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ENERGY STRATEGIC PLANNING IN UKRAINE: Energy-Economy-Environmental optimization TIMES-Ukraine model

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Kyiv, Ukraine**



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Introduction (1/2)

Strategic Planning and Management in Energy Sector – this is a mechanism through which the Government and other stakeholders perform the process of planning, providing and financing of energy services to the society in a way which ensures balance of the economic, ecological and social interests, without jeopardizing development opportunities for future generations.

Through application of the strategic planning and management mechanism in the energy sector, the Government, together with other stakeholders, forms the long-term vision of goals and perspective trends in use of energy resources, quality of environment and social sphere (**vision**), identifies changes (**tasks**) necessary for bringing these trends in compliance with the established limits (**criteria**), and adopts the framework approaches to management that would encourage achievement of these goals.



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Introduction (2/2)

Until recently, efficient strategic planning in the energy sector was practically non-existent in Ukraine because of dominating traditional approach to public administration, which is characterized by excessive bureaucracy, centralized policy making, predominance of paternalism, tardiness of decision making process and low level of public involvement. Currently, there appeared a trend to exit this unfavorable situation.

To ensure accommodation of interests of the society, state and business in development of strategic documents for the energy sector, it is necessary to use mathematical models to forecast economy and energy sector development, to evaluate impact of changes in climate and environmental policy etc., both on the national and local levels. In addition, it is important to permanently update and improve these models, to develop new models in order to ensure adequacy of calculations and extension of survey sphere.



Energy Strategic planning: country, region, world level (1/2)

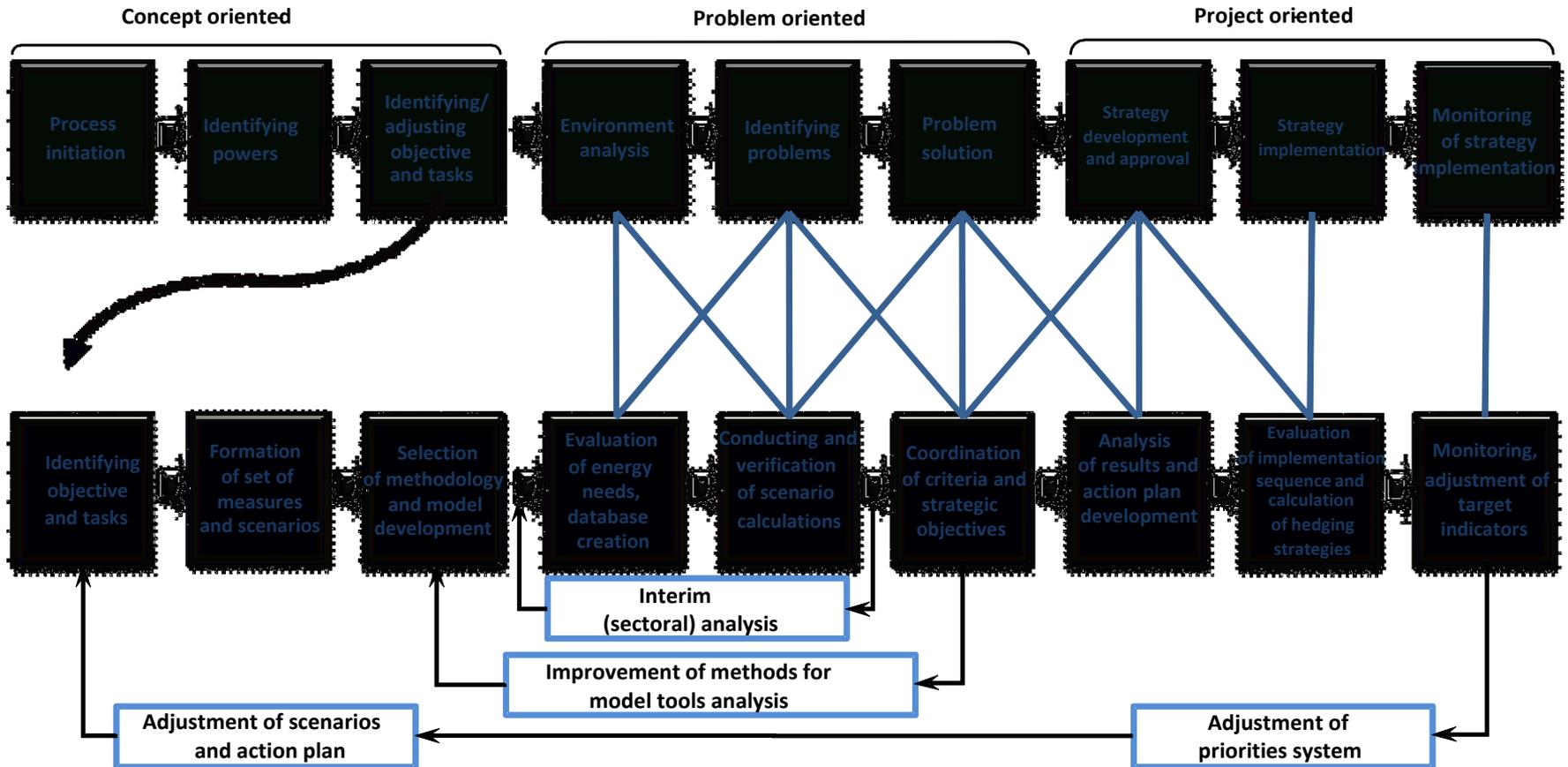


Chart of information and analytical support for strategic planning in energy sector at the country, region and world level is established



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Energy Strategic planning: country, region, world level (2/2)

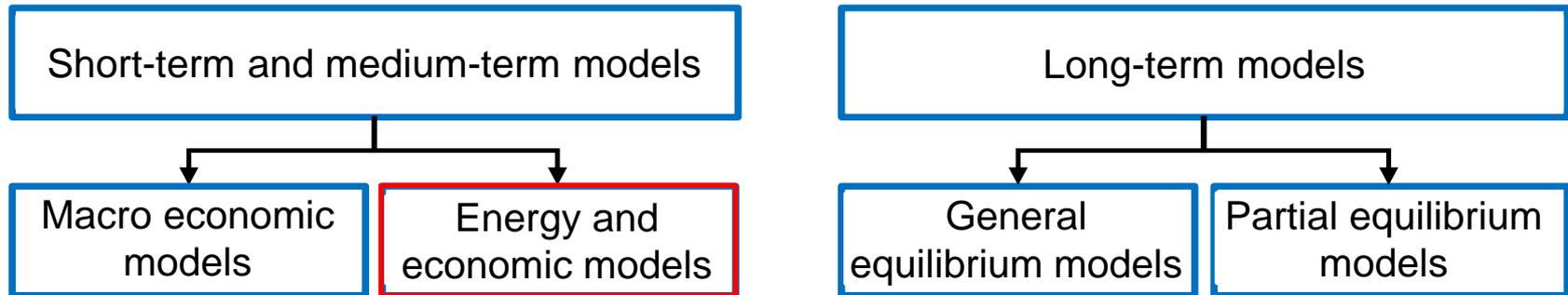
Phases of energy sector development forecasting:

- Identifying categories and quantitative characteristics of energy needs.
- Identifying drivers for energy needs and their functional connection.
- Methods of satisfying energy needs – Outlining energy flow scheme, development of database on energy technologies.
- Evaluation of mutual connection of energy sector with social-and-economic and ecological systems. Coordination of evaluation criteria.
- Formulation of energy sector development vision and strategic goals.
- Calculation of optimal methods for strategic goals achievement with due account for technological, ecological, budgetary and political restrictions.
- Calculation of risk hedging strategies (sensitivity analysis); development of short-term plans with due account for the existing sector regulation model.

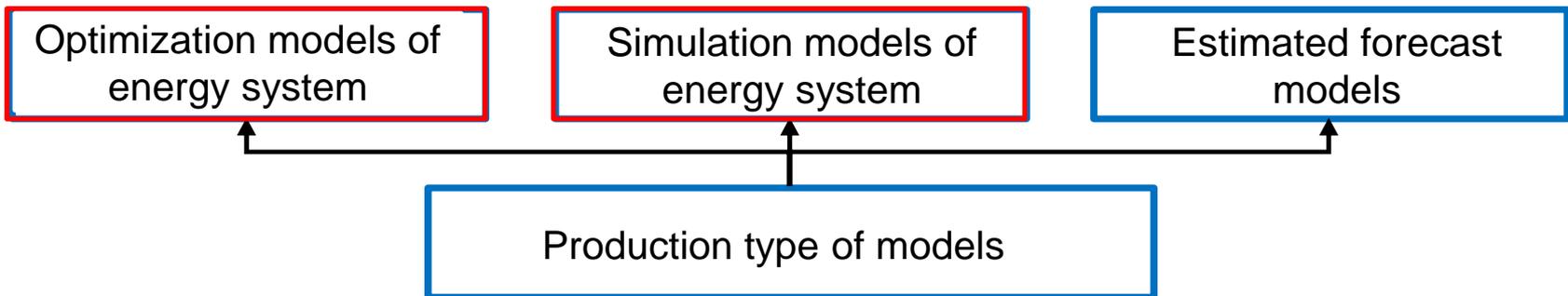


Conceptual approaches for energy modeling, forecasting and strategic planning

Macroeconomic approach



Combined approach



Technological approach



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Using energy system models (incl. MARKAL/TIMES) for energy development policy documents

- World Energy Outlook (International Energy Agency);
- Energy Technology Perspective (International Energy Agency);
- International Energy Outlook (USA);
- Framework for Analysis of Climate, Energy, Technology Systems (USA);
- GHG reduction proposals examination under consideration in the US Congress – Natural Resources Defense Council (USA);
- California Air Resources Board assessment of AB32 (USA);
- Energy Roadmap 2050 (EU);
- National Energy Efficiency Action Plans (Energy Community countries);
- National Renewable Energy Action Plans (Energy Community countries);
- Policy Assessments and Technology Evaluation (JRC, EU);
- Options for a Low Carbon Future (United Kingdom);
- National Communication to the UNFCCC prepared by ENEA (Italy);
- Examination of EU 20/20/20 targets (Greece) and others.



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MARKAL/TIMES models users

- MARKAL/TIMES models are used in nearly 70 countries and by more than 230 organizations for energy and environment forecasts.





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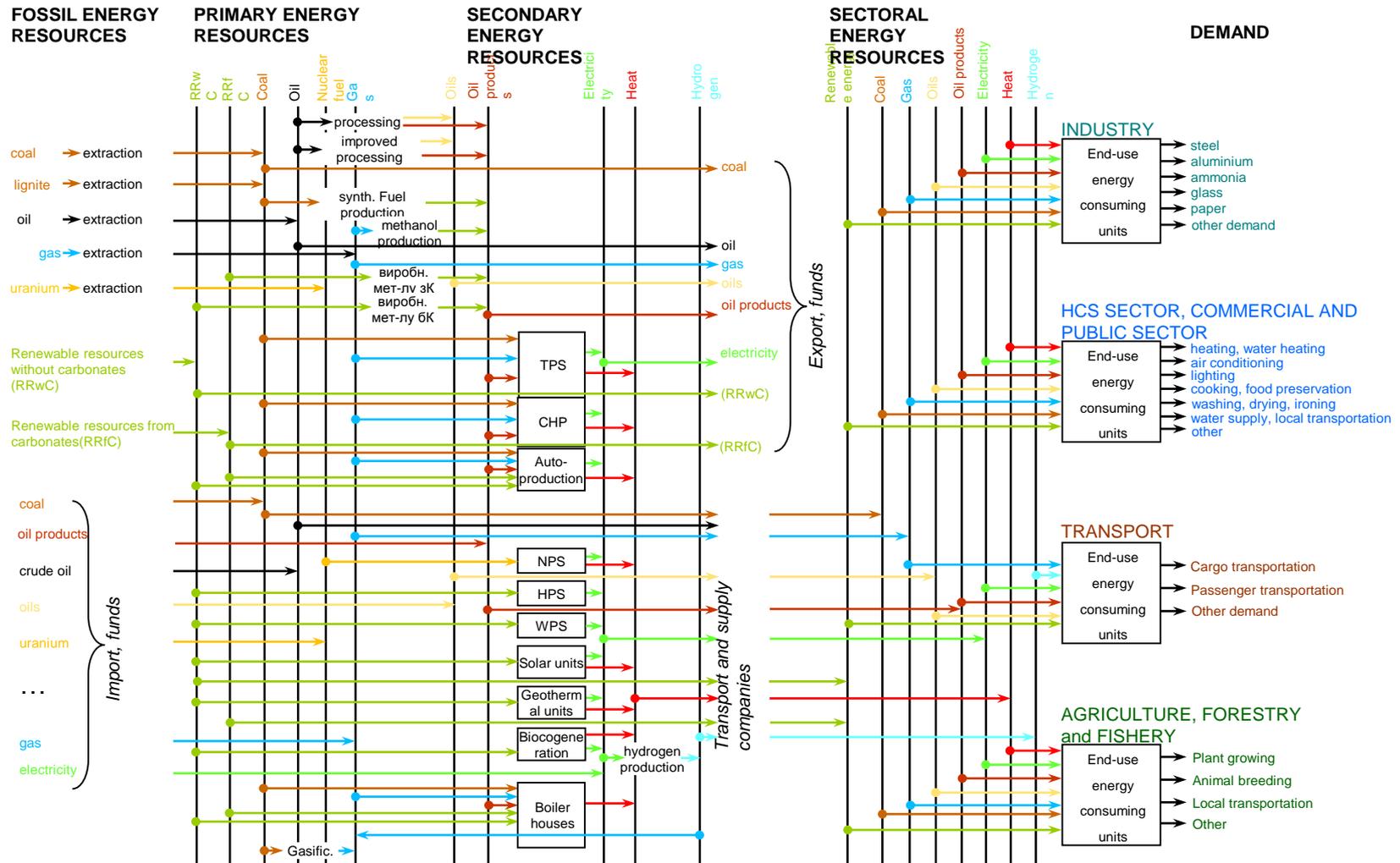
History of TIMES-Ukraine model

- **2004** – start of surveys studying forecasting of Ukraine’s energy balance as part of project implementation by National Academy of Science of Ukraine, **Institute of Economics and Forecasting (IEF), National Academy of Science of Ukraine (NAS)**
- **2006** – **Institute of Economics and Forecasting (IEF)** got the license for TIMES/MARKAL software and **TIMES-Ukraine model emerged**
- **2006** – start of survey on development of the model for optimization of energy flows and forecasting of Ukraine’s energy balance - TIMES-Ukraine model.
- **2009** – beginning of close cooperation with the leading international organizations and academic institutions. **IEF began cooperation with USAID project (implemented by International Resource Group) on improvement of TIMES-Ukraine model and its practical use.**
- **2010-2011** – development of the information-and-analytical system for formation of forecasted energy balance on the basis of TIMES-Ukraine model.
- **2011** – development of recommendations on methodological and organizational support for implementation of the national system of strategic planning and management in the energy sector, where role and place of mathematical models is identified.
- **2012** – development of recommendations on implementation of strategic planning in the energy sector in the system of public administration of the social and economic development. Development of the calculation model for general equilibrium and its use in combination with TIMES-Ukraine model to assess results of introduction of sustainable energy development in Ukraine.
- **2013-2016** – research of strategies for long-term energy sector development, economic policy for optimization of Ukraine’s energy balance, introduction of low emission development for Ukraine’s economy with support of the USAID Municipal Energy Reform in Ukraine Project (hereinafter –USAID Project)



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Reference Energy System in TIMES-Ukraine model





TIMES-Ukraine model data (1/2)

➤ Data of the State Statistics Service of Ukraine

- Form: 1P-NPP “Report on industrial production”; 4-mtp “Report on the use of energy materials and products of oil processing”, №4-TZ “Report on the quantity and technical conditions of cars, busses, motor transport and trailers (semitrailers)”; №51-avto “Report on the volumes of freight and passenger traffic by railway public transport”; №2-tr “Report on the vehicles”; №2-etr “Report on the urban electric transport”; №51-CA “Report on the basic performance of aviation enterprise”; №31-vod “Report on the carriage of goods and passengers by water transport”; №1- auction (oil) “Report on the sale of light oil products and gas”; “Export-import of selected commodities by countries”;
- Surveys “Production and consumption of electricity and some technical-and-economic indicators of Ukrainian power plants performance”; “On the key indicators of the Ukrainian refuse-fired plants and heating networks performance”; “Transport and communications in Ukraine”; “Housing facilities of Ukraine”; “Availability of durable goods for households”; “Socio-demographic characteristics of households in Ukraine”; “Hotels and other places for temporary residence”; “Preschool education in Ukraine”; “General educational institutions of Ukraine”; “Key indicators of Ukrainian higher education establishments performance”; “Cultural, art and physical education establishments of Ukraine”; “Health care establishments and mortality of the population of Ukraine”; “Retail network and restaurant business enterprises”; “The availability and use of distribution network at the markets”; “On the key indicators of Ukrainian water utilities performance”; “On the key indicators of Ukrainian gas facilities performance”.

➤ Ministry of Energy and Coal Industry of Ukraine

- Reports: “Production and distribution of electricity by energy companies and power plants”; “Distribution of heat by energy companies and power plants”; “150, 200, 300 and 800 MW generating units performance”; “The movement of fuel within the energy companies”; “Specific fuel equivalent consumption for electricity supply by Ukrainian energy companies and power plants”; “Specific fuel equivalent consumption for heat supply by Ukrainian energy companies and power plants”; “Technological electricity consumption for transmission through electricity networks”; “Consumption (loss) of heat for its transmission through heat networks”; “The cost of electricity and heat”; “Daily energy consumption schedule for UPS of Ukraine.



TIMES-Ukraine model data (2/2)

➤ Existing and new technologies data:

- *domestic*: State Agency on Energy Efficiency and Energy Saving of Ukraine, national energy generating, energy and gas supply companies as well as oil, gas and coal production companies were adopted;
- *international*: International Energy Agency, Nuclear Energy Agency, Organization For Economic Co-operation And Development (periodical publications, including, Energy Technology Perspectives, database of energy technologies E-TechDS, Projected Costs of Generating Electricity), DIW Berlin university (Current and prospective costs of electricity generation until 2050) and others.

➤ Economic development:

- *domestic*: Institute for Economics and Forecasting, National Academy of Sciences of Ukraine, Ministry of economic development and trade of Ukraine;
- *international*: international financial and rating agencies (for example, International Monetary Fund, World bank, Standard & Poor's, etc.), and others.

➤ Demographic dynamics:

- *domestic*: Institute for Demography and Social Studies of the National Academy of Sciences of Ukraine;
- *international*: United Nations Department of Social and Economic Affairs.

➤ Long-term energy price:

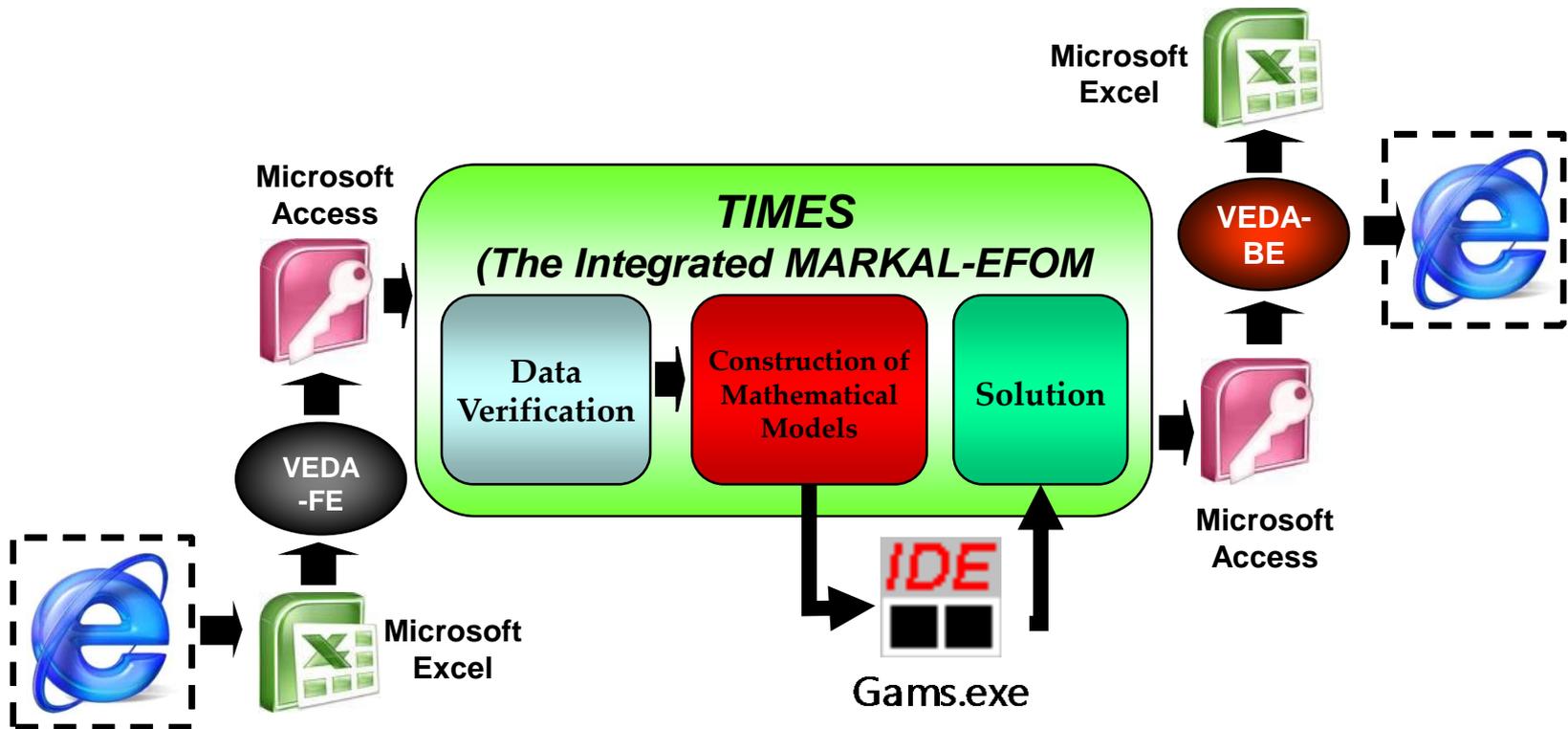
- *international*: International energy agency (World Energy Outlook) and World Bank Commodities Price Forecast.

➤ Factors for CO₂, CH₄ and N₂O:

- *domestic*: the National inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine.



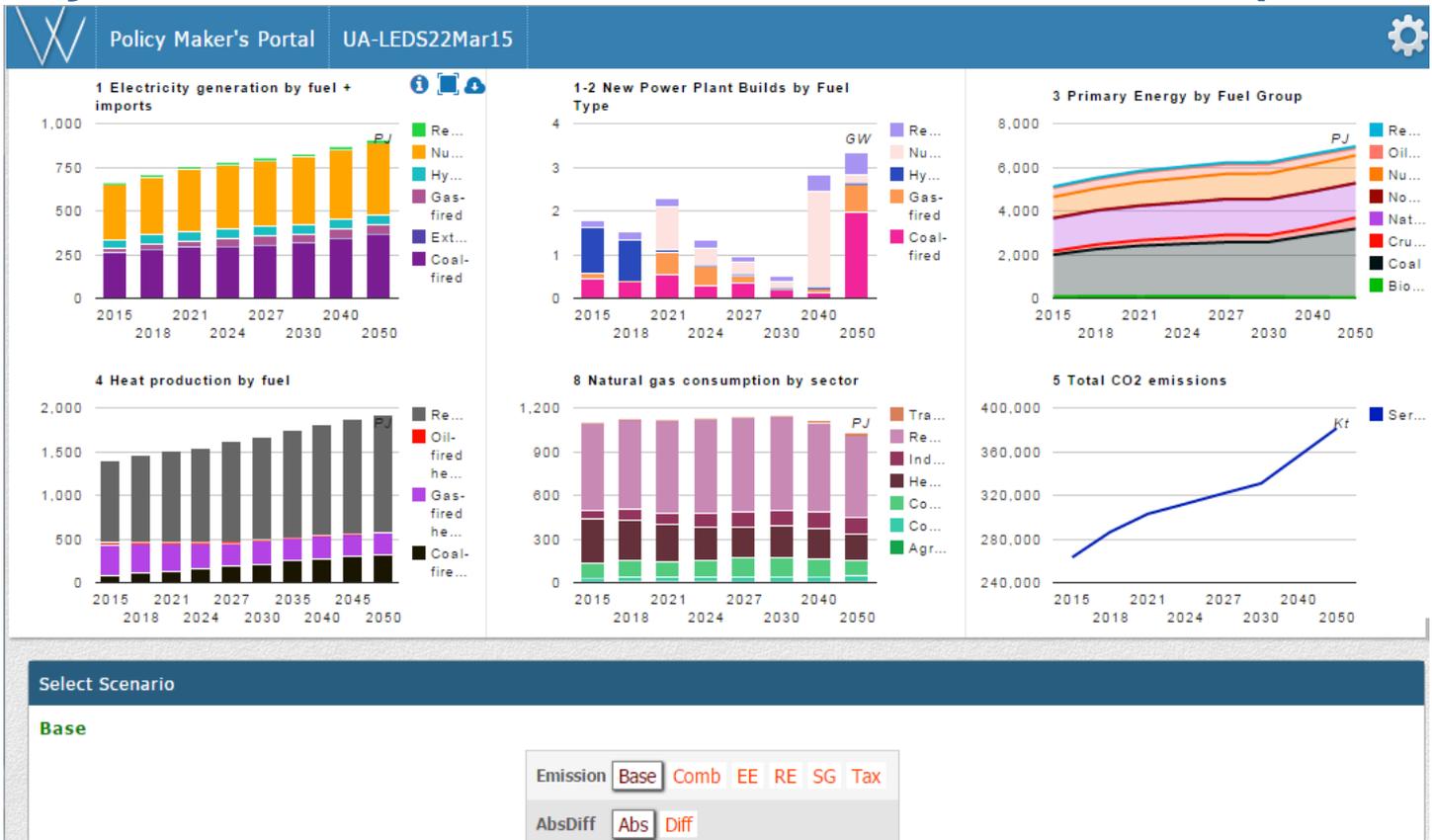
IT-landscape of TIMES-Ukraine model





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Policy Advisor Scenario Review Web Portal (VEDAViz)



- Enables policy advisors to be involved in the analysis process via a highly interactive web-based portal to examine many combinations of scenarios by simply switching between scenario variant values
- Encourages the exchange of ideas & observations via a user forum



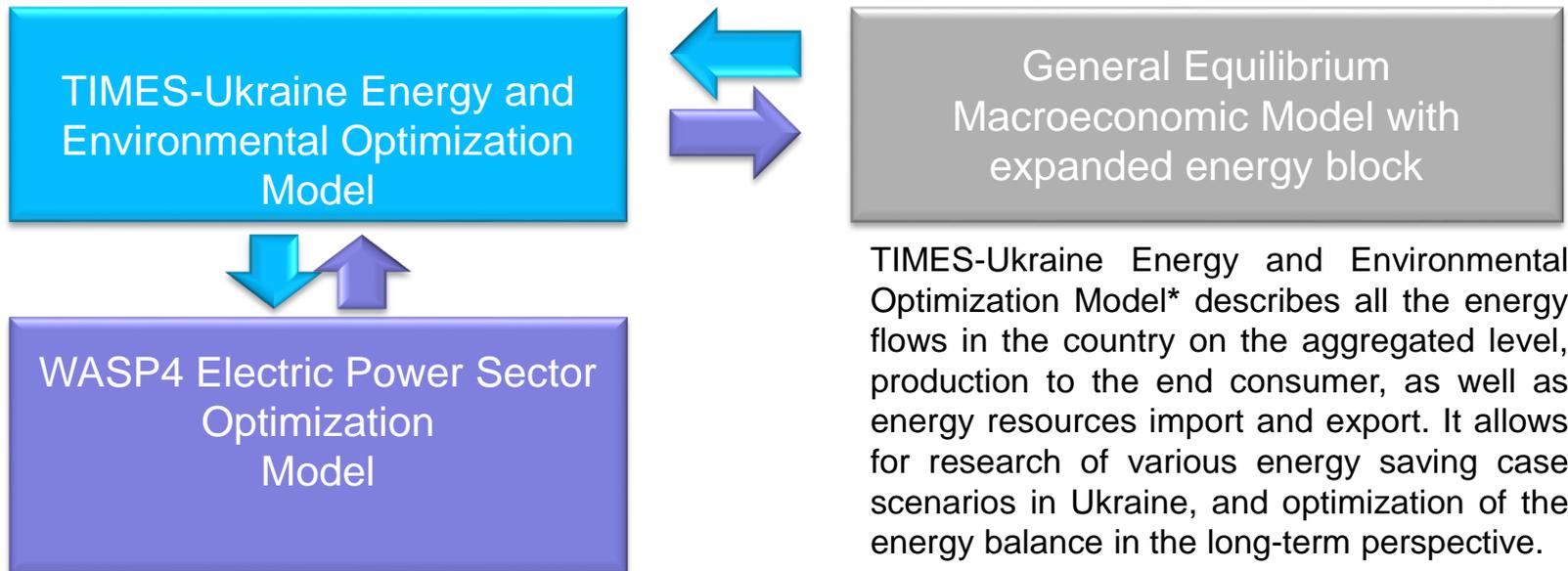
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Participants of TIMES-Ukraine training seminars, organized by USAID Project:

- Ministry of Ecology and Natural Resources of Ukraine;
- Ministry of Economic Development and Trade of Ukraine;
- Ministry of Energy and Coal Industry of Ukraine;
- Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine;
- Ministry of Infrastructure of Ukraine;
- State Environmental Investment Agency of Ukraine;
- State Agency on Energy Efficiency and Energy Saving of Ukraine;
- State Statistics Service of Ukraine;
- National Energy and Communal Services Regulatory Commission;
- Verkhovna Rada of Ukraine;
- Central Council of the Verkhovna Rada of Ukraine;
- Ukrainian Chamber of Commerce and Industry;
- Ukrainian National Academy of Science.



Links with other mathematical models



TIMES-Ukraine Energy and Environmental Optimization Model* describes all the energy flows in the country on the aggregated level, production to the end consumer, as well as energy resources import and export. It allows for research of various energy saving case scenarios in Ukraine, and optimization of the energy balance in the long-term perspective.

WASP4 Electric Power Sector Optimization Model allows detailed and quality presentation of its work in more details taking into account the technical and economic features of electric power plants and electricity transmission lines, as well as allows evaluating the reliability of the forecasted structure of the power generating facilities.

The Computable General Equilibrium (CGE) is used for the purpose of evaluation of the Ukraine's energy development case scenarios economic and social results, as well as for the purpose to improve the energy balance optimization economic policy.



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Practical use of the TIMES-Ukraine model: National

- **Intended Nationally Determined Contribution of Ukraine to the new Global Climate Agreement**
(Ministry of Ecology and Natural Resources);
- **New Energy Strategy of Ukraine through 2020: safety, energy efficiency, competition**
(Committee of the Verkhovna Rada of Ukraine on fuel and energy complex, nuclear policy and nuclear safety).
- **National Action Plan on Energy Efficiency through 2020**
(State Agency on Energy Efficiency and Energy Saving);
- **National Action Plan on Renewable Energy through 2020**
(State Agency on Energy Efficiency and Energy Saving);
- **Fifth National Communication of Ukraine on Climate Change**
(Ministry of Ecology and Natural Resources);
- **Long-term scenarios for development of nuclear energy sector of Ukraine through 2050**
(State company “National Nuclear Energy Generation Company “Energoatom”);
- **Demand for energy resources in short-term and medium-term perspective**
(Ministry of Economic Development and Trade and Ministry of Energy and Coal Industry);
- **General Plan of Coal Sector Development in Ukraine through 2020**
(Ministry of Energy and Coal Industry).



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Practical use of the TIMES-Ukraine model: International

- 2014-16** **Municipal Energy Reform in Ukraine Project (USAID/ENGILITY/IRG, Ukraine)**
- 2014 Evaluation of Energy Efficiency Directive 2012/27/EU impact on Energy Community member countries (*EnC Secretariat, Austria*);
- 2014 Long-term forecast of greenhouse gas emission through 2050 (Targeted Ecological (Green) Investments Fund, Ukraine);
- 2013,15 Capacity building for low-emission development in Ukraine (*UNDP, Ukraine*)
- 2013 Readiness to emission trading in EBRD region (European Bank for Reconstruction and Development, Thomson Reuters Markets (Norge) AS);
- 2012-16 Comprehensive modeling of energy supply in the context of Ukraine's energy safety and sustainable development (International Institute for Applied Systems Analysis, *Austria*);
- 2013** **Research of shale gas potential in Ukraine (USAID/ENGILITY/IRG);**
- 2012 International project on innovative nuclear reactors and fuel cycles (INPRO) (*IAEA/ STC "NNEGC "Energoatom", Ukraine*);
- 2012** **Low emission development strategies and clean energy development strategies in Europe and Eurasia (USAID/Tetra Tech, USA);**
- 2012** **Research of shale gas potential in Ukraine (USAID/IRG, USA);**
- 2009-12** **Energy safety and market development in Europe and Eurasia: analysis of national priorities (USAID/Hellenic AID, IRG/CRES, USA, Greece);**
- 2009-11 Technical assistance and budgetary support for implementation of the Energy Strategy of Ukraine (*European Union, KANTOR company, Ukraine*);
- 2009-11 Program to support coal sector of Ukraine (*European Union, TACIS Project, Human Dynamics company, Ukraine*).



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Key Tasks in USAID/ENGILITY/IRG projects

➤ 2009-2010

- Update of the existing model;
- Complete Reference Scenario;
- Data and Model Assumption Review Process;
- Perform Preliminary Analysis;
- Strategic Planning Analysis;
- Disseminate Analysis Results (National and Regional);
- Final Report and Final Workshop.

➤ 2011-2012

- Update and Expand the Models;
- Prepare for and Support New Analyses;
- Undertake Analyses of National Planning Priorities;
 - Renewable Energy Targets and Energy Efficiency Analyses;
 - Analysis of National Priorities;
 - Carbon Mitigation Strategy for the Energy System;
- Host a Policy Dialog and Strategic Planning Workshop and Contribute to a Regional Strategic Planning Workshop;
- Model Review and "Certification" Process.

➤ 2013

- Adding the shale gas resource to the TIMES-Ukraine model.



Key Tasks in USAID/ENGILITY/IRG projects

➤ 2014-2015

- Unification of joint parameters (assumptions) national (TIMES-Ukraine model) and municipal modeling (SEAP);
- Enhancement and improving TIMES-Ukraine modeling to reflect LEDS;
- Development and implementation of modeling calculations for GHG emissions and energy sector development – baseline and alternative scenarios of GHG emissions/LEDS;
- Training Program for State Officials on development and using the TIMES-Ukraine;
- Technical Consultations with interested ministries and state agencies.

➤ 2015-2016

- Development of the detailed baseline low emission development (LED) scenarios for dynamics of greenhouse gas emission in Ukraine through 2050;
- Assessment of social and economic impact from introduction of low emission development scenarios and industrial processes in Ukraine;
- Development of the structure and contents of Intended Nationally Determined Contributions (INDC) of Ukraine;
- Preparation of separate INDC sections based on the results of modeling of low emission development scenarios for Ukrainian energy sector;
- Participation in discussion and providing support in the process of preparation and presentation of INDC on the national level and (if needed) on the international level;
- Conducting of training for top officials of the ministries and representatives of the Government of Ukraine on use of TIMES-Ukraine model.



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Key Results in USAID/ENGILITY/IRG projects

➤ 2009-2010

- Calibrated model, including all input templates;
- Data sources workbook;
- Ministry briefing presentations;
- Country report chapter.

➤ 2011-2012

- National Policy Brief;
- National TIMES-Ukraine database and model used to conduct a series of priority analyses;
- Briefing material as part of the new national Energy Strategy.

➤ 2013

- Report of economic potential of shale gas in Ukraine.

➤ 2014-2015

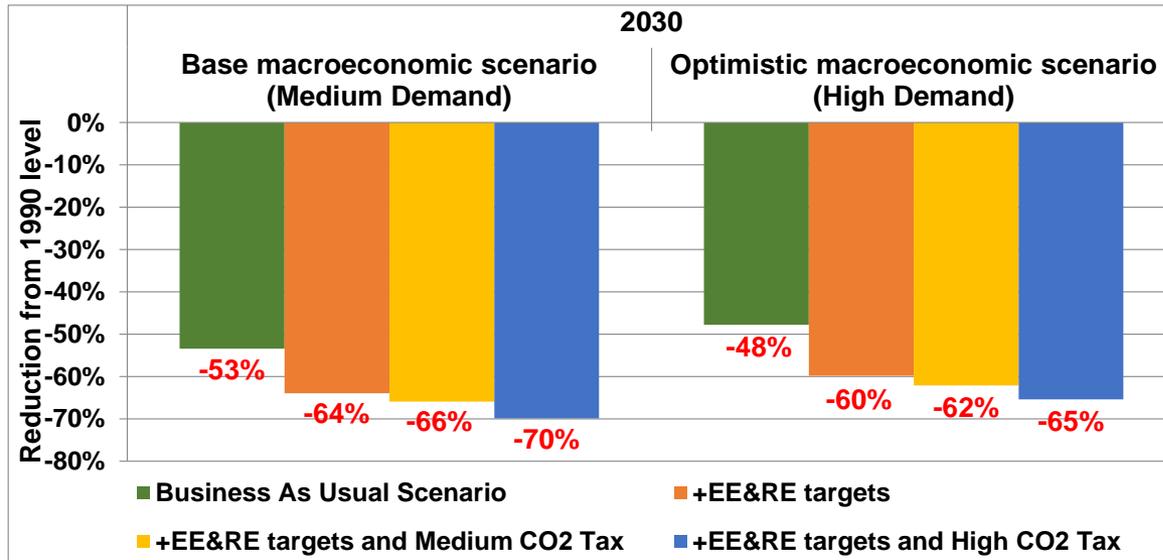
- Improved TIMES-Ukraine model;
- Report of baseline and alternative scenarios of GHG emissions reduction;
- Training materials for State Officials on development and using the TIMES-Ukraine.

➤ 2015-2016

- Added Industrial GHG emission into TIMES-Ukraine model;
- Report on the detailed baseline and LEDS scenarios for Ukrainian energy sector;
- Report on assessment of social and economic impact from LEDS scenarios;
- Training materials on use of TIMES-Ukraine model in the process of strategic planning of the energy sector development of Ukraine.



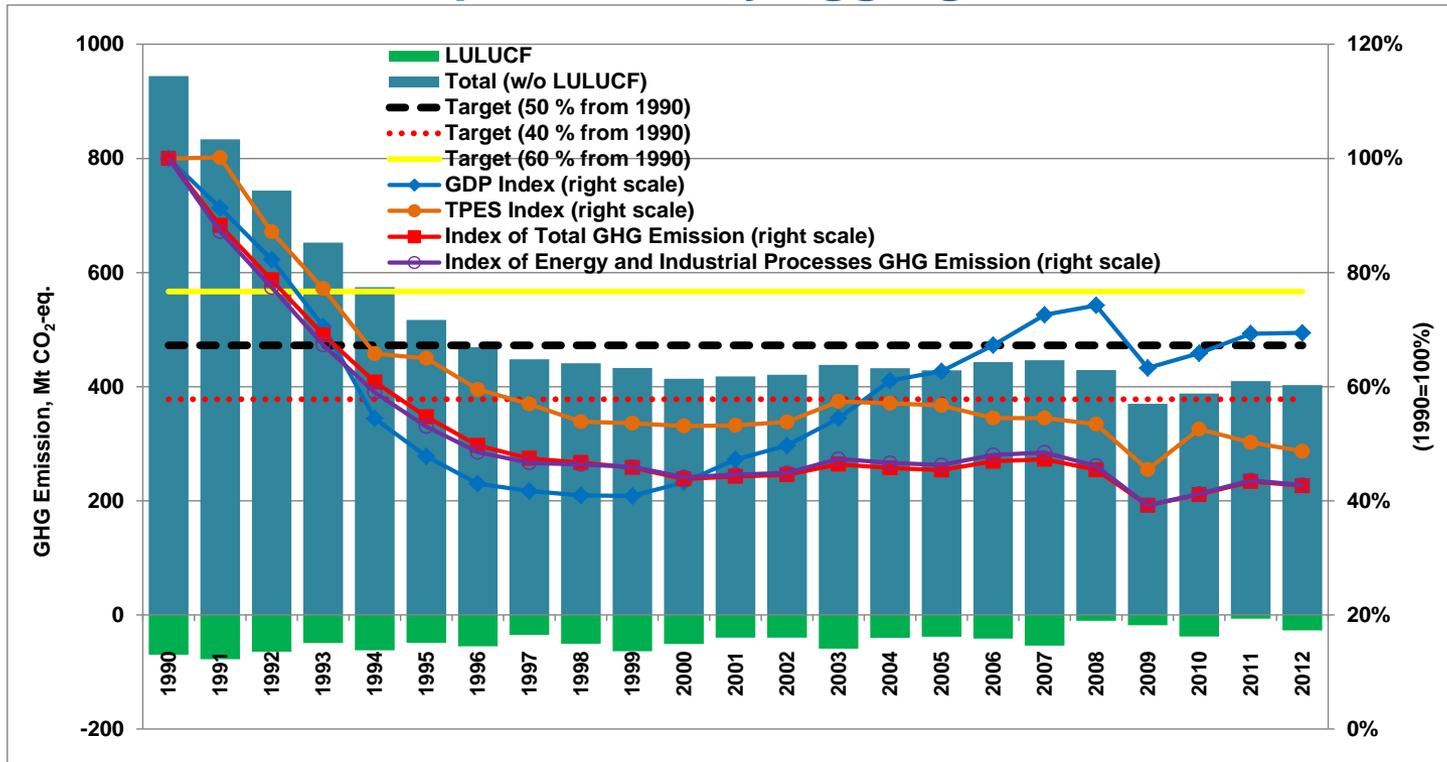
INDC development – Reduction of GHG emission in “Energy” and “Industrial Processes” sectors in 2030 compared to 1990



- In case of achievement of ambitious goals on energy efficiency and RES which correspond to EU goals, GHG emission in 2030 may be **from 35% to 40% of 1990 emission level**, and these will be extremely ambitious goals for low emission development of Ukrainian economy.
- Achievement of these goals will promote economic growth, creation of new jobs, increased competitiveness of Ukrainian economy and increased level of economic and energy safety, will prevent negative impact from fluctuation of world prices for energy resources.
- But achievement of these goals will require attraction in Ukraine’s economy of significant investment resources **from Euro 75 to 100 billion**, one third of which (without inclusion of measures of GHG emission reduction in private transport) will have to be attracted for the housing sector.



INDC development – Key aggregated indicators



- Dynamics of GHG emission follows the curve of primary energy general supply. In 1990-2000, rate of GHG emission was comparable to the rate of GDP decrease, but after 2000, as a result of changed structural proportions in economy, GDP increase was no longer accompanied by the relevant GHG emission increase.
- GHG emission in “Energy” sector in 1990-2012 was 75.9-79.5% of total GHG emission (3.6% difference), and together with “Industrial Processes” sector – 85.2-90.1% (4.9% difference), and determined general dynamics of GHG emission in Ukraine.



INDC development – Forecast of Ukraine’s aggregated GDP - 2015-2030

Macroeconomic scenarios	Growth rate versus previous year, %			
	2015	2016-2020	2021-2025	2026-2030
Aggregated GDP				
Base	-8,6	3.2	3.2	3.3
Investment-active		3.6	4.5	5.0
Inert*		1.7	2.2	2.2
Industry				
Base	-9,0	4.1	3.3	2.7
Investment-active		4.8	7.5	7.8
Inert*		1.8	2.6	1.7

- Speed and direction of economic reforms are considered under three scenarios which differ to certain extent in targeted outrunning growth of separate economy sectors (traditionally energy intensive industries or services), but main difference of which is exactly the rate of economic growth.
- Scenarios with high and low GDP growth rates form the expected deviation of the key aggregated indicators curve, averaged value of which is included in the terms of base macroeconomic scenario.

* **Inert** development scenario envisages preservation of current trends in Ukrainian economy and contains no significant changes in speed and depth of transformation processes. This scenario does not correspond to strategic goals of Ukraine, and it should not be taken into account for formation of Ukraine’s INDC



INDC development – GHG emission in different BAU-scenarios

Years	Scenarios					
	BAU+BAS _{ME} , mln t CO ₂ -equiv	% of 1990	% of 2007	BAU+OPT _{ME} , mln t CO ₂ -equiv	% of 1990	% of 2007
1990	830	100%		402	48.5%	
2007	402	48.5%	100%	402	48.5%	100%
2012	353	42.7%	87.8%	353	42.7%	87.8%
2020	309	37.4%	76.9%	312	37.6%	77.6%
2030	387	46.8%	96.3%	434	52.5%	108.0%

- In view of current economic and military-and-political situation in Ukraine, 60% excess of GHG emission in Ukraine from 1990 level will hardly take place, even in conditions of intensive recovery and capacity increase of energy intensive sectors of industry. According to BAU-scenarios, GHG emission in 2030 will be approximately on the level of 2007.
- In view of the given GDP growth rate and forecasted growth rate of end-use energy consumption and GHG emission, energy intensity and carbon intensity of Ukrainian economy will decrease in all scenarios. At the same time, assumptions were adopted on dynamics of Ukraine's population decrease in future, and end-use energy intensity and carbon intensity per capital will be growing intensively.



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Current practical use of the TIMES-Ukraine model

- **The Energy Strategy of Ukraine through 2035**
Ministry of Energy and Coal Industry of Ukraine
- **The Economic Impact Analysis of the Energy Strategy 2035 of Ukraine**
*Ministry of Energy and Coal Industry of Ukraine,
Ministry of Economic Development and Trade of Ukraine*
- **The Low Emission Development Strategy of Ukraine through 2050**
Ministry of Ecology and Natural Resources of Ukraine
- **Sectoral Low Emission Development Strategies**
Ministries and Agencies
- **The Socio-Economic Development Strategy of Ukraine through 2035**
Ministry of Economic Development and Trade of Ukraine
- **The Development plan of the United Energy System of Ukraine**
National Energy and Communal Services Regulatory Commission
- **The National Energy Efficiency Action Plan through 2030**
State Agency on Energy Efficiency and Energy Saving of Ukraine
- **The National Renewable Energy Action Plans through 2030**
State Agency on Energy Efficiency and Energy Saving of Ukraine



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TIMES-Ukraine future prospects

- Permanent database update in TIMES-Ukraine model
- TIMES-Ukraine model improvement:
 - Incorporation of latest changes in the structure of statistical reporting in Ukraine
 - Detailing of the sector of buildings
 - Detailing of the heating sector
 - Detailing of the set of perspective technologies and their parameters (for example, increase of time-slice number, clean and innovative technologies, technologies for improved energy efficiency and use of RES, reduction of GHG emission in all sectors of economy)
 - Possibility of GHG emission forecasting in non-energy sectors
 - Possibility of stochastic modeling
- Development of modern economic and mathematical models for the electricity and gas markets to assess their functioning by the rules of the Third Energy Package. Its combination with TIMES-Ukraine model
- Improvement of the general equilibrium model with extended energy block and connections to TIMES-Ukraine model
- TIMES-Ukraine training seminars for stakeholders;
- TIMES-Ukraine training seminars for students;
- Improvement and maintaining of VEDA Viz portal for popularization of modeling results