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Global Climatic Threat and Russian Economy:

Searching for **the** Way

May 2020

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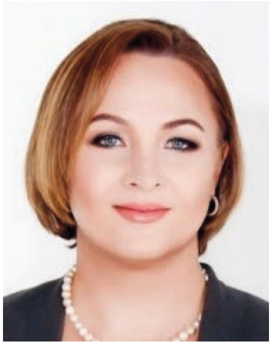

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INTRODUCTION

Offered to your attention is the study drafted mainly in January and February 2020. The COVID crisis and the global oil market collapse happened in March have, on the one hand, shifted the focus of public attention to human life and health protection from the global climate challenges. On the other, they have illustrated the scale and actuality of the ‘global threat’ notion and the ability of the mankind, individual countries or even people to respond adequately. All of a sudden, ‘black swans’ have appeared to be real, and unlikely events occur and create a new environment. The climate threat underestimation risk implies that a whole flock of such ‘black swans’, both humanitarian and economic ones, may be inherent in it. The authors would deem their task fulfilled, if the readers, having familiarized themselves with this study, accept a more conscious approach to this issue, get rid of any myths and try to make a difference.

SUMMARY

The contemporary scientific theory of global climate change has been developing for several decades. The average temperature increase at the Earth's surface (by 0.8°C since the mid-20th century) has proved to be accompanied with deglaciation, rise of the global sea level, water acidification, and warming. The currently observed Earth surface temperature growth is all times high in the last 1,500 years. The identified reason for these processes is a stronger greenhouse effect triggered by human activities (firstly, the fossil fuel use in the energy sector). Climatologists worldwide (in particular, in Russia) have reached consensus on this causal relationship.

Various physical, socio-economic and humanitarian consequences of global climate changes have become obvious. Insurance companies record natural calamities and unfavorable events – floods, hurricanes, heat waves, hail, droughts, and forest fires – steadily growing in number. The overall resulting damages have exceeded USD 5 trillion since the 1980s. Consequences of 5°C warming by the end of the 21st century are regarded as a disaster, both for health and life of the planet population and for the global economy.

Scientific community's concerns about the climate threat are gradually diffusing among politicians, investors, public figures and ordinary people worldwide. As of February 2020, 189 nations acceded to the Paris Agreement intended to maintain the average temperature rise at well below 2°C and to pursue efforts to limit it to 1.5°C, to improve adaptability to the climate change consequences and to shift to low-carbon development. Parties to the Agreement are voluntarily committed to ambitious goals of reducing net atmospheric carbon dioxide emissions. As of September 2019, 65 countries and the European Union declared their plans of carbon neutrality by 2050. Many of them either have launched an emissions trading system or some other form of carbon pricing or tax, or are going to do so in the near future.

Carbon footprint gradually becomes an important feature of products and services. Sales of companies that assume environmental obligations and implement sustainable development programs enjoy higher growth rates than those of their competitors. States plan to adopt customs carbon regulation (the European Union Border Carbon Tax, for instance).

Investors worldwide respond to these actions and sentiments, by curtailing their investments into fossil fuel sectors. Oil and gas and power companies actively restructure their assets to channel them to low-carbon projects and expand investments

into renewable energy, biofuels, carbon dioxide capture, energy efficiency, and hydrogen technologies.

These global trends have fully extended to the Russian Federation. The global climate threat is even more topical for Russia, rather than for many other countries. The climate warming in the Russian territory has been 2.5 faster than the global average, and in the Russian Arctic, 4.5 times faster, in the last 40 years. The climate change in Russia has already threatened human health and life, forced people to migrate, brought risks to food safety and infrastructure.

However, the climate change problem is not among public policy priorities at both federal and regional levels in Russia, while corporate interest in the carbon footprint reduction is gradually increasing, promoted primarily by European shareholders and investors.

At present, the country's climate regulation is in its infancy. The best-case scenario of the draft Russian low-carbon development strategy envisages the 2050 objective to reduce greenhouse gas emissions by 52% on 1990, which is not ambitious compared to flagship countries pursuing climate neutrality (zero net emissions of all greenhouse gases) goals.[1] Moreover, the baseline scenario does not even provide for the roll-out of a carbon dioxide emissions trading system. Meanwhile, Russia has got potential to cut down greenhouse gas emissions to carbon neutrality and even lower, for example, by enhancing energy efficiency, unlocking renewables potential, and improving greenhouse gases absorption on managed lands.

Notwithstanding Russia's goals and performance of Russia's obligations to reduce emissions in its territory, the climate agenda poses a long-term threat to Russians exports of key items, such as oil, refined products, coal, natural gas, metals, wood and chemical industry products. In the absence of special response efforts, this may entail long-term limitations on the Russian economic growth.

Russia's response to the climate threat may depend on the global pace of combating the climate change and on attitudes of the Russian society and the state to this challenge. The main choice seems to be between two extreme scenarios, the Continued Current Policy and the Global Climate Unity.

Both scenarios imply some risks. Continuation of the current policy amplifies the negative impact of climate change. In the long run, this may bring about hardly predictable consequences (for which Russia has no reliable and comprehensive assessment). Limited GDP growth caused by declining demand for Russian

[1] 'Carbon neutrality' stands for zero net emissions of CO_2 whereas 'climate neutrality' extends to emissions of all greenhouse gases.

export items, such as oil, refined products, coal, natural gas, metals, wood and chemical industry products, threatens the national economy. When overlapped, these concurrent risks put a cap on opportunities to adapt to costly climate changes and to recover from natural disasters.

Under the Global Climate Unity scenario, climate change is mitigated by active international measures to mitigate greenhouse gas emissions. In Russia, risks arise from potential loss of current sales markets and reduction in the backbone economic sectors' revenues and tax revenues for the budget. Heat and electricity prices and tariffs are to go up inevitably. On the other hand, an accelerated transition to the low-carbon economic model would diversify the economy and create incentives for innovative developments.

The Continued Current Policy risks prove to be substantially higher and, ultimately, destroy the country's economy. Therefore, for Russia, the second scenario path is deemed to be a more reasonable response to the climatic threat, rather than discussions as to the climate change reasons.

Establishment of a governmental climate monitoring system, relaunch of the energy efficiency program (and other mechanisms to reduce greenhouse gas emissions), development of carbon-free (for instance, hydrogen-based) exports, and improvement of carbon dioxide absorption on managed lands are primary steps that may spur the country moving towards low-carbon future.

Anyway, movement along this way will be slow and painful, should there be no changes in the Russian governmental and social attitudes to the climatic threat. There is not much time left for it, however.

GLOBAL CLIMATIC THREAT: FUNDAMENTALS

The modern scientific theory of global climate changes has been developing for several decades now, and dozens of thousands of scientific articles have been published. In this chapter, the authors try to state the fundamentals of that theory as briefly and simply as possible. For more detailed information on the theory, the authors recommend to refer to the sources listed at page 57.

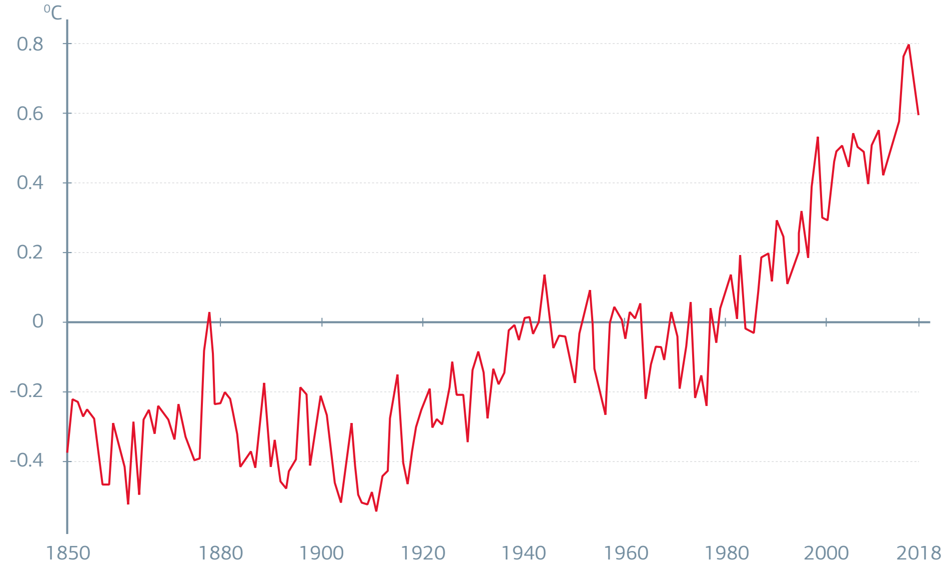
Climate, Temperature and the Greenhouse Effect

Climate means the aggregate of all weather conditions in a given locality for several decades. Climate change is a deviation of climatic parameters from normal values (over a period from three decades[2] to millions of years).

Weather change does not imply climate change – the latter requires steady changes for a number of years. These changes are recorded by tracking one of the main climatic parameters, temperature.

Since the end of the 19th century instrumental measurement has shown an increase in the Earth surface temperature (Fig. 1): it rose by 1.2°C between 1850 and 2019 (in particular, by 0.8°C since the mid-20th century).

Fig. 1 Deviation of the average annual temperature at the Earth surface from the average for 1961 through 1990, by direct measurement, °C



Source: Hadley Centre (HadCRUT4)[3]

As the temperature goes up the total glacier mass[4] decreases and the global sea levels rise (by 3.3 mm annually, according to the satellite altimetry from the early 1990s and according to the

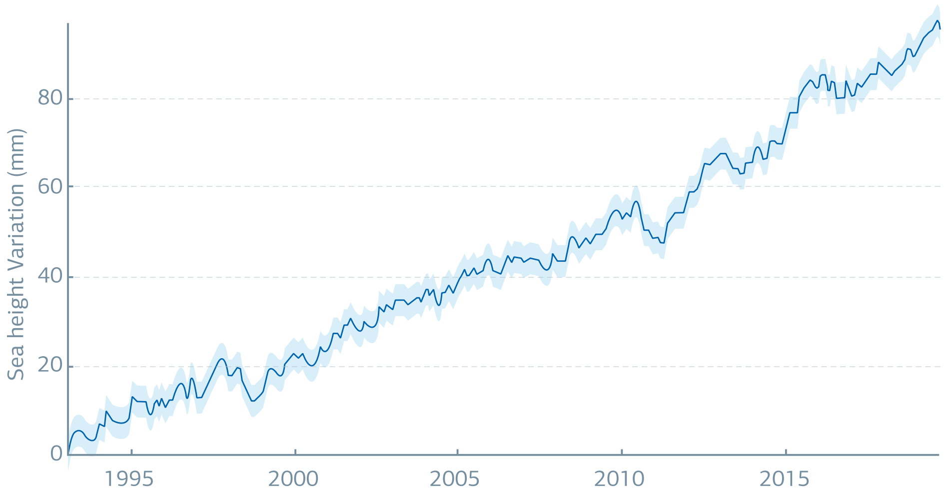
[2] http://www.wmo.int/pages/prog/wcp/wcdmp/GCDS_1.php

[3] https://crudata.uea.ac.uk/cru/data/temperature/

[4] Mass balance measurement of more than 300 mountain glaciers and small ice caps since 1946 (w/o the Antarctic and Greenland) suggests that their thawing has accounted for up to 30% of the increase in the global sea levels in the 20th century. For more details please see: Glacier Mass Balance and Regime: Data of Measurements and Analysis / M. Dyurgerov, Institute of Arctic and Alpine Research. University of Colorado, Boulder, Colorado, USA – 2002.

earlier oceanographic data[5]), while the ocean water gradually acidifies and warms up. Meters register these changes, too. Since 1995, the World Ocean level has risen by 8 cm (Fig. 2). In 2018 alone, the ocean heat content in the uppermost 2,000 meters rose by 25 zettajoules[6], which is 42 times higher than the aggregate global energy consumption from all sources in 2017 (according to the International Energy Agency), and this growth has continued almost incessantly since at least 1950.

Fig. 2 World Ocean level since 1993 according to satellite altimetry, mm



Source: Source: NASA[7]

Thus, the fact that climate in the 20th–21st centuries, as compared to the preindustrial period, has changed is unquestionable. In order to compare the current temperature increase with similar processes in the Earth history, scientists make use of several independent methods that allow to 'reconstruct' the average historical temperature time series rather precisely. Isotope testing of glacier cores is one of these methods.

The methods applied by scientists in different countries yield similar conclusions: temperature has changed many times over Earth's history. These changes have mostly been cyclical over the last 2.6 million years, with the fluctuation periods of 41,000 and 100,000 years, caused by regular changes in the Earth's orbital parameters and the quantity of solar irradiation[8]. For the last 12,000 years (i.e. throughout the human history known to us), the planet temperature has been relatively stable (Fig. 3).

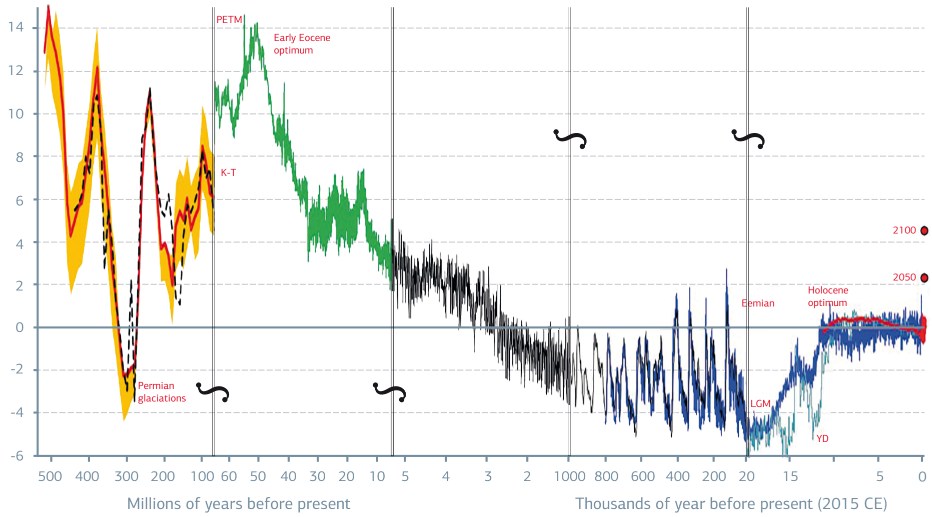
[5] Global and Regional Sea Level Rise Scenarios for the United States / National Ocean Service Center for Operational Oceanographic Products and Services (NOAA). Maryland, USA – January 2017.

[6] Cheng, L., and Coauthors, 2020: Record-setting ocean warmth continued in 2019. Adv. Atmos. Sci., 37(2),137–142

[7] https://climate.nasa.gov/vital-signs/sea-level/

[8] Milankovich cycles: for more details please see https://meteoinfo.ru/about/glossary/4654-2012-02-11-12-46-33

Fig. 3 Estimates of temperature changes at Earth's surface over the last 540 million years as com-pared to the average for 1960-1990.

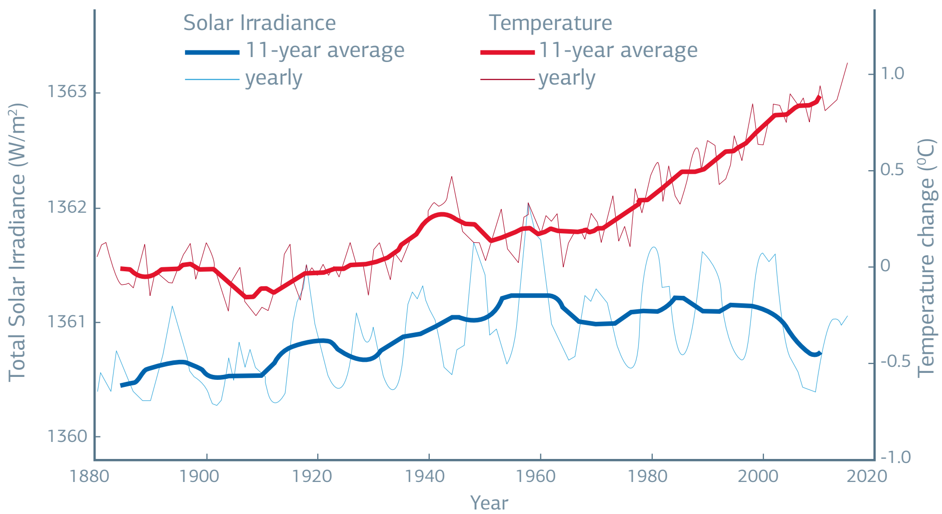


Source: Fergus. Global average temperature estimates for the last 540 My[9]

The current Earth surface temperature increase is the highest over the past 1,500 years[10].

The current period of accelerated temperature growth does not fall within the solar activity peak cycles and cannot be explained by any known astronomic or geological factors[11]. The share of the solar irradiation received by the Earth has not increased, but has rather decreased since the mid-20th century whereas the Earth surface temperature has continued to grow intensively (Fig. 4).

Fig. 4 Changes in Earth's temperature and solar irradiation



Source: NASA, World Radiation Centre[12], Krivova[13]

[9] https://commons.wikimedia.org/wiki/File:All_palaeotemps.png

[10] A Reconstruction of Regional and Global Temperature for the Past 11,300 Years. / Shaun A. Marcott, Jeremy D. Shakun, Peter U. Clark and Alan C. Mix. DOI: 10.1126/science.1228026, Science 339 (6124), 1198-1201. March 2013.

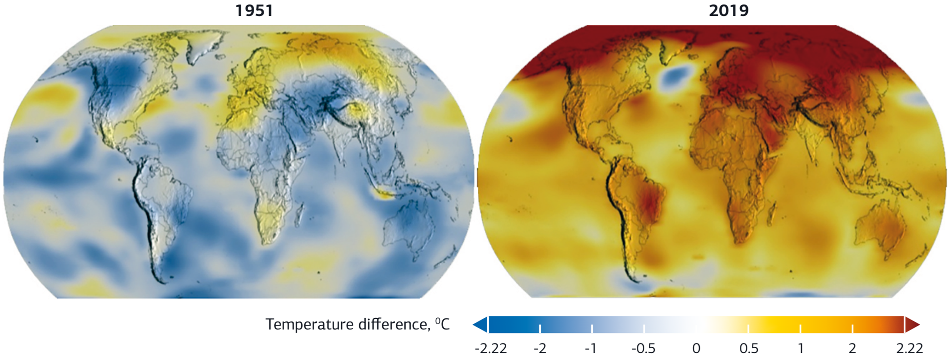
[11] These include the Earth orbit and axial tilt fluctuations.

[12] https://www.pmodwrc.ch/en/institute/pmod-wrc/

[13] Krivova, N. A., S. K. Solanki, T. Wenzler, and B. Podlipnik (2009), Reconstruction of solar UV irradiance since 1974, J. Geophys. Res., 114, D00I04, doi:10.1029/2009JD012375.

The temperature change patterns are different across the globe: since 1979, the land-over temperature has outpaced the temperature over the oceans two-to-one[14]. The Northern Hemisphere heats faster than the Southern one because of different land-to-ocean ratios and the existing oceanic currents (Fig. 5).

Fig. 5 Deviation of temperatures across the Globe from the average temperatures over 1951-1980



Source: NASA[15]

The steady temperature growth testifies that the planet's thermal balance is changing. The established reason for the Earth surface temperature rise (with up to 99.9999%[16] probability) is the strengthening of the atmosphere's greenhouse effect[17], i.e. the reduction in heat emission into the space (via heat radiation) and, consequently, the retention of a greater heat quantity at the Earth surface.

The greenhouse effect was discovered and described in detail in the 19th century. It results in increased temperatures in the lower layers of the planet's atmosphere due to the reradiation of heat by so-called green-house gases, the main ones being: water vapour (H_2O), carbon dioxide (CO_2), methane (CH_4), ozone (O_3) and nitrous oxide (N_2O). As the greenhouse effect contributor, each gas has its own parameters. They also differ by their atmospheric 'lifetimes'[18] and concentration change rates.

If not for the greenhouse effect, the Earth surface temperature would have been –18°C instead of the current +15°C.

Water vapour is the most active contributor to the greenhouse effect (ca. 60%). However, the water steam itself has no 'control' over the Earth's temperature; on the contrary, its concentration depends on this temperature. If the other greenhouse gas concentrations remained unchanged, the water steam quantity in the air would not vary either.

[14] Hartmann, D.L. et al. Observations: Atmosphere and Surface. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the IPCC [Stocker, T.F. et al (eds.)]. Cambridge University Press, UK, NY, USA.

[15] https://climate.nasa.gov/vital-signs/global-temperature/

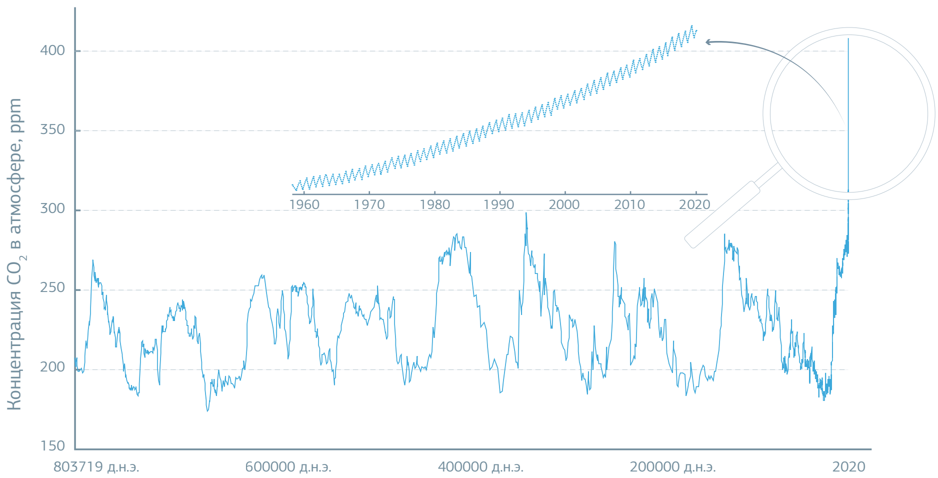
[16] https://www.reuters.com/article/uk-climatechange-temperatures/evidence-for-man-made-global-warming-hits-gold-standard-scientists-idUKKCN1QE1ZW

[17] IPCC Special Report on Global Warming of 1.5°C. https://www.ipcc.ch/sr15/about/foreword/

[18] Lifetime hereinafter means the concentration relaxation time (i.e. the time needed for the concentration disturbance to fade away).

Carbon dioxide, CO_2, is the second most significant greenhouse gas. Its concentration exceeds that of the other gases (except for water vapour) by several orders of magnitude, and its atmospheric lifetime is several centuries (cf: water vapour 'lives' in the atmosphere not longer than 10 days). The carbon dioxide concentration growth leads to higher air density and hygroscopicity, increasing its water vapour content (and thus adding to the greenhouse effect). Carbon dioxide is able to spread in the atmosphere effectively and evenly, hence the greenhouse effect is almost uniform across the planet.[19]

Fig. 6 Atmospheric CO_2 concentration, ppm



Source: Scripps Institution of Oceanography, UC San Diego[20] , NOAA[21]

Atmospheric CO_2 concentration across historic periods can be determined rather precisely by measuring the carbon dioxide concentration in air bubbles inside Greenland and Antarctic ice core. The analysis of obtained data (Fig. 6) suggests that carbon dioxide concentration has averaged at 260 ppm over 800,000 years, ranging from 170 ppm to 300 ppm. Other indirect data indicates that carbon dioxide concentration has also been below 300 ppm for 2.6 million years. Since the mid-20th century, it has grown from 310 ppm to 416 ppm (as of February 2020).

Methane concentration demonstrates a steady growth trend, too. According to GML NOAA[22], it has gone up by approximately 14% (up to 1,875 parts per billion) since 1985. Anthropogenic sources of methane emission (making up for some 60% of total emissions) are agriculture, fossil fuel use (including production, transportation and combustion), landfill sites, and sewage waters, while natural sources are swamp areas, lakes, the ocean,

[19] This is the greenhouse effect's key difference from other air pollutants (e.g. dust, ash, nitrogen or sulfur oxides) whose impact is distinctly local.

[20] https://scrippsco2.ucsd.edu/

[21] Lüthi, D. 2008. High-resolution carbon dioxide concentration record 650,000-800,000 years before present. Nature, Vol. 453, pp. 379-382, 15 May 2008. URL: https://www.ncdc.noaa.gov/paleo-search/study/6091

[22] https://www.esrl.noaa.gov/gmd/ccgg/trends_ch4/

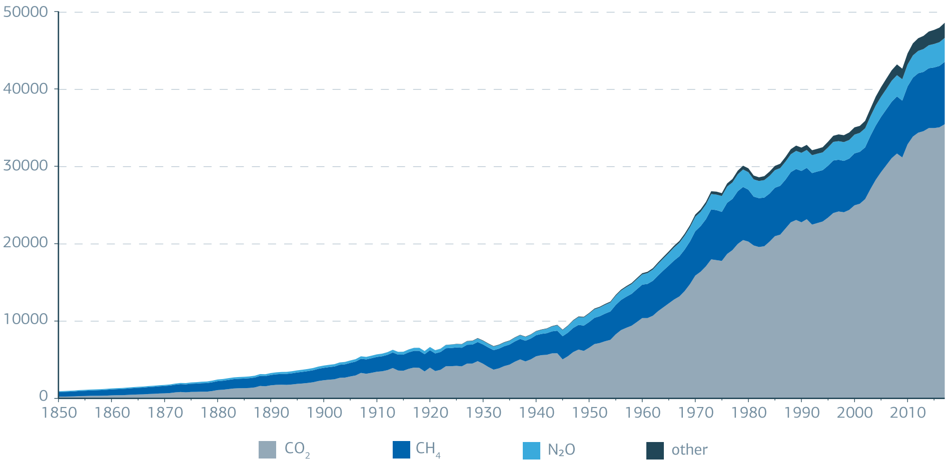
wild animals, termites, natural fires, permafrost, methane hydrates[23] etc. Permafrost methane is present in air bubbles inside the ice and in the form of methane hydrates. Decaying permafrost biomass may also produce methane.

Volcanoes, Swamps or the Anthropogenic Factor?

The growing greenhouse gas concentration enhances the greenhouse effect and changes Earth's heat balance. Reasons for the concentrating greenhouse gases, in particular, carbon dioxide, are divided into natural (volcanic eruptions, forest fires, respiration of living organisms, biomass decay etc.) and anthropogenic (emissions resulting from fossil fuel combustion, cement production, carbon released from wood and reduction in carbon dioxide absorption due to deforestation etc.).

Anthropogenic greenhouse gas emissions have grown 3.4 times since 1950 (Fig. 7), against the background of global economic growth – the world population has almost tripled,[24] while the global economy, energy consumption and natural resource consumption have expanded 18 times,[25] 5 times and 10 times, respectively. The bulk of emissions growth is due to carbon dioxide, methane, and nitrious oxide, especially due to CO_2 emissions by the energy sector which went up by 341%.

Fig. 7 Historic anthropogenic emissions (worldwide) of various greenhouse gases



Source: SKOLKOVO Energy Centre using data from PRIMAP-hist v2.1[26]

[23] Methane hydrates are solid chemical compounds of methane and water, which are stable within certain ranges of low temperature and high pressure only.

[24] Sources: United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019; Historical Estimates of World Population - Census.gov (median estimate)

[25] Sources: Geiger, Tobias; Frieler, Katja (2018): Continuous national Gross Domestic Product (GDP) time series for 195 countries: past observations (1850-2005) harmonized with future projections according the Shared Socio-economic Pathways (2006-2100). V. 2.0. GFZ Data Services. http://doi.org/10.5880/pik.2018.010; World Bank DataBank

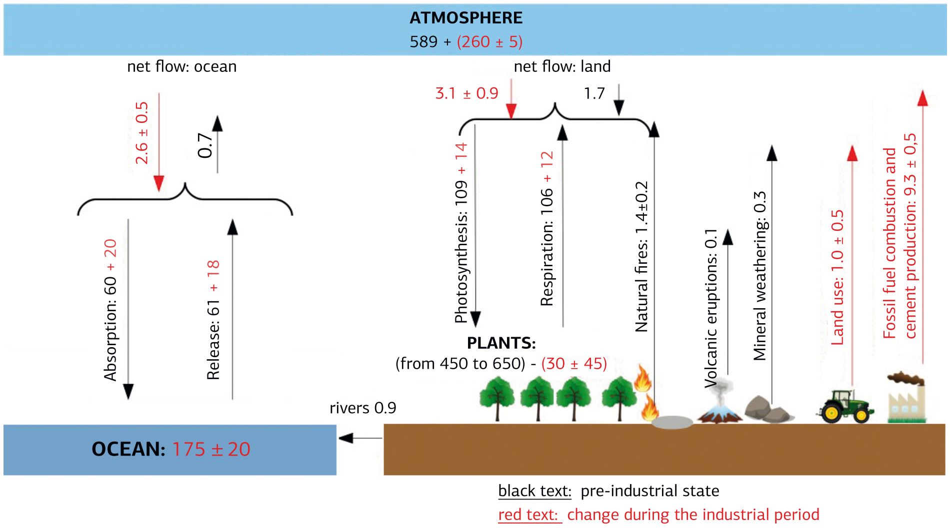
[26] Gütschow, J.; Jeffery, L.; Gieseke, R.; Günther, A. (2019): The PRIMAP-hist national historical emissions time series v2.1 (1850-2017). GFZ Data Services. <https://doi.org/10.5880/pik.2019.018>; scenario prioritizing country-reported data (HISTCR), dataset with extrapolation. Emission volumes were converted into Mt CO_2e using GWP coefficients from IPCC's 4th Assessment Report (AR4, 2007).

Natural carbon dioxide sources are usually in balance with its natural 'absorbers' and sinks – oceans, plants, swamps – within the so-called carbon cycle. Additional human-caused emissions disrupt this balance.

The anthropogenic sources bring about carbon dioxide emissions that account for just over 10% of the CO_2 volumes circulating in the atmosphere (Fig.8). Almost a half of these anthropogenic CO_2 emissions are absorbed by the ocean and land eco-systems, but the other half makes it into the atmosphere, and even this minor 'contribution' is enough for carbon dioxide accumulation.

Volcanic emissions are, on average, equivalent to not more than 1% of all annual anthropogenic emissions and are fully offset by plants and oceans.

Fig. 8 Simplified carbon balance in the atmosphere, billion tonnes per annum



Source: A.V. Eliseev, RAS Institute of Atmospheric Physics[27]

Therefore, the observed global climate change is triggered by the growth in atmospheric carbon dioxide concentration and is determined, above all, by human factors[29]. Climatologists worldwide have reached almost perfect consensus on this subject: numerous reviews completed in recent years, based on dozens of thousands of scientific publications in peer-reviewed journals, shows the scientists' 97%-100% agreement on that statement[30].

All major scientific organizations involved in the respective fundamental studies share this standpoint in Russia. These include:

[27] The global CO_2 cycle: main processes and interactions with climate / A.V. Eliseev, RAS Institute of Atmospheric Physics, Kazan Federal University. // Fundamental and Applied Climatology, No. 4. – 2017.

[28] The global CO_2 cycle: main processes and interactions with climate / A.V. Eliseev, RAS Institute of Atmospheric Physics, Kazan Federal University. // Fundamental and Applied Climatology, No. 4. – 2017.

[29] The Suess effect – increasing air concentration of carbon isotope ^{12}C associated with fossil fuel combustion – also testifies to the carbon dioxide concentration growth caused by the human-caused emissions. For more details see: Köhler, P. (2017): Using the Suess effect on the stable carbon isotope to distinguish the future from the past in radiocarbon , 5th PAGES-OSM Meeting, Zaragoza, Spain, 9 May 2017 - 13 May 2017

[30] Scientists Reach 100% Consensus on Anthropogenic Global Warming / J. Powell. National Physical Science Consortium, Los Angeles, CA, USA // https://doi.org/10.1177/0270467619886266,%20November%202019

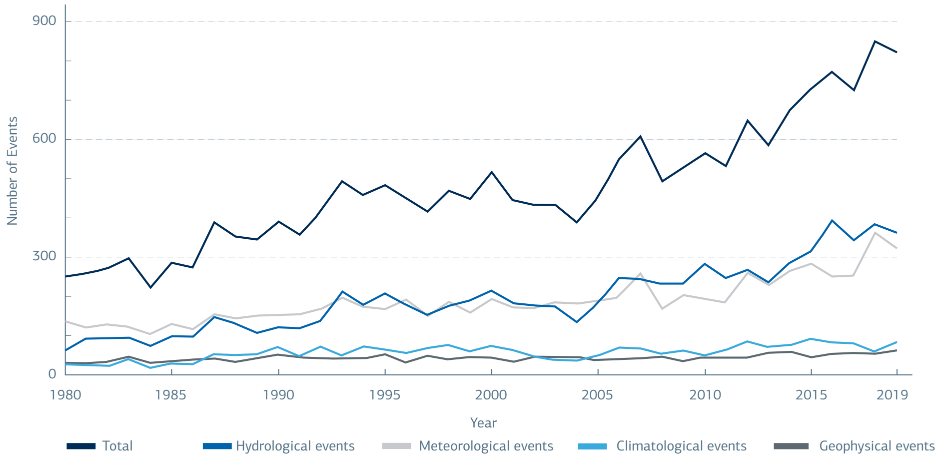
Yu.A. Izrael Institute of Global Climate and Ecology, the Russian Academy of Sciences A.M. Obukhov Institute of Atmospheric Physics, A.I. Voeikov Main Geophysical Observatory, the Arctic and Antarctic Research and Development Institute, RAS Institute of Geography and a number of other organizations.[31]

What Is in the Climate Threat

The global climate change has triggered diverse physical, socio-economic and humanitarian consequences. The World Meteorological Organization regards the following as the key aggravating negative phenomena:

- Floods (35 mln. people affected in 2018);
- The World Ocean acidification and reducing oxygen concentration in the World Ocean (especially in partially enclosed seas, silted estuaries);
- Deaths caused by heatwaves (1,600 people in 2018 in the U.S., Europe and Japan; 70,000 Europeans in 2003);
- Destruction of swamp and peat swamp ecosystems;
- Forced migration (approx. 2 million people fled their houses due to weather catastrophes in 2018); and
- Food safety risks (hunger threatened approx. 821 million people in 2018 because of droughts and hurricanes of the previous years).

Fig. 9 Number of natural calamities and unfavorable events



Source: MunichRe[32]

Insurance companies have recorded an approx. 2.5 times increase in natural calamities and unfavorable events since the early 1980s (Fig. 9), mainly of meteorological and hydrological nature (floods, hurricanes, heat waves, hail, droughts etc.). The resulting total damage since the 1980s has exceeded US$ 5,000 billion,

[31] WMO Statement on the State of the Global Climate in 2018 / World Meteorological Organization. Geneva, 2019.

[32] https://www.munichre.com/en/risks/natural-disasters-losses-are-trending-upwards.html

and this damage has been boosting year by year as the number of events grows.

In January 2020, *Allianz* insurance company published its 9th annual risk rating (Allianz Risk Barometer 2020) based on responses of over 2,700 experts from 100 countries. In that publication, climate risks reached the seventh place for the first time. Companies apprehend both physical losses from climate changes, which involve destruction and devaluation of their assets, supply chains etc., and long-term risks of change in consumer behavior and regulatory environment[33].

Forecasts of further climatic changes give rise to even greater concerns, as carbon dioxide concentration continues to grow, in line with anthropogenic emissions.

For short- and mid-term forecasts of the climate system's future, for assessment of the Earth climate change consequences, scientists make use of multi-parameter climate models. Dozens of specialized laboratories worldwide are engaged in climate simulations. These activities are coordinated by the World Climate Research Program[34] under the auspices of the UN World Meteorological Organization, Russia being a participant.

According to IPCC[35] forecast[36], the average global temperature in the 21st century will go up further under all carbon dioxide concentration change scenarios. The scenarios are called RCP – Reference Concentration Pathway. Four scenarios have been considered: RCP2,6 assumes that carbon dioxide emissions will peak in 2010 to 2020, RCP8,5 envisages that there will be no peak in the 21st century and that the emissions will increase all the time[37]. The probable growth in global temperature (the 2081/2100 level on the 1986/2005 level) will be:

- 0.2°C – 1.8°C under the RCP2,6 scenario;
- 1.0°C – 2.6°C under the RCP4,5 scenario;
- 1.3°C – 3.2°C under the RCP6,0 scenario; and
- 2.6 °C – 4.8°C under the RCP8,5 scenario.

The climate system changes affect socio-economic systems. The McKinsey Global Institute's research[38] in collaboration with the Woods Hole Research Center, dozens of organizations and

[33] https://www.agcs.allianz.com/news-and-insights/news/allianz-risk-barometer-2020.html

[34] https://www.wcrp-climate.org/about-wcrp/wcrp-overview

[35] Intergovernmental Panel on Climate Change. For more details about IPCC please see the International Climate Regulation section.

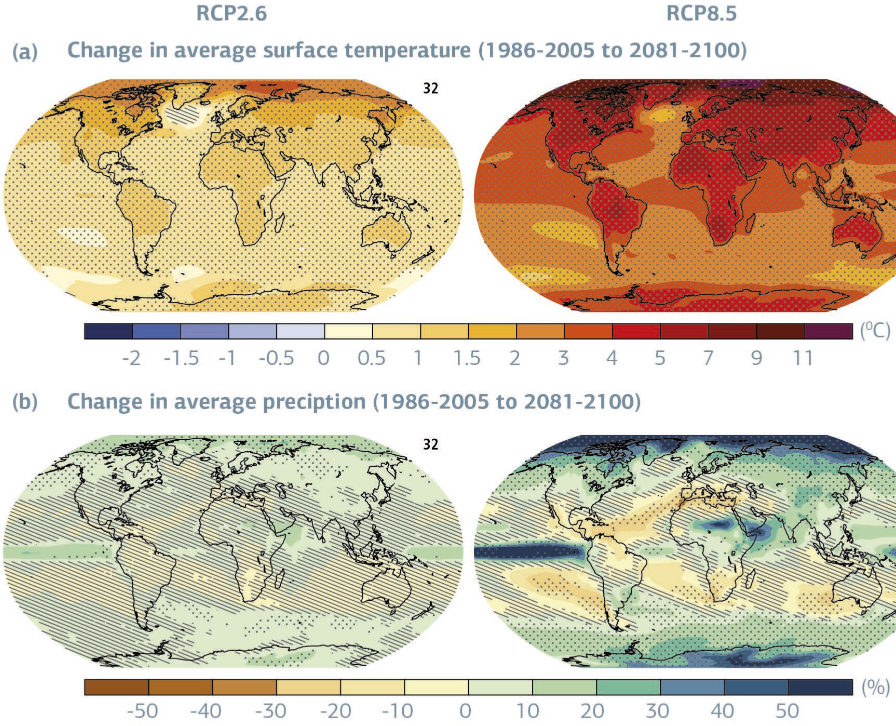
[36] IPCC's Fifth Assessment Report (AR5): Climate Change. https://www.ipcc.ch/report/ar5/syr/

[37] The number following the 'RCP' means the amount of additional heat in W/m^2 the Earth surface will receive because of the greenhouse effect.

[38] Climate risk and response. Physical hazards and socioeconomic impacts / McKinsey Global Institute, January 2020.

a hundred of experts worldwide highlights the following fundamental consequences by 2050 under the RCP8,5 scenario:

Fig. 10 Change in temperature and precipitation in the 21st century under the extreme scenarios, RCP2,6 and RCP8,5



Source: IPCC, the Fifth Assessment Report

- 0.7-1.2 billion people will live in the areas with a 14% probability of lethal heatwaves once a year.
- Crop failure (–15% of the global average) will repeat at least once a decade with 35% probability.
- River flood damages will double, triple or go up fourfold.
- 45% of the Earth's surface will be affected by ecosystem changes.

CRO Forum, an association of insurance companies, regards[39] 5°C warming consequences as catastrophic, namely: 300 times growth in the number of people suffering heatwaves, coastal protection cost upsurge to USD 27.5 trillion, 1.5 times increase in the malaria prevalence area, global GDP impairment and impossibility to insure against most risks (Table 1).

There are two related dimensions of response to the climatic threat:

- Adaptation to climate change.
- Mitigation of climate change through stabilization of greenhouse gas concentrations and reduction of emissions, as well as through climate engineering.

[39] The heat is on. Insurability and Resilience in a Changing Climate. Emerging Risk Initiative - Position Paper / Group Chief Risk Officer (CRO), January 2019.

Table 1 Global climate change's physical and economic consequences by 2100

Warming by 2100	1.5 °C	2 °C	3 °C	5 °C
Physical impacts				
Sea-Level Rise, м	0.3 - 0.6	0.4 - 0.8	0.4 - 0.9	0.5 - 1.7
Coastal assets to defend ($tn)	10.2	11.7	14.6	27.5
Chance of ice-free Arctic summer	1 out of 30	1 out of 6	4 out of 6 (63%)	6 out of 6 (100%)
Tropical cyclones:				
Fewer (#cat 1-5)	-1%	-6%	-16%	Unknown
Stronger (# cat 4-5)	+24%	+16%	+28%	+55%
Wetter (total rain)	+6%	+12%	+18%	+35%
Frequency of extreme rainfall	+17%	+36%	+70%	+150%
Increase in wildfire extent	x1.4	x1.6	x2.0	x2.6
People facing extreme heatwaves	x22	x27	x80	x300
Land area hospitable to malaria	+12%	+18%	+29%	+46%
Economic impacts				
Global GDP impact (2018: $80tn)	-10%	-13%	-28%	-45%
Stranded assets	Transition: fossil fuel assets (supply, power, transport, industry)		Mixed: some ossil fuel assets mothballed, some physical stranding	Physical: uninhabitable zones, agriculture, waterintense industry, lost tourism etc
Food supply	Changing diets, some yield loss in tropics		24% yield loss	60% yield loss, 60% demand increase
Insurance opportunities	New low-carbon assets and infrastructure investment (e.g. CCS)		Increasing demand to manage growing risks	Minimal: recession, tensions, high and unpredictable risks

Source: CROForum

Adaptation stands for the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.[40]

Unlike adaptation, mitigation implies a proactive, rather than a reactive, approach. Anthropogenic GHG emissions can be reduced through, *inter alia*:

- Reduced energy consumption (e.g., via energy efficiency enhancement);

[40] IPCC, 2014: Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, pp. 117-130.

- Use of energy with a smaller carbon footprint (coal and oil have the greatest footprint; natural gas, an intermediate one; electricity generated by solar, wind, bio-, nuclear and hydro power plants as well as the 'green' and 'blue' hydrogen, biomethane and related synthetic fuels, the minimum footprint); and
- Carbon capture, utilisation, and storage (CCUS).

Each of these methods will require enormous implementation costs. The extent of these costs and the selection of an adequate strategy in each country, matched with an assessment of potential climate damage, are the subject of separate scientific macroeconomic studies and public discussions.

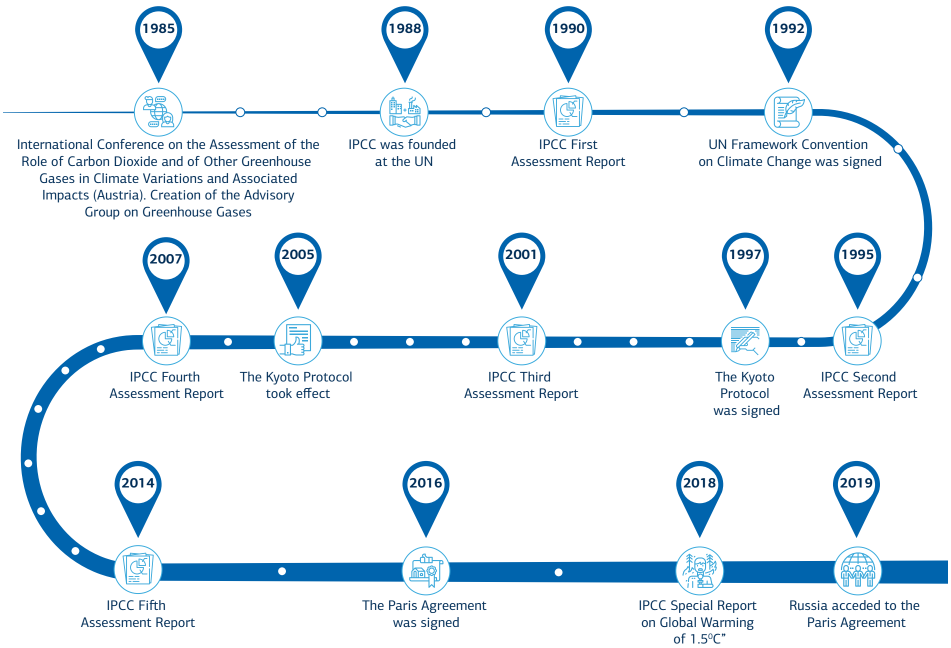
RESPONSE TO GLOBAL CHALLENGE: STATES, BUSINESSES, CONSUMERS

Scientific community's concerns about the climate threat are gradually diffusing among politicians, investors, public figures and ordinary people worldwide. This Section summarizes the principal ways in which these stakeholders' respond to the climate threat.

International Climatic Regulation

At the inter-governmental level, the climate change problem came into focus in the mid-1980s: the United Nations Environment Programme and the World Meteorological Organization established the Advisory Group on Greenhouse Gases that served as a prototype for a higher-level Intergovernmental Panel on Climate Change (IPCC) at the UN (Fig. 11)

Fig. 11 Key events in developing international climate regulation



Source: Moscow School of Management SKOLKOVO

IPCC is an inter-governmental agency headquartered in Geneva that was jointly created by the United Nations Environment Programme (UN Environment) and the UN World Meteorological Organization (WMO) in 1988 and comprises 195 member states (including Russia). It is designed to regularly assess the scientific basis for the analysis of climate change, its consequences, and of future risks as well as adaptation and mitigation options. IPCC itself is not involved in scientific research. Its role is rather to inform politicians and policy makers of the summarized consensus information from scientific (abstracted) and other publications, in the form of routine Assessment Reports (each supplementing and specifying the previous one's findings). The source list of the Fifth Assessment Report includes several thousands of publications. Managed by the IPCC office (with

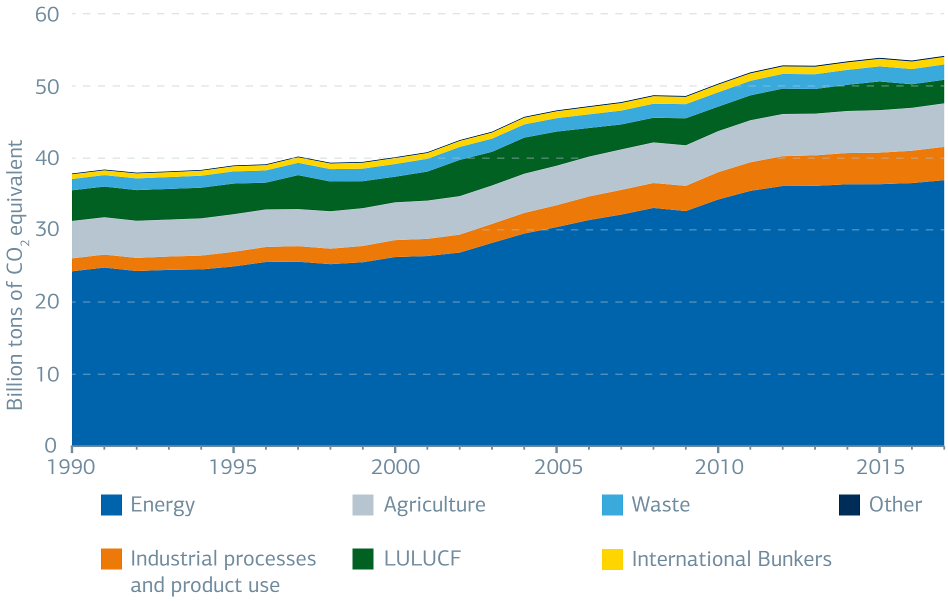
Russian representatives), this work is carried out by thousands of scientists from all over the world (including Russia), mostly on a voluntary basis[41]. References to the publicly accessible Russian summaries of main IPCC reports are provided in the recommended source list.

In 1992, the UN Framework Convention on Climate Change (hereinafter, UNFCCC) was adopted. It is intended to 'stabiliz[e the] greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'[42].

Any further international treaties (the Kyoto Protocol, the Paris Agreement) are concluded under this Convention.

The global anthropogenic greenhouse gas emissions have been on the rise during the period under review (Fig. 12), the strongest growth being registered in the first decade of the 21st century (ca. 25% increment over the 10 years). The power industry, with fossil fuel combustion in different economic sectors and methane leakages in fossil fuel mining, transportation and distribution, remains the main source of emissions.

Fig. 12 Global man-made greenhouse gas emissions, by industries



Source: SKOLKOVO Energy Centre, based on data from PRIMAP-hist v2.1 and UN FAO[43]

The Kyoto Protocol became the first international treaty to limit the anthropogenic greenhouse gas emissions. It proceeded from the principle of common but differentiated responsibility of developed and developing nations for reducing the emissions (through joint use of appropriate mechanisms and tools). The

[41] For more details on the IPCC work please see the Federal Service for Hydrometeorology and Environmental Monitoring website at: http://www.meteorf.ru/activity/international/mgeik and IPCC website, https://www.ipcc.ch/about

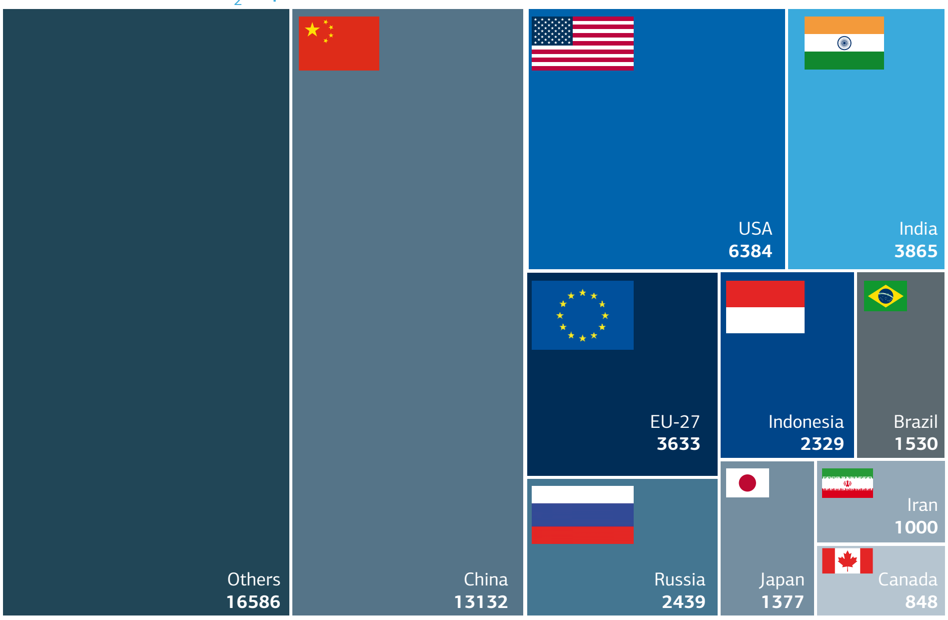
[42] https://unfccc.int/resource/docs/convkp/conveng.pdf

[43] http://www.fao.org/faostat/en/#data/

Agreement introduced limitations on emissions in developed nations, but not in developing ones. Since the Kyoto Protocol's signature date, developing nations (primarily, China) began emitting more greenhouse gases than some of the developed ones, and the schemes embedded in the Protocol were not efficient enough. In 2015, the Paris Agreement was adopted, building upon the experience of governmental interaction under the Kyoto Protocol.

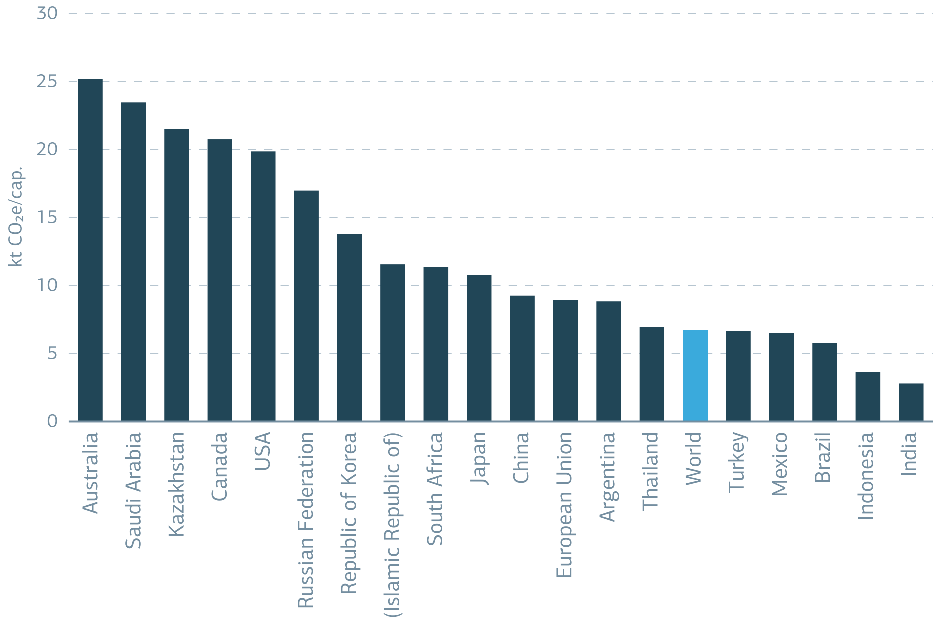
In 2017, China and the U.S. became the biggest anthropogenic greenhouse gas emitters worldwide (including the emissions from land use, land use changes and forestry, hereinafter LULUCF). China, the U.S., India, the European Union, Indonesia, Russia, Brazil, Japan, Canada and Iran accounted for 63.6% of global emissions in 2017 (Fig. 13) and for 60.4% of emissions in 1990–2017. The distribution of per capita GHG emissions among the world's top absolute emitters is illustrated in fig. 14.

Fig. 13 Greenhouse gas emission mix, by countries, in 2017, including LULUCF, in million tons of CO_2 equivalent



Source: SKOLKOVO Energy Centre, based on data from PRIMAP-hist v2.1 and UN FAO

Fig. 14 GHG emissions per capita in 2017 (top-20 absolute emitters)



Source: SKOLKOVO Energy Centre, based on data from PRIMAP-hist v2.1 and UN FAO

The Paris Agreement aims[44] to achieve three equally important goals, namely:

- Keep the average temperature increase well below 2°C, and if possible, not more than 1.5°C as compared to the pre-industrial period;
- Improve adaptability to adverse climate change consequences, foster climate resilience and low-carbon development in a manner that does not threaten food production; and
- Redirect financial flows so as to support transition to low carbon development.

The parties to the Agreement undertake:

- To reach the global peaking of greenhouse gas emissions as soon as possible and then to achieve the global climate neutrality rapidly (i.e. the anthropogenic greenhouse gas emission and absorption parity), by 2050;
- to develop, submit and comply with the Nationally Determined Contributions (NDC);
- to ensure drawing-up and submission of low carbon development strategies to the UNFCCC Secretariat by 2020;
- to submit and update periodically their adaptation plans;
- to actively cooperate on enhancing adaptation action, exchanging technologies, know-hows and lessons learnt; and

[44] A simplified summary of the Paris Agreement is given here. For a detailed study of the text in the original (English) and in the Russian translation please see the UNFCCC website at: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.

- to provide developing country Parties with the financial assistance necessary for achieving climate targets.

As part of the Paris Agreement, developed nations continue to stand as an example and establish targets for absolute (rather than relative) emission reduction for their entire economies.

As of February 2020, the Paris Agreement was signed by all the UNFCCC participants and ratified by 189 states, of which the U.S. are pending withdrawal from the Agreement . Turkey and Iran are the only countries with significant greenhouse gas emissions that have not yet acceded to the Agreement.[45]

NDCs in a whole number of countries (as of the Agreement date in 2015) limit emissions by 25%–40% by 2030 on 1990 or on 2005 (Table 2).

Longer-term low-carbon development strategies (up to 2050) contain even more ambitious goals. Late in 2019, the EU Green Deal initiative was introduced in the European Union. It envisages 100% climate neutrality of the European Union by 2050, both as a whole and on a national level (except Poland so far).[46] The UK, New Zealand, Norway, Argentina, Canada, and Mexico have individually stated similar goals.[47] In total, as of September 2019, 65 countries, the EU as well as 10 regions, 102 cities, 93 businesses, and 12 investors had announced their commitment to carbon neutrality by 2050, according to the UN.[48] Yet another example is Japan which has taken on the obligation to become a "decarbonized society" as early as possible in the second half of this century.[49]

Some regions, cities and municipalities within countries declare their intention to control climate changes rather actively, implement this intention at their regulatory levels and set goals to reduce greenhouse gas emissions. In the USA, these are members of the above-mentioned US Climate Alliance. Another initiative is the Under2Coalition whose members, primarily cities and regional governments, have signed the organisation's Memorandum of Understanding and have thus committed, on a local level, to "keeping global temperature

[45] The resolution to withdraw from the Paris Agreement was adopted by President Trump's Administration. Even though this resolution was implemented, 25 individual states that account for almost half of the country's GDP and of its population, consolidated in the US Climate Alliance, an association in opposition to the U.S. President (as of March 2020).

[46] Sources: §1 of the Conclusions of the meeting of EU Heads of States and Governments, 12 December 2019 / URL: https://www.consilium.europa.eu/media/41768/12-euco-final-conclusions-en.pdf; EU carbon neutrality: Leaders agree 2050 target without Poland – BBC News (December 13, 2019) / URL: https://www.bbc.com/news/world-europe-50778001.

[47]https://www.bbc.com/news/world-europe-50778001. 2 Source: COP 25. Climate Ambition Alliance, Annex II (December 11, 2019) / URL: https://cop25.mma.gob.cl/wp-content/uploads/2020/02/Annex-Alliance-ENGLISH.pdf

[48] https://www.un.org/sustainabledevelopment/blog/2019/09/in-the-face-of-worsening-climate-crisis-un-summit-delivers-new-pathways-and-practical-actions-to-shift-global-response-into-higher-gear/

[49]Source: Japan's Long-term Strategy under the Paris Agreement / URL: https://unfccc.int/sites/default/files/resource/The%20Long-term%20Strategy%20under%20the%20Paris%20Agreement.pdf

rises to well below 2°C with efforts to reach 1.5°C", i.e. essentially the key climate goal of the Paris Agreement.

Table 2 Examples of Nationally Determined Contributions (NDCs) stated in 2015

Countries	Nationally Determined Contributions
China	**By 2030**, to reduce GDP energy intensity by 60 to 65% on 2005, to increase non-fossil fuel energy share in the primary energy consumption by ~20%, to expand forest resources by 4.5 bn m^3 on 2005, and to have peaked on CO_2 emissions (as soon as possible).
USA	**By 2025**, to reduce GHG emissions (incl. LULUCF) by 26 to 28% on 2005.
India	**By 2030**, to reduce carbon intensity of GDP by 33 to 35% on 2005, to reach 40% share of installed carbon-free power generation capacity; and to ensure additional CO_2 absorption of 2,5–3 billion tons.
EU	**By 2030**, to reduce GHG emissions by 40% minimum on 1990.[50]
Russia (intended NDC)	**By 2030**, to reduce GHG emissions by 25 to 30% on 1990, subject to the maximum possible account of absorbing capacity of forests.
Indonesia	**By 2030**, to reduce GHG emissions (incl. LULUCF) by 29% as compared to the business-as-usual scenario (i.e. to ~2.881 billion tons of CO_2 equivalent); and by 41%, in case of international support.
Brazil	**By 2025**, to reduce GHG emissions (including LULUCF) by 37% on 2005; indicative contribution by 2030 is a 43% reduction.
Japan	**By 2030**, to reduce GHG emissions (incl. LULUCF) by 26% on 2013 (by 25.4% on 2005).
Iran (intended NDC)	**By 2030**, to reduce GHG emissions by 4% as compared to the business-as-usual scenario;[51] and by 12%, in case of international support.
Canada	**By 2030**, to reduce GHG emissions by 30% on 2005 (including forest harvesting; inclusion of LULUCF is under consideration).
Mexico	**By 2030**, to reduce GHG emissions by 22%, and black carbon emissions, by 51%, as compared to the business-as-usual scenario; and by 36% and 70%, respectively, in case of international support.
Saudi Arabia	To take steps to improve energy efficiency, to develop gas and RES generation, CCUS[52] technologies (the plan is to capture 1,500 tons of carbon a day), to reduce methane leakage, as well as a number of other efforts that may entail 'annual mitigation co-benefits estimated to be up to 130 mln. tons of CO_2eq by 2030'.
South Korea	**By 2030**, to reduce GHG emissions by 37% as compared to the business-as-usual scenario (i.e. to 850.6 mln tons of CO_2 equivalent), excl. LULUCF; decision to include LULUCF may be made later.
Australia	**By 2030**, to reduce GHG emissions (incl. LULUCF) by 26 to 28% on 2005.
Norway	**By 2030**, to reduce GHG emissions (excl. LULUCF) by 50 to 55% on 1990.

Source: UNFCCC NDC registry (interim)[53], INDC submission portal[54]

[50] According to NDC wordings, a policy on how to account for LULUCF was to be adopted 'as soon as technical conditions allow and in any case before 2020'. At present, there is no additional information in this regard in the NDC database on the UNFCCC website. However, in May 2018, the EU adopted a regulation, whereby annual net GHG emissions in LULUCF of every member state should be kept below zero through action in the sector (the so-called 'no debit' rule). **For more information please see:** https://ec.europa.eu/clima/policies/forests/lulucf_en

[51] No quantitative data on the scenario was provided; also, the scenario was meant to be updated 'in the future years' based on the performance of national development plans, availability of technology transfer and international financing.

[52] Carbon Capture and Utilization/Storage

[53] NDC registry (interim) / UNFCCC website. URL: https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx (date of access: March 30, 2020)

[54] Submission portal. INDC / UNFCCC website. URL: https://www4.unfccc.int/sites/submissions/INDC/Submission%20Pages/submissions.aspx (date of access: March 30, 2020)

There are currently 118 government signees to the memorandum from all over the world as well as over a hundred more so-called endorsers who have expressed their support less formally, including 22 national governments (mostly European and Central or South American).[55] The largest of such coalitions, however, is the Global Covenant of Mayors for Climate & Energy, uniting over 10,000 cities and local governments in 138 countries. Their mission is to “accelerate ambitious, measurable climate and energy initiatives that lead to a low-emission and climate-resilient future.”[56]

Presently, UK has no official NDC due to Brexit; its contribution is under development. According to Kwasi Kwarteng, Minister for Business, Energy and Clean Growth,[57] it will be based, inter alia, on the Fifth Carbon Budget of the United Kingdom for 2028/2032, whereby current GHG emissions are to be reduced by 61% on the 1990 level. Adoption of an NDC is planned for 2020.[58]

Economic incentives for reducing greenhouse gas emissions such as carbon taxes or emissions trading systems are efficient tools to put the goals into action. According to the World Bank[59], by 2019, 46 countries, including Australia, South Africa, Brazil, Argentina, China, Turkey, Ukraine, and Kazakhstan, as well as 28 subnational jurisdictions (in particular, some U.S. states) either have launched a CO_2 emissions trading system or some other forms of carbon pricing or tax, or are going to do so in the near future. The European Union Emissions Trading System (EU ETS) was the first large GHG emissions trading scheme in the world, and remains the biggest.

An emissions trading system is not the only useful means of climate action, though. For example, the EU, over the past decade, has adopted a vast set of regulations aimed at various aspects of sustainability and energy efficiency. An overview of those is provided in Table 3.

[55] https://www.under2coalition.org/

[56] https://www.globalcovenantofmayors.org/

[57] https://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2020-02-05/12811/

[58] https://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2020-01-15/3726

[59] World Bank. State and Trends of Carbon Pricing 2019. June 2019. DOI: 10.1596/978-1-4648-1435-8.

Table 3 An overview of some of the legislative acts regarding energy efficiency and renewable energy sources

Regulation/Directive	Description
Energy Efficiency Directive[60]	Requires a Union-wide reduction in primary and final energy consumption by 20% in 2020 and by 32.5% in 2030 as compared to the respective projections made in 2007; no binding national targets are thus set on national levels, however Member States are required to draw up integrated 10-year national energy & climate plans (NECPs) outlining how they intend to meet the energy efficiency and other targets for 2030.
Energy Labelling Regulation[61]	Introduced a user-friendly energy efficiency labelling (the A-G scale) for a range of consumer and commercial appliances, which producers are obliged to apply for; the scale is being gradually adjusted, tightening the requirements for higher rates.
Ecodesign Directive[62]	Sets minimum requirements of energy efficiency, reparability, and recyclability that apply to all energy-related products sold in the domestic, commercial and industrial sectors, except transport. Is a complement to the Energy Labelling Regulation.
Renewable Energy Sources Directive[63]	Sets a binding target of at least 20% share of RES in the EU's total final energy consumption and at least 10% share of RES in each Member State's transport energy consumption by 2020, as well as at least 32% of energy from renewable sources in the Union's gross final consumption of energy by 2030.
Renewable Energy Sources Directive[64]	Requires that EU countries establish strong long-term renovation strategies aimed at decarbonisation of buildings; that they set cost-optimal minimum energy performance requirements for all newly commissioned buildings; that all new buildings must be nearly zero-energy buildings (NZEB)[65] from 31 December 2020, and all new public buildings, since 31 December 2018; as well as introduces a range of other measures. Is complemented by the Energy Efficiency Directive.

Source: EU legislature

However, global success in decarbonization will crucially depend on the energy policy of major emitters such as China, India, or Indonesia.

[60] Directive 2012/27/EU of the EU Parliament and of the Council of 25 October 2012 on energy efficiency; see also https://ec.europa.eu/energy/topics/energy-efficiency/targets-directive-and-rules/energy-efficiency-directive_en

[61] fficiency-directive_en. 2 Regulation (EU) 2017/1369 of the EU Parliament and of the Council of 4 July 2017 setting a framework for energy labelling; see also https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign/about_en#Energylabels

[62] Directive 2009/125/EC of the EU Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products; see also https://ec.europa.eu/growth/industry/sustainability/ecodesign_en.

[63] Directive 2009/28/EC of the EU Parliament and of the Council of 23 April 2009 and Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from RES; see also https://ec.europa.eu/energy/topics/renewable-energy/renewable-energy-directive/overview_en.

[64] Directive 2010/31/EU of the EU Parliament and of the Council of 19 May 2010 on the energy performance of buildings; see also https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en.

[65] While national definitions of an NZEB differ (see https://epbd-ca.eu/wp-content/uploads/2019/06/CT1-Factsheet-National_applications_of_NZEB_definition.pdf for a review), such buildings must have a very high energy performance, require a very low amount of energy, and be covered to a very significant extent by energy from renewable sources

Physical consequences of climate change for island countries close to the equator are hardly comparable to those for, e.g., Russia or Canada. The developing nations that lead in the total antropogenic GHG emissions nowadays would like to share this responsibility on practice with the developed nations that used to lead in the past (and have therefore contributed notably to the current GHG concentration). There is also the carbon leakage effect whereby greenhouse gas emissions just ‘leak’ from countries with tough climate regulation into those where the regulation is laxer.

So, the overall climate policy performance will be determined by the Paris Agreement participants’ ability to compromise and agree upon uniform and efficient methods of its implementation. According to a UNEP estimate[66] published in November 2019, in order to limit the temperature increase to 1.5°C, the Paris Agreement participants will have to assume and implement 5 times more ambitious emission reduction obligations than those undertaken in 2015–2016.

Consumer Behavior

Not only intentions of governments, city and municipal authorities change – so do the sentiments and behavior of rank-and-file people and of consumers vary, too.

The carbon footprint is increasingly becoming an important feature of a product or service. A similar change in consumer preferences has already resulted from campaigns to support and promote energy efficient technologies. For instance, a now global energy efficiency standard for consumer goods, the Energy Starbrand, is one of the parameters consumers consider in making their choice. They are also willing to pay more for a similar product or service offered by responsible brands[67].

In 2015, sales of consumer goods manufactured by companies with a demonstrated commitment to sustainability grew 4 times as quick[68] as those of their competitors. According to the survey by Nielsen, 66% of consumers declared they were ready to pay more for sustainable brands, and that share expanded steadily over several years. Among the millennial generation, consumers with such values account for as high as 72%.

As the demand for environmentally friendly products and services increases, investors and consumers require greater transparency. To avoid ‘greenwashing’[69], buyers and investors

[66] Emissions Gap Report 2019 / UN Environment Programme, November 2019.

[67] https://www.bsr.org/en/our-insights/blog-view/investors-consumers-markets-demand-climate-action-four-trends-for-business

[68] The sustainability imperative. New insights on consumer expectations / Nielsen, October 2015.

[69] A form of ecological marketing that makes extensive use of ‘green’ PR and methods intended to mislead the consumer as to a company’s or a manufacturer’s goals to make products or service environment-friendly, to show them favorably. The green camouflage is used by dubious manufacturers to create the image of environmentally focused company and to increase sales.

focus on standardized disclosure formats, such as Climate-Related Financial Disclosures (TCFD). For instance, in 2019 over 525 investors holding assets worth of $96 trillion requested companies to disclose their climate-related, water safety and forest use actions under CDP (the Climate Disclosure Project). 8,400+ companies responded to that call, and their share thus increased by 20% y-o-y[70].

In some European retail markets, consumers can indicate their preferences as to renewables or change their electricity supplier. Development of 'green' gas and electricity certificate systems, as well as carbon and environmental footprint certificates for products and services facilitates market development in the power and related sectors.

Energy consumers get the opportunity to take part in climate change mitigation by reducing their consumption or using 'cleaner' energy sources including their own ones, e.g. roof solar panels or fuel cell-powered home energy centres. Eco-friendliness, environmental burden reduction, climate protection are becoming strong demand-side incentives to develop public transportation and bicycles, e-vehicles, to substitute gas- or diesel-powered residential heating for electric heating and to apply renewables-based micro-generation[71].

The non-energy corporate sector is promoting objectives of emissions reduction, too. Some of these efforts are institutionalized: for instance, 226 of the largest global companies[72], (among which were IKEA, 3M, Apple, Danone, Decathlon, eBay, Coca-Cola European Partners, Fujitsu, The Goldman Sachs Group, and Google), undertook to shift to renewable energy sources as part of the RE100 Global Initiative. According to the NAZCA Global Climate Action portal data[73], 3,740 companies and 1,334 organizations have assumed similar obligations worldwide.

'Green' Political Movements

Change in consumer preferences affect citizens' political choice.

In Western Europe, the change of sentiment is obvious: 'green' movements are becoming increasingly popular, and their competitors start making recourse to 'green' rhetoric to win electoral support (Fig. 15).

Besides European countries, record-breaking support of 'green' movements is observed in Canada, Australia, and New Zealand. 'Green' movements are represented in parliaments of 25 countries.

[70] The Sustainability Yearbook 2020 / S&P Global, January 2020.

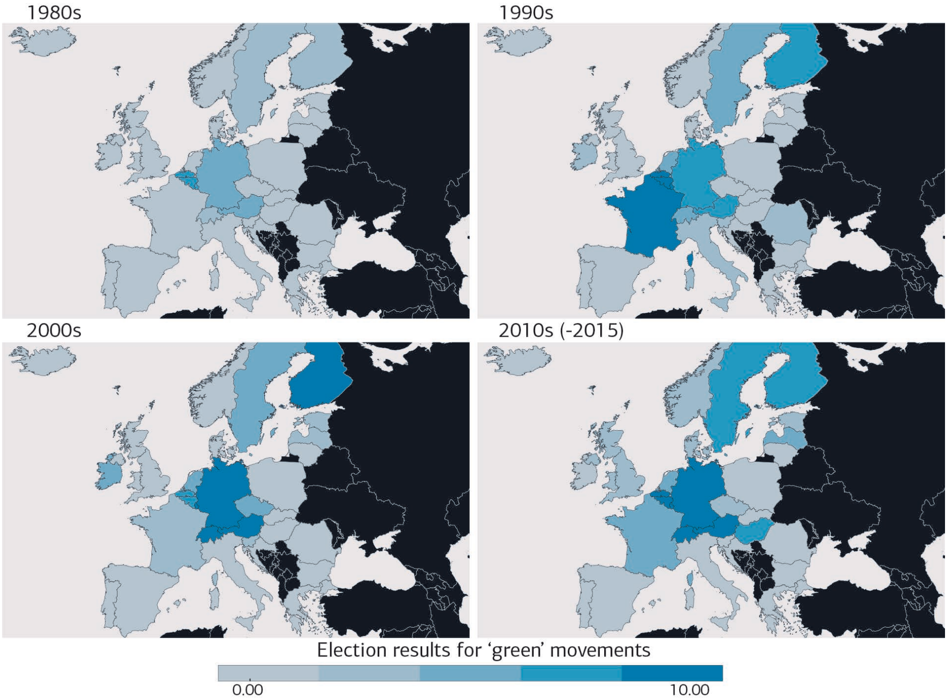
[71] Global and Russian Energy Outlook 2019 / ed. A.A. Makarov, T.A. Mitrova, V.A. Kulagin; ERI RAS – Moscow School of Management SKOLKOVO – Moscow, 2019. – 210 p.

[72] As of 02.03.2020, http://there100.org/companies

[73] As of 02.03.2020, https://climateaction.unfccc.int/

Based on the quantitative analysis[74] of 347 parliamentary elections in 32 countries for 45 years, political scientists explain this success by sentiments of the new generation of electors (the millennials as well as a part of the new middle class) who have grown up in a relatively flourishing society with low unemployment and who create the demand for the life quality, rather than for the economic growth at all costs.

Fig. 15 Change in support to 'green' movements in Europe over the last 40 years



Source: Grant, Tiley, 2019

Climate activists such as Greta Thunberg are part of that generation and are on the same wavelength with it. This is, perhaps, the reason for such wide approval of the activists among the millennials in Western Europe, USA and Canada (strikes and rallies gathered several hundred thousand people in 2019) and the ground for critical debates in other countries (including Russia).

Investors' Preferences

States and regulatory authorities set up the framework and high-level goals for low-carbon development. Consumers change their behavior and demand; the electorate shapes the demand for politicians of the future who will combat climate issues more actively. Investors respond to all three factors: angel, venture, institutional and public investors regard the climate agenda (climate action and policies) as an important factor for investment decision-making and account for it in their strategies.

[74] Zack P. Grant & James Tilley (2019) Fertile soil: explaining variation in the success of Green parties, West European Politics, 42:3, 495-516, DOI: 10.1080/01402382.2018.1521673

Larry Fink, CEO at BlackRock, one of the world's top investment companies, considers climate risks as investment risks in his public letter[75] dated January 2020 (Climate Risk Is Investment Risk). He also called on investors and companies to get ready for significant changes in investments, including by participation in partnerships and collaborations such as the Climate Finance Partnership[76], the Task Force on Climate-related Financial Disclosures (TCFD), or the UN's Principles for Responsible Investment.

Major institutional investors such as the World Bank, the European Investment Bank (EIB), the Swedish Pension Fund Sjunde, the Norwegian Government Pension Fund Global, as well as leading commercial banks such as Goldman Sachs, Deutsche Bank, BNP Paribas, Societe Generale have announced their intentions to withdraw from or stop financing projects related to fossil fuel sector (the so-called 'divestments'). The EIB in particular, declared the EU's "climate bank", has taken an even stronger stance and has promised to dedicate half of its funding capacity to environmental and climate projects by 2025.[77]

Sustainability (focusing on UN Sustainable Development Goals[78] and on the balance between economic welfare and environmental, climate, and social objectives) is an important criterion for investors in their financial decision making, and they need an opportunity to easily assess projects against this criterion. Project initiators, in their turn, benefit from more opportunities to attract investments. In order to facilitate private investment and to support both the project investors and the project initiators, nations develop respective mechanisms.

To illustrate, attaining climate neutrality in the EU by 2050 requires about €175-290 bn in additional Union-wide climate investments annually.[79] Thus the EU Green Deal, besides setting up public financing of €1 trillion over the next 10 years[80], envisages also several initiatives, a taxonomy being the most significant one. The EU taxonomy is a unified European classification system of sustainable investment projects. In order to qualify, a project must meet at least one out of six objectives related to sustainability, namely: climate change mitigation, climate change adaptation, sustainable water and marine resources use, cyclical economy, pollution prevention, and healthy ecosystem. In addition to the taxonomy, the following are under development:

[75] https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter

[76] https://europeanclimate.org/news/governments-and-philanthropies-announce-ground-breaking-partnership-with-blackrock-to-mobilize-and-deploy-climate-finance-at-scale/

[77] https://www.eib.org/en/about/priorities/climate-and-environment/climate-action/index.htm

[78] https://www.un.org/sustainabledevelopment/ru/sustainable-development-goals/

[79] Financing Sustainable Growth Factsheet / European Commission, 2019

[80] https://ec.europa.eu/info/publications/200114-european-green-deal-investment-plan_en

- EU Green Bond Standard,[81]
- methodologies for EU climate benchmarks and disclosures for benchmarks,[82] and
- guidance to improve corporate disclosure of climate-related information.[83]

Higher risks of investments into carbon assets affect the insurance industry: major insurance companies gradually curtail insurance programs for new coal assets; others – like the global insurer *Allianz,* for instance – announce insurance cancellation for new projects and gradual withdrawal from the existing ones by 2040. The risk of investment loss associated with the transformation of climate risks into financial ones, recently labelled as 'stranded assets risks', becomes critical for investors making decisions in the power industry.

According to the calculations by *gofossilfree.org*[84], a total of 1,184 institutional investors and over 58,000 private investors worldwide, with aggregate assets under control exceeding $14.09 trillion, had acceded the so-called Divestment Commitments by the beginning of 2020.

Against this background, the predictable governmental support, together with the availability of climate or 'green' bonds[85] and the comparably short payback period, shape the low risk profile and improve the investment appeal of renewable energy projects. In 2019, green bonds and green lending totaled to US$257.7 billion, having doubled y-o-y. According to the Bloomberg New Energy Finance[86] forecast of 2019, 77% out of US$13.3 billion total investments into new generating facilities in the power industry up to 2050 will be aimed at renewables.

However, according to KPMG[87] estimates, so far the return on renewable energy projects is similar to that on refining and some exploration projects and is still below that on oil and gas production projects.

Many large Western businesspeople take public actions in regard to the climate threat. For instance, in 2015, on the sidelines of the Paris Climate Conference, Bill Gates, Mark Zuckerberg, Jeff Bezos, Jack Ma and 25 other billionaires announced[88] the establishment

81 https://ec.europa.eu/info/publications/sustainable-finance-teg-green-bond-standard_en

82 https://ec.europa.eu/info/publications/sustainable-finance-teg-climate-benchmarks-and-disclosures_en

83 https://ec.europa.eu/info/publications/sustainable-finance-teg-climate-benchmarks-and-disclosures_en

84 https://gofossilfree.org/divestment/commitments/

85 2019 Green Bond Market Summary / The Climate Bonds Initiative. February 2020.

86 https://about.bnef.com/new-energy-outlook/

87 Renewable Energy Sources as a New Development Step for Oil and Gas Companies /KPMG Strategy and Operations Group. December 2019.

88 Source: https://www.independent.co.uk/news/people/paris-climate-change-talks-bill-gates-mark-zuckerberg-and-27-other-billionaires-launch-breakthrough-a6753981.html

of Breakthrough Energy Coalition tasked with investments into climatically neutral energy solutions. The Breakthrough Energy Ventures (BEV) foundation established by the coalition holds over US$1 billion.[89] In May 2019, BEV, jointly with the European Commission and the European Investment Bank, created the BEV-E foundation holding EUR 100 million[90]. In February 2020, Bezos announced his own project, Bezos Earth Fund, in his Instagram[91]. He was going to invest US$10 billion 'to start'. The launch of grant allocation was planned for summer 2020. In February 2020, spouses Bill and Melinda Gates, the Gates Foundation founders, paid special attention to[92] the climate change and gender equality in their annual letter, devoting a separate chapter to each issue. Noting the significance of mitigation efforts, Bill Gates focused on adaptation to the new climate, such as development of more sustainable agricultural species and healthcare improvement in developing nations.

Business Model Transformation in Energy Companies

The conventional energy companies responsible for the bulk of greenhouse gas emissions follow market and regulatory signals and set greenhouse gas reduction (decarbonization) objectives.

Energy companies' decarbonization efforts lie in scaling up investments in renewables, biofuels and carbon capturing, enhancing energy efficiency, increasing the share of 'green' projects in corporate portfolios, tougher monitoring of methane emissions. For instance, BP[93] and Vattenfall have announced their plans to reach carbon neutrality by 2050; EDF in the CAP-2030 strategy designated doubling of renewable energy capacity and more active operations in the global markets of 'carbon-free' generation; ENGIE declared its coal generation exit strategy and its low-carbon energy priority.

Oil and gas businesses show particular interest in two sectors: electricity generation projects and low-carbon technologies. Equinor strengthens its leadership in the offshore wind power industry; Shell and BP develop their biofuel business; Repsol, Total and ENI focus on the solar power industry.

Against this background, some large oil and gas businesses have got down to selling some of their oil and gas assets. Based on the qualitative corporate performance analysis conducted by the HSE[94] Institute of Energy[95], the Japanese Idemitsu was the

[89] Source: https://www.b-t.energy/faq/

[90] Source: https://ec.europa.eu/commission/presscorner/detail/en/IP_19_2770

[91] Source: https://www.instagram.com/p/B8rWKFnnQ5c/

[92] Source: https://www.gatesnotes.com/2020-Annual-Letter

[93] https://www.bp.com/en/global/corporate/news-and-insights/press-releases/bernard-looney-announces-new-ambition-for-bp.html

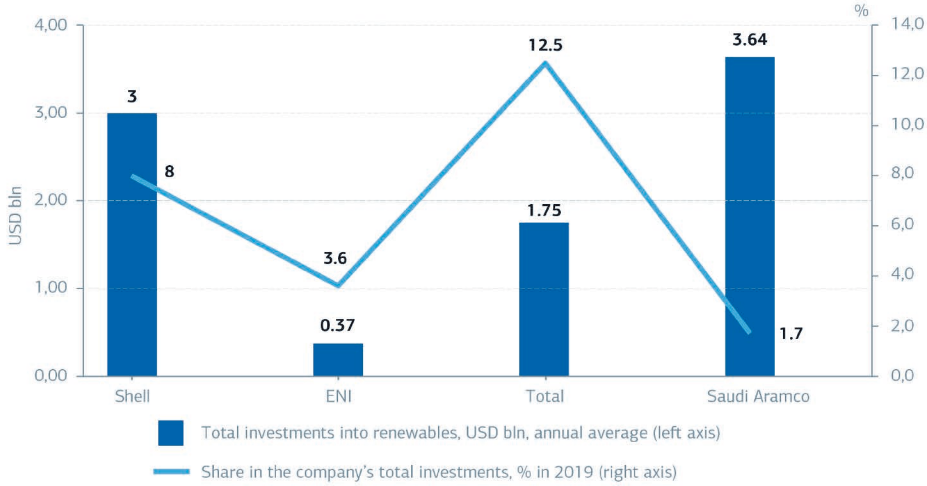
[94] National Research University Higher School of Economics

[95] G.V. Ermolenko: Analysis of Leading Oil and Gas Companies' Activity in Renewable Energy Industry.// Analytical reviews of the HSE Institute of Energy. – October 2017 – 57 pages.

only one out of Top 16 global oil and gas companies, which did not start selling its oil and gas assets by 2016. However, the asset sale itself does not lead to actual industry-wide decarbonization as it only changes the asset owner.

As part of its Energy Transition corporate strategy, Shell reported its plans to change its energy portfolio in the long-term[96] and to get transformed into the power company. Total is moving in the same direction, investing into renewables with a focus on subsequent operation of the power stations.

Fig. 16 Renewables investments in oil and gas companies' long-term strategies (up to 2025/2030)



Source: Moscow School of Management SKOLKOVO, based on KPMG data

Shell, Total, ENI, Equinor and BP actively invest into renewables, hydrogen and related projects: the latter accounted for, on average, 3% to 5% of these companies' total 2018 investments. Meanwhile, according to IEA, oil and gas companies channel just approx. 1% of their total costs towards these ends, primarily towards solar and wind power projects[97].

European energy companies not only switch their corporate strategies to carbon-free solutions and assets but also change their business structure.

For instance, in 2016 the E.ON corporation unbundled its business into a spin-off company Uniper managing thermal power plants and international energy trade, and a core entity focused on renewables, power grids, and new consumer services. In 2008, all renewables-related Enel assets were separated[98] as Enel Green Power, and its innovative business models became part of Enel X. Shell, Total, and ENI created separate business units to manage renewables and low-carbon power projects and investments.

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[96] Shell Energy Transition Report / Royal Dutch Shell plc. April 2018.

[97] The Oil and Gas Industry in Energy Transitions / International Energy Agency, 2020.

[98] https://www.enelgreenpower.com/about-us/a/2017/10/the-company

'Oil to energy' rebranding is another way of energy companies' response. This implies both renaming of the company and shaping of a new sustainable development strategy, usually by transition to the 'green' agenda. The biggest energy company of Denmark, Danish Oil and Natural Gas, has got its new name, Ørsted, and the Norwegian Statoil is known as Equinor now.

In response to the climate threat, energy companies join alliances and initiatives, including:

- Climate Ambition Alliance,
- Enhanced National Climate Plans,
- Carbon Neutrality Coalition,
- Deadline 2020,
- Businesses Ambition for 1.5ºC,
- Net-Zero Asset Owner Alliance,
- Powering Past Coal Alliance,
- UN Global Compact Supports Business Action: Caring for Climate[99], and
- Climate Action 100+[100].

[99] Caring for Climate – Business Case / United Nations Global Compact.

[100] According to the data from the Progress Report 2019. URL: http://www.climateaction100.org/

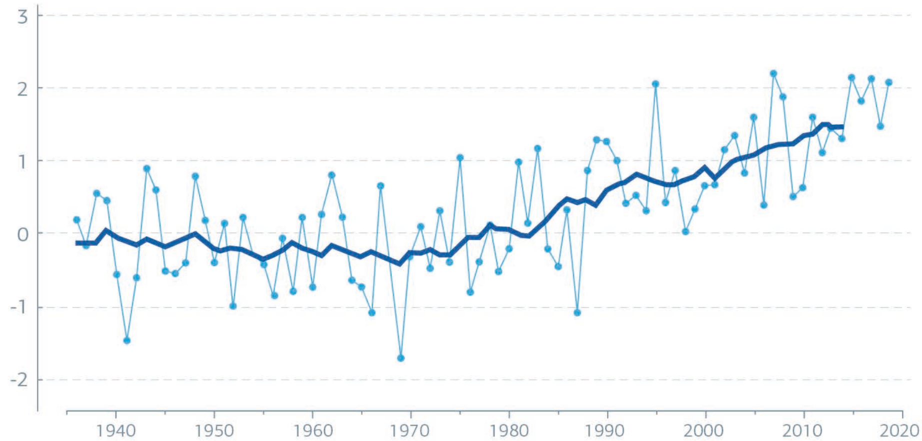
CLIMATE AND RUSSIA: KEY CHALLENGES AND PARTING OF THE WAYS

Climate Change in Russia: Physical Consequences

The global climate change affects directly Russia. The whole country is located in the Northern Hemisphere that heats more than the Southern one, in part due to the differences in land to ocean ratio and oceanic currents.

Moreover, according to the Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet), the climate warming in Russia has been quicker and profounder in the last 40 years than the global average: the temperature growth rate has been approx. 0.47°C over 10 years (vs the world average rate of 0.18°C over 10 years). In the Russian Arctic, the warming rate has been even higher, 0.81°C over 10 years (the air temperature in 2019 proved to be above normal by an average of 2.5°C)[101]. According to the Hydrometeorological Research Center of Russian Federation, 2019 was the warmest in the history of weather observations in Russia. The average annual temperature exceeded normal values throughout the country.[102]

Fig. 17 Average annual abnormality dynamics of surface air temperatures, average for Russia



Source: Federal Service for Hydrometeorology and Environmental Monitoring[103]

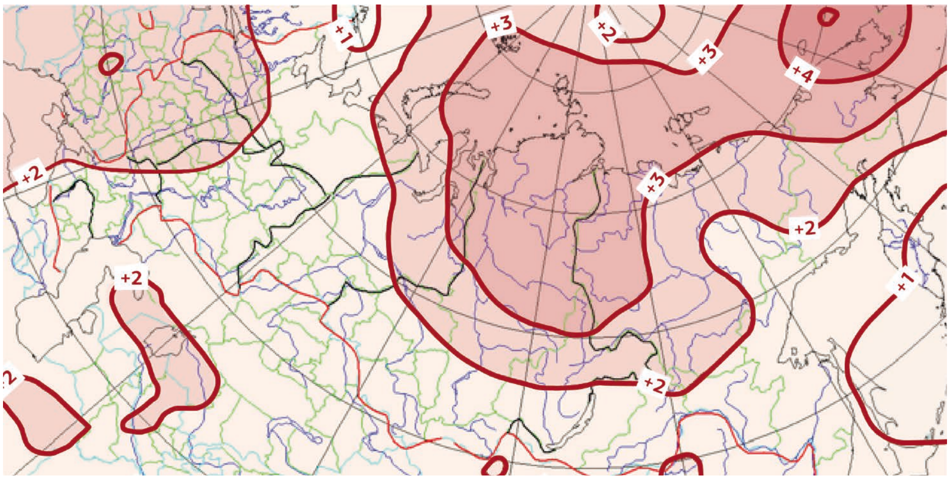
Average annual air temperature abnormalities in some parts of the Russian territory in 2019 are shown in Fig. 18. They reached +4°C across some Arctic regions.

[101] Governmental Report: On Environmental Status and Protection in the Russian Federation in 2018. / Russian Ministry of Natural Resources, 2019. (In Russ.)

[102] Main Weather and Climate Traits in the Northern Hemisphere / Hydrometeorological Research Center of Russian Federation, 2019.

[103] Report on Climate Traits in the Russian Federation in 2019. / Federal Service for Hydrometeorology and Environmental Monitoring, 2020. (In Russ.)

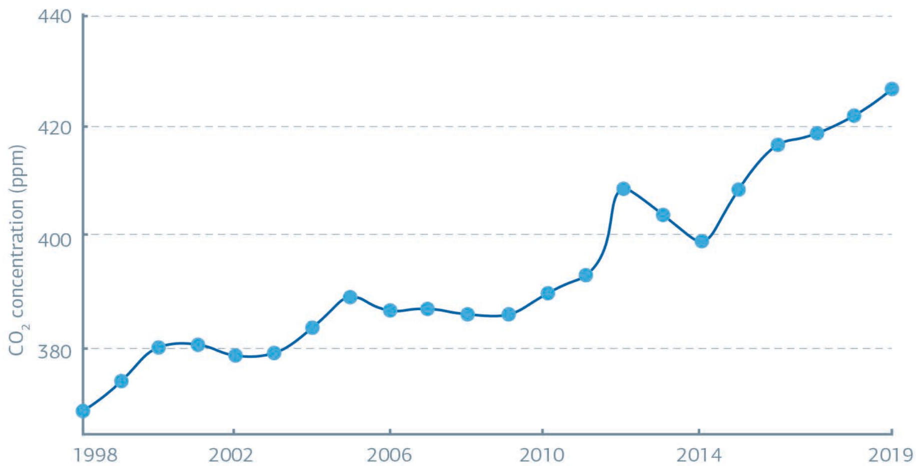
Fig. 18 Average annual air temperature abnormalities in Russia, 2019



Source: Hydrometeorological Research Center of Russian Federation[104]

CO_2 concentration growth has also been recorded. In 2019, the new northern altitude maximums of carbon dioxide concentrations – on average, 414 ppm for the year – were registered (Teriberka, New Port, Tixi stations in the Arctic). In Russia's moderate climate, at the Obninsk station, the parameters have already been close to 430 ppm (Fig. 19).

Fig. 19 Average annual CO_2 concentration at the Obninsk Station, ppm

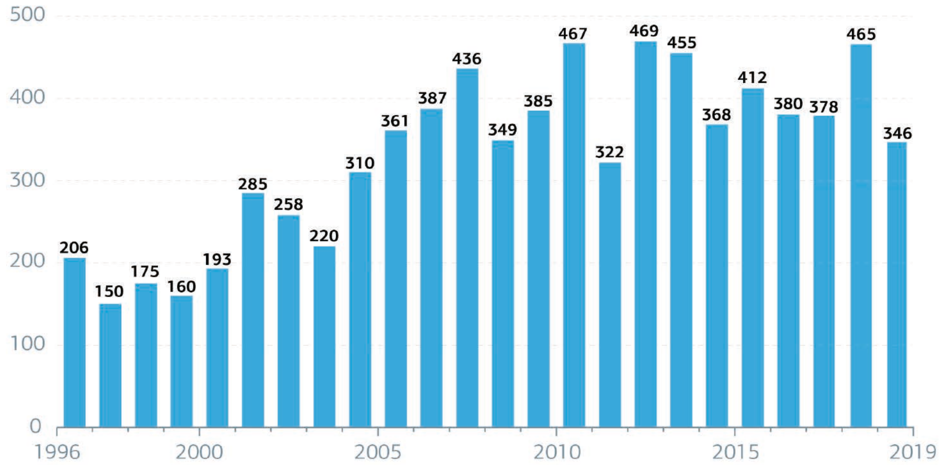


Source: Federal Service for Hydrometeorology and Environmental Monitoring

An increase in the frequency of unfavorable hydrometeorological events that significantly affected the economy has also been observed (Fig. 20).

[104] Main Weather and Climate Traits in the Northern Hemisphere of the Earth / Hydrometeorological Research Center of Russian Federation, 2019.

Fig. 20 Unfavorable hydrometeorological phenomena in Russia



Source: Federal Service for Hydrometeorology and Environmental Monitoring, 2020

Further temperature growth forecasts built on modern climate models suggest that warming in Russia will be more intensive than the average world pace will[105]. The greatest surface temperature rise is expected in winter, aggravating northwards and peaking in the Arctic. By the mid-21st century, the summer temperature is to go up by 2°C - 3°C (RCP2.6 scenario) or by 3°C - 4°C (RCP8.5 scenario) on the late 20th century.

Heavier precipitation (in particular, in winter), with increased 'suddenness' and extreme intensity, in the form of strong freshets and floods, windstorms, alternating cold and warm weather periods, is anticipated during the 21st century.

The climate change, temperature increases, more frequent unfavorable weather events and climatic zone shifts impact on:

- **human health and life** (more frequent natural hazards and their consequences; diseases related to heat and cold waves, water and food pollution, transmission of infections from insects and rodents, allergy etc.);

  According to UNISDR[106], the abnormal heatwave of 2010 in European Russia ranked among the Top 10 most lethal calamities on the Earth over the last 20 years (No. 7 in the ranking of calamities). Following Russian and foreign studies quoted by the Roshydromet, 54,000 to 55,700 persons fell victims of the heat.

- **migration of the population** from regions adjacent or close to Russia, for their living standards will degrade due to climate change consequences, water shortage in Central Asia for instance;

[105] Report on Climate Risks in the Russian Federation / Climate Center of the Federal Service for Hydrometeorology and Environmental Monitoring. St. Petersburg. – 2017.

[106] United Nations Office for Disaster Risk Reduction, a.k.a. UNDRR

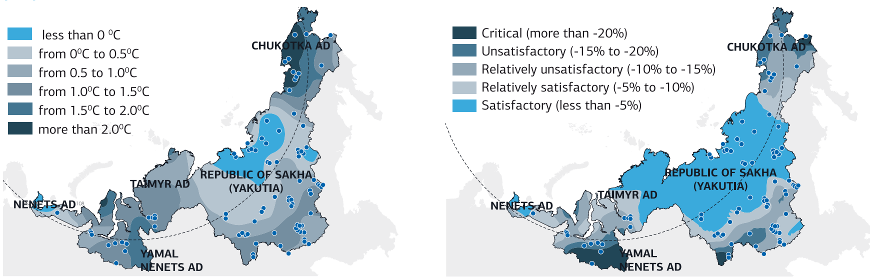
- **food safety** (more frequent droughts and desertization in the main cropping areas of Russia, such as the Stavropol Region or the Rostov Region, entail risks);

  By the mid-21st century, the Russian bioclimatic potential may improve by 5% to 15%, but cereal yield may drop by 8% to 10%[107]. Forest area shifts and a higher probability of wildfires are to occur in the forestry.

- **natural ecosystems** (their degradation leads to biodiversity loss, while more frequent forest fires directly influence the regional environment and bring about greenhouse gas emissions);

- durability of **buildings and structures** due to design condition changes (fluctuations of temperature, humidity, growth in freeze-thaw cycles, moisturizing with frost penetration, rising of ground waters, liquid forms of precipitation in cold seasons accelerate wear and tear of buildings). An additional important factor is permafrost stability (Fig. 21).

Fig. 21 Change in average annual air temperatures (on the left) and estimated load-bearing capacity of pile foundations (on the right) in 1960/1970 and in 2000/2010 (the dots represent main cities and towns population centers)



Source: Anisimov, Streletsky [2015][109]

With the changing external conditions, many buildings constructed in the 1960s have become dilapidated (for example, basements of brick structures in Yakutsk have been fully destroyed by wall moisture condensation, and the number of Norilsk buildings damaged in the last 10 years have proved to be higher than in the previous 50 years[110]). The negative impact of ever more frequent freeze-thaw cycles is most pronounced in European Russia.

- **the pipeline infrastructure,** mostly created in the mid-20th century and not designed for a warming climate, increased

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[107] National Report, Global Climate and Soil Landscape in Russia: Assessment of Risks and Environmental-Economic Consequences of Land Degradation, Adaptive Systems and Rational Nature Management Technologies (Agriculture and Forestry Sectors) / Edited by A.I. Bedritsky, V.V. Dokuchaev Soil Science Institute, GEOS, 2018.

[108] Autonomous District.

[109] O.A. Anisimov, D.A. Streletsky, Geocryological hazards of thawing permafrost / The Arctic. 21st century. Natural Sciences. 2015. No. 2.

[110] Ibid

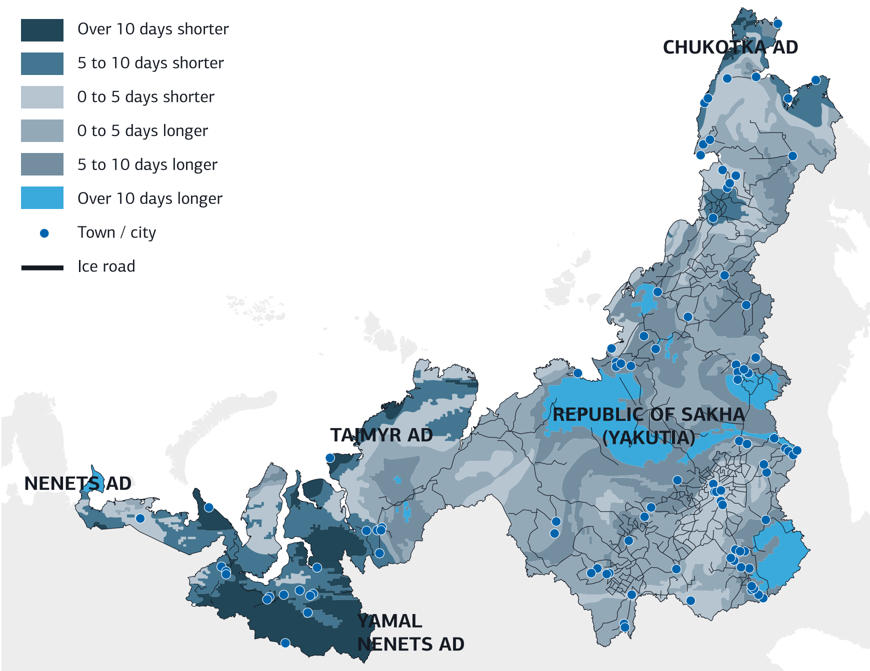
river flow rate and greater intensity of riverbed deformations (which mean risks of damage to pipelines at water crossings);

About 50,000 km of oil pipelines and 150,000 km of gas pipelines run through Russia and cross numerous rivers. Ca. 2,000 oil pipelines passing large and medium rivers have been built. Each of these crossings accommodates up to 25 pipe strings. Pipelines built on permafrost can be damaged due to lower soil stability. This infrastructure is associated with the risk of more frequent emergencies (with additional environmental damage) as well as extra repair and maintenance costs, depending on the route and the region it is located in.

- **transport infrastructure stability.** Winter roads (temporary ice roads used in cold seasons only, when their roadbeds are stable), critical for Russia's northern and eastern regions (in particular, oil and gas production regions), are sensitive to changes in the climate.

  As of the early 21st century, winter road operating periods had shortened by up to 10 days in the Yamal Nenets AD (Fig. 22) and had extended by up to 10 days in the Republic of Sakha (Yakutia) on 1965/1975.

Fig. 22 Change in estimated winter road operating periods in the Russian Arctic in 1965/1975 and 1995/2005



Source: Anisimov, Streletsky [2015]

- **heat and electricity consumption.** A warmer climate will render heating periods shorter while increase electricity consumption during heatwaves.

Of particular importance to Russia is the issue of growing greenhouse gas emissions from thawing permafrost, a process that will accelerate as the climate warms. Permafrost covers up to 65% of the country's territory (which is approximately 30% of the total world permafrost area). Under the RCP 8.5 scenario, a significant (by 30 to 99%) reduction in near-surface permafrost is expected throughout the Arctic by 2100, entailing the emission of 10 to 240 billion tons of carbon in the form of CO_2 and methane into the atmosphere and a further increase in the pace of climate warming.[111] Recent American and Canadian research carried out by their Arctic institutes show[112] that some 20% of the onshore Arctic permafrost is vulnerable to abrupt thaw. This may lead to a threat of one-off 'explosive' emissions. Complex simulation of emissions and greenhouse gas absorption in the permafrost area in the 21st century is at an early stage of development, and there are no well-defined quantitative assessments of these processes yet.

Physical consequences of climate change in these and other sectors of the Russian economy may be assessed by special simulation models. Such models should account for the uncertainty factors, i.e. differences between Russia's federal districts and regions; differences in the global climate change scenarios and the options to adapt to these changes; the available infrastructure safety margin and other factors. It is important to consider both economic and non-economic damages, i.e. from loss of ecosystem services, from loss of livelihood by the inhabitants, from forced migration etc.

No findings of comprehensive quantitative research into the climate change impact on the national economy, by branches and regions, have been published in Russia in the last 5 to 7 years. According to estimates, annual Russian losses from climate hazards only are as high as RUB 30 billion/ RUB 60 billion[113], and those from permafrost thawing, up to RUB 150 billion[114]. RAS Institute of Economic Forecasting estimated in 2010 that economic losses from climate changes may come up to 2% of GDP, and in certain vast territories, even 4% to 5% of regional GDP[115].

[111] IPCC, 2019: Summary for Policymakers. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner et all. (eds.)]. In press.

[112] Turetsky, M.R. et al. Carbon release through abrupt permafrost thaw. Nat. Geosci. 13, 138–143 (2020). https://doi.org/10.1038/s41561-019-0526-0

[113] https://www.vedomosti.ru/politics/news/2015/11/17/617205-ezhegodnii-uscherb-rossii-ot-opasnih-klimat-icheskih-yavlenii-dostigaet-30-60-mlrd-rub-minprirodi

[114] https://www.bloomberg.com/news/articles/2020-03-08/yen-slides-as-oil-price-war-adds-to-global-worries-markets-wrap

[115] The estimates are based on the analog approach and employ data on developed countries and the global economy in general. For more details please see: Assessment of Macroeconomic Impacts of Climate Change in the Russian Federation until 2030 and beyond, edited by V.M. Katsov, B.N. Kobyshev, V.P. Meleshko, Federal Service for Hydrometeorology and Environmental Monitoring, 2011 (p. 174; in Russ.)

Climate Regulation in Russia: the State, Cities and Businesses

Russia has been actively involved in IPCC since its establishment. Mr. Yu.A. Izrael (1930/2014), RAS academician, Chairman of the USSR State Committee for Hydrometeorology, was among its founders and represented Russia in IPCC when the First, the Second, the Third, the Fourth and the Fifth Assessment Reports were drawn. Yu.A. Izrael Institute of Global Climate and Ecology (IGCE) FSBI coordinates Russia's contribution to IPCC and is supervised by the Federal Service for Hydrometeorology and Environmental Monitoring and the Ministry of Natural Resources and Environment of the Russian Federation[116].

Climate change has given way to other priorities of public concern and strategic agenda of the state so far.

Russians regard pollution of rivers, seas and oceans (70%), deforestation (66%) and air pollution (62%) as the key environmental issues. By contrast, climate change concerns a mere 20% of Russians[117]. Climate change management is not listed among national goals and priorities for the Russian Government up to 2024 either[118].

Climate is mentioned as part of the governmental policy measures to promote national development goals, in the *Ecology and Use of Natural Resources section*. This section covers compliance with international treaties, greenhouse gas emission regulation to be implemented, greenhouse gas emissions monitoring and reporting system to be established, and conditions for greenhouse gas emission reduction and absorption.

Nonetheless, the *Ecology* national project does not touch upon the climate change and greenhouse gas emissions at all[119]. Meanwhile, following the Energy Security Doctrine of the Russian Federation [120], "intensification of international efforts to implement the climate policy and to ensure accelerated transition to the 'green economy'" is one of the foreign policy challenges to Russian energy security. The same document states as follows:

"The Russian Federation supports global efforts to counter climate change, <...> takes part in addressing international climate policy issues to the extent such policy meets the Russian Federation's national interests of living standards improvement

[116] http://www.meteorf.ru/activity/international/mgeik

[117] Based on the October 2019 survey: https://media.fom.ru/fom-bd/d42ek2019.pdf

[118] The Main Activities of the Government of the Russian Federation up to 2024 http://static.government.ru/media/files/ne0vGNJUk9SQjlGNNsXlX2d2CpCho9qS.pdf

[119] The national project Ecology data sheet approved by the Presidium of the Russian Presidential Council for Strategic Development and National Projects (Minutes dated December 24, 2018, No. 16) http://www.mnr.gov.ru/activity/directions/natsionalnyy_proekt_ekologiya/

[120] Approved by the Russian Presidential Decree No. 216 dated May 13, 2019 https://minenergo.gov.ru/node/14766

for its citizens, environment protection and conservation. Russia deems inappropriate any biased consideration of climate change and environmental safety, any impairment of energy resources-producing states' interests and any deliberate disregard of such sustainable development aspects as universal access to energy and development of clean hydrocarbon energy technologies."

At the executive level, responsible for climate change issues are the following authorities:

- Russia's Special Presidential Envoy for Climate,
- Russian Government (several Deputy Prime Ministers[121] and several Ministries are vested with climate change functions; there is no single coordinating Deputy Prime Minister or Ministry);
- Russian Ministry of Economic Development (put in charge of developing a comprehensive system for governmental regulation of greenhouse gas emissions[122]); and
- Russian Ministry of Natural Resources and Environment (and, subordinate to it, Roshydromet; both responsible for climate change monitoring in Russia and international cooperation at IPCC).

Russia's share in global greenhouse gas emissions is around 5%. In the early 1990s (before 1998), against the economic recession background, Russian anthropogenic emission of greenhouse gases dropped significantly, followed by slow growth till 2008 when they amounted to approx. 1.5 billion tons[123] of CO_2 equivalent, including LULUCF (Fig. 23), or about half of the 1990 emissions. LULUCF excluded, the reduction was approx. 30%.

According to 2017 data, 47% of anthropogenic greenhouse gas emissions in Russia came from the electric power and heat supply sectors. Another 43% of emissions are provided by industry, fuel combustion in the transport sector, and methane emissions from the production and transportation of fossil fuels.

The role of LULUCF in Russia is more important than in a number of other major emitter countries - managed lands in Russia have provided a steady trend of increasing net absorption of greenhouse gases - up to 577 million tons (27% of the total emissions in all other sectors).

Russia's preliminary Nationally Determined Contribution (NDC) under the Paris Agreement envisages 25% to 30% emission reduction by 2030 on 1990, including LULUCF. Thus, this

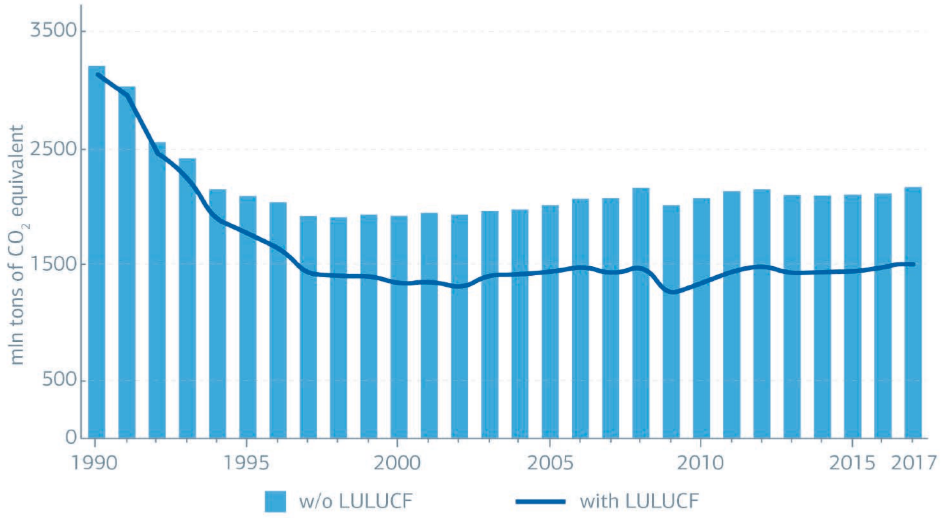
[121] http://government.ru/en/gov/responsibilities/

[122] https://economy.gov.ru/material/directions/investicionnaya_deyatelnost/obespechenie_razvitiya_ekonomiki_v_usloviyah_izmeneniya_klimata/klimaticheskaya_politika

[123] The scope of emissions is determined by calculation and the method selected. In 2018, Russia's emissions were estimated at 2 bn tons (by 0.5 bn tons greater), due to different approaches to assessment of methane leakage in gas transportation and distribution networks.

commitment was fulfilled in the early 1990s and has been over-fulfilled so far. The Government has not discussed any more ambitious goals so far, though.

Fig. 23 Aggregate anthropogenic greenhouse gas emissions in Russia



Source: Federal Service for Hydrometeorology and Environmental Monitoring, National Report on the Cadastre of Anthropogenic Emissions[124]

However, the Russian economy has got potential to achieve carbon neutrality. There is a lot of room for cutting down on greenhouse gas emissions[125] through energy efficiency enhancement and other low-carbon technologies as well as for absorbing the gases in the LULUCF sector[126].

Carbon regulation in Russia is in the infancy. The draft Federal Law *On State Regulation of Greenhouse Gas Emissions* may be adopted by the end of 2020[127]. CO_2 emissions are not under state regulation yet; introduction of the emission charge system or 'carbon price' is not yet on the agenda. In December 2019, the Action Plan for the First Phase of the Economy and Population Adaptation to Climate Change up to 2022[128] was passed. It comprises institutional, organizational and methodical steps to define approaches to the adaptation objective. The Plan does not specify any greenhouse gas reduction or adaptation efforts.

Russia's low-carbon development strategy was drafted[129] and published for open discussion in the end of March 2020. The

[124] National Report on the Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of All Greenhouse Gases Not Controlled by the Montreal Protocol / Federal Service for Hydrometeorology and Environmental Monitoring. M., 2019.

[125] Bashmakov, I.A., Myshak, A.D. Comparison of greenhouse gas emission forecasts in Russia's energy sector for 2010–2060. Stud. Russ. Econ. Dev. 25, 37–49 (2014). https://doi.org/10.1134/S1075700714010031

[126] Romanovskaya A.A. et al. 2019. Greenhouse gas fluxes and mitigation potential for managed lands in the Russian Federation. - Mitigation and Adaptation Strategies for Global Change. DOI 10.1007/s11027-019-09885-2.

[127] https://tass.ru/obschestvo/691791

[128] http://government.ru/docs/38739/

[129] Draft of Russia's low-carbon development strategy until 2050. (in Russian). URL: https://economy.gov.ru/material/file/babacbb75d32d90e28d3298582d13a75/proekt_strategii.pdf

best-case scenario of the draft envisages the 2050 objective to reduce greenhouse gas emissions by 52% on 1990, which is not ambitious compared to flagship countries pursuing carbon neutrality goals. Moreover, the baseline scenario does not even provide for a carbon dioxide emissions trading system roll-out.

In the baseline scenario, emission reductions are planned to be achieved, first of all, by increasing energy efficiency (the role of renewable energy sources is not so significant). At the same time, it is planned to reduce the energy intensity of GDP by almost 50% by 2050 - although the beginning of this process falls on 2030.

A fairly low priority of climate protection at the federal level translates down to **regional and municipal levels.** Russian cities neither announce climate 'emergency' nor set tasks to reduce greenhouse gas emissions – Moscow being the only exception. The city has joined the C40 Alliance[130], a network of mega-cities committed to addressing the climate change problem. However, this exception is very formal. Even though Moscow has been implementing large-scale projects to reduce greenhouse gas emissions (coal to gas shift; co-generation development; public transport development; e-bus procurement), the public hardly associates these projects with climate protection.

Among Russian **corporates**, the climate agenda is topical for public companies that raise foreign investments, take on foreign bank loans, or have foreign shareholders. As the respective policies, first in Europe, get tougher, these corporations become increasingly interested in carbon trace reduction.

RUSAL aluminium company, part of En+ Group, is implementing a programme of environmental upgrading so that to curtail the company's greenhouse gas emissions by 2025: for its aluminium plants, by 15%, and for its alumina production facilities, by 10%. Since 2017, the company accounts for internal carbon prices when assessing investment projects, even though Russia is hardly going to introduce such a system in the near future. Additionally, in 2019, En+ Group span off its coal power plants into a separate entity to be sold later.

In 2018, Arkhangelsk Pulp and Paper Mill JSC, a wood-chemical company, approved its low-carbon development strategy up to 2030, whereby it assumed a voluntary 2030 obligation to cut down its total direct and energy-related indirect greenhouse gas emissions by 55% on 1990, i.e. to 1.4 mln. tons of CO_2 equivalent a year[131].

[130] https://www.c40.org/about

[131] https://www.appm.ru/press-center/atsbk-prinyal-strategiyu-nizkouglerodnogo-razvitiya-do-2030-g/

In December 2019, LUKOIL presented[132] a long-term strategy. In the Company's opinion, to keep the global temperature growth to well below 2°C, not only should renewables be used more broadly, but also carbon dioxide capture, utilization and storage (CCUS) technologies should be implemented actively, and forest cultivation and land use should be approached differently. Moreover, scheduled for 2020 is approval of the Company's climate strategy aimed at zeroing carbon dioxide emissions by 2050.

In autumn 2019, Tatneft oil company updated its health, safety, and environment policy by including principles and basics of climate change prevention and of comprehensive accounting for greenhouse gas emissions in it for the first time.

The number of Russian companies showing their interest in climate risk analysis for enterprises is noticeably greater. Companies in oil and gas (Gazprom, Rosneft, Tatneft, Lukoil, Surgutneftegaz, Novatech), mining and metallurgical (Rusal, Polymetal, Metalloinvest, Uralkali, EVRAZ), power (INTER RAO UES, FSK UES), woodworking (Ilim Group, Segezha Group, Arkhangelsk Pulp and Paper Mill) and other sectors have got interested in TCFD reports[133].

Russian Export Risks

For reasons of climate agenda, long-term risks for the entire Russian export have already emerged (notwithstanding the physical impact of climate change on the Russian economy, the Russian stakeholders' attitude to climate protection and the climate regulation development pace in Russia).

In 2018, oil, gas, coal and refined products accounted for some 64% of Russian exports (Fig. 24). The European Union nations provided almost third of the export revenues. According to 2011 data, Russia was the world's absolute leader (among major economies) by carbon intensity of export (Fig. 25), for its high share of energy sources and energy intensive products.

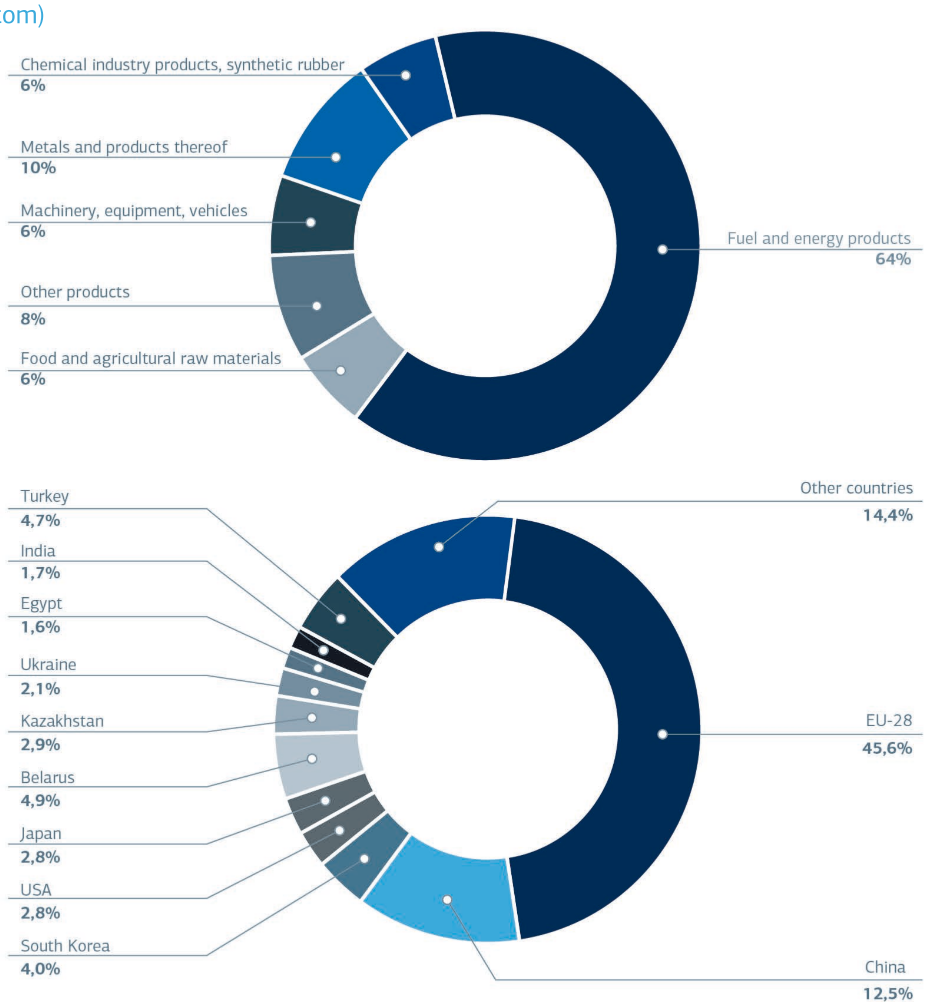
A relatively low technological level and, consequently, low energy efficiency of the Russian economy aggravate carbon intensity of export. According to the International Energy Agency, energy intensity of Russian GDP is two to three times higher than that of most developed nations. According to the Russian Ministry of Economic Development, Russia's GDP energy intensity declined by mere 12% in 2018 on 2007.[134]

[132] https://www.interfax.ru/business/688438

[133] https://www.eic-ano.org/post/семинар-по-оценке-и-раскрытию-климатических-рисков-и-возможностей

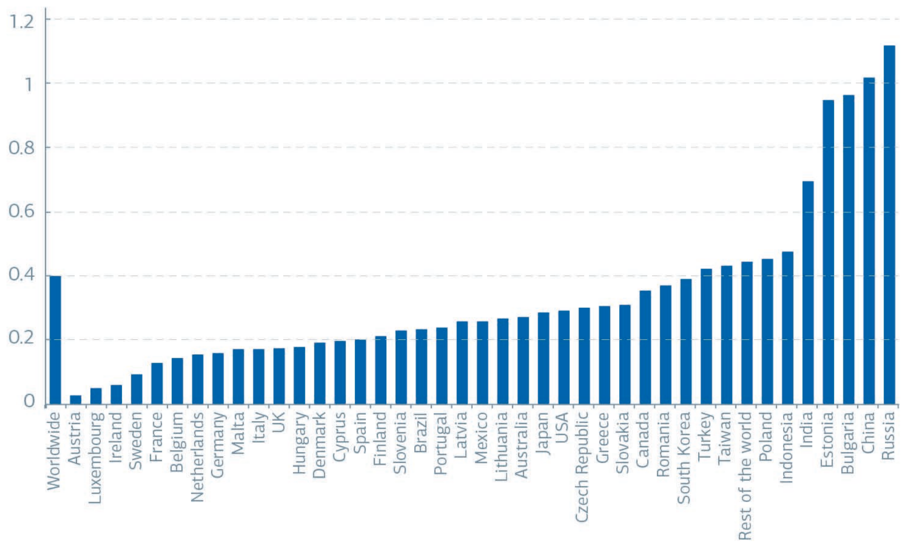
[134] Governmental Report on the State of Energy Saving and Energy Efficiency in the Russian Federation in 2018 / Russian Ministry of Economic Development, December 2019. (In Russ.)

Fig. 24 Russian export mix in 2018, by product type (top) and by importers (bottom)



Source: Moscow School of Management SKOLKOVO, based on the Russian Ministry of Economic Development[135], the Federal Customs Service[136] data

Fig. 25 Carbon intensity of export worldwide in 2011, tons/'000 USD



Source: Makarov, Sokolova, HSE[137]

[135] http://www.ved.gov.ru/monitoring/foreign_trade_statistics/basic_goods_export (accessed on March 4, 2020).

[136] Foreign trade by major countries. January/December 2018 // FCS [website]. URL: http://customs.ru/storage/document/document_statistics_file/2019-06/04/IyU0/WEB_UTSA_09.xls

[137] I.A. Makarov, A.K. Sokolova. Carbon Emissions Embodied in Russia's Trade // HSE Economic Journal. 2014. Vol. 18. No. 3. p. 490.

In this regard, introduction of the Carbon Border Adjustment Mechanism proposed by the European Commission under the European Green Deal in December 2019 poses a major risk.138 The adjustment is likely to be via an additional charge on certain energy intensive product types[139] imported to Europe. The goal is to better trace carbon footprint and, thus, to remedy the situation where some imported goods do not share the burden of tough environmental compliance, are therefore cheaper and, consequently, have a competitive edge over European suppliers' products. Different forms of the mechanism are considered: a carbon tax on selected products (both imported and domestic); a carbon customs duty or import tax; or an extension of the European Emissions Trading System (EU ETS) to imports. A probable obstacle to this initiative will be its alignment with WTO requirements that prohibit inequality in conditions for foreign and domestic manufacturers of similar products. The bill is expected to be finalized in 2021[140]; the European Commission has started working on it and launched collection of feedback on the initiative.[141]

The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)[142] approved at the 39th International Civil Aviation Organization (ICAO) Assembly in October 2016 is another example of risks for Russian companies. This system imposes obligations on all ICAO member states to stabilize carbon dioxide emissions in aviation at the 2020 level and to halve them by 2050 on 2005. At the preliminary stage (during the socalled baseline period) started in January 2019, all major[143] airlines undertook to compile and submit data on their carbon dioxide emissions, to have the data verified by accredited institutions and then to file with their state for publication[144]. The system will come into operation from 2021, and airlines will be obliged to fully offset their emissions exceeding the 2020 level, by investing into 'green' projects (not necessarily in aviation). Before 2026, ICAO member states will be able to voluntarily participate in the pilot implementation; however, after 2027, the system will be mandatory for all members, except for the least developed, island states, and landlocked developing nations.

[138] Source: https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf.

[139] Steel, cement and aluminium markets may become the pilot sectors for this mechanism – source: https://www.reuters.com/article/us-climate-change-eu-carbontax-explainer/explainer-what-an-eu-carbon-border-tax-might-look-like-and-who-would-be-hit-idUSKBN1YE1C4

[140] Source: https://ec.europa.eu/commission/presscorner/detail/en/ip_20_335

[141] Source: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12228-Carbon-Border-Adjustment-Mechanism.

[142] Binding upon all member states of the Organization, the document set was finally adopted as an Annex to the Chicago Convention.

[143] With annual CO_2 emissions exceeding 10,000 tons/year.

[144] https://www.icao.int/environmental-protection/Documents/CorsiaBrochure_8Panels-RUS-Web.pdf

There are no publicly available comprehensive quantitative assessments of the Carbon Border Adjustment Mechanism or CORSIA risks for the Russian economy.

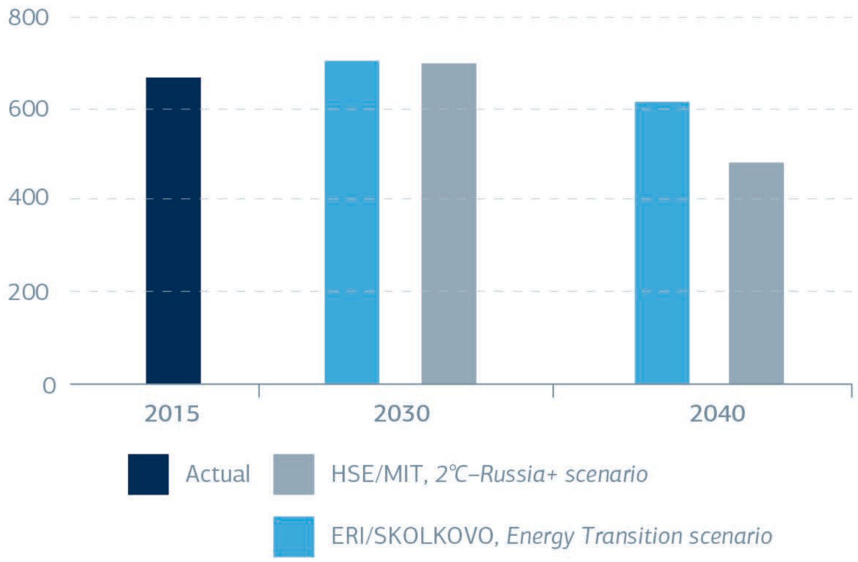
Scenario estimates of changes in Russia's main export item, energy resources, in the horizon up to 2030/2040 are available, however.

HSE and MIT study (2014) considers several scenarios of the future, in particular the *2⁰C–Russia+ scenario* envisaging the Paris Agreement implementation by its member countries. In *the Global and Russian Energy Outlook* made by the RAS Energy Research Institute and the Moscow School of Management SKOLKOVO (2019), *the Energy Transition* scenario also assumes these member state contributions accompanied with the 'energy transition' to low-carbon technologies, their rapid development and cross-border transfer.

In these scenarios, Russian export of energy resources is to decrease significantly by 2040 on 2015: in the ERI-SKOLKOVO forecast, by 9%, and in the HSE forecast, by 44%. According to the ERI-SKOLKOVO forecast, 2040 exports are to fall in both natural and monetary terms, 15% and 17% below the current level (2019), respectively (Fig. 26).

It is important to note that these estimates were made before the "coronacrisis", and taking into account the COVID-19 impact on the energy market conditions, all forecasts will be even more negative.[145]

Fig. 30 Russia's energy resource export outlook to 2030 and 2040, MMTOE



Source: RAS ERI - Moscow School of Management SKOLKOVO[146], HSE[147]

[145] Coronacrisis: the COVID-19 impact on fuel and energy sector globally and in Russia / Moscow School of Management SKOLKOVO. April 2020. (In Russ.)

[146] Global and Russian Energy Outlook 2019 / Edited by A.A. Makarov, T.A. Mitrova, V.A. Kulagin. RAS ERI – Moscow School of Management SKOLKOVO – Moscow, 2019.

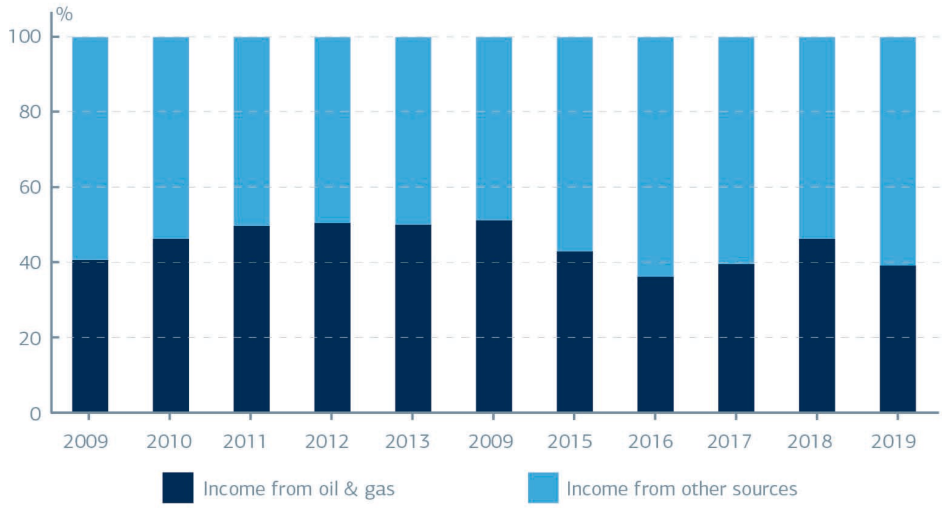
[147] I.A. Makarov et al. Impacts of Paris Agreement on Russian Economy. // Voprosy Ekonomiki. 2014. Vol. 18. No. 3. Pp. 76–94. (In Russ.)

More positive(in terms of the export environment) forecast scenarios allow for some growth in energy resource exports by 2040 on 2015 (following HSE assessment, by approx. 44%, and in the RAS ERI and the Moscow School of Management SKOLKOVO forecast, by 10%). Yet, the probability of these scenarios goes down as the climate policy in Russia's key export markets toughens.

The shrinking of Russia's energy export is primarily caused by falling oil exports, and even to a greater extent, refined product exports. This is explained by simultaneous impact of both internal (no oil production growth) and external (narrowing demand for liquid hydrocarbons on the European market and fiercer competition on the Asian market) factors.

Hydrocarbon exports play a vital part in the national economy. Despite Russian Government's efforts[148] to encourage non-commodity exports, the oil and gas income share ranging from 36% to 51% of the federal budget has not shown a steady downward trend in the last 10 years (Fig. 27).

Fig. 26 Share of Russian federal budget income coming from oil and gas, %



Source: Russian Ministry of Finance[149]

The impact of decreasing energy resource exports on the Russian economy development rates is estimated in the ERI-SKOLKOVO forecast. By 2040, budget receipts are expected to decline drastically in all scenarios under review, for the new complex production and transportation projects would need significantly stronger financial (including tax) support and fuel exports would expand in the absence of export duties. Under the Energy Transition scenario assuming no adaptation of Russian energy policy to the changed external environment, GDP growth rate may be limited to 0.6%-0.8% a year up to 2040.

[148] In particular, as part of the National Security Strategy of the Russian Federation until 2020. Access mode: http://kremlin.ru/supplement/424

[149] Ministry of Finance of the Russian Federation. Annual Report on Execution of the Federal Budget (data since January 1, 2006) / Access mode: https://www.minfin.ru/ru/statistics/fedbud/

Response Options

The authors suggest that Russia's alternative responses to the global climate threat may depend on the two main uncertainties:

(**1) Global climate change response promptness** – in the range from slow to rapid;

(2) Attitude of the Russian society and governmental authorities to the climate change challenge – in the range from passive to active.

A slow global response to climate change is in line with current trends in climate regulation and technology development[150]. Global climate treaties (e.g. the Paris Agreement) miss their goals because of their participants' unwillingness to compromise. This triggers worst-case scenarios for carbon dioxide concentration and global temperature. The developed nations envisage just moderate investments into the 'green economy'.

A rapid global response to climate change corresponds to successful contributions by parties to global climate treaties (e.g. the Paris Agreement). This will help implement the best-case scenarios of carbon dioxide concentration and global temperature[151]. This scenario may be facilitated by sped-up development of new technologies and by manifold acceleration of their transfer from the developed nations to the developing ones. A large-scale governmental support to energy saving and introduction of low-carbon technologies will be necessary.

Passive attitude of the Russian society and governmental authorities to climate change is essentially preservation of the status quo (see the *Climate Regulation in Russia: the State, Cities and Businesses* section).

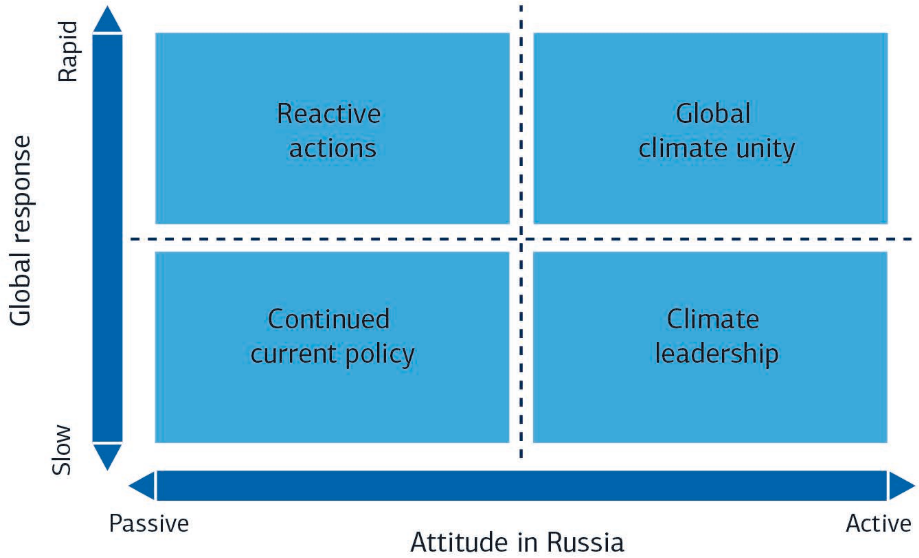
Active attitude of the Russian society and governmental authorities to climate change may consist in recognizing this problem as one of the priorities for public policy and public scrutiny, like in the EU (as described in the previous section).

Depending on the two key uncertainty factors above, there is room for different scenarios of the future (Fig. 27).

[150] This option corresponds to the Conservative scenario described in a greater detail in the Global and Russian Energy Outlook 2019, ERI – SKOLKOVO.

[151] This option corresponds to the Energy Transition scenario from the Global and Russian Energy Outlook 2019, ERI – SKOLKOVO.

Fig. 27 Future scenarios, depending on the foreign and Russian responses to the climate change problem



Source: Moscow School of Management SKOLKOVO

Four extreme scenarios can be singled out from the multitude of development options: "Continued Current Policy", "Reactive Actions", "Climate Leadership" and "Global Climate Unity". Possible framework for some of the key energy and climate policy parameters for these scenarios is presented in Table 4.

Table 4 Key parameters of the Russian energy and climate policy in climatic threat response scenarios.

Key Parameters	Continuation of Current Policy	Reactive Adaptation	Climate Leadership	Global Climate Unity
Role of national climate policy	Low priority	Moderate priority	High priority	High priority
Nationally determined contribution	Keep current targets (70 - 75%*)	Moderate scale up of targets (50%*)	Moderate scale up of targets (50%*)	Aggressive scale up of targets (30%*)
National climate monitoring system	Establish	Establish	Promptly establish	Promptly establish
Carbon pricing	Not implemented	Not implemented	Implemented	Implemented
GHG emission reduction actions	Implement existing initiatives	Implement existing initiatives	Implement existing initiatives and limited additional actions	Implement existing initiatives and broad range of additional actions
Investments in fossil-fuel sector	Continue on current high level	Gradually decrease to level necessary to cover internal demand	Gradually decrease to level necessary to cover external demand	Significantly decrease
Hydrocarbon export	Continue to increase	Stabilize and gradually decrease	Continue to increase	Stabilize and gradually decrease
Export of romising new products (hydrogen, platinum group metals and other raw materials)	Opportunistic approach	Proactive approach	Opportunistic approach	Proactive approach

*2030 National target compared to 1990 level including LULUCF

Source: Moscow School of Management SKOLKOVO

The global Energy Transition to low-carbon development poses not only threats, but also opportunities for the Russian economy. First of all, they are associated with an increase in global demand for new products - low-carbon energy carriers (for example, hydrogen) or platinum group metals and other raw materials. These materials are critical for the development of energy storage systems, electric vehicles, fuel cells, wind and solar energy, control systems, etc. - all technologies providing Energy Transition and whole decarbonization. In the "Climate Leadership" and "Global Climate Unity" scenarios, a multiple increase in demand for these products can be expected.

The Reactive Actions and the Climate Leadership scenarios are possible but seem to be unlikely for Russia.

Under the Climate Leadership scenario, the country will have to act as a flagship in combating climate change, against the background of other countries' inactivity in this field. In this course of events (when other major emitters are not involved) the negative physical consequences of climate change (including in the Russian territory) will not be prevented all the same. Russian economic losses from introduction of high carbon prices and other measures are almost inevitable. Thus, Russia will have no incentives to implement this scenario (on the contrary, it needs to be avoided).

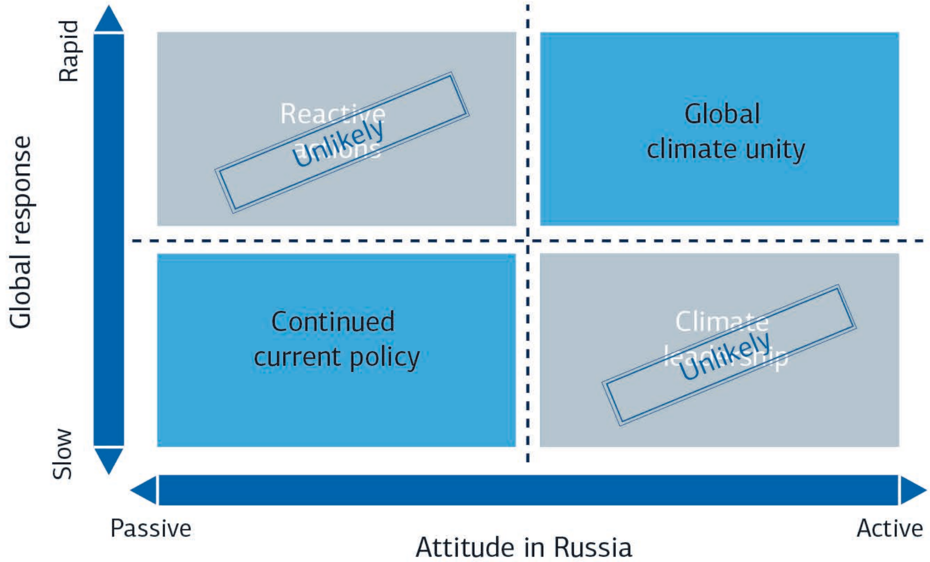
On the other hand, the Reactive Actions scenario, with export mix modification only, is unlikely to be successful either. Under this scenario, the risk to Russian exports is high because of their high carbon intensity and hydrocarbon prevalence. Given the Russian domestic market focus on hydrocarbons and limited implementation of measures to reduce greenhouse gas emissions, it will be very difficult to develop low-carbon export opportunities. Any low-carbon (e.g., "green" or "blue" hydrogen) project will most often be uncompetitive within the country compared to its hydrocarbon-based counterpart - recall that, in this scenario, no carbon pricing is introduced. This will decimate the volume of the domestic market and make Russian export projects less attractive compared to competing countries. Furthermore, it will be difficult to use the opportunities for innovative economy development in such a scenario - Russian suppliers of innovative low-carbon solutions, in the context of a narrow domestic market, will be incentivised to move outside Russia. Therefore, the scenario of "Reactive actions" seems to authors to be non-viable in the long run.

In our opinion, the main choice is therefore between the Continued Current Policy and the Global Climate Unity scenarios. Each of them is associated with specific risks.

Risks in the Continued Current Policy scenario are as follows:

- greater losses to be borne by the population, economy, and environment resulting from the physical impact of climate change;
- reduction in Russian export volumes and proceeds; and
- a limited capacity of economically available fossil fuels (and resource-based economy models) in terms of the national economic growth support in the long-term.

Fig. 28 Future scenarios, depending on the foreign and Russian responses to the climate change problem



Source: Moscow School of Management SKOLKOVO

Barriers to the Global Climate Unity scenario implementation are the following:

- no reliable comprehensive estimates of potential physical climate change damages to Russia, i.e. no clear understanding of the climate threat's extent;
- risks of losing the current sales markets (primarily in fossil fuel), as triggered by weaker competitiveness and, consequently, declining revenues in the backbone economic sectors and less tax revenues for the budget;
- social limitations: workplaces in the energy sector determine the viability of many cities and even some regions; this scenario requires their reorientation to meet a low-carbon economy's needs; and
- growth in heat, electricity and other utility rates for all consumer types in Russia, including the population.

Risks of all scenarios are shown in Fig. 29.

Fig. 29 Risks of extreme scenarios for Russia

RESPONSE OPTIONS	Continued current policy	Reactive actions	Climate leadership	Global climate unity
Scale of climate change and its consequences	High	Medium	Medium	Low
Risks for investors in the fuel and energy sector	High	Low	High	Low
Risks for non-commodity investors	High	High	Low	Low
Growth in local utility rates	Low	Medium	Medium	High
Risk of economic slowdown	High	Medium	Medium	Low

High Medium Low

Source: Moscow School of Management SKOLKOVO

Proponents of the Continued Current Policy view the low-carbon development path as a threat to the national interests, and Russia's current contribution to fighting climate changes, as significant and sufficient. They accuse other countries of promoting unfair competition and carbon protectionism and even voice a suspicion that the climate agenda is deliberately initiated by hydrocarbon importing countries to promote their own renewable energy-based technologies.

Regardless, the conspiracy theory discussions will not help neutralize the above risks of the Continued Current Policy scenario or diversify the Russian economy. Meanwhile, in order to start moving towards the Global Climate Leadership scenario, Russia may take a few small steps without waiting for drastic changes in the economy. These include:

- accelerated establishment of the National Climate Monitoring System, in particular for monitoring the climate, consequences of its change and climate activities (both mitigation and adaptation)[152];
- inclusion of climate protection and net greenhouse gas emission targets into national projects and governmental programs;
- analysis and introduction of global climate reporting standards for Russian businesses as the first step towards development of customized carbon trace reduction programs;
- more active efforts to enhance energy efficiency, including resumption of budget financing; and
- selection of low-carbon development priorities out of those promising for Russia, e.g. carbon dioxide capture, utilization and storage technologies, hydrogen technologies, energy efficiency or increased carbon dioxide absorption on managed lands etc.

[152] A.A. Romanovskaya. On the concept of national governance and monitoring in the area of climate change in Russia / PEMEM, Vol. XXX, Nos. 3-4, 2019. DOI: 10.21513/0207-2564-2019-3-61-83

The above steps are insufficient for Russia to join the global leaders in combating climate change. However, they may spur the country moving forward, by gradually lifting the existing barriers and by addressing the Continued Current Policy risks.

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