Understanding the criteria for Russian climate policy: Energy and Economy modeling

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Institute of
Economic Forecasting
RAS

Climate agenda

The climate agenda has become one of the key factors in the development of socio-economic and energy policies in most countries of the world

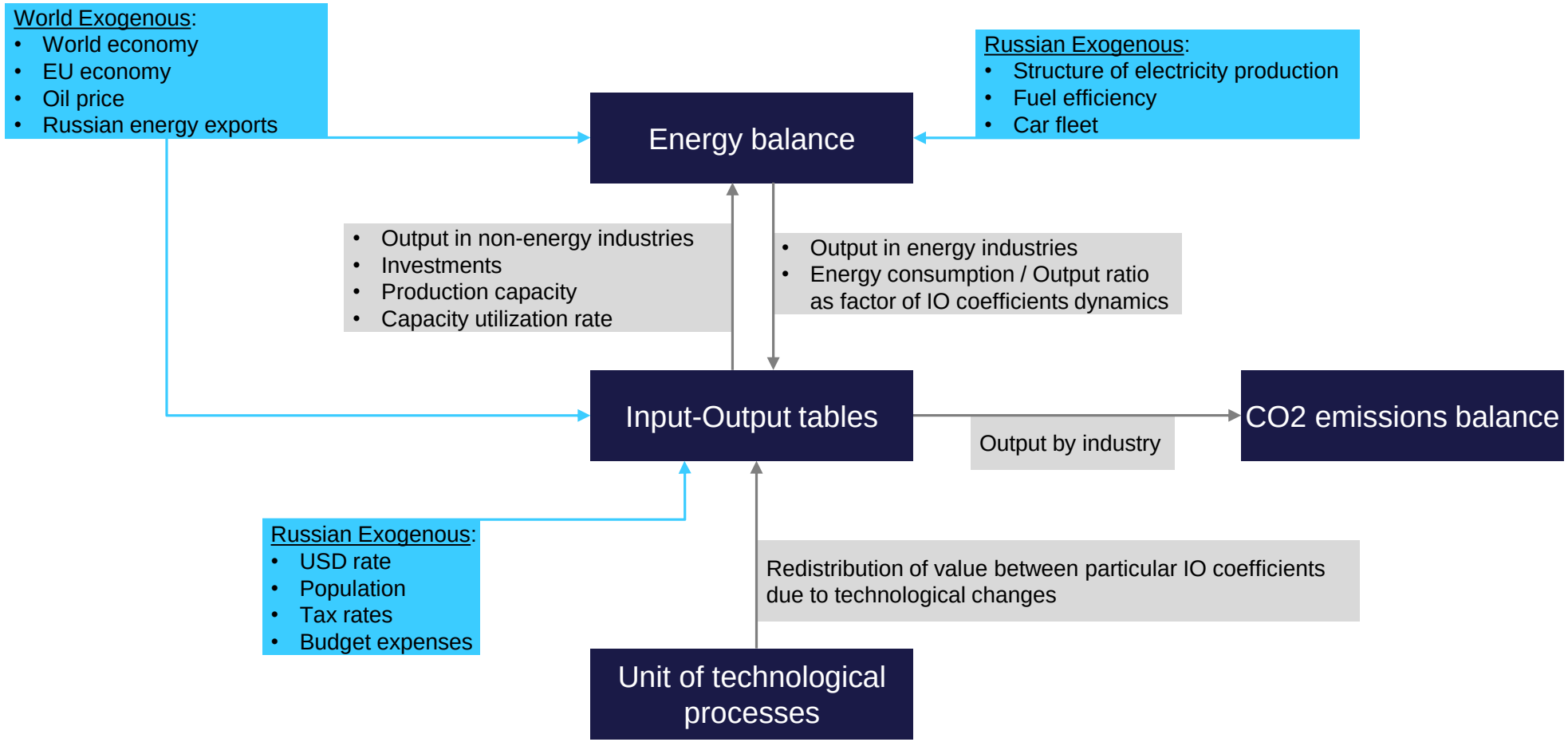
Russia has signed but not yet ratified the Paris Agreement

Currently, Russia pays special attention to the goal of ensuring the sustainable economic growth. That’s why any initiative is carefully analyzed for socio-economic consequences. And the national climate policy is no exception. Russia cannot afford the measures that excessively limit the growth potential of its economy

Climate policy is always aimed at the restriction of CO2 emissions, which appear when carbon-containing energy resources are consumed. The set of solutions is wide enough, but the key measures are:

- Energy efficiency
- Electric cars
- Renewable energy

Our Input-Output Tool for Economy-Energy-Emissions modeling



Energy efficiency issue

Any energy model considers the energy consumption as a function of economy and demography. Energy efficiency is what we additionally “put” into this function (efficiency may be described as energy consumption to output/population ratio):

$$Energy = Economy,Demography * Efficiency$$

Efficiency is usually set as exogenous parameter. But it has decisive impact on the total energy consumption and, consequently, emissions.
For instance, decrease in CO2 emissions by 1% currently requires either increase in solar and wind energy use by 70% or improvement in energy efficiency by 1%

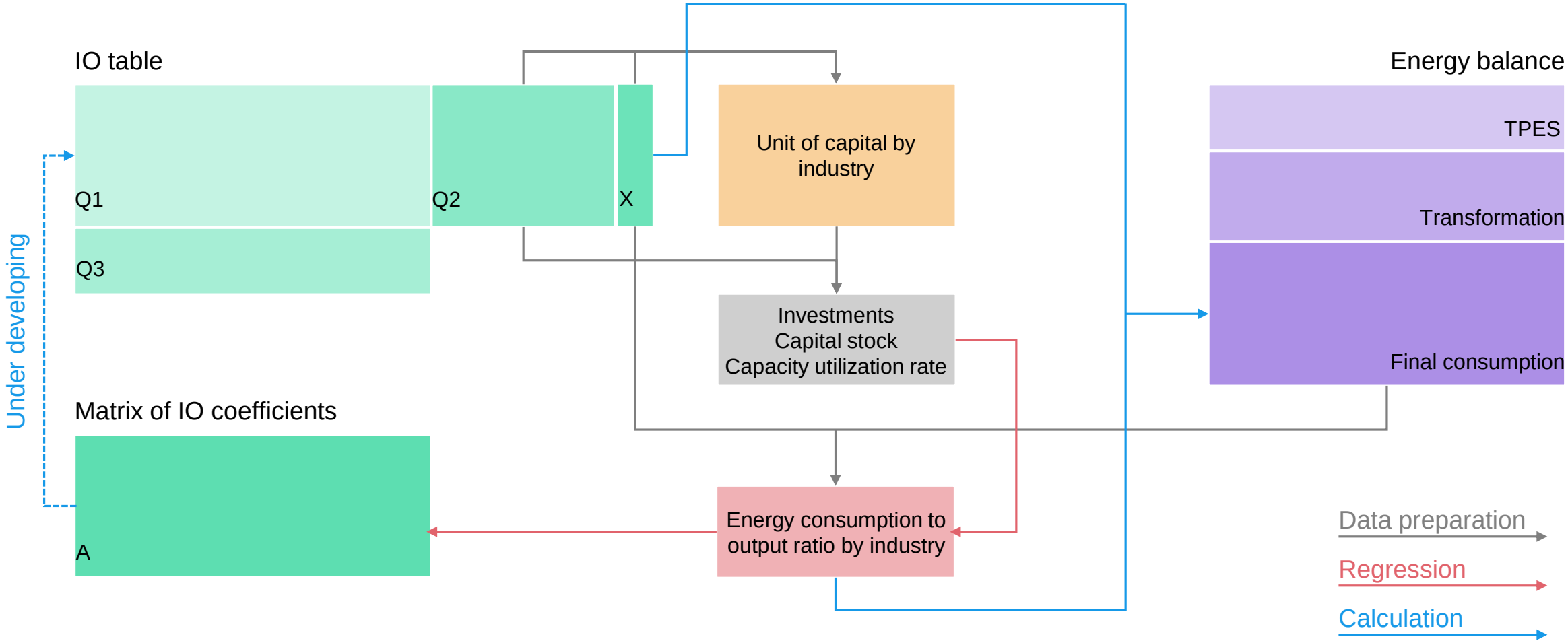
IEF RAS investigates the linkages between IO table and Energy balance in order to model the dynamics of energy efficiency in particular industries:

Energy consumption to output ratio (*S*) is a function of investments (*I*), capital stock (*C*), capacity utilization rate (*U*):

the higher *I, C, U*, the lower *S*

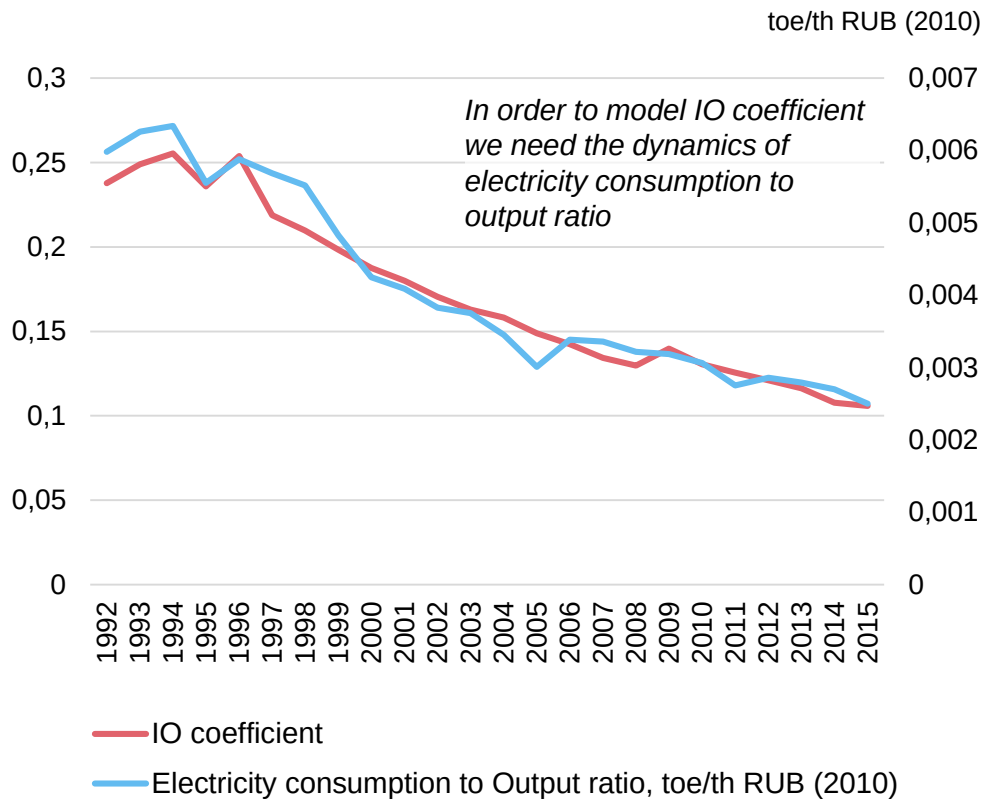
IO coefficient is a function of *S*

Logic of energy efficiency modeling

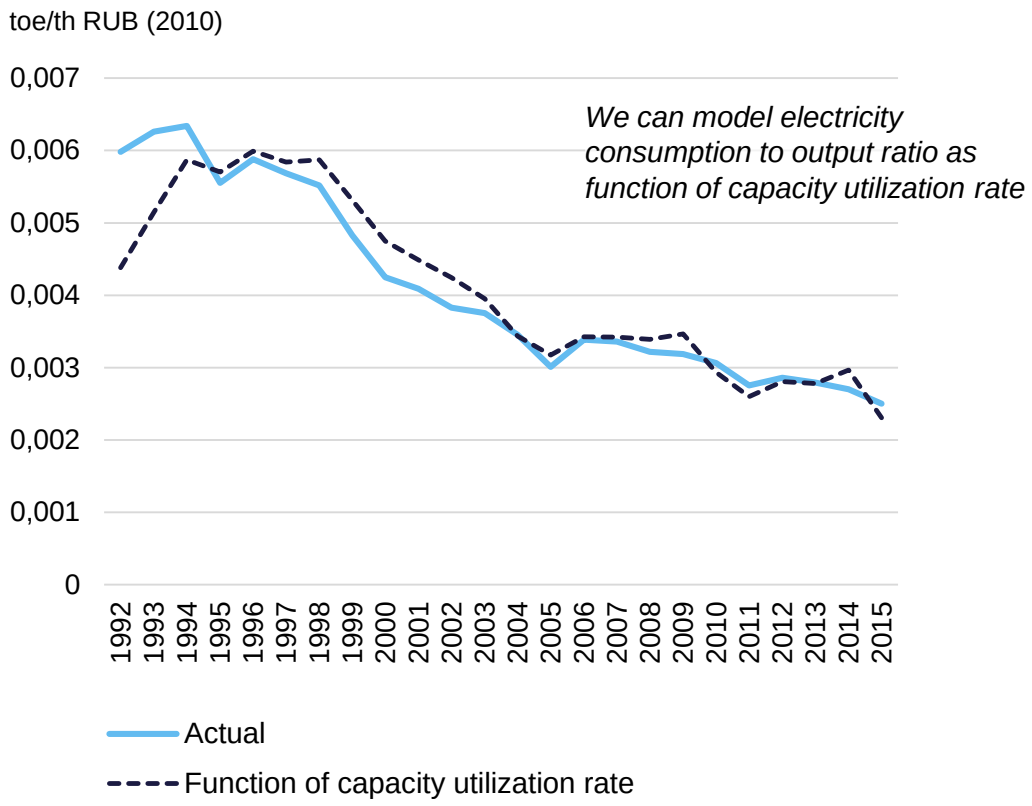


Input-Output coefficient and energy efficiency modeling case: electricity consumption in manufacture of chemicals

Parameters of electricity consumption in chemicals manufacture



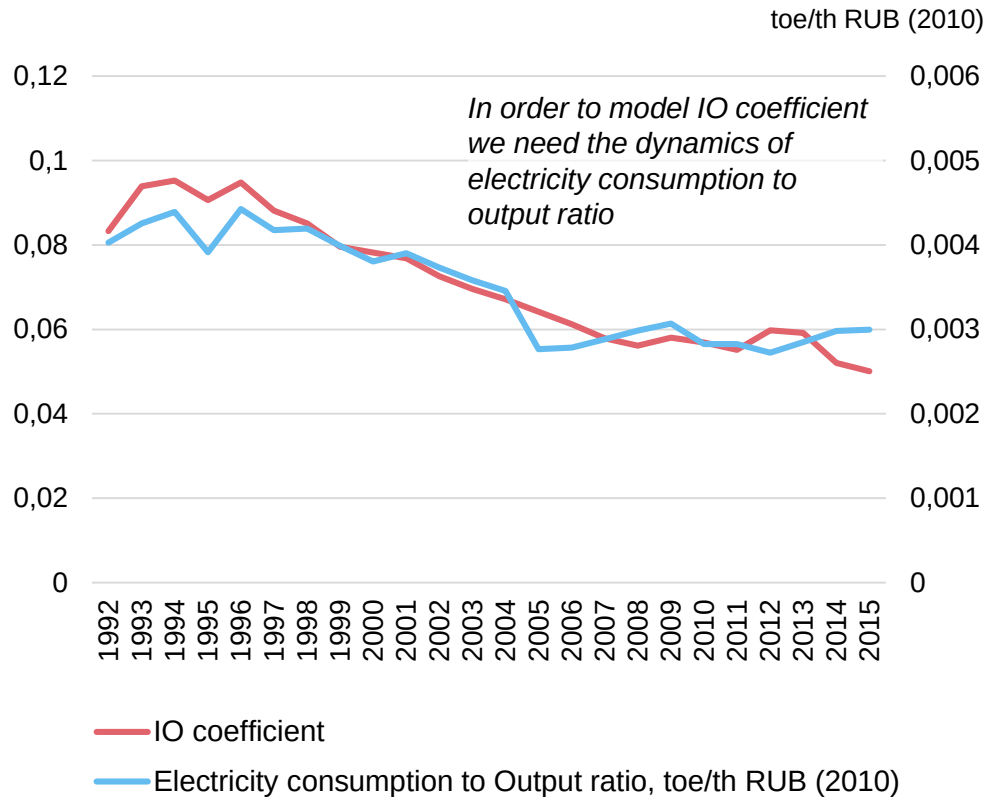
Electricity consumption to Output ratio



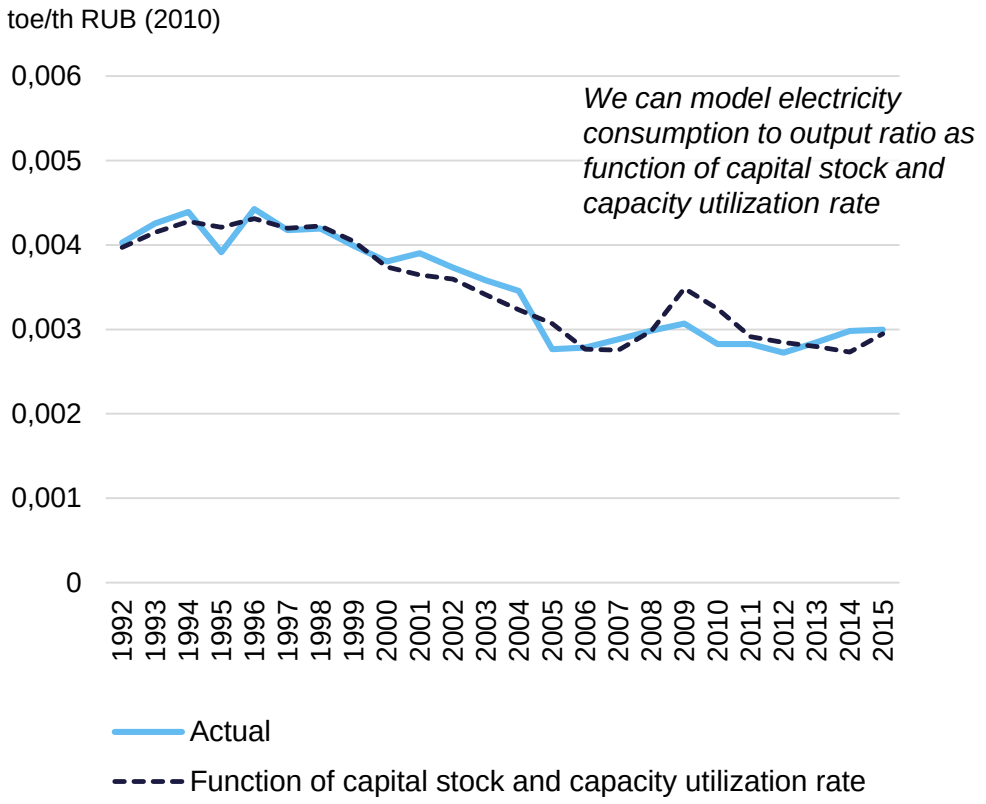
Source: IEF RAS

Input-Output coefficient and energy efficiency modeling case: electricity consumption in manufacture of ferrous metals

Parameters of electricity consumption in ferrous metals manufacture



Electricity consumption to Output ratio



Source: IEF RAS

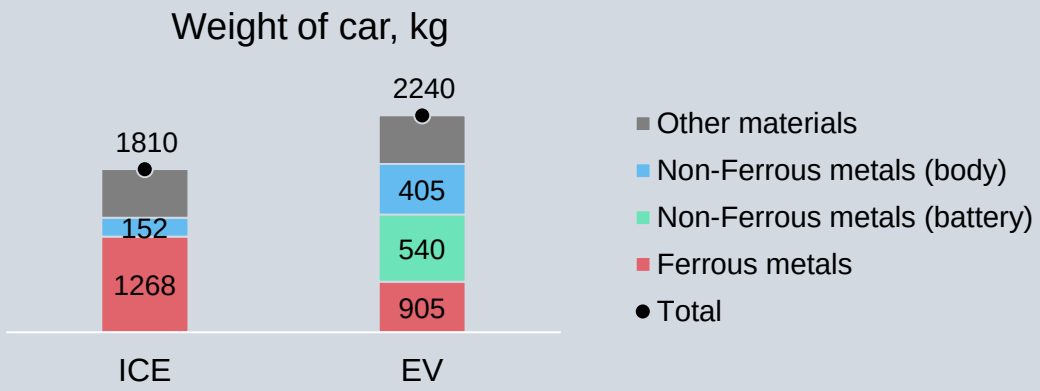
Input-Output modeling of technological shift: Electric cars case

$$X = (E - A)^{-1} * Y$$

Column “Manufacture of motor vehicles, trailers and semi-trailers”:

- Redistribution of IO coefficients: from the diagonal one and “Manufacture of Ferrous metals” to “Manufacture of Non-Ferrous metals” (body) and “Manufacture of electrical equipment” (battery)

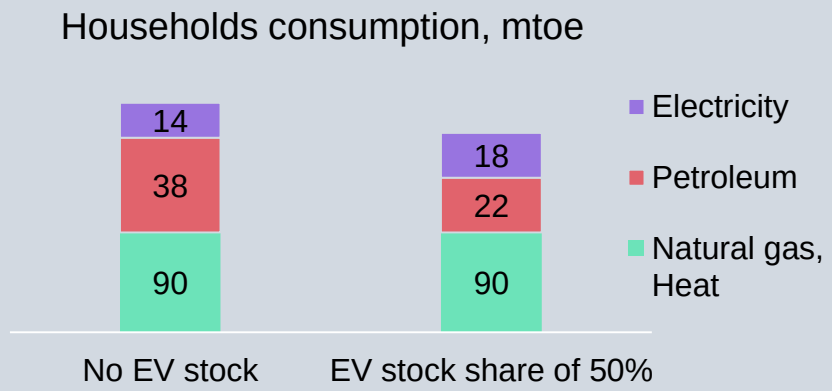
We do it on the basis of average weight of cars



Column “Households final consumption”:

- Redistribution of value from “Manufacture of coke and refined petroleum products” to “Electricity, gas, steam and air conditioning supply”

We do it on the basis of Energy balance shifts



Source: IEF RAS

Input-Output modeling of technological shift: Electric cars case

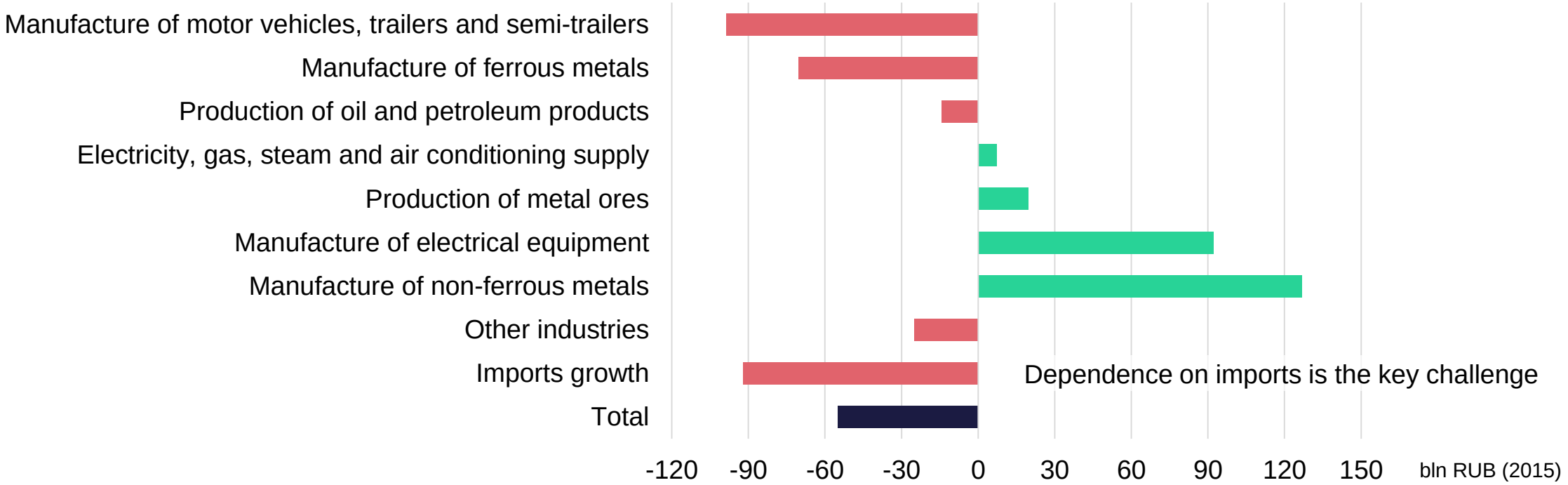
Changes in IO coefficients in case Russia produces only EVs

	Manufacture of motor vehicles, trailers and semi-trailers
Manufacture of motor vehicles, trailers and semi-trailers	0,199→0,145 -27%
Manufacture of Ferrous metals	0,129→0,094 -27%
Manufacture of Non-Ferrous metals	0,028→0,073 +160%
Manufacture of electrical equipment	0,024→0,085 +255%

Source: IEF RAS

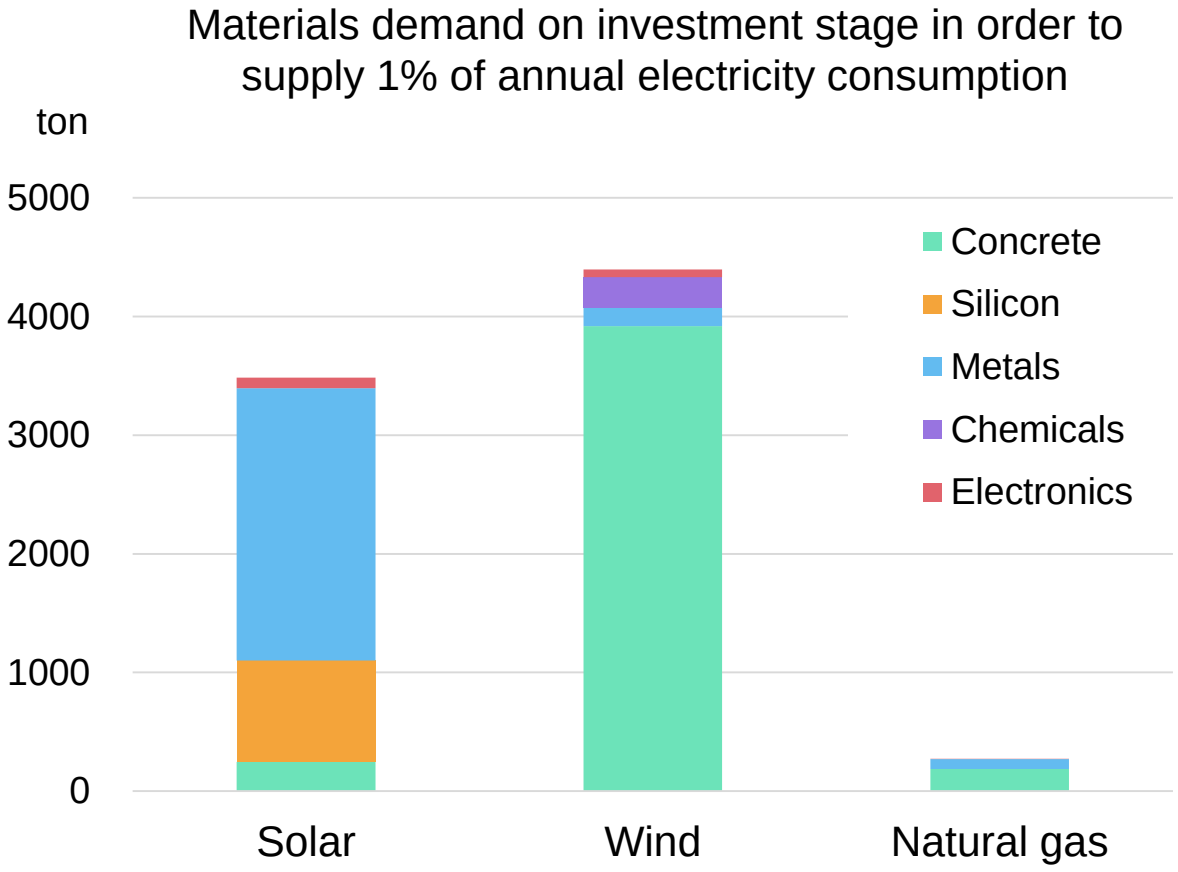
Input-Output modeling of technological shift: Electric cars case

Change in annual output by industry in case Russia produces only EVs
(production capacity is about 3% of total car stock)



Source: IEF RAS

Input-Output modeling of technological shift: Renewables case

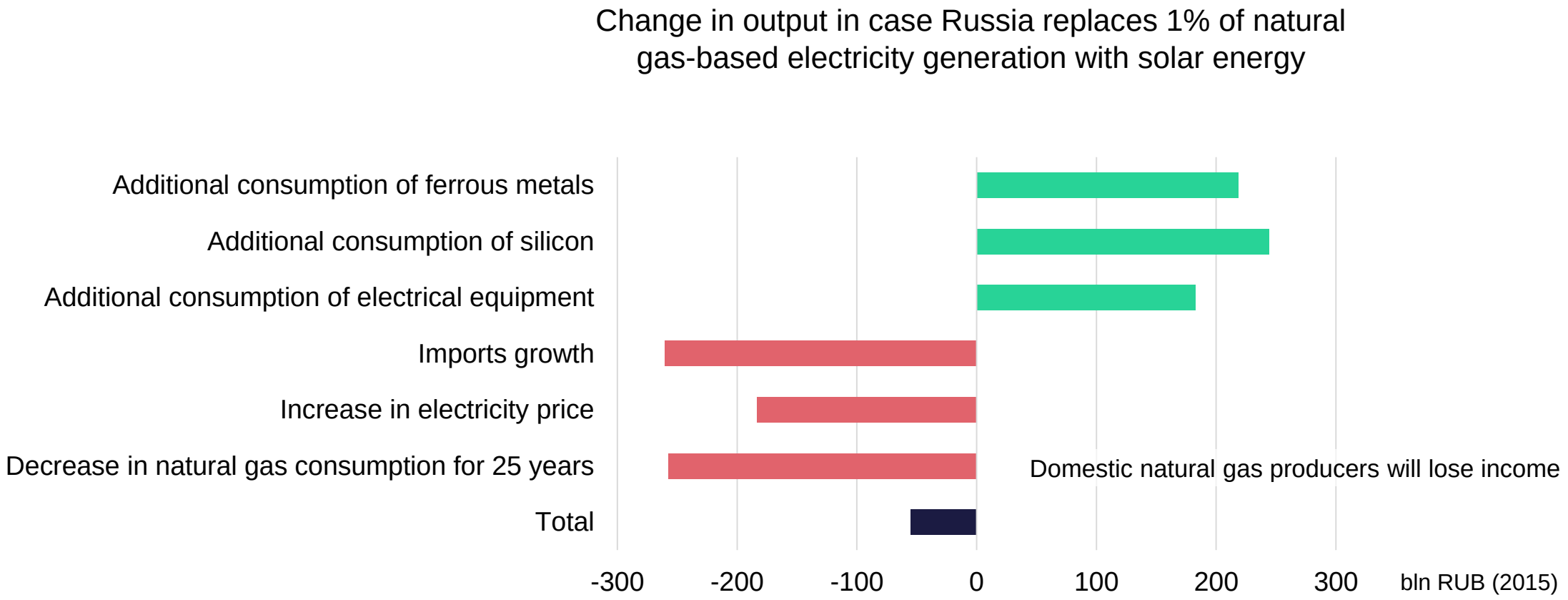


The fundamental features of renewables-based electricity generation are:

- it doesn't require the fuel at the operational stage
- however, due to the lower energy density and fewer hours of capacity utilization, it takes much more renewables-based capacities to generate the same amount of electricity (compared to traditional energy). This leads to significantly higher consumption of materials at the investment stage

Source: IEF RAS

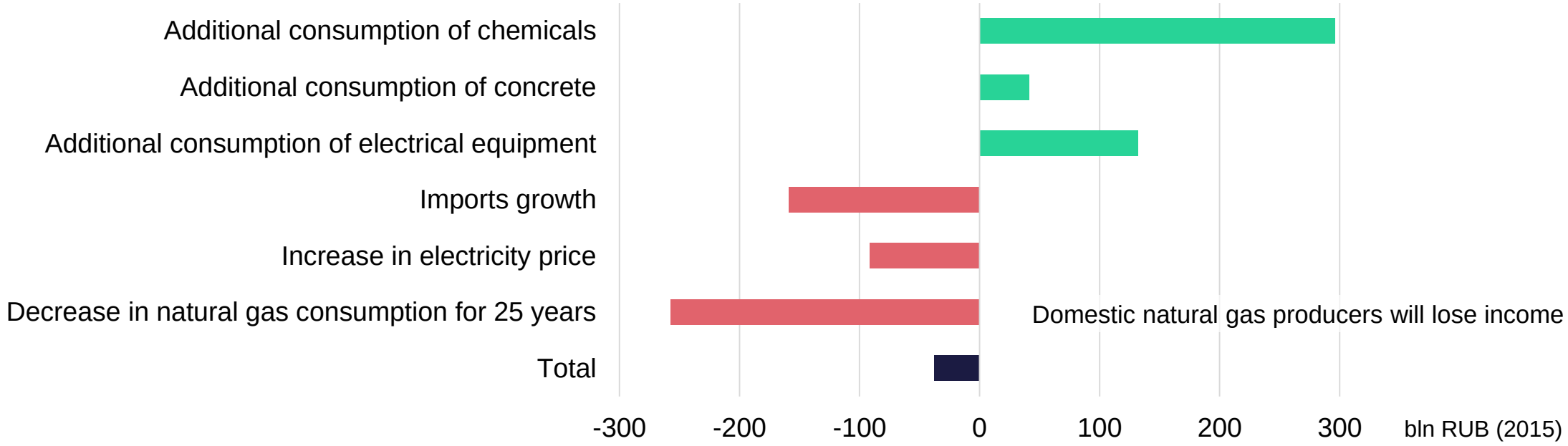
Input-Output modeling of technological shift: Renewables case



Source: IEF RAS

Input-Output modeling of technological shift: Renewables case

Change in output in case Russia replaces 1% of natural gas-based electricity generation with wind energy



Source: IEF RAS

Key points

- Energy efficiency is one of the CO2 mitigation measures but it depends on the investments and positive economic activity
- Decrease in imports dependence is a crucial for low-carbon solutions (like electric cars and renewables) to be economically effective in Russia
- Sustainable and dynamic economic growth is the most effective way of successful energy transformation and CO2 emissions mitigation in Russia

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