



Arctic Mining –

Technological Challenges and Potentials

Michael Havbro Faber
Professor, Risk and Safety
Global Decision Support Initiative - GDSI
Centerleder for ARTEK
Danmarks Tekniske Universitet



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Sustainable societal developments?

- There is no absolute consensus on what sustainable societal developments really are – but it is agreed that sustainability involves:
 - Intra- and intergenerational equity (long term perspective)
 - Socio-economics (culture, education, livelihood, economic capacity, income, expenditures,...)
 - Health (economics on physical and mental welfare and safety)
 - Environment (strong/weak economics on qualities of the environment)
- Sustainable developments may be pursued by appropriate decision making – however, significant uncertainties affect the outcome of decisions
- Risk informed decision making constitutes the best available framework to support sustainable developments (WEF/OECD)



Sustainable societal developments?

- Sustainable societal developments:
 - is a preference defined at societal level
 - there are no consistent drivers for sustainable developments in the “free market”
 - necessitates “new thinking” for all involved stakeholders
 - new “rules/partnerships” must be defined for all involved stakeholders
 - long term commitment is required



Key challenges for Greenland

- The overall objective of the decision making is to:
 - Enhance sustainable and robust developments for Greenland through strategic exploration and exploitation of natural resources

subject to the boundary conditions:

- Very substantial geographical area
- Minute and geographically distributed population
- Significant economic reliance/dependence on a few natural resources
- Vulnerable cultural heritage
- Highly fragile environment
- Uncertainty associated with effects of climate change
- Geopolitical "super power" interests in Greenland
- Monopoly with respect to trade/export of REE
- Volatile "raw material" markets
- Uncertain developments of "global" economic crisis
- Small national economy – lack of possibility for portfolio diversification
- Myopic "free market" interests – focus on short term investment returns



Opportunities – what should not be missed?

- Take benefit from the unity of the Realm to facilitate :
 - Sustainable societal developments in Greenland
 - Development of new production industries in Denmark/EU
- Establish “smart” PPPs:
 - The Danish State
 - The Greenlandic Self Rule
 - Danish and Greenlandic industry
 - Foundations
 - Research and education institutions



Opportunities – what should not be missed?

- The natural resources of Greenland – if strategically explored and exploited can indeed facilitate enhanced sustainable and robust societal developments in Greenland
- Long term strategic plans should be developed – not only at project level or market driven – but at societal level – for the targeted progress of exploration and exploration activities
 - based on broadly agreed informed value settings
 - continuous stakeholder involvement and commitment
 - incorporating and accounting for different scenarios with respect to global economy, market conditions, demographics, climate change, etc.
 - assessing decisions and future options on the basis of their short and long term risks to welfare, environment, culture and economy



Opportunities – what should not be missed?

- Activities of exploration and exploitation will leave tangible foot-prints in society – beyond cash flow:
 - specific exploration/exploitation facilities and sites
 - impact on livelihoods, landscape, environment and wild life
 - cultural changes
 - demographic developments
 - ...
 - infrastructure (traffic, energy, communication, waste/spill disposal, water,...)
 - buildings, hospitals, schools, higher education and industrial facilities
 - organizations (border control, surveillance, rescue and loss prevention, land use, educational, health, social,...)
 - Human resources (trained/educated professionals at many levels)
 - ...
- By targeted up-front planning the short and long term benefits can be maximized and potential adverse consequences minimized



Technological Potentials in Mining Activities

- **GreenTech energy**

- Hydro power (mining sites and cities)
- Solar and wind energy (supplement to housing and industry)
- CleanTech reduction of emissions from powerplants
- Export of technology know-how



Technological Potentials in Mining Activities

- **CleanTech waste treatment**

- Innovative solutions for furnace plants and waste water treatment
- Introduction of materials logging/tracing systems
- Reduce traffic and energy consumption to transport of waste
- Export of technology know-how



Technological Potentials in Mining Activities

- **Zero Footprint installations and infrastructure**
 - Installations/sites melting into the landscape (form/colors)
 - Installations which minimize landscape changes
 - Development of new solutions for ports, roads, bridges and foundations which are removable after use

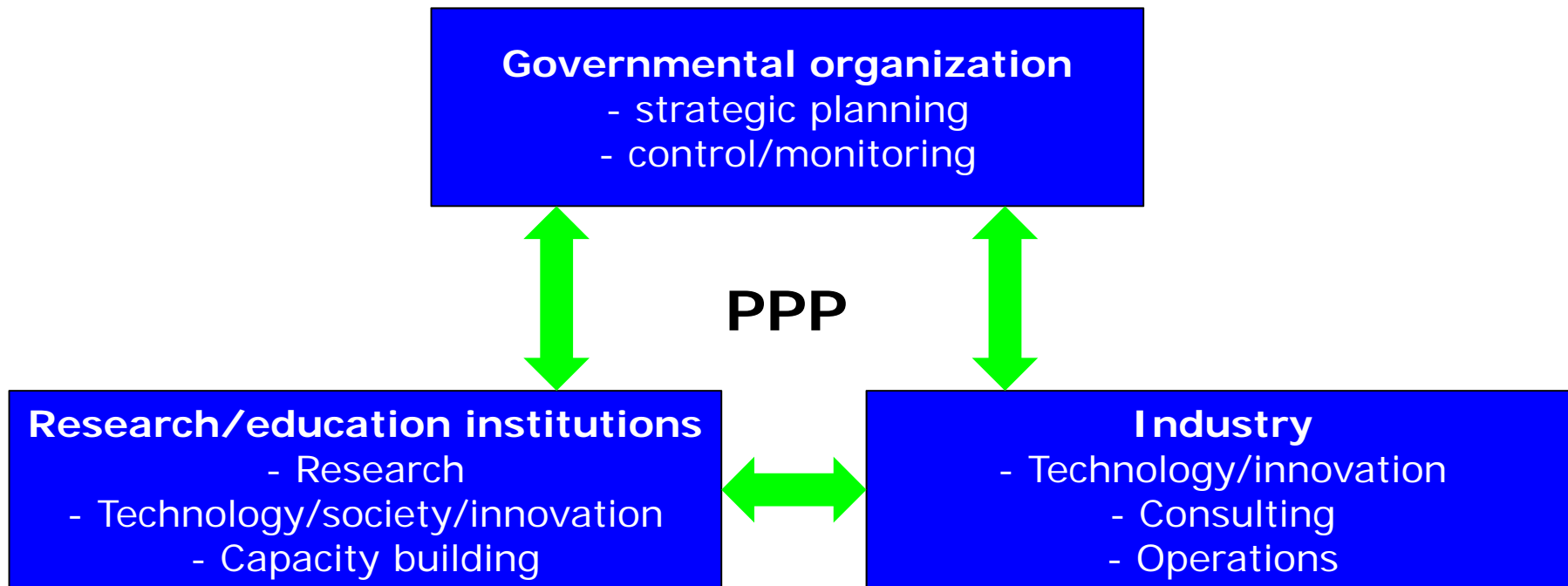


Looking forward – how to proceed?

- Pressing tasks:
 - Development of adaptive and robust strategies for exploration and exploitation activities – enhancing sustainable societal development
 - Stakeholder engagement in value setting, planning and operation
 - Development of infrastructure and built environment
 - Development of organizational/administrative capacity
 - Development of human resources
- To realize this necessitates partnerships
 - Joining forces between public and private stakeholders – long term PPP

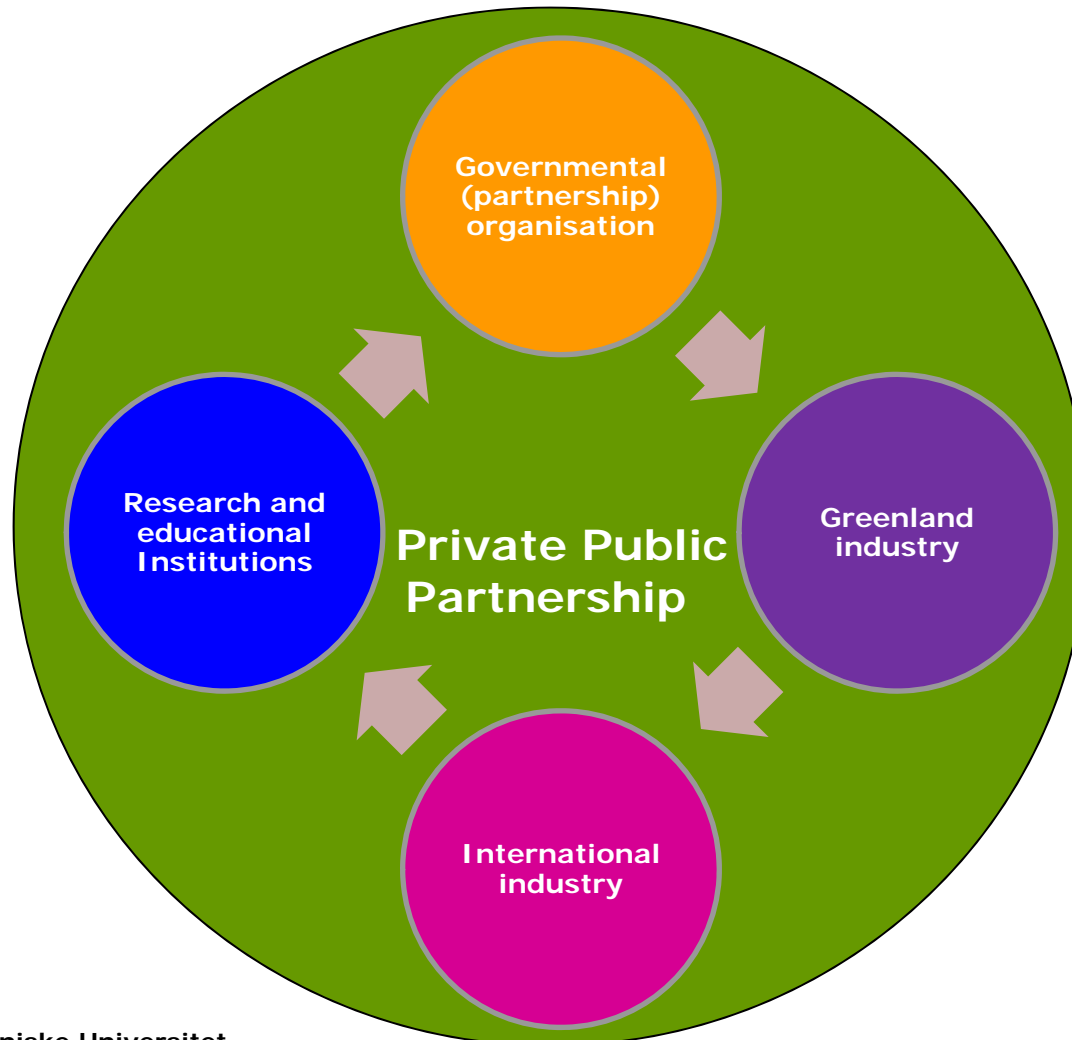


Looking forward – how to proceed?



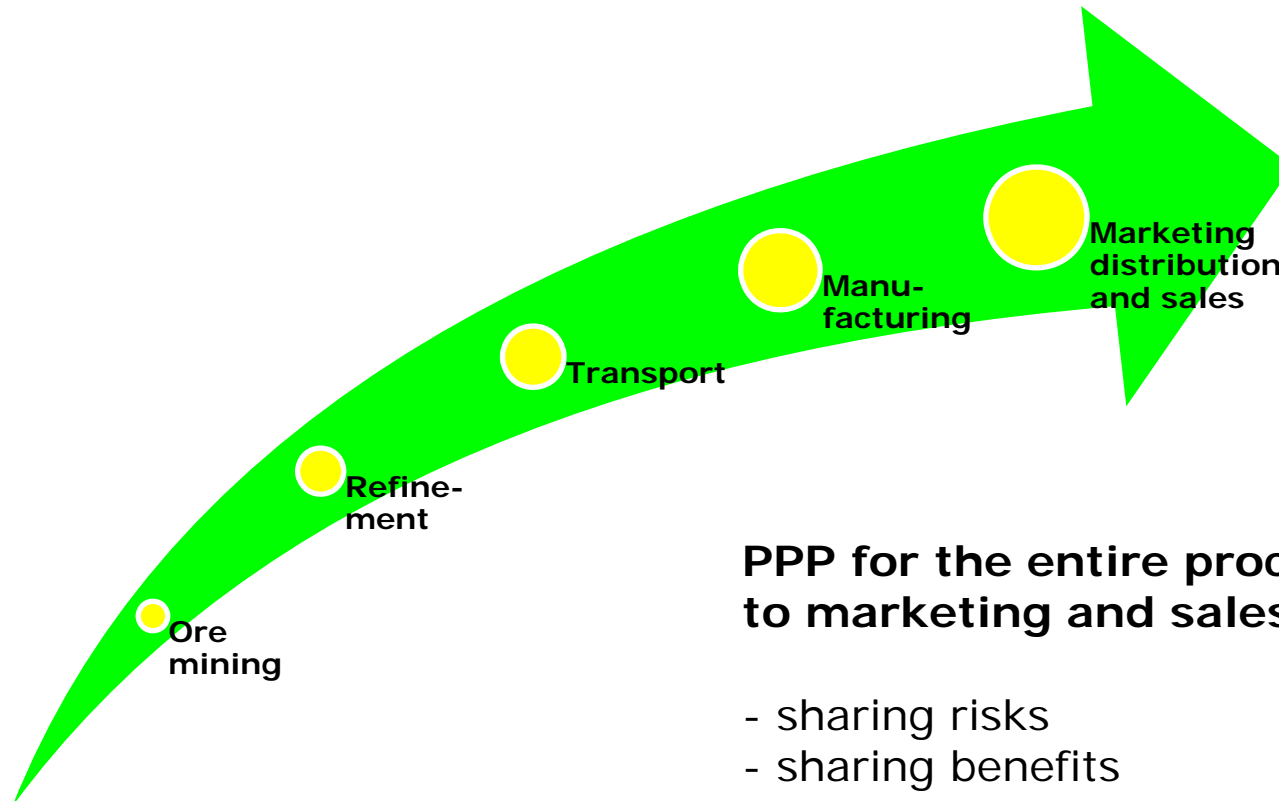


Looking forward – how to proceed?





Looking forward – how to proceed?



PPP for the entire process from exploration to marketing and sales

- sharing risks
- sharing benefits
- increasing robustness
- enhancing sustainable developments



Looking forward – how to proceed?

Role of research and education institutions

- Mobilizing available knowledge and best practices
- Capacity building and education
- Assessing and monitoring sustainability/environmental impact/risks
- Innovation of new and better technical mining solutions – Clean Tech
- Innovation in support of products manufacturing - GreenTech
- Targeted education programmes for engineers and societal planners
- Laboratory tests and facilities

Platforms

- Polar DTU, Ilisimatusarfik, Artek, Arctic Station, InterAct, Vision 125, Arctic Research Centre, CIRCLA, KIC RawMatters,.....



The ATV Report and its 7 Recommendations

ATV



7 main recommendations

- 1) Investments; rawmaterials exploitation bears significant potential for supporting sustainable developments – provided that the necessary boundary conditions are ensured – investments into competence building and general societal infrastructure
- 2) Private Public Partnerships; sustainable societal developments are not inherent in the free market mechanisms – the unity of the Realm can support this by providing infrastructures, financial and political stability – minimizing investment risks and maximizing investment appetite – DONG model



The ATV Report and its 7 Recommendations

ATV



7 main recommendations

- 3) Education: OPPs are recommended as platforms for targeted educational offers to support industry and competence building also in public authorities
- 4) Carreer building: The rawmaterials industry as an attractive carreer for indigeneous people must be branded and communicated, moreover compatible strategies for immigrant work forces must be established and implemented



The ATV Report and its 7 Recommendations

ATV



7 main recommendations

- 5) Arctic technology development; It is recommended to collaborate closely in international networks of expertise covering the entire educational value chain
- 6) Targeted competence building;
Competences:
 - directly related to and associated with the rawmaterials value chain
 - new trades
 - traditional trades and functionalities



The ATV Report and its 7 Recommendations

ATV



7 main recommendations

- 7) Greenland as investment country;
Attractiveness of investing into activities in Greenland should be improved through elimination of adverse political and social factors

Center for
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**Thanks for your
attention 😊**

Michael Havbro Faber

mihf@dtu.dk

