

ENERGY TRANSITION IN RUSSIA: WHAT IMPLICATIONS FOR NATURAL GAS ?

Dr. Olga GARANINA

Dr. Silvana MIMA

5th AIEE Symposium on Energy Security
December 17, 2020

Energy transition in Russia: what implications for natural gas?

1. Introduction
2. Methodology
3. Russian energy and climate policies
4. Russia's gas demand prospects by sector
 1. Power generation
 2. Industry
 3. Transformation of the transport and sustainable mobility
 4. Residential, services and agriculture
5. Domestic production outlook and export issues
6. Conclusions

Introduction

In 2019, Russia ratified the Paris Agreement with the pledge to reduce its GHG emissions to 70-75% from the 1990 level by 2030

Although the emissions fell sharply with the collapse of the Soviet Union, Russia is the world's fourth largest GHG emitter and plays important role for global efforts to combat the climate change

Adherence to the Paris Agreement results from various political and economic motives (i.e. foreign policy, technological policy, "climate protectionism" concerns)

Emissions in 2020 are about twice less to their 1990 level which makes the national climate target faintly encouraging

Natural gas provides about half of Russia's primary energy demand and is one of the key macroeconomic drivers. Natural gas role faces versatile impacts of the global energy transition and its role in Russia's transition requires further study

Research objective:

What are the main challenges of natural gas demand in Russia, and what are the future prospects under climate policies constraint?

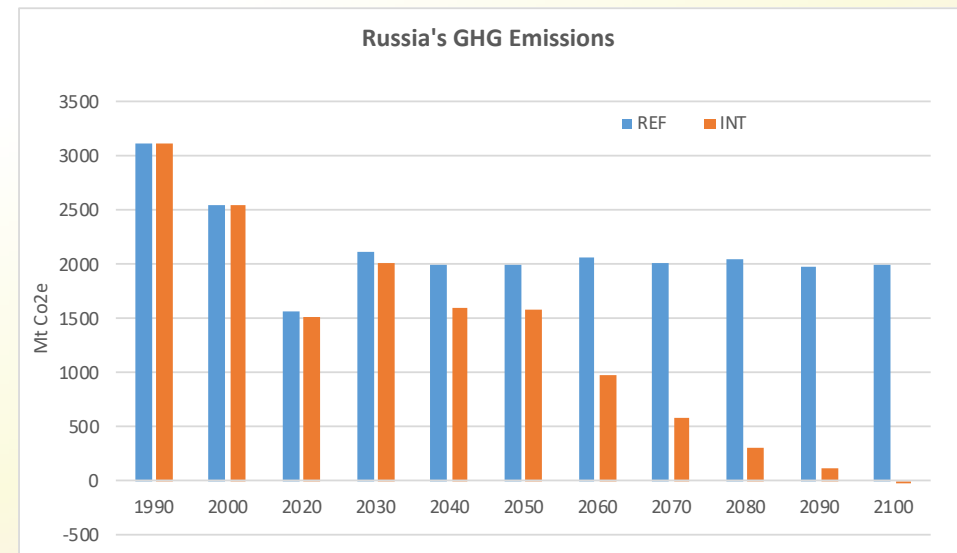
- **Will natural gas become the winner of energy transition in Russia, and why?**
- **Whether, when and in what uses gas could face increasing competitive pressures from lower carbon energy sources?**
- **What are the implications for export volumes, and what kind of energy dependency can be profiled for Russia in a long-run perspective?**

Methodology

POLES model (Prospective Outlook on Long-term Energy Systems): a partial equilibrium bottom-up model of the world energy system combining various energy sources, with a variety of technologies and end-uses, under different climate policy assumptions

Scenarios: *Reference scenario* and *Intensive Scenario* (a 2D type of scenario) till 2100 adjusted for the targets of Russia's Strategy of the Long-Term Low-Carbon Economic Development for the period till 2050 (draft, published by Ministry of Economic Development of RF in March, 2020)

- **Reference:** Implementation of all planned policies for the period 2020-2027. After 2028-2030, supplementary measures are assumed to achieve the reduction of energy intensity to 50% by 2050. The rates of energy efficiency improvements improve due to new measures adopted to stimulate energy & resource savings in all sectors and radical reduction of energy losses. Significant reduction of forest cuts, protection of forests (MED RF, 2020).
- **Intensive:** In addition to the reference, this scenario includes national regulation of GHG emissions (price regulation of emissions), increasing RES-based generation, large-scale electrification and digitalization in transport and industry, introduction of CCS. Ban on forest cuts and increased level of foreign protection. This scenario helps achieving *carbon neutrality by the end of 21 century* (MED RF, 2020).



Source: POLES-GAEL (2020)

Targets:

Reference: GHG emissions reduction to 67% in 2030; 64% in 2050 to 1990 level

Intensive: 64% in 2030; 52% in 2050 to 1990 level

Russian energy and climate policies

Doctrine of energy security of RF (2019)

International efforts to limit the climate change, slowdown of fossil fuel demand, increasing share of RES in the global energy mix and rising competition in international oil and gas markets stand among the economic and political **challenges to Russia's energy security**

Energy Strategy 2035 (adopted in 2020)

Reliance on fossil fuels through the planification period

Natural gas is expected to win from the energy transition due to its low carbon footprint in comparison to other fossil energies, as well as gas demand in the electricity sector

Growth of natural gas production by 18-37% by 2035; stagnating domestic consumption (growth 2-5% 2035 to 2018) and **export growth** (growth of pipeline exports by 15-36%, and a 4-7 fold increase of LNG exports)

Strategy of the Long-Term Low-Carbon Economic Development for the period till 2050 (Draft, 2020)

“**Critically insufficient**” targets (Carbon Tracker): Russia's **GHG emissions are expected to rise** from 50 percent of 1990 level in 2017 up to 64 - 67 percent by 2030 (taking into account LULUCF)

Underperformance risk arises only if the forest absorptive capacity is not taken into account. A slower than expected economic growth could also ease the emissions constraint

The main effort of low-carbon development is postponed for the period after 2030, with major contribution expected from efficiency improvements

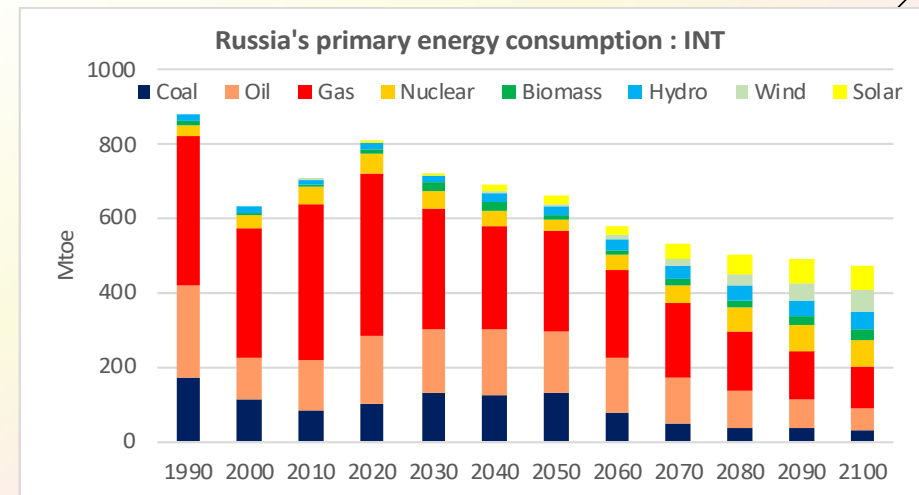
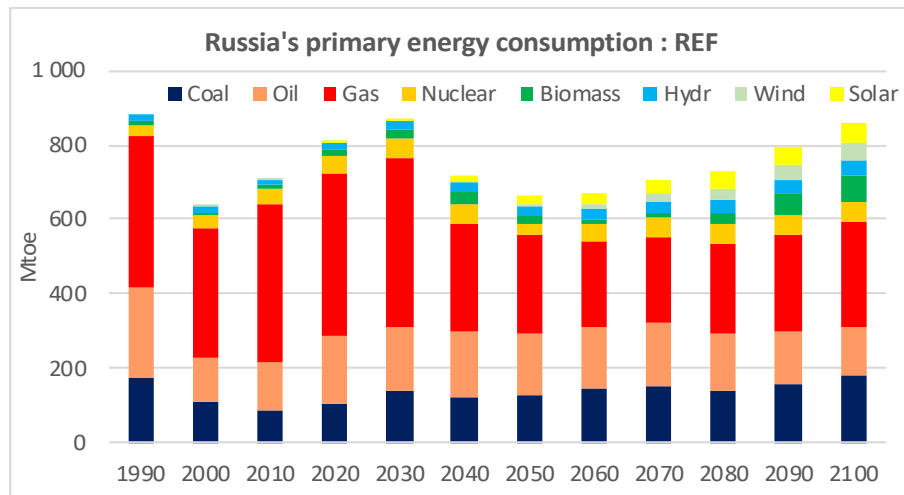
Role of natural gas in Russian primary energy mix

Natural gas covers currently more than 50% of Russia's energy needs, although diversification of the energy mix is observe in both scenarios

The share of gas in primary energy mix declines to about 33% in the REF and 22% in INT by 2100

- In the REF case, gas consumption significantly curbs in 2030s but remains relatively stable afterwards
- In the intensive scenario, gas consumption declines steadily till 2100, representing about 1/4 of the current consumption by 2100

In both scenarios, the role of nuclear, biomass and renewables increases, totaling to 31-58% of the primary energy mix by 2100



Source: POLES-GAEL (2020)

Role of natural gas in Russian primary energy mix

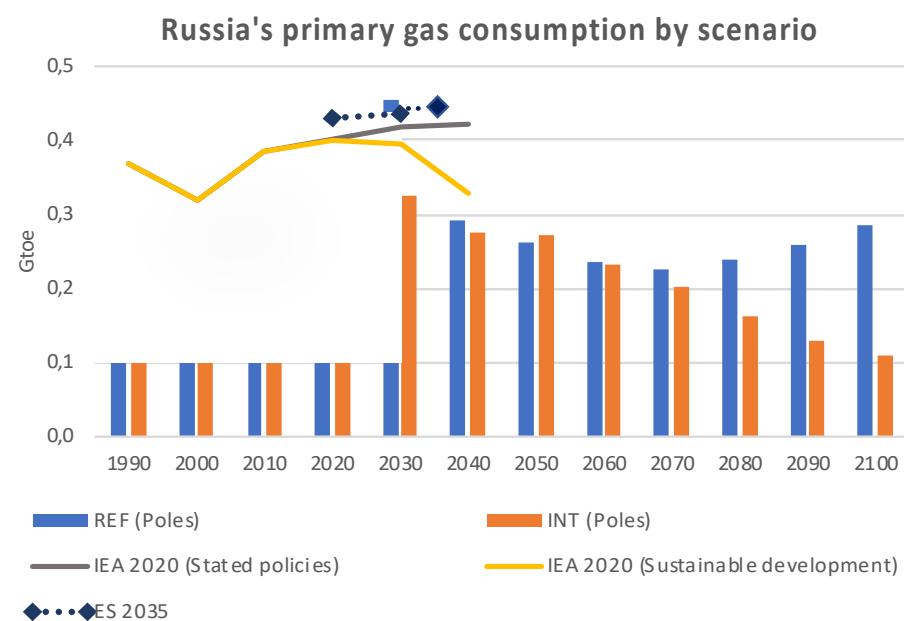
Natural gas is not to become the winner of energy transition in Russia, with significant demand loss in the domestic market in both REF and INT scenarios

Slight recovery of gas demand in REF scenario in the end of the century is mainly due to auxiliary gas use in unconventional gas production segment

Primary gas demand enters into decline as early as in 2030s even in the REF case, which differs from baseline assumptions of Russia's Energy Strategy till 2035 and IEA (2020)

Shrinking gas demand creates stranded assets risks in the domestic market

Given the reserve abundance, low domestic demand propels competition in the internal market and gives additional importance to the export strategy



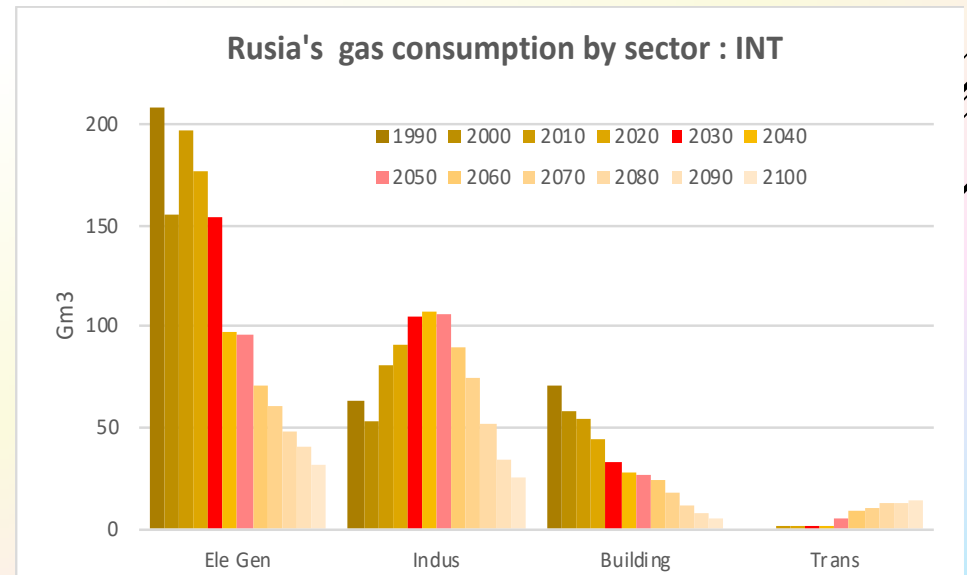
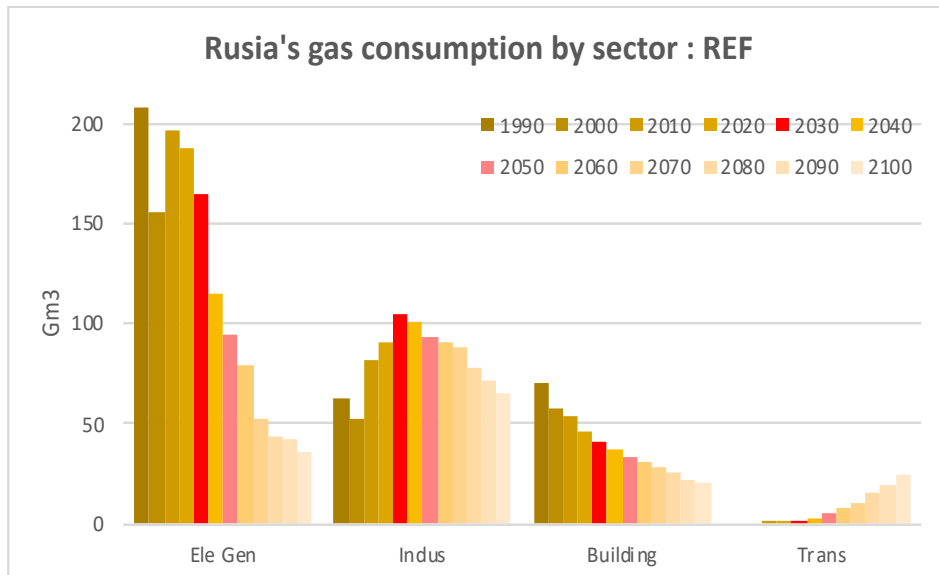
Russia's gas demand by sector

The main demand drivers are electricity sector and industrial use, with smaller contributions provided by building and transportation sectors

Decarbonization of power sector translates into comparable gas demand levels in both REF and INT scenarios

INT scenario implies a more pronounced shift away from gas in industrial sector and buildings

Although gas has a growth potential in the transportation sector in both scenarios, the demand potential is relatively weak in comparison to other sectors



Source: POLES-GAEL (2020)

What role for gas in decarbonization of the power generation mix?

Modernization of the existing coal- and gas-powered capacities

Over 60% of Russia's electricity generation is represented by thermal power plants. Russia's centralized heat supply system is well developed with CHP accounting for more than 50% of the installed fossil-fueled capacity. However, most of thermal plants are based on out-of-date technologies. Only about a quarter of gas-based power plants use gas turbine or combined-cycle technology, and only 22% of coal-fired power plants apply supercritical technologies (Mitrova & Melnikov, 2019).

Modernization program is currently in progress, but until now the selected projects have mostly represented rather maintenance of existing plants rather than upgrading to the most recent technological solutions. Still, in the long run, modernization will negatively affect the gas demand.

Installing new efficient capacities

About 50 GWe of generating capacity in the European part of Russia is closing in on the end of its design lifetime (WNA, 2020). Nevertheless, the structure of fuel use in Russian TPP – gas (72%); coal (23%); oil and other fuels (5%) – is to remain unchanged in years (Minenergo, 2020).

In Siberia, coal generation plays an important socio-economic role, where it relies on reduced transportation costs (Khokhlov & Melnikov, 2019). Thus, a coal-to-gas shift potential is limited.

Enhancing renewable generation potential

Although currently **wind and solar** do not make a strong contribution to Russia's generation, in longer run, cost reductions are likely to drive their penetration into Russia's power generation mix. In parallel with this Russia is increasing its **hydro-electric** capacity, with most of potential located in Siberia and Far East.

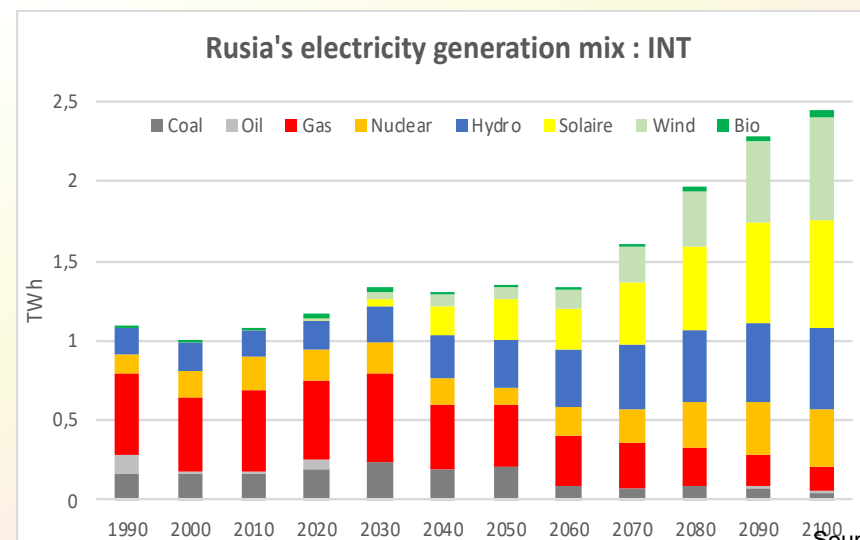
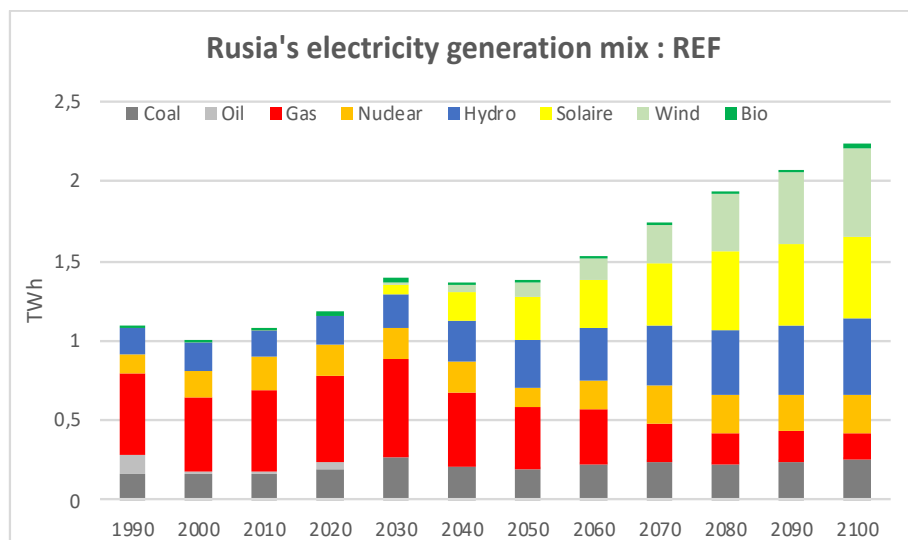
Nuclear energy development

State program for nuclear complex development envisages the growth of nuclear power generation from 207,6 billion kWh in 2020 to not less than 221,7 billion kWh in 2027 (Government of the RF, 2020).

In longer run, fast neutron power reactors with fuel recycle are expected to play increasing role. Russia possesses global leadership in fast neutron reactor technology and intends to further develop its technical capacities.

Towards carbon neutral electricity

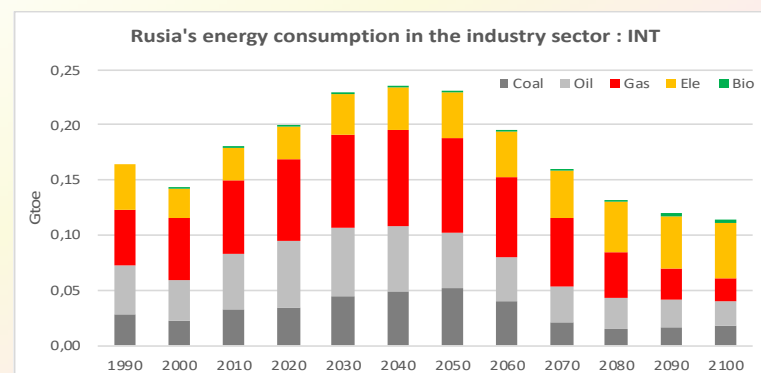
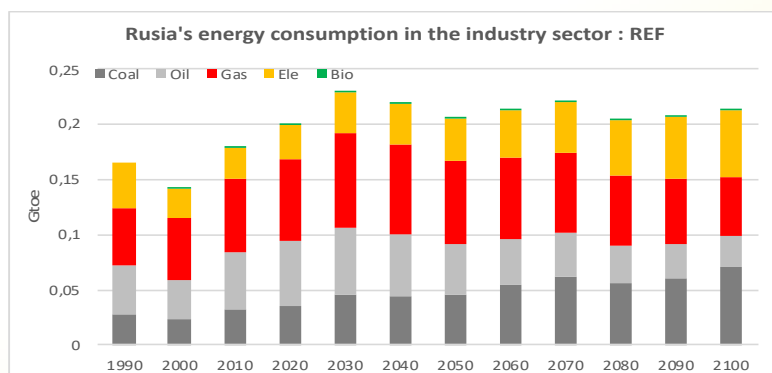
- In both scenarios, gas loses its share in the power generation mix in the long run. In result, gas contributes for about 7% of the power generation mix by 2100 due to increasing competition from renewables. The share of variable renewables reaches up to about 50% by 2100, while nuclear and hydro add up to 30-40% by the end of the century
 - The ability to balance intermittent renewables does not compensate for the gas market share loss
- The gas phase-out takes place mostly during 2030-2060s, which requires policy effort to avoid the emissions lock-in due to heavy reliance on natural gas, and to ensure power system adequacy during the transition period
 - Current modernization of power plants unlocks efficiency improvements, but in longer term major restructuring of the power system needs to be envisaged
 - As Russia heavily relies on heating co-generation plants, decarbonization of the power sector should be coordinated with electrification of the residential sector



Source: POLES-GAEL (2020)

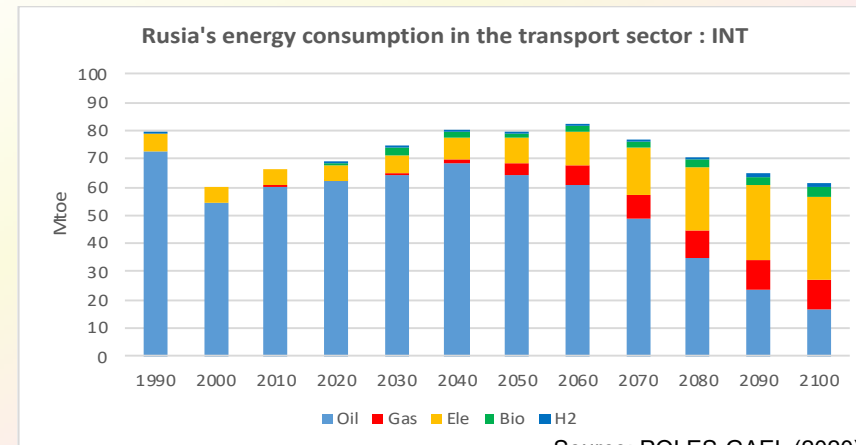
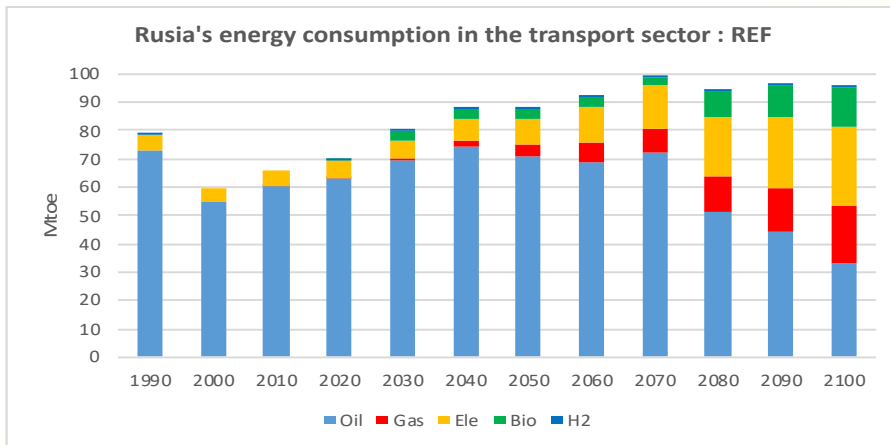
Towards carbon neutral industry

- Main consumers of gas in Russian industrial sector are metallurgy and gas-to-chemicals. To a lesser extent, gas is also consumed in petrochemicals, cement production and oil refining (Bylkin, Posypanko & Lvova, 2018). While in the gas-to-chemicals sector gas is used as a raw material, metallurgy and cement industries use gas for fuel and non-fuel purposes.
- Emissions from heavy industries are considered as particularly difficult to abate due to a lack of alternatives to fossil fuels for high temperature heating purposes (Tsafos, 2020).
- As the emissions reduction targets for 2050 are relatively weak, little change is expected concerning the volume and structure of energy consumption before 2050s in both scenarios.
 - Demand patterns will be majorly affected by industrial growth and optimization of fuel costs. Most of demand growth is expected to come from the export-oriented gas-to-chemicals sector. The metallurgical sector is to a larger extent domestically oriented due to high transportation costs and international trade barriers (Bylkin, Posypanko & Lvova, 2018)
- In longer run, we expect the gas demand to curb after 2070-80s in both scenarios. In INT scenario, gas share is roughly halved in comparison to 2020, while gas consumption is reduced approximately by a factor of three
- Industry gas demand prospects may be negatively affected by some factors which are not accounted by our model, like deteriorating international trade conditions (i.e. trade sanctions, carbon border adjustments) or rising international competition on behalf of emerging players (i.e. in petrochemicals)



Towards carbon neutral transport

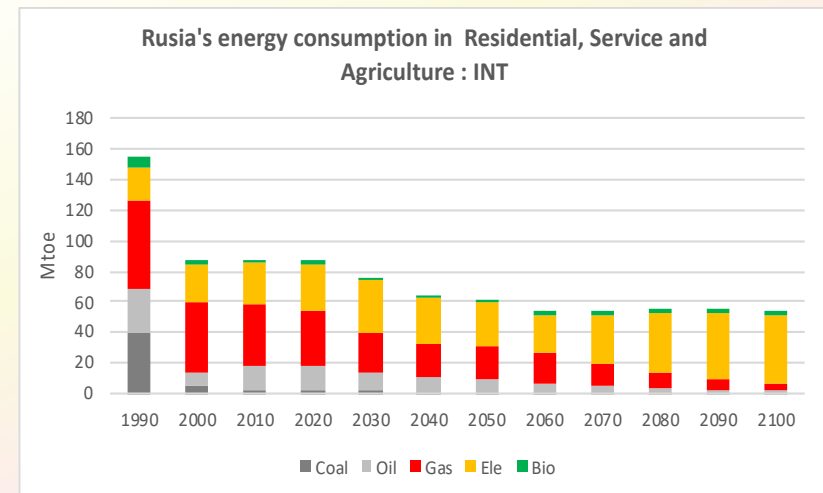
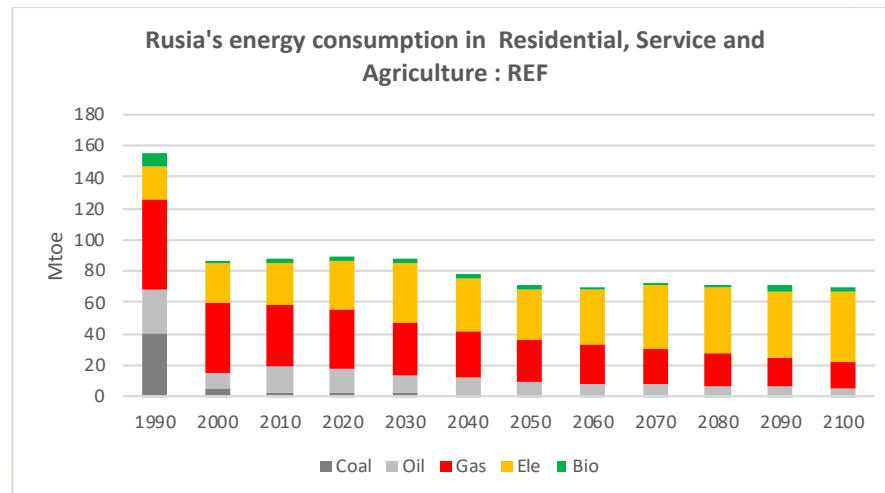
- Russian Transport Strategy to 2030 (amended in 2014) includes measures to promote the shift to natural gas in automobile or maritime transportation fuel, through incentives for the development of refueling infrastructure and pilots with natural gas vehicles. The Transport strategy assumes that the share of all alternative fuels in automobile fuel mix will rise from 4% in 2011 to 27-30% by 2030, of which gas should account for 21-24% by 2030. Special support is given to conversion of municipal transport in major cities (Decree 767, 2013).
- Despite the governmental support and the efforts of Gazprom to promote the use of gas as a transportation fuel, the progress is very modest (Bylkin, Posypanko & Lvova, 2018). Gas attractiveness as a transportation fuel is hindered by low availability of refueling networks, as well as higher maintenance fees (Kolbikova & Timonin, 2018).
- Although transport is the sector with the lowest use of natural gas in near term, gas role increases during the period in both scenarios, representing from close to zero in 2020 to about 20 % in 2100 in both scenarios.
- In case of Russia, we expect a stronger policy support for CNG and LNG vehicles rather the EVs, which could drive up the gas demand. Gas stands as a preferential option for decarbonizing the transportation sector, as it relies on huge fuel production capacities, possibility to adapt the fleet produced by national car manufacturers, as well as a rapid recovery of costs related to vehicle fuel switch (Kolbikova & Timonin, 2018).



Source: POLES-GAEL (2020)

Residential, services and agriculture

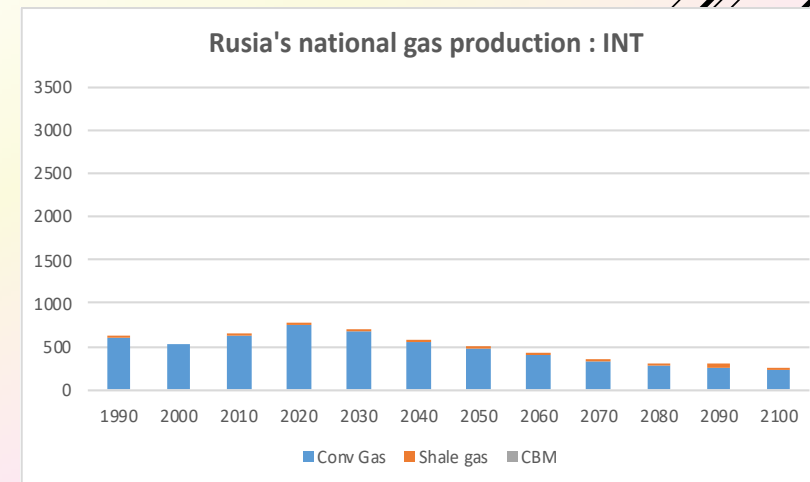
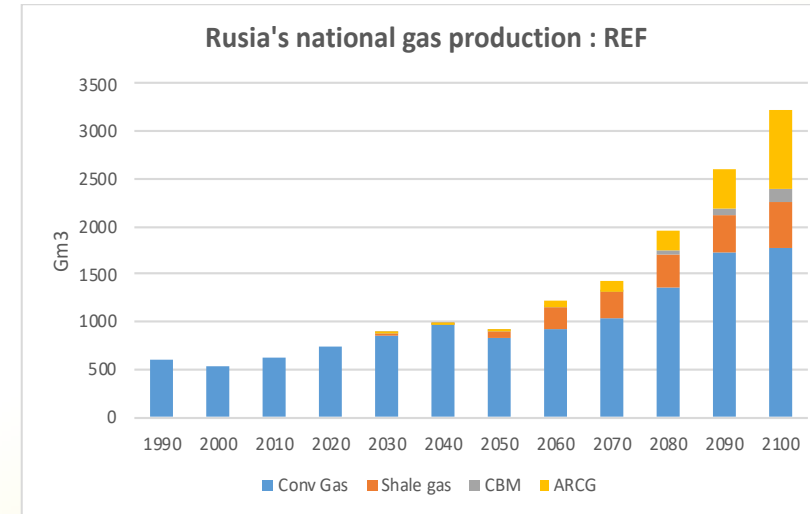
- Electricity is the major winner of decarbonization in buildings sector
- In the residential, service and agricultural sectors, gas loses its share against electricity in both scenarios, declining from over 40% in 2020 to 7-20% in INT and REF respectively to 2100
- In the residential sector, gas demand is expected to decrease due to energy efficiency improvements propelled by implementation of heat control and metering systems, improved efficiency of boilers or better housing insulation (Bylkin, Posypanko & Lvova, 2018).
- Although continuation of gasification program could create new demand from expanded residential market, new users do not make a significant contribution to the gas demand, being located in remote areas with small population. So, the gas network expansion fulfils rather political or social motives, rather than the economic ones (Bylkin, Posypanko & Lvova, 2018)



Source: POLES-GAEL (2020)

Russia's natural gas production outlook

- Due to reserve abundance, Russia's gas production is usually considered as demand-driven
- Russia intends to increase its gas production to 860-1000 bcm by 2030 (ES 2035), accounting on expanding gas demand in foreign markets due to environmental benefits of gas as a clean fossil fuel
- In the REF scenario, Russia's annual gas output more than triples by 2100, as Russia presents itself as the main global gas producer by the end of the century. This requires putting in production of shale gas and Arctic gas after 2050s, as well as huge effort to develop the gas production and transportation infrastructures
- However, a 2D scenario suggests phasing out fossil fuels, including natural gas. In the INT scenario, Russia's gas production is about its peak levels in 2020, and will decline to around 250 bcm in perspective to 2100
 - Stringent climate policy efforts induce stranded assets risks in the gas industry due to decreased global gas demand
 - This leads to destabilize Russia's macroeconomic indicators given its high dependency on hydrocarbon revenues



Russia's gas exports outlook

POLES shows very high level of uncertainty over gas export volumes depending on the scenario.

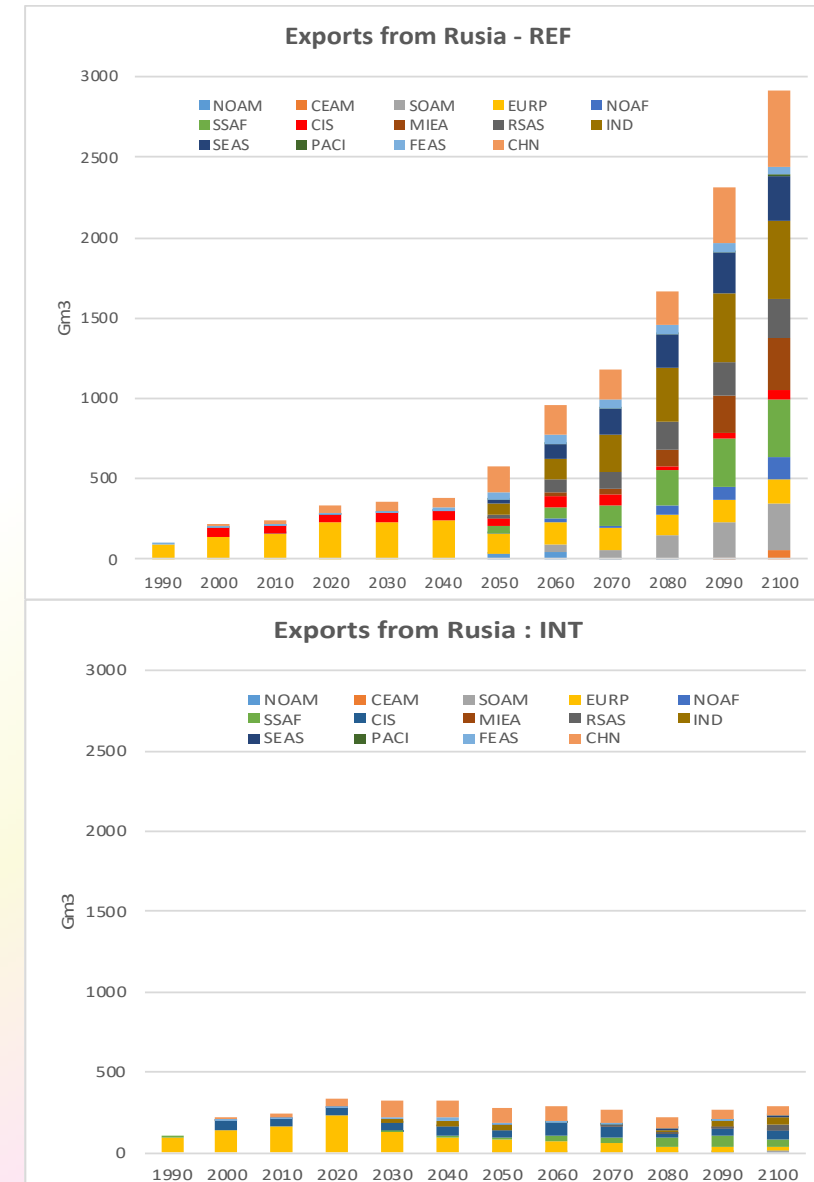
In the REF, exports growth explodes after 2040 propelled by rising energy needs, especially on behalf of emerging economies (China, India).

- Russia's dependency on the EU as the major buyer is reduced in the long run due to the export diversification and declining supplies to the EU in absolute volumes.

Carbon neutrality targets on behalf of key prospective consumers (i.e. China, India) pose serious risks to Russian gas export strategy in the long run.

In the INT scenario, Russia's gas exports remain stable peaking in 2020, decreasing after, below the the current level.

- In long term export's structure becomes more diversified in favor of emergent countries.
- Russia-EU gas dependency tends to shrink by the end of the century due to high emission reduction targets.
- Decline of pipeline gas supplies towards the EU reinforces the role of LNG for Russia's exports. Enhancing international competitiveness of Russian LNG becomes a priority, and may entail further requests for policy support on behalf of Russian gas producers



Source: POLES-GAEL (2020)

Hydrogen: an interesting vector for Russia?

Gas reserve abundance and availability of transportation infrastructures allow expanding the hydrogen production in Russia (RF Energy Minister Novak, 2020)

Hydrogen can be produced either by using renewable energy by electrolysis, or through pyrolysis of natural gas. Russia is able to do both and is also developing technology to capture the carbon emissions created during hydrogen production from natural gas.

POLES model does not reveal the emergence of hydrogen economy even in the long run due to weak cost competitiveness of the technology. Therefore, scaling the use of hydrogen will require strong policy support to be put in place.

Hydrogen exports are seen as a way to monetize the huge gas reserves and use existing export infrastructures to avoid sunk costs. However, grey H₂ is not a good solution for global emission reductions.

Conclusions

- While the world is moving toward a low-carbon direction, Russia cannot remain behind without a transparent strategy of greenhouse gas emissions reductions and has to catch up with the rest of the world. On the other side, the climate agenda poses significant risks to Russia's energy exports and country's macroeconomic equilibrium.
- Natural gas provides about half of Russia's primary energy demand and is one of the key macroeconomic drivers. Natural gas plays a versatile role in the short and long term energy transition :
 - Reshaping the national energy mix composition is not currently accounted in the Russian Energy Strategy till 2035, but needs to be addressed in longer term in order to avoid the emissions lock-in.
 - In the power generation, the role of gas as a contributor during peak periods must be highlighted and valued.
 - In the industrial sector, decarbonization presents challenges for gas rather in the longer run. Strengthening the gas demand potential requires industrial competitiveness policies and softening trade barriers, especially for the export-oriented sectors
 - Gas can assert itself as an appropriate solution in the transportation sector, which is looking for an alternative to liquid hydrocarbons.
 - A 2D type of scenario suggest a phase-out of gas starting from now, which implies that current Russian gas production and exports are around their peak levels and will decline in future years
- In the long run, the oil and gas sector will play a much smaller role in country's economy. Increasing ambition today is a contribution to the country's future development through support of clean technologies. Russia has strong potential in nuclear technologies development, and is preparing for solar and wind energy deployment through support of domestic equipment manufacturing. For the longer run, hydrogen could become an interesting option but it requires strong policy support in order to scale the deployment.

References

- Bashmakov, I.A. (2020). Russian low carbon development strategy. *Voprosy Ekonomiki*. 2020;(7):51-74. (In Russian)
- Boute A., A. Zhikharev (2019). Vested interests as driver of the clean energy transition: Evidence from Russia's solar energy policy. *Energy Policy* 133 (2019) 110910
- Bylkin A., Posypanko N., Lvova A. (2018). Domestic Gas Demand: a Trend towards Stagnation? Vygon Consulting, March 2018
- Decree No. 767 of Government of RF (2013) On regulation of relations in the area of gas motor fuel use, including the use of natural gas as a motor fuel
- Doctrine of energy security of Russian Federation (2019). Adopted by Decree of President of Russian Federation of 13 May 2019 No.216.
- Energy Strategy of Russian Federation for the period until 2035 (2020). Adopted by Decree of Government of RF No 1523-p, June 9, 2020.
- Government of the Russian Federation (2020). Decree of 16.03.2020 No.289-13 On amendments to the state program of RF The Development of Nuclear Energy and Industry Complex.
- IEA, (2020). World Energy Outlook 2020. OECD/IEA.
- Khokhlov, A. and Melnikov, Y. (2019) Coal-fired generation in Russia: new challenges and opportunities. Skolkovo Energy Centre, January 2019 (in Russian)
- Kolbikova E., Timonin I. (2018) Electric Vehicles: No Lift off Without State Support. Vygon Consulting – September 2018.
- Makarov I., Chen H., Paltsev S. (2020). Impacts of climate change policies worldwide on the Russian economy. *Climate Policy* <https://doi.org/10.1080/14693062.2020.1781047>
- Minenergo (2020) Main characteristics of Russian power sector. <https://minenergo.gov.ru/node/532>
- Mitrova T. & Yu. Melnikov, (2019) Energy transition in Russia. *Energy Transitions*, 3: 73-80.
- Mitrova T. et al. (2020) Global Climatic Threat and Russian economy: Searching for the way. Skolkovo Energy Centre, May 2020.
- Novak, A. (2020) Russia rules out cutting fossil fuel production in next few decades. Interview to Guardian, taken by J. Ambrose, <https://minenergo.gov.ru/node/19287>
- Orlov, A., & Aaheim, A. (2017). Economy-wide effects of international and Russia's climate policies. *Energy Economics*, 68, 466–477. <https://doi.org/10.1016/j.eneco.2017.09.019>
- Ross, K. (2020) Russia's Proposed Climate Plan Means Higher Emissions Through 2050. World Resources Institute, April 13, 2020
- Sharmina, M. (2017). Low-carbon scenarios for Russia's energy system: A participative backcasting approach. *Energy policy*, 104 (2017) 303–315
- Strategy of the Long-Term Low-Carbon Economic Development for the period till 2050 (draft, published by Ministry of Economic Development of RF in March, 2020)
- Transport Strategy for the period until 2030. Amended by Decree of Government of RF No 1032-p, June 11, 2014.
- Tsafos N. (2020), How Will Natural Gas Fare in the Energy Transition? CSIS, January 2020
- WNA (World Nuclear Association). 2020. "Nuclear Power in Russia." World Nuclear Association. <https://www.world-nuclear.org/information-library/country-profiles/countries-o-s/russia-nuclear-power.aspx>

THANK YOU!

A decorative graphic in the bottom right corner consisting of several parallel diagonal lines in black and grey, set against a background with a rainbow gradient from yellow to blue.