Challenges for exploitation of the Arctic region

Satellite Applications Catapult Centre
and the Centre for Earth Observation Instrumentation (CEOI)
25th June, 2013

Arctic opportunities and risks - keeping the licence to operate

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- Robert B Spies - An Independent Review of USGS Circular 1370: "An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska" Prepared for the Pew Environment Group and Ocean Conservancy

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DOCUMENT

Improved Situational Awareness in the Arctic

Statement of Work

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European Space Agency
Agence spatiale européenne

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Loss of MS Explorer in the Antarctic

AP Image

In 1984, the Explorer was the first cruise ship to navigate the Northwest Passage. She was lost on 23rd November 2007 off the South Sandwich Islands, Antarctica.

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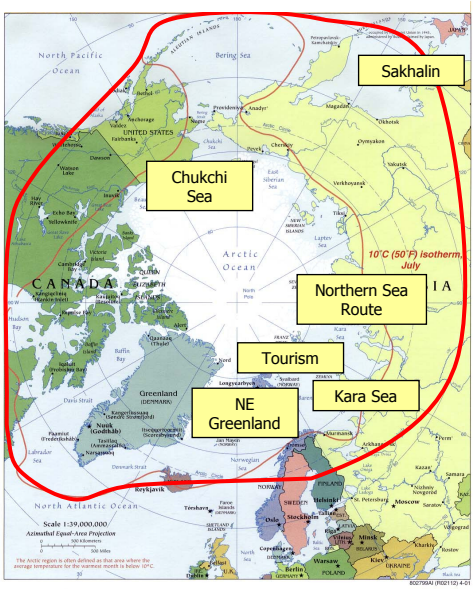
Exxon Valdez 1989

Licence to operate can be lost by one event – one mistake and you are out

The Circumpolar North

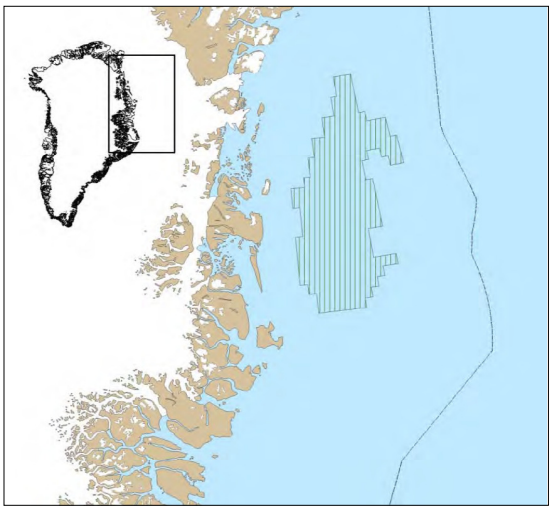
- A region of common concepts and attributes - vegetation, fauna, ice and snow, sparseness of human habitation
- Not homogeneous in climate – Barents Sea quite different from the Kara Sea
- 8 per cent of the earth's surface
- 15 per cent of the earth's land area
- 5 per cent of the earth's oceans



Armstrong, Rogers and Rowley 1978

Business Opportunities

Northeast Greenland Licensing Rounds

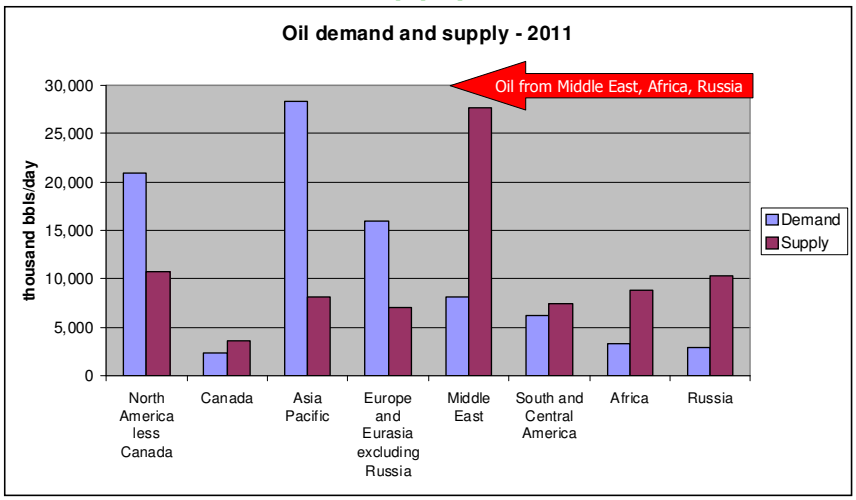


Significant unexplored sedimentary basins exist in many regions of the Arctic

NE Greenland is the most interesting of the unexplored basins

Context for Oil and Gas development prospects in the Arctic

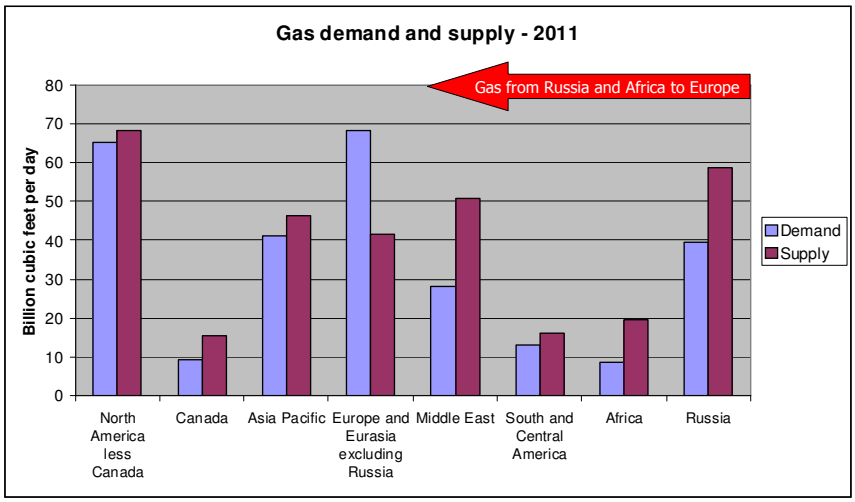
Oil Demand and Supply



55% of oil demand and 61% of projected growth is from transport
Not easy to substitute transport fuel

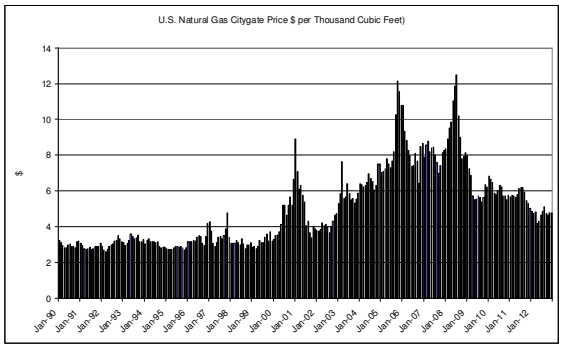
BP Statistical Review 2011

Gas Demand and Supply



BP Statistical Review 2011

US Citygate Gas Price

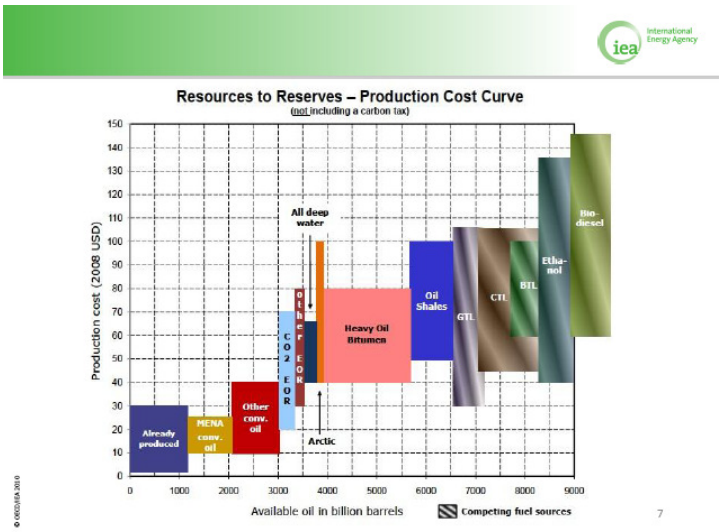


EIA data

1.03 million Btu equals 1,000 cubic feet

The US gas market has dramatically changed through the development of shale gas – shale oil is next

US manufacturing is returning from offshore because of low energy prices. Europe needs to reduce energy costs to remain competitive.



Bo Diczfalusy
Director
Directorate of Sustainable Energy Policy and Technology
International Energy Agency

UK business interests in the Arctic are substantial

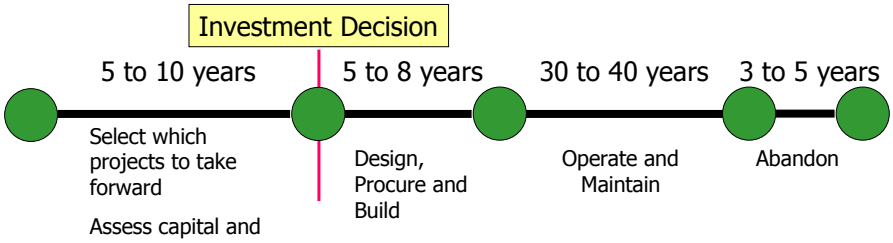
- **Oil and Gas**
  - BP, Royal Dutch Shell, Second Tier companies – Cairn Energy
- **Defence**
  - BAE Systems and suppliers
- **Metals and Minerals**
  - AngloAmerican
- **Insurance and Finance**
  - Lloyd's insurance market, Investment Banking
- **Shipping**
  - Clarkson's, P&I Clubs, BMT, BAE Systems, Lloyd's Register, DnV
- **Consultancy – Engineering and Environmental**
  - Arup, Halcrow (CH2M Hill), Wood MacKenzie, ERM, MRAG, Fugro UK
- **Research Services**
  - BAS, NOC, SAMS, Universities, TSB, Catapult Centres, RCUK
- **Suppliers**
  - Schlumberger, Wood Group, Alstom Power
- **Fishing and Fish Processing**
  - Boyd Line, Smales
- **Tourism**
  - UK tour companies specialising in polar expeditions or cruises

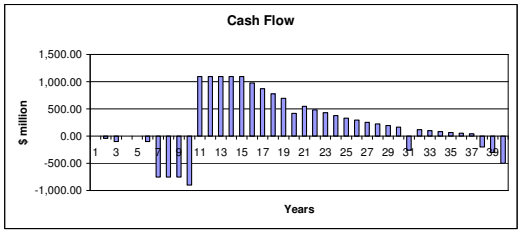
Risks to Consider

- Reputational risk
- Price risk – oil, gas, mineral or metal
- Tax wedge or appropriation risk
- Environmental pollution liability exposure
- Socio-economic impact risks
- Political risk
- Design load risk
- Project risk
- Exploration and appraisal risks
- Technological risks
- Sector specific risks – well blowout
- Shipping export or supply interruption
- Pipeline damage

Project timeline – a long haul

Estimate Net Present Value and Internal Rate of Return with risk sensitivities



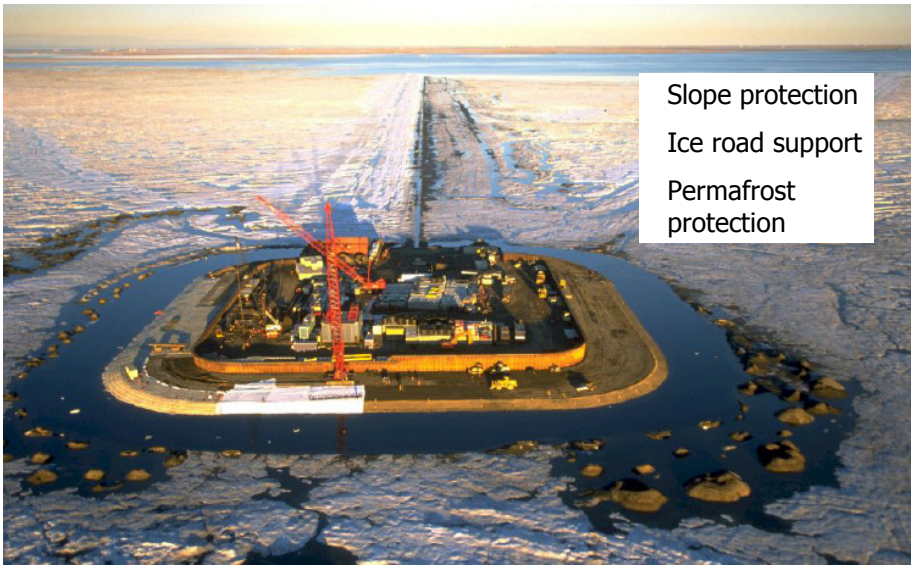


Appraisal Questions

- Future price forecast for life of the field
- Export options – pipeline or shipping
- Environmental conditions
- Capital and operating costs – design brief
- Drilling costs
- Political risks – change of government, taxation structure, regulatory framework, changes to equity, contract structures
- Exchange rate risk - local currency to dollar for local costs
- Comparison to other possible projects

Ice Mechanics and Design Loads

Northstar, Alaska



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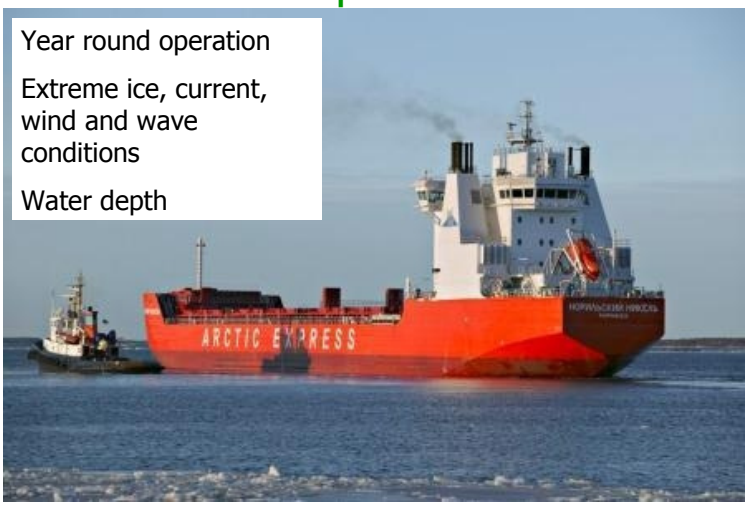
Nickel Ore Transport



Year round operation

Extreme ice, current, wind and wave conditions

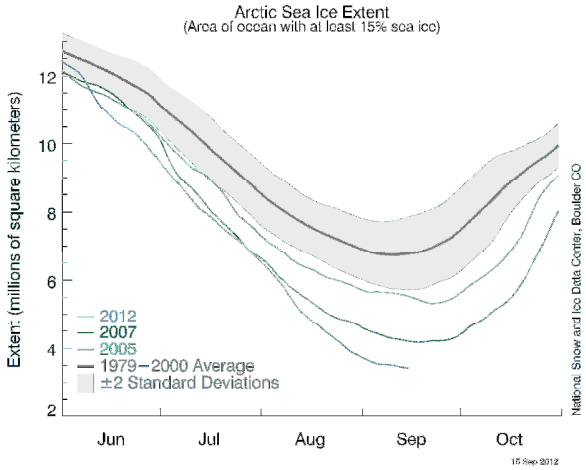
Water depth

Norlisky Nickel

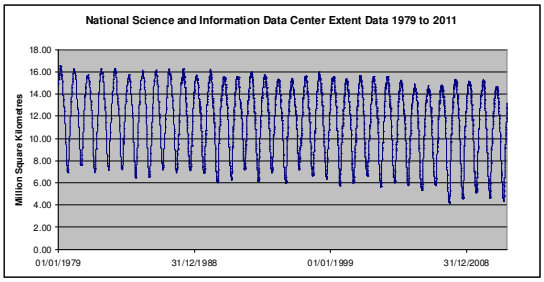
Economic ice breaking and open water transit

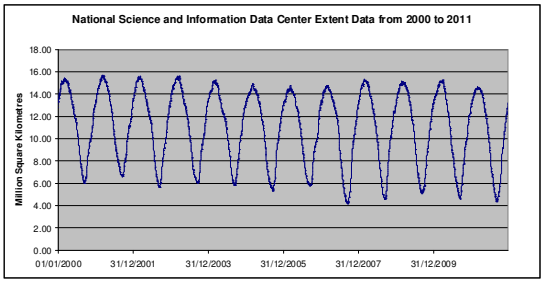
5:10 Ctrl-F

Arctic Sea Ice Extent from NSIDC



Inter-annual Variability – Sea Ice Extent





For design load estimation local ice conditions requires extreme values distributions for thickness, type, surface area and velocity

Very site specific – long time series are required

The annual minimum extent is a small part of the story

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Stimulating Innovation

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Canadian technological innovation

Shell Photographic Services, Shell International Ltd

- Molikpaq – Steel caisson – used in Sakhalin
- SSDC – Single Steel Drilling Caisson
- Kigoriak – experimental ice breaker
- Spray ice island
- Hibernia – iceberg resistant structure
- Gravel island with concrete caissons
- Ice roads and ice mechanics
- Satellite image processing

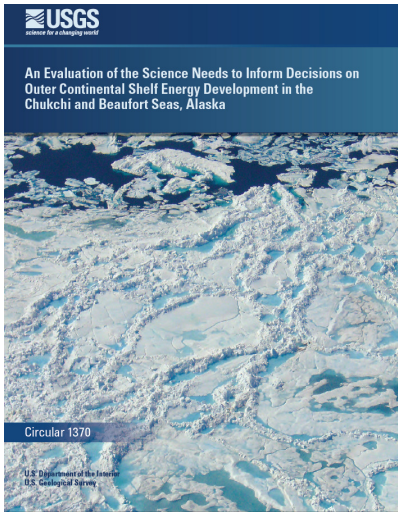
Arctic/Offshore Patrol Ships (AOPS) for Canada

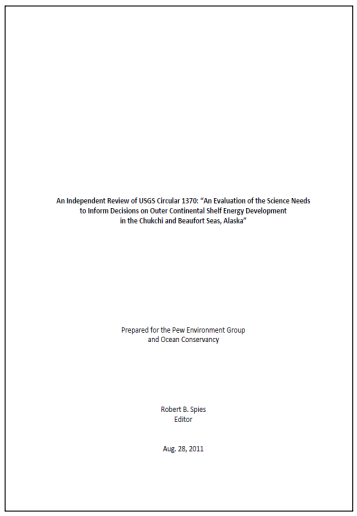
Definition, Engineering, Logistics and Management Support (DELMS) contract for six to eight ice strengthened patrol vessels won by BMT working with Aker Yards Marine (AYM) and BAE Systems

Realistic Disaster Scenarios

Insurance - Realistic Disaster Scenarios

- Well blowout under ice during winter in the near shore zone
- Vessel runs aground on uncharted rocks off Svalbard
- Pipeline damaged by ice scour
- Nickel ore carrier suffers engine failure while in heavy ice
- Tour vessel with 500 passengers and crew capsizes and passengers and crew take to the life boats in international waters near the North Pole

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Prepared for the Pew Environment Group and Ocean Conservancy

Robert B. Spies
Editor

Aug. 28, 2011

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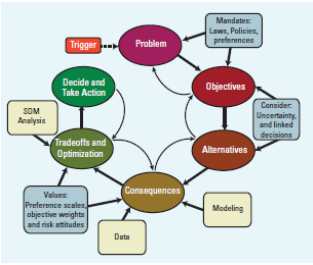
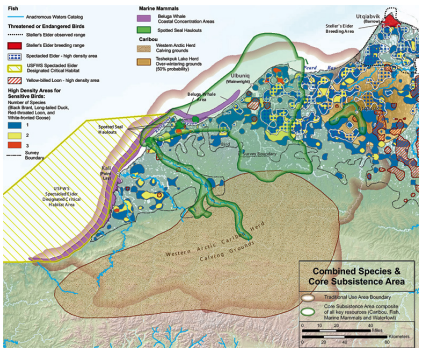
Structured Decision Making Process

- In every area where development is proposed in the Arctic there are a plethora of studies often undertaken in isolation
- Data depositories are essential to capture study data sets and inform a structured decision making process



Alaskan Coastal Studies



USGS Fact Sheet 2011-3048

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US BSEE Responding to Oil Spills in Arctic Environments Study

Joint industry and agency study of oil spill response for an Arctic spill:

Scenarios: Identify activities that could generate an oil spill (marine transportation routes, cruise ships, fishing, pipeline locations, fuel storage facilities, oil and gas exploration and production) and preventative steps that could be taken to avoid a spill.

Preparedness: Describe the anticipated operating conditions and hydrographic and charting data

Response and Clean Up: Evaluate the effectiveness and drawbacks of current methodologies used in response to a spill in Arctic conditions.

Strategies for Establishing Environmental Baselines for Spill Response Decisions

Bureau of Safety and Environmental Enforcement

Remote Sensing Opportunities

- Base line surveys for potential site specific development
- Long time-series to monitor changing environmental conditions
- Lifetime monitoring of developed sites
- Mashing of data from multiple sources to identify correlations and verify model forecasts

Summary

- Arctic development options need to be assessed in a global context
- Arctic development is inevitable
- The Arctic environment is fragile – one mistake and the licence to operate will be lost
- Research both by governments and industry needs prioritising and closer co-operation between researchers to avoid duplication of effort and to promote pooling of data in open access depositories

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