7TH INTERNATIONAL FORUM ON ENERGY FOR SUSTAINABLE DEVELOPMENT

18-21 OCTOBER 2016 ▪ BAKU-AZERBAIJAN

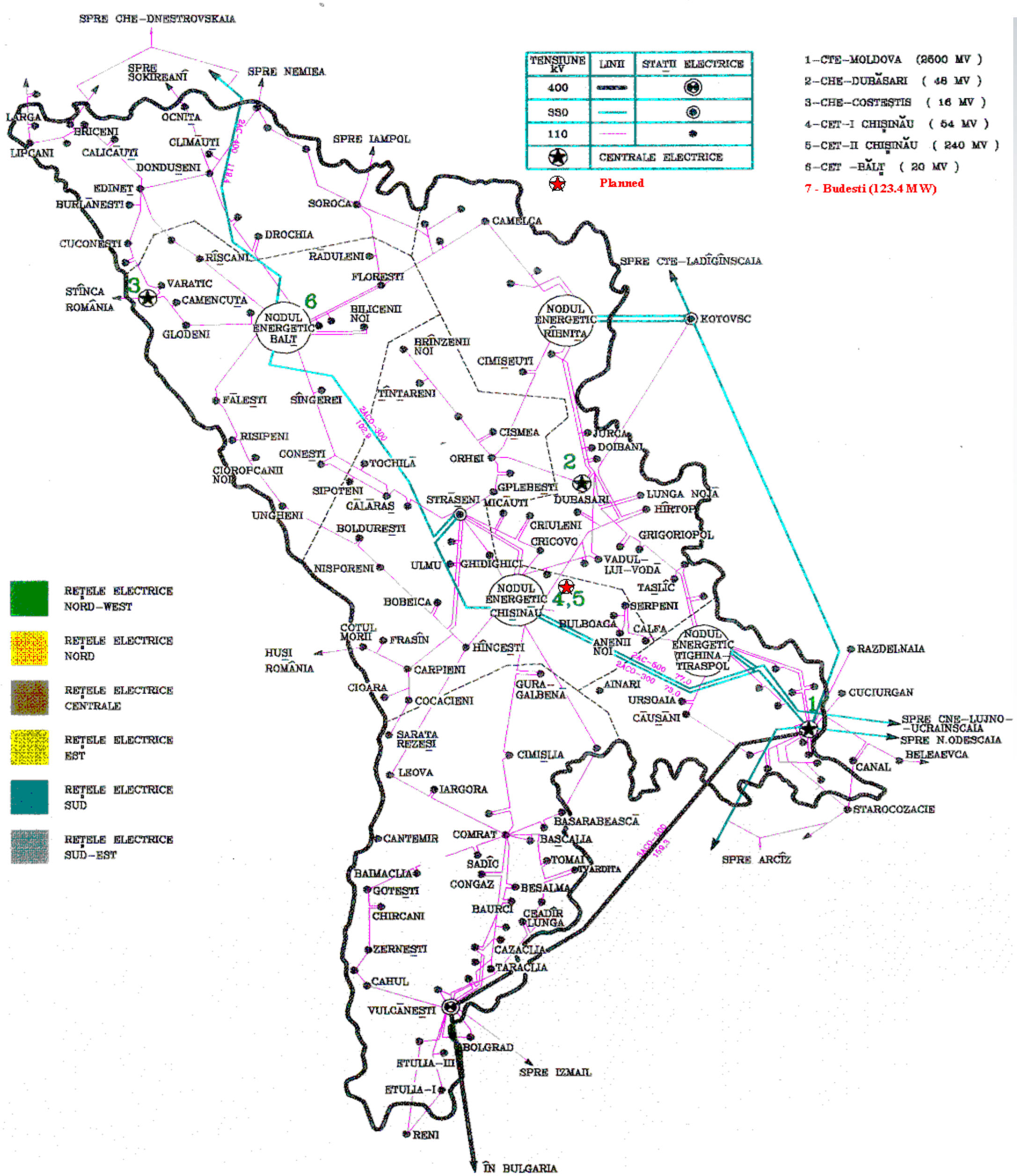
Pathways to Sustainable Energy:

National approaches to a global challenge

Sergiu Robu, Republic of Moldova

Baku, Azerbaijan
October 21, 2016

SCHEMA REŢELELOR ELECTRICE 110–400 kV ALE SISTEMULUI ENERGETIC NAŢIONAL



ENERGY SYSTEM OF MOLDOVA

1. **PP Moldova – 2500 MW**
2. **HPP Dubasari – 48 MW**

3. **HPP Costesti – 16 MW**
4. **CHP 1 Chisinau - 64 MW**
5. **CHP 2 Chisinau - 240 MW**
6. **CHP Balti – 20 MW**

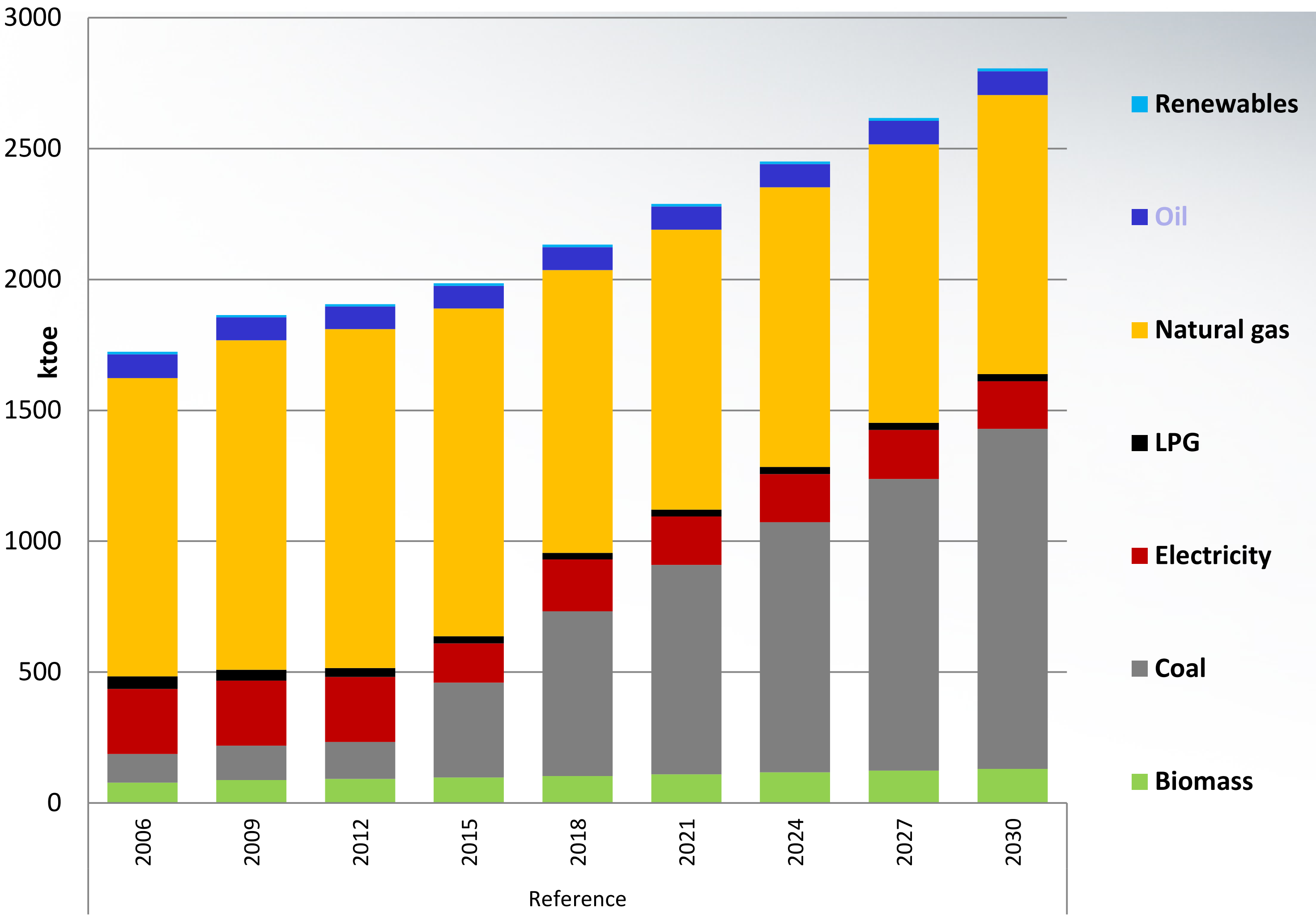
Policy Drivers and Implications for Alternate Scenarios

The Energy Strategy of the Republic of Moldova until 2030, provides concrete guidelines for Moldova's energy sector development, with the **main goal to provide the required basis for economic growth and improved social welfare**.

1. Key Insights Arising from EE/RE Policies to be Examined

- In which sectors of the energy system will EE/RE measures have the most significant impact (benefits)?
- How much (additional) direct investment will be required to achieve the RE target?
- To what degree are investments in EE/RE projects offset by the reduction of fuel expenditures, notably for imports?
- How do EE/RE policies impact the energy and electricity generation mix?
- What is the impact on CO_2 emissions?

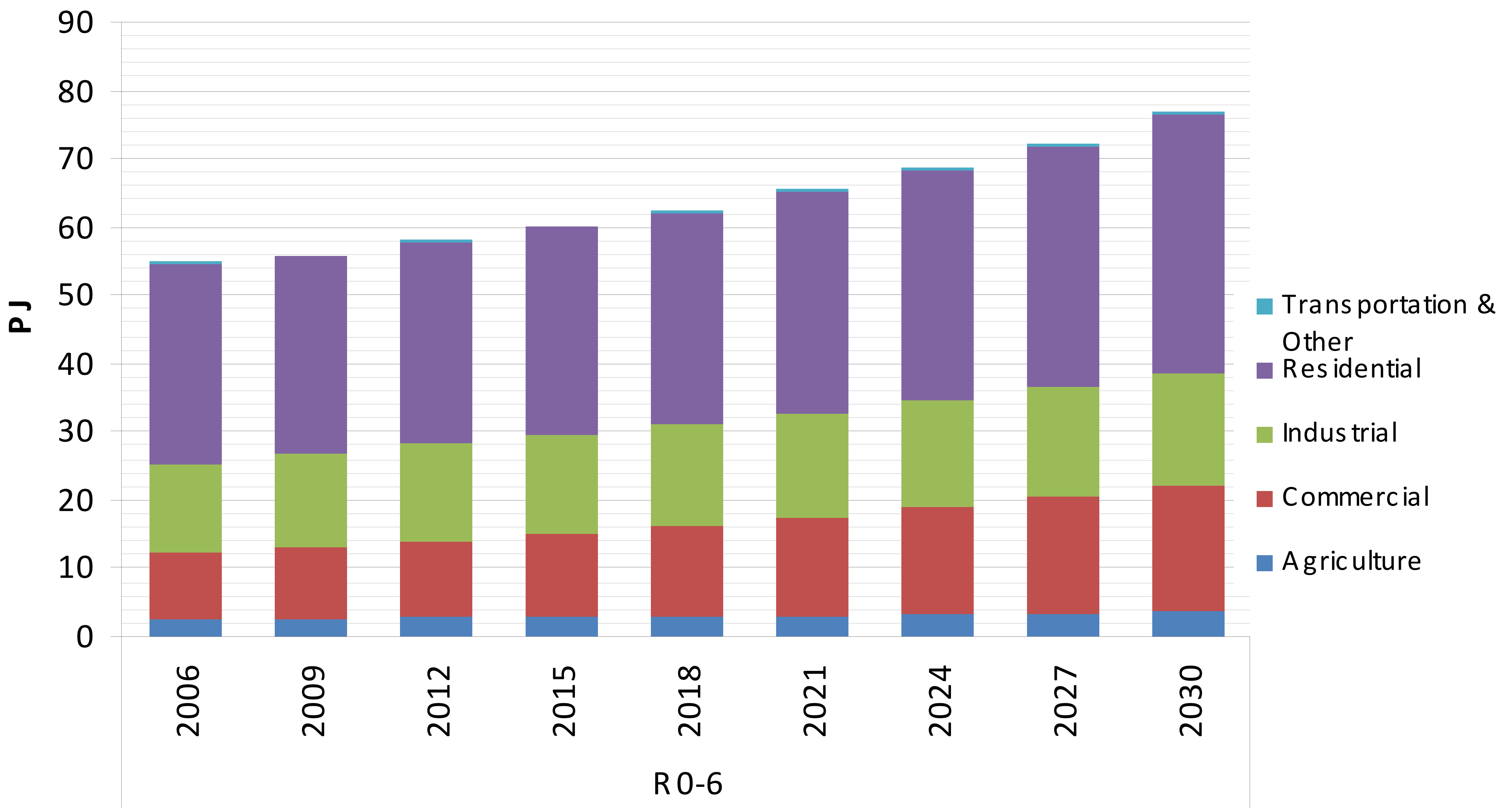
Primary Energy



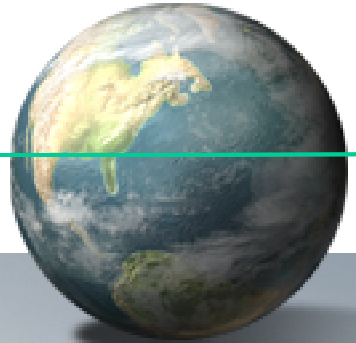
Total Primary Energy Supply (TPES), ktoe

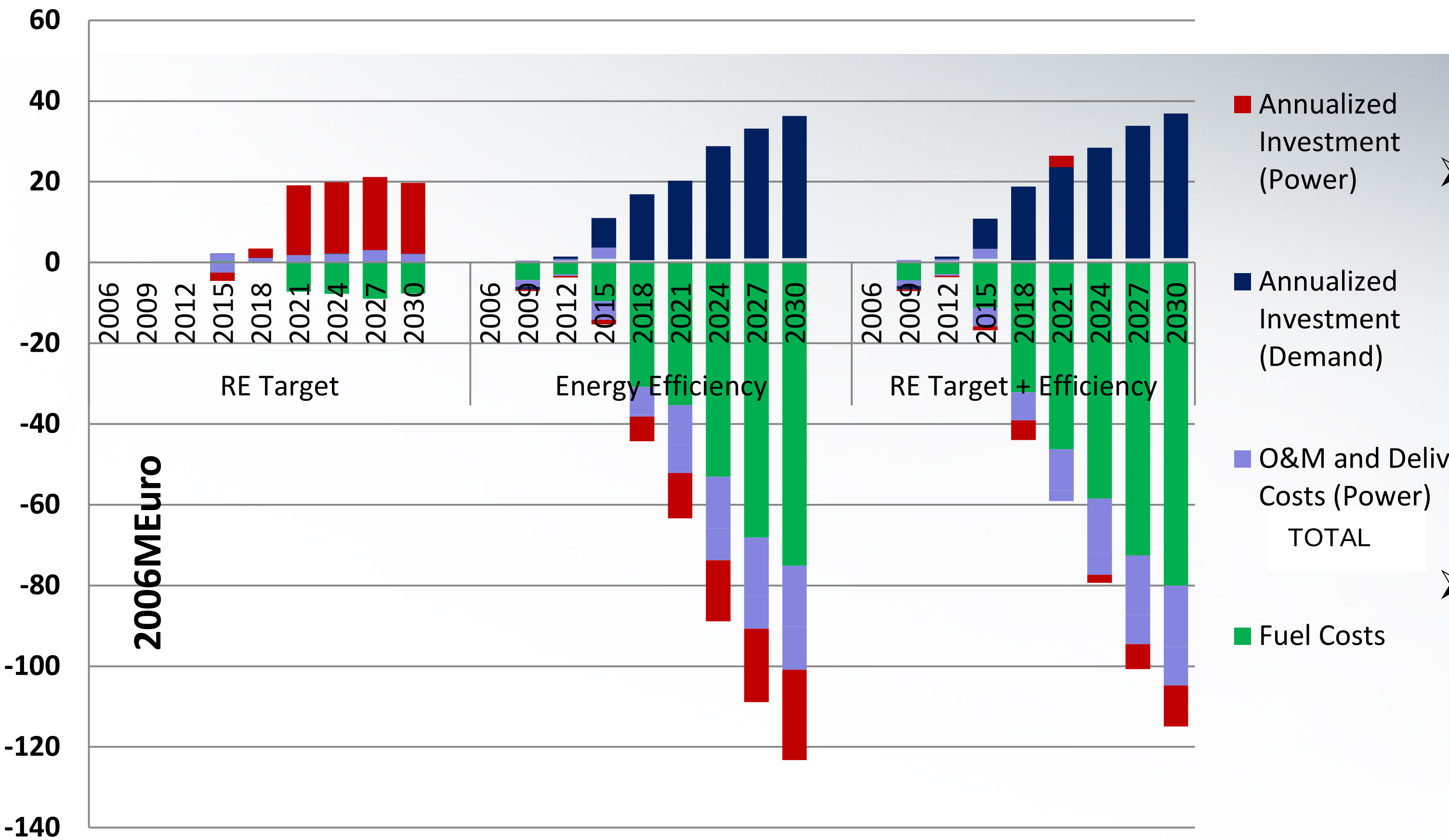
- **Gas** use decreases due to investment in new coal-based capacity starting in 2015, moving from **66%** of primary energy supply in 2006 to **38%** in 2030.
- **Electricity imports** decrease from **14% to 6%** in 2030.
- **Biomass** supply will double, to 131 ktoe in 2030.
- **Coal** imports increase from **6.4% to 46.3%** in 2030 due to the coal-fired power plant.

Final Energy Consumption by Sector [PJ]



Energy System Expenditures

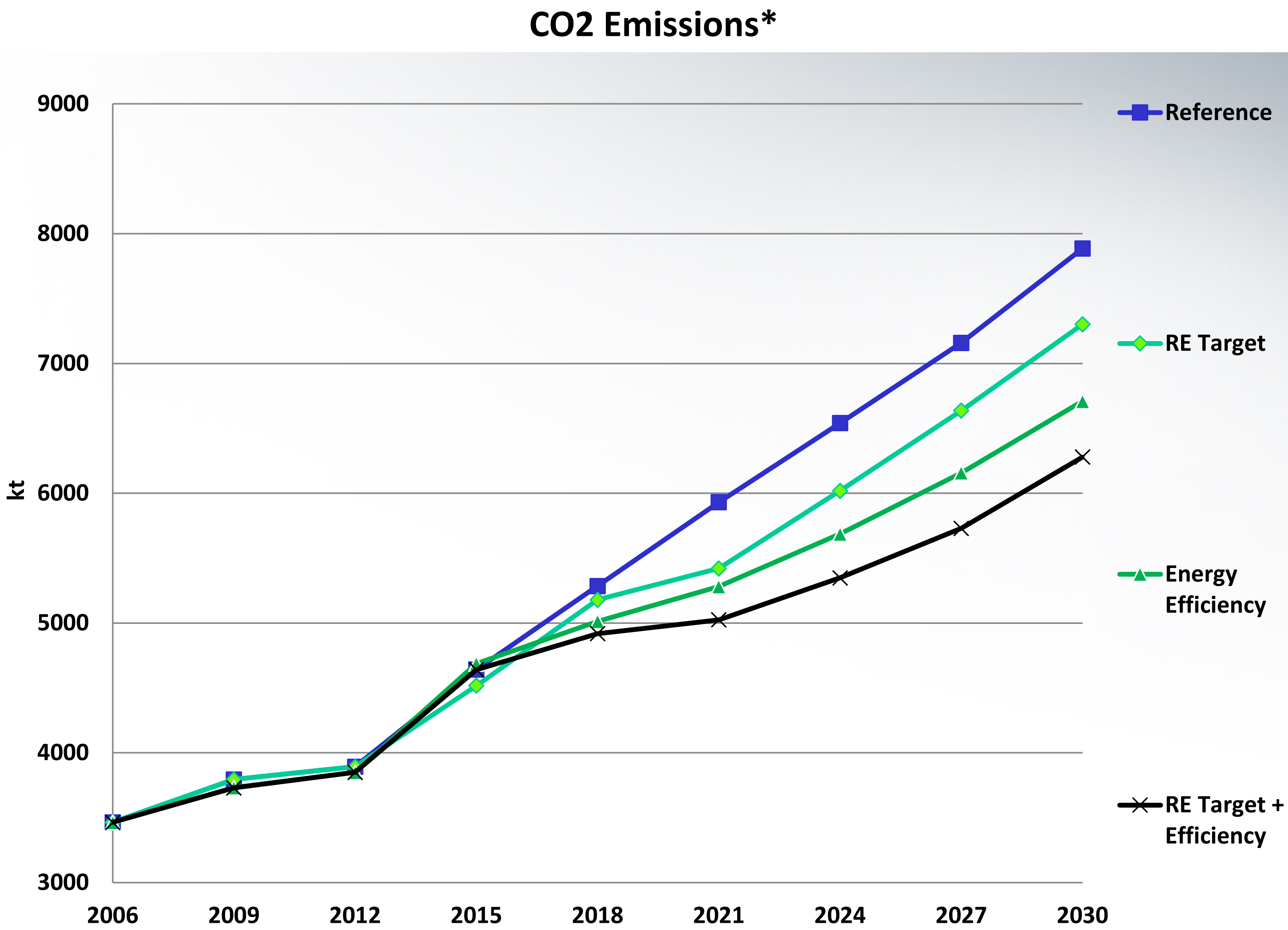




Change in Energy System Expenditures

- Substantial savings on fuel (green), can be seen under EE policies, reaching a cumulative reduction of **310 €M** in the combined scenario, which corresponds to a 3-to-1 savings for the investment.
- Spending on improved demand devices, which reaches a cumulative increasing of **145 €M**, is **double** compensated for by the fuel savings.
- Increased costs for renewable power plants is more than offset by the fuel savings with EE policies.
- The combined scenario achieves an overall savings of **110 €M** per year by 2030.

Climate Change Implications



* Without Transnistria, MTPP and transporation

- CO_2 emissions grow 130% by 2030, reaching 7900kt per year.
- Avoided cumulative CO_2 by scenario:
  - EE: -12Mt, -8.3%
  - RE:-7.1Mt, -4.9%
  - EE+RE: -16.8Mt, -11.6%.
- EE+RE policies curb that growth to 6300kt CO_2 per year by 2030, that is about 500% below 1990 level of 34500 kt CO_2.

Summary Conclusions for EE&RE Policies

- Energy Efficiency measures lead to less power plants additions and payments for fuel, resulting in a more competitive energy system.
- Proposed RE Targets can be achieved at modest cost by means of additional, wind and biomass power plants, along with more direct consumption of biomass.
- Coordinating RE Targets with increased Energy Efficiency lowers the cost of RE compliance owing to the overall drop in energy consumption, which thereby reduces the total amount of RE needed.
- Further CO_2 emissions reductions are achieved when RE Targets are combined with enhanced Energy Efficiency measures.

Law on Promotion of Energy from Renewable Sources

The adoption of the Law on Promotion of Energy from Renewable Sources in 2016 is a great step towards creating an enabling framework for renewable energy projects. Following the adoption of the Law on Promotion of Energy from Renewable Sources in 2016, the implementation of the entire set of measures via the adoption of secondary legal acts has to follow.

The significant agricultural potential of the country should be tapped into to develop domestic biofuel production rather than relying on imports of biofuels to reach the 10% target in 2020.

More on: https://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/Implementation/Moldova/Renewable_Energy

Targets set by the Republic of Moldova

in the energy security specific domain:

a) to perform energy interconnectors: 139 km of power lines and 40 km of natural gas pipelines in 2020;

b) to stimulate the use of energy produced from renewable sources, in relation to the total internal gross consumption: 20% in 2020, with an intermediate objective of 10% in 2015;

c) to ensure a 10% share of biofuels in the total fuels by 2020, with an intermediate objective of 4%;

d) to increase the internal power production capacities up to 800 MW by 2020; e) to ensure a 10% annual share of power produced from renewable sources by 2020.

Targets set by the Republic of Moldova

in the energy efficiency specific domain:

a) to reduce the energy intensity by 10% in 2020;

b) to reduce losses in the transmission and distribution networks by up to 11% in 2020 (up to 13% in 2015) for power, by 39% in 2020 (by 20% in 2015) for natural gas and by 5% in 2020 (by 2% in 2015) for thermal energy;

c) to reduce greenhouse gas emissions (compared with 1990) by 25% in 2020;

d) to reduce the energy consumption in buildings by 20% in 2020;

e) to achieve a 10% share of refurbished public buildings in 2020.

According to EU energy efficiency improvement objectives and taking into account Moldova's commitments, in line with the Community Acquis, the National Programme for Energy Efficiency 2011-2020 sets up long run energy savings of up to 20% by 2020. The intermediate objective for energy savings, to be achieved by 2016, is set up at 9%.

Critical problems requiring adequate and swift measures

- no connection with the EU’s internal electricity market
- to liberalize the market
- attraction of financial means
- the incomplete implementation of the acquis and the lack of specific actions to connect to the ENTSO-E system and to the EU system of main natural gas pipelines question the importance of political measures of liberalizing the energy markets.

More info:
http://www.serviciilocale.md/public/files/Energy_Strategy_2030_Final.pdf

Thank you!

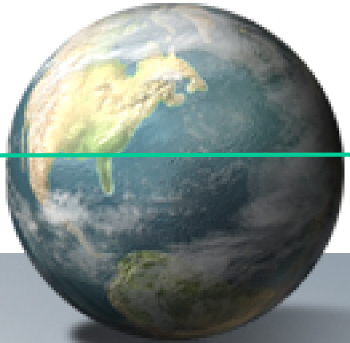
Sergiu Robu,

Institute of Energy,

Academy of Sciences of Moldova

sergiu.robu@asm.md

Practical Applications of MARKAL-Moldova



Publications

- Sergiu Robu, Elena Bikova, Philip Siakkis, Dr. George Giannakidis, “**MARKAL Application** for Analysis of Energy Efficiency in Economic Activities of the Republic of Moldova and Feasible use of Renewable Energy Sources”, Electronic Journal nr. 2(13) (2010), Problems of the Regional Energetics http://ieasm.webart.md/data/m71_2_145.doc
- **IEA-ETSAP** MARKAL/TIMES Workshop, Stockholm, Sweden, June 24, 2010 presentation

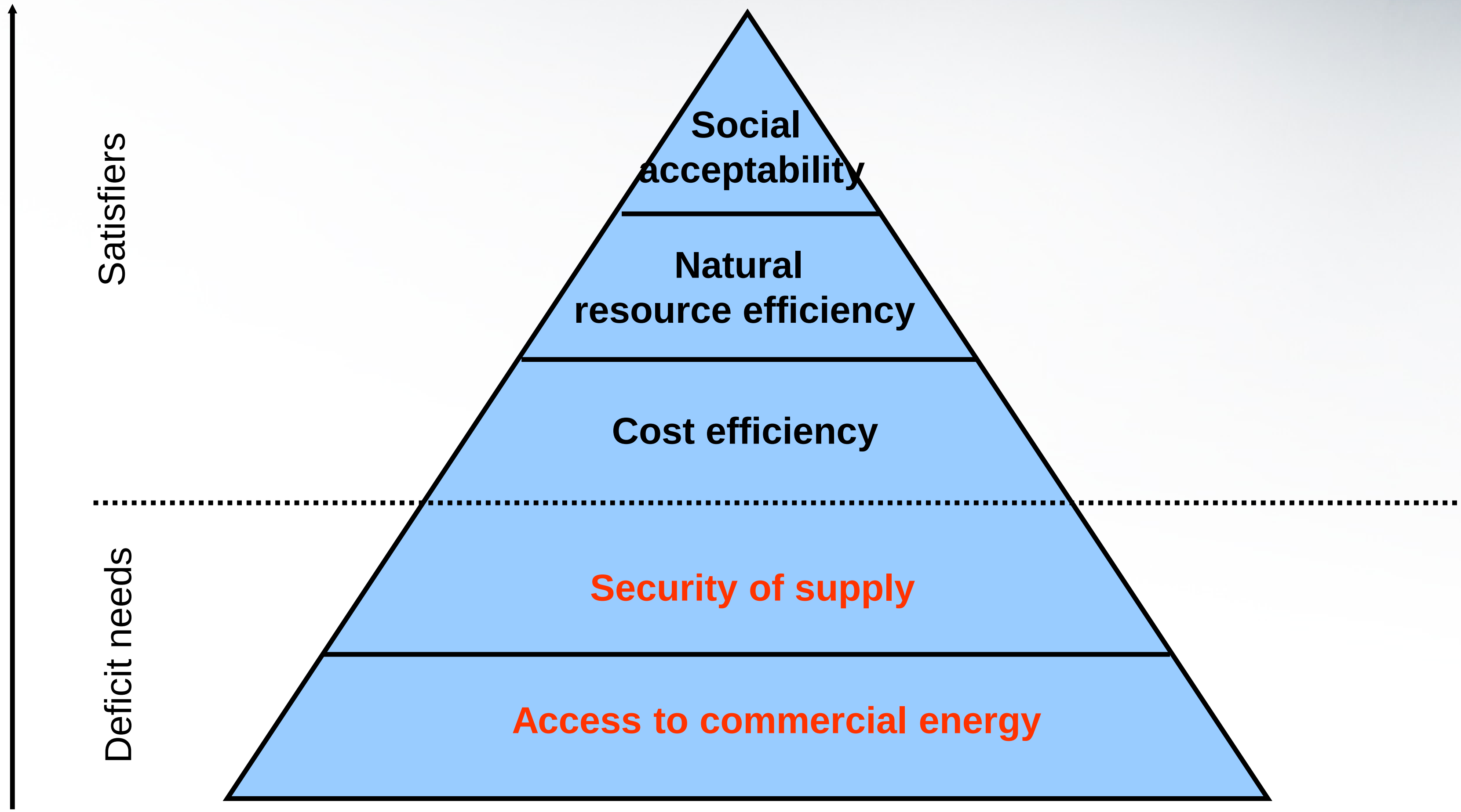
  http://www.etsap.org/Workshop/Stockholm_Sweden_2010/Index.htm

DESIGNING SUSTAINABLE ENERGY SYSTEMS – MAJOR ISSUES

Sustainable Energy

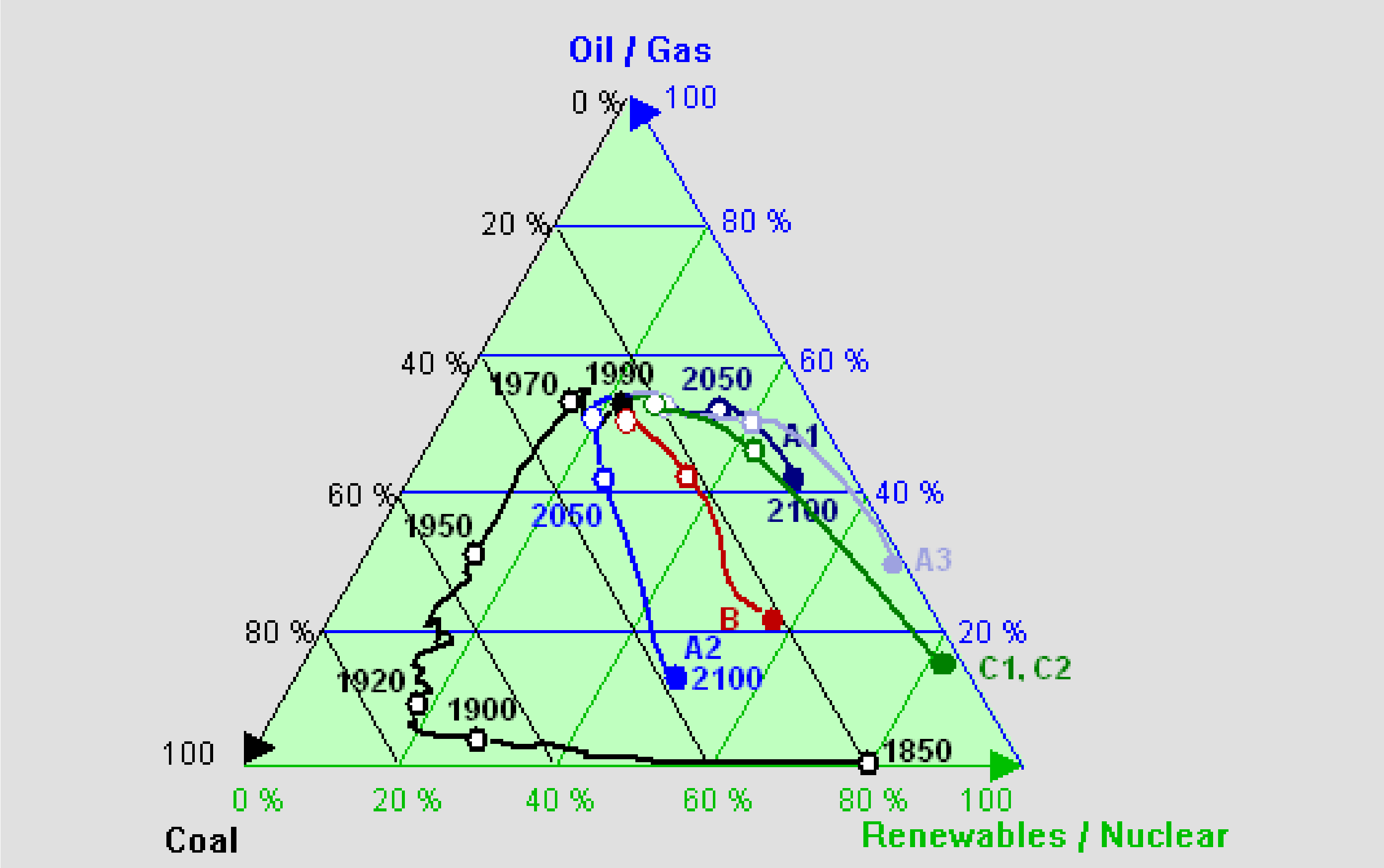
- Energy produced and used in ways that **support** human development over the long-term in all its **social, economic and environmental** dimensions is what is meant by **sustainable energy:**
  - Energy as source of prosperity - adequate services for satisfying human needs, improving social welfare, achieving economic development
    - Accessible, affordable, reliable energy services
  - Should not endanger quality of life of current and future generations and should not exceed the carrying capacity of the ecosystem

The Energy Need Pyramid



Source: C.W. Frei, Energy Policy 32 (2004)

The Energy Route



What will be after another 100 years ?

Source: IIASA

The Characteristics of Sustainable Energy System

Compatibility Criteria

- Based on three pillars of sustainable development – economic, social and environmental – the following compatibility criteria can be used to evaluate energy technologies and energy systems:
  - Economic compatibility
  - Environmental compatibility
  - Intergenerational compatibility
  - Socio-political compatibility (or public acceptance)
  - Geopolitical compatibility (security of supply/ import dependence)
  - Demand compatibility

Future Energy Technology Development

- Will depend on consumer preferences, producer profitability and government policies which together shape the energy system seen as most satisfactory in terms of:
  - Costs
  - Quality
  - Reliability
  - Security
  - Convenience
  - Environmental impacts
  - Social impacts

Economic Compatibility

- Sustainable energy services must be
  - Accessible
  - Affordable
  - The prices of energy services must cover the true social cost
- The contradictory objective here is: full social costs but affordable
- The solution is efficiency, effectiveness and competitiveness
  - **If the technology, or the system that is not competitive – it is NOT sustainable**

Environmental Compatibility

- The inputs to and outputs from each link of the energy system chain must minimally intrude the nature’s flows and equilibria, e.g., do not overload carrying capacity of the ecosystems
- Decommissioning of energy technologies, fuel cycles and infrastructure must be technically and economically feasible

Intergenerational Compatibility

- Energy services must be based on inexhaustible energy sources or finite sources that lead to creation of energy substitutes

- Waste should not pose a risk to future generations

Public Acceptance

- The technology links of the energy systems must be tolerated by general public
- Public attitude and perceptions change and can be influenced by education campaign
- Issues such as:
  - Safe operation of nuclear energy
  - Long-term solution for radioactive waste disposal

Security of Supply

- Heavy dependence on imported fuels pose instability and risk disruption in supply
- Expose to price hike or crisis
- A good combination of sources ensure a more stable supply and higher security

Designing Sustainable Energy System

Future Sustainable Energy Possible ?

- Realising sustainable future requires a well-balanced combination of technological measures:
  - Higher energy efficiency (thus reducing demand for energy services)
  - Increased penetration of renewable energies
  - Use of advanced energy technologies
- And policy measures:
  - Continued market reform
  - Consistent regulations
  - Price incentive for higher efficiency, competitiveness as well as development and diffusion of sustainable energy technologies
  - Getting the prices right

Steps in Designing SES

- Construct future social, economic and demographic background and future trends
- Translate these trends into physical indicators and values on the level of economic activities thus requirements for energy services
- Take inventory of the most important options and technologies that can play a role in future energy system. This inventory includes:
  - Energy efficiency options in the industrial, residential and commercial and transport sectors

Steps (continued)

- Inventory includes:
  - A wide variety of energy conversion technologies
    - Fossil fuel based
    - Renewables
    - Nuclear
- Technological options are related to the socio-economic context:
  - Availability
  - Social acceptance/preferences

Steps (continued)

- Quantitative analysis of scenarios with focus on sustainability objective (indicators):
  - Economic compatibility:
    - Cost of energy services
    - Accessibility and affordability
  - Environmental compatibility
    - Emissions (PM10, SO2, NOX, GHG)
    - Waste
  - Intergenerational compatibility
    - Use of resources
    - Waste

Steps (continued)

- Sensitivity analysis
- Interpretation of quantitative indicators, summary and recommendations

- Use computer tools.

Sustainable Development

↓ ↑

Energy for Sustainable Development

↓ ↑

Sustainable Energy System

↓ ↑

Designing Sustainable Development

Thank you!

Sergiu Robu,

Institute of Energy,

Academy of Sciences of

Moldova

sergiu.robu@asm.md