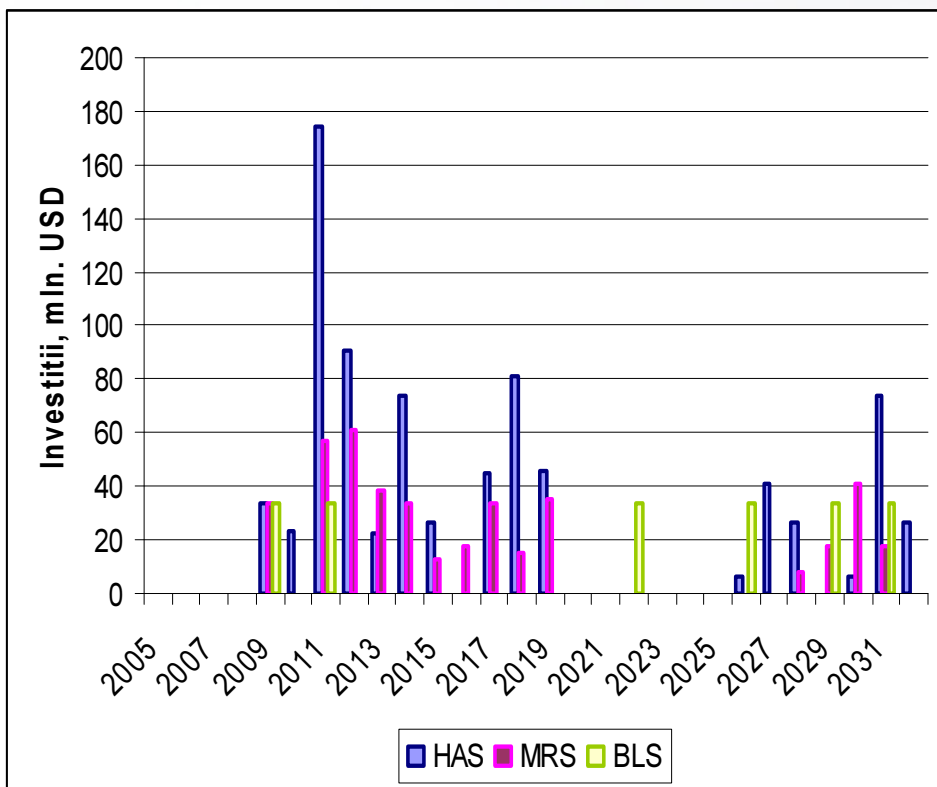
- HAS: 50% import and construction of new gas-fired units

year	2010	2012	2013	2014	2015	2016	2018	2019	2020	2029	2032	2033
Nr and power, MW	50	50	2x179	3x5	50	1x100	50	2x5	1x179	1x100	50	1x100
Type of unit	Import	Import	CCWE	CETS	Import	CCSS	Import	CETS	CCWE	CCSS	Import	CCSS

Results



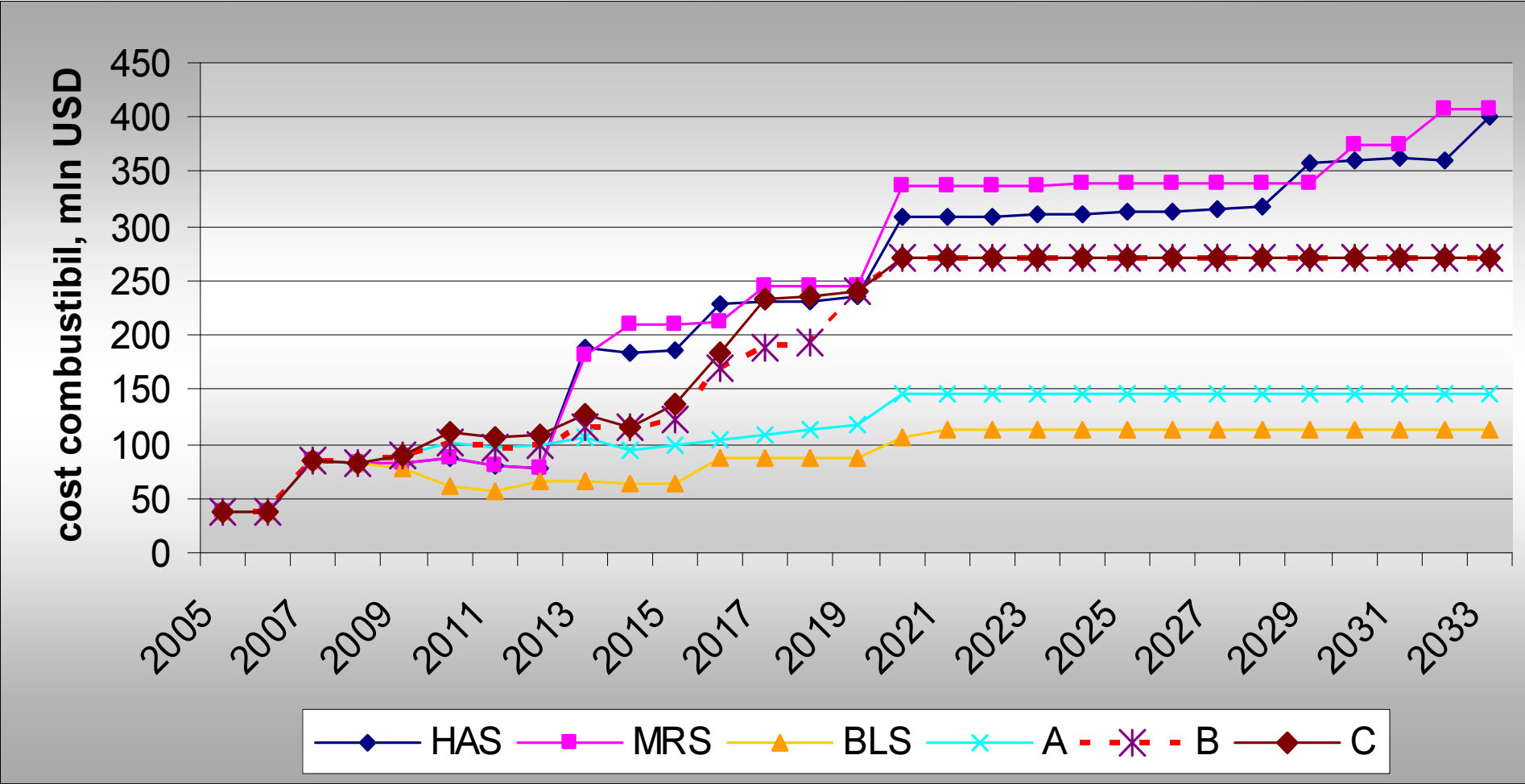
Investment required



Results



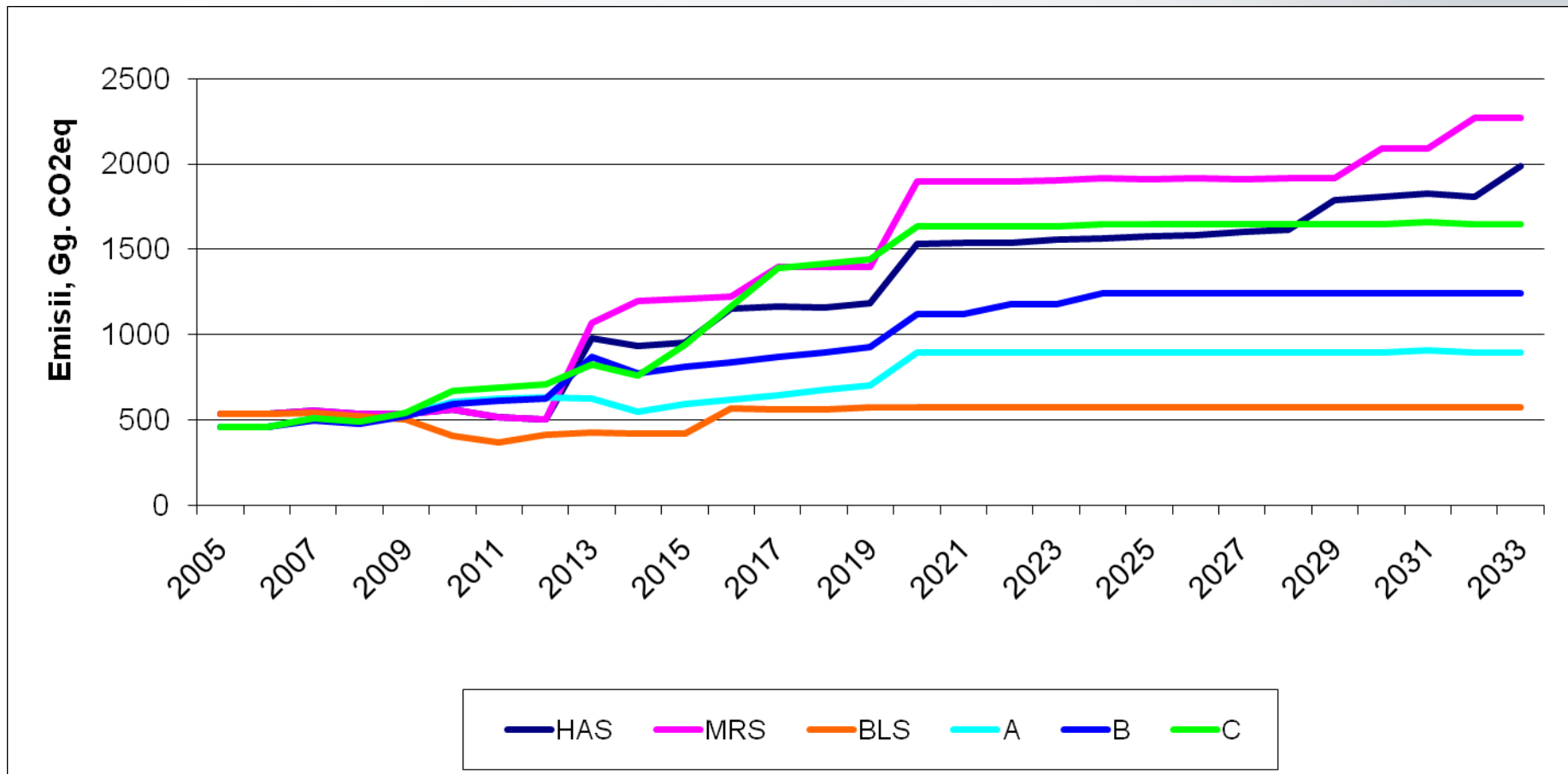
Fuel costs



Results



GHG emissions

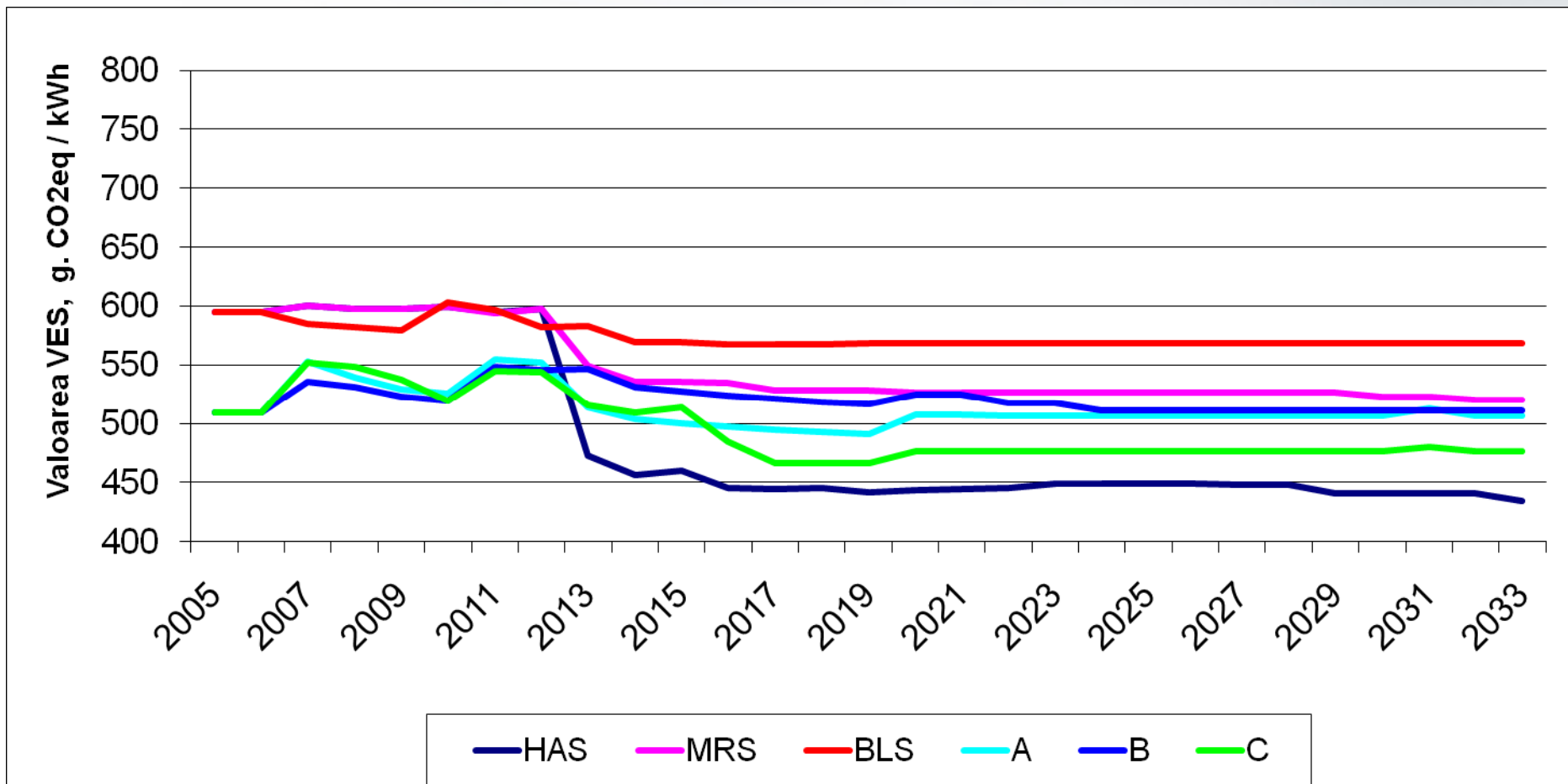


No GHG emissions from import

Results



Emissions per 1 kWh



Conclusions



In the conditions of the Republic of Moldova it should be evaluated the emissions per kWh not only absolute values of emissions:

- HAS - 8,3 Tg CO₂ echivalent,
- C - 6,2 Tg CO₂ echivalent,
- MRS - 2,7 Tg CO₂ echivalent,
- B cu 2,6 Tg CO₂ echivalent,
- A cu 2,4 Tg CO₂ echivalent.

Conclusions



HAS is the preferable scenario from the point of view of lowest GHG emissions and from emissions/kWh. If average cost for import of electricity is 50 \$/MWh then average price for electricity for study period is 69.2 \$/MWh in HAS, in MRS is 63.9 \$/MWh.

Measures for adaptation



R&D

- It is necessary to create a capacity building network in order to promote utilization of computer tools for evaluation of vulnerability of energy systems to climate change
- External costs of energy generation are to be considered in order to evaluate damage cost of GHG emissions

Thanks for Your Attention



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