Annual report for ARTEK 2016
1. Introduction

Commitment and academic competency are two of the main headlines describing our diverse activities in 2016. DTU has created a new, international MSc programme in Cold Climate Engineering, with one semester taking place in Sisimiut. This makes the environment at ARTEK in Sisimiut highly international and is a great inspiration for everyone. Student activities have, among other things, included a highly visible landmark in Sisimiut: the bridge from the mainland to Assaqutaq built by our Arctic Engineering students during their introduction course.

Our work received academic recognition, and approx. 100 participants from across the Arctic attended the ARTEK International Conference on Sanitation in Cold Climate Regions in Sisimiut, making it the largest conference we have held to date. During the year, ARTEK participated in many important working groups in Greenland and internationally. In addition, ARTEK students and a research project with the active participation of ARTEK received awards.

‘Vision 125’ provides the framework for ARTEK’s development in the coming years. In 2016, there was focus on the work with the ‘Vision 125’ business plan. This work culminated with an interesting and forward-looking workshop in Nuuk in November with the participation of the Steering Committee, the Advisory Board and ARTEK’s scientific staff. The future therefore seems to offer an exciting development of ARTEK.

Students building a suspension bridge from the mainland to Assaqutaq, introduction trip in August 2016.
2. Teaching

2.1 BEng education – Arctic Technology

In 2016, the BEng education in Arctic Technology celebrated its 15th anniversary. As has been the case so far, the students take the first three semesters of their education at DTU in Sisimiut (located together with KTI), and then three semesters at DTU in Denmark. Later on the students have to do an internship with a company in the Arctic engaged in the field of engineering. Most students choose to do the internship in Greenland. ARTEK has a fruitful collaboration with internship companies, and our students benefit largely from the knowledge they gain. The education is concluded with a BEng project within a topic of special focus. The project is scheduled to run for one semester, after which the students are ready to embark on their engineering career. In the 15 years of ARTEK’s existence, more than 80 Arctic engineers have graduated from ARTEK. After completing the education, the majority of all BEng graduates choose to apply for a job in Greenland, while the remaining graduates primarily find employment in Denmark or Norway.

In Sisimiut, 23 new students started the education in August 2016, two of which have dropped out. At the end of the year, approx. 95 students were enrolled in the Arctic Engineering Education Programme.

During the first half of 2016, Associate Professor Emeritus Egil Borchersen held the position as acting head of studies for the BEng programme in Arctic Technology. In that period, Egil Borchersen lived in Sisimiut. From July to November 2016, Professor Lisbeth M. Ottosen served as acting head of studies. The vacant position as head of studies was announced in 2016. It was, however, not possible to fill the position. A decision was made to appoint Associate Professor Tove Lading with effect from November 2016. Tove Lading does not live in Sisimiut, but spends four-five months a year in Sisimiut. At the end of the year, a vacant administrative position was announced in the Sisimiut department, which will be filled by a new employee in early 2017.

Several new teaching-related initiatives were implemented in 2016 in connection with the BEng education in Arctic Technology. Key initiatives are outlined below.

2.1.1 NEW INTRODUCTION PROGRAMME CONCEPT IN SISIMIUT

For a number of years, the introduction programme for the new students of the Arctic Engineering Education included the building of a small cabin, which was then placed in the Sisimiut area for everyone to use.

In 2016, we decided to implement a new concept which involved a new structure and strategy for the introduction. As a new initiative, the introduction trip (where the primary purpose is for the students to get to know each other and the area) and the introductory course were combined into one programme, where the students were to work on a specific technical task. First in the classroom, then in the workshop, and finally in the mountains during a multi-day hike. The topic of the project was discussed with Qeqqata Kommunia to find a suitable task which would benefit all parties. In 2016, it was decided to design and construct a bridge from the mainland to the island of Assaqutaq just south of Sisimiut.

2.1.2 SUPPLEMENTARY DANISH LANGUAGE COURSE IN SISIMIUT

In 2016, students enrolled in the education and who have Danish as a second language were offered a supplementary Danish language course as a continuation of a pilot project conducted in 2015. Throughout the year, language consultant Halfdan Petersen from Pikkoritta Consult in Aasiaat taught the course either physically in Sisimiut or via skype or other internet-based teaching. The language course took place concurrently with the engineering courses, so that the students had the opportunity to work together with the consultant on written papers.

The reason for the supplementary Danish language course is that the majority of the Greenlandic students on the Arctic Engineering Education and with Danish as a second language experience major challenges expressing themselves in written Danish in an academic context. ARTEK therefore aims to establish a permanent arrangement to meet the students’ needs while they are studying in Sisimiut and in Denmark. In 2016, the initiative was funded through a DKK 180,000 grant from the Government of Greenland’s drop-out reduction pool. Unfortunately, the pool was discontinued with effect from 2017, and it is therefore necessary to explore alternative, permanent forms of funding to ensure that the students can continue to receive language teaching. There will still be a considerable need for the language course among the Greenlandic students in the coming years.
2.1.4 FROM DTU IN SISIMIUT TO DTU IN DENMARK

Every year in January, fourth semester students enrolled on the Arctic Engineering education relocate from DTU’s campus in Sisimiut to Denmark to continue their studies. 2016 was the first year where the students were to continue their studies at DTU’s centre for BEng programmes in Ballerup, and not at DTU’s campus in Lyngby. The transfer to the new location was thoroughly prepared by ARTEK’s study administrative unit in collaboration with the Department for Construction and Infrastructure in Ballerup, which offers the courses for fourth and fifth semester Arctic Engineering students. For ARTEK, it was important to ensure that the students were given a proper introduction to the new location, and that they felt welcome from day one. At the same time, it was important to ensure that DTU’s lecturers in Ballerup already were familiar with the specific conditions and the course of study on the Arctic Engineering Education, as they had not previously worked together with ARTEK. Therefore, an introduction programme of several days was planned and took place at the Lyngby and Ballerup campus.

In Ballerup, the Arctic Engineering students participated in an introduction day for all new students together with the approx. 75 new students on the BEng programme in Construction and Infrastructure. In addition, they attended a lunch event organized by ARTEK where their new lecturers as well as the study administration in Ballerup attended. The students had the chance to introduce themselves and the lecturers presented their courses.

At the Lyngby Campus, ARTEK invited the new students for breakfast. Lecturers, administrative staff and many of the senior students participated and welcomed the new students. After breakfast the students were on a guided tour of DTU’s campus followed by a lunch and social activities. The same day there was an information meeting for the Greenlandic students at the student counselling office in The Greenlandic House in Copenhagen. The student counselling office is responsible for offering student counselling during their stay in Denmark.

A major challenge in connection with the new setting where the Arctic Engineering students are based at the Ballerup Campus is the physical distance to the Lyngby Campus. This complicates the regular contact between the students and the ARTEK staff and senior Arctic Engineering students based at the Lyngby Campus. ARTEK’s study administrative coordinator has therefore been provided with an office in Ballerup. This enables the coordinator to be present on a regular basis and to maintain contact with the students and have an ongoing dialogue with the administration and the lecturers in Ballerup.

In June 2016, ARTEK held an evaluation meeting with the Arctic Engineering students in Ballerup with focus on the lessons learned during the first semester. The conclusion was that the students had settled in well in Ballerup, especially thanks to the solid and active study environment, good physical framework and skilled lecturers. However, many students needed more time than expected to adjust to the new way of teaching, which is different from the first three semesters in Sisimiut. The evaluation also showed that there was a need for some adjustments in the programme in Sisimiut as to ensure that the Arctic Engineering students have the same academic prerequisites for participating in teaching activities in Ballerup as the rest of the students. These adjustments have subsequently been implemented in the programme in Sisimiut.

The majority of the Arctic Engineering students at DTU in Denmark live either at the Nyborgård Dormitory close to Lyngby or in halls of residence close to the Ballerup Campus. Only a few live in a private flat.
2.2 MSc programme ‘Cold Climate Engineering’ and the Arctic Semester

In the autumn of 2016, the first students were enrolled on the MSc programme Nordic Master in Cold Climate Engineering. The programme is offered through Nordic Five Tech (N5T), together with the Norwegian university NTNU and Aalto University in Finland. A total of seven students are enrolled on three study tracks: Land (four students), Sea (two students), and Space (one student). Among the students admitted to the Land track is a BEng graduate in Arctic Technology. Although the intake appears to be modest, the number of students is satisfactory considering that it is a new programme under N5H. For students enrolled on the Land track, the first semester takes place at DTU in Lyngby, the second semester in Sisimiut, and the third and fourth semesters at NTNU in Norway, where the students also have the chance to take courses at The University Centre in Svalbard (UNIS). ARTEK does not offer courses on the Sea and Space tracks. The head of studies and the programme coordinator for the entire programme is Associate Professor Gunvor M. Kirkelund. Gunvor Kirkelund is also affiliated with ARTEK. The Nordic Council of Ministers has funded the planning and start-up of the Nordic Master in Cold Engineering programme.

The Arctic Semester—a semester with MSc level courses—was conducted for the first time in the spring of 2016 in Sisimiut. 12 students participated and came from Greenland, Canada, Bulgaria, Slovakia, Norway, Iceland, France, Switzerland, and Scotland. Six of the students took the semester as part of their DTU programme, and six were exchange students from the University of British Columbia (Canada), the University of Stavanger (Norway), ETH Zürich (Switzerland), and the Heriot-Watt University (Scotland). The semester was a success and there was a lot of positive feedback from the students. The students did fieldwork, worked with Greenlandic cases on the courses and participated in the conference ‘Sanitation in Cold Climate Regions’. In the future, the Arctic Semester will be a mandatory part of the Land track on the Nordic Master in Cold Climate Engineering programme.

2.3 BEng, BSc, and MSc projects at ARTEK in 2016

**BEng** final projects on the Arctic Technology programme in 2016:
- ’Hovedstadsstrategi’ (Capital strategy), Ludvig Petersen
- ’Analyse og modellering af sedimentation af partikler i procesvand fra tunneldrift’ (Analysis and modelling of sedimentation of particles in process water from tunnel operation), Mikkel Bue Lykkegaard. Collaboration with Istak, Norway and the National Institute of Aquatic Resources, DTU.

**BSc** projects carried out at ARTEK in 2016:
- ’Undersøgelse af mængden af ultrafine partikler i Sisimiut og deres kilder’ (Study of the quantity of tiny particles in Sisimiut and their sources), Una Petursdottir, collaboration with DTU Environment

**MSc** projects carried out at ARTEK in 2016:
- ’Miljøundersøgelse af Cu minetailings fra Nordnorsk Fjord’ (Evaluation of environmental impacts of a submarine tailing deposit in Northern Norway), Manja Marie Kudahl and Mie Vesterskov Henning, in collaboration with Akvaplan Niva in Tromsø.

BSc and MSc projects are available on [www.artek.byg.dtu.dk](http://www.artek.byg.dtu.dk)
2.4 Award-winning ARTEK student projects

Mie Henning and Manja Kudahl came in third in DTU’s student competition “Green Challenge” in the category ‘Bachelor final project idea’ with the project ‘Evaluation of environmental impacts of a submarine tailing deposit in Northern Norway’.

Una Petursdottir (supervised in a collaboration between ARTEK and DTU Environment) won the award for the best BSc project 2016 at DTU Environment.

2.5 E-learning development

The course ‘Arctic Mineral Resources: Environmental Impacts and Technologies’ was conducted as a 100 per cent e-based course—but on a different platform than previously, as DTU is in the process of changing suppliers and testing various platforms.

As part of the regular teaching in Sisimiut, ARTEK has experimented with conducting some lectures over the internet for both Arctic Engineering students and students in the Arctic Semester. E-learning has the advantage that the lecturer can be located at DTU when giving the lecture. The students gain academic knowledge through the lecturer, but without the lecturer having to travel from Denmark, which is both costly and time-consuming. Both half-day distance learning and single lectures have been conducted. The idea is good, but requires that a lecturer is available in Sisimiut in connection with subsequent teaching in which the lecture is incorporated. Despite the fact that the teaching takes place over the internet, the contact between the students and the lecturer is good, as the students ask questions just like they would during a regular class. ARTEK will continue with this form of teaching as a supplement to the regular classroom teaching. This form of teaching will also increase the possibility of, e.g., involving lecturers from consulting firms and authorities from the rest of Greenland.

2.6 Vision 125—Strategy workshop on 8-9 November in Nuuk

In November 2016, ARTEK organized a strategy workshop on Vision 125 in Nuuk. In addition to ARTEK’s management and researchers, the participants were the primary collaboration partners and stakeholders from the Government of Greenland, the Greenland Business Association, municipalities, the Advisory Board and the steering committee as well as two specially invited guest lecturers: the CEO of ICC Greenland and the president of the University of the Arctic. The purpose of the workshop was to evaluate, discuss and reaffirm Vision 125 and the underlying strategic key elements in terms of research and education based on the current needs and framework conditions in Greenland.

Main conclusions from the workshop:

• All key actors contributing to the realization of Vision 125 and collaborators continuously support the strategy and the ongoing work to implement the agreed elements of the strategy. The strategy is supported because it has the right perspective and build up a long-term knowledge that benefits sustainable development for and with the Greenlandic society.

• Qeqqata Kommunia maintains its full commitment to the realization of Vision 125 and the establishment of a technical university centre in Sisimiut. The municipality has reserved an area in its local planning, where the new buildings described in the strategy could be built. The area is located in the vicinity of KTI’s existing buildings and the current industrial area. The municipality has also earmarked large areas for building more halls of residence.

The ARTEK model—characterized by the existing collaboration between the Government of Greenland, DTU, and KTI as well as key ARTEK stakeholders—is regarded as a crucial element for the realization of Vision 125. The ARTEK model emphasizes the anchoring into the society and the mutual benefits are reflected in the strategy.
3. Research

The four main fields of research at ARTEK are: Arctic Environmental Engineering; Planning, Sustainability, and Infrastructure; Constructions and Physical Environment; and Buildings and Energy in the Arctic. Highlights from 2016 for the individual research fields are provided below.

3.1 Arctic Environmental Engineering

Research of Arctic environmental technology remains concentrated on wastewater and drinking water treatment as well as resource-optimizing strategies in relation to different waste fractions in the Greenlandic society. Measures have been taken to strengthen research, especially in relation to the management of waste from mining operations in collaboration with the Norwegian company Akvaplan Niva in Tromsø. Akvaplan Niva is evaluating the environmental consequences of depositing mine tailings in the fjords near the mines. ARTEK has been a partner in this project, particularly in relation to the laboratory work and discussions of the results obtained. In connection with mine tailings, a Chinese PhD student working on purification and resource optimization in connection with mine tailings has initiated an eight-month stay as a guest student at ARTEK.

The ARTEK International Conference (AIC) was held on 12-14 April 2016 in Sisimiut under the topic ‘Sanitation in Cold Climate Regions’. With more than 100 participants, 55 presentations, and representatives from all of the Arctic countries, the attendance at AIC 2016 was higher and more international than in the past. The conference was a contribution to the activities of the Arctic Council’s working group on health in the Arctic—Arctic Human Health Experts Group. ARTEK contributed with four lectures at the subsequent conference ‘Water Innovation for Healthy Arctic Homes’ (WIHAH2016) in Anchorage, Alaska.

The conference has generated an international network that continues to work with the ideas from the conferences, the development of research projects, and the dissemination of knowledge in this field. The networking activities are funded by the University of the Arctic. For example, efforts are being made to establish an e-based MSc course within the topic of the conference as well as a special edition of a scientific journal with articles based on the presentations given at the two conferences. Furthermore, a PhD project entitled ‘Development of Strategies for Efficient Water Usage for Production of Safe Fresh and Ready-to-eat Seafood Products in Remote Communities’ has been initiated in collaboration with DTU Food and Royal Greenland.
ARTEK is also part of the EU-funded Northern Periphery and Arctic (NPA) project ‘Circular Ocean’. ARTEK’s role is to investigate the possibility of using worn-out fishing nets in construction materials. This project won the European Commission’s RegioStar Award in 2016. The award is given to projects which make a major contribution to regional development and innovation in the local community.

3.2 Planning, Sustainability, and Infrastructure

Within this focus area the year started with a workshop on water abstraction and water treatment in island operated communities in the Arctic. The workshop was organized by ARTEK and held in Ilulissat and Kangerlussuaq. The participants were key players in relation to water abstraction in Greenland, such as Nukissiorfiit, the Ministry of Nature and Environment, the Department of Spacial Planning under the Ministry of Finance and Taxes, Qaasuitsup Kommunia, and Asiaq. In addition, the workshop attracted participants from Tromsø in Northern Norway, Longyearbyen in Svalbard, Ísafjörður municipality and EFLA Consulting Engineers from Iceland, as well as the National Association of Municipalities from the Faeroe Islands. The workshop was part of a NO-RA-funded project and has been extended thanks to an additional grant to support the continuation of the advanced stage of work.

The collaboration with Nukissiorfiit and the Ministry of Municipalities, Settlements, Outer Districts, Infrastructure and Housing has been further developed and strengthened in relation to developing a water supply solution in Qaanaaq. Qaanaaq is one of the world’s northernmost naturally populated areas. The town of Qaanaaq is located on a moraine deposit with permafrost in a diffuse riverbed. The river supplying water for the town is only running four months a year. During that period of time two large water tanks are filled to ensure the water supply for an additional four months. Throughout the rest of the year, icebergs are collected on the sea ice with a dumper and a loader tractor and the ice is melted in a special facility connected to the water supply network. This generates a production price of more than DKK 600 per m³ in the period during which Greenlandic halibut is bought and processed. The work with collecting icebergs has become increasingly dangerous due to more unstable ice conditions caused by climate change. Extensive preliminary studies in Qaanaaq were planned in 2016 as to investigate whether the water abstraction period in the riverbed could be extended by creating deeper boreholes, and to find locations and solutions for the establishment of two additional water tanks, taking into account the changes in the permafrost. It will also be investigated where and how to construct buildings and other infrastructure in the best way. Nukissiorfiit and the Ministry of Municipalities, Settlements, Outer Districts, Infrastructure and Housing are financing the preliminary studies.

In 2016, the international UArctic thematic collaborative network “Sustainable Arctic Resources and Social Responsibility” was established with the participation of ARTEK and a number of universities in and related to the Arctic. ARTEK has also contributed to the Arctic Council with a series of data within the main topics of its research.

3.3 Constructions and Physical Environment

In 2016, DTU intensified the Arctic collaboration with NTNU in Trondheim through participation in NTNU’s centre for research-based innovation, Sustainable Arctic Marine and Coastal Technology (SAMCoT). The collaboration between NTNU, DTU Space, and ARTEK is supported by the universities through allocation of two PhD scholarships: one PhD study at NTNU dealing with mathematical models to describe waves in icy coastal waters, and one PhD study at DTU Space regarding oceanographic models for arctic fjord systems, and how data from remote sensing can be used in the model system to calibrate and validate the model results. ARTEK co-supervises both projects.

In the spring of 2016, an ARTEK PhD student participated in a five-week international expedition to the Greenlandic ice cap. The expedition was headed by Mike MacFerrin from the University of Colorado. The aim was to study refiltration and refreezing of melt water in firn—old snow at the pre-ice stage. Upon the return, the RETAIN research project organized a workshop with international participation. Leading researchers met to
discuss these processes in the firn package, of which we still have very little knowledge. ARTEK also participated in the building of a numerical model for simulation of the processes in the firn package in collaboration with the other RETAIN partners at the Danish Meteorological Institute and GEUS.

The AMAP (Arctic Monitoring and Assessment Programme) project ‘Adaptation Actions for a Changing Arctic’ was continued in 2016 with the preparation of the regional report for Baffin Bay—the Davis Strait region (Nunavut and West Greenland). The report summarizes and analyses research and knowledge regarding changes in the region as to help local decision-makers and stakeholders in the region to develop adjustment tools and strategies that are better suited to handle climate change and other urgent environmental challenges. The report was concluded with a public hearing and a review phase in the spring of 2016. The technical processing and graphic production is expected to conclude with a publication by mid-2017.

Derived from the AMAP work and the current interest in the airport infrastructure in Greenland, the research group has also worked on consolidating the knowledge and research which ARTEK has produced over the years with regard to permafrost and geotechnical conditions, especially at the Kangerlussuaq and Ilulissat airports. In collaboration with Råstofskolen—Greenland School of Minerals & Petroleum, a new 100-meter-deep borehole has been dug in Sisimiut. The borehole makes it possible to measure temperatures in the mountain and shows that the permafrost in the area has a thickness of about 50 metres.

### 3.4 Building and Energy in the Arctic

ARTEK conducts research within various relevant areas within Building and Energy in the Arctic. The main areas are described below.

**RECENT ARCTIC BUILDING PRACTICE**

ARTEK generally operates with a systematic pooling of experience within Arctic building practice. In Greenland, almost every decade has seen new ways of construction, but often without first drawing lessons from and describing the experience. This is where ARTEK comes in and ensures that new construction methods in the future are based on experience and new knowledge.

In that context, ARTEK has formulated a major comparative research project which, based on six parameters, aims to investigate and document technical experience with construction in the Arctic. The purpose is to identify issues as well as present poor and good solutions as to define the most appropriate construction methods under arctic conditions. The six parameters are:

- Construction technology, building envelope and the climatic impact
- Energy concept, indoor climate, ventilation
- Construction process, buildability, logistics, operation
- Planning and architecture
- Sustainability
- End Users (application and satisfaction)

The project will be carried out in collaboration with Ilisimatusarfik, the Danish Building Research Institute/Aalborg University, and the Royal Danish Academy of Fine Arts, School of Architecture, Design and Conservation, and in constant dialogue with reference groups of Greenlandic stakeholders. The total budget is DKK 13 million, the majority of which is applied for from private funds. Co-funding has also been applied for from different Greenlandic stakeholders.

**ENERGY-EFFICIENT CONSTRUCTION**

The e-Lighthouse project ([http://elighthouse.eu/](http://elighthouse.eu/)) deals with energy savings in municipal buildings in the Arctic. The project is funded through the European NPA programme. The e-Lighthouse is an international project with participants from Greenland, Finland, Ireland, Sweden, Scotland, and Norway. The project was initiated in the spring of 2016 and is scheduled to run for three years. In addition, an energy-efficiency project was funded through the Bjarne Saxhof Foundation. The project focuses on developing new energy-efficient building envelope systems as well as heating, ventilation and air conditioning systems for Greenlandic buildings.
LIGHTWEIGHT STRUCTURES
ARTEK initiated a new line of research within the use of lightweight structures in the Arctic regions. The vulnerable Arctic nature is under pressure due to an increasing demand from new and often temporary settlements, e.g. in connection with the establishment of mines and tourism. Lightweight structures are systems with minimal energy use, but with optimal geometry allowing the efficient use of materials. Lightweight combined with smart strategies for assembling the structure make them flexible, as well as easy to transport and erect and to relocate without leaving traces in the environment. In connection with lightweight structures, ARTEK conducts research of various optimizations of shell and membrane structures affected by extreme loads, such as design optimizations, form finding, and topology optimizations. Lightweight structures are generally of relevance in the Arctic.

SNOW DRIFTS AROUND BUILDINGS
The integration of snow drifts and snow layers as part of the early design phase of a construction project in the Arctic can appropriately be implemented. Current international knowledge is, however, not detailed enough for this purpose. ARTEK aims to change this by working with physical and mathematical models for snow drifts and snow layers. Experimental work is carried out in a wind tunnel in Denmark and compared with experience gathered in connection with construction work in Greenland. The aim is to develop a scaled experimental model in the wind tunnel which simulates reality, and which therefore can actively be used in the design phase in future.

4. Scientific advice

ARTEK has participated in the current preliminary studies related to the airport expansion in Ilulissat, which involves carrying out geophysical measurements and establishing a monitoring programme for permafrost temperatures. Laboratory work on the frozen samples taken from the airport area will be commenced in ARTEK’s laboratories in 2017.

ARTEK is heading the project regarding the geotechnical study of permafrost and water supply conditions in Qaanaaq (see 3.2). The project is based on collaboration with Nukissiorfiit and the Ministry of Municipalities, Settlements, Outlying Districts, Infrastructure and Housing. In addition, collaboration has also been established with the private company GEO for the drilling, and KTI and Røstfiskolene—Greenland School of Minerals & Petroleum also contribute to the collaboration by providing the drill and personnel.

In autumn, three ARTEK students carried out analyses of the opportunities and potentials for establishing a new quay in Kangaamiut, including an analysis of the socio-economic consequences. In October, the students stayed for a longer period of time in the settlement. The project was carried out in collaboration with Qeqqata Kommunia.

At the end of the year, a collaboration was formalized between the Ministry of Finance and Taxes and ARTEK on the development of parameters and methods for the overall national planning strategy and the upcoming statement for the national planning strategy.
5. Organizing and participating in conferences and meetings with academic content

Networking and collaboration are an essential part of ARTEK’s work. ARTEK’s employees participate actively in both Greenlandic and international seminars and conferences, and ARTEK is also responsible for organizing important conferences. In the course of 2016, several ARTEK students and employees have received funding for exchange visits and mobility programmes at ARTEK partner institutions in the Arctic. North2north, which is a mobility programme for students and employees, is funded in Denmark by the Danish Agency for Science, Technology and Innovation. Furthermore, ARTEK received significant support from UArctic for organizing the ARTEK International Conference in Sisimiut in April 2016.

5.1 CONFERENCES ARRANGED BY ARTEK

- Water in Arctic island-mode operation communities—NORA Workshop, 12-15 January 2016, Ilulissat and Kangerlussuaq, organized by Kåre Hendriksen. In addition, Thomas Ingemann-Nielsen and Niels Foged Nielsen participated

5.2 Participation in conferences, workshops, and meetings in Greenland

- Workshop on the establishment of the natural science programmes at Ilisimatusarfik, University of Greenland, Nuuk, 28-29 January 2016, ARTEK participants: Kåre Hendriksen and Lisbeth M. Ottosen
- Tomorrow’s housing construction in settlements and remote districts, Ministry of Housing and Infrastructure, Upernavik, 9-10 March 2016, ARTEK participant: Kåre Hendriksen with presentation.
5.3 Participation in conferences, workshops, and meetings in other countries

- **Polar DTU Annual Meeting**, 18 January 2016, ARTEK participants with presentations: Kåre Hendriksen and Lisbeth M. Ottosen.
- **Arctic Circle 2016**, Reykjavik, Iceland, 6-9 October, ARTEK participant: Kåre Hendriksen invited as speaker.
- **Arctic Workshop on Research and Education**, Hindsgavl Slot, 29-30 March 2016, ARTEK participants. Kåre Hendriksen and Lisbeth M. Ottosen.
- **SAMCoT seminar**, Trondheim, 10-12 May 2016. ARTEK participant: Thomas Ingeman-Nielsen
- **International Conference on Permafrost**, Potsdam, June 2016. Participants from ARTEK: Thomas Ingeman-Nielsen, Sonia Tomaskovicova, and three students from the Arctic Semester.
- **Waste Management 2016—8th International Conference on Waste Management and the Environment**, Valencia, 7-9 June. ARTEK participants with presentations: Gunvor M. Kirkelund and Pernille E. Jensen
- **Workshop on Meltwater Retention on the Greenland Ice Sheet**, 3-5 June 2016 at GEUS. ARTEK participant: Baptiste Vandecruix.
- **How is an investment fund established in Greenland?** The Danish Society of Engineers, 12 September 2016, ARTEK participant with presentation and panel discussion: Kåre Hendriksen.
- **UArctic congress 2016 og UArctic north2north mobility programme meeting**, St Petersburg, Russia, 12-15 September 2016. ARTEK participant, Niels Hoedeman, ARTEK’s institutional co-ordinator for North-2north
- **Drinking water and wastewater in the Arctic**, Society for Arctic Technology, 14 September 2016, ARTEK participant with presentation: Kåre Hendriksen.
- **Karthus PhD school, Glaciers and Ice Sheets in the Climate System**, 13-23 September 2016 in Karthaus, Italy. Participant: Baptiste Vandecruix
- **Water Innovations for Healthy Arctic Homes**, Anchorage, Alaska, 18-21 September 2016. ARTEK participants with presentations: Pernille Erland Jensen and Kåre Hendriksen, as well as Kristian Hammeken, Arctic engineer who is currently taking an MSc in Environmental Engineering at DTU.
- **Isafjordur University—public meeting**, 25 September 2016, ARTEK participant with presentation: Kåre Hendriksen.
- **Danish Meteorological Institute**, management group, 12 October 2016, ARTEK participant with presentation: Kåre Hendriksen.
- **Polar research conference: Drones, satellites, and other new polar research platforms**, 1-2 November, DTU: ARTEK participant Gunvor M. Kirkelund.
- **Sustainable Arctic Resources and Social Responsibility**, UArctic Thematic Network, Syktyvkar State University, Russia, 7-9 December 2016, ARTEK participant with presentation: Kåre Hendriksen.
6. Publications

Below is the list of publications written by ARTEK employees. The list contains the full research articles and reports.

- Pedersen, K.B.; Jensen, P.E.; Ottosen, L.M.; Evenset, A.; Christensen, G.N.; Frantzen, M. Metal specification of historic and new copper mine tailings from Repparfjorden, Northern Norway. before and after acid, base and electrodialytic extraction, Minerals Engineering (DOI: http://dx.doi.org/10.1016/j.mineng.2016.10.009) 2016.
7. ARTEK’s organization

ARTEK’s employees are organizationally anchored in the Section for Arctic Technology and Sustainable Solutions at DTU, Department of Civil Engineering. The section has a total of 26 employees, of which 20 are directly employed at ARTEK. The section works with education and research linked to the Arctic engineering programmes and other tasks in relation to Arctic technology.

The employees are partially located at the Sisimiut campus and the Lyngby campus and include researchers/lecturers, technical and administrative staff and PhD students. The centre is managed by Niels-Jørgen Aagaard (Head of Centre) and Lisbeth M. Ottosen (Vice Head of Centre and Head of Section).

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<td>Fatehmed Shouli Pour</td>
<td>Guest PhD student</td>
</tr>
<tr>
<td>Gunvor Marie Kirkelund</td>
<td>Associate Professor, Head of Studies, and Cold Climate Engineering programme coordinator</td>
</tr>
<tr>
<td>Ida Maria Gieysztor Bertelsen</td>
<td>PhD student</td>
</tr>
<tr>
<td>Ingrid Vernimmen</td>
<td>Secretary</td>
</tr>
<tr>
<td>Jennifer Fiebig</td>
<td>PhD student</td>
</tr>
<tr>
<td>Jessica Fernandoy Pedreros</td>
<td>Postdoc</td>
</tr>
<tr>
<td>Kåre Hendriksen</td>
<td>Associate Professor</td>
</tr>
<tr>
<td>Lisbeth Ottosen</td>
<td>Professor, Deputy Director, Head of Section</td>
</tr>
<tr>
<td>Malene Grønvold</td>
<td>Laboratory Technician</td>
</tr>
<tr>
<td>Martin Kotol</td>
<td>Postdoc</td>
</tr>
<tr>
<td>Niels-Jørgen Aagaard</td>
<td>Head of Centre, Head of Department for DTU Civil Engineering</td>
</tr>
<tr>
<td>Niels Hoedeman</td>
<td>Secretariat Coordinator</td>
</tr>
<tr>
<td>Natasja Rudbæk Eggertsen</td>
<td>Laboratory Technician Trainee</td>
</tr>
<tr>
<td>Nina Sigvardsen</td>
<td>Research Assistant</td>
</tr>
<tr>
<td>Pernille Erland Jensen</td>
<td>Researcher</td>
</tr>
<tr>
<td>Raimon Pares Viader</td>
<td>PhD</td>
</tr>
<tr>
<td>Sabrina Hvid</td>
<td>Laboratory Technician, maternity/paternity leave in 2016</td>
</tr>
<tr>
<td>Sonia Tomaskovicova</td>
<td>PhD student</td>
</tr>
<tr>
<td>Thomas Ingeman-Nielsen</td>
<td>Associate Professor</td>
</tr>
<tr>
<td>Tove Lading</td>
<td>Associate Professor, Head of Studies for the BEng programme in Arctic Technology.</td>
</tr>
<tr>
<td>Wan Chen</td>
<td>PhD student</td>
</tr>
</tbody>
</table>
8. ARTEK’s financial situation

ARTEK is operated jointly by the Government of Greenland and DTU and in a joint venture with Kalaallit Nunaanni Teknikimik Ilinniarfik (KTI) in Sisimiut. The operation of the centre is funded by the Government of Greenland, a grant from DTU and external funding. The funding for the operation of ARTEK is based on a three-year agreement between the Government of Greenland and DTU. DTU furthermore provides funding for positions, offices, laboratory and testing facilities, and other facilities supporting the education and the research activities at ARTEK.

Financial statements 2016

<table>
<thead>
<tr>
<th>Expenses</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Arctic Engineering Education, teaching, and student projects</td>
<td>9,296,672.00 kr.</td>
</tr>
<tr>
<td>Research, research based consultancy and communication</td>
<td>4,784,850.00 kr.</td>
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<tr>
<td>Income</td>
<td>14,128,123.00 kr.</td>
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<tr>
<td>Operating grant, Government of Greenland, and DTU</td>
<td>11,634,483.00 kr.</td>
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<tr>
<td>Other external funding</td>
<td>2,493,640.00 kr.</td>
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<td>Result 2016</td>
<td>46,601.00 kr.</td>
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</tbody>
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