FEDERAL RESEARCH CENTRE
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Climate Change Challenges for Mining Industry in the Arctic

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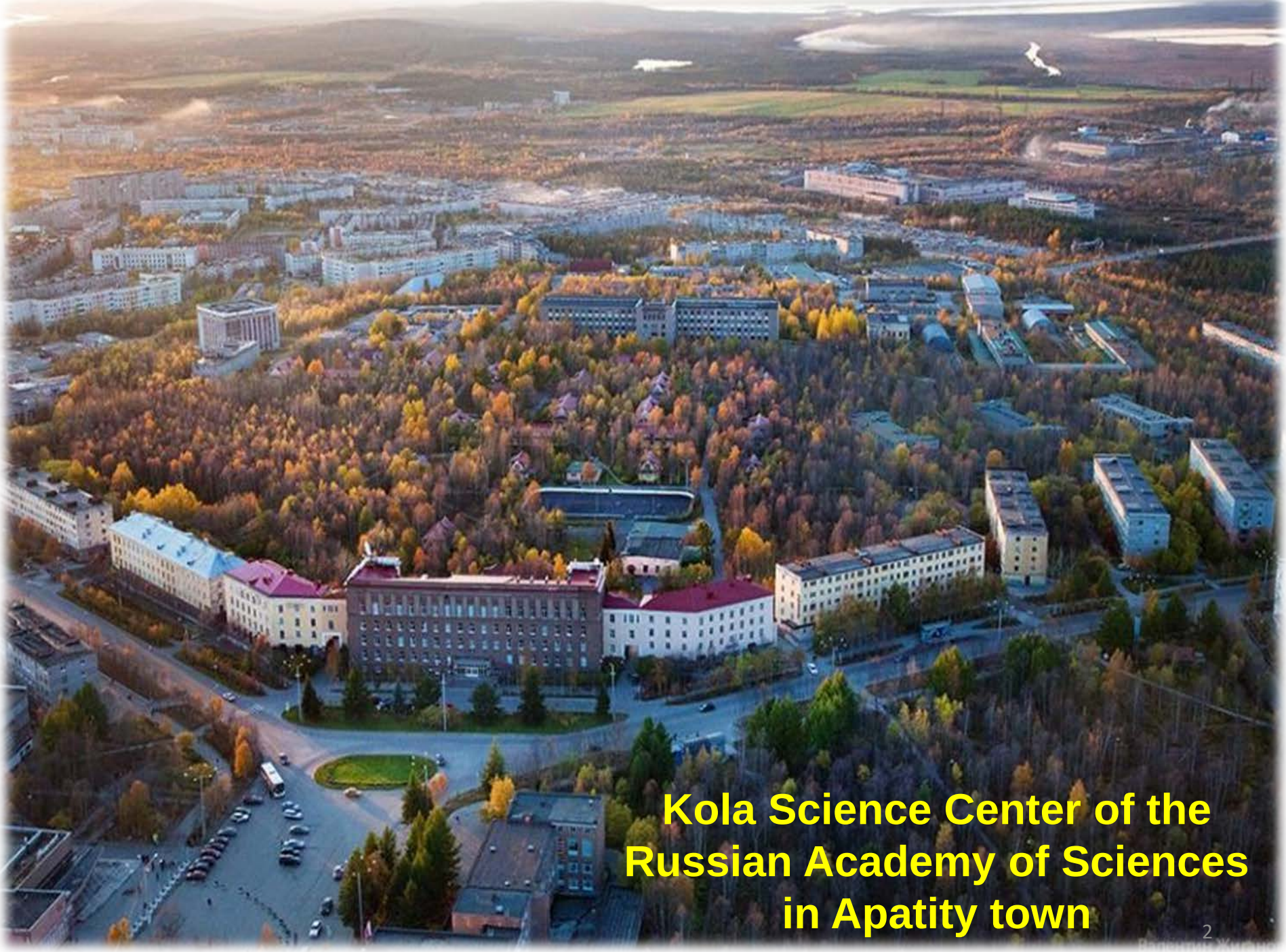
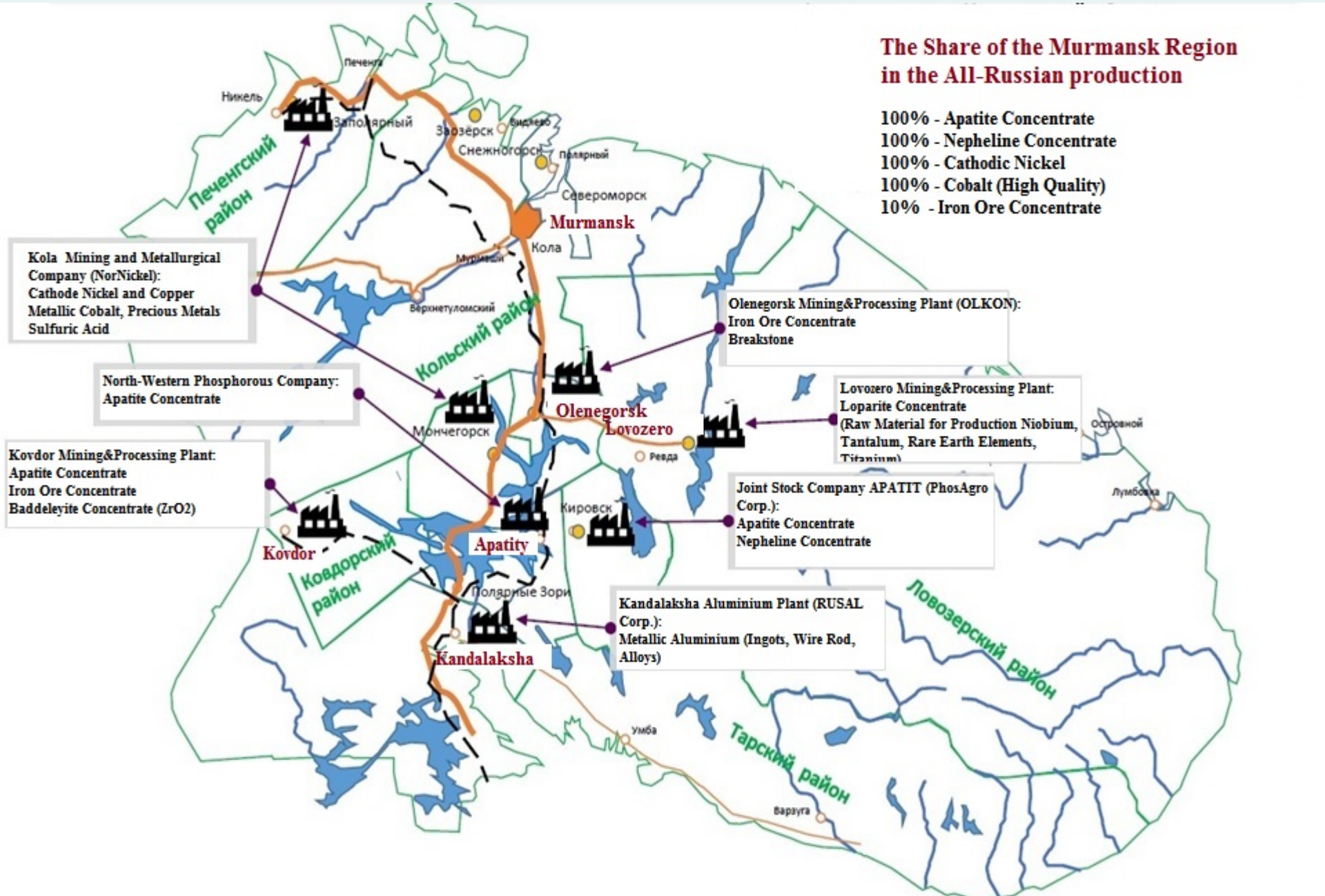
Problems in the North

Grant RFBR "Areas of intensive nature management in the Russian Arctic under climate change conditions"


Kola Science Center of the
Russian Academy of Sciences
in Apatity town

Mining complex of the Murmansk region



Arctic mining means: SNOW and COLD

and includes the following dimensions and concerns to be addressed to be sustainable:

- **Sensitive environment**
- **Long winter with substantial rainfall causing challenges in water balance management**
- **Cold climate causing challenges in machinery operation and maintenance**
- **Long transport from remote areas**
- **Rights of indigenous people**

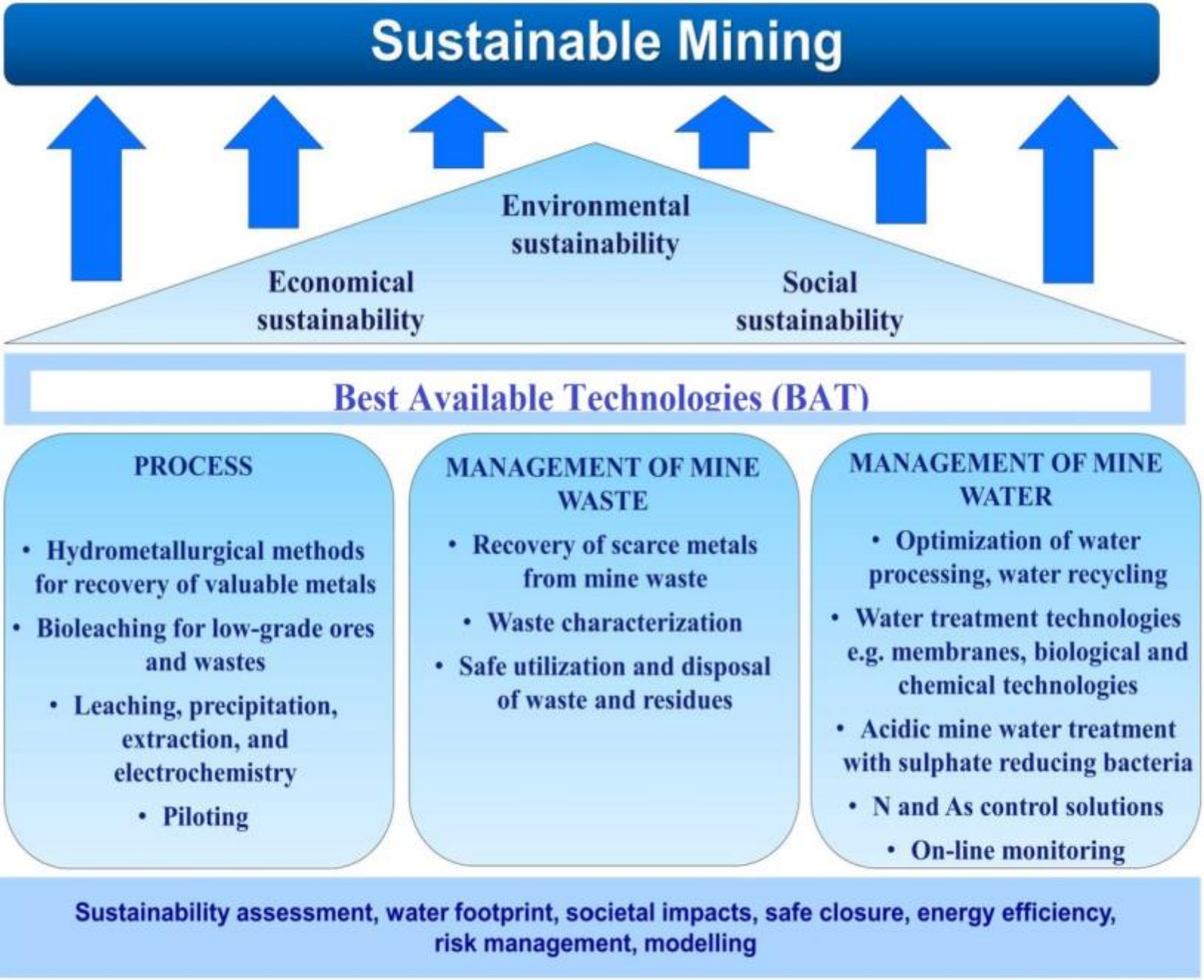
Global challenges in mining industry

- Health and safety
- Shortage of skilled labor
  - Lack of technical people
- Complex, lower grade ore bodies
- Sustainability
  - Water
  - Carbon footprint
    - Energy
    - Materials consumption
- Meeting the needs of local stakeholders
  - Demanding less environmental impact
    - Infrastructure issues
    - Land re-use – waste disposal
  - Taxes, royalties, rents

Green Mining Principles Make Traditional Mining Industry Environmentally Acceptable

- Environmentally acceptable
- Sustainable use of raw materials
- Net social aspects positive by constructive communication with stake holders
- Economic welfare to whole the community
- Continuous improvement of technical and management processes
- Strong and internationally networked mining cluster


Industry based on natural resources and conditions
Economic sustainability
Integration between economic sectors
Industrial region
Development of service economy
Secure future
Sustaining the vitality of the region
Viable knowledge and skills
Public acceptance
Managing the environmental stress
Sustainable mining
Social capital
Fragile nature
People's region
Ecological sustainability
Social licensing
Social and cultural sustainability
Sustaining the diversity of the nature
Recognising the originality and characteristics



From J. Salminen, VTT, 2014

Climate change impacts on mining:

- **Distruptions on electrity supply or logistic networks may have severe impacts on the mining sector;**

- **Shortage of water as well the excess of water may be critical;**

- **Changes in permafrost may affect the logistic network or mine tailings;**

- **Socio-economic pressures may increase as the local communities are affected;**

- **Many companies are not planning for future climate change**
  - ***Lack of knowledge***
  - ***Costs and uncertainties***

Source:
International Council on Mining & Metals, Adapting to a changing climate: implications for the mining and metals industry, 2013

Water Consumption by Mining Enterprises

Mining Enterprise	Main Production	The yearly mine water flow, mln m^3 per year
JSC Apatit	Phosphate ore	~172
JSC Kovdor MPP	phosphate ore, zirconium, iron ore	~40
JSC Olkon MPP	iron ore	~2
JSC Kola MMC	nickel, copper, cobalt, PGM	~10
Lovozersky MPP	rare earth metals, tantalum, niobium, titanium	~10

Climate change-driven trends in freshwater ecosystems of the subarctic

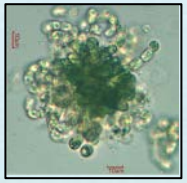
Increase the toxicity of water
Accumulation of pollutants in ecosystems

Change in trophic status

Change the direction and speed of succession

Reduced strength and stability

The effects of anthropogenic eutrophication Arctic waters



Blooms of blue-green algae (Dolichospermum lemmermannii (Ricter) Wacklin, Hoffm. & Komárek) and the death of young fish

Mining ⟷ Climate Change

Black Carbon Emission (BC)

The mining industry is the largest source of BC emissions in the Murmansk region, emitting 71% of all BC emissions because of its large diesel consumption and absence of emissions controls.

Mines consumed 139,000 tons of diesel in 2012 and large mining trucks are the major diesel consumers. Using information from individual mines (there are no less than 250 mining trucks). Mining operations continue nonstop and on average each truck operates well over 6,300 hours per year.

The PM2.5 emission factor for off-road, industrial mobile sources and machinery without emission controls was assumed to be 3.551 g/kg fuel and the emission factor of engines with some controls to be 0.967 g/kg fuel.

So, it is possible to estimate total BC emissions in the mining industry in Murmansk Region at 279 tons per year.

(Nazar Kholod et al. 2014)

The future of the mining industry in the Arctic zone of the Russian Federation in the conditions of climate change

Analysis of Russian and foreign sources shows that in the future, the intensive development of mining projects in the Arctic are the following challenges:

1.Integration of indigenous and minority peoples of the North. The preservation of traditional nature use practices. The involvement of indigenous communities to ensure food security for mining projects in the Arctic along the route of the NSR;

2.The training of sufficient numbers of qualified and motivated personnel for mining projects in the Arctic;

3.The needs to develop new technologies for environmental safety and low resource and energy intensity of mining projects in the Arctic.


Thanks You very much for
Your attention!
Благодарю за внимание!