Green Building in Arctic Region

Subjects: Engineering, Civil

Contributor: Lucrezia Ravasio , Svein-Erik Sveen , Raymond Riise

Nowadays, buildings are a large contributors to climate change due to their significant global energy consumption and greenhouse gas emissions. Since in the Arctic Region the effects of climate change are amplified and lead to global consequences, governments and international organizations are developing solutions to promote sustainable constructions, hence reducing the impact of buildings on the environment.

Arctic, Green Building, Sustainable construction

1. Introduction

In recent decades, the consciousness of the impact of human activity on the natural environment has grown. This awareness has affected the construction industry, highlighting the link between *sustainability* and *environment* and thereby giving it strength and momentum [1]. The green movement, having spread in all fields of society, has led to the emergence of worldwide, national, and local programs advancing green principles in both construction and home-building sectors [2]. Indeed, studies show that buildings play a significant role in climate change.

The term *climate change* generally refers to the long-term shift in global or local climate patterns, usually identified with the rise of average temperature over the years, owing to human activities. Among all the regions of the planet, because of its special physical and geographical properties, the Arctic is experiencing the most severe effect of climate change through greater and more rapid rise of average temperature [3]. The *Arctic Region* is commonly defined as the area north of the Arctic Circle (66°32′ N), or as the area north of the 10 ℃ July isotherm as shown in Figure 1a. Alternatively, it can also be defined by vegetation or oceanographic characteristics. In this review, the definition used by the Arctic Monitoring and Assessment Program (AMAP) is adopted [4]. It considers the area delimited by the tree line as shown in Figure 1b. The arctic climate is typically characterized by extreme seasonality and variation in temperature and precipitation, strong gradient in latitude solar, and UV radiation [5]. In addition, low temperatures lead to an extensive and permanently ice-covered or frozen ground, i.e., *permafrost*, which makes the region vulnerable to climate change. Warming of the Arctic and consequent melting has global implications, such as alteration of global ocean circulation, sea level rise, and release of methane and carbon dioxide trapped in the permafrost, i.e., gases that are feeding and accelerating the process of temperature-rise [6].

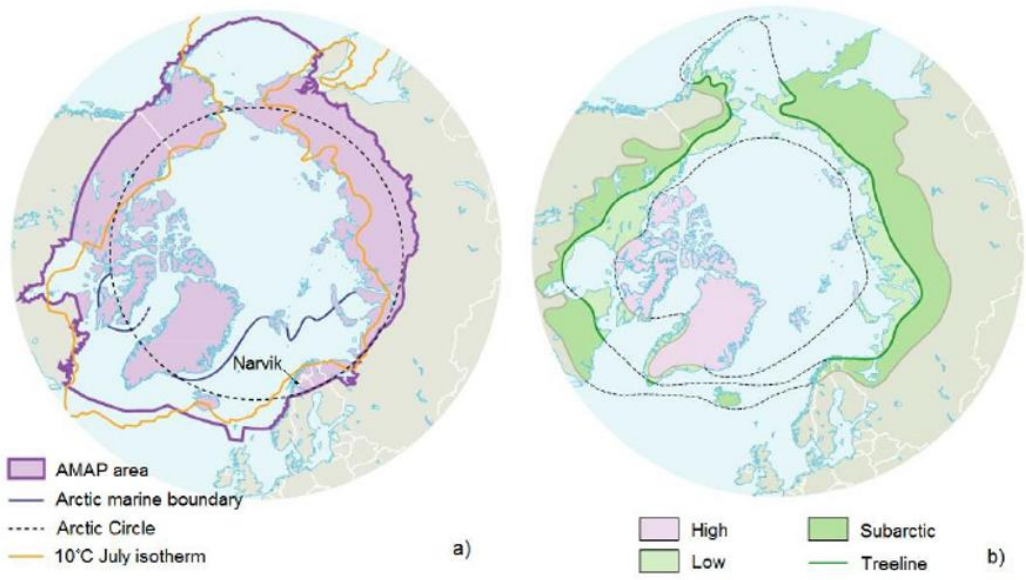

Figure 1. (**a**) The Arctic defined by the 10 °C July isotherm. (**b**) Arctic floristic boundaries [7].

According to the Global Status Report of 2019 [8], buildings and constructions together account for 36% of global energy use and 39% of energy-related carbon dioxide emissions in 2018. This makes buildings the largest contributing sector to global warming. The same report declares that, due to the strong floor area and population expansions, total global energy consumption in buildings in 2018 increased 1% from 2017. In perspective, Green Buildings become a potential strategy and investment to limit demand and reduce energy intensity. In fact, through the introduction of new building codes and adoption of advanced certifications for high-energy performance, all participants in the building and construction value chain are globally contributing to decarbonization of building stocks and to the improvement of building's energy performances.

By definition, a *Green Building* is a high-performance building with a reduced negative impact on the natural environment and human health [9]. This is achieved by applying measures that take into account the building location, as well as water, energy and material use efficiency, resource conservation, indoor air quality, building operation, and maintenance over the entire building life-cycle [10]. Green Buildings also provide benefits from an economic and social perspective, through lower building life-cycle costs and improved comfort and well-being of their occupants [11]. This promising solution is also expressed in different building concepts related to sustainable and environmental design such as net and nearly zero-energy buildings, zero-emission, zero-carbon, and carbon-neutral buildings [12].

With this backdrop, policies aimed at safeguarding and protecting the arctic environment represent a challenge of paramount importance for the region at the present and for the future [13]. Governments with territories in the Arctic —Norway, Sweden, Finland, Denmark, Iceland, Russia, Canada, and United States—are closely involved in the development of new initiatives both locally, with national legislation, and globally, through the *Arctic Council*. Established in 1996 with the Ottawa Declaration, the Arctic Council is an intergovernmental forum promoting cooperation, coordination and interaction among the Arctic States [14]. The Arctic Cooperation also includes the European Union, the Nordic Cooperation, the Barents Cooperation, and the United Nations [15].

2. Sustainable Buildings and Construction Policies

Worldwide, climate change actions and policies are primarily driven by the Paris Agreement. Established in 2015, the Paris Agreement, signed by 190 countries, sets out a global framework of targets to [16]:

1. Keep the increase in global average temperature to well below 2 °C by the end of the century, preferably limit the temperature increase to just 1.5 °C;
2. Increase the ability to adapt to climate change;
3. Make finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilience development.

According to the Paris Agreement, 2020 is a key-year. Countries are asked to communicate their new or updated nationally determined contributions (NDCs) delineating their efforts to reduce national emissions, and adapt to the impacts of climate change. In view of this challenging target, and the effects of global warming in the Arctic as summarized in the previous section, this paragraph introduces medium- and long-term strategies developed by the arctic governments for the housing and building sector of the region. The aim is to analyze the relationship between policies for mitigation of climate change in the Arctic and policies for decarbonization and improvement of energy performance of buildings at a national level, thus highlighting the role such legislation has on the Green Building growth-process.

The following subsections present a brief synthesis of national strategies for the Arctic and for the building sector for the following Arctic Countries: Norway, Sweden, Finland, Iceland, Russia, Canada, and United States with Alaska. Denmark, whose territories of Greenland and Faroe Islands are part of the Arctic, has been excluded from the discussion because, according to the Arctic Human Development Report of 2003 [17], building emissions are not considered to significantly affect climate conditions due to the small population size. Data relating to national strategies have been extracted from the official publication channels of the respective governments.

2.1. Norway

The strategy for fulfilling targets of the Paris Agreement is presented in the “Climate Change Act” released in 2018 [18]. The national goals to achieve together with the European Union (EU) include reduction of greenhouse gases by at least 40% by 2030 and reducing of greenhouse gas emissions in the order of 80–95% by 2050, resulting in Norway becoming a low-emission society. In both cases, the reference year is 1990 and climate targets should be reviewed every five years. The Climate Change Act identifies five priorities areas: Transportation sector; supply of renewable energies; low emissions and clean production technologies; environmentally sound shipping; and carbon capture and storage.

Development in the Arctic has also been a priority in the Norwegian Government’s agenda since 2005, demonstrated by several proposals released over the years. The most significant official publications include “New Building Blocks for the High North” and “Norway’s Arctic Strategies between geopolitics and social development”. The first program, established in 2006 and released in 2009, contains 22 specific action points enclosed in seven

prioritized areas ranging from technical to humanity. The purpose of the project is to enhance knowledge in and about the north, increasing government activity and presence in the area, and lay foundations for sustainable economic and social development in the Arctic regions [19]. The second program, presented in 2017, reveals the government's vision for economic, environmental, and social sustainability in the Arctic, highlighting the need to reduce greenhouse gas emissions and pollution through promotion and transition to green transport, energy, and construction [20]. However, both plans, released in a unified manner on a national level, lack strategies strictly related to the building sector.

As described in the document "The Property Sector's Roadmap toward 2050"—released in June 2016 by the Norwegian Green Building Council, Grønn Byggallianse, and Norsk Eiendom—the vision for 2050 is to achieve a climate-neutral construction industry with zero emissions of environmental toxins, in accordance with the Paris Agreement [21]. The requirements to meet national and international goals for greenhouse gases emissions reduction for the building sector are provided in the national building code "Regulations on technical requirements for construction works—TEK 17", whose latest version was released in July 2017 [22]. However, attention is not only on new buildings, in which energy requirements have been tightened to nearly-zero Energy Building standards in 2020 [23], but also on existing building stocks, whose performance must be upgraded in case of a planned renovation. In reference to refurbishing of existing buildings, Grønn Byggalliance released a booklet in November 2019, "Think twice before demolishing", encouraging renovation of dwellings instead of their demolishing, promoting their conversion into Green Buildings to achieve the 2050 climate goals [24]. Long-term initiatives for reducing the carbon footprint of buildings can also be found in the program "Building for the future—environmental action plan for the housing and building sector 2009–2012". It states long-term initiatives for reducing the carbon footprint of buildings, acting on their energy needs and waste production [25].

2.2. Sweden

The Swedish climate change and energy policies framework was published by the Swedish parliament in June 2018. According to EU regulations and the Paris Agreement, main objectives are set at 10-year intervals and mainly include reduction of emissions, taking 1990 as a reference year. These policies are presented in the report "Sweden's draft integrated national energy and climate plan"[26], which introduces the following measures for achieve the climate target set for 2030 for dwelling houses:

1. Limits in the specific energy use (kWh/ and year), average thermal transmittance [W/(K)], and building's average air leakage [1/(s] for new and existing buildings.
2. A support scheme for renovation and energy efficiency of rental apartments, introduced to incentivize renovation and energy efficiency of rental apartments in areas with socioeconomic challenges.
3. Establishment of an Information Centre for Sustainable Building for promoting energy-efficient renovation and energy-efficient construction using sustainable materials and low climate impact from a life-cycle perspective.
4. Implementation of an Energy Performance Certificate Act, a law on energy performance certificates for buildings, to promote efficient use of energy and healthy indoor environment.

These strategies, which are similar to those implemented in Norway, with TEK 17 and *Energi-forskriften* (Energy Regulation), were also presented in the document "Sweden's Seventh National Communication on Climate Change"[27], along with the report of the downward trend in emissions between 1990 and 2015, due to the transition from oil-fueled heating of homes and commercial to electricity.

However, actions are being taken by the government at a regional and local level, and include a new energy labelling directive (Ecodesign Act SFS 2008:112) as well as requirements for setting minimum energy performance standards (Energy Performance of Building Directive 2010/31/EC), and the implementation of a law on energy performance certificates for buildings (Energy Performance Certificate Act SFS 2006:985) [27]. Specific policies regarding the construction sector have been developed by the Swedish National Board of Housing, Building, and Planning and include the Planning and Building Act (2010:900), and the Planning and Building Ordinance (2011:338). In particular, the second chapter of the legislation 2010:900 aims to promote a planning with regards to natural and cultural values, environmental and climate aspects through also a long-lasting and effective management of land and water areas, energy resources and raw materials [28].

The strategy developed by the Swedish Government for the Arctic was presented in 2014 through the "Sweden's strategy for the Arctic region" program, where priorities and the outlook for Sweden's arctic policy have been outlined. The government's goal is to promote sustainable development in an economic, social and environmental dimension, and to reduce global emissions of greenhouse gases and short-lived climate forces, along with the implementation of the Arctic cooperation program [15].

2.3. Finland

In October 2012, the Finnish Government adopted their latest artic policy, extensively summarized in the report "Finland Strategies for the Arctic Region 2013". Once again, the main objectives are related to the promotion of stability, national and international cooperation, and sustainable development [29]. The program also examines possibilities to promote and achieve them, but a specific action for reviewing and redefining the role of buildings for the Arctic is not covered. The government's plan for the building sector is explored in the document "Government Action Plan 2017–2019" [30], where mid-term national objectives and activities for different sectors—such as Employment, Education, Health, Bioeconomy, and Digitalization—are presented through five strategic priorities and 26 key projects. Priority number 4—*Bioeconomy and Clean Solution*—reveals Finland's interest in introducing and exporting of sustainable solutions to achieve climate objectives of reducing greenhouse gases and the economical state of the country in the Baltic Sea [30]. This general statement includes also the building sector, whose priorities are identified in the "Energy and Climate Roadmap 2050", a strategic level guide to permit attaining Finland's long-term objective of a carbon-neutral society [31]. Concerning buildings and constructions, the program outlines the necessity, in line with the Paris Agreement, of new buildings to meet nearly-zero energy standards by the end of 2020. It also emphasizes the necessity of meeting stricter energy efficiency requirements as set out by the updated national building code of 2013 for renovation, or retrofit, construction projects [31].

2.4. Iceland

Iceland's Climate Policy is introduced in the report "Iceland's Climate Action Plan for 2018–2030", released in September 2018 [32]. Once again, efforts are directed at cutting net emissions to meet the Paris Agreement targets for 2030 and reach the government's ambitious aim of carbon neutrality before 2040. The plan consists of 34 actions, divided in four categories—clean energy transfer in transport; clean energy transformation in other sectors; climate mitigation in land use and forestry; other measures—in which buildings and use of energy do not find a direct collocation. In fact, as largely covered by the document "Iceland's Seventh National Communication and Third Biennial Report", the construction sector, with a high energy-demanding space heating, accounts for the 6% of the total GHG emissions in the energy sector in 2015 [33]. However, according to the same report, 99% of energy used for space heating is already produced by renewable energy sources such as hydropower and geothermal power. Specific legislation and regulation on construction are mostly intended to ensure safety human life and the environment. Sustainable development is also a guiding concern in design and construction of energy efficiency in building operations [33].

In addition, the Arctic Council Chairmanship program 2019–2021—"Together Towards a Sustainable Arctic"—which highlight the national commitment for the sustainable development and protection of the Arctic environment, does not refer directly to a plan for the building sector [34]. Measures primarily involve the arctic marine environment, the Arctic Council, the people and the community, the climate, and green energy solutions. In this last section, the government encourages the development and application of practical green energy solutions in the Arctic to reduce emissions and improve air quality.

2.5. Russia

In 2008, the Russian Federation defined a state policy comprehended the national interest for the Arctic to be achieved by the end of 2020—"Basic Principle of Russian Federation State Policy in the Arctic to 2020". Primary goals include promotion of social and economic development, peace and cooperation, protection of the ecosystem, and a shipping route through the Northeast Passage [15]. In March 2020, the government released a new version—"Basic Principles of Russian Federation State Policy in the Arctic to 2035"—updating the goals to achieve by the end of 2035 [35]. Even though the strategy lacks direct or indirect measures for reducing the carbon footprint of buildings in the Arctic, national building legislation is continuously evolving. Indeed, to meet EE (Energy Efficiency) standards, the Government implemented rules for determining energy efficiency class of apartment buildings (Order if the Ministry of Russia n.339/pr of 6 June 2016), and the requirements for energy efficiency of building, structures, and facilities (Order if the Ministry of Russia n.1550/pr of 17 November 2017). In 2016, it also released a "Road Map for EE buildings and structures" (Russian Federation Government Order N.1853-R of September 1 2016), in which primary objectives for the housing sector are emphasized, such as the rational use of energy resources; increase of high-energy efficiency in design and construction of buildings; and development of technical regulation and standardization in EE. In addition to new energy efficiency standards, in 2017 the government set several mandatory technical requirements regarding measuring energy consumption in new dwellings and the implementation of requirements for building envelopes. Russia's most recent plan for the building sector aims at modernizing building and production, and increasing the contribution from the technological sector in reducing the energy consumption for the Gross National Product (GDP) by at least 1.5% per year [36]. It also aims to provide a

large-scale increase of energy efficiency of Russian economy by intensifying the renewable-sources-based energy generation, as well as large-scale electrification. The goals to be achieved in order to meet the Paris Agreement's target are reduction of Russian GDP by 9% by 2030 and carbon neutrality by 2050.

2.6. Canada

The latest version of the Canadian Government's arctic policy "Arctic and Northern Policy Framework" was released in September 2019. The three key opportunities highlighted in the strategy for the circumpolar Arctic region are: Strengthening the rule-based international order in the Arctic; defining Canada's Arctic boundaries; and finally, broadening Canada's international engagement and contribution to the priorities of Canada's Arctic and North [37].

Even though Canada's arctic policy is mostly focused on international cooperation and on local communities, the government is committed to climate action policy directed at the building sector. Canada's strategy for combatting climate change considers the emissions-productive sources. Among them, homes and buildings account for 11% of Canada's total emissions. The government's long-term solution aims to create a low-carbon building sector, ensuring high-quality standards through the development of new building codes. The first is a "net-zero energy ready" model building code for new buildings. The second is a model code for existing buildings to guide the process of retrofitting buildings to accommodate energy efficiency improvements during renovations [38]. Moreover, the government aims to support home and building retrofit programs across Canada, and improve energy efficiency of historical buildings as well as building located in indigenous communities' [39].

The most recent commitment dates from March 2020, when the Canada Green Building Council also launched an initiative—financed by the *Environment and Climate Change Canada*—for designing the updated Zero Carbon Building Standards [40]. The second version (V2) of the Zero Carbon Building Standards provides more rigor to ensure zero emission and flexibility to encourage the boundless adoption of zero-carbon buildings [41].

2.7. Alaska

United States' policy for the Arctic—"National Strategy for the Arctic Region"—was first released in May 2013, implemented in January 2014, and later updated in March 2016 [42][43]. The main points covered by the strategy concern the advancing of United States security interests; pursuing responsible Arctic Region stewardship; and strengthening international cooperation. In addition, development of renewable energy resources and the adoption of sustainable strategies are on the Government's Arctic agenda.

Despite the USA government withdraw from Paris Agreement in November 2019, the main targets of Alaska for Climate Change, presented in the report "Climate Change Action Plan Recommendations to the Governor", are still to support and incentivize energy efficiency, renewable energy, decarbonization and beneficial electrification across all sectors [44]. In line with this program, the State of Alaska is currently following the Building Energy Efficiency Standards (BEES), regulations established and updated since 1991, comprised of the 2018 International Energy Conservation Code (IECC); ASHRAE 62.2 2016 and Alaska Specific Amendments. These standards aim to

promote construction of energy efficient building and nowadays a minimum energy rating of five stars is required [45].

References

1. Kibert, C.J. Introduction and Overview. In Sustainable Construction: Green Building Design and Delivery, 4th ed.; John Wiley & Sons Incorporated: Hoboken, NJ, USA, 2016; pp. 1–36.
2. Kubba, S. Green Concepts and Vocabulary. In Handbook of Green Building Design and Construction: Leed, Breeam, and Green Globes; Elsevier Science & Technology: Boston, MA, USA, 2012; pp. 21–59.
3. Arctic Monotoring and Assessment Programme (AMAP). Amap Arctic Climate Change Update 2019: An Update to Key Findings of Snow, Water, Ice and Permafrost in the Arctic (Swipa) 2017; Arctic Monotoring and Assessment Programme (AMAP): Oslo, Norway, 2019.
4. Arctic Monotoring and Assessment Programme (AMAP). Amap Assessment Report: Arctic Pollution Issues; Arctic Monotoring and Assessment Programme (AMAP): Oslo, Norway, 1998.
5. Pettersen, J.B.; Song, X. Life Cycle Impact Assessment in the Arctic: Challenges and Research Needs. Sustainability 2017, 9, 1605–1625.
6. Hassol, S.J. Arctic Climate Impact Assessment. In Impacts of a Warming Arctic; Cambridge University Press: Cambridge, UK, 2004; pp. 34–45.
7. Sveen, S.E. Artificial Thawing of Seasonally Frozen Ground: Performance Characteristics of Hydronic Based Thawing. Ph.D. Thesis, Norwegian University of Science and Technology (NTNU), Trondheim, Norway, 2017.
8. Global Alliance for Buildings and Construction;International Energy Agency (IEA). 2019 Global Status Report for Buildings and Construction: Towards a Zero-Emission, Efficient and Resilient Building and Construction Sector; Global Alliance for Buildings and Construction: Paris, France, 2019.
9. Yudelson, J.; Fedrizzi, S.R. What Is a Green Building? In The Green Building Revolution; Island Press: Washington, DC, USA, 2008; pp. 13–26.
10. Kubba, S. Components of Sustainable Design and Construction. In Handbook of Green Building Design and Construction: Leed, Breeam, and Green Globes; Elsevier Science & Technology: Boston, MA, USA, 2012; pp. 61–104.
11. Akreim, M.A.S.; Suzer, O. Motivators for Green Buildings: A Review. Dev. Sustain. 2018, 7, 137–156.

12. Wang, R.; Zhai, X. Introduction to Green Building Concepts. In Handbook of Energy Systems in Green Buildings; Springer: Berlin/Heidelberg, Germany, 2018; pp. 3–10.
13. Commission of the European Communities. Communication from the Commission to the European Parliament and the Council: The European Union and the Arctic Region; Commission of the European Communities: Bruxelles, Belgium, 2008.
14. The Arctic Council. Declaration of the Establishment of the Arctic Council; The Arctic Council: Ottawa, ON, Canada, 1996.
15. Government Offices of Sweden. Sweden's Strategy for the Arctic Region; Government Offices of Sweden: Stockholm, Sweden, 2014.
16. United Paris Agreement; United Nations: Paris, France, 2015.
17. The Nordic Council of Ministers. Arctic Human Development Report; Stefansson Arctic Institute: Reykjavik, Iceland, 2003.
18. The Ministry of Climate and Environment. Climate Change Act; The Ministry of Climate and Environment: Oslo, Norway, 2018.
19. The Norwegian Ministry of Foreign Affairs. New Building Blocks in the North—The Next Step in Government's High North Strategy; The Norwegian Ministry of Foreign Affairs: Oslo, Norway, 2009.
20. The Norwegian Ministries. Norway's Arctic Strategy—Between Geopolitics and Social Development; The Norwegian Ministries: Oslo, Norway, 2017.
21. Norwegian Green Building Council; Norsk Eindom. The Property Sector's: Roadmap Towards 2050; Norwegian Green Building Council: Oslo, Norway, 2016.
22. The Norwegian Building Authority. Regulations on Technical Requirements for Construction Works—Tek17; The Norwegian Building Authority: Oslo, Norway, 2017.
23. The Norwegian Ministry of Climate and Environment. Norway's Climate Strategy for 2030: A Transformational Approach within a European Cooperation Framework; The Norwegian Ministry of Climate and Environment: Oslo, Norway, 2016.
24. Norwegian Green Building Council. Think Twice before Demolishing: Advice on Carrying out a Successful Construction Project without Demolition; Norwegian Green Building Council: Oslo, Norway, 2019.
25. The Norwegian Ministry of Local Government and Regional Development. Building for the Future: Environmental Action Plan for the Housing and Building Sector 2009–2012; The Norwegian Ministry of Local Government and Regional Development: Oslo, Norway, 2009.

26. The Ministry of the Environment and Energy. Sweden’s Draft Integrated National Energy and Climate Plan; The Ministry of the Environment and Energy: Stockholm, Sweden, 2017.
27. The Ministry of the Environment and Energy. Sweden’s Seventh National Communication on Climate Change; The Ministry of the Environment and Energy: Stockholm, Sweden, 2017.
28. Swedish National Board of Housing, Building and Planning. Legislation Planning and Building Act (2010:900) Planning and Building Ordinance (2011:338); Building and Planning Swedish National Board of Housing: Stockholm, Sweden, 2016.
29. Prime Minister’s Office. Finland’s Strategy for the Arctic Region 2013. Government Resolution on 23 August 2013; Prime Minister’s Office: Helsinki, Finland, 2013.
30. Prime Minister’s Office. Finland, a Land of Solutions: Mid-Term Review. Government Action Plan 2017–2019; Prime Minister’s Office: Helsinki, Finland, 2017.
31. Parliamentary Committee on Energy and Climate Issues. Energy and Climate Roadmap 2050—Report of the Parliamentary Committee on Energy and Climate Issues on 16 October 2014; The Ministry of Employment and Economy: Helsinki, Finland, 2013.
32. The Ministry for the Environment and Natural Resources. Iceland’s Climate Action Plan for 2018–2030; The Ministry for the Environment and Natural Resources: Reykjavik, Iceland, 2018.
33. The Ministry for the Environment and Natural Resources. Iceland’s Seventh National Communication and Third Biennial Report; The Ministry for the Environment and Natural Resources: Reykjavik, Iceland, 2018.
34. The Arctic Council. Together Towards a Sustainable Arctic. Iceland’s Chairmanship Arctic Council 2019–2021; The Ministry for Foreign Affairs: Reykjavik, Iceland, 2019.
35. The Russian Federation. Basic Principles of Russian Federation State Policy in the Arctic to 2035; The Russian Federation: Moscow, Russia, 2020.
36. Ministry of Construction Industry, Housing and Utilities Sector of the Russian Federation; United Nations Economic Commission for Europe (UNECE). Energy Efficiency Requirements in Buildings in Russian Federation; Housing and Utilities Sector of the Russian Federation Ministry of Construction Industry: Moscow, Russia, 2018.
37. Arctic and Northern Policy Framework. Available online: https://www.rcaanc-cirnac.gc.ca/eng/1560523306861/1560523330587 (accessed on 1 October 2020).
38. Homes and Buildings. Available online: https://www.canada.ca/en/services/environment/weather/climatechange/climate-action/federal-actions-clean-growth-economy/homes-buildings.html (accessed on 1 October 2020).
39. Government of Canada. Advisory Council on Climate Action; The Minister of Environment and Climate Change: Ottawa,Canada, 2019.

40. World Green Building Council. Advancing Net Zero Status Report 2020; World Green Building Council: Toronto, ON, Canada, 2020.
41. Canada Green Building Council. Zero Carbon Building—Design Standard Version 2; Canada Green Building Council: Ottawa, ON, Canada, 2020.
42. The Government of United States. National Strategy for the Arctic Region; The Government of United States: Washington, DC, USA, 2013.
43. The Government of United States. Implementation Framework for the National Strategy for the Arctic Region The Government of United States: Washington, DC, USA, 2016.
44. The Climate Action for Alaska Leadership Team. Climate Change Action Plan Recommendations to the Governor; The Climate Action for Alaska Leadership Team: Jeneau,AK, USA, 2017.
45. Building Energy Codes Program. Available online: https://www.energycodes.gov/adoption/states/alaska (accessed on 1 October 2020).