

Climate Change, International Convention for the Prevention of Pollution from Ships (MARPOL) (Norwegian and Russian ocean-going cargo ships) and modelling of atmospheric pollution in Barents sea region

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1. Summary

- Climate change at the Barents Sea expected/predicted- ice melting, ice-free winters, summers.
- Shipping will increase- on existing shipping routes, opening of new shipping routes.
- MARPOL convention, Annex VI- detailed ships emission/ air pollution reduction procedure. No technical specifications for ice-infested waters.
- Russia- not party to Annex VI, MARPOL. Predicted/expected increasing shipping in Russia- planning economic activities- oil & gas exploration.
- Air pollution problem- long-range transport of air pollution over Barents Sea- to marine and land ecosystems

2. Introduction

Barents Sea is rich in fisheries, biodiversity and contains high economic potential for oil and gas resources. Climate change at the Barents Sea by IPCC scenario predicts/ expects ice-free winters at the sea by 2020. The future of the Barents Sea is uncertain due to predicted increase of shipping by international and local transit transport routes.

The Annex VI of the International convention MARPOL has still low ratification among European countries.



The development strategy of the Russian Ministry of Transport till 2015 on the northern sea route not considering modernisation of the national fleet towards reducing air pollution from the ships by ratification of the Annex VI.

Toxic effects from increasing air pollution and long-term accumulation of the toxic pollutants in marine ecosystem accumulated and transported from land ecosystem remains unclear.

The alternative measures to reduce air pollution from the ships includes increasing protection of the Barents Sea by designation as a special area, amendment of technical specification of the Annex VI specifically for ice-infested waters and production of better quality and cost-effective marine fuel.

3. Research Methods

1. Research problems

- Climate change- is inevitable
- Present extent of air pollution, Increase of air pollution related with increase in shipping in the future- economic activities (oil & gas), opening new routes- ice melting
- Toxic effects to marine & land ecosystems from shipping
- Applicability of technical aspects of conventions specifically for the polar region

2. The Research objective

- To analyze using Environmental Assessment (IEA) tool possible consequences of increasing shipping related to economic activities- oil and gas exploration and opening of new transport routes (climate change) and related increase of air pollution from ships.
- To analyze changes from 1990 to 2010, 2030 and 2050, building scenarios.

3. Research questions

- What is the present extent of air pollution related with shipping at the Barents Sea?
- What is the future extent of air pollution from increasing shipping (and climate change- opening new routes) by estimation of IMAGE, WRF-Chemistry (or Oslo CTM) and EDGAR models?
- What is the possible economic and environmental consequences from increasing air pollution from shipping?
- What is the applicability of technical aspects of MARPOL and LRTAP Conventions for the Barents Sea- ice infested waters?

4. Research Methodology

- Research on toxic pollutants of the Barents sea
- Information analysis related to climate change- opening of new transport routes, changes in ice-cover
- Information analysis of IMAGE, EDGAR and WRF-Chemistry model
- Analysis of applicability of MARPOL, LRTAP Conventions for polar region
- Scenario analysis- from year 1990 to 2010, 2030 and 2050

4. Research issues

Climate change

- Simulations based on the Community Climate System Model version 3 (CCSM3)CMIP3 model -suggests projected sea-ice reductions until 2100 at Arctic (2008, National Snow and Ice Data Center, University of Colorado, USA)
- IPCC- Intergovernmental Panel on Climate Change- projected scenario -40% of ice in Arctic region will become thinner during late summer, Barents sea expected to become ice-free in winter by 2020

Increase of shipping

- Arctic - important international & local transport route.
- Barents Sea expected/predicted to be ice-free during winter by 2020
- Economic development interests towards High North- Norway & Russia
- "Perspectives on the Arctic and Norway's High North Policy" Arctic Frontiers Conference, Tromsø, 19 January 2009.
- "Transport Strategy of the Russian Federation in the period to 2030"; "Development of Northern region in Russia in period to 2015".

Acknowledgements

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The complete list of references- text and maps is available in Thesis report. Maps & diagrams produced for research purpose only.

4. Research issues

Present & future oil & gas exploration- Norway & Russia largest producers/exporters in the world.

Different development scenarios and economic situation in Norway and Russia.

Norway

- Third largest oil producer/exporter in EU/world. Petroleum systems- North sea, Norwegian sea, Barents sea
- Economical viable giant field (72 million ton oil equivalent) Snøhvit net production 2.25 million tons (per year)
- Contingent resources- not currently economic of Barents sea 5% . So far -exploration success disappointing. Complicated geology.
- Forecast- reduction of oil & gas exploration starting by year 2015-2030
- Main port at the Barents sea- Kirkinen (no rail road connection); floating terminals- Statoil Snøhvit and some proposed/existing locations for unloading, loading terminals- Bøkfjord, Vadsø, Sarnesfjord, Sørøya, Melkoya, Goliat. Limited capacity of container terminals.

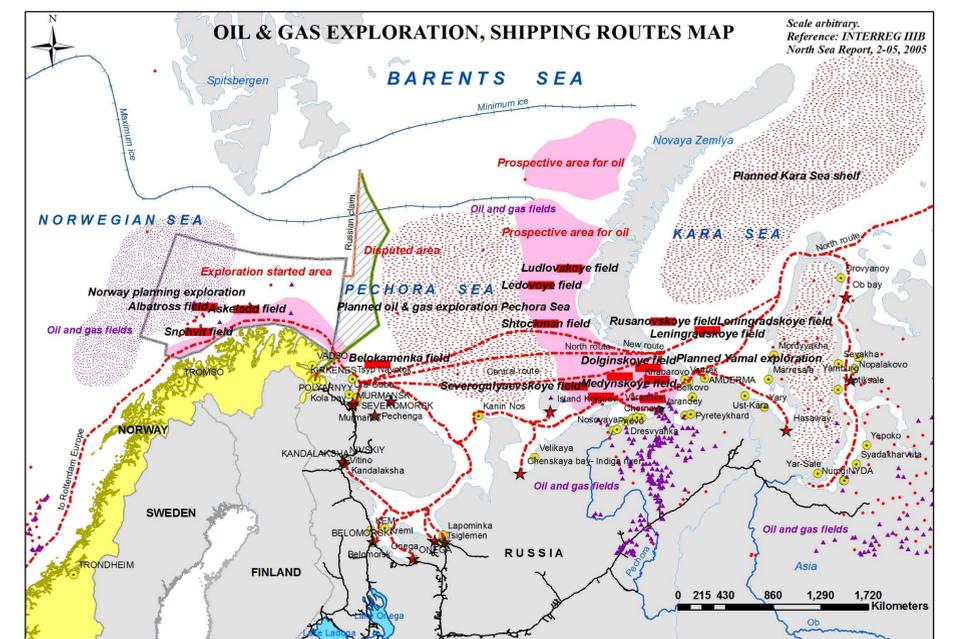


Figure 1. Oil & gas exploration , shipping routes sketch map

Russia

- One of the largest producers/oil exporters expected to become in future, from 2015-2030
- Economically viable giant fields- Timano-Pechora; Yamalo-Nenets Autonomous district; the Republic of Komi.
- Main ports- Murmansk, Arkhangelsk, Varandey. Rail connections, Murmansk- main port
- Main shipment- bulk & dry cargo; oil shipment. Limited capacity of container terminals
- Russian part of the Barents sea expected/predicted to become main transport route- transit to & from Russia.

Increase of air pollution from increasing shipping

- Air pollution main sources- Heavy fuel oil; High fuel consumption; Ships engine-combustion process.
- Toxic effects from increasing air pollution-increasing acidification, eutrophication, deposition on ice.

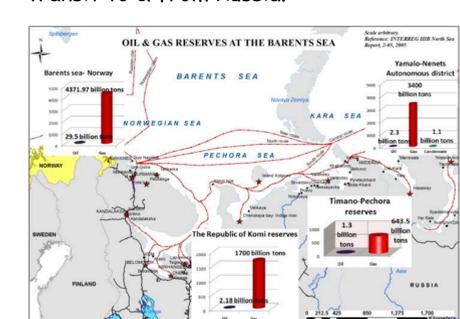


Figure 2. Oil & gas reserves at the Barents Sea

International Conventions- Ratification by Norway and Russia

Time gap between adoption & ratification

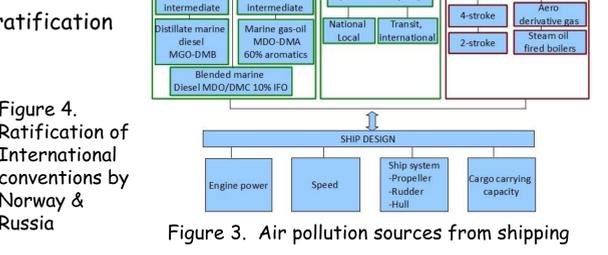
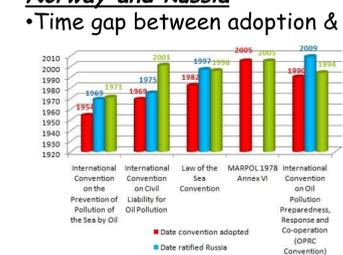


Figure 3. Air pollution sources from shipping

5. Conclusions

- Matter of concern- increasing use of Heavy Fuel oil IFO 180 & IFO 380 as cheap option. Reducing sulphur & heavy metals content in refinery process is possible
- Modernisation for Annex VI MARPOL concerns mainly ship engine. Fuel quality included (Chapter 18)- but, not producers responsibility, only suppliers responsibility
- Economic constrains to follow Annex VI MARPOL convention- too many modifications on ships engine, not cost-effective if fuel is not high quality
- Modernisation of national fleet in Russia- economic constrains; ships using mainly heavy oil fuel
- Fuel switching can reduce about 44% of SO2 emissions ("Cost-Effectiveness of Reducing Sulfur Emissions from Ships", 2007, University of Delaware, Rochester Institute of Technology, USA).

Port	IFO 380		IFO 180		MDO		MGO		Del. Date
	US\$/mt	Delivered Price							
Hamburg	455.00	415.00	461.00	420.00	477.00	430.00	615.00	575.00	D 2009-10-22
Rotterdam	446.50	405.50	464.00	415.00	480.50	435.00	653.00	613.00	D 2009-10-22
Tallinn	465.00	425.00	480.00	435.00	475.00	430.00	685.00	645.00	D 2009-10-22

Source: <http://www.bunkerindex.com>, UK, 2009

Figure 5. Prices on marine fuel- Northern Europe

- At the moment prices on low content sulphur & better quality marine fuel not cost-effective. Therefore costs of high quality fuel is responsibility of ship owners and customers.