Yakov and Partners × ROSCONGRESS Building Trust

The Energy Transition: Challenges and Opportunities for Russia

A Study

August 2024

Summary: successful energy transition will depend on the accelerated commercialization and integration of technologies of the future

- The ongoing global energy transition is driven by **long-term fundamental, irreversible factors.** The turbulent recent years have given it a new impetus toward **energy security and accessibility** in the emerging multipolar world
- **Global demand for primary energy is expected to climb 22%** by the year 2050, with **electricity consumption set to nearly double.** Meanwhile, the deficit of **critical materials**, the need for substantial **investment**, and unreadiness of most new **technologies** for commercial utilization combine to lend a **non-linear quality** to the energy transition, creating the potential for a first mover advantage. A window of opportunity thus opens, and it can be taken advantage of
- Even if the optimal scenario, which is the **Rational Balance** scenario, takes hold, primary energy derived from fossil fuels will account for **about 55% of the world's energy**, and **75% in Russia** by 2050, which is to say that fossil fuels will remain the dominant source of energy. The **"greening"** of fossil fuels and advancement of commercially viable **beyond-the-horizon technologies** form the groundwork of success, however, the structure of the energy system will depend on the local **features of individual nations and regions**

- In the baseline scenario, Russia's fuel mix will be changing **inertially**. To use the window of opportunity, Russia will have to advance in these **three key areas**
  - **Energy sovereignty:** closing the strategic gaps in raw materials, technology, supply- and demand-side supply chains, and availability of workforce and financing
  - **Infrastructure for accelerated growth of domestic demand** (including the priority development hubs in the Arctic and the Far East) and **electric vehicles**, to be developed by private sector players in partnership with the state
  - **Advancement of new low-carbon energy options:** a breakthrough by dint of economies of scale, made possible in part by international partnerships and by integrating technologies into **turn-key energy solutions** for the domestic and international markets

- **The solution** for Russian energy utilities may be defined as **"dual-speed management"**
  - The idea is to strike a balance between win-win moves and strategic bets, on the one hand, assuring **stable, effective, and sustainable business** today,
  - and on the other hand, taking advantage **of the window of opportunity** to press ahead with technological development in order to secure a **strategic edge**
- To that end, Russia must accept these five management imperatives: scenario planning, dynamic portfolio management decision-making, ecosystem approach, focus on long-term value, and an adaptive operating model

Agenda

01 The energy landscape is changing: what's going on?

02 Challenges and opportunities for Russia: what does this mean?

03 New strategy planning imperatives: what is to be done?

Driven by long-term fundamental, irreversible factors, the energy transition leads to a radical reshaping of the supply-demand patterns

Fundamental drivers →

Community
- Population growth (9.7 billion by 2050)
- Urbanization (up to 80% of the population lives in urban areas)
- Changes in energy's value for consumers

Economics
- Industrialization and de/reindustrialization
- Changing GDP energy intensity
- Convergence of industries

Environment and climate
- Fighting climate change: the drive to reduce emissions from 58 Gt CO_2e to 0
- Resource conservation: fostering a closed loop economy

Global politics
- Geopolitical barriers, international institutions and leadership in crisis

4D trends →

Decarbonization
- Reducing emissions by launching/ decommissioning demand generators and power generating facilities

Decentralization
- Generating facilities moving closer to consumers
- Local market growth

Digitalization
- AI and big data technology for improved performance
- Flexible smart grids

Deglobalization
- Nations, local communities, and households striving toward energy self-sufficiency
- Resource nationalism

Changes in global energy mix

On the supply side

Broader use of clean energy generating and storing technology (RES[1], SNPP[2], CCUS[3], collectors, etc.)

"Greening" of fossil fuels

Advancements in low-carbon fuel technology (hydrogen, synthetic fuels, natural gas, etc.)

On the demand side

Increased energy usage and energy efficiency

Transportation sector switching to electric motors

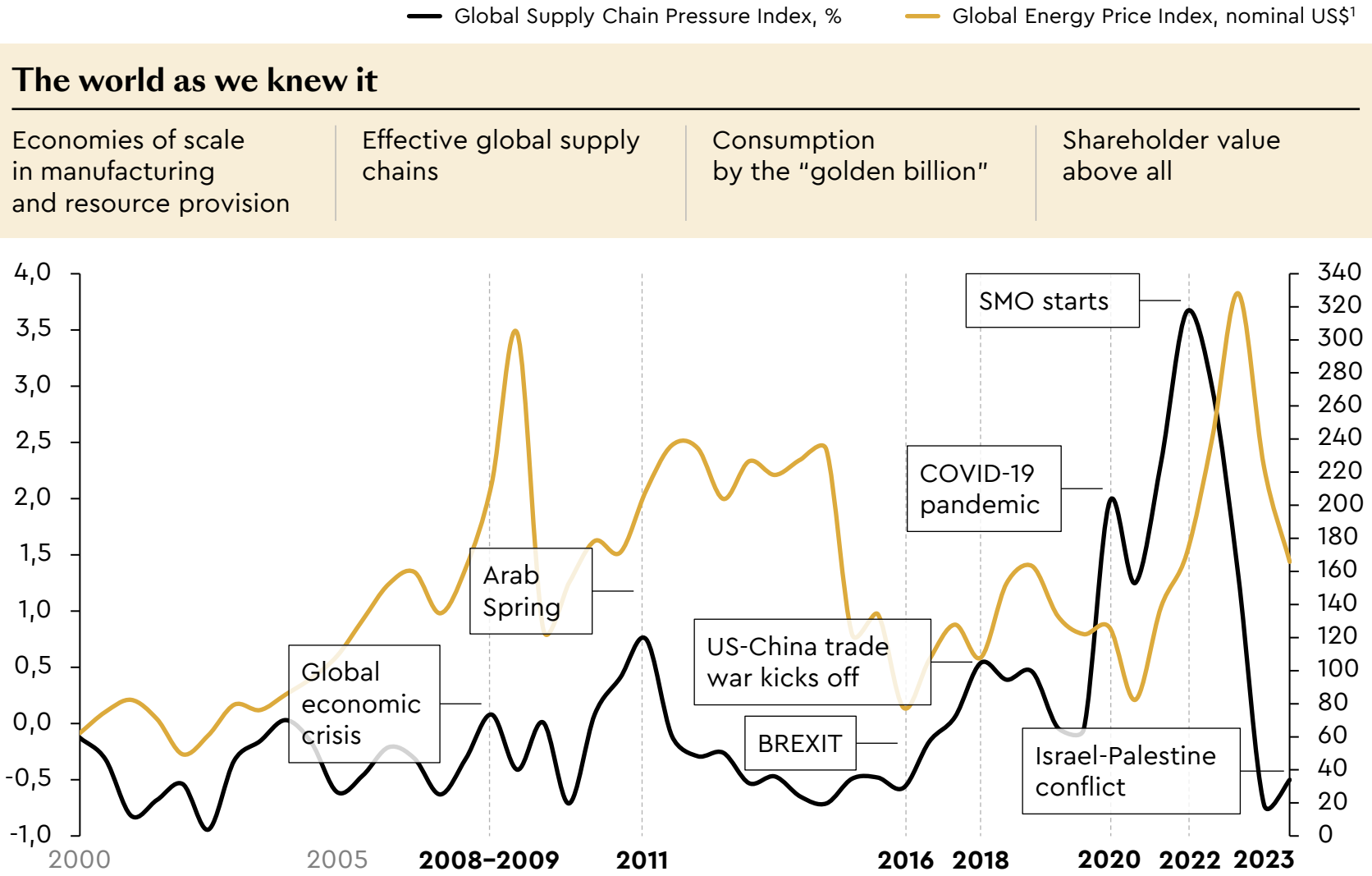
Electrification of industries and households

1. Renewable energy sources
2. Small nuclear power plants
3. Carbon capture, utilization and storage, including direct air capture (DAC)

Source: World Population Prospects; DNV (Energy Transition Outlook 2023); public sources

The past few turbulent years have radically reshaped the world and will impact the future energy markets

How geopolitical events impact energy supply chains and investment



The world as we knew it

- Economies of scale in manufacturing and resource provision
- Effective global supply chains
- Consumption by the "golden billion"
- Shareholder value above all

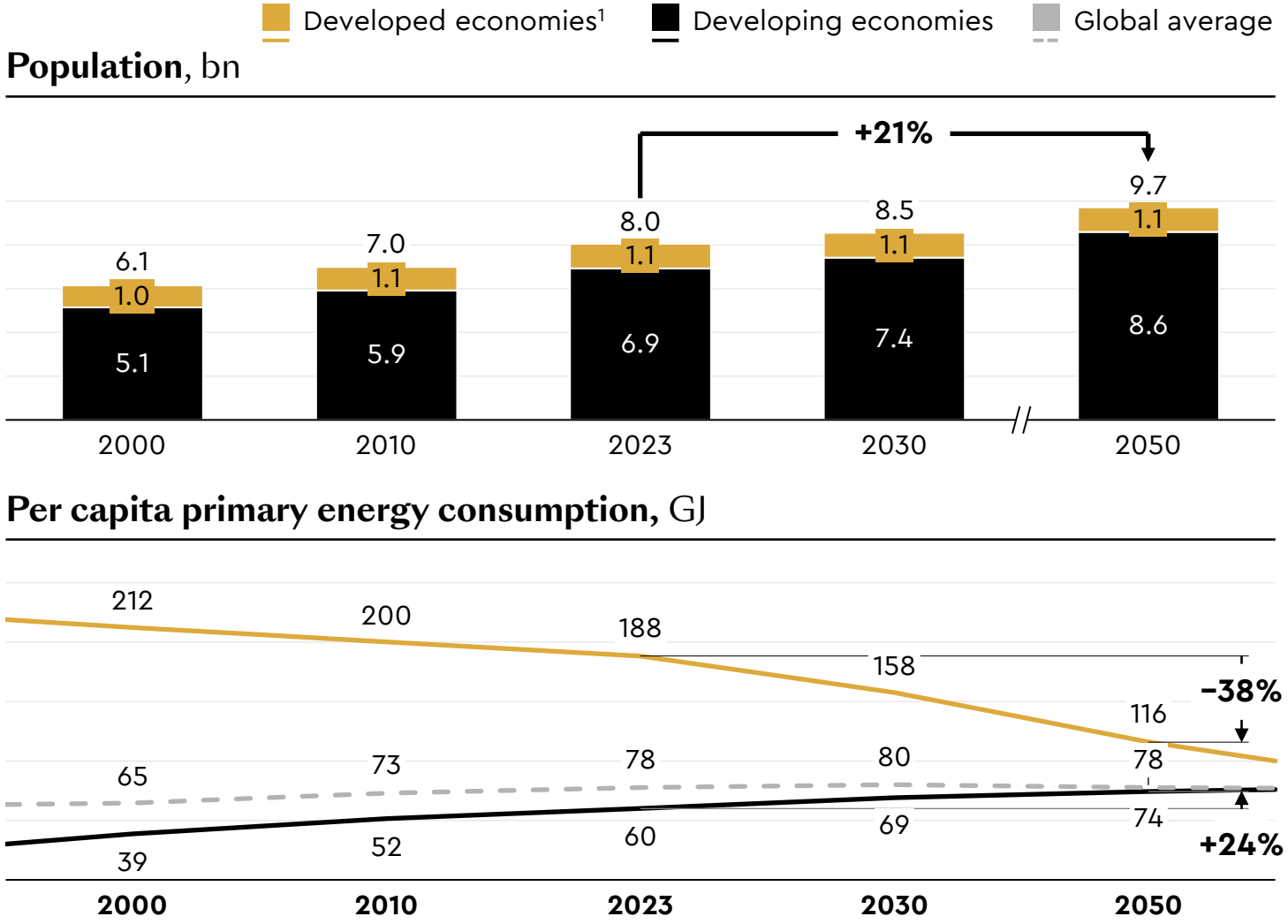
The world we are headed for

- Disrupted supply chains, a multipolar economic landscape
- Tendency to stave off risks by building sovereign energy ecosystems
- Growing tendency to prioritize friendly nations for energy deals
- Emphasis on affordable, sustainable energy as the bedrock of long-term value for society

1. Base year = 2016, index = 100

Source: Federal Reserve Bank of New York; Bloomberg; public sources

The rise in global demand for primary energy will be driven by population growth and increasing per capita consumption in developing economies



1. According to the UN classification

Source: World Bank; DNV; International Energy Agency; OECD Data Explorer; ExxonMobil Global Outlook 2024; Yakov and Partners analysis

Comments

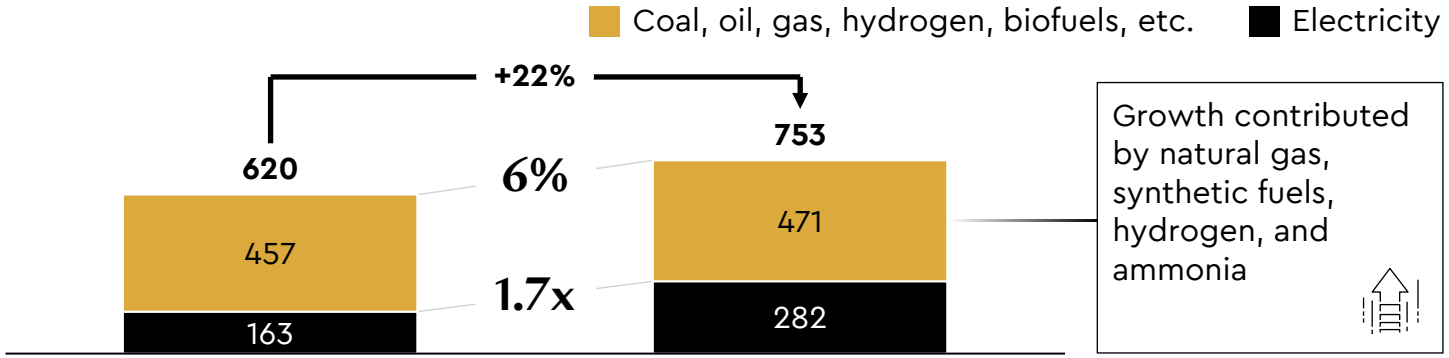
01 According to estimates, **the world's population** stands to increase by more than **20%** by the year **2050**, with population growth driven primarily by the developing nations. Per capita consumption will also increase, driving **global demand** for resources, **energy** included

02 **The developed economies** will see fossil fuels getting progressively **substituted** by electricity or renewable alternatives in transportation, manufacturing, and households, which will be accompanied by improvements in energy efficiency

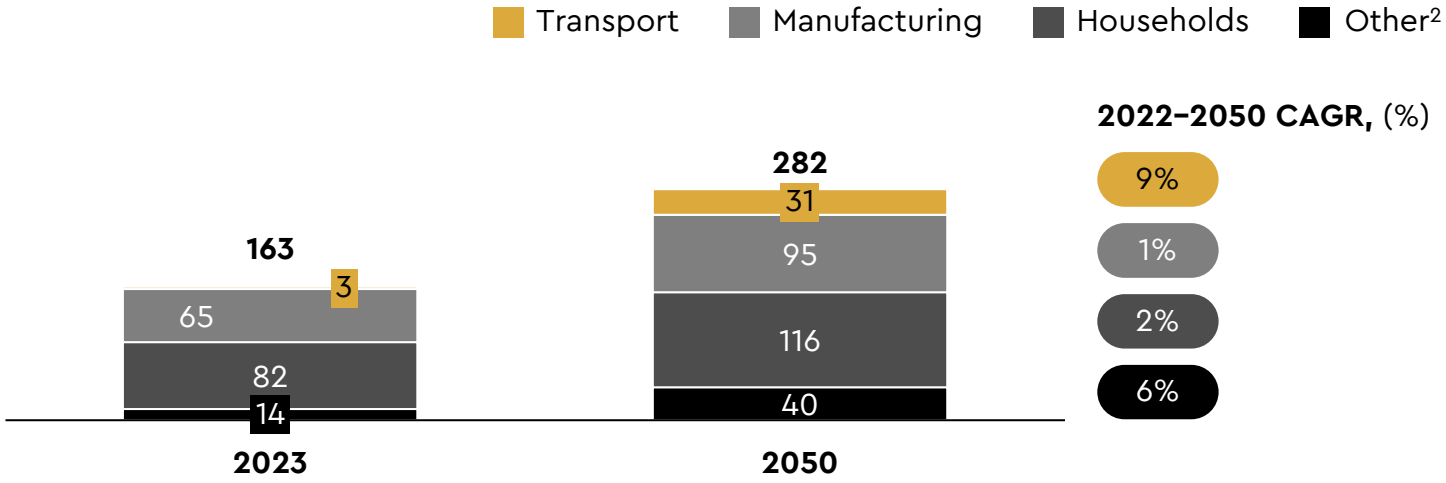
03 **There will be only a limited** substitution effect **in the developing economies,** therefore, the **rise** in energy demand and consumption will be driven by industrialization of the growing regions and expanded opportunities for consumers

Aggregate demand for electric power is set to increase 1.7 times across all sectors by 2050

Electricity's percentage share of aggregate primary energy consumption, EJ



Electricity consumption by economic sector,[1] EJ



1. Primary energy equivalent
2. Including electrolysis

Source: Energy Institute 2024, DNV (Energy Transition Outlook 2023); IEA; McKinsey & Company; Yakov and Partners analysis

Comments

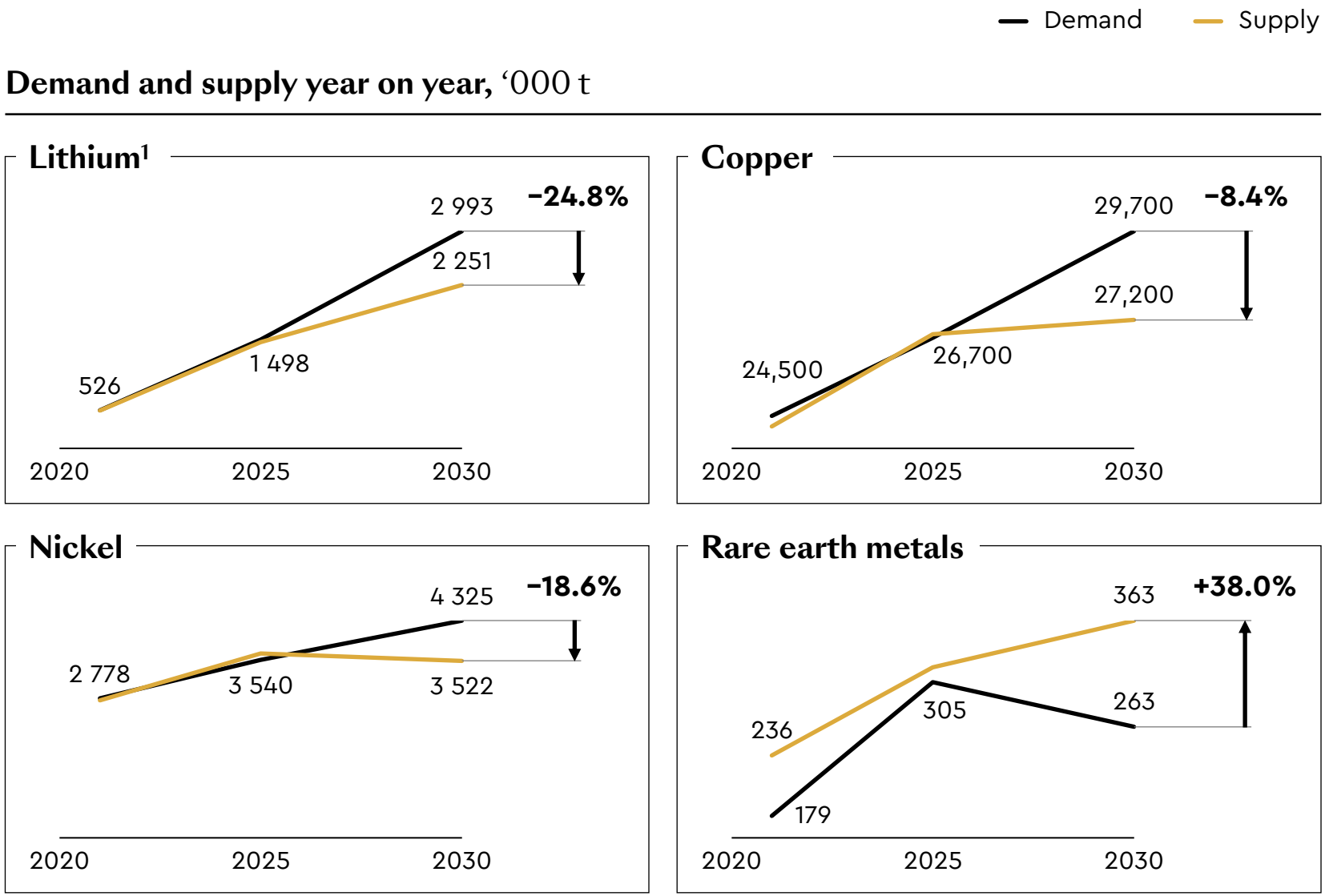
01 **Consumption of electricity,** which has **consistently increased** in percentage terms **vs** aggregate primary energy consumption, will account for **over 35%** of the lot by 2050 vs 26% in 2023

02 **Growth drivers**

- More electric vehicles and a greater percentage of EVs in the overall car fleet
- Electrification of low- and medium-temperature industrial processes
- Advances in electrolysis technologies for the production of green hydrogen and synthetic fuels (ammonia, methanol, etc.)
- Rising household demand for electricity, contributed in part by air conditioning and heating needs

03 The developing economies' contribution to global electricity consumption will climb from **59% in 2022 to 66% in 2050**

The energy transition will be seriously impeded by the deficit of critical metals



1. Lithium carbonate equivalent

Source: Critical Minerals Data Explorer; IEA; EY (US Energy Transition Narrative); McKinsey (Lithium mining, 2022)

Comments

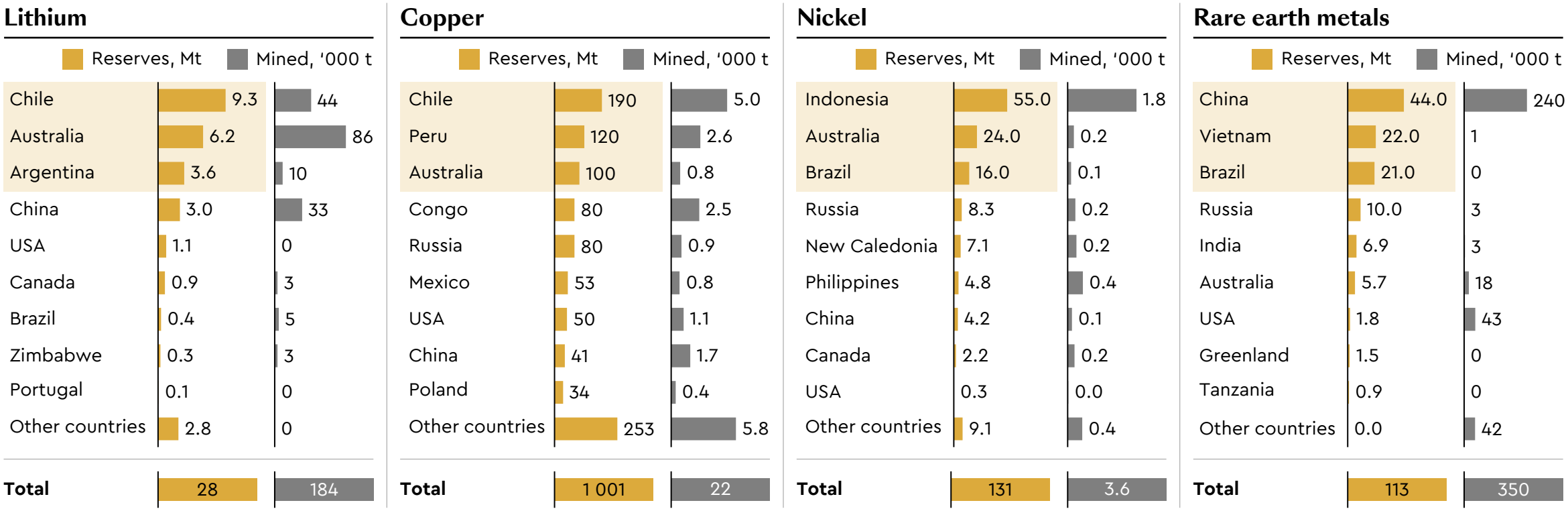
01 **Certain minerals** (lithium, copper, nickel, and some others) **are critically important for the manufacturing industries** and most of the **green technologies** involved in the energy transition

02 **By the year 2030,** global demand **for** critical minerals is expected to **exceed supply** by 10% to 20%

03 This will **lead to** price hikes **and tougher competition over access to these resources**

Localization of critical metal resources, coupled with a worsening geopolitical situation, may fuel resource nationalism

Critical element reserves, mining, and processing capacity (2023)



Note

China controls **40% of copper processing** and mines **70% of rare earth metals and 15% of lithium.** Australia controls 46% of lithium mining

Indonesia is the world's largest nickel producer with a share of **about 50%,** however, most of its nickel is of inferior quality and **unfit for use in the energy sector**

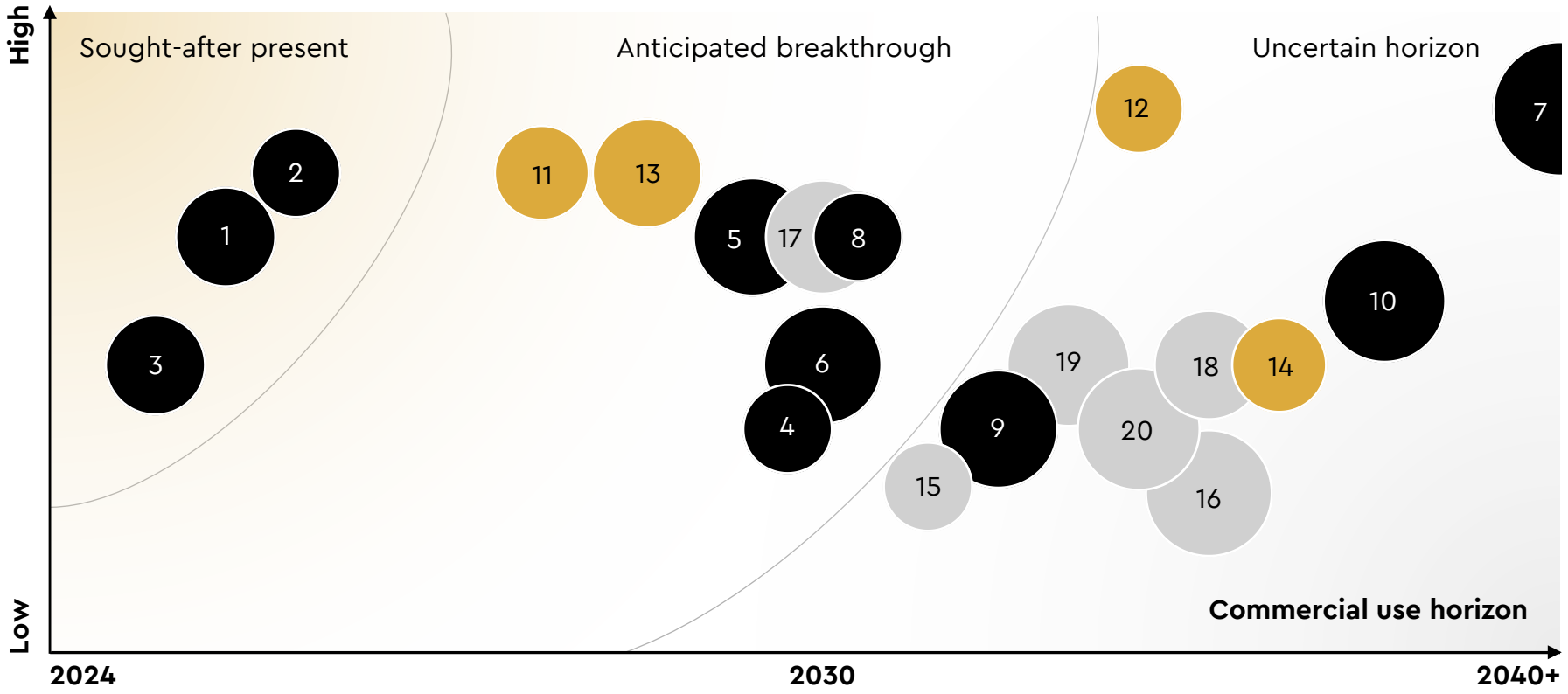
Geopolitical factors and **increasing propensity of nations to control their own natural resources** may shrink the supply, **creating further challenges** for the global energy market

Source: Mineral Commodity Summaries 2024; Yakov and Partners analysis

Most of the promising new technologies are at a low level of maturity and have ways to go before they are fit for commercial use

○ Size matches the required investment ● Energy generation technologies ● Energy storage technologies ● Auxiliary technologies

Technology's potential in the energy transition context



1. Wind power
2. Solar power
3. Hydroelectric power
4. Biofuel
5. Generation III+ SNPP
6. Generation IV NPP
7. Fusion power
8. Fuel cells[1]
9. Blue hydrogen
10. Green hydrogen
11. Networked energy storage
12. Long duration energy storage
13. Non-battery energy storage
14. Lithium-free battery technology
15. V2G[2]
16. Over-the-road charging[3]
17. Smart grids
18. Energy-efficient buildings
19. CCUS[4]
20. Hydrogen transportation

A unique business opportunity that promises first player advantage in fast-tracking new technology commercialization

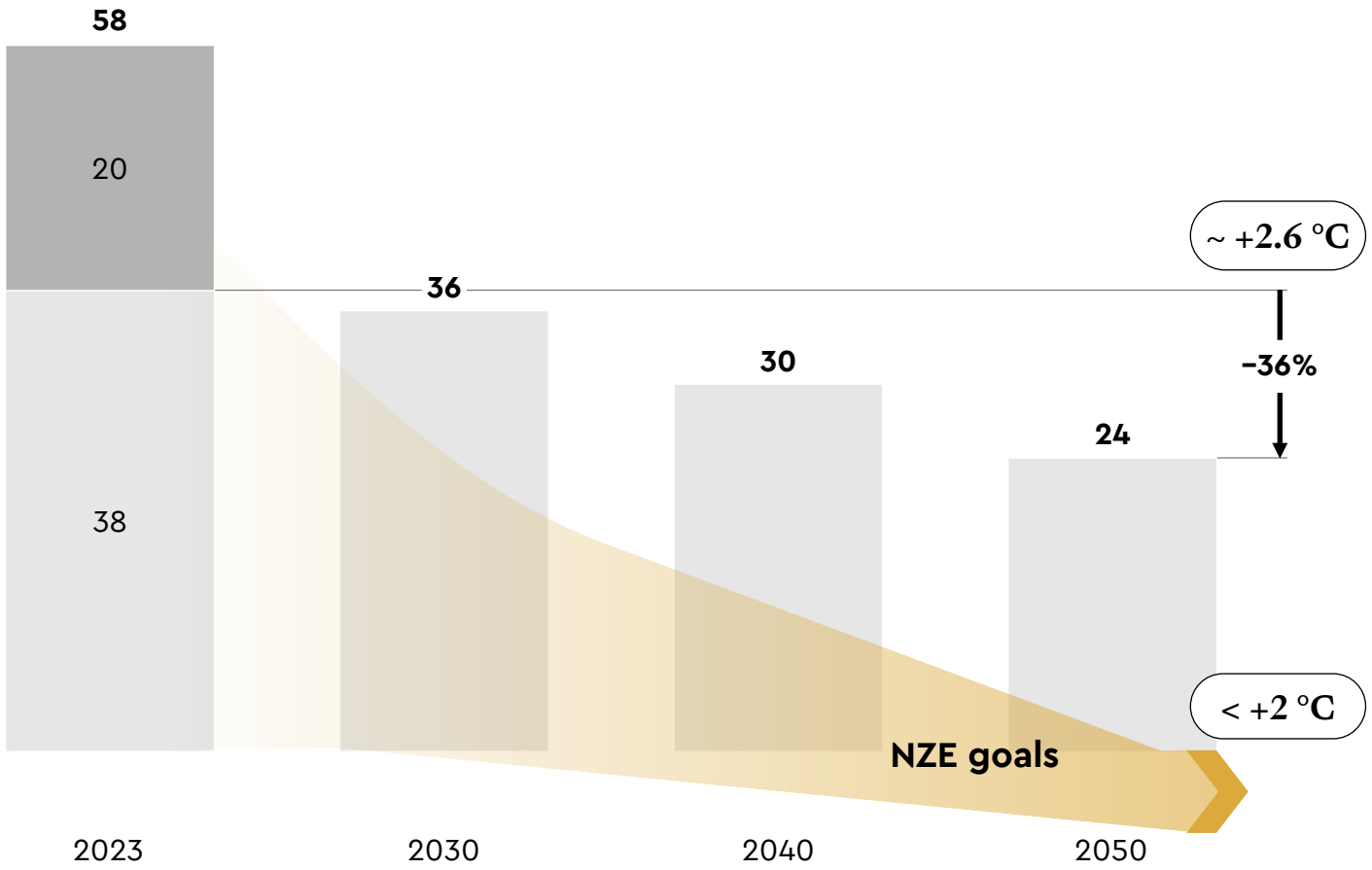
1. Electrochemical accumulators and converters of energy, mostly that of hydrogen
2. This technology permits electric vehicles to return energy to the electric grid for subsequent redistribution on the market (Vehicle-to-Grid)
3. Electric vehicle charging while on the move
4. Carbon capture, utilization and storage, (CCUS), including direct air capture (DAC)

Source: public sources; expert interviews; Yakov and Partners analysis

The current efforts to reduce the contribution and carbon intensity of fossil fuels will not be enough to limit global warming to below 2°C

Emissions: other forms of human impact | Emissions: energy | XX Global temperature rise

Annual average global emissions, CO_2e, Gt



Steps to mitigate climate change impact

Advances in clean energy technologies, namely RES and NPP, will help reduce CO_2 emissions to a limited extent only

To counteract the remaining 64% of CO_2 equivalent emissions from fossil fuels, the following actions will be required

On the supply side

- **Reduce the carbon intensity of power generation,** such as by stepping up the retirement of old coal-fired thermal power stations
- Promote the development of **CCUS**[1] technologies
- Build a **closed loop economy**

On the demand side

Raise **the energy efficiency** and **electrification** coverage of different economic sectors

- **Households**: deploy heat pumps, solar batteries, energy storage systems, etc.
- **Transportation**: promote electric vehicles and the use of hydrogen fuel directly at production site
- **Manufacturing**: use "green" steel, cement, methanol, ammonia, and other chemical products

1. Carbon capture, utilization and storage, (CCUS), including direct air capture (DAC)

Source: Intergovernmental Panel on Climate Change (IPCC); Emissions Database for Global Atmospheric Research; UN Emission Gap Report 2023; IEA

Investment in energy transition technologies has reached the minimum level required to sustain the transition, but 1.6 times more investment is needed to achieve NZE

Power generation technologies

Cumulative investment needed to implement energy transition throughout 2022–2050[1], US$ trillion

	Supply				Demand					% of global GDP/year[8]
	Fossil fuels[2]	Solar and wind	Other RES,[3] nuclear, storage	Hydrogen	Grids	CCUS[4]	Electric vehicles[5]	Closed loop[6]	Heat pumps	
Energy transition continued (~ +2.6°C)	26	14	3	~0	13	~0	54	9	~0	2.7%
NZE[7] (< +2°C)	15	27	9	2	21	11	92	10	8	4.4%

Why investment cannot be dramatically increased

1. Weakness of international institutions
2. Continued geopolitical tensions
3. High cost of capital and barriers for technology transfer to developing nations

2.7%
2023

1. Excluding investments in the decommissioning of power generating assets and in the mining of critical minerals
2. Including oil, gas, and coal
3. Including hydroelectric power, geothermal power, and biofuels
4. Carbon capture, utilization and storage (CCUS), including direct air capture (DAC)
5. All types of electric vehicles
6. Including processing facilities for aluminum, steel, chemicals, etc.
7. NZE (Net Zero Emissions) is the commitment declared by the Paris Agreement to limit global temperature rise to between 1.5 °C and 2 °C during this century
8. Averaged value

Source: BloombergNEF (New Energy Outlook 2023); Yakov and Partners analysis

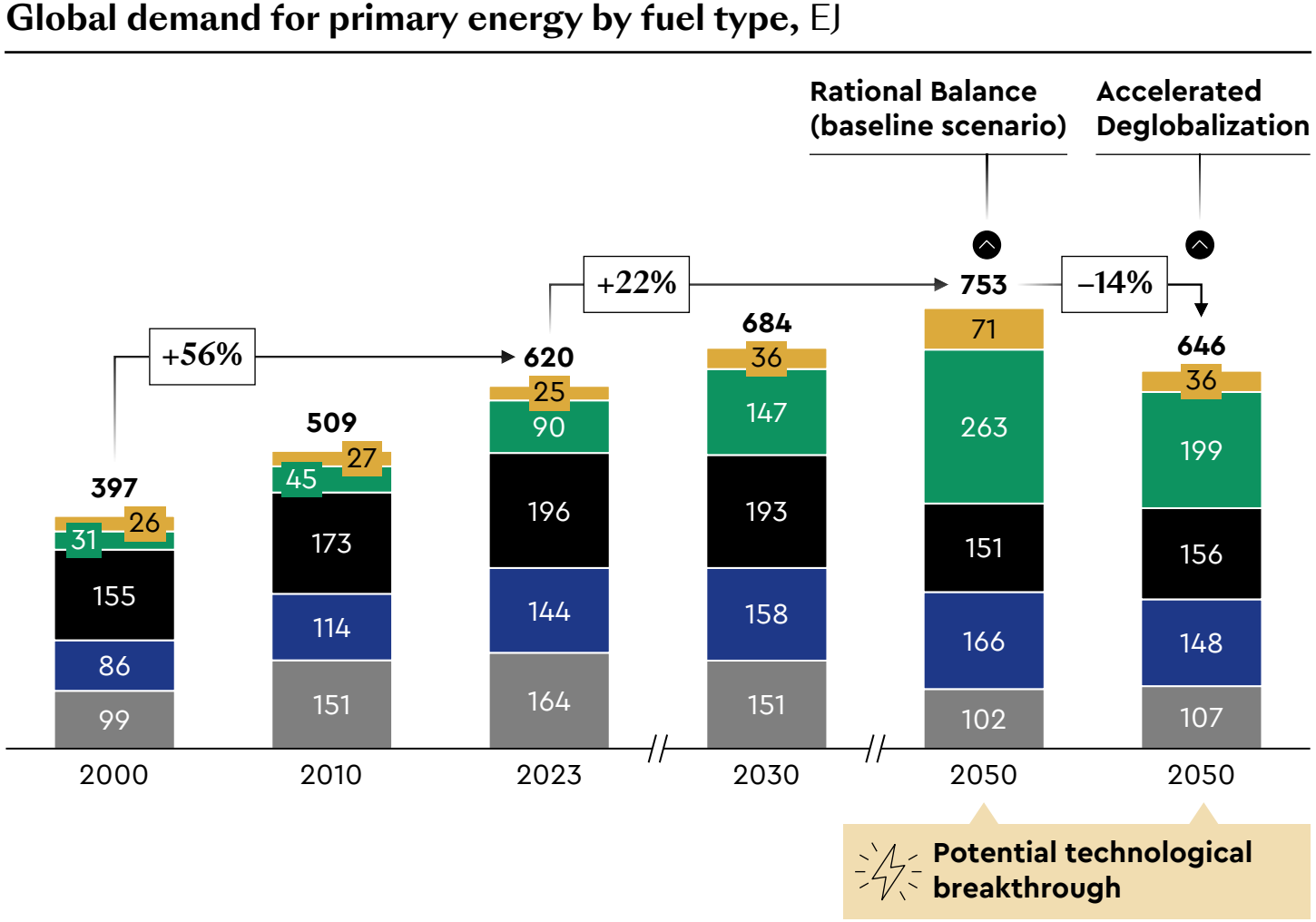
In view of the necessary changes and the apparent risks, two key development scenarios may be identified for the global energy mix

Scenario assumptions

	Rational Balance (baseline scenario) 1 The energy portfolio evolves in alignment with the environmental and economic interests concerned	Accelerated Deglobalization 2 Polarization of the world and disintegration of energy supply chains cause the energy transition to slow down considerably
Geopolitical tensions	Geopolitical stabilization Cooperation between new regional alliances of a multipolar world paves the way for Globalization 2.0	Continued polarization in politics, economics, and technological development Preexisting supply chains disrupted
Worldwide economic development	Moderate global economic growth (1.5% to 2% annually)	Global economy stagnates until 2030, followed by slow growth
Technological development	Radical technological breakthroughs on the horizon (before 2030) Technology transfer opportunities taken advantage of to achieve economies of scale within the available partnerships	No technology transfer; technological breakthrough never happens or is local in nature so that no opportunity arises to benefit from economies of scale
Consumer activism and the green agenda	New generation changes consumer habits in favor of sustainable environmental practices Massive investments in the energy transition by the US, EU, and China, with other nations following suit to varying degrees	Communities prioritize immediate access to energy resources at all costs All nations prioritize energy security, economic viability is secondary
Regulatory framework	The energy transition gets economic and social incentives from international institutions and other parties	Inertia persists, leadership crisis continues in international institutions
Access to critical supplies	Critical supplies are shared within the newly formed supply chains	The developed economies have the technology but no necessary resources; the developing economies have the resources but no technology to develop them

The share of fossil fuels will decline, but no single energy transition technology will gain dominance

Global demand for primary energy by fuel type, EJ



1. Including wind, solar, hydroelectric, and geothermal power, biofuels, and hydrogen

Source: Energy Institute 2024; IEA (World Energy Outlook 2023); DNV; Yakov and Partners analysis

Comments

In the baseline scenario, RES and nuclear power generating capacities will **triple;** however, **fossil fuels** will continue to contribute **~55%** (down a quarter vs current level)

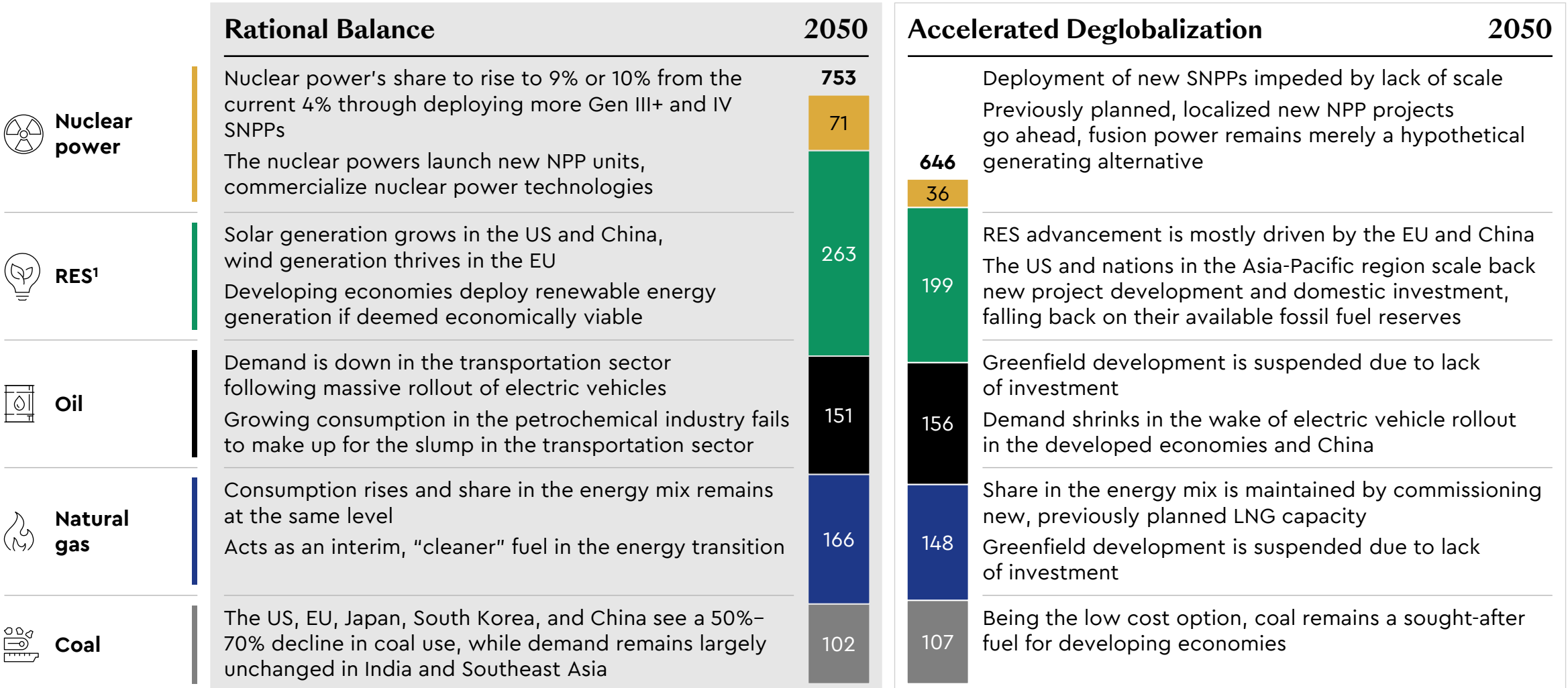
In the Accelerated Deglobalization scenario, energy consumption growth will **slow down** by a factor of **3.5**, with **hydrocarbons** contributing **upwards of 60%**

Renewable energy alternatives will not solve the problem entirely in any scenario

The "greening" of fossil fuels and advancement of **new generation technologies beyond the confines of** commercial utility **and into the realm of technological breakthrough** will be the cornerstone of success for energy transition

The share of clean energy will be the first to shrink from geopolitical impact as resources are mobilized and restrictions placed on technology and partnership

Situation in the global market for primary energy by fuel type, including demand (EJ)

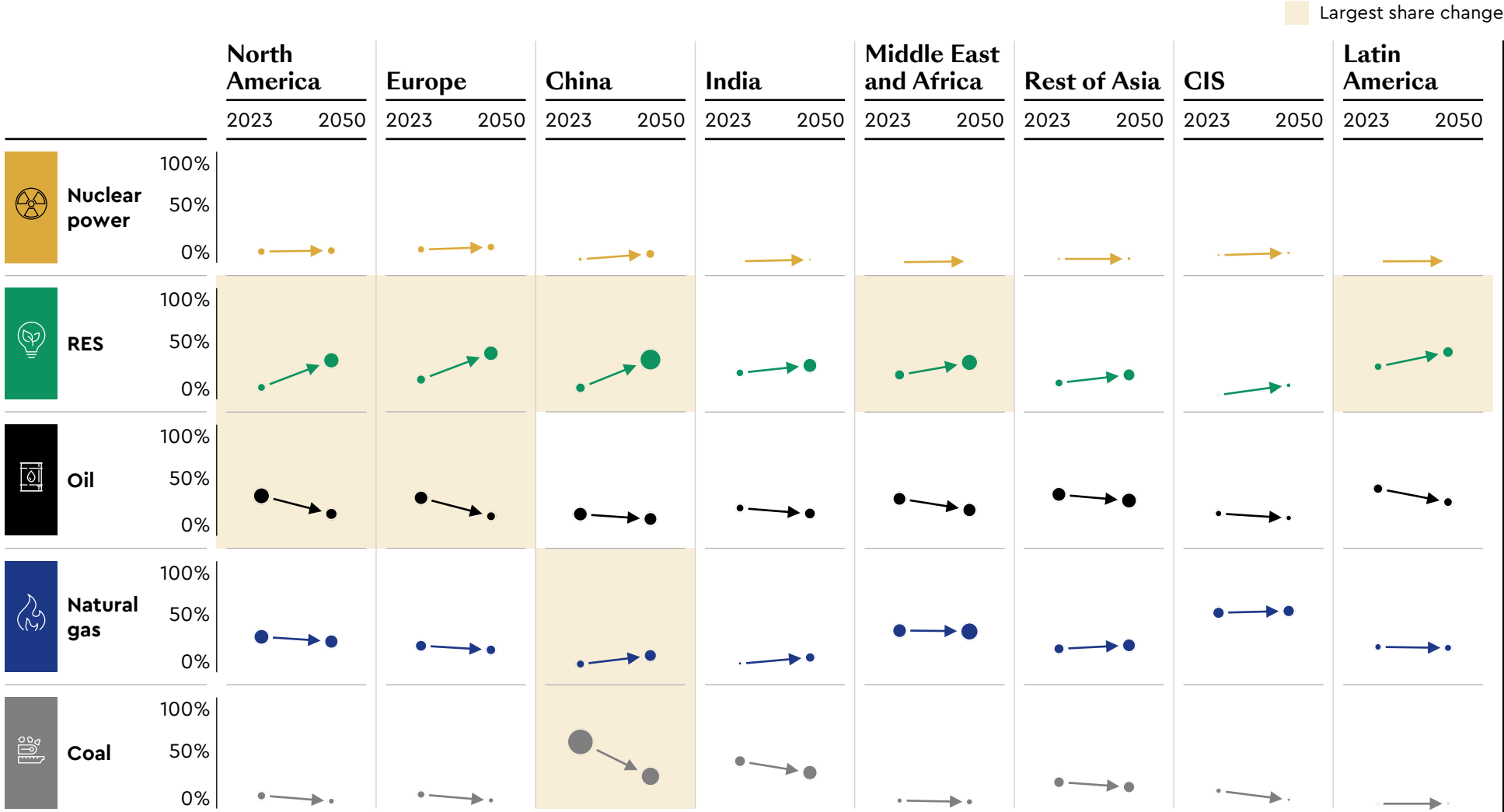


1. Including wind, solar, hydroelectric, and geothermal power, biofuels, and hydrogen

Source: Yakov and Partners analysis

The global energy mix will depend on national and regional differences and the rational choices made by countries and regions

Changes in primary energy generation share in the energy mix of selected regions by 2050



Comments

01 Oil consumption to drop **16% by 2050 in North America and Europe** as **demand slumps for gasoline-powered vehicles** and the transition is made to renewable energy alternatives

02 Coal consumption to **drop 31% in China** as natural gas consumption increases (**+9%** by 2050) and clean energy alternatives – **RES, NPP, HEP – come to supplant the less environmentally friendly options**

03 In the **Middle East, Africa, and Latin America, the share of RES is set to increase 12%** by 2050 in consequence of **energy source diversification** in the emerging markets

Source: DNV; Russian Energy Agency; Yakov and Partners analysis

Achieving energy sovereignty in a new reality requires a concerted, systematic impact upon the fundamental factors

Community

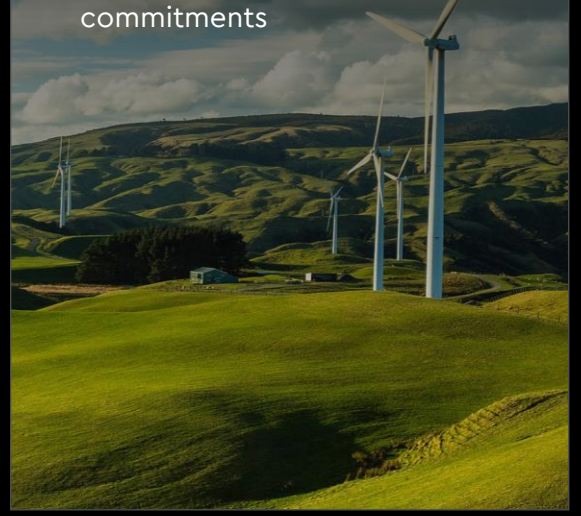
- Focus on trends contributing to climate change and irrational use of resources
- Due consideration to demographic change: stratification of society, overurbanization, and migration
- Consumer engagement

Economy and technology

- Reshaping of demand structure sector-to-sector
- Accelerated commercialization of emerging technologies of promise by engineering economies of scale
- Shift of focus from shareholder value to long-term value

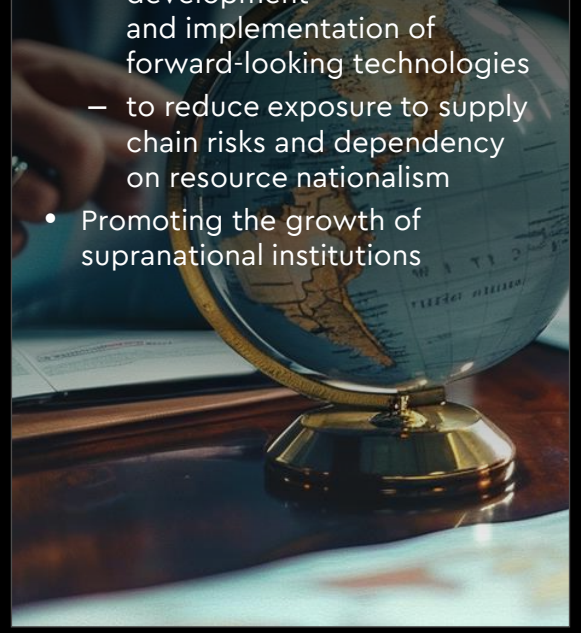
Environment and regulators' role

- Support for the advancement of forward-looking technologies for energy transition, and investments in clean energy and "greening" of fossil fuels
- Efforts to encourage carbon market growth
- Support for the Paris Agreement climate action initiatives and carbon emission reduction commitments



Geopolitics

- Cementing of the energy and technological sovereignty
- Ecosystem cooperation between friendly nations
  - to foster economies of scale and expedite the development and implementation of forward-looking technologies
  - to reduce exposure to supply chain risks and dependency on resource nationalism
- Promoting the growth of supranational institutions



Agenda

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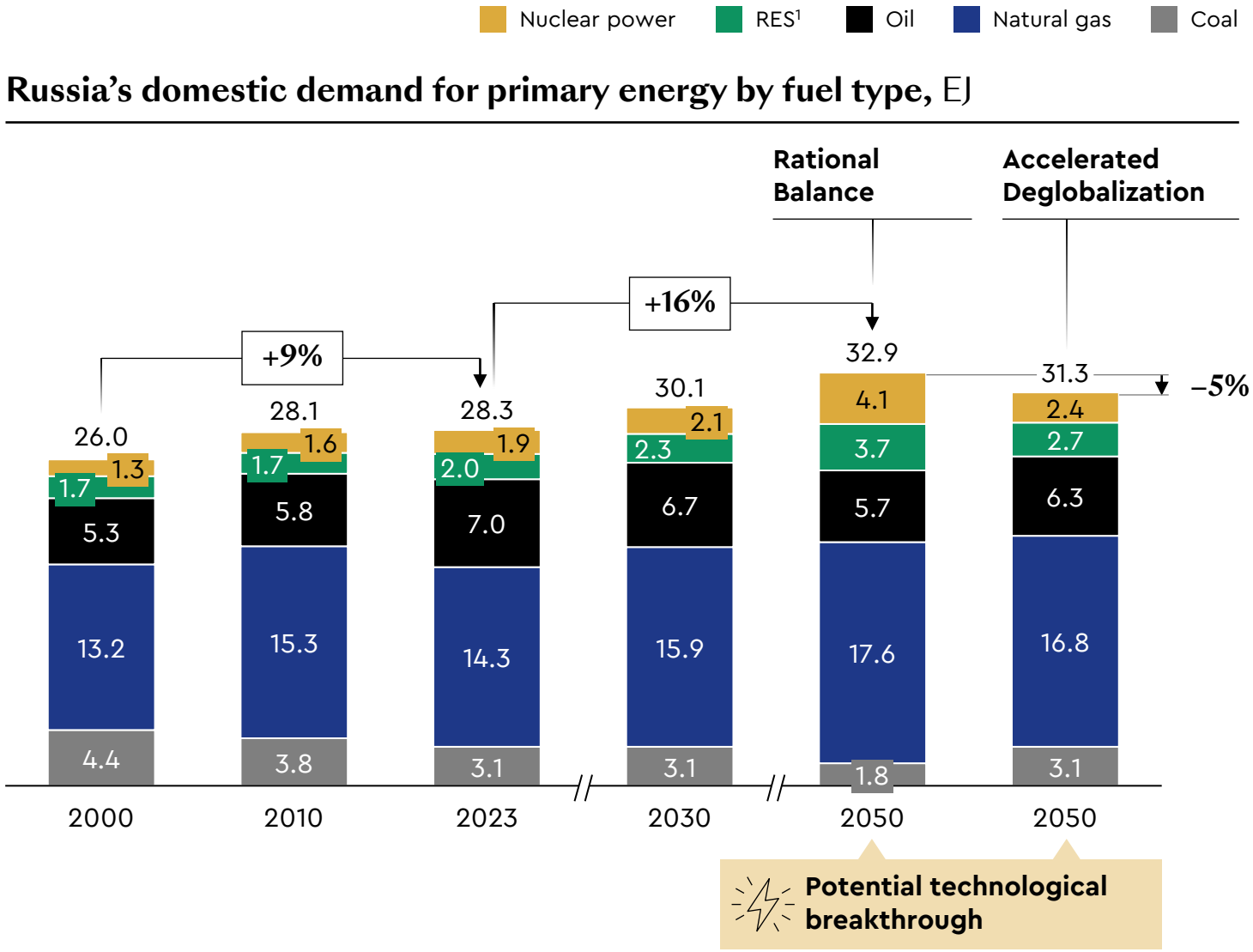
02 Challenges and opportunities for Russia: what does this mean?

03 New strategy planning imperatives: what is to be done?

Russia's fuel mix will be changing inertially in the years up to 2050

Russia's domestic demand for primary energy by fuel type, EJ



1. Including wind, solar, hydroelectric, and geothermal power, biofuels, and hydrogen

Source: Energy Institute; Rosstat; Yakov and Partners analysis

Comments

Russia is replacing its fossil fuels at a markedly **slower pace** than the rest of the world
In the baseline scenario, their share is expected to drop from the current **86%** to **~75%** by 2050, versus a global average of **~55%**

Russia's electricity consumption will be increasing at an annual rate of 2%, compared to 2.2% in the rest of the world

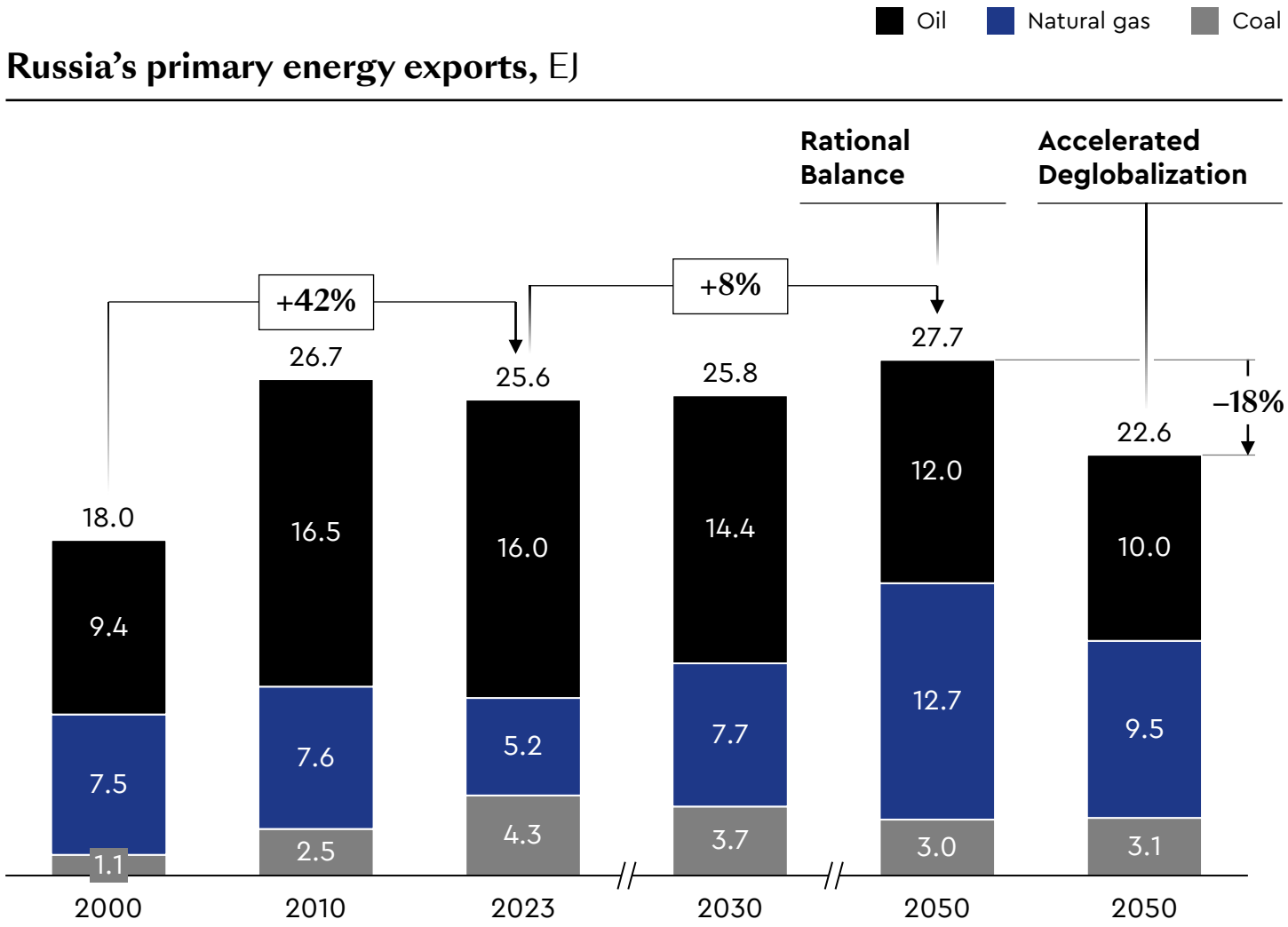
The consumption mix will change **as Siberian thermal power plants switch from coal to natural gas** following the launch of Power of Siberia 2 gas pipeline and **further development of renewable energy alternatives and nuclear power plants**

New technology **development is imperative** for both **clean energy production** and **"greening" of fossil fuels**

The **Accelerated Deglobalization scenario will see domestic consumption shrink** while the **respective shares** of different fuel types will remain practically the same in **the 2050 energy mix**

High-tech development and new project launches must be prioritized if fossil fuel export volumes are to be maintained

Russia's primary energy exports, EJ



1. Large-capacity natural gas liquefaction

Source: Energy Institute; Rosstat; Yakov and Partners analysis

Comments

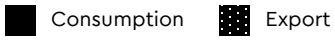
In the Rational Balance scenario, high export volumes can be maintained if oil and gas production returns to the previous level, provided that the ongoing new projects are completed, namely:

- **Power of Siberia gets filled to capacity**, **Power of Siberia 2 goes into operation**
- Proprietary technologies are developed (**LC LNG[1], oilfield services**)
- Russia expands **its own fleet of ice-class vessels**
- **New export destinations are explored and logistical bottlenecks are eliminated** (Eastern Polygon, Northern Sea Route, infrastructure construction in the Arctic and the Far Eastern Federal District)

In the **Accelerated Deglobalization scenario,** exports will decline **18%** due to the lack of **mining technology** and **essential logistics infrastructure**

Mounting geopolitical pressure may impair Russia's energy potential

Situation in Russia's primary energy market by fuel type, including demand and export (EJ)



Rational Balance 2050

Nuclear power

- Launch of new Gen IV NPP units
- Full-scale operation of Gen III+ SNPPs for remote regions kicks off
- The nuclear fuel cycle is closed

RES[1]

- Economically viable renewable energy generating assets – solar and wind farms, small hydro projects – are launched to serve, in particular, the more energy-deficient and remote regions
- Hydrogen is produced in priority development hubs

Oil

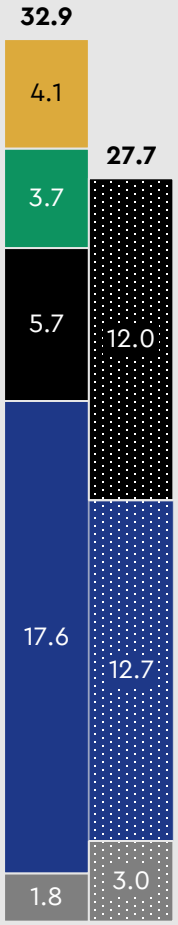
- Russia adapts to export restrictions and insufficient fleet, enters new markets
- Domestic consumption drops in the transportation sector and so does generation after 2030

Natural gas[2]

- Gas infrastructure is extended to more regions
- Domestic manufacturing of combined cycle gas turbines substitutes imports
- Demand rises for chemicals derived from natural gas: fertilizers and synthetic fuels
- Deferred implementation of Arctic LNG 2 and new fields, expansion of the Northern Sea Route

Coal

- Demand declines slowly due to lower efficiency and higher CAPEX requirements at coal-fired power plants compared to gas-fired ones
- Transportation restrictions are lifted (Eastern Polygon)
- Greening technologies begin to be applied to coal



Accelerated Deglobalization 2050

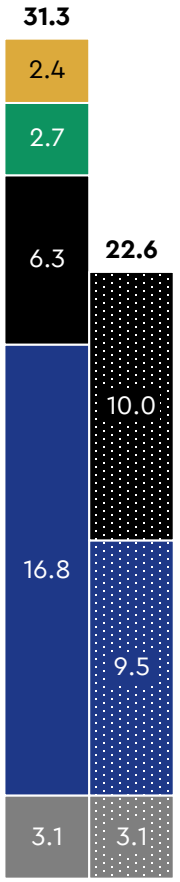
- Launch of new NPP units is delayed
- Reduced demand for electric power translates into reduced investment in nuclear power development
- Gen III+ SNPPs operate at partial capacity

- The previously announced RES projects – solar and wind farms, small hydroelectric plants – are completed and launched, but new projects are deferred on account of new technologies and investments being inaccessible

- Projects are only marginally profitable as key importers of Russian oil impose predatory pricing
- There is no sufficient domestic investment to develop hard-to-reach fields
- Slower consumption decline in the transportation sector

- Domestic manufacturing of combined cycle gas turbines fails
- Coal is not substituted in power generation
- Gas consumption drops in manufacturing
- New major projects in natural gas-based chemical industry are stalled
- The Northern Sea Route never reaches full capacity for lack of demand

- China's and India's energy imports decline, and Russia has to compete with Indonesia
- Cross-border regulations make export look less attractive when commodities are mined using obsolete equipment



1. Including wind, solar, hydroelectric, and geothermal power, biofuels, and hydrogen
2. Including capacities reserved for the production of blue hydrogen with CCUS

Source: Energy Institute; Rosstat; Yakov and Partners analysis

The realistic scenario offers a three-way window of opportunity for Russian companies

01

Securing energy sovereignty and the safe, robust, and efficient use of energy resources today

02

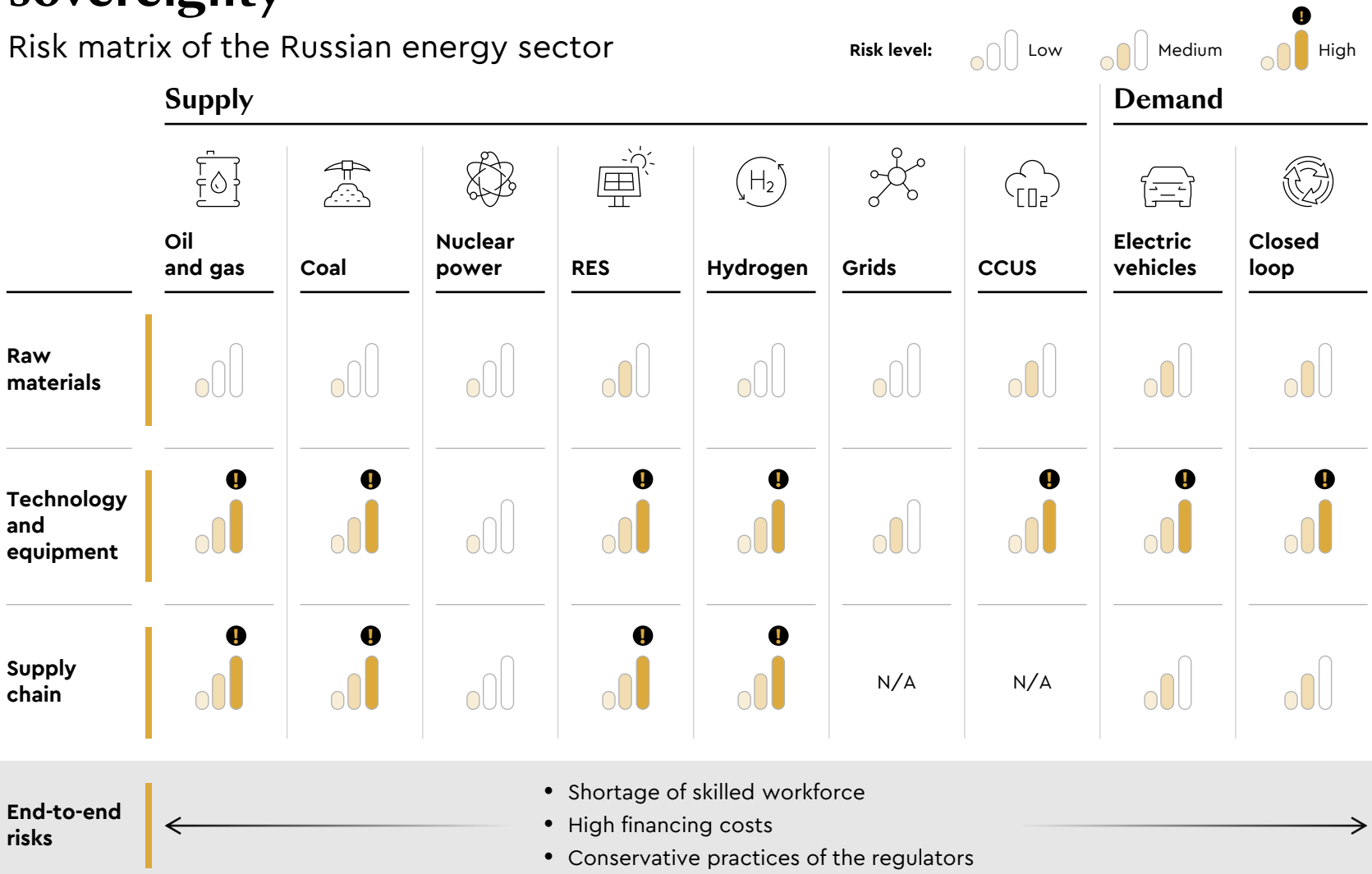
Promoting domestic demand, sustainable land development: securing access to generating assets and grids, revitalization in the Arctic regions and the Far East, accelerating the spread of electric vehicles

03

Development of forward-looking technologies in ecosystem partnerships with other nations in order to secure technological cooperation and economies of scale, stepping up entry into developing economies

1 Technology, equipment, and supply chains are the more vulnerable aspects of the drive toward energy sovereignty

Risk matrix of the Russian energy sector



1. In 2022, the percentage of imports substituted by domestic manufacturing was 60% in oil and gas, and 64% in coal mining

Source: Yakov and Partners analysis

Comments

Despite the sufficient supply of raw materials, there may be a deficit of certain critical inputs (such as lithium or rare earth metals)

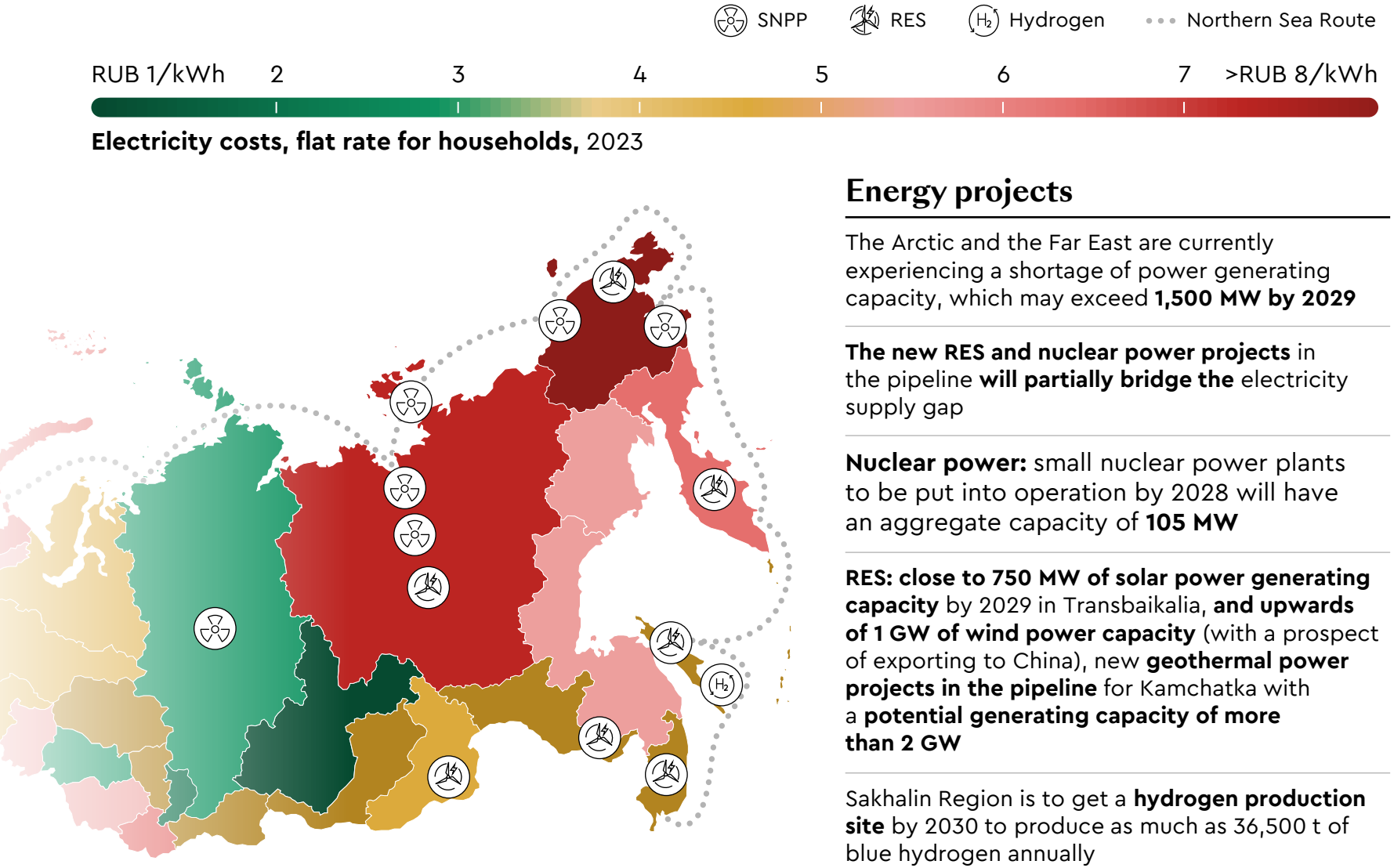
The key risks are associated with access to advanced technology and equipment

To mitigate those risks, **imports of critical equipment have to be substituted by domestic production,**[1] particularly in LNG and thermal power generation

Less-than-reliable supply chains pose a high risk to fossil fuel exports, advancement of clean energy technologies (RES, NPP, hydrogen), and potential surges in demand for them

Debottlenecking options include design **of comprehensive solutions** and **cross-sector collaboration arrangements** in the energy sector for scaling up in the new markets and for other purposes

2 Infrastructure development to fuel domestic demand, particularly in the remote regions



Electricity costs, flat rate for households, 2023

Energy projects

The Arctic and the Far East are currently experiencing a shortage of power generating capacity, which may exceed **1,500 MW by 2029**

The new RES and nuclear power projects in the pipeline **will partially bridge the** electricity supply gap

Nuclear power: small nuclear power plants to be put into operation by 2028 will have an aggregate capacity of **105 MW**

RES: close to 750 MW of solar power generating capacity by 2029 in Transbaikalia, **and upwards of 1 GW of wind power capacity** (with a prospect of exporting to China), new **geothermal power projects in the pipeline** for Kamchatka with a **potential generating capacity of more than 2 GW**

Sakhalin Region is to get a **hydrogen production site** by 2030 to produce as much as 36,500 t of blue hydrogen annually

Source: Rosstat; public sources; Yakov and Partners analysis

Comments

The remote regions are **a testing ground for trying out new technologies** that cannot be competitive in central Russia

Gasification of coastal areas will become a more attractive proposition following the launch of year-round navigation on the **Northern Sea Route**

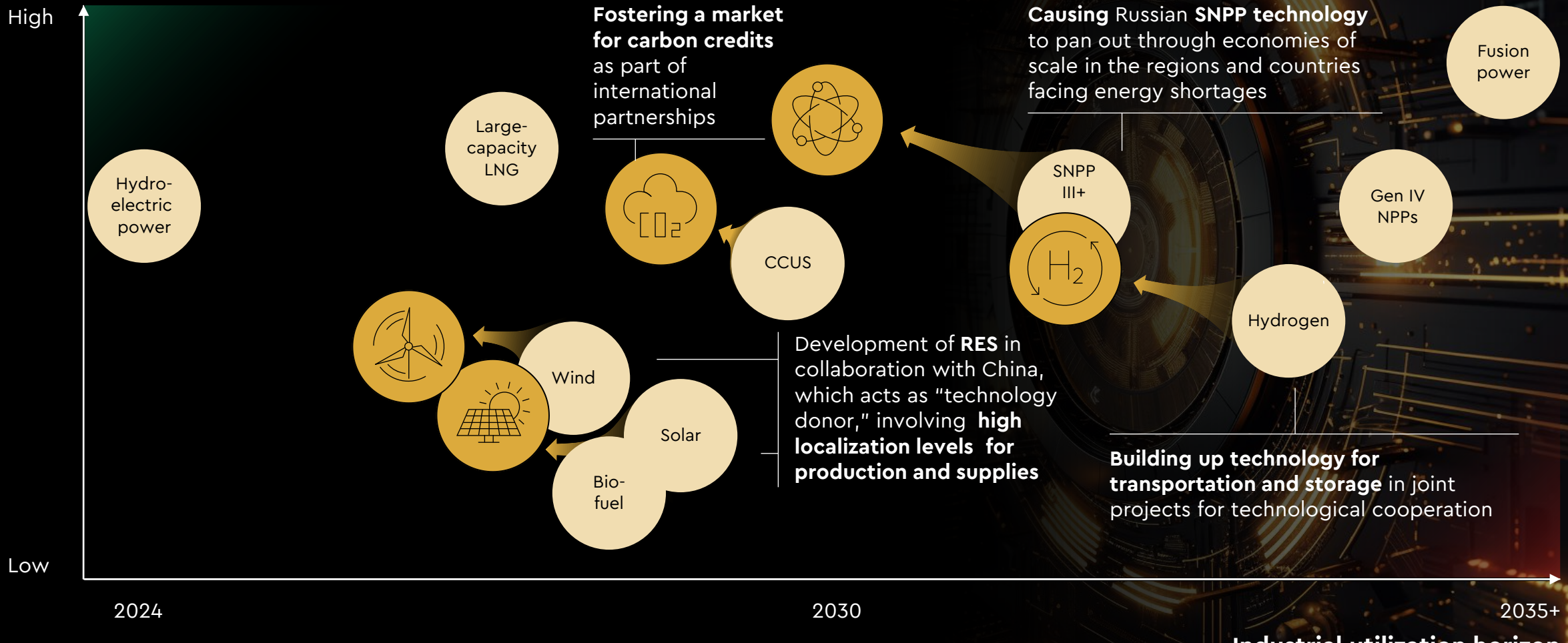
Development **of SNPPs and RES** (where feasible) will help to **eliminate high** fuel shipping costs

Sakhalin has the potential to emerge as an international cooperation hub for clean energy technology on account of its special economic zone status and geographic proximity to Asia-Pacific nations

3

Urgent advancement of new clean energy technologies: achieving a breakthrough by dint of economies of scale, made possible in part by international partnerships

New technology's potential in the energy transition context



Source: public sources; expert interviews; Yakov and Partners analysis

By taking advantage of the new windows of opportunity, Russia will, on top of other benefits, build up the export potential of its energy sector with state-of-the-art technologies and solutions

Workforce training

Design end-to-end retraining and specialist training programs, targeting both Russian and international trainees

Financing

Take advantage of the system for export incentives, risk insurance, and subsidizing of tech-intensive projects

Supplies and raw materials

Localize materials production processes

Secure self-reliance in resources at every process stage

Technology and equipment

Assure the competitiveness of technologies developed in Russia

Build reliable supply chains

Project implementation

Build a mix of sophisticated turn-key energy projects for export

Electric power generation

Put in place portfolio solutions for low-carbon generation, including nuclear power

Managing electric power storage and grid

Develop world-class products for grid flexibility and energy storage with an eye on export opportunities going forward

Customer-side solutions

Commercialize smart digital solutions on the customer side (demand management)

Coordinated action is needed as part of the Russia Incorporated ecosystem

Agenda

01 The energy landscape is changing: what's going on?

02 Challenges and opportunities for Russia: what does this mean?

03 New strategy planning imperatives: what is to be done?

Commercialization of new technology must be accelerated for Russia's energy sector to develop successfully

XX Russia's share of the global energy mix | Russia | Rest of the world

Russia's energy sector in 2050

Domestic consumption

Critical energy equipment is manufactured in Russia

Robust supply chains are in place to underpin stable supply and demand

Domestic demand grows due to new natural gas- and nuclear power generating assets

New RES assets are added where this is economically viable

Export

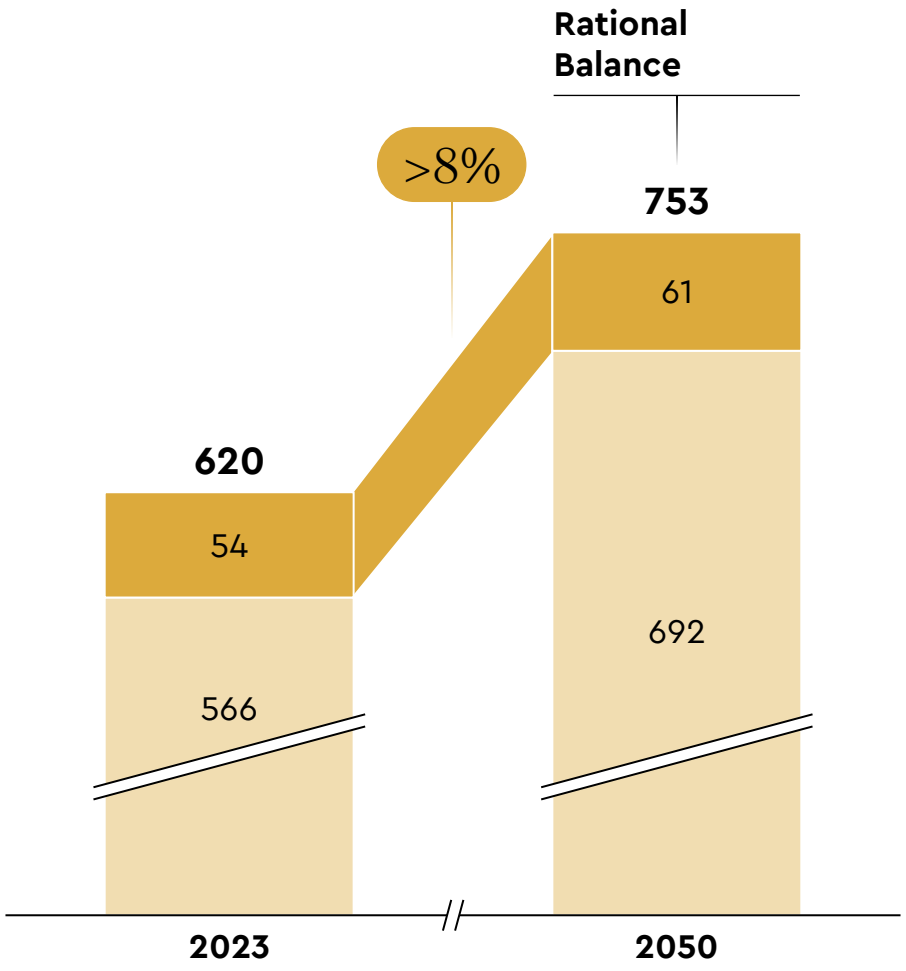
Russia keeps export volumes high while diversifying the fuel mix and adding turn-key offers to its portfolio

Natural gas exports (including LNG) may increase by a factor of 2.4 by 2050, supplanting some of oil's export share

Emphasis is placed on high-tech and low-carbon energy carriers

The export potential is fulfilled for the new generation technologies that were beyond the commercial utilization horizon in 2023

Energy production, EJ



Source: Yakov and Partners analysis

Win-win moves and strategic bets for the Russian energy sector

Win-win moves

Securing sovereignty

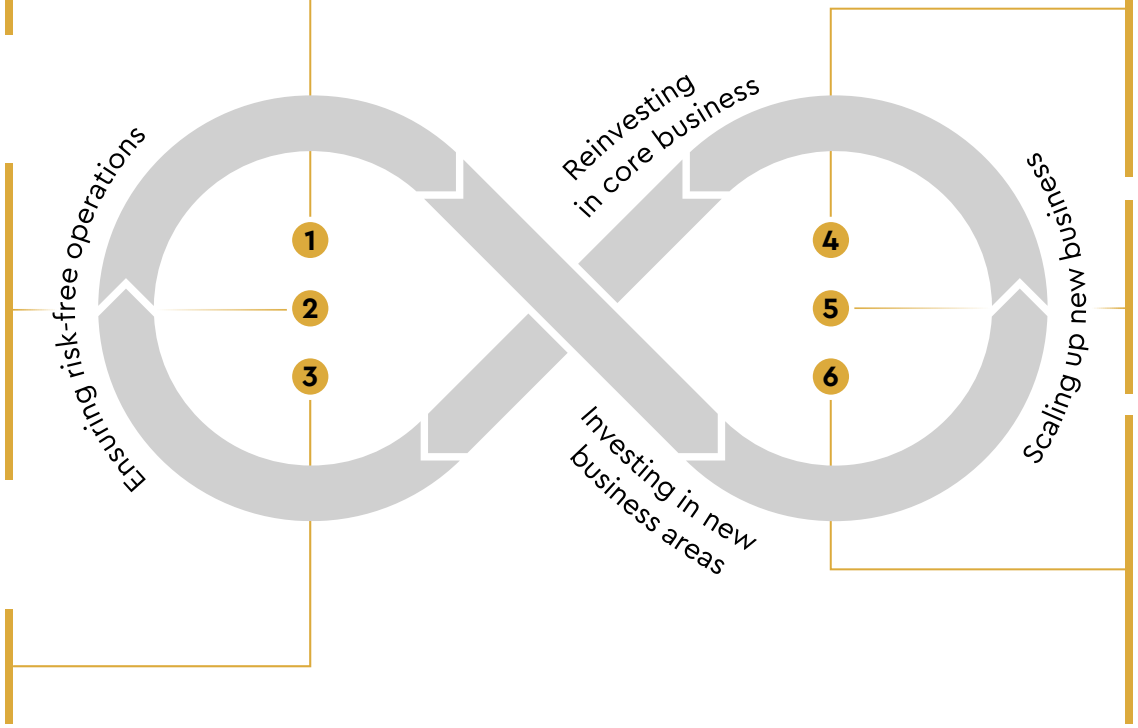
- Access to technology, equipment, and supply chains
- Systemic elimination of end-to-end risks (human resources, financing, etc.)

Raising productivity and OpEx and CapEx efficiency

- Industrial uptake of digital technologies
- Attaining a new efficiency level in operations and MRO
- Perfecting the implementation of CapEx projects
- Securing energy efficiency

Emphasis on customer-centricity

- Coming up with solutions that create value for consumers



Focus on the "beneficial growth cycle"

Strategic bets

Expedited development of new technological solutions

- Investment in technology and new energy transition models: CCUS, hydrogen, electric vehicles, small nuclear power plants, microgrids
- Development of turn-key solutions for the domestic and international markets

Focus on long-term value

- Focus on environmentally friendly, low-carbon solutions
- Commitment to social responsibility principles in executive decision-making

Building the energy ecosystem of the future

- Giving due consideration to uncertainty factors, flexible decision-making
- Expanding the ecosystems, greater cooperation between competitors
- Transformation of the governance model

Five steps toward success for the Russian energy sector

Scenario-based planning

Simulating extreme but possible scenarios for the external environment over a long-term planning horizon, and "pulling" them close to the present day

01

Dynamic decision-making

Maximizing the strategic value of an asset or equity portfolio over a certain time horizon, taking into account the emergence of new technologies and potential management impact

02

Focus on long-term value

Giving priority to investment decisions geared toward creating long-term value for the company, the state, and society, and converting that value to shareholder value

03

Innovative business model development

Actively working toward building up a portfolio of new business opportunities, a shift toward competition at the level of ecosystems, partnerships, and alliances, which may include direct rivals as members

04

Transformation of the governance model

Differentiated approach to the governance model

- Resource concentration to give impetus to cutting-edge competencies for the future
- Development of customer-centric verticals and flexible risk management
- Merciless cost-cutting by means of digitalization or otherwise

05

Insights

If dual-speed management is done right, Russia will be able **to contribute at least 8% to the global energy mix by 2050.** Technology exports will further augment the global share of Russia's energy sector

Key focus areas for Russia include value chain localization in the energy sector to secure **energy sovereignty**, growth **of domestic demand**, **new technology** development**,** and **partnerships**

"Run faster to stay in the marketplace": provided that the existing gaps are filled and ample investment is made in new technology, Russia is able not only to achieve **a 16% increase in primary energy production** but also to **add 8% to its energy exports** by 2050

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The Energy Transition: Challenges and Opportunities for Russia

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