# Low-carbon development of Russia: insights, national specifics

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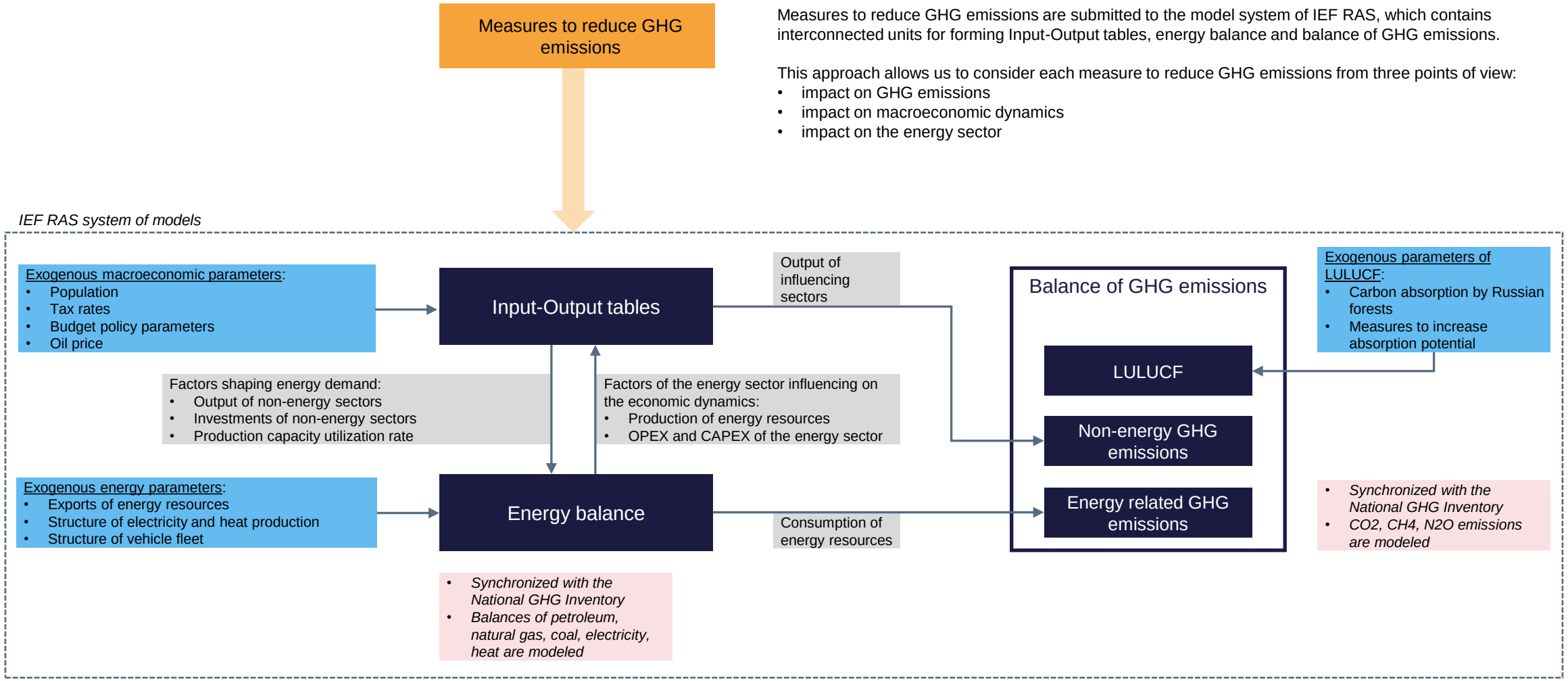
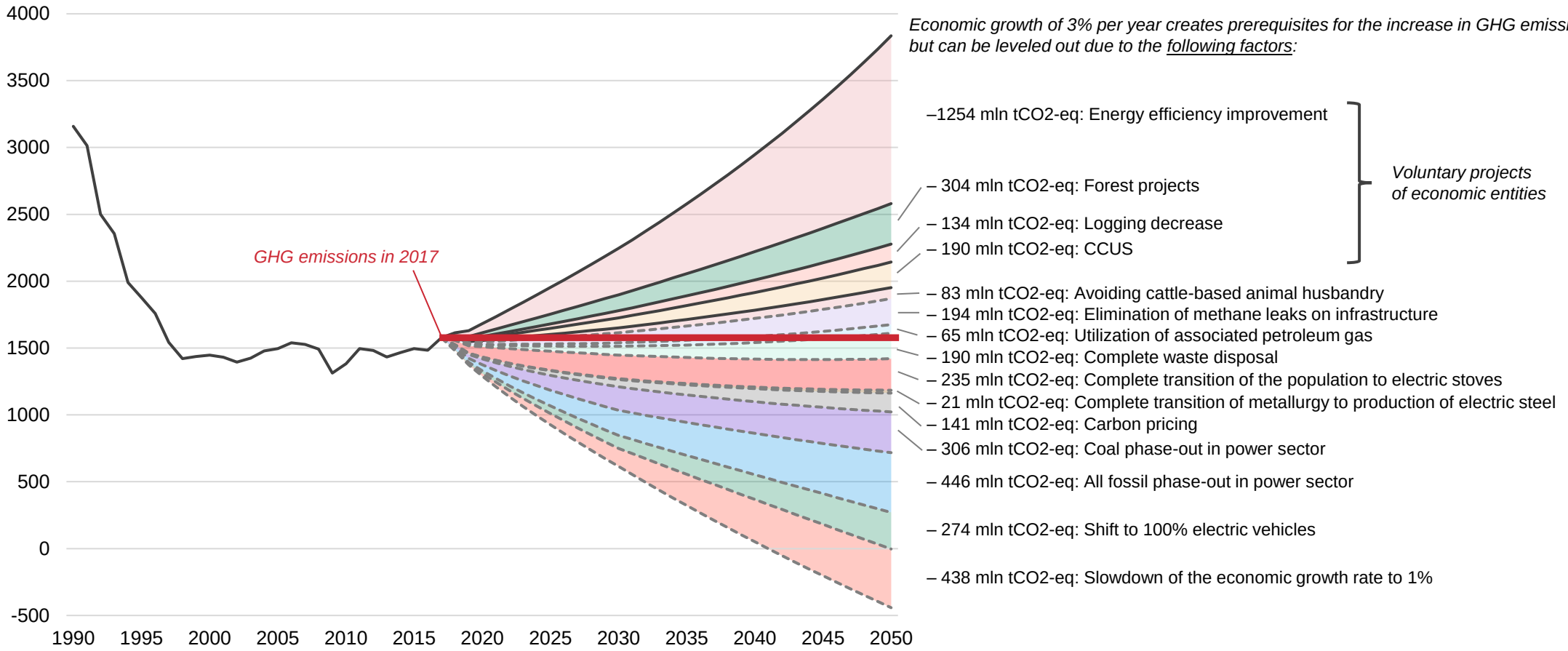
# Modeling the low-carbon development of Russia

Measures to reduce GHG emissions are submitted to the model system of IEF RAS, which contains interconnected units for forming Input-Output tables, energy balance and balance of GHG emissions.

This approach allows us to consider each measure to reduce GHG emissions from three points of view:
- impact on GHG emissions
- impact on macroeconomic dynamics
- impact on the energy sector



## **Potential for mitigating the GHG emissions (with LULUCF) in Russia,** mln tCO2-eq






Source: IEF RAS

## **Long-term scenarios for GHG mitigation in Russia** (all values given for the year 2050)

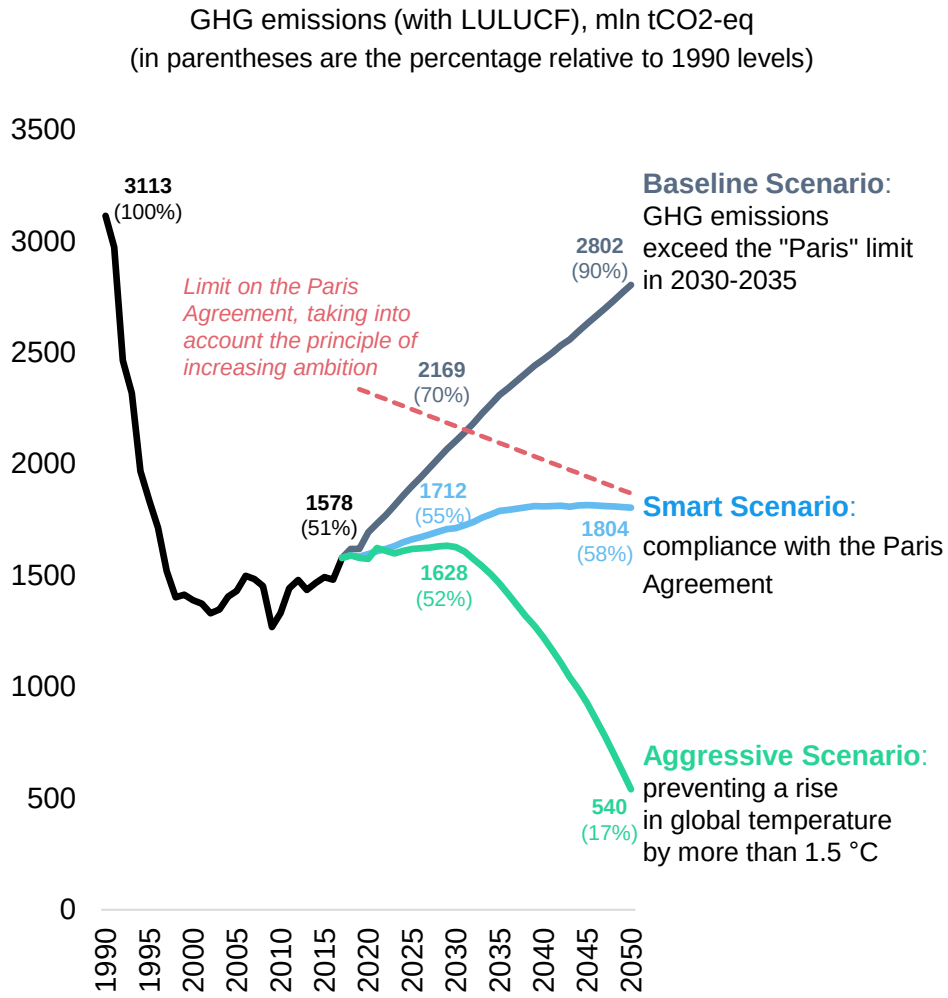
| | Baseline Scenario | Smart Scenario | Aggressive Scenario |
|---|---|---|---|
| General principles | Economic growth ensuring the improvment of the resource use efficiency | Economic growth ensuring the improvment of the resource use efficiency and diversification of the economy | Decrease in hydrocarbons exports by 90%; implementation of carbon tax ($10 per tCO2-eq. in 2030 with a gradual increase to $50 in 2050) |
| Production of electricity and heat | Reduction of hydrocarbons share in the fuel structure from the current 72% down to 55%; uniform growth in the shares of nuclear, hydro and renewable energy | Reduction of hydrocarbons share in the fuel structure down to 40%; accelerated growth of nuclear energy share (including with storage) | Reduction of hydrocarbons share in the fuel structure down to 15% and transition to renewables + storage system (50% share); capturing 25% of $CO_2$ emissions |
| Road transport + Refining | Increase in the share of electric vehicles in the personal car fleet up to 10%; improvement of the fuel efficiency (for personal cars) to 6.5 liters per 100 km | Increase in the share of electric vehicles in the personal car fleet up to 25%; improvement of the fuel efficiency (for personal cars) to 6 liters per 100 km | Increase in the share of electric vehicles up to 65% in the personal car fleet and up to 50% in the truck fleet; improvement of the fuel efficiency (for personal cars) to 5.5 liters per 100 km; capturing 25% of $CO_2$ emissions at refineries |
| Pipeline transport | No special measures | Reduction of $CH_4$ leaks by 30% | Indirect effect of hydrocarbons exports decrease; reduction of $CH_4$ leaks by 30%; capturing 25% of $CO_2$ emissions from pumping stations |
| Production of hydrocarbons | Stable rate of useful utilization of associated petroleum gas at the level of 85% | Increase in the rate of useful utilization of associated petroleum gas up to 99%; reduction of $CH_4$ leaks by 50% | Indirect effect of hydrocarbons exports decrease; increase in the rate of useful utilization of associated petroleum gas up to 99%; reduction of $CH_4$ leaks by 50%; capturing 25% of $CO_2$ emissions |
| Residential | Increase in energy efficiency of buildings by 25% | Increase in energy efficiency of buildings by 40%; transferring 50% of gas stoves to electricity | Increase in energy efficiency of buildings by 50%; transferring 90% of gas stoves to electricity; transferring 50% of heating to electricity |
| Agriculture | Increase in the average productivity of cows up to 5500 kg per year | Increase in the average productivity of cows up to 7000 kg per year, which makes it possible to reduce their livestock by 15% | Decrease in the number of cattle by 50%; changing the diet of the population; switching 50% of farming to organic methods |
| Metallurgy | Increase in efficiency of coke use by 30% | Increase in efficiency of coke use by 35%; transferring 30% of converters to electric furnace | Increase in efficiency of coke use by 35%; transferring 75% of converters to electric furnace; capturing 25% of $CO_2$ emissions |
| LULUCF | Decrease in LULUCF absorption by 85% | No growth in logging, voluntary reforestation projects at the level of 1% of business profit | No growth in logging, voluntary reforestation projects at the level of 1% of business profit |
| Waste | Inertial growth of waste associated with GDP per capita increase | Recycling 50% of waste associated with GHG emissions | Recycling 90% of waste associated with GHG emissions |
| Air transport | Increase in fuel efficiency by 25% | Increase in fuel efficiency by 25% | Increase in fuel efficiency by 25%; transferring 30% of air transportation to high-speed railway communication |



Source: IEF RAS

# Long-term scenarios for GHG mitigation in Russia

- In **the Baseline Scenario** (reaching economic growth rates not lower than the world ones, but without cardinal improvements in the production and technological structure of the economy), **Russia will exceed the "Paris" limitation in 2030–2035**. Therefore, the task is to develop possible scenarios for the country's long-term development with ensuring low levels of GHG emissions
- **The Smart Scenario** is based on compliance with the Paris Agreement (taking into account the increased ambition) mainly due to the internal potential of the Russian economy. The scenario is driven by the **structural and technological modernization** of the Russian economy. Comprehensive efficiency gains will not only have a positive impact on the carbon intensity of the Russian economy, but will also generate revenues to finance tailored measures to limit GHG emissions
- **The Aggressive Scenario** targets the reduction of GHG emissions in order to prevent an increase in global temperature by more than 1.5 °C (compared to the pre-industrial level), **regardless of the possible consequences for the sustainable development of the Russian economy**. It suggests the most stringent climate policy measures



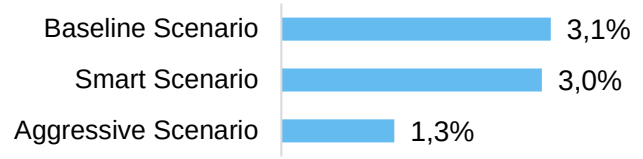



Source: IEF RAS

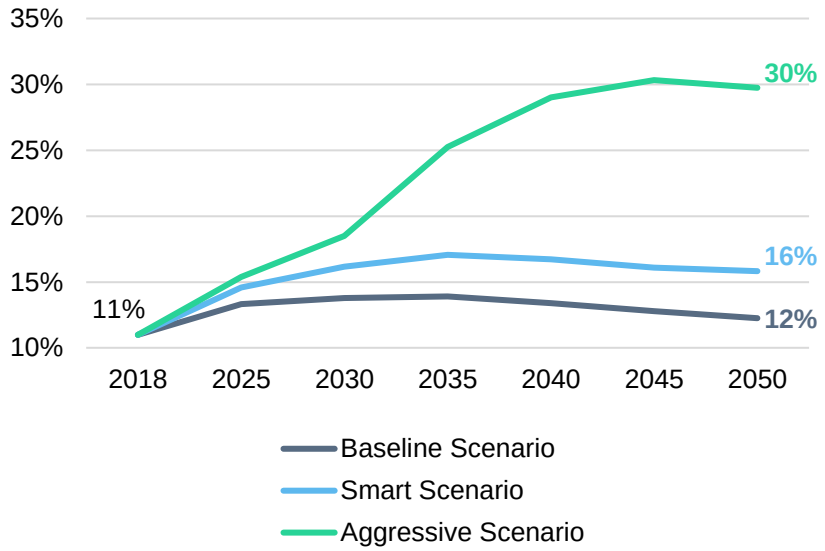
# Impact of GHG mitigation scenarios on the economic dynamics

- **Implementation of the Aggressive Scenario turns out to be incompatible with sustainable economic growth in Russia**. The collapse of hydrocarbon sector, the devaluation of the national currency, high mitigation costs that are unproductive from the economic point of view at times, and the import of technologies to reduce emissions are factors that cannot be leveled out
- **The price of the Aggressive Scenario for the Russian economy is lowering the average annual GDP growth rate by almost 2 percentage points by 2050**
- Tough measures to reduce GHG emissions involve **energy costs increase to unprecedented levels** – from the current 11% of the GDP to 30% of the GDP by 2040. Such a burden would hardly be compatible with economic growth. In any case, with such dynamics, economic growth will not translate into an improvement in the standard of living of the population
- **Following the Reasonable Scenario involves structural and technological modernization of the economy**, which leads to an increase in its efficiency. It is the main resource that provides income to finance costs aimed at reducing net GHG emissions (a significant part of which is unproductive and associated with imports). As a result, the loss of the GDP growth rate turns out to be minimal

Average annual GDP growth rate of Russia in 2021-2050




Energy cost for the economy,% of GDP






Source: IEF RAS

# Impact of GHG mitigation scenarios on the economic dynamics

| Factor | GHG emissions, mln $tCO_2$-eq. | GDP growth rate (%) / Impact on average annual GDP growth rate up to 2050 (percentage points) |
|---|---|---|
| | *Baseline Scenario analysis* | |
| **Fact – 2017** | **1578** | **1.6%** |
| Baseline increase in output | +2534 | |
| Vehicle fleet growth by 65% | +127 | |
| Baseline increase in energy efficiency of the economy (in all areas) | -1151 | |
| Change in the sectoral structure of output | -713 | +1.5 p.p. |
| Baseline change in the fuel structure of energy consumption | -190 | |
| Baseline reduction in the LULUCF absorption | +512 | |
| Baseline waste growth | +105 | |
| **Baseline Scenario – 2050** | **2803** | **3.1%** |
| | *Deviations of the Aggressive Scenario from the Baseline Scenario in 2050* | |
| Reduction of hydrocarbon exports by 90% (with an accompanying devaluation of the ruble) | -627 | |
| Decline in energy efficiency of the economy (due to a slowdown in the economic growth and investment) | +238 | -1.4 p.p. |
| Imposition of the carbon tax ($10 per tCO2-eq. in 2030 with a gradual increase to $50 by 2050) | -89 | -0.07 p.p. |
| Spread of renewables – 50% share in the structure of power sector generation | -473 | +0.27 p.p. |
| Spread of electric vehicles (taking into account the imports required) | -150 | -0.25 p.p. |
| Transferring 90% of gas stoves to electricity in residential sector | -234 | - |
| Transferring 75% of converters to electric furnace in metallurgy | -18 | -0.02 p.p. |
| Refusing of agriculture from cattle and nitrogen fertilizers by 50% | -111 | -0.04 p.p. |
| Capturing 25% of GHG emissions in the real sector | -152 | -0.19 p.p. |
| Waste recycling | -178 | -0.02 p.p. |
| Increase in the LULUCF absorption (no growth in logging, reforestation projects) | -385 | -0.03 p.p. |
| Other measures | -84 | -0.06 p.p. |
| **Aggressive Scenario – 2050** | **540** | **1.3%** |
| | *Deviations of the Smart Scenario from the Baseline Scenario in 2050* | |
| Improving the structural and technological efficiency of the economy and exports | -155 | +0.12 p.p. |
| Additional change in the structure of power sector (mainly due to nuclear energy) | -121 | +0.02 p.p. |
| Spread of electric vehicles (taking into account the imports required) | -34 | -0.1 p.p. |
| Transferring 50% of gas stoves to electricity in residential sector | -71 | - |
| Useful utilization of associated petroleum gas at the level of 99% | -73 | -0.01 p.p. |
| Reduction of infrastructural GHG leaks | -49 | -0.01 p.p. |
| Waste recycling | -94 | -0.02 p.p. |
| Increase in the LULUCF absorption (no growth in logging, reforestation projects) | -385 | -0.03 p.p. |
| Other measures | -17 | -0.03 p.p. |
| **Smart Scenario – 2050** | **1804** | **3.0%** |



Source: IEF RAS

# Linkage between energy efficiency and investments

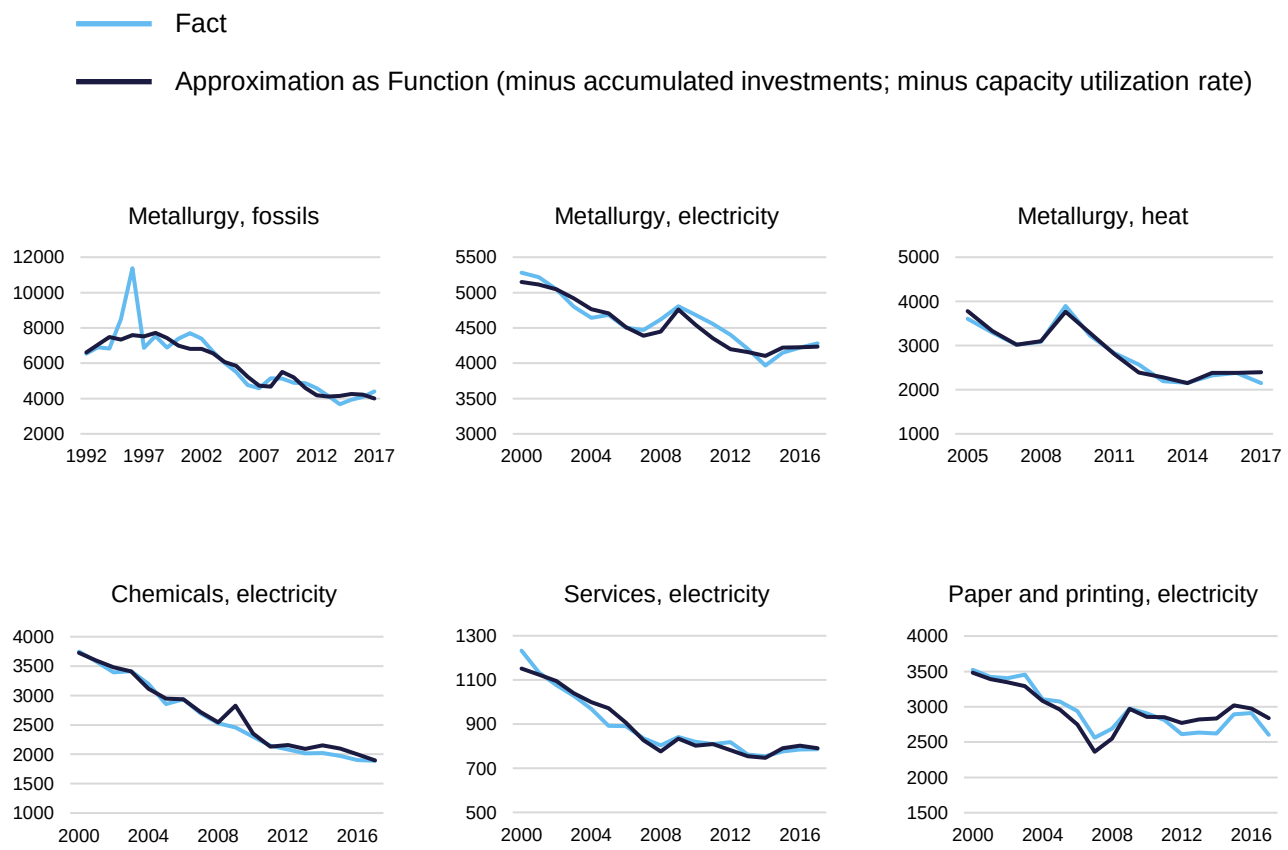
Regression analysis shows that energy efficiency in key sectors of the Russian economy correlates well with indicators characterizing the investment process in the production sectors, as well as capacity utilization:

**the higher the accumulated investment / capacity utilization rate, the lower the specific energy consumption**

This means that economic growth is a key condition for improving energy efficiency, because it is associated with the accumulation of modern highly efficient capital, as well as with the utilization of existing competitive production capacities to increase output

Loading of production capacities is a necessary condition for efficiency growth. If they stand idle, this will lead to an increase in the conditionally constant energy costs

Specific energy consumption in some industries per unit of output, kg ce / mln RUB (2010)

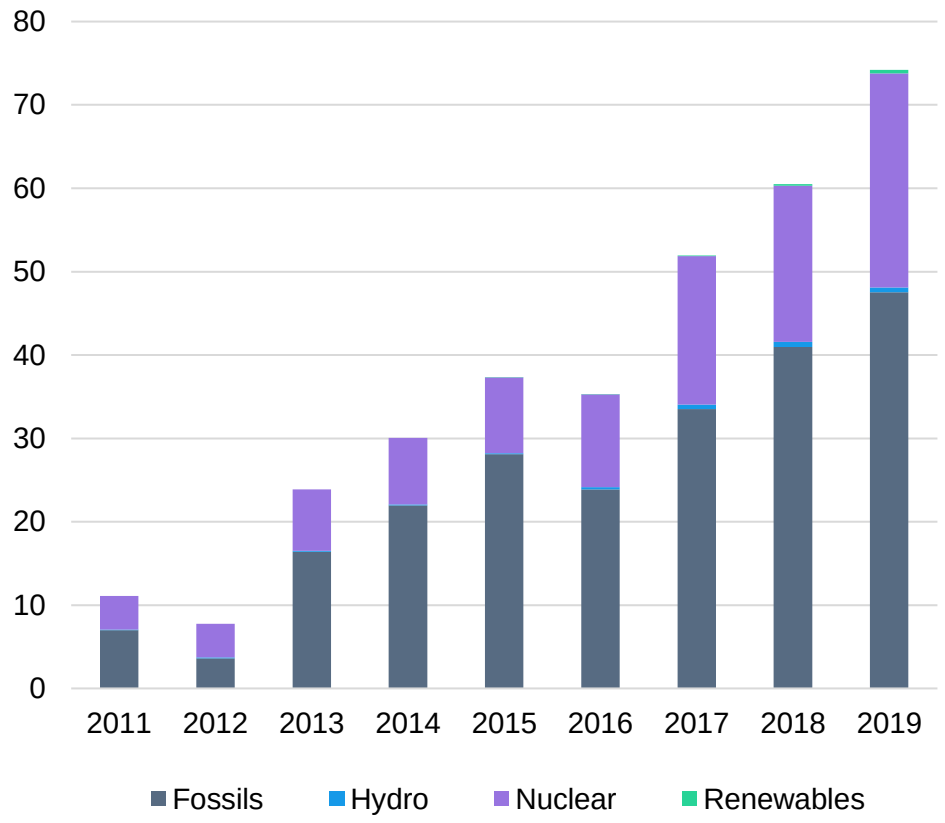





Source: IEF RAS

# Efficiency of GHG emissions reduction in the Russian power sector

Emissions “saved” by new power plant projects, mln $tCO_2$




Cost of “saved” emissions by new power plant projects, euro per $tCO_2$

| | 2017 | 2018 | 2019 | 2017-2019 weighted average |
|---|---|---|---|---|
| Nuclear | 83 | 84 | 94 | 88 |
| Hydro | 168 | 143 | 136 | 148 |
| Renewables | 995 | 808 | 826 | 854 |
| Thermal (Fossils) | 116 | 89 | 79 | 92 |
| EU ETS price | 6 | 16 | 25 | 16 |

- The least costly “carbon-saving” way is the construction of new nuclear power plants. "Saving" emissions due to building new hydro power plants is 1.5 times more expensive; due to renewables – almost 10 times more expensive
- Even though new thermal power plants use carbon-containing fuels, they are comparable to nuclear power plants in terms of improving the carbon intensity of electricity generation



Source: IEF RAS

# Carbon sink by Russian forests

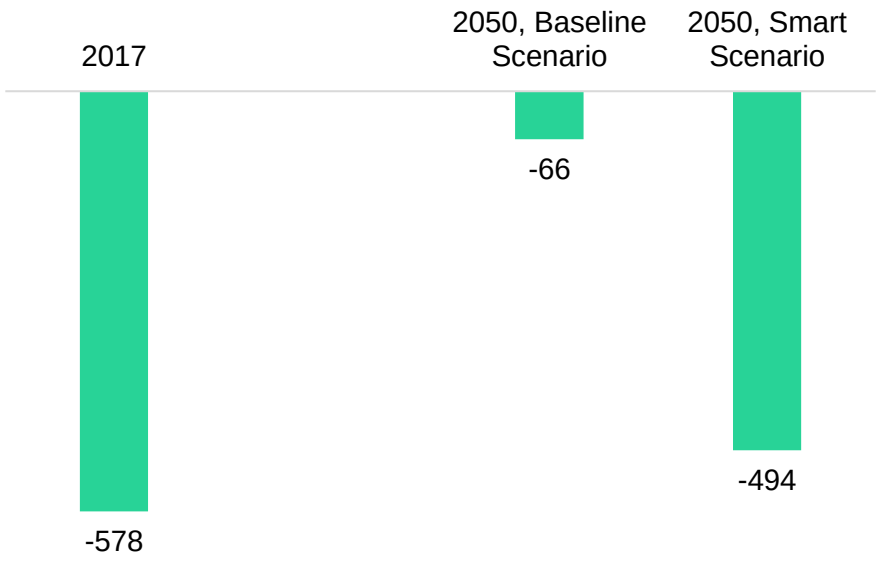
## Challenges

- Discussion about the methodology – a wide range of estimations for the potential of the national forests to remove and sink the GHG
- Lack of long-term scenarios for carbon sink by Russian forests

Change in carbon balance of Russian forests

| | 2017-2035 | 2017-2050 | Factors considered |
|---|---|---|---|
| Zamolodchikov | –20-40% | –35-60% | Growth of harvesting |
| Zamolodchikov, Grabovsky | –40-65% | –65-85% | Ageing, growth of harvesting |
| Institute of Global Climate and Ecology | –4-8% | – | Fire prevention, growth of harvesting |

LULUCF dynamics in the scenarios, mln tCO2-eq



## Questions to discuss

**Electricity**

- Perspective structure of the electricity generation in Russia
- Socio-economic restrictions for the spread of low-carbon technologies
- Dependance on import

**Manufacturing sector**

- Ways to decarbonize the manufacturing sector of the Russian economy
- The most perspective technologies
- Impact of the economic conditions

**Forests**

- Carbon sink potential of Russian forests and ways to maximise it
- Cost of forest projects
- Optimistic scenarios for LULUCF

# Contacts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