World Economic Dynamics (WED) Model: Modeling and forecasting of global economy and total primary energy consumption

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General Methodology

- Economic modeling and forecasting
- Primary energy modeling and forecasting
- Electricity output modeling and forecasting
- Oil consumption modeling and forecasting
- Gas consumption modeling and forecasting
- Coal consumption and forecasting
Modeling and forecasting global economy and primary energy consumption: methodology

- Our analysis takes into account historical data from 1980 to 2013.
- The main sources of information are: The World Bank, International Monetary Fund, International Energy Agency.
- We present global economy and energy projections in the period to 2045.
- Our model and projections include 27 countries, European Union, and aggregate «Other countries» (89% of world GDP and primary energy consumption in 2013).
Modeling and forecasting global economy and primary energy consumption: WED model

**Economic module**

- Incremental capital-output ratio
- Gross fixed capital formation (% of GDP)
- GDP, PPP (2005 trillion $)
- Population (million people)
- GDP per capita (2005 thousand $)
- GDP per capita growth (annual %)
- GDP growth (annual %)

**Energy module**

- Total primary energy consumption (Mtoe), includes: Oil, Gas, Coal, Nuclear power, Hydro power, Other renewables
- Primary energy consumption per thousand $ GDP (Mtoe)
- Primary energy consumption per capita (Mtoe)
- Electricity production (TWh)
Modeling and forecasting global economy and primary energy consumption: general logic

Projections for economic dynamic

- Projections for total primary energy consumption
  - Projections for oil
  - Projections for gas
  - Projections for coal - balance method
  - Projections for nuclear, hydro power and other renewables - from the external forecasts
- Projections for electricity production
WED Content

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Economic growth: modeling

GDP per capita growth $t = \frac{\text{Gross fixed capital formation } t-1}{(\text{Incremental capital-output ratio } t-1 + 1)}$

Key assumptions:

• The United States remains the leader in the field of economy and technology. In the long run, the gap between other countries and the United States will be reduced

• Developing countries are trying to achieve the level of developed countries by increasing the Gross fixed capital formation

• Productivity of capital will decline in all countries (in the absence of breakthroughs in science and technology)

• Working-age population in the major developed countries is reduced. Population growth rates in emerging economies are also gradually declining
In our projections developed and emerging economies both will see a decline in their annual GDP PPP growth rate. Economic growth rates, which were before the crisis of 2008, will not be achieved.

The share of developed economies in global GDP growth will rise. But the main contribution to the global economic dynamics will be made by emerging economies.
Economic growth: forecasting

The structure of global GDP will change to 2045:

- the share of developed countries (EU, USA, Japan) falls
- the share of emerging economies (India, China) rises
- China become the largest world economy in 2020
- the share of Russia and Brazil not increases
General methodology

Economic modeling and forecasting

Primary energy consumption modeling and forecasting

Electricity output modeling and forecasting

Oil consumption modeling and forecasting

Gas consumption modeling and forecasting

Coal consumption modeling and forecasting
Total primary energy consumption: modeling

3-step methodology: preparing data, regression, calculation of forecasts

Energy intensity growth rate (EI) 1980-2013

GDP growth rate (GDP) 1980-2013

Regression
EI_t = a × GDP_t + b

Regression coefficients

GDP elasticity of energy intensity forecast

Total primary energy consumption forecast

GDP forecast

Step 1

Step 2

Step 3
Total primary energy consumption: forecasting

In our projections global energy demand increases by 50% from 2013 to 2045.

Driven with government policy in support of energy efficiency, improvement in primary energy intensity is expected to continue.

Demand increases for all types of energy (but at a significantly different rates):
- oil 35%;
- gas 78%;
- coal 32%;
- nuclear 55%;
- hydro 45%;
- renewables 67%.
As a result the share of gas, other renewables in global primary energy consumption will rise to 2035.

The share of oil and coal will fall.

The shear of nuclear, hydro remaining constant.

Emerging economics (China, India) and USA will be a key drivers of global energy demand growth.
Thank you for your attention!