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Climate Change in the Arctic: Adaptation to New Challenges

Elena N. NIKITINA
PhD in Economics, Head of the Section for Global Economic Problems
Primakov National Research Institute of World Economy and International Relations of the Russian Academy of Sciences, 117997, Profsoyuznaya St., 23, Moscow, Russian Federation
E-mail: elenanikitina@bk.ru
ORCID: 0000-0002-8431-7990

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ABSTRACT. *Global climate change in the Arctic has been unfolding more rapidly than in other parts of the world, and its impacts affect vulnerable northern ecosystems, health and well-being of the Northerners, economic sectors and infrastructure in the polar regions of the eight Arctic states. Consequences of climate change for human society are analyzed in synergy with ongoing transformations in social, economic and institutional systems in the Arctic region. Their cumulative effect exposes a variety of challenges for sustainable development of the northern communities, regions and countries; it reveals a number of uncertainties in the future pathways within the transformative context, as well as a combination of risks and opportunities for societies. It requires human responses and societal adaptations to consequences of the Arctic change. Adaptation to climate change in combination with climate change mitigation through greenhouse gas reduction turns into an important component of climate policies and measures of the Arctic states. This article presents innovative results of analysis of the major trends and features in formation of adaptive governance in the Arctic. It is based on a polycentric design, and particularly, on coordination of response actions at various levels, on interactions and networks of a variety of the Arctic stakeholders, on taking into account local environmental and socio-economic contexts, on combination of multidisciplinary and flexible approaches and packaging of governance mechanisms and instruments. The study analyses the major developments and innovations in adaptation policies and practices of the Arctic regions in N. America (Canada) and Europe (Norway). Its focus is on assessment of priorities, strategies and planning, institutions, economic instruments, climate services, application of struc-*

tural measures for disaster risk reduction. It explores possibilities of regional exchange of best practices in the Arctic, and core barriers for success in implementation of adaptation policy options. The role of the Paris agreement in formation and structuring of adaptation policies and measure of the northern regions of the Arctic states is analyzed.

KEY WORDS: *The Arctic, adaptation to climate change, adaptive governance, institutional coordination, climate policy and measures, climate services, partnerships of stakeholders, Paris agreement, disaster risk reduction, sustainable development*

Consequences of Climate Change

Currently, international discussion on the prospects for implementing the Paris climate agreement focuses primarily on anthropogenic greenhouse gas (GHG) emission reductions that are essential to prevent global climate change. Adaptation to consequences of climate change is often overlooked, but remains an equally important segment in international regulations and in domestic policies. While there is a wide variety of both uncertainties and alternative otions available to the international community in climate change mitigation and transfer to low-carbon development, the challenge to adapt to the actual and future impacts of a changing climate is obvious.

Adaptation of society and reducing its vulnerability to impacts of global climate change is especially important for the Arctic region: compared to other parts of the planet, the warming is occurring twice as fast here; research shows that this trend will continue in the long term [Climate Change 2014; Russian Federal Service for Hydrometeorology and Environmental Monitoring Second Assessment Report 2014; Adaptation Actions for a Changing Arctic. Perspectives from the Barents Area 2017; Adaptation Actions for a Changing Arctic. Perspectives from the Bering-Chukchi-Beaufort Region 2017]. There is evidence showing that Arctic climate is becoming ever more variable and unstable – with increase in the frequency and intensity of natural disasters, including floods, ice jams, wildfires, storms, gales and blizzards, avalanches and landslides, formation of icebergs. Extreme natural hazards threaten the safety, health and well-being of people living in the Arctic and pose risks to economic development in the polar regions, affecting exploration and extraction of natural resources, sea and land transportation, infrastructure, housing and agriculture. This, combined with the effects of slowly creeping natural processes (permafrost thaw, changes in land and marine ice cover, sea level rise, northward movement of invasive plant and animal species, pests and infectious diseases, etc.), will make Arctic communities much more vulnerable and lead to potentially severe economic losses [*Bengston, Nikitina* 2017; Russian Federal Service for Hydrometeorology and Environmental Monitoring Second Assessment Report 2014]. Consequences will vary depending on the natural environment and the specifics of socio-economic development of the Arctic territories. Adapting to climate change is not only turning into a new priority issue on the sustainable development agenda in the Arctic both on national and international levels, but is also becoming a daily challenge for the northerners.

For several years in a row, natural disasters and extreme weather events have been among the top in the ranking of global risks presented annually by the international Global Risks report [The Global Risks 2019, p. 6]. As of today, there are no aggregate estimates of damage from natural disasters in the Arctic macro-region, and the national data available are not sufficiently systematized. For example, according to the 2017 report of Russia's EMERCOM, the damage from emer-

gencies (natural, man-made, and epidemics) in three Russian northern regions (Komi Republic, Nenets Autonomous Okrug, and Krasnoyarsk Krai) was estimated at about 775 million rubles (7 percent of total domestic damage from emergencies); by 2030, the RF environmental ministry forecasts that the annual damage from extreme weather in highly vulnerable Arctic regions of Russia could reach 4-5 percent of GRP[1], about three times higher than the national average[2]. Russian scientists estimate that by the year 2100, the damage from permafrost degradation due to global climate change could amount to 1.1-1.2 percent of the world's GDP; for Russia, specifically, by 2030, the annual damage (resulting from climate change in the Arctic) to constructions and housing alone would constitute around 200 billion rubles, or 2.5 percent of the GRP of Russia's Arctic [*Porfiriev, Voronina, Semikashev, Terentyev* 2017, p. 16]. According to international assessments, the global economic damage from natural disasters in 2017 amounted to $334 billion[3], while the World Bank's estimate was at $520 billion.[4] In the past two decades, 77 percent of natural disasters were caused by hydrometeorological factors, and the resulting economic damage had been at about $2,245 billion.[5]

An important characteristic of the Arctic territories with a low density of population is that natural disasters are a threat to human safety in populated areas of cities and villages, and are associated with risks to infrastructure and industrial facilities. In the Arctic wilderness, they are considered part of the natural cycle and usually do not call for any protective actions. However, the remoteness and isolation of many Arctic settlements make them particularly vulnerable and complicate search and rescue operations. In cases of emergencies, local resources and capacities are extremely limited: for example, emergency services in Greenland's municipalities located far from the capital have only a few teams of sled dogs.[6] In June 2017, three coastal villages were hit by a massive tsunami caused by landslides in the Nuugaatsiaq fjord (11 houses were swept away into the water, several people died). Limited local resources, remote location of the settlements, a lack of roads and difficulties in access from the sea delayed rescue operations in a situation when timing was critical.

Climate change is by far not the only factor of transformations in the Arctic. It is, however, closely interconnected with socio-economic, technological and institutional dynamics, and changes in international law – which are, in turn, driven by global and local challenges. This is why the consequences of climate change for society are increasingly often considered in conjunction with the impact of the Arctic transformations on socio-economic, institutional, and legal systems [Adaptation Actions for a Changing Arctic. Perspectives from the Barents Area 2017; Adaptation Actions for a Changing Arctic. Perspectives from the Bering-Chukchi-Beaufort Region 2017; *Lazhentsev* 2016; *Tatarkin, Zakharchuk, Loginov* 2015]. Their synergy has a multiplier effect on the sustainable development of the northern regions of the eight Arctic states. In the process

1 Gross regional product.

2 Davydova A. (2017) Russia to assess damage from upcoming bad weather // Kommersant. February 7, 2017 // https://www.kommersant.ru/doc/3212233, accessed 12.12.2019.

3 Wallemacq P. (2018) Natural Disasters 2017. Lower Mortality, Higher Cost, Brussels, p. 2.

4 Results Brief – Climate Insurance (2017) // The World Bank, December 1, 2017 https://www.worldbank.org/en/results/2017/12/01/climate-insurance, accessed 12.12.2019.

5 Wallemacq P. (2018) Economic Losses, Poverty & Disasters 1998–2017, Brussels, Geneva, p. 33.

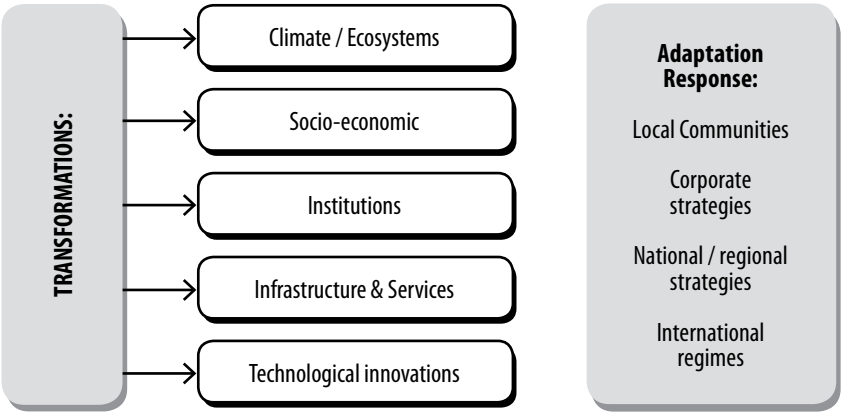
6 Veselov I.A. (2012) The First Legally Binding Agreement on the Arctic // Arkticheskie Vedomosti/The Arctic Herald. No 1. p. 54 // https://issuu.com/arctic-herald/docs/arctic-herald-1-full, accessed 12.12.2019.

of societal adaptation to the consequences of current and future climate change, it is essential to take into account the potential impact of all aspects of systemic transformations (Fig. 1), and when choosing a response to emerging risks/benefits from global warming, one should look broader and beyond just the climate component [*Leksin, Porfiriev* 2017]. It is important to consider the entire range of intertwining factors, as they determine the capacity of the northern regions and their stakeholders for responce actions to climate challenges [*Nikitina* 2013].

The consequences of climate change and the need to adapt to them have been increasingly often explored by researchers in the context of diversity of drivers towards transformations since the environmental and socio-economic changes are taking place simultaneously, affecting one another and forming complex causalities. The processes are closely interlinked, as are the adaptive responses to their effects. The issues of adaptation are often assessed within an interdisciplinary context [Adaptation Actions for a Changing Arctic. Perspectives from the Barents Area 2017; Adaptation Actions for a Changing Arctic. Perspectives from the Bering-Chukchi-Beaufort Region 2017], and application of a wide range of coordinated administrative, legal, institutional, political, socio-economic, scientific, technical and financial instruments is suggested within formation of adaptive governance system. When analyzing the chain of relationships between the drivers of change and the responses to their cumulative impacts, the role and weight of each is determined individually [*Adger, Arnell, Tompkins* 2005] depending on the local context. For example, the invasion of polar bears into the villages of Novaya Zemlya in the winter of 2019 is not only associated with the wild species habitat shift due to global warming, but also, and most importantly, with the fact that man-made food waste dumps turned out to be extremely attractive to these animals. Therefore, in this case, the solution to the problem lies not in trapping and transporting the endangered predators to remote areas, but in applying modern practices of sorting, storage and disposal of household waste – with the participation of the local population, as is done in most polar communities.

In practice, during decision-making process, when one ranks the role of cli-

Fig. 1. Synergy of Arctic Change



mate change, comparing it with the effects of other transformations taking place in the Arctic, it often appears that climate factors are not among the top priorities, and that preference is be given to other, more urgent problems. For example, according to a recent ranking of the key drivers of change (7) in the Barents region for a 30–50-year perspective[7] based on a survey conducted among experts and local stakeholders, climate change holds the fifth place. The drivers that ranked highest in terms of their priority were: economic changes and lifestyle transformations, political and institutional dynamics, and technological innovations [Adaptation Actions for a Changing Arctic. Perspectives from the Barents Area 2017]. Our analysis of current adaptation practices in the northern regions of Arctic countries shows that for many local governments the issues of climate change are not of a priority in contrast to education, jobs, pensions, healthcare, local transportation, infrastructure, and ensuring the safety of the population. Financial resources are allocated accordingly. While in the corporate strategies, the mining companies operating in the north increasingly consider the role of climate change, the dynamics of global commodity markets remain the dominant factor [*Nikitina* 2018]. So, in many cases, the ultimate decision with regard to adaptation options is dictated not by climate change concerns, but by other, more powerful factors. Such specifics is to be taken into consideration when designing futures adaptation strategies.

In the Arctic, the effects of global climate change are associated with a combination of possible risks and benefits [*Bengston, Nikitina* 2017]; according to most recent international assessments, most of climate change consequences pose considerable risks to the society (*IPCC, AMAP, SWIPA*). Among widely discussed advantages is the decline in the extent of the Arctic sea ice and the resulting better access to previously inaccessible areas, which, in turn, should present new opportunities for economic development. Changes in the Arctic sea ice are associated with the exploration of oil and gas of the continental shelf, the development of Arctic shipping and potential maritime transit routes between Europe and Asia, as well as of the relevant service infrastructure and tourism, including cruise ship tourism. Some point out the possible benefits of globalization for the sustainable development of the north, including new opportunities for investments, business, small and medium-size enterprises, job creation and socio-economic development. However, there is also a combination of factors that might limit making use of these new advantages in practice. These include the high risks and costs of extracting and transporting resources in harsh polar conditions, volatility of the global markets of energy and mineral commodities, the development of alternative energy sources, gaps in effective technologies for emergency oil spills mitigation, the tightening of environmental regulations and restrictions in the Arctic, insufficient climate services, unpreparedness of the Arctic infrastructure and services for a rapid expansion of economic activity in the region, as well as extreme weather conditions and the problem of icing on ships and offshore platforms. A detailed assessment of a set of all possible risks and opportunities and their interactions is a basis for selection of available adaptation options.

7 Factors of change: 1) climate, 2) socio-economic, 3) institutions and policies, 4) human potential, 5) technological innovation, 6) demographic dynamics, 7) ecology.

Adaptation: 'Living with risk'?

Adaptation is the process of adjustment to actual or expected climate and its effects, in order to either lessen or avoid harm or exploit beneficial opportunities for sustainable development [Climate Change 2014, p. 76]. Ensuring safety and security of the population and critical infrastructure is the top priority in the Arctic context. 'Living with risk' is an everyday reality and a lifestyle under severe polar conditions; in the future, this trend is likely to consolidate, while adaptation actions to diversify.

To be of a success, the adaptation process in the Arctic requires wise governance: most failures in responses to modern climate challenges are due to failures in selection of governance options. A typical example is dealing with emergencies and ensuring the safety of the population and infrastructure during floods in the basins of northern rivers. Past experience shows that the problem cannot be solved exclusively by emergency rescue teams acting quickly and professionally. An effective response requires a package of integrated institutional and governance solutions towards natural disaster risk reduction,ensuring (a) preparedness, (b) search and rescue, (c) recovery after the event, and (d) risk prevention. Rescue operations are carried out in combination with coordinated efforts by administrative structures. The latter involves interacting with the affected local population, regular disaster alerts and the evacuation, preventing cases of looting in flooded areas, and rehabilitation actions. It also includes efforts to minimize risks by ensuring that the hydrotechnical infrastructure is reliable and in operating condition, that its construction was completed in full compliance with safety standards, that riverbeds are regularly cleaned up, etc.

Currently, the issue on the agenda is to form an *adaptive govrrnance* system that is characterized by a polycentric approach [*Ostrom* 2007] – namely, by the coordinated governance schemes that involve (a) a set of mechanisms and instruments at various levels (local, regional, national, international), (b) key stakeholders taking part in adaptation (the state, local governments, businesses, the population, nonprofit organizations, funds, etc.), (c) high flexibility of institutional structures under the uncertainty of future change and its impacts. Partnerships that coordinate actions across different levels and between actors to achieve common goals are becoming an integral part of adaptative governance. This model is already started to be employed in adaptation practices of the Arctic countries. Due to dynamic environmental and socio-economic transformations in the Arctic, the emerging adaptive governance systems are likely to be flexible enough to adjust to the uncertainties of the new challenges [*Young* 2017] and ensure that institutions are manoeuvrable enough and complex interdisciplinary solutions are able to deal with a variety of surprises from transformations. Adaptative governance presupposes taking into account the local context of the polar regions, their natural, socio-economic circumstances, adaptation capacities, and sustainable development priorities [*Pahl-Wostl, Lebel, Knieper, Nikitina* 2012, p. 25]; that said, the assessment of needs and priorities of the local stakeholders are extremely important in this errand. It is slightly possible that universal recipe for adaptation would be a perfect panacea to fit all northern provinces and communities of the eight Arctic countries: each should take into account the local context as much as possible. Only then can they be truly useful. Naturally, adapting the local population and economic sectors to extreme polar conditions has been and remains a 'traditional' way of their survival. There is a great deal of knowledge and a variety of practices accumulated over the years that are to

be taken into account in decision-making. A combination of formal institutional regimes with informal practices that the local population relies on in emergency situations can greatly reduce risks [*Corell, Kim J. D., Kim Y. H., Moe, VabderZwaag, Young* 2018, p. 165].

Formation of adaptive governance system in the Arctic states involves a combination of regulatory mechanisms, economic and institutional tools, and structural measures. *Strategic planning* is at the core of the system. Most countries have either enacted strategies for adaptation to climate change, or adaptation is incorparated into climate action plans. For example, there are special adaptation programs developed in the polar regions (Canada's First Nation Adaptation program). Some Arctic territories implement regional adaptation action plans (Alaska in the United States, Tromso in Norway); a number of regions have joint programs with neighboring territories (Canada's collaborative strategy for adaptation and partnership between the governments of Yukon, Nunavut, and Northwest Territories). Both Alaska and northern provinces of Canada have introduced adaptation plans for individual settlements.

A characteristic feature of adaptive governance in all northern regions is the use of *structural measures*[8] that are particularly useful for reducing disaster risks [*Birkmann, Teichman 2010*]. This practice has diverse applications. For instance, in Alaska, there is extensive engineering work carried out to strengthen the coastal settlements. In Svalbard, after a series of avalanches resulting in human losses mountain slopes near settlements in avalanche-prone areas were reinforced. In Canada, roads and runways are treated with innovative surface materials; thermosiphon foundations for buildings and roads are used to stabilize the active permafrost layer. Flood protection through structural measures is a key element of adaptation in the northern parts of Finland and Sweden. Flood damage prevention plans have been developed for major river basins and include spatial planning measures, technical codes and regulations, construction permits, compliance monitoring, upgrades of hydraulic structures and regular flood control works [*Tennberg, Vuojala-Magga, Vola, Sinevaara-Niskanen, Turunen* 2017]; all practical measures are in line with the requirements of the *EU Water Framework Directive* and the *EU Floods Directive*. Prevention of risks in areas with relatively high population density requires additional engineering measures, including protective constructions, reinforced infrastructure, strengthening the foundations of buildings, and banning construction in the regularly flooded river valleys. Strict monitoring of land use, construction and settlement standards in flood-prone areas helps reduce damage. Prevention of emergencies through structural measures is one of the priorities for the economic sectors, including transportation and infrastructure, pipelines, power networks and in construction. According to *Zurich Insurance Group*, the cost of addressing the consequences of natural disasters, especially floods, is usually 9 times higher than the cost of preventing them[9].

The practice of using *economic tools* in the Arctic regions adaptation actions

8 Structural measures for disaster risk reduction include a set of engeneering, construction and technology tools for enhancing safety and stability of infrastructure; for example, in flood mitigation they involve dams, flood levies, ocean wave barriers, permafrost thaw- and erosion-resistant construction and evacuation shelters // http://www.preventionweb.net/terminology/view/505, accessed 12.12.2019.
9 Szoenyl M. (2018) Flood Resilience Alliance 2.0: A Look at Five Years of Supporting Communities Building Resilience against Floods // Zurich Insurance Company, March 7, 2018 // https://www.zurich.com/en/knowledge/articles/2018/07/flood-resilience-alliance-2, accessed 12.12.2019.

shows a lot of promise. These include *inter alia* subsidizing local agricultural products as, for example, in Alaska, northern provinces of Canada, and Chukotka. Many regions use economic tools to stimulate the production of traditional products by individual farms or launch initiatives to expand the range of products of reindeer herding and hunting. Authorities support job creation in new markets of local services and small businesses in tourism sector. Insurance and reinsurance in case of natural disasters are expanding; climate factors are taken into account when developing insurance products. For example, in Norway, which has comparatively developed system of natural disaster risk insurance, there was a public-private partnership established in 2018 between the Directorate for Civil Protection and Emergency Planning, the Ministry of Finance and the insurance sector to help minimize disaster-related damage[10]. In 2017, the coverage by insurance companies for cases related to damage from floods and other natural disasters amounted to about $168 million.[11]

The creation of a new market of infrastructure services in the Arctic is another important innovation. Among its segments - provision of *climate services* to consumers in the polar regions and establishing specialized climate services centers. An international EC research project *Blue-Action*[12] is currently analyzing the prospects for the regional market of climate services, and performs inventory of stakeholders needs for those services [*Kuznetsov, Nikitin, Baronina* 2019, p. 65]. For example, one of the goals is to provide climate services to adapt fisheries strategies depending on the modeling of ocean surface temperatures. Another objective is to develop reliable ways of informing the owners of ski resorts in northern countries about the expected rates of snow accumulation in the upcoming season. In the Arctic, the formation of a regional emergency preparedness system has started, which includes search and rescue operations at sea, as well as joint operations in case of emergency oil spills. The first steps in this direction were taken within the framework of the Arctic Council, following the signing of the relevant regional agreements.[13] A number of bilateral programs are being implemented by the Arctic countries in response to possible risks of climate change and the expansion of economic activity in the region.

However, there is a number of obstacles for success of adaptation actions in the Arctic. Among them is the lack of *financial* resources in the northern regions and municipalities to cover the costs of detailed assessment of the local effects of climate change and carry out response measures. These actions are often funded from whatever is left after all other costs are accounted for – unlike socio-economic programs which often receive priority funding. In some cases, corporate strategies (for example, social responsibility and sustainable development) executed by companies operating in the North directly or indirectly support local adaptation projects. But the issue of limited funding available for adaptation is typical not only for the North – it is a general current trend in climate financing. A similar problem can be observed within the European Union. For example, under the climate

10 The purpose of the partnership is to create a joint data bank on natural disasters, disaster-related damage, climate change assessments, and insurance for citizens to support the work of local governments in disaster risk and damage reduction.

11 Cook R. (2018) Civil Protection and Finance Sector Join Forces in Norway // PreventionWeb, February 26, 2018 // https://www.preventionweb.net/news/view/57227, accessed 12.12.2019.

12 Blue Action. Climate Service Case Studies Booklet, 2018. Blue-Action: Arctic Impact on Weather and Climate, European Commission, Horizon-2020 Program // https://www.blue-action.eu, accessed 12.12.2019.

13 Agreement on cooperation on Aeronautical and Maritime Search and Rescue in the Arctic, 2011; Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic, 2013.

financing[14] of the EU Multiannual Financial Framework 2014-2020, the bulk of the funds are allocated for the transition to low-carbon development and reduction of GHG emissions, while adaptation[15] receives only a relatively small proportion of all funding[16]. In mid-2010s, there was also a disparity in resource mobilization at the global level: in 2014, as little as 16 percent of all funding was directed to adaptation, while 84 percent had to do with GHG emission reductions[17]. Other limitations for adaptation include institutional aspects of adaptive governace systems in the Arctic countries, such as the lack of a clear *division of responsibility* between agencies and offices, gaps in coordination, overlapping tasks and activities, and deficit of *control and verification* over the execution of adaptation plans. Finally, some of the major obstacles have to do with *limited information*, *uncertainties in scientific models* of climate change, inability to predict long-term societal effects of climate change and inadequate taking into account the local context along with the rich traditional experience and knowledge about climate change impacts on their well-being. All of the above creates barriers to decision-making and selection of effective responses to the Arctic challenges.

The Paris Agreement

Adaptation to global climate change is becoming an important new area of international law and regulations. Until recently, adaptation was not a priority of climate policy, and adaptation actions were fragmented. Currently, the main climate change international regime is the 1992 United Nations Framework Convention on Climate Change (UNFCCC) with its protocols - the 1997 Kyoto Protocol and the Paris Agreement replacing the latter since 2020.[18] The core feature of the Paris Agreement is that, in addition to measures aimed at *GHG emissions reduction*, it also regulates *adaptation to climate change*. Now these are the two main areas of climate change international regulation, including in the Arctic region.

The Paris Agreement establishes a long-term global goal of carrying out policy and measures to enhance adaptive capacity, strengthen resilience and reduce vulnerability, with a view to contributing to sustainable development (Article 7., item 1). It describes adaptation as a global challenge "faced by all with local, subnational, national, regional and international dimensions, and a key component to the long-term global response to climate change to protect people, livelihoods and ecosystems"; adaptation measures take into consideration the individual characteristics of countries and regions, and "vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems" (Article 7,

14 Up to 20 percent of the European budget expenditures are expected to be earmarked for climate action.

15 Adaptation measures are integrated into the EU policies regulating individual sectors; the process is carried out using the European funds system (structural and investment funds, regional development funds, social funds, agricultural funds, maritime and fisheries fund, etc.). Adaptation is also integrated into the financing system; the European Investment Bank and the European Bank for Reconstruction and Development provide loans for the cause; the Horizon 2020 program funds research on adaptation.

16 Climate Action. Financing Adaptation // European Commission // https://ec.europa.eu/climate/policies/adaptation/financing_en, accessed 12.12.2019.

17 D. Waskow, Jennifer Morgan J. (2015) Paris Agreement: Turning Point for a Climate Solution // World Resources Institute, December 12, 2015 // https://www.wri.org/blog/2015/12/paris-agreement-turning-point-climate-solution, accessed 12.12.2019.

18 As of today, all Arctic countries had ratified the Paris Agreement; in 2017, the United States announced its intention to withdraw its ratification from the Paris Agreement.

items 2, 5)[19]. The main provisions of the agreement are in line with the adaptation priorities of the northern regions and the Arctic agenda: its goals dealing with climate challenges for the most vulnerable population groups and territories are particularly important for the Arctic regions. The need to strengthen the resilience of local populations, including indigenous people highly sensitive to impacts of climate change, whose lives, households and daily activities are dependent on nature and are vulnerable to extreme natural disasters – is a key focus of this international agreement.

The role of the Paris Agreement in strengthening the adaptation capacity in the Arctic is to set a common format and promote for the Arctic provinces to better structure their approaches and climate actions. It serves as a driver for the development of adaptation policies, for selection of the most effective adaptation instruments depending on the local context. In compliance with its provisions the member states develop national adaptation plans, implement appropriate policies and measures, and constantly improve their design. The Paris Agreement provides for dynamic adaptation planning and selection of optimal options within five-year cycles introduced by the agreement. It also proposes flexible regulatory mechanisms based on periodic assessment of national adaptation policies: every five years, the results of adaptation activities are evaluated and action plans are formulated for the next period.

The northern regions take part in the implementation of national commitments under the global climate regime, including their contributions to national communications and regular reporting on meeting their climate goals and actions undertaken. Impacts of climate change and responses in particularly vulnerable areas are then assessed, followed by international exchange of good practices. For the Arctic regions, in particular, highly relevant are the provisions of the Paris Agreement dealing with the prevention of damage and losses from natural disasters, including early warning systems, emergency preparedness, rescue and evacuation of affected population, rehabilitation of territories, as well as risk assessment and risk management. These measures are part of the regional climate policies currently developed by most Arctic countries. As obligations of the member states envisage the submission of climate reports, the international standards define a common format and procedures for the national inventory of adaptation measures taken. The 'climate adaptation' section of national communications by the Arctic countries to the UNFCCC secretariat contains the following data: (1) assessment of the risks and consequences of climate change for territories, economic sectors, and populations; (2) policies; (3) strategies; (4) programs; (5) adaptation mechanisms, instruments and measures; (6) climate services provided to consumers; (7) results of scientific research; (8) meeting the adaptation plans and assessment of issues encountered; (9) international cooperation; (10) assistance to developing countries. All eight Arctic countries regularly report on their inventory of climate actions, including adaptation. Their most recent national reports were submitted in 2017[20] and contain information and assessments for their polar regions.

19 The Paris Agreement. The United Nations Framework Convention on Climate Change. 12.12.2015 FCCC/CP/2015/L. 9

20 All 8 countries of the Arctic region are included in Annex 1 (43 members, including the EU) of the UNFCCC; since 1994, they have submitted 7 national reports on climate change.

When developing their strategies of climate action, the Arctic countries take into account the specific feautures of their northern regions. There is a certain imbalance between the anthropogenic input of these regions to global warming, on the one hand, and the extent of observed climate change impacts within these territories, on the other. The role of the northern provinces of the Arctic countries in national GHG emissions is modest, as none of them are major emitters. For example, in the US and Canada, ranking accordingly 2nd (14.3 percent) and 10th (1.5 percent) in global emissions – the share of their polar regions in national emissions output is insignificant. According to Canada's latest national communication on climate change, the total share of its three northern provinces (Yukon, Northwest Territories, and Nunavut) in domestic CO_2 emissions in 2015 was only 0.3 percent of the national total [Canada's Seventh National Communication 2017, p. 48]. Alaska's share in US emissions in 2015 accounted for 0.63 percent, and it ranks 40th among other US states[21]. According to the GHG emission inventory from the northern regions of the Arctic countries, the main sources here are industries, including oil/gas energy production, transport, and also households. Share of emission sources from wastes and agriculture in the overall emissions profile of the northern territories are relatively small (in Alaska – about 1 percent for each source). Due to such regional specifics, the adaptation actions might be of a priority over mitigation measures wthin the climate policy of the northern territories. Assessment of local context and adaptation challenges of the northern stakeholders, their interests, needs and action is essential for selection of effective adaptation mechanisms and tools in the North.

The formation of a new international regime on global climate change is currently among top priorities on the international agenda, especially among the EU states. However, in recent years, there has been an increasing risk that political factors may hinder the implementation of global climate goals and adaptation actions. For example, in the summer 2017 Donald Trump announced his intention[22] to withdraw from the Paris Agreement by revoking the US ratification. It provoked extremely negative stance in Europe and elsewhere, and was also strongly criticized by many of the US politicians, citizens, business circles and the scientific community. The governors of several US states responded by forming the United States Climate Alliance, committed to implementing actions to meeting the Paris goals . Despite the US administration's decision to withdraw from the agreement, local authorities and states have been consistently taking climate actions: a significant number of the US cities, states, and companies support meeting the GHG emission reduction targets. Alaska is among them, and has developed its own strategy for climate change mitigation and adaptation. It includes an action plan for reducing GHG emissions, participating in the North American carbon trading system and in climate change adaptation[23].

21 Greenhouse Gas Emissions Inventory 1990–2015 (2018) // Alaska Department of Environmental Conservation, January 30, 2018 // http://dec.alaska.gov/air/anpms/projects-reports/greenhouse-gas-inventory, accessed 12.12.2019; Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2015 (2017) // EPA, April 2017 // https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2015, accessed 12.12.2019.

22 According to Article 28 of the Paris Agreement, withdrawal of a party from the agreement must be carried out by giving written notification to the depositary not earlier than 3 years after the agreement enters into force for the relevant party; formal withdrawal of the United States can take place in 2020, but during the 'interim' period the country must comply with its obligations.

23 Alaska Climate Change Action Plan Recommendations to the Governor. September 2018. Climate Action for Alaska // http://climatechange.gov.alaska.gov, accessed 12.12.2019.

Adaptation in Arctic Countries

In the past decade, Arctic countries have started to develop policies and measures aimed at adapting to the effects of climate change. They are characterized by a number of common features and regional specifics. In the sections below, we present an analysis of North American (Canada) and Western European (Norway) experiences and practices of adaptation to climate change. The analysis focuses on the main trends in formation of domestic adaptive governance, including the development of policies and measures at various levels, institutional organization and coordination, the role of stakeholders, as well as the approaches and priorities of adaptation in the Arctic.

Analysis of adaptation practices by the Arctic countries over the past decade indicates that they have started designing a system of mechanisms and instruments for adaptive governance that combines traditional methods for enhancing resilience of societie with innovative tools. These tools include: (1) assessment of risks and consequences for individual territories and stakeholders; (2) state regulations, adoption of legislation, construction standards and norms; (3) measures to prevent and reduce hydrometeorological risks, protect the population and critical infrastructure in case of natural disasters; (4) strategies and programs, territorial planning that accounts for climate factors; (5) institutional structures; (6) economic tools; (7) new types of products, services, marketing; (8) coordination, partnerships, cooperation; (9) scientific research and monitoring; (10) innovations in technology and engineering.

CANADA

Approaches and results of adaptation in the northern provinces of Canada are of particular interest. Warming of climate in Canada, which is especially fast in the northern regions, is associated with risks to the local communities and health of the northerners, as well as to economic sectors.. Canada's top priorities in these territories include ensuring safety and well-being of its citizens, preventing damage to critical infrastructure, and providing climate services. Policymaking, strategic planning and carrying out of adaptation measures take place at the level of provinces, including its three arctic provinces – Yukon, Nunavut, the Northwest territories (NWT), as well as by the northern municipalities and with support from the federal level.

To implement the Paris Agreement ratified by Canada in 2016, the Pan-Canadian Framework on Clean Growth and Climate Change was adopted, which aims to (1) strengthen resilience to climate risks and (2) promote low-carbon development. In 2017, a five-year plan for financing the adaptation and development of 'green infrastructure' was approved, including creation of the Disaster Mitigation and Adaptation Fund, and programs for strengthening critical infrastructure. Domestic strategies are formed with due regard for specific features of the Arctic territories and with participation of local stakeholders. Arctic provinces, territories, and associations of indigenous people are involved in developing strategies and implementing specific measures – territorial planning, infrastructure innovation, mapping, and risk assessment. Many companies operating in the north are now integrating climate change into their corporate strategies and investment programs in order to strengthen their sustainability and competitiveness. The banking sector now factors the climate change in the risk reports. For example, the *Toronto-Dominion Bank* and the *Royal Bank of Canada* are among 14 international banks participating in the UNEP Finance Initiative to help financial institutions improve their climate risk assessment systems.

There is a fairly coherent institutional system of coordination and strategic planning being formed on many levels, which deals with adaptation policies and measures and involves, among other items, the interaction between stakeholders. The focus is on the sustainable development of the northern territories and coastal areas. This type of coordination is among the first examples in the government regulatory system in Canada. At the federal level, regular funding for adaptation programs formally started in 1998 with support of research and assessments of climate change and its impacts; their results were used to develop investment programs, coordinated among provinces, municipalities, and indigenous communities. The Ministry of Natural Resources launched the Adaptation Platform to bolster partnerships between stakeholders. The Standards Council has been implementing two new programs – Standards to Support Resilience in Infrastructure and the Northern Infrastructure Standardization Initiative – aimed at developing norms and standards for weather and climate data-sets and climate change modeling in the regions. Currently, Canada is in the process of preparing the Northern Adaptation Strategy, the purpose of which is to coordinate investment and practical actions in the North. Strategic planning is based on detailed assessments of the climate change impacts in the provinces and coastal areas, and also of possible risks and opportunities for the specific economic sectors and indigenous communities[24]. Recently, a study launched in cooperation with the Arctic provinces (NWT and Nunavut) assessed the vulnerability of the engineering infrastructure of three polar airports (Churchill, Inuvik, Cambridge Bay). The Yukon government is developing new methods for assessing the financial consequences of permafrost thawing, and is conducting engineering work to construct and maintain infrastructure.

Key priorities of Canada's adaptation strategy include further development of polar research and innovative technologies. A special legislation on scientific research in the Arctic was enacted, as well as a work program for 2014-2019.[25] Climate services is an emerging sector, which involves the development of information products and services aimed at the needs of the end users. In 2017, the center for Climate Services was established to provide consumers with climate data and results of simulations. At the same time, northern provinces are actively developing a much-needed regional climate service system. For example, Yukon's priorities include conducting monitoring and assessment programs to select investment options for infrastructure development and enchance safety of local population during natural disasters. Local stakeholders are provided with a regular access to special forecasts and information about the risks of flooding.

All Arctic provinces and territories independently or jointly with the federal authorities implement adaptation measures. These include provincial adaptation strategies, funding of research and technological development, risk assessments, disaster prevention, land use and settlement spatial planning, investments into critical infrastructure, refining of building codes, etc. The goal of the current Yukon climate strategy is to ensure that local settlements are resilient to the effects of climate

24 From Impacts to Adaptation: Canada in a Changing Climate, 2014; Canada's Marine Coasts in a Changing Climate, 2016; Climate Risks and Adaptation Practices for the Canadian Transportation Sector, 2017.

25 Canadian High Arctic Research Act, 2015; Polar Knowledge Canada's Pan-northern Science and Technology Program Priorities for 2014–2019.

change. In 2015, a report on the implementation of the five-year action plan on climate change was prepared[26]. The Northwest Territories is developing a framework regional climate strategy that combines climate adaptation and climate mitigation measures. The province of Nunavut has focused on strengthening its adaptive capacity, population safety, as well as economic and infrastructure development. In land-use planning, standard assessment methods are used in combination with traditional knowledge on the environment and climate of the polar regions. In recent years, the climate change Secretariat in the government of Nunavut has implemented a series of adaptation projects, including the organization of a permafrost databank and a center for climate risk information. The Canadian system of adaptive governance at the federal and provincial levels is complemented by the coordination of adaptation projects of the northern municipalities, realised as part of the Municipal Adaptation Action Plan. Associations of indigenous peoples play an active role in Canada's climate adaptation system.

In recent years, Canada has seen an increase in climate change adaptation financing. For example, in 2016, the federal government increased funding for these programs up to $245 million (scientific research, healthcare, indigenous people of the north, economic sectors, building polar codes, adaptation by municipalities); in 2017, the adaptation budget was supplemented[27] by an additional $260 million for a five-year period[28]. Starting from 2017, climate projects face an increase in funding for 'green infrastructure' ($21.9 billion)[29], including for the implementation of bilateral agreements with the Canadian provinces and territories ($9.2 billion) and for support of infrastructure projects of the Disaster Mitigation and Adaptation Fund ($2 billion) [Canada's Seventh National Communication 2017, p. 193]. In 2016, Canada's climate assistance to developing countries through multilateral and bilateral channels amounted to $242 million: most of the funds were allocated to adaptation programs in comparison to the projects aimed at GHG emissions reductions[30].

NORWAY

In Norway, the main features of its emerging adaptive governance system are similar to those of other Scandinavian countries (Finland, Sweden). The development of a national adaptation policy is in the competence of executive ministries and agencies, while the implementation of practical measures is delegated to local municipalities, since they are responsible for local socio-economic development, for functioning of infrastructure, and for territorial planning. Coordinating the actions of municipalities is formally entrusted to regional structures, primarily to regional governors. In 2017, the Norwegian Parliament, the Storting, approved the Climate Change Act, containing norms to regulate adaptation and climate change mitigation. The national climate adaptation policy is based on the White Paper 'Adaptation to climate change in Norway', adopt-

26 Yukon Government. 2015 Climate Change Action Plan Progress Report, Whitehorse.

27 Programs aimed at helping the communities of the north by strengthening infrastructure sustainability, improving disaster risk prevention, providing climate services, and boosting infrastructure innovation.

28 Building a Strong Middle Class. Budget 2017 (2017) // Government of Canada // https://www.budget.gc.ca/2017/docs/plan/budget-2017-en.pdf, accessed 12.12.2019.

29 Additionally, it is planned to allocate $5 billion to green infrastructure programs through the Canada Infrastructure Bank.

30 In the period between 2015 and 2016, annual funding for international assistance to adaptation programs was approximately 15 times higher than that provided for measures to reduce emissions; there was an increase in assistance for adaptation, from $36.1 million in 2015 up to $45.5 million in 2016 [Canada's Seventh National Communication 2017, pp. 213, 236].

ed by the Norwegian Parliament in 2013; it defines the key challenges and actions in response to climate change risks[31]. This started the creation of a system of adaptive governance at the national level and in the Arctic regions – Troms, Finnmark, Nurland, and in Svalbard. Municipalities continue to work on integrating adaptation measures in their strategic planning.

Norway, which positions itself as one of the safest and most prosperous countries in the world, defines climate change adaptation as one of its national priorities – namely, aimed to ensure security by reducing risks, preventing and protecting against natural hazards. Among the key risks in its northern regions are the increase in the frequency and intensity of storms, floods, avalanches, erosion and landslides, sea level rise, changes in precipitation and sea temperature. The recently adopted White Paper 'Risk in a Safe and Secure Society' considers the consequences of climate change as one the major threats to Norway's security. Due to specific priorities of Norway, the main focus of adaptation is on planning territorial development and land use, ensuring the preparedness of municipalities for natural disasters and emergencies, and strengthening the civil security systems[32].

The national climate change adaptation strategy of Norway involves an integrated assessment of possible risks and benefits, as well as a set of potential responses cross-cutting various levels, economic sectors and stakeholder groups. It stresses the responsibility of each stakeholder – both private and public – for assessing risks and taking actions to reduce or prevent a disaster. The scope of responsibility and details on practical measures are specified in a series of acts adopted by the Norwegian Parliament according to concrete directions and sectors, i.e. protection from natural disasters, floods and landslides, ensuring health and quality of life, forestry, agriculture, reindeer husbandry and transportation networks. Relevant amendments were made to legislation on land use, natural resources, water, forestry, agriculture, infrastructure, insurance, and food security.

Partnerships and coordination of responses to climate challenges are at the core of Norway's national system. The Ministry of Environment and Climate is responsible for implementing adaptation policies and measures; the Environment Agency is responsible for inter–agency coordination and interactions between economic sectors and stakeholders. Since one of the priority tasks is to ensure safety in emergency situations, interaction has been established between relevant specialized agencies. Public protection measures, planning of concerted action in emergencies, prevention and reduction of natural disaster risks are all carried out in tandem by the Directorate for Civil Protection and the Ministry of Justice and Public Security. The Ministry of Energy is responsible for reducing risks from floods, avalanches and landslides, and coordinates its actions with the executive body, the Water Resources and Energy Directorate. The latter helps municipalities with risk mapping, disaster prevention, territorial planning, funding and expertise in implementing structural measures and engineering and construction of protection facilities. The governors of the polar regions are responsible for coordinating and supervising the actions of municipalities with regard to adaptation. This goes for risk assessment, monitoring the application of building codes, road construction standards, and organ-

31 Norwegian Ministry of the Environment, 2013. Climate Change in Norway – Meld St.33 (2012–2013) Report to the Storting (White Paper), Ministry of the Environment, Oslo.

32 Norway's Seventh's National Communication under the Framework Convention on Climate Change, 2017. Norwegian Ministry of Climate and Environment, Oslo, Norway, p. 117.

isation of disaster alerts, protection, and rescue in emergency situations. For example, the Governor of Svalbard is responsible for making decisions and organizing rescue operations in case of emergencies; a team of professional rescuers and a fleet of rescue equipment are available for prompt deployment. In Norway, the responsibility for adaptation efforts in most cases lies with the local authorities, which is why, when assessing risks and vulnerabilities of specific territories and developing appropriate response measures, they are required to take into account the climate factor[33].

The practical insights accumulated in a course of implementation of of Norway's adaptation policies and measures present an interesting evidence.. For example, the climate change factor is included into the methodology for mapping and assessing the flood risks parameters. These methods are a part of the dam safety manual, which has recently been used in inventory of potentially insecure dams; decisions on land use, urban and settlement planning and necessary protective measures are verified against its norms and standards. There are detailed guidelines on flood and landslide risks reduction in the areas of small mountain rivers. A system for sea level monitoring has been established, which provides information and operational data on emergency situations related to coastal flooding. A national warning system for extreme weather events, floods, avalanches and landslides is being created for the transport sector. The Norwegian coastal administration is assessing the risks and vulnerabilities of coastal areas in order to adapt existing infrastructure projects to impacts of climate change. Like in Canada, much attention has been paid to the development of climate services. In 2013, the Norwegian Climate Service Center was established to provide services to municipalities and industries. In 2015, the center developed a review report on the climate of Norway until 2100, and started preparing disaggregated estimates and climate profiles for individual areas.

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Experience, insights and the innovative institutional approaches utilized by the Arctic countries in developing adaptation policies and measures are particularly relevant for the contemporary Russia. Russia's national strategy for climate change adaptation has been adopted at the end of 2019. It becomes an integral part of the national climate doctrine and the corresponding national action plan. It is expected to consolidate coordination between Russia's northern regions in implementing their climate change adaptation policies and measures in the Arctic. Its main focus is to assess a combination of risks and benefits from climate change, develop a methodology for calculating potential costs and damage to regions and economic sectors and risks for the northerners, and to develop a package of innovative measures and scenarios for climate change adaption. Russia's approach to adaptation aims to minimize and prevent negative consequences, and involve Russian regions and businesses in implementing adaptation programs that are particularly important for sustainable development of Russia's Arctic areas. These trends are in line with the ongoing efforts to tie together activities carried out within the frameworks of the core national projects and government programs, the corporate investment strategies in the North, and programs for the development of the

33 Norwegian Ministry of the Environment, 2010. Society's Vulnerability and Adaptation Needs to Consequences of Climate Change. Official Norwegian Report, NOU. Ministry of Climate and Environment, Oslo, Norway, 2010, p. 10.

Arctic regions, the pillar zones and urban areas. A new national strategy for the development of Russia's Arctic until the year 2035 is being prepared, as well as a bill that would create a system of preferences for the investors in the Arctic territories. Taking into account the best foreign practices and climate change adaptation insights from across the Arctic is a promising challenge for the northern regions. This, combined with international exchange of innovative approaches to climate change assessments and of research results on climate variability in polar regions, accumulated by the world-famous Russian scientific school of climatology, would promote for strengthening international cooperation in climate adaptation in the Arctic. In 2021, Russia will assume presidency of the Arctic Council, and would likely to focus on the climate adaptation issues and transformative change in the Arctic, making it one of the priorities of the perspective international cooperation agenda for the region.

Russia signed the Paris Agreement in 2016, and ratified it in 2019. In terms of climate adaptation policies, Russia holds a relatively strong international position and its adaptation profile demonstrates a number of significant advantages. In this area, Russia accumulated considerable experience and a set of innovative practices, including the emergency early warning systems, methods of emergency search and rescue, structural measures in natural disasters mitigation, and integrated climate risk assessment and management are applied. Its track record in adaptation to climate change impacts that are extremely diversified due to its vast territories and a variety of environmental contexts, including those in its Arctic regions, and insights from adaptation practices in the north are among important drivers for wider regional exchange and further development of international cooperation within the Arctic climate change agenda.

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