The concept of best available techniques as an instrument for increasing industrial resource efficiency and reducing environmental impact in the Arctic

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The concept of best available techniques as an instrument for increasing industrial resource efficiency and reducing environmental impact in the Arctic

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Abstract. This paper develops an approach established on the concept of Best Available Techniques (BAT), which is used to promote industrial resource efficiency while reducing negative environmental impact. Authors focus their attention on the Arctic Region of the Russian Federation. They analyse the current situation on the BAT implementation in the Arctic and consider requirements of relevant legislative acts and standards, sectoral structure of the Arctic industries, and specific environmental issues of the region. Authors consider challenges and opportunities for enhancing the overall understanding of the BAT concept via capacity building of industrialists, civil servants, researchers, university teachers and students. Additionally, the paper describes an Arctic "green" case study analysing results achieved by a Russian mining industry by the means of BAT implementation. Authors suggest using "green" case study-oriented training programmes to provide for the multidisciplinary approach and to make university courses and professional qualification courses more interactive and effective.

1. Introduction

The Arctic ecosystems are mostly characterized by their fragility. The environmental issues (and problems) of the Arctic are highly likely to develop from regional to global ones. In 1991, eight Arctic States) adopted the Arctic Environmental Protection Strategy.

Five years later, the States of the Arctic region joined the Ottawa Declaration and formed the Arctic Council, an intergovernmental forum promoting co-operation, co-ordination and interaction between Arctic States, representatives of the various peoples native to the region and other Arctic inhabitants on the most pressing issues in the region related to the protection of the Arctic environment and sustainable development [1].

The United Nations Environment Programme (UNEP) identifies the several environmental problems of the Arctic: oil and chemical pollution of the northern seas, climate change issues, a decrease in the population of Arctic animals and changes in their habitats. The main environmental

threats in the Arctic zone of Russia are environmental pollution and significant anthropogenic impacts, waste accumulation; high environmental risks of the extraction, transporting and processing of natural resources; global climate change and its impact on the permafrost area [2].

To develop Russian Arctic regions in the sustainable way, it is necessary to achieve an equilibrium between the economic, social and environmental aspects, providing support to the indigenous peoples, favourable conditions for the economic growth and, at the same time, guaranteeing high industrial resource efficiency and environmental performance. This paper considers this main challenge in the light of the Best Available Techniques concept, accepted internationally since the 1980s and being further developed in the Russian Federation.

2. Best Available Techniques: Development of the International Concept in the Russian Federation

The concept of the Best Available Techniques (BAT) and opportunities for the practical implementation of BAT in various economic sectors have been discussed among Russian experts, industry practitioners and scientists since the end 20th century. Moreover, since early 2000s several Russian oil refineries, pulp & paper, metallurgical, and cement installations underwent technological BAT-based modernisation achieving high resource and production efficiency while simultaneously reducing negative environmental impact [3,4].

In 2014, Russia adopted the Federal Law No 219-FZ on Best Available Techniques, which laid the foundation for the technological and environmental modernisation of the Russian industry (and, in broader sense, the whole economy) by means of the gradual BAT implementation [5].

Criteria for identifying BAT are similar to those set by the Directive 2010/75/EU of the European Parliament and the Council on Industrial Emissions [6], though a stronger attention is given to the resource efficiency aspects.

In 2015-2021, new BAT-related Government Decrees and orders of Federal Authorities were passed. Nowadays (by February 2022), new requirements are fully reflected by the Federal Law FZ-7 “On Environmental Protection”; two Ministries are responsible for BAT implementation in Russia: the Ministry for Natural Resources and Environment and the Ministry for Industry and Trade [5]. The reason for this decision is that BAT is considered as the instrument of both environmental and industrial policies; moreover, it has a strong potential for the reduction of greenhouse gases (GHG) emissions and becomes a recognised instrument of the climate policy [7].

In Russia, BAT implementation is mandatory for larger installations of key industrial sectors (these BAT application areas are very much alike to those addressed by the EU Industrial Emissions Directive, IED) [6]. Criteria for categorising Russian installations were first set in 2015 and refined later in 2020 [5]. The list of IED-like installations (called Category I installations) amounts ~6,900 positions. By 2025, these installations have to introduce appropriate BAT and obtain Integrated Environmental Permits (IEPs). It is a serious challenge because industrialists are often reluctant to analyse benefits of the technological modernisation and therefore see BAT and IEPs exclusively as the instruments of the new environmental regulation [5,8].

The list of so-called major polluters, contributing towards 60 % of total industrial emissions in Russia, contains 300 positions; major polluters have to obtain (or at least to apply for) BAT-based IEPs until the end of 2022. By the beginning of 2022, only 71 industrial installations have obtained BAT-based Integrated Environmental Permits (to be discussed later).

BAT requirements are set by the national Reference Documents on Best Available Techniques (Russian BREFs or Information and Technical Documents on BAT). In 2015-2017, 39 sectoral and 12 “horizontal” BREFs were drawn up and officially published; since 2019, Russian BREFs have been reviewed in accordance with the special Decree of the Russian Government [5]. BAT-Associated Emission Levels (BAT-AELs) are established in each sectoral BREF. Following the Presidential Instruction (2020), Resource Efficiency Levels (similar to the EU BAT-Associated Environmental Performance Levels, BAT-AEPLs) have to be inserted in the revised BREFs [8,9].

A wider range of BAT-AELs as well as resource efficiency indicators make it possible to thoroughly assess performance of industries functioning in this sector. It is very important because the resource efficiency focus provides for the stronger attention to modernising manufacturing technologies rather than installing “end-of-pipe” techniques. At the same time, this approach conforms with the internationally accepted BAT criteria [10] such as (1) the application of the technology characterised by significant decrease in waste product generation; (2) the high resource (including energy) efficiency; (3) the introduction of less hazardous substances into technological process; (4) the further stimulation of recovery and recycling of industrial by-products and waste (where appropriate) [3,6,11]. Undeniably the criterion formulated as (5) the necessity to prevent or minimise the risk to the environment and the overall environmental impact of the industrial emissions, remains utmost important [12].

3. Russian Industries in the Arctic: Main Sectors and Their Impact on the Environment

According to the Presidential Decree “On the Overland Territories of the Arctic Zone of the Russian Federation” (2014), the Russian Arctic embraces a huge region adjacent to the Arctic Ocean and includes the territories and municipalities of eight Federation subjects (two oblasts, two republics, three autonomous okrugs and one kraj) and lands and islands located in the Arctic Ocean listed in the Decision of the Central Executive Committee of the Soviet Union of 26.04.1926 and other acts of the USSR [13]. Economic development of the Russian Arctic attracts attention of politicians and economists, who point out that innovative technologies have to be implemented to provide for the rational use and conservation of natural resources. In November 2020, the Federation Council emphasised also the necessity to foster BAT implementation and to strengthen environmental monitoring systems to provide for the environmental well-being of the Arctic region population.

Each Arctic region has its specific economic structure depending on available natural resources and climate conditions. In order to support pollution reduction and minimise environmental risks in the region, the AC established the Arctic Contaminants Action Program (ACAP). ACAP pays special attention to (1) persistent organic pollutants (POPs) and mercury; (2) on-shore waste management to prevent marine litter, hazardous substances and chemicals of emerging concern; (3) short-lived climate pollutants such as methane, black carbon and hydrofluorocarbons; and (4) any other significant sources of pollution in the Arctic region.

The Arctic zone of the Russian F3ederation has around 240 Category I installations characterised by the large consumption of natural resources and significant environmental impacts. The list of priority BAT-related industrial sectors for the Arctic zone was prepared by the authors and discussed with regional stakeholders during the series of workshops performed in 2018-2021 (see Figure 1).

As it can be seen, large and medium combustion plants and municipal wastewater treatment installations (in Russia, regulated on the basis of BAT) are located in all subjects of the Russian Arctic. Hydrocarbon exploration sites and oil and gas refineries form a sector which tends to widen; new industries are being built in the Siberian Arctic. Mining and metallurgical industries function both in the European and Asian Arctic regions, while pulp & paper sites are situated mostly in the Barents Euro-Arctic region or in the southern parts of Siberia. Cement and inorganic chemistry plants are located in the Krasnoyarsk kraj and are included in the list of priority sectors mostly due to the long-distance migration of pollutants.

Migration and transformation processes of persistent pollutants originating from sources located outside of the officially described Arctic region, may lead to the contamination of regions laying far from such sources. This is why the industrial installations with significant emissions of acidifying gases such as nitrogen and sulphur oxides sulphur oxides (NO_X and SO_X), particulate matter (dust), ground-level ozone, and various environmental pollutants (mercury and POPs being among them) also contribute to the overall pollution of the Arctic and require expert support in the process of BAT implementation.

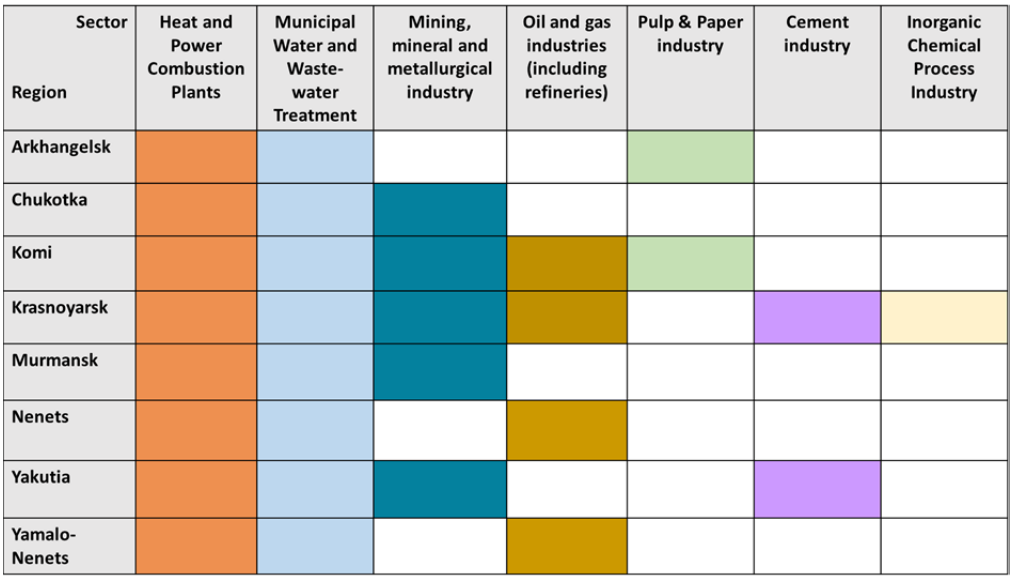

Figure 1. Economic sectors developed in the Arctic region and regulated on the basis of Best Available Techniques

4. Training and Capacity Building

In general, lessons learnt in 2019-2021, prove the necessity to increase the level of preparedness to implement BAT of both employees (engineers and managers) of industrial companies and consulting firms (those offering their services in the field of development of various environmental applications and substantiations) as well as representatives of the Federal Service for Supervision of Natural Resources (Rosprirodnadzor) and regional environmental authorities of the Russian Federation [14]. So far, only 71 industrial installations (of ~6,900) have obtained BAT-based IEPs, which is partially caused by the difficulties in understanding requirements of the system of norms, standards, legislative acts, Reference Documents of Best Available Techniques, etc. [4,15].

The core success factor for the implementation and application of BAT at any and all industrial installations across the regulated sectors (and thereby promote a factual decrease of pollution) is related to the legal instruments used to encourage and, if necessary, force the industry to operate its business in accordance with BAT. While encouragement (promotion) instruments are operated by the Ministry for Industry and Trade, while the enforcement measures (including pollution charges and fines) remain the obligation of Rosprirodnadzor.

The main BAT implementation instruments used in Russia in this respect are: (1) economic incentives (subsidies to installations installing innovative resource and energy efficient equipment as well as the differentiated pollution fees and charges); and (2) environmental permitting (Integrated Environmental Permits including Environmental Performance Enhancement Programmes (EPEPs) for the installations not complying with the established BAT-Associated Emission Levels (BAT-AELs)).

To actively participate in the promotion of BAT, major stakeholders have to understand (1) the origin of the BAT concept; (2) opportunities and barriers for the environmental performance enhancement and resource efficiency improvement in industry; and (3) regional and sectoral priorities (including those related by the economic development and environmental pollution). This statement provides for the implication, that in Russia, there is a need to work out and implement both students-oriented university level training programmes (at the Master of Science, Technology and Economy levels) and professional qualification improvement courses. University training programmes have to be incorporated in the existing training system, and certain attempts have already been made in relation to such disciplines as chemical engineering, energy generation, metallurgy, etc. Professional qualification enhancement courses differ a lot – from high level and tailor-made programmes to formal

short-term courses provided locally by organisations and people who are not experiences in the BAT development and implementation.

Thus, while several universities located in Moscow and Saint-Petersburg (such as Dmitry Mendeleev University of Chemical Technology of Russia, National Research University "Moscow Power Engineering Institute", MIREA – Russian Technological University, Saint-Petersburg ITMO University) participating in drawing up and reviewing of the national BREFs and implementing national and international projects, tend to include BAT-related courses into their curricula, educational establishments situated outside the capitals (including those of the Arctic region) need a strong continual methodological support to form a sustainable system (network) of BAT training. This network should explore the interdisciplinary approach and cover legislative, technological, technical, and managerial aspects of BAT implementation, pollution prevention and control.

To make university (students-oriented) and professional qualification training programmes interactive and effective, it is logical to suggest focusing such programmes on regional and sectoral case studies ("green" case studies) addressing priority sectors and pollutants of the Arctic region and clearly explaining the interrelatedness of BAT and industrial modernisation, Environmental Performance Enhancement Programmes and Integrated Environmental Permits, official requirements and voluntary activities of industries and civil society.

5. BAT implementation in the Arctic: Green Case

In 1994, the Ministers of the Environment of the States involved adopted the Barents Euro-Arctic Region Environment Action Programme. In 2003, a report on 42 environmental problems of the Barents Region had been prepared and published. The document called for action and urge the Barents states to take action upon these environmental Hot Spots.

Two years later, the Ministers of Environment of Finland, Norway, Russia and Sweden agreed upon launching investment projects with the goal to eliminate 41 Hot Spots by 2013. In 2010, a Hot Spot exclusion procedure from the Barents list was submitted to the Ministers of Environment [16], 15 Hot Spots have been excluded since then, and the work on environmental progress at other sites is being continued [17]. In 2020, two Hot Spots (one pulp & paper installation and one municipal wastewater treatment plant) were excluded from the List of Hot Spots due to the implementation of Best Available Techniques.

In the revised 2013 Report of the Artic Monitoring and Assessment Programme (AMAP) and Nordic Environmental Finance Corporation (Nefco) on Barents Environmental Hot Spots, the Kovdor Mining and Concentration Plant (JSC "Kovdorskiy GOK") was considered to be a Hot Spot M5 (primarily due to large discharge of wastewater) [17].

In 2020, the operators of JSC "Kovdorskiy GOK" had assessed their compliance with both BAT-based and other environmental requirements and sought official approval/recognition of the improvements achieved in 2014-2020. The industry decided to develop an EPEP in accordance with the requirements of the Russian legislation and to address to the Inter-Departmental Commission with the request for retrospective consideration of this programme. The track of exclusion was chosen in order to receive expert opinions on the technological, technical and managerial solutions selected by the operators and on the reconstruction results and support JSC "Kovdorskiy GOK" in its work on preparing an IEP application (the operator plans to submit it to Rosprirodnadzor in 2022).

During 2020-2021, the Regional Hot Spots Exclusion Group of the Murmansk Oblast identified and adopted the following specific exclusion criteria for JSC "Kovdorskiy GOK":

- implementation of the Best Available Techniques from the applicable Russian BREFs;
- wastewater volume discharge reduction no less than 30-35 % (including per unit of product manufactured);
- pollutant mass discharge reduction no less than 25-30 % (including per unit of product manufactured);

- use of mining drainage and underground water in the water cycle, not less than 75 %.

Thanks to the continual implementation of BAT-based approaches to the enhancement of resource efficiency, the plant has been able to achieve a significant reduction of its environmental impact:

- the productivity of the industry and the variety of products manufactured grew significantly;
- consumption of fresh water has been terminated;
- the gross volume of wastewater discharge into water bodies has reduced by 40 %;
- the total amount of pollutants discharge into water bodies has reduced by 28 %;

The complete list of BATs implemented by M5 can be found in the retrospective EPEP of JSC "Kovdorskiy GOK".

Results of the resource efficiency and environmental performance enhancement measures implemented by JSC "Kovdorskiy GOK" are schematically presented in Figure 2.

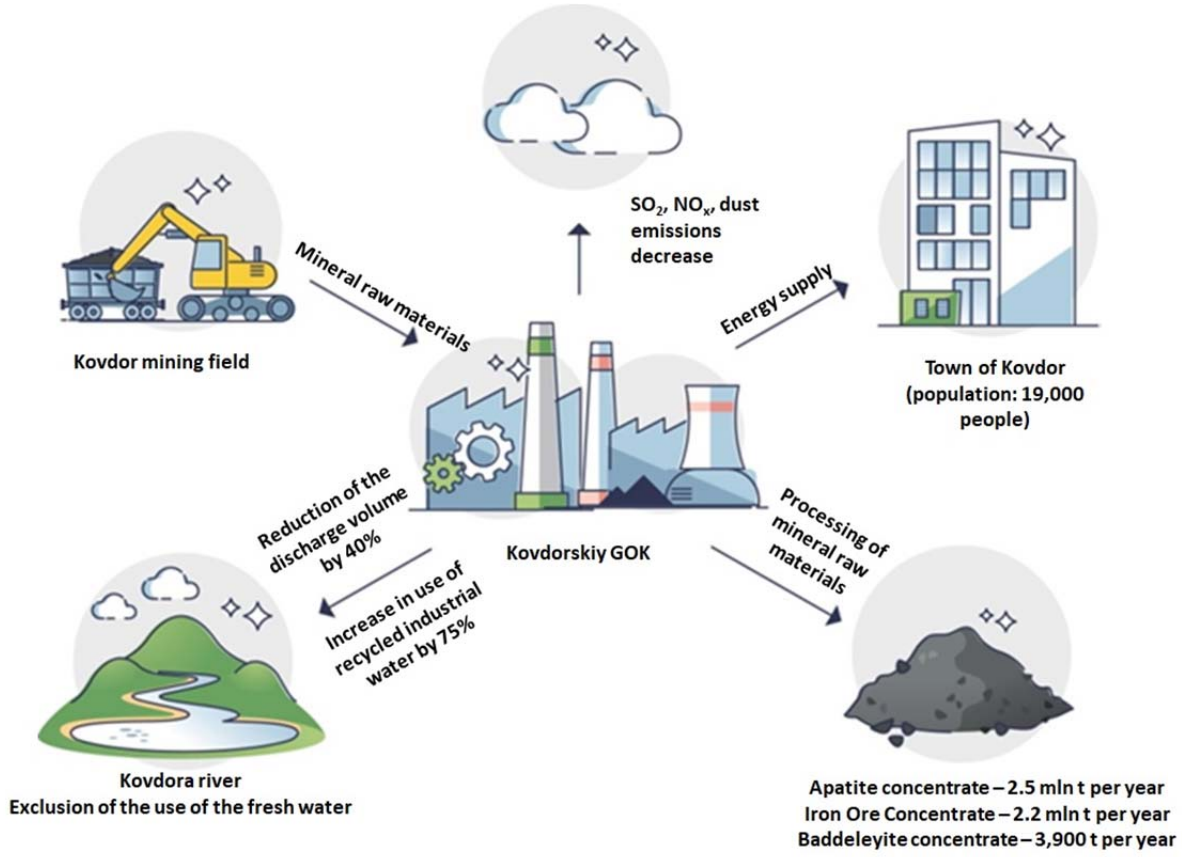

Figure 2. Kovdor "green case": resource efficiency enhancement and environmental impact reduction in the mining industry.

JSC "Kovdorskiy GOK" complies also with the requirements of the existing single-medium permits, and the company management prepares to the submission of the application for the Integrated Environmental Permit in 2022. Additionally, JSC "Kovdorskiy GOK" has been approved for exclusion from Barents "Hot Spot" List by international Subgroup on Hot Spot Exclusion comprising of Finnish, Swedish, Norwegian and Russian environmental scientists and experts. Experts additionally pointed out that JSC "Kovdorskiy GOK" has established promising approaches to the implementation of the circular economy principles (implementing technical water cycle and reducing

mining waste [18-20] and managed to decrease air emissions using techniques described in the Russian BREF for combustion plants.

6. Conclusion

In 2018-2021, the basis for the capacity building has been built both by Russian and international experts working in various sectors and regions (including the Russian Arctic) and promoting the BAT concept in Russia.

Preparedness of industrial companies, Federal and regional authorities, and other stakeholders to implement BAT plays the crucial role in the transfer of the Russian economy to Best Available Techniques. First lessons learnt by the practitioners and described as “green” case studies contain very important information, descriptions of measures undertaken and programmes implemented as well as quantitative data.

For many years, the authors collaborate with federal and regional educational establishments and research institutions, run awareness raising and training events, publish research articles in co-operation with the international and Russian experts. These activities form the basis needed to establish a sustainable system (network) of training centres providing BAT-related support to the Arctic region stakeholders.

The authors after assessing recent legislative and regulatory changes and previous experience received during the work in the Arctic region suggest to (1) focus the BAT-related capacity building on regional and sectoral case studies (“green” case studies) addressing priority sectors and pollutants of the Arctic region (including mercury and POPs) and clearly explaining the interrelatedness of BAT, resource efficiency enhancement, cleaner production, Environmental Performance Enhancement Programmes and Integrated Environmental Permits; (2) pay special attention to the opportunities for reducing GHG emissions via the implementation of BAT and resource efficiency improvement; and (3) emphasise the critical role of the BAT concept for the industrial modernisation and sustainable development of the Russian Arctic.

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