

Technical Education and Capacity building for
the Raw Materials Industry in **GREENLAND**



ATV Recommendation Report



CONTENTS

Preface	3
Introduction	4
Recommendations for education and capacity building	5
Two scenarios for mining of raw materials in Greenland	7
Status of mining of raw materials globally and in Greenland	8
How to unfold the potential of raw materials?	10
Activities in direct connection with the mining of raw materials	12
The need for technical competencies in the mining industry	14
Recruitment in the local and international work forces for the mining industry	18
Mining of raw materials as a catalyst for growth and transition	20
Proactive, strategic procurement of framework conditions for raw material industries in Greenland	22
Interview panel	24
References	25
ATV's financial supporters	26

Recommendation report by ATV, May 2015

THE WORK GROUP BEHIND THE REPORT

Head of Department Michael Havbro Faber,
DTU Civil Engineering (Chairman)
Research coordinator Hanne Thomsen, Polar DTU
Chief Consultant Sune Nordentoft Lauritsen, DTU Space
External Consultant Thomas Stengade Sønderkov

THE WORK GROUP BEHIND THE PROJECT

Managing Director Henrik Garver, FRI
(the Danish Association of Consulting Engineers)
Chairman Niels Boserup, the Oticon Foundation
Managing Director Charles Nielsen, TREFOR A/S
Professor Anja Boisen, DTU Nanotech

REVIEW

CEO Brian Buus Pedersen, Greenland Business Association
Head of Section Martin S. Jacobsen,
Ministry of Business and Growth Denmark

SECRETARIAT OF ATV

Senior Consultant Dorthe Brander Pedersen

Dialogue meeting, interviews and preparation of the report
have been carried out by financial aid from the COWIfonden
and the Knud Højgaards Fond.

Cover photo: Polar DTU
Design and production: Westring kbh

ISBN-no.: 978-87-7836-078-6

PREFACE

Greenland holds large natural resources but has limited experience in the exploitation of raw materials and limited insight in the mining industry. Can Denmark support a viable growth in Greenland by giving advice and focusing on the technological challenges?

More than 40 years ago drilling for oil began in the North Sea. At that time Denmark did not possess the expertise but, with great political backing, Danish oil engineers were educated and Denmark obtained a needed technology boost. Could we do it again – for the sake of Greenland and The Kingdom of Denmark? Can we identify the needs for education in relation to technology and market understanding in Greenland – and contribute to education and the obtainment of competencies?

In 2014, the above-mentioned contemplations made ATV's Think Tank focus on how to improve technological competence in Greenland – first at a dialogue meeting for invited participants and, then, by interviewing key experts. In order to develop and hold the dialogue meeting, a work group consisting of ATV members was established. For the preparation of this report, more experts joined the work group and an external consultant carried out the interviews and worked out the first edition of the report.

The dialogue meeting was held on 19. June 2014 at which 25 invited participants intensely discussed education and competencies as well as infrastructure on the basis of three presentations on raw materials exploitation, energy infrastructure and educational challenges. The interviews were conducted in the period of November 2014 – January 2015.

On the basis of the dialogue meeting and the interviews as well as accessible knowledge and literature, the purpose of this report is to identify the need for enhancing the capacity in relation to technical education and for pinpointing related focus areas which may act as a lever to ensure a substantial Greenlandic yield of raw materials exploitation. This report relates to two scenarios and puts forward seven tangible recommendations for enhancing education and competencies.

ATV would like to thank the members of the work group for their committed and constructive work. Special thanks to both reviewers of this report. The members of the work group and the reviewers are mentioned in the colophon.

ATV also wishes to thank the external experts which have participated in the interviews. The experts are mentioned in the appendix.

Finally, ATV wishes to express its gratitude to COWIfonden and Knud Højgaards Fond for having contributed to the financing of the dialogue meeting, the interviews and the report.

Michael Havbro Faber
Head of Department, DTU Civil Engineering
Chairman of ATV's Greenland Group

Carsten Orth Gaarn-Larsen
President, ATV

INTRODUCTION

The purpose of this report is to identify the need for enhancing the capacity in relation to technical education and for pinpointing related focus areas which may act as a lever to ensure a substantial Greenlandic yield of raw materials exploitation. In the nature of things, the Danish Academy of Technical Sciences focuses on the capacity building within the field of technical education. Naturally, we are aware of the need for many other competencies in the Greenlandic society and we hope that the contribution of this report will form a part in a larger society analysis.

The potential for mining raw materials in Greenland is significant but, in order to exploit the full potential for the benefit of the Greenlandic population, this will demand a strategic and proactive effort. This must be done in order to establish the right framework conditions which are necessary to attract the interest of the raw materials industry, and further to ensure that the capacity of the Greenlandic administration is sufficient to secure a sustainable management of the raw materials activities.

Within The Kingdom of Denmark, the necessary framework conditions may be supported by establishing one or more public-private partnerships (PPP). These can in their capacity of project organisations ensure that raw materials activities in the Greenland of the future will support the political objective for the development of the Greenlandic society. Taking into account the limited capacity of the Greenlandic economy, this could be obtained by sharing the financial risk between state and industry, by improving a facilitating infrastructure including energy, transport and communication, and by enhancing education and the capacity to support industry and the public sectors.

On the basis of the above-mentioned perspective, this report gives tangible recommendations as to how the raw material sector potentially may contribute to a sustainable Greenlandic society, not as a “quick fix” of the economy but as a lasting cornerstone of an autonomous economy.

This report concentrates only on non-energy raw materials as off-shore oil and gas extraction has such a long-term perspective that it cannot be expected that this industry can create business opportunities within the near future.

This report includes 13 semi-structured interviews with various stakeholders in Greenland, Denmark and Sweden. Additional material is included in the form of strategies and evaluation reports on competence and capacity building partly from the state of Western Australia and Australia's largest mining industry in the northern region of Pilbara as well as from Nunavut in Canada. In both regions, there are societal and infrastructural conditions and challenges related to the enhancement of education and competencies which are comparable to the Greenlandic ones. Finally, this report includes relevant data on raw materials for the analysis of the present situation and, in addition, former reports on other perspectives of the industrial development in Greenland.



RECOMMENDATIONS ON EDUCATION AND CAPACITY BUILDING

1

Investment

It is estimated that the mining of raw materials in Greenland can contribute substantially to a sustainable development of business and society, although on the condition that a proactive, strategic and structured political, public and commercial effort is made. To achieve this, it is proposed that industry and The Kingdom of Denmark lead the way to create the right framework conditions for a raw material industry by means of investments to raise the level of competencies and in general infrastructure in Greenland.

2

Public-private partnerships

It is recommended that public-private partnerships are formed, for instance inspired by the energy company DONG Energy, which may ensure holistic and long-term investments in infrastructure such as energy supply and transport network, which both represent lasting values for society, and investments in an actual enhancement of competencies at all levels. The Kingdom of Denmark could support this model by creating a financial safety net in order to minimise the investment risks and to increase the willingness to invest.

3

Education

As to education, close public-private partnerships should be established in order to develop purposeful educational opportunities and to support close connections between education and the labour market, among other things in order to secure internships and training places for students and adult apprentices in Greenland and, furthermore, to create a financial commitment on a general level on the part of commerce and business. In addition, it should be ensured that educational initiatives within the raw materials industry itself are complemented by an equivalent capacity building in commerce and business as well as in the public authorities. Suggestions for actions are exemplified in the report.

4

The mining industry as a career

In addition to education, it is important to focus on informing the youth in Greenland of the opportunities in the raw material sector so that it will become attractive to pursue a career in the mining industry. Tangible suggestions for implementation hereof are mentioned in this report. A strategy for the immigration of employees for the mining industry should also be developed which is coordinated and compatible with the recruitment of Greenlandic manpower.

5

Arctic technology development

It is recommended to cultivate a close relationship between technical universities with research in Arctic technology in Scandinavia, the USA and Canada in order to strengthen Arctic technology development. This research is to be included in the educational opportunities at both universities and technical colleges.

6

Capacity building

The focus areas for raising the competencies in Arctic technology for both industry and public authorities should include the special areas directly related to raw materials extraction and, also, to the technical areas which are essential for the societal development in Greenland on a long-term basis, such as infrastructure, building and construction, energy, environment and fishery technology.

7

Greenland as a country of investment

The recommended activities as to capacity building and investments should contribute to the goal of making Greenland more attractive for international raw material operators, among other things by eliminating political and societal factors which could have a negative effect on investors' willingness to establish themselves in Greenland. Further descriptions are included in this report.

* The gold mine at Nalunaq in Southern Greenland. Photo by Louise Josefine Belmonte, DTU Civil Engineering.



TWO SCENARIOS FOR RAW MATERIALS EXPLOITATION IN GREENLAND

This Academy report relates to two futuristic scenarios for raw material exploitation in the year of 2025 which have been described in the report *“Future Scenarios for Greenland”*¹ from 2013. Briefly summarized, they can be said to represent two extremities within the area of possible scenarios presuming that raw material exploitation will be a part of Greenland’s economic future.

RAW MATERIALS COMPLACENCY (INACTION) – in this futuristic scenario, society has not prepared itself for a raw material industry. Revenues from the mining industry only benefit the few and, thus, create inequality in society. Due to the lack of qualified labour bottlenecks and wage push arise to the prejudice of other professions, and the mining companies import labour from abroad. There is no incentive to carry through societal reforms as Greenland receives revenues here and now, and no investments in capacity building will be made.

This futuristic scenario represents the status quo which arises from a passive wait-and-see policy letting coincidence prevail. Lack of strategic management could lead to this scenario in which Greenland would not be capable of making use of the development opportunities which derive from increased revenues and supply of employment. The tendency to pursue a wait-and-see policy, which is widely spread in large parts of the Greenlandic society, is a symptom of this. A significant negative consequence of this scenario would be that the industrial activity, which will take place in

Greenland in the raw material sector, would have a minimal persistent effect on Greenland’s societal development both during and after the period in which the raw material exploitation would take place.

GREENLAND 2.0 – In this future scenario, the political governance of Greenland strives to obtain an economically viable and competitive society by obtaining consensus on the utilisation of the economic possibilities created by means of raw material exploitation. This could be done by carrying through the necessary societal reforms and by capacity building in order to support the raw materials sector in coordination with the generally desired development of society.

In this future scenario, it is presupposed that society proactively relates to the possibilities and challenges which raw material exploitation entails.

This report discloses the potential which the raw material industry can induce to the benefit of a sustainable society and, furthermore, how raw material exploitation may be fitted into a strategic development of society when it comes to parameters such as infrastructure, education and capacity building. What will the potential be if the development is orchestrated jointly between The Kingdom of Denmark, industry and the public authorities?

¹Future scenarios for Greenland. Copenhagen Centre for Futures Studies’ Scenario Studies for Greenland, September 2013



STATUS OF RAW MATERIALS EXPLOITATION GLOBALLY AND IN GREENLAND

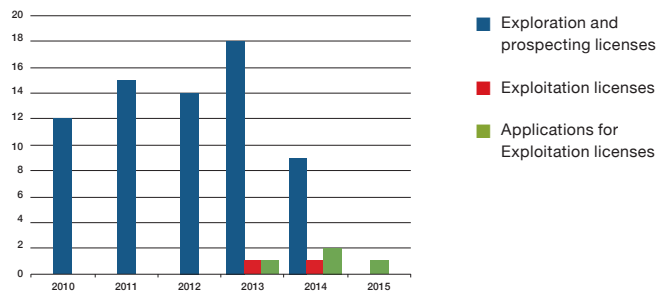
Recently, the raw material sector has experienced massive investments in mining of raw materials which have led to the realisation of several mining projects. In 2013 and 2014 the production in the raw material consuming industry stagnated and declining prices have caused many mining corporations to put planned activities on hold, small junior companies to disappear, and the mining industry unable to attract risk capital. It is well-known for the mining sector that the prices on raw materials fluctuate. The difficult conditions are determined by the prices on the financial market for raw materials and strategic price regulations, especially on the non-financial market for raw materials. The economic prognoses suggest that, in the near future, the need for raw materials will rise again, not least to supply the growing middle-class in the BRIC-countries, and that the prices on the financial market therefore will improve on a more profitable level for the manufacturers. It primarily applies to bulk raw materials such as iron, nickel and copper in which Greenland is rich. As to the prices on the non-financial market for raw materials, the situation is different as for example rare earth elements are almost exclusively offered by China on the world market. The pricing of these raw materials is expected to remain set by the global foreign policy.

Raw material activities in Greenland reflect the market, and in a global perspective the present slowdown in activities is neither inexplicable nor unique. The interest has primarily been concentrated on gold, silver, zinc, lead, iron, nickel, copper, platinum, rubies, sapphires, chromite, vanadium, titanium, rare earth elements and uranium. Statistics from the Mineral Resource Authority in Greenland on the development of licenses and applications during the past five years are shown in **Figure 1**.

The total number of applications including off-shore for exploration and prospecting licenses for 2015 which have not yet been completed amount to five.

A total of six exploitation licences have been granted in Greenland for the past 15 years. Angel Mining (Gold) A/S has re-opened the old Nalunaq mine at Nanortalik. Minelco A/S was granted a permit to extract olivine at Fiskefjorden in West Greenland. Black Angel Mining A/S obtained a

* Figure 1: Number of exploration and exploitation licenses as well as submitted exploitation licenses from 2010 to March 2015



permit to re-open a lead and zinc mine at Maarmorilik and Selskabet Malmbjerget Molybdenum A/S received a permit allowing extraction of molybdenum at Malmbjerget in East Greenland. These projects have either been closed down or put on hold. London Mining Greenland A/S obtained a permit to a large scale project for the mining of iron at Isua fjorden north of Nuuk, and True North Gems a permit for a ruby mine south of Fiskefjorden on the southwest coast south of Nuuk. London Mining Plc has handed over the license to General Nice Development Limited based in China². The iron ore mine is expected to potentially create about 3,000 jobs during the construction phase. True North Gems (TNG) is expected to start mining in 2015. During the operational phase, 40 employees will be needed at the mine and 14 in Nuuk³.

Projects submitted to the authorities include Greenland Minerals and Energy (GME), extraction of rare earth elements and uranium at Kvanefjeld in South Greenland. 735 jobs are expected during the operational phase⁴. IronBark, possibilities for a zinc and lead mine at Citronen Fjord in North Greenland with 450 jobs expected⁵. Tanbreez, deposit of rare earth elements at Kringlerne in South Greenland. 97 jobs expected⁶. Hudson Resources, deposit of anorthosite at White Mountain southeast of Sisimiut; 57 jobs expected⁷.

² <http://naalakkersuisut.gl/da/Naalakkersuisut/Nyheder/2015/01/080115-London-Mining>

³ www.truenorthgems.gl/upload/pdfs/ProjectBrief-DanishFinal.pdf

⁴ <http://gme.gl/fremtidens-kvanefjeld-nye-attractive-jobs-til-gronland>

⁵ <http://ironbark.gl/projects/greenland/citronen/>

⁶ <http://tanbreez.com/en/social-environmental-conditions/>

⁷ Documents from a public hearing published at the home-page of the Mineral Resource Authority: Hudson Resources Inc White Mountain anorthosite project Greenland property license 2002-06. Greenland Social Impact Assessment.



Geological Map of Greenland with Mineral Deposits

(GEUS Geological Survey of Denmark and Greenland/MMR Ministry of Mineral Resources, Government of Greenland)



★ Ore with rubies and a cut ruby from Fiskerisø in East Greenland. Photo: True North Gems.

HOW TO UNFOLD THE POTENTIAL OF RAW MATERIALS?

In the raw materials industry, Greenland is considered to be a country of great potential due to the purity of its deposits although it is commonly acknowledged that Greenland poses a number of difficulties if the country is to form a successful part of the global competition for raw materials.⁸ In the Investment Attractiveness Index 2014 of the Canadian analysis institute Fraser Institute, Greenland has dropped from a place in the top ten to no. 41 on the world ranking list of attractive mining countries.⁹ This is primarily due to the unsettled framework conditions exemplified by the introduction of royalties according to which the companies have to pay a fixed tax rate of the value which the raw materials in the ground are expected to represent. Unsystematic access to geological data is a matter which was improved by the introduction of a new digital Greenland portal presented at the international trade exhibition of mining PDAC in March 2015 in Toronto.

When it comes to several parameters, Greenland does not differ that much from other regions: most of the mines in action are placed in remote areas with sparse and under-educated population without infrastructure involving huge

transport costs and situated at a great distance from the markets. As to investments, establishing infrastructure and operating the mining activities pose additional costs. The cold climate poses an extra challenge; technology adapted to the climate could form a vital part of the solution to this challenge. However, the climate cannot be perceived as a real hindrance if compared to the ranking of Arctic Canada in Fraser's Index in which all regions are placed in the top ten.

From an international perspective, the hesitance of establishing a raw materials industry in Greenland seems to originate in the framework conditions for mining activities, lack of infrastructure at a general level and, probably, a temporary decline in prices on raw materials. Add to this the national challenges of a society and a population which are not prepared for a mining industry and the fact that there does not seem to be a political will to ensure stability in this area.

The planned mining projects will entail a poor societal effect as singular sources of revenue if an active effort is not



★ Open pit mine. Photo: Bigstock.

performed in order to strategically incorporate these in a superior plan for a sustainable development of society in coordination with a generally desired development of education, capacity building, business, infrastructure and housing. One of the core questions is how mining activities can contribute as a lever for this development.

Apart from the geological conditions, a number of political and societal factors exist which are essential for the evaluation of mining companies when it comes to assessing a country's attractiveness for investments. The most important factors are:

- ◆ Efficient and transparent administration of licenses, environmental regulation and legislation
- ◆ Infrastructure
- ◆ Socio-economical and local community conditions for the development, including IBA¹⁰
- ◆ Political stability
- ◆ Safety
- ◆ Access to competent work force

If a proactive, strategic effort is made to improve these parameters, this would at the same time strengthen the capacity building in the whole of the Greenlandic society. A raise in competencies in society is not without costs economically and time wise. One of the solutions may be to ensure a close cooperation between public and private stakeholders and across education, practice and innovation all the way from strategy to regional and local implementation. A possible model for solution I is presented at the end of this report.

⁹⁾ The international mining magazine Global Mining Finance has in its annual report 2014 a portrait of Greenland as a mining nation in Europe and a profile of the American company North American Nickel which holds an exploration license for the nickel deposit at Manitsok. www.globalminingfinance.com/documents/gmf-2014/GMF-2014-fullbook-v3-withlinks.pdf

⁹⁾ Fraser Institute Annual Survey of Mining companies 2014: www.fraserinstitute.org/research-news/display.aspx?id=22259

¹⁰⁾ The Impact Benefit Agreement stipulates binding objectives for the benefits which the local population and business community should obtain from the big scale projects



ACTIVITIES DIRECTLY CONNECTED WITH RAW MATERIALS EXPLOITATION

Already before a mine is put into operation, a huge amount of work has been made as to prospecting mineral and metal deposits and analysing the potential of such deposits for commercial utilisation. Then follows the assessment of the safety, economic, environmental and societal factors in relation to the planned mining project. Establishing the mine itself with limited or no infrastructure at all, also demands much planning and construction work before the mine can be taken into operation. At the end of the lifespan of the mine, the area must be given a clean-up, the environment must be safeguarded and, in some cases, nature restoration has to be carried through.

Many of the functions which are needed to establish and run a mine are traditionally handled by means of contracts with other companies which then act as subcontractors. Therefore, there will in the entire lifespan of the mine be ample opportunities for the subcontractors to handle a part of the activities in which they have specialised: Arctic building and construction, logistics, catering, cleaning, interpretation, language education, safety, accounting, legislation and environmental assessments just to mention a few. Some mining companies choose to select subcontracts from a list of business partners which have been “screened” for their competencies to work in the mining industry. It can be incorporated in an overall, political plan for capacity enhancement that as many Greenlandic subcontractors as possible are qualified for this list of approved subcontractors so that subcontracting business is developed in Greenland in order to avoid import of such services by the mining companies. IBA can support this process. It would have a long-term effect if IBA were to take a nationally strategic perspective rather than the local focus of today.

Exploration and prospecting activities

Exploration and prospecting are mostly performed by specialised geologists and geophysicists. In addition, logistic services such as airplanes, helicopters, camps, equipment and provisioning will be in demand. Often it will be advantageous for the prospecting teams to use people with local knowledge as guides and consultants.

Evaluation

The evaluation as to whether it will be profitable to mine a deposit will most often be made by the mining companies which employ their own specialists but also lawyers, economists and investors will be involved. It is at this stage that the negotiations with the Mineral Resource Authority and the Government of Greenland as to exploitation licences are initiated. It may last five to ten years from prospecting a deposit to constructing the mine itself.

Construction and Mining

During the construction phase there will be a need for a specialised work force including engineers, technicians such as electricians, carpenters, masons and workers who can handle heavy machinery (forklift and crane drivers) and so forth. In most cases a whole infrastructure has to be built from the very bottom – facilities for the mine itself, power supply, roads and, in many cases, a harbour and an air strip. Most of the projected mines will be so-called *open pit mines* rather than mines underground.

During the mining phase the need for employees at the mine itself will be lower than during the construction phase. Now, specialised employees are needed for extracting, sorting, transporting and, to a certain degree, processing the



ore. In addition, daily maintenance of equipment, buildings and energy supply is needed.

During both the construction and the mining phases there will be a need for personnel responsible for safety, health, canteen, supplies and other service tasks, logistics, transport and environmental assessments.

Processing

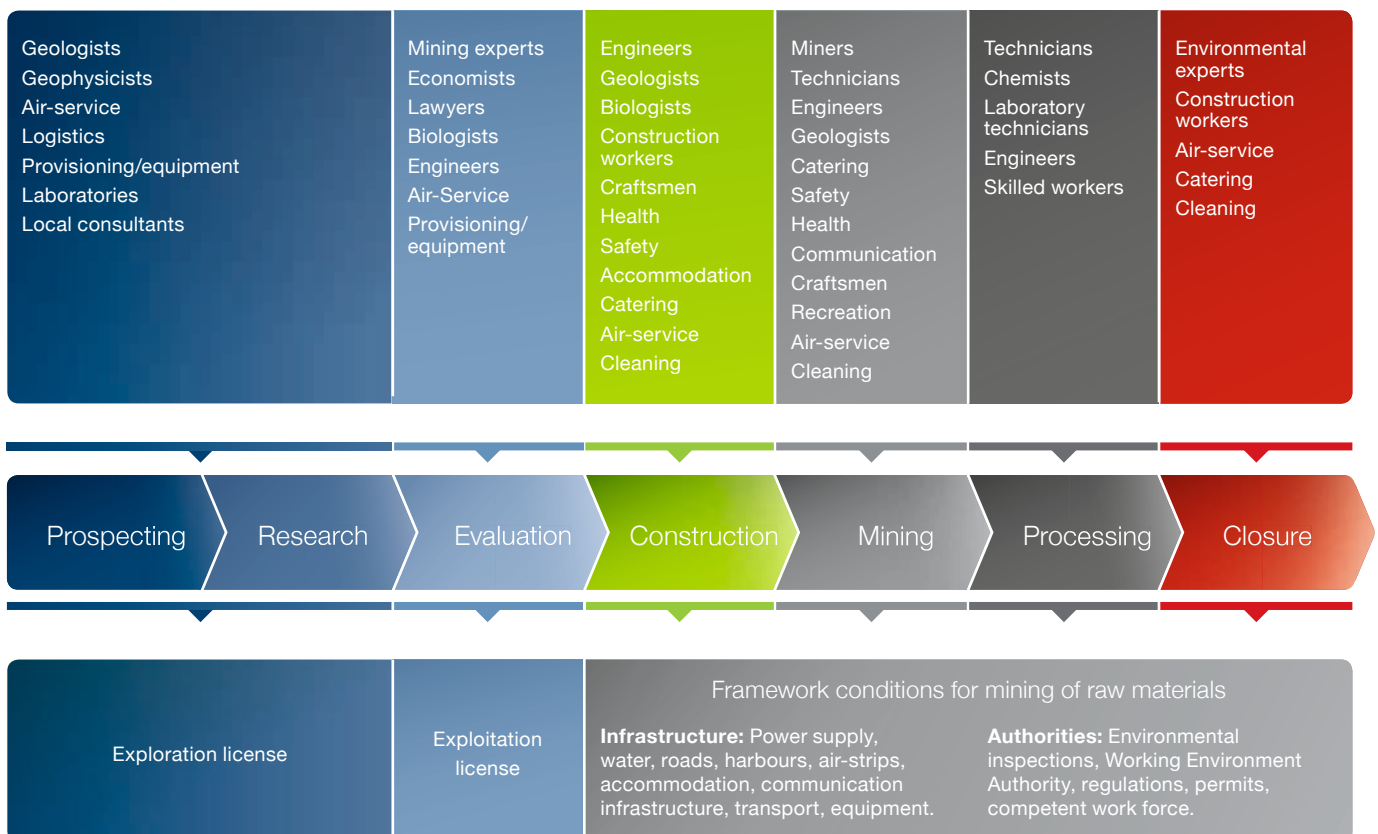
In relation to the mining there may be a need for refining the ore. There are several levels and stages as to processing metals and minerals which can be done at the mining site if the necessary processing plants have been constructed or the ore can be transported to existing processing plants outside of Greenland. A certain level of economic optimisation could be achieved if the processing of the ore could take

place at the mining area by using renewable energy such as hydropower for the energy consuming processing. This would at the same time reduce the transport costs when only a concentrated cargo consisting of refined ore is to be transported.

Closure

When it is no longer profitable to mine, it will demand a huge effort to close down activities and leave the area in a state which is both safe and environmentally responsible. At this stage, there will be a need for environmental experts, engineers and technicians. The possible afterlife of the mine may either be negotiated and defined in the exploitation license and/or subsequently in a dialogue with the local authorities – agreements for instance that the infrastructure to and from the mine is handed over to the local population.

Functional needs during the various phases of mining and framework conditions for mining



THE NEED FOR TECHNICAL COMPETENCIES IN THE MINING INDUSTRY

In this report, focus is on the construction and mining phases as it is estimated that it is during both these phases that the need for technical competencies is the greatest and the possibilities for Greenlandic jobs are the best. Building upon the existing constructional competencies of local contracting and engineering companies and the established educational systems in Greenland it may be possible to qualify a part of the work force to engage in the mining industry.

Even though an unknown number of years may pass before there will be a sufficient number of mining companies which can offer jobs related to the raw materials industry, a strategic capacity building may create business opportunities both within and beyond Greenland virtually at once, as the

achieved technical competencies can be applied in many other sectors of business. A similar situation arose in the 1990s at the Faroe Islands which focused on an oil-gas industry by means of intensive drilling in the sea around the Islands. In spite of the fact that extraction still has not begun and still is based on doubtful results from the sea bed, the Faroe Islands have achieved to educate its work force for jobs in the oil and gas sector. Furthermore, a number of companies have been established to work as subcontractors for the international oil-gas industry in the North Sea¹¹ – mainly offshore services such as provisioning, shipping, air-service and technological solutions.

¹¹ Source: The Faroese Employers Association.
www.industry.fo/Default.aspx?ID=3992



★ Tech College Greenland and Artek at Sisimut. Photo: ARTEK.



Continues on next page ▶

Continued from previous page

The direct need for a capacity building in accordance with the primary construction and mining phases can be defined in the following specialized competencies:

Technical and vocational education and training (TVET):

- ♦ Blasting experts
- ♦ Construction workers
- ♦ Processing operators
- ♦ Miners
- ♦ Mine safety personnel
- ♦ Technicians e.g. in control rooms
- ♦ Operators of heavy machinery (forklifts, cranes etc.)
- ♦ Specialized electricians
- ♦ Semi-technical functions such as store and logistic managers, laboratory technicians and front line supervisors (environmental inspections)
- ♦ Mechanics
- ♦ Navigators
- ♦ Shipmasters

Tech College Greenland at Sisimiut (KTI) offers courses in some of these specializations. Technical competencies relating to underground pit mines have not been included as only open pit mines are planned.

Diploma and Master's degree programs:

- ♦ Mining plant managers with qualifications in minerals and metals
- ♦ Mining engineers
- ♦ Engineers specialized in the fields of chemistry, construction, electrical and electronics engineering, environment, soil engineering, mechanical engineering, production, project/management, soil information systems
- ♦ Geologists, geophysicists, geo-statisticians
- ♦ Hydrologists
- ♦ Environmental education – biologists and the like
- ♦ Experts in radiation safety (when mining uranium)



★ Heavy equipment at training mine, Sudbury, Canada. Photo DTU.

According to their own announcements the companies that plan mines in Greenland expect to recruit the majority of their academic employees abroad. During a relatively short number of years, there will be suitable, Greenlandic candidates who can be qualified to work in the mining industry in engineering and environmental functions by expanding the present educational platform. Experiences from Western Australia show that some TVET-candidates do have the skills to complete a diploma program and even a Master's degree program when correctly guided. It is therefore suggested to establish a close cooperation between technical colleges and technical universities offering interdisciplinary and postgraduate courses.

It is believed that the existing cooperation between ARTEK (a cooperation between the Government of Greenland and the Danish Government via the Technical University of Denmark (DTU)) and Tech College Greenland at Sisimiut could form an important lever.

Due to safety reasons industry demands practical skills training as well as the educational qualifications which are offered in both TVET-education and academic education. Furthermore, substantial investments are needed for an expansion of the Greenlandic educational system to accommodate the various needs for specific qualifications. This can be achieved by establishing a close cooperation between educational institutions, mining corporations and public authorities with a view to develop and implement targeted educational offers and to ensure training places, internships and apprenticeships before and after education. It can be contemplated to make a form of external funds available for the founding of such cooperation. Mining companies are traditionally interested in investing in the training of employees for specific functions, but not in all-round qualifications. In Canada, the government has established a foundation of 500 m dollars yearly available for so-called skill training and specifically for Nunavut an amount of 1.5 m dollars¹². A possibility to invest in the enhancement of competencies can also be based on revenues from the mining activities like the suggested raw materials foundation in the report *For the Benefit of Greenland*¹³.

If the right experience/basic training could be ensured by means of such a public-private partnership, certification of informal competencies and training would be a natural consequence. The right level of certification could be determined among other things by looking at the certification requirements for other mining countries. It could for instance be accredited training at the mining companies so that the acquired competencies could also be used internationally.





¹²⁾ www.prnewswire.com/news-releases/governments-of-canada-and-nonavut-finalize-agreements-to-help-people-in-nunavut-get-jobs---final-agreementreached-on-creation-of-the-canada-job-grant-276002171.html

¹³⁾ For the Benefit of Greenland, the Committee for Greenlandic Mineral Resources for the Benefit of Society, Ilisimatusarfik, Copenhagen University, 2014

RECRUITMENT AMONG THE LOCAL AND INTERNATIONAL WORKFORCES FOR THE MINING INDUSTRY

The mining industry can experience difficulties in attracting a qualified young workforce as the work places are often situated far from towns or perceived as dangerous or dirty workplaces. If the Greenlandic youth is to be motivated to seek a career in the mining industry, their awareness of the possibilities could be strengthened by:

- ♦ Designing a strategy for integration of new employees in the workforce
- ♦ Establishing school courses in mining subjects in both Greenlandic and global perspectives – provided that school teachers get the means to upgrade their skills in such subjects
- ♦ Establishing local training and visitor centres at which schools and colleges can gain insight into mining
- ♦ Clarifying the international job opportunities in the mining industry and encourage and support the young who wishes to go on a study visit abroad

It cannot be expected that Greenland on its own can mobilise a sufficient workforce for the mining industry if all the

planned projects are implemented. Therefore, a strategy for receiving and integrating a foreign workforce in Greenland is needed with due regard to the regulation defined in the so-called Large-Scale-Legislation for import of foreign workers during the construction phase¹⁴.

Accommodation is one of the issues concerning mines situated outside inhabited areas and often without a proper infrastructure. It will affect people's choice of career whether they prefer to move to mining camps to which they can bring along their families or whether they prefer the so-called fly-in / fly-out structure due to which the employees experience an out-home cycle. The fly-in / fly-out structure is expected to have the biggest impact on the major towns in Greenland which are expected to function as hubs for the mining employees. There will be a need for more urbane infrastructure which will also benefit the local community and a need for a local strategy for the integration of an international work force.

¹⁴ Inatsisartut law no. 25 dated 18. December 2012 regarding construction works in Large scale projects, chapter 5.





● The international airport at Kangerlussuaq

* Photo: Polar DTU.



★ Arctic technology. Photo: ARTEK.

EXPLOITATION OF RAW MATERIALS AS A CATALYST FOR GROWTH AND CONVERSION

Spill over effect on the job market

In addition to the jobs which are created due to the operation of the mine itself, mining of raw materials may generate additional growth in the whole of the society. The effect of mining operations on the job market is normally said to be an additional 3 – 4 jobs in other sectors for each mining job. Jobs created due to an increased need for health services, child care, teachers, accountants, insurance people and retail employees; however, mining will also generate enhanced possibilities for promoting entrepreneurship in a number of other lines of business such as communication, art, culture, tourism, restaurants and food etc. Thus, there will be a need for capacity building in a number of areas which are not directly connected to the mining industry but which can be an asset in the overall strategy of societal development¹⁵.

Public capacity building

Greenland has a well-argued demand that mining must take place on sustainable terms environmentally, economically and socially. In order to support this, it is necessary to strengthen the capacity and competency enhancement of the public authorities. This can be ensured by continuing professional development in areas such as raw materials politics and mining economy, thereby giving civil servants a generally better understanding of mining operations, but also by ensuring that the public authorities have employees who are

educated in supervising mining activities – the so-called front line supervisors. These employees must have specialist knowledge of nature and work environment corresponding to bachelor level or higher.

Mining of raw materials can be a catalyst for enhancing the ability to manage public administration and the job continuity among public employees, among other things by making education and continuing professional development available.

Investment in and the use of infrastructure

The comprehensive infrastructure necessary for setting-up a mining industry in Greenland holds a potential which by means of a long-term strategy for its use can create permanent business opportunities, also after a closure of a mine.

Especially the idea of renewable energy in a business model holds great perspectives in which Greenland after the closure of a mine may establish a more permanent source of income by selling energy to international companies. The conditions in Greenland for establishing hydropower plants are good and this could be combined with wind power, thus providing 100 per cent green energy. In connection with mining operations, plants for ore processing can be set up which generates a huge need for energy. This has been done



★ Government of Greenland. Photo: private.

successfully in Iceland for the production of aluminium from bauxite. Greenland holds the same potential, for instance at White Mountain where Hudson Resources has applied for the utilisation rights for a deposit of anorthosite which is used for the production of fibreglass and paint as well as alumina¹⁶.

Mining-related harbours and airports are used as transport hubs for equipment, personnel and raw materials in connection with mining operations but can also be used by the energy and processing industries. They can form part of the national infrastructure in which the potential applications are numerous, ex. in connection with tourism, trade, fishing, military purposes / safety at sea and research. An extended season of passable waters in and around Greenland could entail as to an increase in international shipping.

Development of Arctic technology

The cold, Arctic climate is a challenge for mines which must operate 365 days a year. Buildings, equipment, energy supply and transport have difficult terms at very low temperatures, wind, snow and ice. There is a need for technology to meet the challenges that can impede social and economic development. Arctic technology development and specialization in the areas of mining, energy and construction could be one of several positive side effects of a

mining industry in Greenland where access to and competencies in Arctic technology can create a favourable competitive position for Greenland.

To ensure this, capacity building can be based on existing, international education and research cooperation agreements. An interdisciplinary and a cross-institutional cooperation through the “Nordic Five Tech” – the technical universities of Scandinavia has recently been established. This has resulted in a joint master’s degree in Cold Climate Engineering with participation of Greenlandic students and a network for research infrastructure focusing on the Arctic. ARTEK plans to expand its educational range by a master’s degree in Arctic technology and to establish a university centre for education and research in Greenland – Vision 125 – which will carry on the international profile.

Likewise, an extended cooperation with universities from other Arctic nations such as Canada and the USA can be established in order to create a strong platform for the development of new technological solutions to common, circum-polar challenges.

¹⁵⁾ Corresponding experiences in Western Australia: Government of Western Australia, Department of Training and Workforce Development: *Skilling WA – A workforce development plan for Western Australia 2014* www.dtwd.wa.gov.au/workforceplanninganddevelopment/skillingWA/Pages/default.aspx

¹⁶⁾ http://aheadoftheherd.com/Advertising/Sponsor_Page/HudsonResourcesInc/index.html

PROACTIVE, STRATEGIC PROCUREMENT OF FRAMEWORK CONDITIONS FOR THE RAW MATERIALS INDUSTRIES IN GREENLAND

Minerals, metals, oil and gas are strategically important on a national level and can, if exploited correctly, be a significant source for economic growth and sustainable, social development. Industrial extraction and export of oil and gas have for instance transformed the Norwegian society from a poor fishing community in the 50s and 60s into one of the wealthiest communities in the world with unmatched welfare and total energy independence.

Minerals and metals in Greenland hardly have a potential comparable with the importance of oil and gas in Norway. But mining and related raw material extraction activities in Greenland have a substantial potential to support the desired societal development. It is vital though that The Kingdom of Denmark keeps a holistic perspective.

If The Kingdom of Denmark has the political will to sustain a modern standard of living in the Greenlandic population, there will still be a long-term need to support the Greenlandic community either by direct funding or guarantee agreements which could constitute a safety net under the Greenlandic, financial risk portfolio.

Experience shows that there is substantial potential in thinking holistically concerning investments supporting welfare and the development of society. It is vital to achieve the largest possible gearing from the free market and ensure that development of the society, resulting from the investments, meets the political objectives of democracy. Over a number of years, such models can justify the profitability of a substantial, compiled investment compared to a financial support that does not entail gearing from the free market. In addition, if it can be ensured that a large portion of the direct, financial support is used for investments with a very long lifespan such as general infrastructure, water, wind and solar plants and not least enhancement of competencies, knowledge and capacity in industry and the public sector, business mechanisms can be attained turning passive investments into active, profitable investments. Furthermore, it may ensure a healthy socio-economic mechanism for value creation, job promotion and welfare enhancement – and, in

this way, become a self-reinforcing mechanism promoting a sustainable development of society.

Possible models for active and profitable investments in activities within the above-mentioned categories are major public ventures and public-private partnerships. As the public funds of Greenland are very limited, The Kingdom of Denmark and the Danish pension funds must be the leading forces. The establishment of Statoil in Norway and DONG Energy in Denmark are examples of public ventures based on long-term perspectives and with a strategy of commitment and co-financing on the part of the free market.

According to the same model, it is probable - with financial support or a safety net on the part of The Kingdom of Denmark and with partnerships among industries which by means of PPPs together span over several links in the value chain of raw materials – to create frameworks which ensure an equalisation of risk among the contributing partners. Thus, industrial commitment and financing of a long-term and valid nature may be attracted.

Under the auspices of The Kingdom of Denmark, PPPs could also be established for tenders for societal infrastructural services such as energy production and -supply, transport and communication.

PPPs can also be used building-up competencies and capacity both in industry and the public sector. The ARTEK-model, cooperation between the Government of Greenland and the Danish Government via the Technical University of Denmark (DTU), is a successful example. If such joint projects are magnified on a bigger scale and opened for involvement and investments from both private investors and industry, this could contribute to boosting knowledge build-up in Greenland and, thus, also the competitiveness and welfare in the Greenlandic society. Vision 125 is an example of such a PPP. Vision 125 is the establishment of a technical Arctic university centre at Sisimiut in Greenland with a permanent research staff in Greenland and 125 students accepted each year.



INTERVIEW PANEL

Greenland Business Association

Brian Buus Pedersen, CEO
Karsten Klausen, Head of Secretariat, Legal Counsellor
Thomas Tyt Mogensen, Consultant

Inuplan

Kristian Lennert, CEO

Rambøll Management

Henrik Fenger Jeppesen, CEO

True North Gems

Bent Olsvig Jensen, CEO

Nuna Minerals

Ole Christiansen, CEO

Kisserup International

Pernille Fischer Boulter, CEO

Technical University of Denmark (DTU), Civil Engineering

Michael Havbro Faber, Head of Department

Natural History Museum of Denmark, University of Copenhagen

Minik Rosing, Professor

Luleå University

Bertil I. Pålsson, Senior Lecturer, Mineral Processing, Dept. of Civil,
Environmental & Natural Resources, Luleå University of Technology

Naalakkersuisut, Ministry of Industry, Labour and Trade

Per Aksel Petersen, Head of Department

Sermersooq Business Council

Ulla Lynge, CEO

REFERENCER

Canada's Economic Action Plan (2014):
Northern Adult Basic Education Program
<http://actionplan.gc.ca/en/initiative/northern-adult-basic-education-program>

Canadian Literacy and Learning Network (2012):
Nunavut – State of the Field Overview
<http://www.literacy.ca/content/uploads/2012/11/Nunavut-2012.pdf>

Canadian Northern Economic Development Agency (2014):
Northern Adult Basic Education (NABE) Program
<http://www.cannor.gc.ca/eng/1386781838257/1386781934840>

Department of Development & Transportation (2007):
Nunavut Mineral Exploration and Mining Strategy,
http://gov.nu.ca/sites/default/files/Parnautit_Mineral_Exploration_and_Mining_Strategy.pdf

Government of Canada (2014):
Governments of Canada and Nunavut finalize agreements to help people in Nunavut get jobs – Final agreement reached on creation of the Canada Job Grant
<http://news.gc.ca/web/article-en.do?nid=886309>

Government of Western Australia, Department of Training and Workforce Development:
Skilling WA – A workforce development plan for Western Australia 2014
<http://www.dtwd.wa.gov.au/workforceplanninganddevelopment/skillingWA/Pages/default.aspx>

Government of Western Australia, Department of Training and Workforce Development:
Skilling WA final report, 2010-14
<http://www.dtwd.wa.gov.au/workforceplanninganddevelopment/SkillingWA/skillingWAreports/Pages/default.aspx>

Government of Western Australia, Department of Training and Workforce Development:
Pilbara workforce development plan 2013-2016, executive summary
http://www.dtwd.wa.gov.au/workforceplanninganddevelopment/regionalworkforcedevelopmentplans/Documents/Pilbara_ExecSummary_web.pdf

MiHR's Portal for Aboriginal Engagement in Mining:
Education & Training – Aboriginal Minerals Training and Employment Program (AMTEP)
<http://www.aboriginalmining.ca/en/careersguide/EducationAndTrainingInExploration.asp>

NABE Northern Adult Basic Education Symposium (2014):
NABE Background
<http://nabesymposium.com/Background.aspx>

Skills Canada Nunavut:
Jobs in Mining – Our land. Our Possibilities,
publiceret efter 2008,
http://www.skillsnunavut.ca/pdf/3229-018%20Mining_Eng.pdf

Western Australian MINING Industry: WORKFORCE DEVELOPMENT PLAN, 2010
http://ritcwa.com.au/LinkClick.aspx?fileticket=mQ_ZlFRxsT8%3d&tabid=133

Reports:
Fremtidsscenerier for Grønland (Future Scenarios for Greenland)
Scenarios for Greenland by the Copenhagen Institute for Future Studies, September 2013

Til gavn for Grønland (For the Benefit of Greenland)
The Committee for Greenlandic Mineral Resources to the Benefit of Society, Ilisimatusarfik, University of Copenhagen, 2014

Fremme af kommercielt erhvervsarbejde mellem Grønland og Danmark (Stimulation of Commercial Cooperation between Greenland and Denmark)
Ministry of Business and Growth Denmark and Naalakkersuisut, February 2015

THE ACADEMY'S FINANCIAL CONTRIBUTORS

Companies

Arla Foods amba
Carlsberg A/S
Coloplast A/S
COWI A/S
Danfoss A/S
Danish Crown A/S
Danish Power Systems
DONG Energy
DuPont Nutrition Biosciences ApS
Exiqon
EY P/S
FORCE Technology
GlaxoSmithKline A/S
GRUNDFOS Holding A/S
Haldor Topsøe A/S
H. Lundbeck A/S
MAN Diesel & Turbo
MT Højgaard a/s
NIRAS A/S
Nordic Sugar A/S
Novo Nordisk A/S
Novozymes A/S
Nykredit
Per Aarsleff A/S
PwC
Rambøll Danmark A/S
Rockwool International A/S
Scanventure ApS
Siemens A/S
SUND & BÆLT Holding A/S
Danish Technological Institute
Widex A/S

Universities and Research Institution

CBS – Copenhagen Business School
DTU – Technical University of Denmark
University of Copenhagen, Faculty of Science
University of Copenhagen, Faculty of Health and
Medical Sciences
RUC – Roskilde University
SDU – University of Southern Denmark
AAU – Aalborg University
AU – Aarhus University

Organisations

FRI – The Danish Association of Consulting
Engineers
GTS – Advanced Technology Group
IDA – The Danish Society of Engineers
The Danish Agriculture and Food Council
The Danish Confederation of Professional
Associations
The Danish Metalworkers' Union

Public authorities and institutions

Danish Patent and Trademark Office
SSI – Statens Serum Institut

Foundations, private and public

Innovation Fund Denmark
Knud Højgaards Fond
The Danish Industry Foundation
The Hempel Foundation

★ Nuuk. Private photo.



ATV IS AN INDEPENDENT, MEMBER-DRIVEN THINK TANK.

ATV'S VISION IS THAT DENMARK SHALL BE ONE OF THE
FIVE LEADING SCIENCE AND ENGINEERING REGIONS IN THE
WORLD – TO THE BENEFIT OF FUTURE GENERATIONS.

READ MORE AT WWW.ATV.DK

ATV

THE DANISH ACADEMY OF TECHNICAL SCIENCES
LUNDTOFTEVEJ 266, 2800 KGS. LYNGBY
PHONE +45 45 88 13 11
ATVMAIL@ATV.DK
WWW.ATV.DK

MAY 2015