The Economic and Environmental Implications of Russian Sustainability Policy

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Energy efficiency and sustainability policies in Russia

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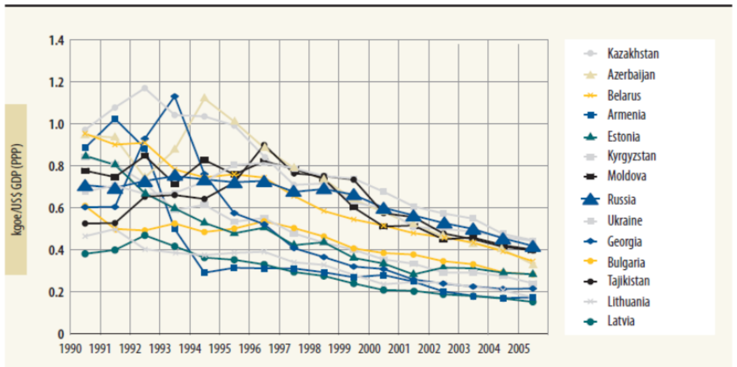
Outline

- Motivation & Objectives
- Policy Background: Environmental Issues in Russian Federation
- Environmental Module
- Illustrative Simulation Runs with the Sust-Rus Model
- Conclusions

Motivation

- Russia is today the third largest CO_2 emitter standing behind China and the United States; it is also one of the biggest emitter of SOx, NOx, VOC and PM;
- "Favorable" fuel mix in the Russian economy: more than 60% of CO_2 emissions are generated by combustion of gas in 2005;
- Energy intensity (amount of energy consumed per unit of GDP) is higher than in any of the world's 10-largest energy-consuming countries; EI in Russia is the highest even among the countries of the FSU;

(a) EI in Russia vs. countries of the Former SU (1990-2005)



(b) EI in Russian steel sector (2005)

Source: Worldbank and IFW (2008)

Economic risks of poor energy efficiency

Decision makers' economic risk perception includes:

- Potential threats to the intention to act as a reliable energy supplier;
- In the past, shortages of natural gas and electricity supply to the industry slowed down the economic growth ("the limits of growth");
- Deterioration of international competitiveness of Russian industries even during the period of strong economic recovery;
- Growing burden on households and municipal budgets to pay the energy bills;

Related risks of poor energy efficiency

Adverse impacts on health and ecosystems from air pollution & acidifying emissions:

- Air pollution levels exceed maximum allowable concentrations in major urban areas of Russia;
- Acidifying emissions lead to surface water acidification (e.g. in the border areas between Russia and Norway) and to heavy damages of forests (e.g. in Norilsk).

  Today around 50% of total SO2 emissions come from the five largest sources in the ferrous metals production.

Russia’s strategy to combat air pollution

- Improving energy efficiency: 40% reduction of Russia’s energy efficiency by 2020 compared with 2007 levels (Presedent Medvedev signed a decree in June 2008); significant increase in energy efficiency of electric power sector (government order of Prime Minister Putin 2009) ;
- Climate Doctrine of the Russian Federation approved in 2009:
  Reduction of the share of energy generated from natural gas to 46% or 47% by 2030, doubling of nuclear power capacity, limit the burning of gas produced from oil wells, increase the use of renewable energy in electricity production to 4,5% by 2020;
- Compliance with international agreements (e.g. UNFCCC / Kyoto; UNECE Convention on Long-Range Transboundary Air Pollution / 1994 Oslo Protocol: 40% SO2 reduction compared to 1980 levels) ;

Literature review & objectives of the study

CGE-based simulation studies (global & single country models):

- Bayar et al. (2010) and Orlov et al. (2011): Assessing energy policy and carbon emissions in Russia;
- Böhringer et al. (2007) , Lokhov and Welsch (2008): Analyzing "where-flexibility" & "hot air for sale" potential;
- Paltsev (2011): Russia's natural gas export potential up to 2050 and impact of global and sub-global climate regimes;

Simulation model development for Russia: "state of the art"

- So far, regionally disaggregated model for Russia at the level of federal districts which captures multi-gas emissions is not available;

EnvModule in the SUST-RUS model

- SUST-RUS includes three environmental dimensions:

- **Global:** climate change (CO2 emissions)

  - Restrictions in the analysis of global warming policies and damage valuation: SUST-RUS is not a global model, i.e. RoW is represented at an aggregated level and is exogenous.

- **Regional and local** (transboundary effects): emissions of SO2 and NOX depositions and ambient air concentrations (deposition of acidifying emissions, PM)

- **Analysis of trade-off** and **synergies** between global warming and acid rain policies (co-benefits of climate policies)

EnvModule: Data and model parametrization

Modelling emissions:

- CO_2, SO_2, NOx and PM emissions are related to the fuel input used in production of sectors and in consumption of households;

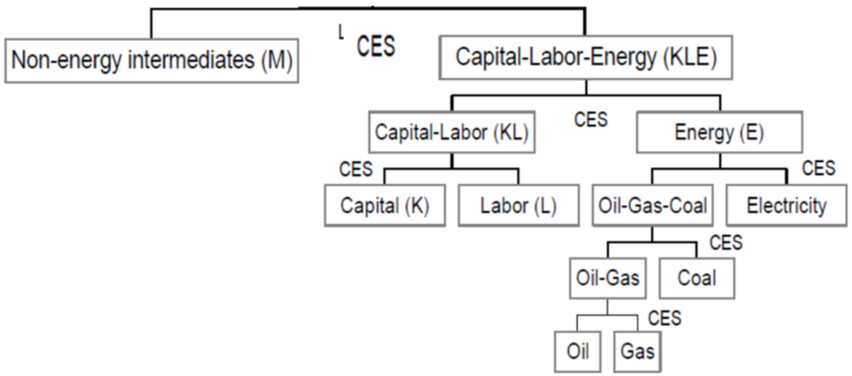
Data (emissions-related)

- *TER* Database from Goskomstat (2006)
  - Energy consumption in physical units at the disaggregated sectoral and regional (federal) level;
- *Beyond2020* Database from IEA (2010)
  - Input-specific emission factors & calculation methodology; emissions levels;
- *National statistical publications* from Goskomstat: emissions for SO_2, NOx and PM.

Abatement options in Sust-Rus model (1)

- **Decline in production:** environmental constraint → higher selling prices → demand for intermediates decreases → output reduction
- **Technological update:** exogenously given technological change, e.g. leading to higher energy efficiency
- **Substitution of fuels within existing technologies:** production of sectors is modeled via nested CES production functions allowing for some flexibility of input choice.

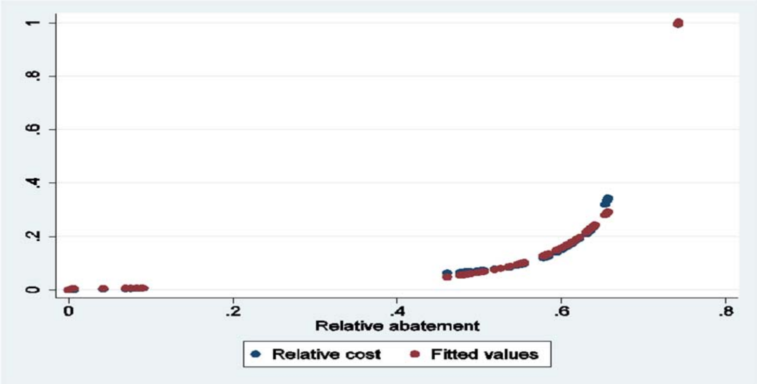
(a) Nesting in non-fossil fuel production



Abatement options in Sust-Rus model (2)

- **End-of-pipe abatement:**

  - Limited to SO_2, NOx and PM;
  - **Sector-specific** estimates for the RF from the IIASA GAINS-Europe model;



  - Not yet introduced: bottom-up abatement options for CO2 at the sectoral level from Bashmakov et al. (2008)

Illustrative policy experiment: gas price increases

General settings:

- Time horizon: 2015

Scenario A	Scenario B	Scenario C	Scenario D
consumers: annual gas price increase by **10%** from 2012	**firms:** annual gas price increase by **10%** from 2012	**consumers & firms:** annual gas price increase by **10%** from 2012	**consumers & selected firms:** annual gas price increase by **10%** from 2012

Reference scenario ("doing-nothing case"):

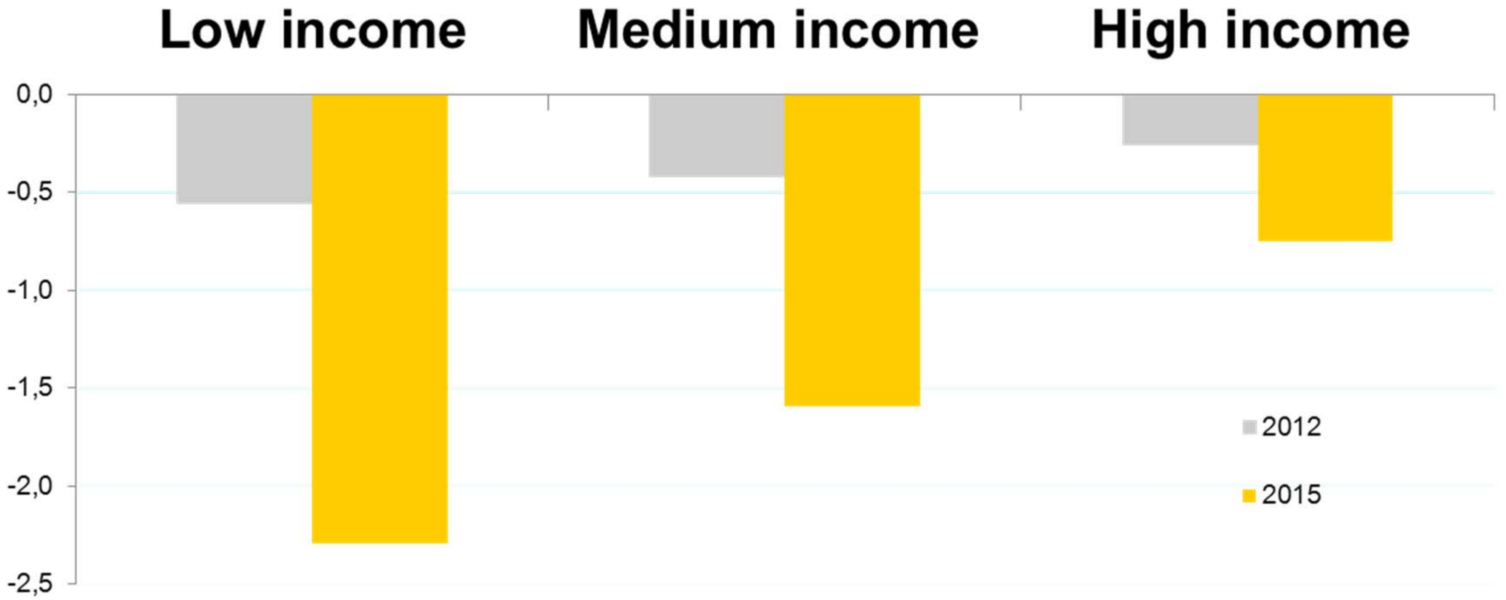
- *BaU*: Business-as-Usual reference scenario

Energy intensity in 2015 (kgoe/$US)

Scenario A: Annual consumer gas price increase by 10% from 2012 onwards will leave country's energy intensity **virtually unchanged** in 2015 in comparison to "doing-nothing case"

Social impacts (% change in consumption vs. BaU)

Scenario A: Annual consumer gas price increase by 10% from 2012 onwards will have a **moderate but regressive impact** on citizen's welfare in comparison to "doing-nothing case"



➔ Robust insight confirmed by other inequality measures such as Gini, Atkinson and Kakwani indices

Summary: Impact assessment

- Tax revenues ↑ (0.4% vs. Bau)
- Public savings ↑ (1.5% vs. Bau)

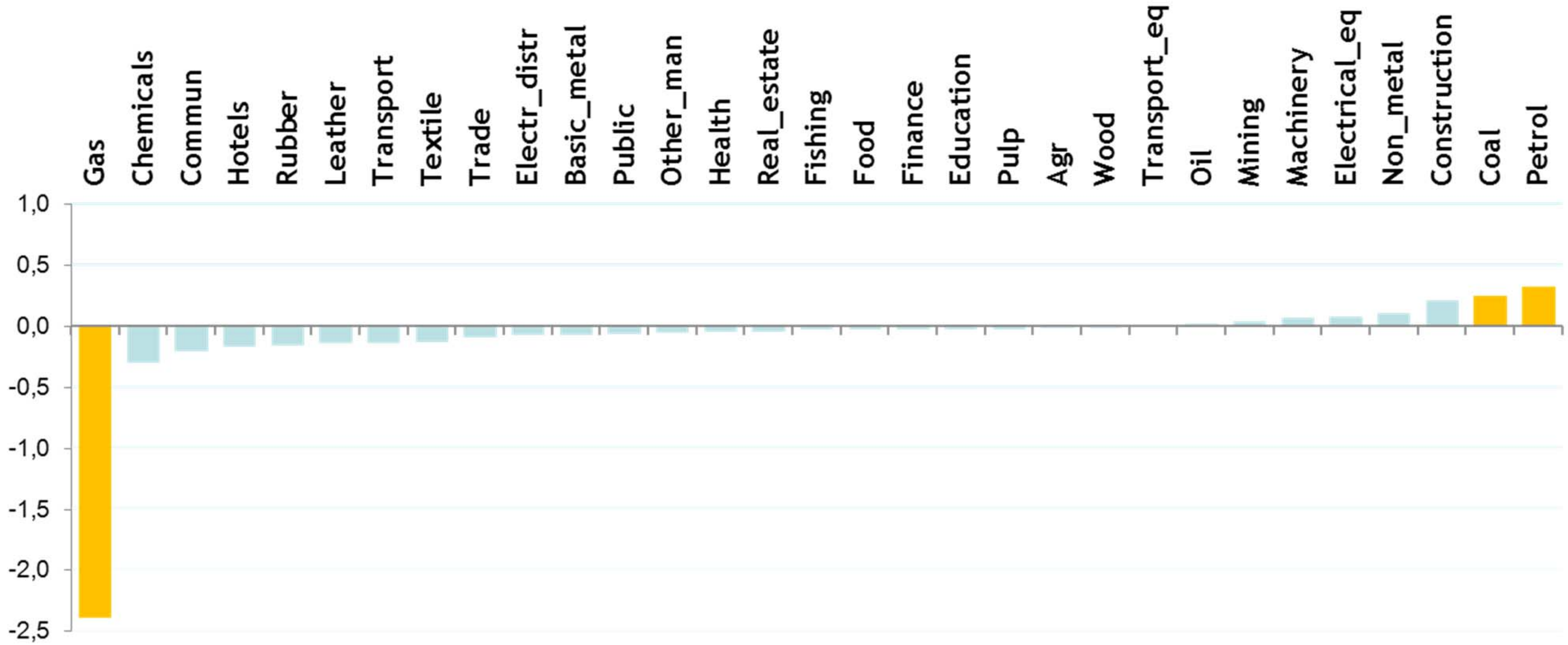
- Social impacts ↓ (0.4% vs. Bau)
- Energy intensity → (<0.1% vs. Bau)
- CO2 emissions →
- NOx emissions ↑ (0.9% vs. Bau)

Energy intensity in 2015 (kgoe/$US)

Scenario B: Energy intensity decreases significantly if **sectors** face gas price increases (10% annually from 2012 onwards). In comparison to “doing-nothing case, the regional rate of improvement varies between 12% and 14%

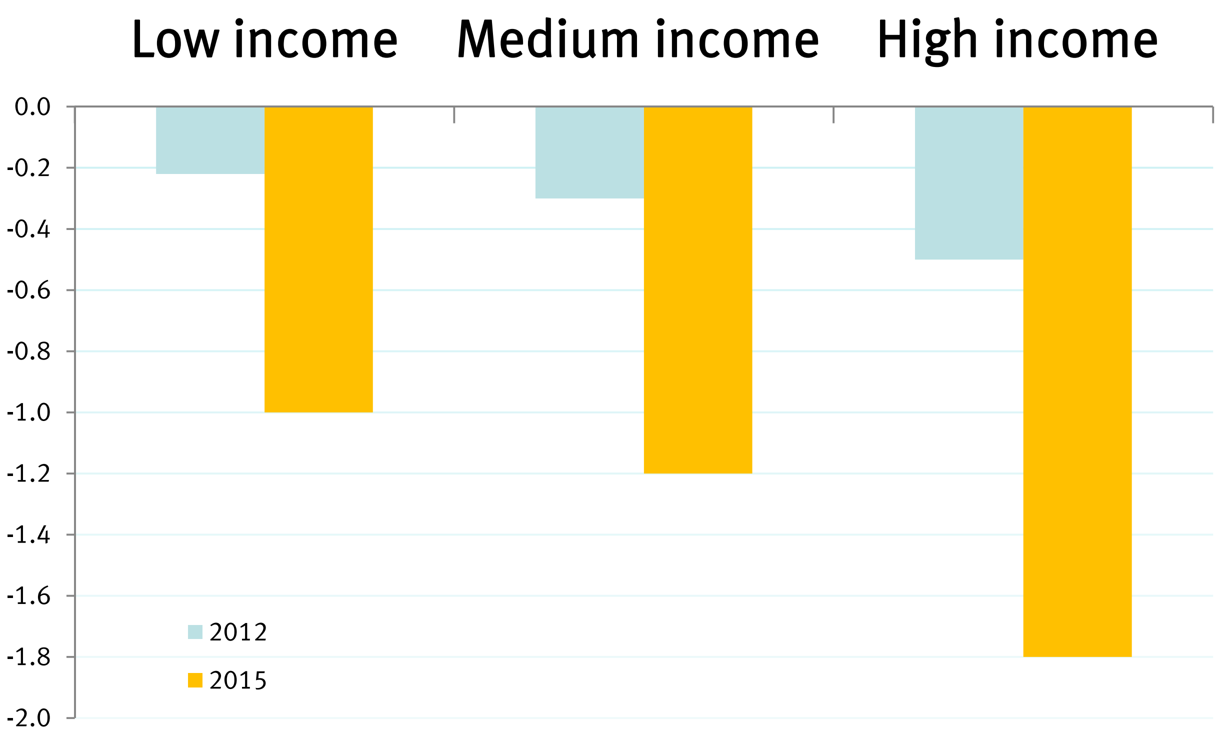
Interindustrial impacts (% output changes) in 2015

Scenario B: Moderate output losses for most **sectors** with few experiencing some improvements in comparison to “doing-nothing case”



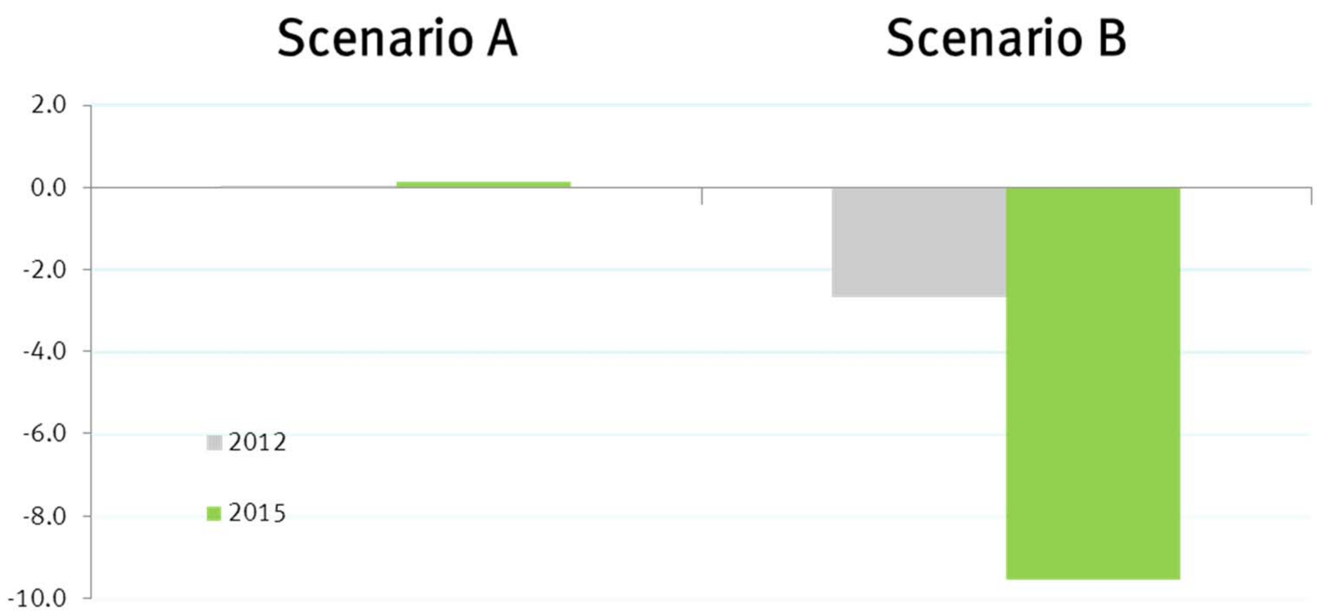
Social impacts (% in consumption vs. BaU)

Scenario B: Firm's gas price increase (10% from 2012 onwards) will have a **moderate and progressive impact** on citizen's welfare in comparison to "doing-nothing case"



Environmental impacts - CO_2 (% change vs. BaU)

Scenario A + B: Annual gas price increase to be faced by firms (10% from 2012 onwards) will lead to a non-negligible CO_2 reduction in comparison to "doing-nothing case" and Scenario A



Conclusions

Sust-Rus model = first regionally disaggregated model for Russia at the level of federal districts which captures multi-gas emissions

Sust-Rus model = Rationale basis for equity-efficiency debate

- Identifying policy-relevant robust insights
- Providing explanations for differences in impact assessment (data, assumptions)
- Identifying high priority areas for future research ("missing gaps")

Thank you very much for your attention!

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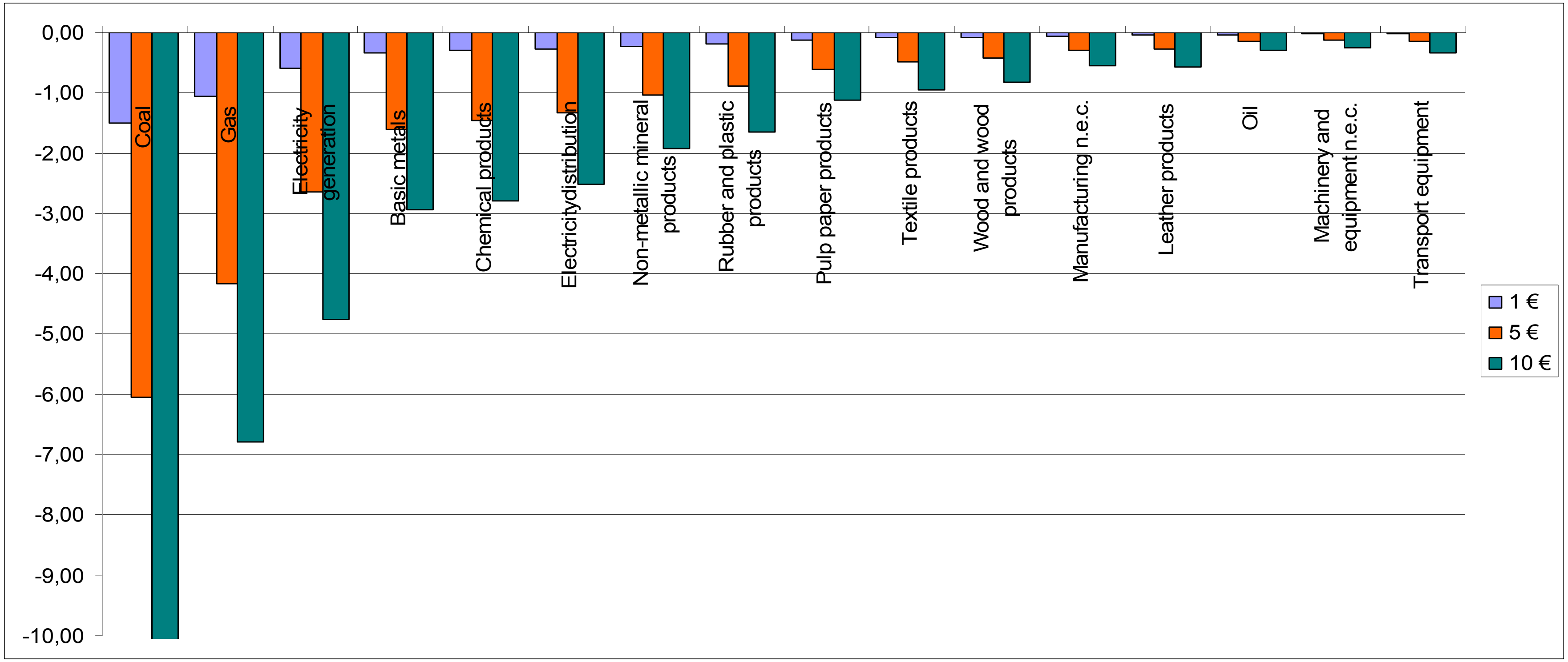
Additional application: Environmental taxation

- **Introduction of environmental levy (CO2 tax) to the economy in 2006:**
  - The amount of the environmental levy is 1€/ton of CO_2, 5€/ton of CO_2 and 10€/ton of CO_2
  - Uniform emission pricing, i.e. no differential emission pricing in favour of energy-intensive and trade-exposed industries and no exemptions from taxation;
  - Recycling mechanism: Revenues are returned to the households via lump-sum transfers;

Model results: Sectoral output effects (% change vs. BAU)

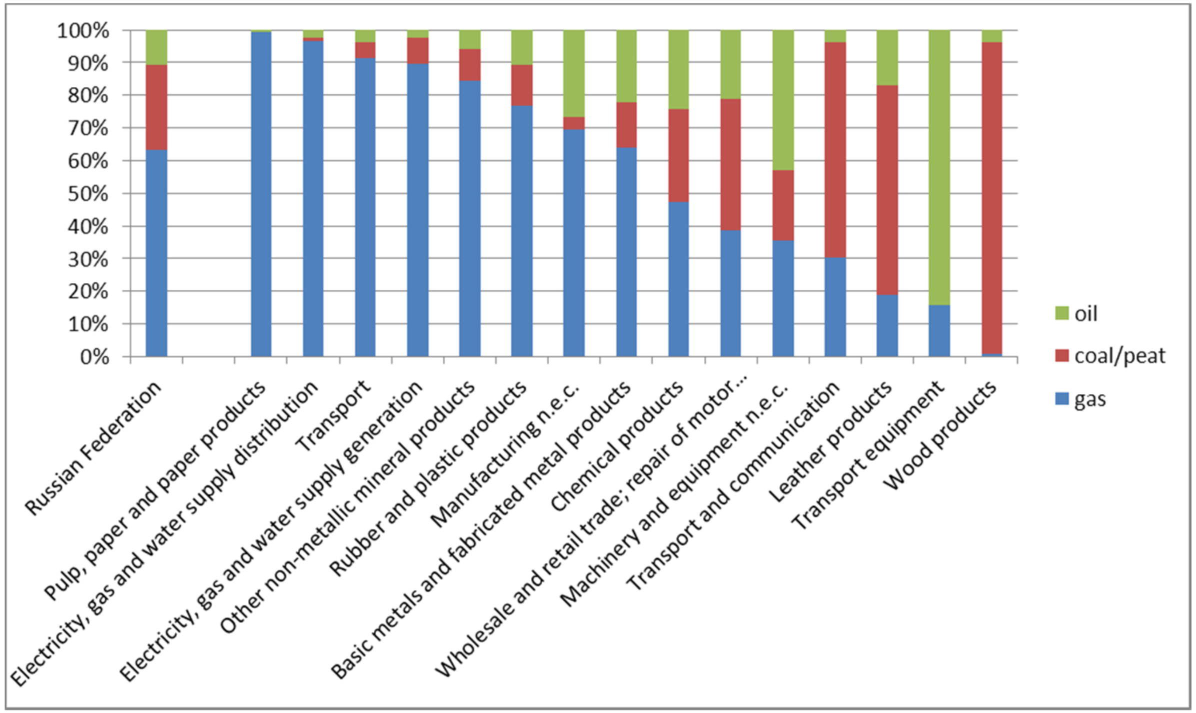
- Heterogeneous effects at the sectoral level: In energy producing sectors up to 10% output losses vs. BAU;
- Producers of ferrous metals, non-metallic minerals and chemical producers: moderate losses (up to 3% vs. BAU at 10€/ton) ;



CO_2 emissions by fuel type in 2005

Economy-wide and sectoral perspective for the RF

- *Sectoral heterogeneity* in terms of CO_2 emissions by fuel type: Emissions of manufacturers of wood products, transport equipment and leather products are from combustion of oil and/or coal.

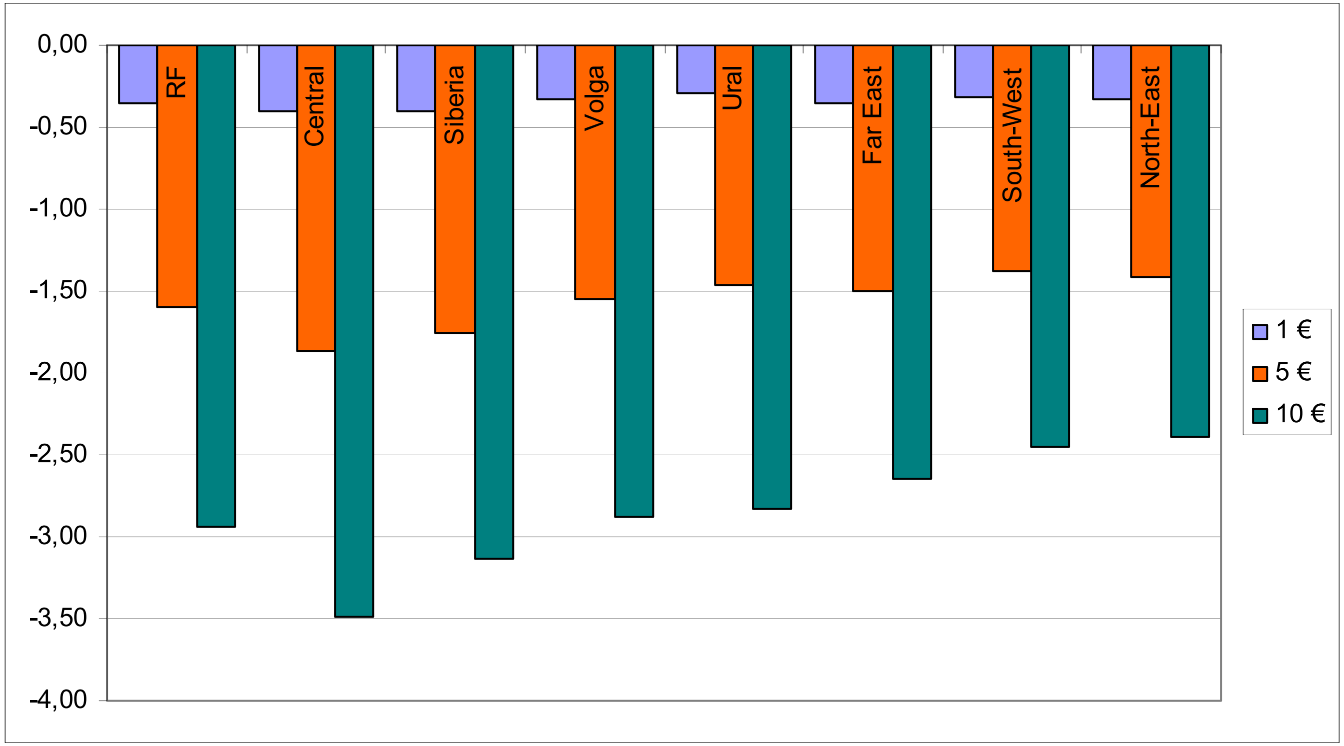


Source: Goskomstat TER-Database

Sectoral output effects: Basic metals (% change vs. BAU)

Value-added of regional disaggregation

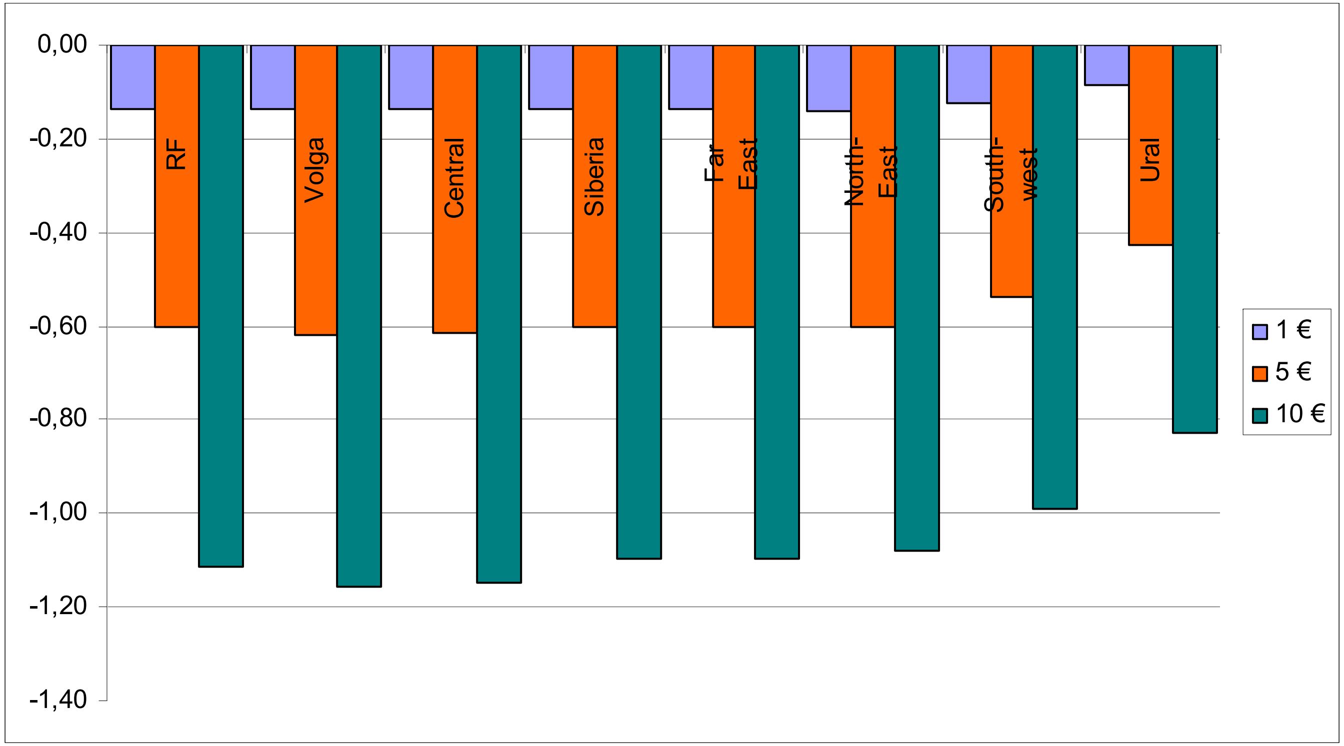
- At 1€/ton, the regional differences in terms of output losses in basic metals production are rather moderate; they become rather pronounced towards higher CO_2 taxes;



Sectoral output effects: Paper industry (% change vs. BAU)

Value-added of regional disaggregation

- More homogenous implications in paper industry across regions, except for Ural region;



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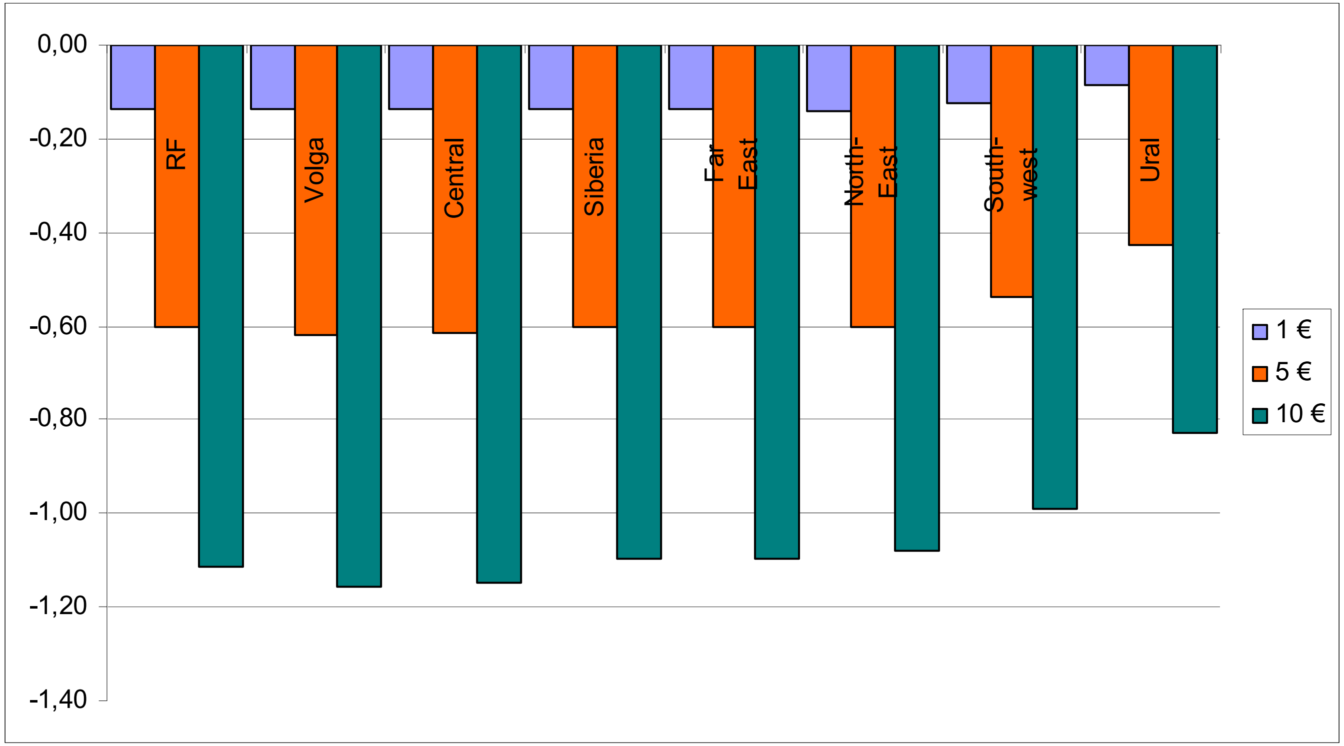
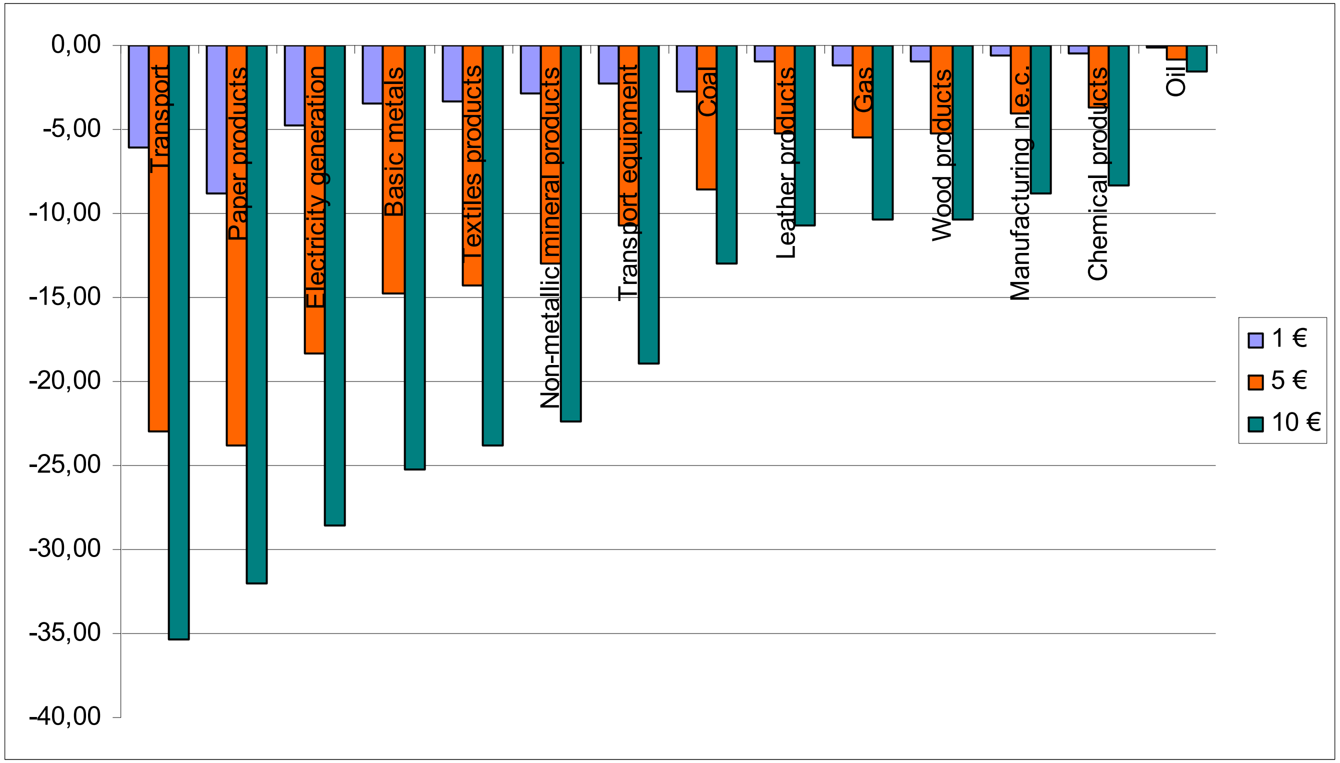


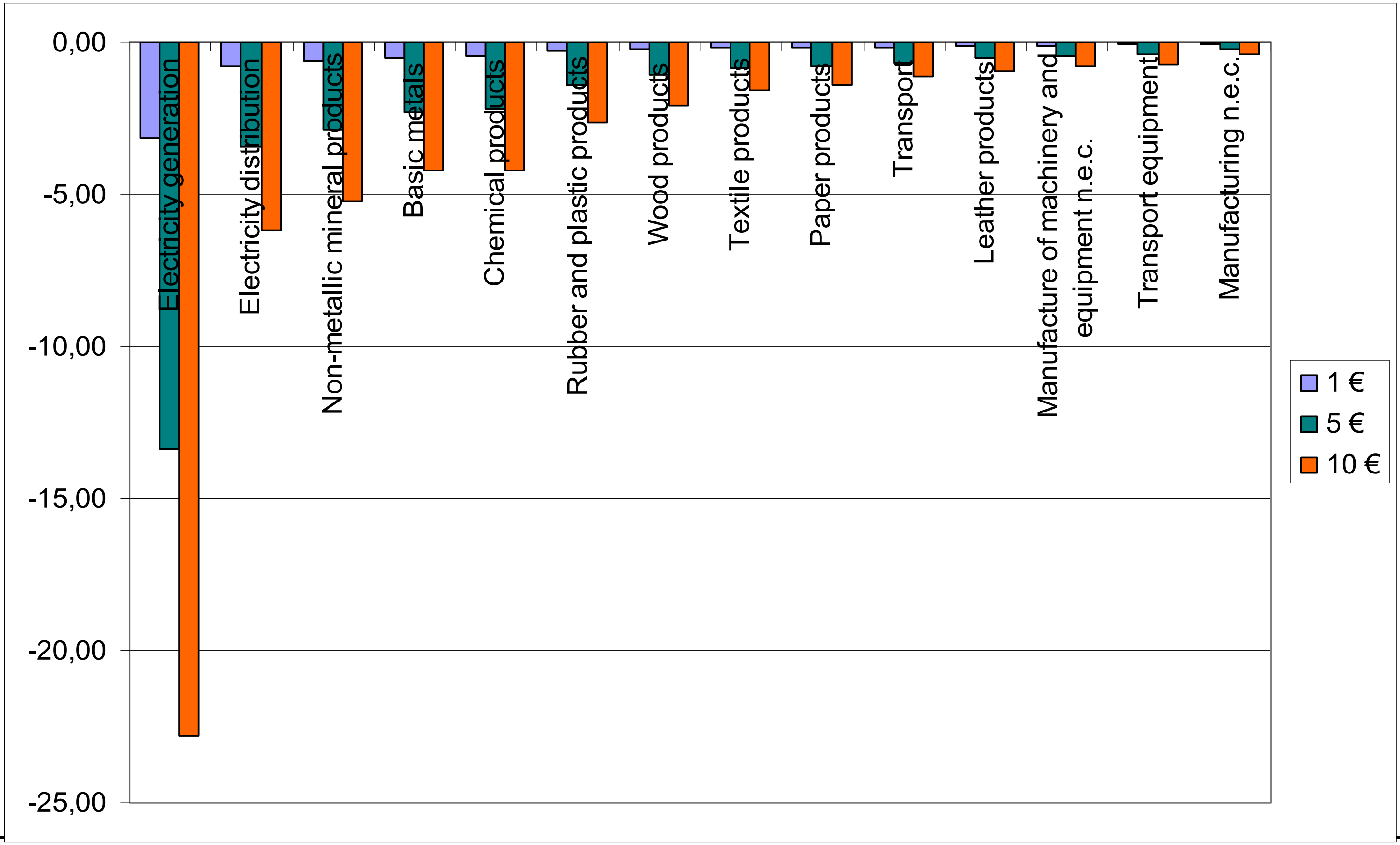
Emissions reduction (% change vs. BAU)

- Economy-wide emission reductions: 6.2% (1 €/ton), 21.5% (5 €/ton), 32.4% (10 €/ton)
- Significant emissions reduction, in particular in sectors which are known to be the biggest emitters in Russia: energy generation, manufacturing of basic metals and non-metallic minerals;



Exports to the EU (% change vs. BAU)

- Moderate adjustments in exports levels in most sectors, except for power generation;



Results

- **Key finding: Environmental levies allow reducing CO_2 emissions significantly without sacrificing economy-wide welfare (less than 0.3% for the most ambitious tax level) and international competitiveness of the Russian industry:**
  - significant reductions of CO_2 emissions in key industries such as energy generation, basic metals and non-metallic minerals production are possible (up to **25% vs. BAU**);
  - The scope for significant reductions is consistent with an extensive usage of energy at the sectoral level;
  - Output effects vary significantly **across sectors and regions**, but adjustments remain rather moderate, except for the energy producing industry; for example, the output losses in the basic metals production is not likely to be more than **3.5% vs. BAU)**; an important driver behind the output adjustments is a sectoral heterogeneity in terms of fuel mix;
  - Exports to the EU are not likely to be heavily adjusted.

Outlook

- Apply to other policy issues:
  - bottom-up abatement options for CO_2 at the sectoral level from Bashmakov et al. (2008); this allows capturing the technological update of the production facilities;
  - supply restrictions of gas to the industry – in the mid-term it is intended by the Russian government to rely more heavily on coal; what are the implications?
  - VOC emissions into the model;
  - modeling health impacts from air pollution (SO2, NOX, PM, VOC emissions and ozone).