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ARCTIC REMOTE ENERGY NETWORK ACADEMY (ARENA)

Achievements Report

May 2019
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PROJECT LEADS

ORIGINATOR OF THE ARENA CONCEPT

Gwen Holdmann, Director for the Alaska Center for Energy and Power, Fulbright Arctic Initiative Scholar

SDWG CO-LEADS

United States of America
Reid Creedon
U.S. Head of SDWG Delegation, U.S. Department of State

Ed Canuel
Senior Advisor, Secretary for Management and Resources, U.S. Department of State

Canada
Sarah Cox
Canadian Head of SDWG Delegation, Crown-Indigenous Relations and Northern Affairs Canada

Jyoti Bhargava
Circumpolar Analyst, Crown-Indigenous Relations and Northern Affairs Canada

Iceland
Jon Erlingur Jonasson
Icelandic Head of SDWG Delegation, Iceland Ministry of Foreign Affairs

Gwich’in Council International
Grant Sullivan
Executive Director, Gwich’in Council International

Aleut International Association
Liza Mack
Interim Executive Director, Aleut International Association
TECHNICAL CONTRIBUTORS

George Roe, Alaska Center for Energy and Power. Course facilitation and participant liaison.

Lúdvík S. Georgsson, UNU Geothermal Training Programme. Course facilitation and participant liaison.

Robert Cooke, Polar Knowledge Canada. Course facilitation and participant liaison.

SPECIAL THANKS

Chief Kochon and the Colville Lake Community, Northwest Territories, Canada

Chief Darryl Marlowe and the Lutsel K’e Community, Northwest Territories, Canada

Mayor Karl Kassel, Fairbanks, Alaska, U.S.

The community of Kotzebue, Alaska, U.S.

The community of Nome, Alaska, U.S.

The community of Reykjavik, Iceland

COLLABORATORS

ABB; Alaska Center for Energy and Power; Alaska Division of Economic Development; Alaska Energy Authority; Alaska Power and Telephone; Alaska Technical Center; Alaska Village Electric Cooperative; Arctic Energy Alliance; Bering Straits Development Company; Cordova Electric Cooperative; Geothermal Training Programme of the United Nations University; Government of Northwest Territories; Huntley & Associates, LLC; Crown-Indigenous Relations and Northern Affairs Canada; Institute of the North; Intelligent Energy Systems; Kawerak, Inc.; Kodiak Electric Association; Kotzebue Electric Association; Lumos Energy: Catalyst 20/20 program; Marsh Creek, LLC; NANA Development Corporation; Natural Resources Canada; Northwest Territories Power Corporation; Nordic Environment Finance Corporation; Polar Knowledge Canada; RAO Energy
Systems of the East; Renewable Energy Alaska Project; STG Incorporated; University of Alaska Fairbanks; VTT Technical Research Centre of Finland

PRESENTERS

Northwest Territories:

Carl Brothers, CEO, Frontier Power Systems
Christopher Henderson, CEO, Lumos Energy
Ian Flood, Project Manager, NTPC
Jay Pickett, Director, Hydro Operations, NTPC
JP Pinard, Independent Wind Energy Consultant
Klaus Dohring, CEO, Green Sun Rising
Linda Todd, Project Officer, Arctic Energy Alliance
Matthew Miller, Environmental Licensing Specialist, NTPC
Paul Toom, Director, Asset Management and Engineering, NTPC
Pierre Rivard, CEO, Tugliq Energy

Alaska:

Bill Thomson, Alaska Village Electric Cooperative
Bob Tsigonis, Lifewater Engineering
Brad Reeve, Kotzebue Electric Association
Brian Hirsch, Deerstone Consulting
Chris McConnell, Renewable Energy Alaska Project
Connie Fredenberg, Utility Management Assistance
Dan Bishop, Golden Valley Electric Association
George Roe, Alaska Center for Energy and Power
Gwen Holdmann, Alaska Center for Energy and Power
Ian-Baring-Gould, National Renewable Energy Laboratory
Jim St. George, STG Incorporated
John Glassmire, HOMER Energy
John Handeland, Nome Joint Utility System
Josh Craft, Alaska Energy Authority
Larry Daniels, Kikiktagruk Inupiat Corporation
Liz Cravalho, NANA Regional Corporation
Matt Bergan, Kotzebue Electric Association
Matt Ganley, Bering Straits Development Company
Robbin Garber-Slaght, Cold Climate Housing Research Center
Roderick Phillip, Puvurnaq Power Company
Iceland:

Bjarni Pálsson, Engineer, Landsvirkjun National Power Corporation
Einar Gunnlaugsson, Chief Geologist, Reykjavik Energy
Geir Thórólfsson, Chief Engineer, HS Orka.
Ingimar Haraldsson, Deputy Director, UNU-GTP
Kristín Vala Matthíasdóttir, Head of the Reykjanes Resource Park
Málfífrídur Ómarsdóttir, Environmental Scientist, UNU-GTP

Note: This project was undertaken as an endorsed project of the Arctic Council’s Sustainable Development Working Group. The project report was prepared by a project team and does not necessarily reflect the policy or positions of any Arctic State, Permanent Participant or Observer of the Arctic Council.
CHAPTER 1: INTRODUCTION

Throughout the Arctic, there are many examples of human resourcefulness and creativity in developing and adapting technology to the challenging environment and remoteness of the region. Maximizing the use of locally available renewable resources to provide heat and power is a priority across the region. This is demonstrated by the fact that the region as a whole generates approximately 46% of its electric power from renewable resources – more than double the global average and the highest of any region in the world.

Nonetheless, there are disparities in where and how renewable resources have been developed. For remote communities not connected by transmission or pipeline to a larger regional or national network, taking advantage of local renewable resources poses a unique set of technical challenges, but also a key opportunity for demonstrating local self-reliance/autonomy. Energy for heat, power, and transportation must either be imported as liquid fuel at high cost, or accessed using renewable resources that must be used in close physical and temporal proximity to its origin. Effective integration of these resources to achieve the highest locally attainable balance of energy security, environmental and public health, and economic viability is a challenging problem.

The Arctic Remote Energy Network Academy (ARENA) was launched with the view to address the goals of improving economic and living conditions for Arctic communities under the U.S. Chairmanship of the Arctic Council. The project addresses the need for affordable, reliable, clean and renewably sourced energy solutions for communities that are located in more remote areas of the Arctic.

ARENA responds to the need for the development of community energy experts to ensure affordable, reliable, and renewable energy solutions for

1 http://www.akenercyauthority.org/Content/Efficiency/EndUse/Documents/AlaskaEndUseStudy2012.pdf
Arctic communities. Its approach integrates web-based seminars with classroom learning and field exposure, and draws from best practices established through the experience of the people living and the organizations operating in the Arctic.

The project was co-led by Aleut International Association, Canada, Gwich’in Council International, Iceland and the U.S. under the aegis and guidance of the Arctic Council Sustainable Development Working Group (SDWG). With support from Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC), the Alaska Center for Energy and Power (ACEP), Polar Knowledge Canada (POLAR) and the United Nations University Geothermal Training Programme (Reykjavik) a pilot project comprising of three one-week sessions was developed for ARENA.

A select group of eighteen individuals participated in the pilot project that combined laboratory demonstrations with visits to communities and sites operating with renewable energy resources in Canada, Alaska, and Iceland between March and November 2017. Each geographic location was required to focus on key individual elements of clean energy generation.

Participants acquired knowledge, skills, tools, and a network of collaborators to help facilitate integrating clean energy technologies in their communities and improving management of fossil fuel resources used for power production and heating. Each participant brought to the program their community’s unique energy situation and developed a feasibility study on how to integrate cleaner sources of energy as a final project.

CHAPTER 2: ACTIVITIES AND OUTPUT

ARENA is a capacity building program aimed at providing renewable energy champions from remote communities across the north with the new skills, knowledge and networks necessary to complement their Indigenous
and local knowledge in the development of clean energy projects for their own communities and regions.

The project offered the participants a unique opportunity to broaden their understanding of renewable energy solutions through site visits across the Arctic, on-line learning as well as classroom teaching from renowned energy experts. It draws from best practices established through the experiences of the people living, and the organizations operating, in the Arctic.

ARENA addresses the need for the development of community energy experts to ensure affordable, reliable, and renewable energy solutions for Arctic communities. Inter-regional sharing of energy system experiences, challenges and opportunities contributes to our shared goal of a sustainable future for the Arctic.

OVERVIEW OF ACTIVITIES:

In collaboration with researchers and subject matter experts from across the Arctic, ARENA provided training related to both theoretical and practical elements and was divided into three sections: 1) a broadly accessible webinar series; 2) a six month program, between March and November 2017, that included mentoring, distance learning, in-person training and visits to sites in Canada, the U.S. and Iceland respectively; and, 3) an outreach session at the Arctic Energy Summit in Helsinki.

The project undertook the phased approach outlined below.

- Webinar Series, 2017
- On-site Program hosted by Canada in Yellowknife, Northwest Territories, 20-27 March 2017
- On-site Program hosted by United States in Fairbanks and Kotzebue, Alaska, 17-24 June 2017
- Outreach: ARENA at the Arctic Energy Summit, Helsinki, Finland, 18-20 September, 2017
- On-site Program hosted by Iceland in Reykjavik, 5-11 November 2017
ONSITE SESSIONS PLANNING:

The onsite programs were designed to consist of course work covering all stages of energy project development and implementation, as well as site visits to energy projects. The objective of the presentations was to provide participants with an academic background on key topics such as: different resource types, techniques for measuring and monitoring resources, financial management skills, and how to work with government and utilities to integrate renewable energy into existing microgrids.

Once the curriculum was established, relevant experts were identified and invited to present and detail their experiences of building clean energy projects. Early contact was made with each speaker and a draft course outline, including timelines and locations, was provided. Although all speakers were initially offered the opportunity for an honorarium, no one took up this offer and all donated their time for free. ARENA covered travel expenses and accommodations for participants.

Leads also felt it important that ARENA be much more than just a classroom learning experience and that to reinforce knowledge, especially on how to build projects, it would be beneficial to visit projects that had already demonstrated a degree of success. It was also agreed that the curriculum would focus on community engagement and demonstrating best practices from communities given that ARENA is targeted, in part, at remote communities across the north.

A cohort of twenty participants was selected in consultation with the SDWG Head of Delegations. Applicants from all backgrounds were encouraged to apply. The primary criterion was to be, or expect in the near future to be, involved in a community-scale renewable energy project or initiative. Other minimum requirements to apply for the on-site program were: familiarity with energy systems; good English language communication skills; and, the ability to influence future energy projects in home country, region or community.
2.1 ON-SITE SESSION, NORTHWEST TERRITORIES, CANADA

Introduction

Between 19 and 26 March 2017, seventeen participants from the Arctic Council member states gathered in Yellowknife, Northwest Territories, Canada for the inaugural session of the Arctic Remote Energy Network Academy (ARENA). The individuals came from four of the Arctic Nations (Canada, Greenland, Russian Federation, United States) and include three of the Permanent Participant organizations (Aleut International Association, Arctic Athabascan Council, Gwich'in Council International), and one of the Observers (World Wildlife Foundation).

The Yellowknife course focused on wind and solar projects with a strong community development perspective. Resource theory sessions, delivered by leading industry and government experts from across Canada, were interspersed with site visits within the Territory, including the Behdzi Ahda First Nation community of Colville Lake and the Lutsel K’ee Dene First Nation community of Lutsel K’e. This allowed participants to develop a holistic view of clean energy project development and execution, as well as an opportunity to discuss the project with developers and community members.

The local power utility, Northwest Territories Power Corporation (NTPC), also delivered presentations and provided support and sponsorship. This extended to technical briefings on diesel generation efficiencies, variable speed generators, permitting and hydro power. The presentations were supplemented by site visits to a diesel generating plant and hydro facility. Presentations were also delivered on federal and territorial government strategies and programs aimed at promoting the uptake of clean energy on local, national and international levels and possible options for project funding.
Project Leads agreed early that the Yellowknife course would focus on areas that were most relevant to the Northwest Territories, namely wind and solar projects. The Northwest Territories has two important demonstration solar projects, Colville Lake and Lutsel K’e. Lutsel K’e is a community driven project with a negotiated Power Purchase Agreement between the community and the utility, Northwest Territories Power Corporation (NTPC). On the other hand, Colville Lake is owned predominantly by the utility but is operated in close collaboration with the community.

It is widely recognised that Government of Northwest Territories (GNWT) and NTPC have taken a more proactive approach to encourage the uptake of clean energy projects. It was anticipated that ARENA participants could be from areas of the Arctic with very different models for energy utilities and so participants could gain a broader perspective for how utilities can work. In addition, it was expected that each participant would be partnered with Independent Power Producers (IPPs) and/or be involved in Power Purchase Agreements (PPAs). Many of the issues needing to be overcome by utilities
will also be issues that future IPPs could face. It therefore felt essential that the participants understood all the significant challenges that a utility can face when integrating renewable energy into their grids. A synopsis of the schedule is provided in Table 1. A more detailed version of the itinerary is provided in Annex B.

Table 1. Yellowknife On-Site Session Program Elements

<table>
<thead>
<tr>
<th>Yellowknife Program Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sunday, March 19, 2017</strong></td>
</tr>
<tr>
<td>• Team meeting</td>
</tr>
<tr>
<td><strong>Monday, March 20, 2017</strong></td>
</tr>
<tr>
<td>• Introduction and administrative announcements</td>
</tr>
<tr>
<td>• Role of Utilities, Purchase Power Agreements – Emanuel DaRosa</td>
</tr>
<tr>
<td>• Student Presentations</td>
</tr>
<tr>
<td>• Networking lunch</td>
</tr>
<tr>
<td>• Capacity building and negotiation in renewable energy project development with Chris Henderson, President Lumos Energy</td>
</tr>
<tr>
<td><strong>Tuesday, March 21, 2017</strong></td>
</tr>
<tr>
<td>• Scoping a project: RETScreen Micheal Ross</td>
</tr>
<tr>
<td>• Introduction to wind energy – Carl Brothers, GM Frontier Power Systems Practical Application of Wind Energy</td>
</tr>
<tr>
<td><strong>Wednesday, March 22, 2017</strong></td>
</tr>
<tr>
<td>• Introduction to solar energy for remote community projects – Klaus Dohring, President Green Sun Rising</td>
</tr>
<tr>
<td>• Working lunch: Building a Solar Project – Ian Flood, Project manager, NTPC</td>
</tr>
<tr>
<td>• Colville Lake Site Visit</td>
</tr>
<tr>
<td><strong>Thursday, March 23, 2017</strong></td>
</tr>
<tr>
<td>• Tour of Lutsel K’e solar project and meeting with Chief and</td>
</tr>
</tbody>
</table>
community
• Community Feast

Friday, March 24, 2017
• Introduction to hydro power and water licensing in NWT – Jay Pickett, Director, Hydro, NTPC; Mather Miller, Environmental Licensing Specialist, NTPC
• Visit to Jackfish Power Plant; brief discussion on diesel generators
• Bluefish Hydro Dam site visit

Saturday, March 25, 2017
• Energy Futures lab (role playing simulation) – Erin Romanchuk, Associate, the Natural Step

Sunday, March 26, 2017
• Discussion: lessons learned, action plans, recommendations

Key Outcomes
Feedback from the Yellowknife course indicated that all participants felt they benefitted from the formal instruction and site visits. The format for the course allowed participants to mingle which was beneficial in establishing a strong network that extended beyond the project.

Utility and territorial government support was key to the success of the program. The Chief Executive Officer of Northwest Territories Power Corporation spent two full days with the participants as well as making a number of key personnel available for presentations and allowing participants to visit power generating facilities local to Yellowknife. Productive discussions with presenters, mentors and among the participants were also highly valued outcomes.
The high-point of the course was the community site visits; these allowed participants to view ‘real’ projects, talk with community members, and experience other northern cultures. It is recommended that future courses develop a framework around, and are located in the vicinity of, community energy projects that can serve as demonstration models.

Overall, the Yellowknife course was highly successful; feedback and formal course evaluations suggested that all participants felt that the course was structured appropriately and course content was highly beneficial and relevant.

### 2.2 ON-SITE SESSION, FAIRBANKS AND KOTZEBUE, ALASKA

**Introduction**

During the initial planning for the 2017 ARENA program, the organizing team agreed that microgrid systems and integration of distributed energy sources would be the primary area of emphasis for the Alaska on-site session.

At the close-out of the Canada on-site session, participants were polled for their preferences with respect to the planned agenda and asked for input regarding focus areas that would complement what they had learned and seen in Canada. In addition to the planned areas of emphasis, their responses indicated a shared interest in technologies, programs and lessons learned related to local food, drinking water, waste water, solid waste, energy integration, sustainable development, and policy.

The agenda for the on-site session in Alaska was designed to provide the ARENA participants with access to technical expertise, hardware
deployment sites, and community resources that implemented the ARENA program's over-arching vision and addressed interests specific to the 2017 cohort.

**Program Description**

The Alaska on-site session included classroom and site visit activities in Fairbanks and Kotzebue, and an optional side trip to Nome following the main on-site sessions. While in Fairbanks, ARENA participants attended the 2017 Alaska Wind-Diesel conference, providing them with access to a broad cross-section of technical information related to integrated energy systems in the north, and with the opportunity to network with personnel from the communities, equipment suppliers, project developers, and government agencies implementing these systems. A synopsis of the schedule is provided in Table 2. A more detailed version of the itinerary is provided in Annex C.

**Table 2. Alaska On-Site Session Program Elements**

<table>
<thead>
<tr>
<th>Fairbanks Program Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Saturday, June 17, 2017</strong></td>
</tr>
<tr>
<td>• Welcome Dinner and Orientation</td>
</tr>
<tr>
<td>• Midnight Sun Run (Optional)</td>
</tr>
<tr>
<td><strong>Sunday, June 18, 2017</strong></td>
</tr>
<tr>
<td>• On-site Program Plan Highlights &amp; Administrative Items</td>
</tr>
<tr>
<td>• Participant Project Update Presentations</td>
</tr>
<tr>
<td>• Chena Hot Springs and Pilgrim Hot Springs Project Overviews – Gwen Holdmann</td>
</tr>
<tr>
<td>• Chena Hot Springs Visit – Bernie Karl</td>
</tr>
<tr>
<td><strong>Monday, June 19, 2017</strong></td>
</tr>
<tr>
<td>• Microgrids Overview – Dr. Marc Mueller-Stoffels</td>
</tr>
<tr>
<td>• Power Systems Integration Lab Tour / Demonstration – Dr. Marc Mueller-Stoffels</td>
</tr>
</tbody>
</table>
• Sustainable Southeast Partnership – Local & Regional Engagement- Shaina Kilcoyne
• Water Treatment Systems in Rural Alaska – Eric Hanssen
• Cold Climate Housing Research Center Tour – Robbin Garber-Slaght
• Tour of Calypso Farm and Ecology Center – Tom Zimmer

Tuesday, June 20, 2017
• Golden Valley Electric Association Briefing – Dan Bishop
• HOMER Pro Training – John Glassmire, Dr. Peter Lilienthal
• Community Leaders Panel – Shannon Erhart, Roderick Phillip, Connie Fredenberg, Amanda Byrd (moderator)
• "Fireside Chat" with Energy Project Developers – Jim St. George, Bill Thomson, Rob Bensin, David Messier, George Roe (moderator)
• Energy Efficiency and Conservation – Dr. Tom Marsik
• Lifewater Engineering Tour – Bob Tsigonis
• GVEA Battery Energy Storage System Facility Tour
• Trans Alaska Pipeline Viewing Station Visit
• Sustainable Residence Tour - Karl Kassel

Wednesday, June 21, 2017
• Alaska Wind-Diesel Workshop
• Celebration Dinner – Hosted by US Department of State

Kotzebue Program Elements
Thursday, June 22, 2017
• Flight to Kotzebue
• Alaska Technical College Overview & Tour - Cheryl Edenshaw
• Solar & Heat Pumps in NW Arctic Borough – Ingemar Mathiasson
• Advanced Technologies for Hydroponics & Local Food / Greenhouse Tours
• Overview of Water & Waste Management / Water Plant Tour – City of Kotzebue
  o Kikiktagruk Inupiat Corporation – Larry Daniels
  o Northwest Arctic Borough- Jeff Buchholz

Friday, June 23, 2017
### ARENA – ACHIEVEMENTS – MAY 2019

<table>
<thead>
<tr>
<th>NANA Regional Corporation - Liz Cravalho</th>
<th>City &amp; Borough of Kotzebue – Mayor Gayle Ralston</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kotzebue Electric Association Overview – Brad Reeve, Matt Bergan</td>
<td>Kotzebue Electric Association Power Plant &amp; Wind Turbine Site Tour</td>
</tr>
<tr>
<td>Kotzebue Landfill &amp; Sewage Lagoon Visit (optional) – Brad Reeve</td>
<td>Closeout Dinner</td>
</tr>
<tr>
<td>Nome Program Elements (optional side trip)</td>
<td></td>
</tr>
<tr>
<td>Pilgrim Hot Springs Geothermal Exploration &amp; Local Food Project – Rob Bensin, Chris Pike</td>
<td>Bering Straits Regional Development Opportunities, Impact of Energy – Matt Ganley</td>
</tr>
<tr>
<td>Norton Sound Economic Development Corporation Seafood Plant Tour – Tyler Rhodes</td>
<td>Nome Landfill And Recycling Center Visit (optional) – Anahma Shannon</td>
</tr>
</tbody>
</table>

Presenters, panelists, and site visit hosts contributing to the Alaska on-site session came from utilities, industries, non-profits, communities, state government, and the University of Alaska. Several Alaska-based mentors came to Fairbanks to meet with their ARENA participant mentee in-person. Copies of the presentation materials were saved to the Google Drive repository shared by the ARENA participants.
Key Outcomes

Participants especially appreciated the opportunity to visit operational sites and research facilities actively participating in sustainable local energy initiatives. Insights from the real-time demonstration of microgrid energy element integration challenges via the Power Systems Integration laboratory were noted as very useful context for interactions between communities interested in broader integration of local renewable energy resources and their regional utilities. The Community Leaders panel was a highlight for many participants, providing the opportunity for candid discussion and interaction. Advance communication with the Wind-Diesel Workshop organizers allowed tailoring of its content to include items of particular relevance to the ARENA participants, and ensured its timing and venue were well-aligned with the ARENA program elements. Opportunities for social / recreational interaction strengthened relationships between the participants, and provided opportunities for sharing observations and mutual learning.

2.3 ON-SITE SESSION, REYKJAVIK, ICELAND
Introduction

In early 2016, at the request of Tómas Orri Ragnarsson, Counsellor in Arctic Affairs from the Directorate for International and Security Affairs at the Ministry for Foreign Affairs (MFA), Iceland, UNU Geothermal Training Programme (UNU-GTP) accepted to co-lead on behalf of Iceland in the ARENA project. The aim of the initiative was to establish a curriculum in line with UNU-GTP, which deals with renewable energy solutions for the many isolated villages and small towns distributed over the Arctic region.

Iceland hosted the final on-site session of ARENA in Reykjavik. A group of 16 participants and 5 project supervisors from Alaska and Canada gathered in Iceland on Saturday November 4, 2017 for the last event of this first phase of the ARENA project, staying in Iceland through Saturday November 11. The agenda for the on-site session focused on providing the participants an understanding of the development and utilization of geothermal energy. The program also included visits to micro hydro power plants. At the end, ARENA participants presented and discussed their projects.

Program Description

The Iceland on-site session included lectures from energy experts and site visits in Reykjanes Peninsula and Southern Lowland. The participants were exposed to several geothermal energy systems. Lectures provided the participants strategic geographical and historical understanding of geothermal and hydropower development. This included an overview of low and intermediate temperatures for heating systems, greenhouses, spas and ground source heat pumps. Lectures were given in the Energy House, were UNU-GTP is located. The detailed program in provided in Annex D.

Table 3. Reykjavik On-Site Session Program Elements

<table>
<thead>
<tr>
<th>Date</th>
<th>Program Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saturday, November 4, 2017</td>
<td>• Dinner for all participants</td>
</tr>
<tr>
<td>Sunday, November 5, 2017</td>
<td>• Operations of Reykjavik Energy introduced in the morning by Dr.</td>
</tr>
</tbody>
</table>
Einar Gunnlaugsson

- Old Thvottalaugar – Washing Pools Hot Springs
- Visit to the deep production well and pumping station at the Laugardalur geothermal field
- Visit to the distribution network and hot water tanks at Perlan
- Swimming in the Laugardalur Swimming Pool, courtesy of the City of Reykjavik

Monday, November 6, 2017

- Dir. Lúdvík S. Georgsson on methodology of geothermal exploration
- Dr. Páll Valdimarsson on the main possibilities in utilization of geothermal energy

Tuesday, November 7, 2017

- Site visit to the Reykjanes Peninsula, under the guidance of Lúdvík and Ms. Málfrídur Ómarsdóttir. The main stops: the geothermal field at Reykjanes, the Haustak fish drying factory, visit to HS Orka – energy company, where the operations of the company were presented and discussed, by Mr. Geir Thórólfsson, Chief Engineer, and Ms. Kristín Vala Matthíasdóttir, Director
- Swimming in the Blue Lagoon

Wednesday, November 8, 2017

- Additional lectures on the possible utilization of geothermal, given by Dr. Páll
- Electricity production from low- to intermediate-temperature resources discussed in the afternoon

Thursday, November 9, 2017

- Trip through the Southern Lowlands of Iceland
- Set Pipe Factory, which produces pre-insulated pipes for district heating systems
• Visit to the Ljósafoss hydro power plant in Sog River and exhibition by Landsvirkjun – National Power Company
• Visit to the carbon dioxide plant at Haedarendi
• Two greenhouse farms were visited, Melar at Flúdir and Espiflöt in Biskupstungure
• Visit to the Gullfoss – the Golden Waterfall and Thingvellir National Park

Friday, November 10, 2017
• Majority of the participants listened to lectures by Ms. Málfrídur Ómarsdóttir and Mr. Ingimar Haraldsson on aspects of geothermal utilization
• The rest of the participants participated in computer modelling of geothermal utilization through special engineering programmes under the control of Páll
• Dr. Bjarni Pálsson introduced utilization of hydro power in Iceland, with special emphasis on micro power plants

Saturday, November 11
• Emphasis was on presentation of the projects carried out by the participants, which extended well into the afternoon. Project feedback given
• Celebration dinner, hosted by the MFA through Mr. Tómas Orri Ragnarsson, where the participants received a certificate as proof of their work

Figure 3. ARENA participants at the Melar greenhouse. Iceland
Key outcomes

Participants benefitted from presentations given by energy experts, geologist, government officials, environmental scientist, industries and utilities. Visits to fish pants, geothermal greenhouse, blue lagoon etc. provided participants a rich and varied understanding of Iceland’s energy solutions.

Generally, the short courses captured the interest of the participants and the project work seemed to be successful. The main result in the participant-filled questionnaire was satisfaction with the ARENA project. This was very much the case regarding the Icelandic part, where both the field trips and lectures received very high marks. It is recommended that ARENA is kept going in some form as it seemed to be very useful for the participants and their protégés.
The ARENA webinar series introduced viewers to the remote energy networks (microgrids) that provide power and heat across the Arctic. The webinar series included a range of topics using examples and information from subject matter experts across the Arctic. Through this mechanism, we reached a wide range of viewers across the globe, and generated dialogue about renewable energy development.

The webinar series included a range of topics using examples and information from subject matter experts across the Arctic. Through this mechanism, we reached a wide range of viewers across the globe, and generated dialogue about renewable energy development.

The webinars were pre-recorded in English, and packaged as self-contained modules that can be watched as streamed media or downloaded for off-line viewing. They are available at the website for the 2017 ARENA program. A brief description of the webinars is provided below:

**Remote Energy Networks in the Arctic**
Introduction to ARENA program and overview of remote energy networks across the Arctic, with emphasis on integration of locally available renewable energy resources.

**Diesel Power Plants**
Discussion of diesel-fueled power generation systems attributes for Arctic microgrids, including current experiences with their operation and control when integrated with renewable energy resources.

**Variable Renewable Energy Resources in the Arctic –Solar**
Discussion of Arctic-appropriate solar energy systems at community-scale power levels, while addressing resource assessment considerations, solar photovoltaic and solar thermal options, and integration with other energy resources.

*Variable Renewable Energy Resources in the Arctic – Wind*
Discussion of Arctic wind energy resources, Arctic wind turbine technologies, Arctic-specific installation / integration challenges, and their integration with other energy system elements.

Introduction to district heating systems, their attributes, options, and benefits as either stand-alone or integrated elements of an overall community energy system.

*Integrated Energy Perspectives – Heat Generation and Distribution (Part II)*
Approach for effective district heating system designs, including requirements analysis, development of system-level architecture and component-specific attributes, and tools for predicting performance.

### 2.5 ARENA MENTORING PROGRAM

Each ARENA participant was aligned with another professional whose experience and organizational context somehow complemented / supplemented the resources already available to the participant. While the near-term focus for the particular mentor-participant pairing was associated with the nature of the ARENA, participant's program project interests and existing work assignment(s), it was anticipated that these mentors would become part of the participants' long-term network of colleagues.
In some cases a mentor was selected more on their ability to serve as a catalyst and/or gateway for the participant's interactions with others, than because the mentor had all-encompassing expertise in the particular subject area(s) being emphasized by the participant. Participants were encouraged to engage multiple mentors over the course of the program, based on the evolving nature of their ARENA project and on developments in their area(s) of particular interest over the course of the program. In some cases, there were formal changes in the mentor-participant combinations, due to changes in focus by the participant or other factors. Table indicates the participant-mentor alignments, based on the focus areas identified in the participants' ARENA application.

Table 4. ARENA 2017 Participant / Mentor Alignment

<table>
<thead>
<tr>
<th>2017 Participant</th>
<th>Participant Priorities (per application)</th>
<th>Mentor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anahma Shannon</td>
<td>Waste-to-energy, regional energy plan, sustainable development at Pilgrim Hot Springs, solar, public-private partnerships (PPPs)</td>
<td>Paul Valdimarsson, Rob Cooke, Gwen Holdmann</td>
</tr>
<tr>
<td>Bill Williams</td>
<td>Implement hamlet's recently-developed <em>Green Energy Plan</em>, solar integration via net-metering, hamlet as pathfinder / inspiration for territory, utility rates impact of renewables, leverage of aboriginal status to find win-win</td>
<td>Brad Reeve</td>
</tr>
<tr>
<td>Brad Reeve</td>
<td>Solar (photovoltaic, thermal), ground source heat pumps, &quot;shoulder season technologies&quot;</td>
<td>Ian Baring-Gould</td>
</tr>
<tr>
<td>Participant</td>
<td>Participant Priorities (per application)</td>
<td>Mentor(s)</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Daniel Powers</td>
<td>Curriculum for &quot;energy solutions in the north&quot; independent study degree, hydrokinetics, storage, combined heat and power (CHP)</td>
<td>Ron Johnson</td>
</tr>
<tr>
<td>Erika Tizya-Tram</td>
<td>Act on results from feasibility studies, learn from examples of others regarding renewables integration (especially solar), attract investors consistent with community's interest in self-governance, establish sustainable recycling / hazmat / backhaul program and leverage available energy from waste to heat and power a &quot;Free Store&quot; sharing center</td>
<td>Eric Hanssen</td>
</tr>
<tr>
<td>Eva Sheldon</td>
<td>Economic development associated with energy affordability improvement, non-grant funding options, regional approach</td>
<td>Chris Rose</td>
</tr>
<tr>
<td>Henry Nielsen</td>
<td>Energy efficiency, renewables integration, learn from other communities, focus on Sand Point with application to other areas in region / state</td>
<td>Rich Wies</td>
</tr>
<tr>
<td>Jordan Peterson</td>
<td>Local project management, power purchase agreements from community to crown utility, variable speed generators, solar</td>
<td>Greg Poelzer</td>
</tr>
<tr>
<td>Kate Ballegooyen</td>
<td>Solar panels, geothermal well, wind farm, run of the river, power purchase agreements, First Nation (Kluane Region)</td>
<td>Mark Masteller</td>
</tr>
<tr>
<td>2017 Participant</td>
<td>Participant Priorities (per application)</td>
<td>Mentor(s)</td>
</tr>
<tr>
<td>-----------------</td>
<td>------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Kecil Joseph</td>
<td>Implementation of Energy Management Plan (community ownership / investment), policy-driven implementation)</td>
<td>Scott Waterman</td>
</tr>
<tr>
<td>Keith Charlie</td>
<td>Energy efficiency / conservation across community, stakeholder motivation and engagement, regional collaboration</td>
<td>Peter Crimp Rob Bensin</td>
</tr>
<tr>
<td>Mogens Nielsen</td>
<td>Wind-diesel for small communities, regional interties, hydrogen/ammonia energy storage, PPP with mining developments, water as export</td>
<td>Meera Kohler</td>
</tr>
<tr>
<td>Oana Spinu</td>
<td>Regional energy plan integrating renewables with upcoming diesel end-of-life replacements, solar, wind, storage</td>
<td>Brad Reeve</td>
</tr>
<tr>
<td>Rhonda Pitka</td>
<td>Biomass, district heating, solar, implement recently developed community energy and development plans, identify possible funding paths</td>
<td>Martin Miller</td>
</tr>
<tr>
<td>Rolf Sloth</td>
<td>Stability of small grids integrating variable renewables (solar, wind), effective use of hydroelectric/drinking water resource</td>
<td>Clay Koplin</td>
</tr>
<tr>
<td>Tyler Kornelis</td>
<td>Energy efficiency, asset-based development</td>
<td>JP Pinard</td>
</tr>
</tbody>
</table>

It was stressed that the mentors were a resource for the participants, making their time and experience freely available to the ARENA participants, within the constraints of their other obligations, and that the participants were
responsible for leveraging that resource to their best benefit. Table 5 highlights the possible roles and engagement opportunities envisioned for the mentors. This information was provided to both the mentors and the participants at the outset of their interaction.

**Table 5. Guidelines for ARENA Mentors and Participants**

<table>
<thead>
<tr>
<th>Envisioned Roles &amp; Contributions by ARENA Mentors</th>
<th>Suggestions for ARENA Participants Regarding Interaction with Mentors</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Processing &amp; Support – Mentors serve as a &quot;sounding board&quot; for participants to discuss their ARENA experience</td>
<td>• Get to know each other (e.g., background, resume, publications, lessons learned)</td>
</tr>
<tr>
<td>• Goal Setting &amp; Roadmaps - Mentors work with participants as they define the goals and approach for their individual ARENA project plan</td>
<td>• Exchange &quot;why I'm part of ARENA&quot; perspectives and motivations</td>
</tr>
<tr>
<td>• Information - Mentors share their knowledge, experiences, and wisdom</td>
<td>• Describe your (participant's) work responsibilities and setting</td>
</tr>
<tr>
<td>• Contacts - Mentors provide valuable connection opportunities by sharing academic, career, and personal contacts that may be useful to the participant</td>
<td>• Explain the project you are working on as a way of applying what you learn and experience as an ARENA participant</td>
</tr>
<tr>
<td></td>
<td>• Get feedback on your project plan, especially with respect to defining the desired results as specifically as possible, and with regard to gaining the maximum amount possible from your ARENA-related opportunities</td>
</tr>
<tr>
<td></td>
<td>• Discuss your ARENA experience (on-sites, webinars, interactions, etc.) and how these relate to your overall professional development and interests</td>
</tr>
<tr>
<td></td>
<td>• Ask questions that allow your mentor to share their own knowledge and enable you to access their network</td>
</tr>
<tr>
<td></td>
<td>• Stay in regular contact - brief tag-up calls or emails each week, more significant interactions on at least a monthly basis</td>
</tr>
</tbody>
</table>
In retrospect, based on post-program feedback, it appears that less than half of the ARENA participants benefited significantly from the mentor resource. There were, however, some individuals where this interaction was arguably the most important element of the program. Those instances where a mentor and participant were able to meet in-person, in addition to interacting via phone / email, proved to be very beneficial. Some of the mentors exhibited significant initiative in reaching out to and engaging with their participant.

For the future, consideration should be given to facilitating an opportunity for an in-person meeting between the participants and mentors early in the program, preparing the participants for effective engagement with mentors (e.g., a training session on mentoring early in the program), and encouraging (and documenting in a non-punitive but accountability-encouraging way) the regularity and substance of participant interactions with their mentor.

### 2.6 OUTREACH: ARENA AT THE ARCTIC ENERGY SUMMIT

The ARENA Team Leads from Alaska, Iceland and Canada, along with three selected ARENA participants, travelled to the Arctic Energy Summit in Helsinki. Although it would have been preferable to expose all participants to the Summit, budget constraints necessitated selecting three: Kate Ballegooyen from Kluane First Nation, Keith Charlie from the Native Village of Minto and Tyler Kornelis from the Kodiak Area Native Association. Participants were primarily selected because of the strength of their individual projects and their ability to represent their Indigenous communities.

ARENA was selected to be showcased during one of the concurrent sessions incorporated in the summit; the theme of the session was capacity building. Team leads and participants were given the opportunity to provide short power point presentations on their projects and experiences with ARENA to be followed by a question and answer session.
CHAPTER 3: CONCLUSION

SUMMARY

Overall the 2017 ARENA program was highly successful and achieved its primary goal of bringing together prospective energy champions from remote northern communities and giving them skills, knowledge and collaboration networks that will support their work on clean energy projects in their respective communities and regions. All participants felt that they gained greatly from the on-site sessions and especially from meeting fellow participants and mentors from across the north and gaining a better understanding of the challenges associated with developing clean energy projects. In particular the community visits received very positive feedback, not just because they afforded ARENA participants the opportunity to see real clean energy projects in operation, but also because they provided the opportunity to discuss the project with key developers as well as speak to community members about the importance of the projects to their communities.

OUTPUTS AND OUTCOMES:

1. Created avenues for sharing knowledge between practitioners in the circumpolar Arctic region to foster and increase the region’s global leadership in integrating renewable energy in remote energy networks.
2. Established and strengthened community and organizational relationships for knowledge sharing and collaboration.
3. Created an online resource drawing from lectures, field trips, and student projects, providing broad pan-Arctic access to the information shared and facilitating its adaptation / extension via the SDWG to multiple local scenarios.
4. Developed action plans for highly place-relevant projects that can be implemented by participants and their host organizations / countries.
INTEGRATION OF INDIGENOUS KNOWLEDGE AND LOCAL KNOWLEDGE:

Sharing Indigenous knowledge and Local knowledge throughout rural Arctic communities was key for the success of this project. For example, awareness of local environmental conditions, historical trends, and land and resource use priorities are critically important for developing relevant and acceptable place-based solutions. To maximize the probability of incorporating these insights, participation from the Permanent Participant members was highly encouraged and valued. This ensured that the program brought together knowledge from a wide array of Arctic communities to facilitate appropriate integration of clean energy technologies throughout the region.

CHAPTER 4: FORWARD-LOOKING CONCLUSIONS

1. The Arctic Council and SDWG should continue to promote innovative approaches encouraging renewable energy in even the most remote Arctic communities.

2. The Arctic Council and SDWG work should promote stronger international and circumpolar cooperation, including sharing of knowledge.

3. In particular, the Arctic Council and SDWG should continue to benefit from the extensive Indigenous knowledge and Local knowledge of Arctic communities and Permanent Participants as there is a deep connection to any meaningful understanding and applicability in the Arctic region.

4. The Arctic Council and SDWG should consider a long-term model for ARENA. This would provide an opportunity to the chair country to host an ARENA session and showcase their renewable energy
resources during their chairmanship. This will promote the development of clean energy projects in circumpolar region.

5. Participation of the Indigenous applicants should continue to be the key emphasis of the initiative. ARENA would provide a platform to: help build local workforce capacity; improve community energy resilience enable sustainability in arctic energy development, and share Indigenous and local perspectives.

Figure 4. ARENA participants, Yellowknife on-site visit
### Annex A

**ARENA 2017 Participants**

<table>
<thead>
<tr>
<th>Name</th>
<th>Country</th>
<th>Territory/State</th>
<th>Community</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kate Ballegooyen</td>
<td>Canada</td>
<td>Yukon,</td>
<td>Burwash Landing</td>
<td>Kluane First Nation</td>
</tr>
<tr>
<td>Marzena Banks</td>
<td>Canada</td>
<td>Nunavut</td>
<td>Toloyoak</td>
<td>Hamlet of Toloyoak</td>
</tr>
<tr>
<td>Oana Spinu</td>
<td>Canada</td>
<td>Nunavut</td>
<td>Iqaluit,</td>
<td>World Wildlife Foundation</td>
</tr>
<tr>
<td>Eryn Stewart</td>
<td>Canada</td>
<td>Ontario</td>
<td>Ottawa</td>
<td>Lumos Energy</td>
</tr>
<tr>
<td>Erika Tizya-Tramm</td>
<td>Canada</td>
<td>Yukon</td>
<td>Old Crow</td>
<td>Vuntut Gwitchin Government</td>
</tr>
<tr>
<td>Bill Williams</td>
<td>Canada</td>
<td>Nunavut</td>
<td>Kugluktuk</td>
<td>Hamlet of Kugluktuk</td>
</tr>
<tr>
<td>Kecil Joseph</td>
<td>Canada</td>
<td>NWT</td>
<td>Inuvik</td>
<td>Town of Inuvik</td>
</tr>
<tr>
<td>Jordan Peterson</td>
<td>Canada</td>
<td>NWT</td>
<td>Inuvik</td>
<td>Gwich’in Tribal Council</td>
</tr>
<tr>
<td>Keith Charlie</td>
<td>USA</td>
<td>Alaska</td>
<td>Minto</td>
<td>Native Village of Minto</td>
</tr>
<tr>
<td>Tyler Kornelis</td>
<td>USA</td>
<td>Alaska</td>
<td>Kodiak</td>
<td>Kodiak Area Native Association</td>
</tr>
<tr>
<td>Rhonda Pitka</td>
<td>USA</td>
<td>Alaska</td>
<td>Beaver Creek</td>
<td>Chief, Beaver Village Council</td>
</tr>
<tr>
<td>Danny Powers</td>
<td>USA</td>
<td>Alaska</td>
<td>Anchorage</td>
<td>Kasteler Consulting Inc.</td>
</tr>
<tr>
<td>Brad Reeve</td>
<td>USA</td>
<td>Alaska</td>
<td>Kotzebue</td>
<td>Kotzebue Electric Association</td>
</tr>
<tr>
<td>Anahma Shannon</td>
<td>USA</td>
<td>Alaska</td>
<td>Nome</td>
<td>Kawerak, Inc.</td>
</tr>
<tr>
<td>Eva Sheldon</td>
<td>USA</td>
<td>Alaska</td>
<td>Anchorage</td>
<td>Self (previously NANA)</td>
</tr>
<tr>
<td>Mogens Nielsen</td>
<td>Greenland</td>
<td></td>
<td>Nuuk</td>
<td>Nukissiorfiit (Greenland Utility)</td>
</tr>
<tr>
<td>Rolf Sloth</td>
<td>Greenland</td>
<td></td>
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</tr>
<tr>
<td>Yulia Shamis</td>
<td>Russia</td>
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<td>Moscow</td>
<td>RAO Energy System of East</td>
</tr>
<tr>
<td>Tony Carroll</td>
<td>USA</td>
<td>Alaska</td>
<td>Fort Yukon</td>
<td>Gwitchyaa Zhee Utilities</td>
</tr>
<tr>
<td>Henry Nielsen</td>
<td>Nielsen</td>
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<td>Alaska</td>
<td>Sand Point</td>
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</tbody>
</table>
### Unable to Attend Canadian Site Visit

<table>
<thead>
<tr>
<th>Name</th>
<th>Country</th>
<th>Region</th>
<th>Location</th>
<th>Company</th>
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<tr>
<td>Yulia Shamis</td>
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<td>RAO Energy System of East</td>
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<tr>
<td>Tony Carroll</td>
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<td>Alaska</td>
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<tr>
<td>Henry Nielsen</td>
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<td>TDX Sand Point</td>
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</table>

### Unable to Attend American Site Visit

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<tr>
<td>Marzena Banks</td>
<td>Canada</td>
<td>Nunavut</td>
<td>Toarlooyak</td>
<td>Hamlet of Toloyoak</td>
</tr>
<tr>
<td>Yulia Shamis</td>
<td>Russia</td>
<td></td>
<td>Moscow</td>
<td>RAO Energy System of East</td>
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<tr>
<td>Tony Carroll</td>
<td>USA</td>
<td>Alaska</td>
<td>Fort Yukon</td>
<td>Gwitchyaa Zhee Utilities</td>
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### Unable to Attend Icelandic Site Visit

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<th>Country</th>
<th>Region</th>
<th>Location</th>
<th>Company</th>
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<tbody>
<tr>
<td>Marzena Banks</td>
<td>Canada</td>
<td>Nunavut</td>
<td>Toarlooyak</td>
<td>Hamlet of Toloyoak</td>
</tr>
<tr>
<td>Yulia Shamis</td>
<td>Russia</td>
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<td>RAO Energy System of East</td>
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<td>USA</td>
<td>Alaska</td>
<td>Fort Yukon</td>
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<tr>
<td>Henry Nielsen</td>
<td>USA</td>
<td>Alaska</td>
<td>Sand Point</td>
<td>Sand Point</td>
</tr>
</tbody>
</table>
Agenda

ARCTIC REMOTE ENERGY NETWORKS ACADEMY (ARENA)
Arctic Council’s Sustainable Development Working Group Project
Canadian On-Site Program
Yellowknife, Northwest Territories
March 19-26, 2017

Sunday March 19th 2017
Genesis Room
NFS Conference Services, 201 5109 48th St (across from Boston Pizza)

16:30 – 18:30: Team meeting: All participants are invited to a pizza supper to meet each other in person and the ARENA leadership team. Sponsored by University of Alaska.

Monday March 20th 2017
Yellowknife, Northwest Territories

08:00 - 8:30: Breakfast

Introduction and Administration Announcements

08:30 - 9:00: Robert Cooke, Technology Advisor, Polar Knowledge Canada
Introduction to the program, key administrative issues, and introduce the agenda.

09:10 - 09:20: Wally Schumann, Minister of Industry, Tourism & Investment, Public Works & Services, Transportation: Why NWT is a leader in clean energy across the north; vision for clean energy going forward.
09:20 - 09:40: Gwen Holdmann, Director Alaska Center for Energy and Power
Opening address on the concept behind ARENA, the Arctic Fulbright Program.

09:40 – 09:45: Ed Canuel, Senior Advisor, Office of the Deputy Secretary for
Management and Resources (D-MR), US Department of State

09:45 – 10:00: Emanuel DaRosa, CEO Northwest Territories Power Corporation
Role of the Utility, how the utility is structured in NWT, why Utility are embracing
clean energy, Power Purchase Agreements (PPAs) etc., vision for the future of a
utility with respect to clean energy.

10:00 – 11:50: Student Presentations – all students are being asked to have a
project/theme relevant to their region

11:50 – 12:00: Wayne Walsh, Director General, Northern Strategic Policy Branch,
Northern Affairs Organization, Indigenous and Northern Affairs Canada: Arctic
Council - Sustainable Development Working Group (SDWG)

12:00 - 13:00: Networking Lunch

13:00 - 14:00: Student Presentations - continued

14:00 - 16:00: Capacity Building and Negotiation: Chris Henderson, President
Lumos Energy. Presentation on community energy planning, and the importance of
community readiness and capacity building in remote communities: as a foundation
for Renewable Energy Project Development.

18:00: Participant dinner at Quarry Restaurant, Chateau Nova hotel

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Tuesday March 21st 2017
Yellowknife, Northwest Territories

08:00 - 08:30: Light breakfast

08:30 - 12:00: Scoping a Project: RETScreen Michael Ross, Training & Applications
Expert, RER Energy Inc. ARENA is looking at the possibility of also extending
RETScreen support to include interactive one-on-one follow up sessions after the
Yellowknife course.

12:00 - 13:00: Lunch
13:00 - 14:30: Wind Theory: Carl Brothers, GM Frontier Power Systems
Practical Application of Wind Energy – An introduction and discussion on the
economics of wind energy relative to other renewable and non-renewable energy
resources. A description of economic benefits and summary of funding agencies and
potential resources from a Canadian context.

14:30 - 16:00: Building a Community Wind Project: JP Pinard, PhD, President,
Consulting Engineer. Detailed discussion on the Kluane wind project.

16:00: Alternate Renewable (A&R) in Industry: Pierre Rivard, President and CEO,
TUGLIQ Energy. A detailed discussion of the Raglan Mine project, Tugliq Energy’s
involvement, possible future for industry and renewables.

18:30 – 21:00: Networking evening: Prince of Wales Northern Heritage Center,
Museum Café

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**Wednesday March 22nd 2017**
**Yellowknife, Northwest Territories**

07:30 to 08:00 – Light breakfast

08:00 - 10:00: Solar theory and considerations for remote community solar projects:
Klaus Dohring, President Green Sun Rising

10:00 - 12:00: (Working lunch) Building a Solar Project: Ian Flood, Project Manager,
Engineering, Northwest Territories Power Corporation. Project overview: size,
location, why Colville Lake – determining factors.

12:00: Bus pick up NFS Conference Services to Air Tindi

13:00: Flight to Colville Lake

15:00 - 17:00: Colville Lake Site Visit

19:00: Bus transfer to Explorer

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**Thursday March 23rd 2017**
**Site Visit to Lutsel K’e, Northwest Territories**
07:00: Bus pick up Explorer lobby, boxed breakfast provided

08:00 – 09:00: Flight to Lutsel K’e

09:00 – 09:30: Transport to Lutsel K’e

11:00 - 12:00: Tour of Project and Community. This project was established by the community and the community then negotiated a power purchase agreement (PPA) with the NTPC.

12:00 – 13:00: Meeting with Chief and Council. How a decision to select solar was made, other considerations. Capacity building. PPA (Power Purchase Agreement) discussions. Future options.

13:00 - 14:00: Community Feast

14:00-15:30: Building a Community Solar Project: Sean Magee, Renewable Energy Champion/Linda Todd, Program Coordinator Arctic Energy Alliance

Building on the work that Bullfrog and Arctic Energy Alliance did in helping Lutsel K’e develop the project, support provided, on-going work.

17:30: Bus transfer from Air Tindi to Explorer

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**Friday March 24th 2017**

**Yellowknife, Northwest Territories**

**Site Visits to Jackfish Power Plant and Blue Fish Dam**

07:30 – 08:00: Light breakfast

08:00 – 09:00: Hydro – The importance, and type, of renewable hydro to NWT power generation. (Jay Pickett, Director, Hydro – NTPC)

09:00 – 09:45: Water licensing and environmental impact studies. (Matthew Miller, Environmental Licensing Specialist – NTPC)

10:00 - 11:00: How does NTPC reduce and maximize efficiency of diesel in thermal communities. (Paul Toom, Acting Director of Asset Management and Engineering – NTPC)
11:00 – 12:15: (Working Lunch sponsored by NTPC) Importance of renewable energy on government and utilities (GNWT and NTPC). (GNWT Public Works & Services: Geraldine Byrne, Manager, Energy Research & Development)

12:15 – 12:30: Transport to Jackfish

12:30 – 13:30: Visit to Jackfish Power Plant – a tour of the generating system used to support Yellowknife when Snare/Bluefish Hydro Power Facilities are not generating power. A brief discussion on diesel generators, generation control to include integration of hydro and diesel.

13:30 – 14:30: Transport to Bluefish Dam

14:30 - 17:00: Bluefish Hydro Dam site visit – Visit to Bluefish dam in Yellowknife to get a perspective of what is involved in building a major hydro project.

17:00 - 18:00: Return to Yellowknife bus transfer to Explorer Hotel

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**Saturday March 25th 2017**

**Yellowknife, Northwest Territories**

08:00 - 08:30 am: Light Breakfast

08:30 – 16:00: Energy Futures Lab: the Newtonian Shift to include working lunch Alison Cretney, Director of Knowledge and Design, the Natural Step; Erin Romanchuk, Associate, the Natural Step. *Energy Futures Lab: The Newtonian Shift* is a facilitated role-playing simulation that allows players to experience decades of energy transition in one day.

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**Sunday March 26th 2017**

**March 26th, 2017**

07:30 to 08:00: Breakfast

08:00 – 10:00: Renewable Energy and the Government of Canada (GoC) Stephen Bowman, INAC, Robert Cooke, Technology Advisor, Polar Knowledge Canada, David Alexander, CanNor. A brief look at some of the programs that GoC offer to help increase the uptake of renewable energy across Canada but with a focus on remote communities and reduction in diesel dependence.
10:00 - 12:00: Discussions: Lesson Learned, Action Plans and Recommendations, Potential Additions for Alaska and Iceland Courses (facilitated by Robert Cooke)

12:00 - 13:00: Lunch

13:00 – Participants depart Yellowknife, NT
Annex C

Alaska On-site Session – Program Agenda

Agenda
ARCTIC REMOTE ENERGY NETWORKS ACADEMY (ARENA)
Arctic Council’s Sustainable Development Working Group Project
Alaska On-Site Program
Fairbanks, Kotzebue & Nome Alaska
June 17-24, 2017

Saturday June 17th 2017
Fairbanks, Alaska

Arrivals throughout the day / Check into Wickersham Hall – University of Alaska, Fairbanks Campus

18:00   BBQ Dinner on roof of Lola Tilly Commons
22:00   Midnight Sun Run (Optional) – start is at Lola Tilly Commons

Sunday June 18th 2017
Fairbanks, Alaska

Lola Tilly Commons Large Conference Room
411 Tanana Loop East, UAF

08:30   Hot Breakfast
09:00  On-site Program Plan Highlights & Administrative Items

09:15  Participant Project Update Presentations – Progress since March (5 minutes each)

11:00  Chena Hot Springs Background – Gwen Holdmann, ACEP
       Pilgrim Hot Springs (Nome) Project Overview

12:00  Depart for Chena Hot Springs Visit and Lunch Stop Enroute

13:30  Chena Hot Springs (CHS) Visit
13:30  CHS Power Plant & Facility Tour – Bernie Karl

15:00  Ice Museum Tour – Bernie Karl

15:45  Free Time

17:00  Dinner at Chena’s Restaurant, featuring fresh ingredients grown on-site

18:30  Depart for Fairbanks and return to Wickersham Hall

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Monday June 19th 2017
Fairbanks, Alaska

Lola Tilly Commons Large Conference Room
411 Tanana Loop East, UAF

07:30  Light breakfast

08:30  Microgrids Overview – Dr. Marc Mueller-Stoffels, ACEP

Marc will provide an overview of the diesel-based power grids serving the remote communities of Alaska, including the integration of various renewable energy sources and energy storage.

09:30  Power Systems Integration Lab Tour / Demonstration – Dr. Marc Mueller-Stoffels, ACEP

The PSI lab can be configured to represent, at full power, the Alaska rural community energy grids, including a mix of renewable energy sources integrated with diesel-generated power and electrical energy storage.
11:30  Lunch at Lola Tilly

12:30  Sustainable Southeast Partnership – Local & Regional Engagement- Shaina Kilcoyne

The Sustainable Southeast Partnership (http://sustainablesoutheast.net) is a diverse network of organizations and individuals working together to reach prosperity for their communities and region. Shaina will provide highlights from their experience so far.

13:30  Water Treatment Systems in Rural Alaska – Eric Hanssen

Key issues and approaches to provide safe drinking water and manage liquid waste throughout the year in rural communities will be reviewed as background for the tours of Lifewater Engineering and the water treatment facilities in Kotzebue.

14:00  Transit to Cold Climate Housing Research Center

14:30  Tour of Cold Climate Housing Research Center – Robbin Garber-Slaght

The Cold Climate Housing Research Center (http://www.cchrc.org) is a nonprofit corporation created to facilitate building technologies for people living in cold climates. Robbin will provide an overview of their work and provide ARENA participants with the opportunity to explore a range of solar energy, thermal energy storage, water treatment, and built-structure technologies.

16:00  Transit to Calypso Farm and Ecology Center

17:00  Tour of Calypso Farm and Ecology Center – Tom Zimmer

Calypso Farm (http://www.calypsofarm.org) is a non-profit, educational organic farm in Ester, Alaska offering hands-on education programs and grows fresh food through community-supported agriculture (CSA) and markets.

18:00  Dinner at Calypso Farm and Ecology Center

20:00  Transit to Wickersham Hall

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**Tuesday June 20th 2017**

**Fairbanks, Alaska**

Lola Tilly Commons Large Conference Room
411 Tanana Loop East, UAF

07:30  Light Breakfast & Golden Valley Electric Association Briefing – Dan Bishop

GVEA (http://www.gvea.com) is the electric power utility serving Fairbanks and the surrounding region. It has an inter-tie to the grids in Anchorage and the Kenai Peninsula. Dan Bishop will provide an overview of the Battery Energy Storage System we will be visiting.

Track I – HOMER Pro Training

08:15  Transit (walk) to Ernest Gruening Building (Room 408)

08:30  HOMER Pro Training – John Glassmire, Dr. Peter Lilienthal

HOMER Energy (http://www.homerenergy.com/index.html) will provide training in the use of the HOMER Pro software for analyzing microgrid energy system options and provide support for development of models representing ARENA participant communities.

Track II – Community Leaders Panel

08:30  Community Leaders Panel – Shannon Erhart, Roderick Phillip, Connie Fredenberg (moderated by Amanda Byrd)

The panelists will share from their experience working in rural Alaska communities to achieve greater self-reliance in local sustainable energy systems and priorities.

11:30  Transit to Lunch at Lola Tilly

12:00  "Fireside Chat" with Energy Project Developers – Jim St. George, Bill Thomson Rob Bensin, David Messier

The panelists will share from their experience implementing energy infrastructure in Alaskan settings.

13:30  Energy Efficiency and Conservation – Dr. Tom Marsik

14:30  Transit to Lifewater Engineering

15:00  Tour of Lifewater Engineering – Bob Tsigonis
Lifewater Engineering (http://lifewaterengineering.com) provides arctic-suitable solutions to address wastewater management challenges, with system configurations that span the residence-community-industrial application space.

15:45 Transit to GVEA Battery Energy Storage System Facility

16:00 Tour of GVEA Battery Energy Storage System Facility – Dan Bishop

BESS is one of GVEA's initiatives to improve the reliability of service. The system can provide 27 megawatts of power for 15 minutes, avoiding the requirement for "just in case" active spinning reserve to protect against problems in Anchorage or Fairbanks.

16:45 Transit to Home of Fairbanks North Star Borough Mayor Karl Kassel

Enroute stop at Trans Alaska Pipeline viewing station and information display near Fox, Alaska.

17:30 Home Tour and Dinner – Mayor Karl Kassel

The Kassel residence one of the greenest homes in Alaska. Our visit will provide an opportunity to both hear the vision and technologies that motivated its development.

21:00 Transit to Wickersham Hall

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**Wednesday June 21st 2017**
Fairbanks, Alaska

Alaska Wind-Diesel Workshop (ARENA participants will attend all day)
Alyeska Pipeline Training Center

07:00 Transit from Wickersham Hall to Alyeska Pipeline Training Center

07:15 Registration and Hosted Breakfast

08:00 Wind-Diesel Workshop

17:30 Transit to Trail Breaker Kennel for Celebration Dinner

18:00 Celebration Dinner – Hosted by US Department of State
ARENA participants and stakeholders gather to celebrate highlights from the time in Fairbanks and enjoy an Alaska Native dance performance by students in the Rural Alaska Honors Institute.

21:00 Transit to Wickersham Hall

21:30 Pack / Prepare for Checkout

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**Thursday June 22nd 2017**  
**Kotzebue, Alaska**

06:00 Depart Wickersham Hall

07:35 Flight departs for Kotzebue with a stop in Anchorage

12:25 Arrive Kotzebue (Ravn 922)  
Transport from Airport to Alaska Technical Center (ATC)  
Check into ATC Dormitory

13:00 Lunch at ATC

14:00 Alaska Technical College Overview & Tour - Cheryl Edenshaw

14:30 Solar & Heat Pumps in NWAB – Ingemar Mathiasson (via Internet)

15:15 Advanced Technologies for Hydroponics & Local Food – Jeff Buchholz

15:45 Overview of Water & Waste Management in Kotzebue – City of Kotzebue

16:15 Walk from ATC to Water Plant

16:30 Water Plant Tour – City of Kotzebue

17:00 Visits to Containerized Hydroponic Greenhouse Systems (split into groups A & B)

17:00 Group A: Kikiktagruk Inupiat Corporation – Larry Daniels  
Group B: Northwest Arctic Borough- Jeff Buchholz

17:30 Group A: Northwest Arctic Borough- Jeff Buchholz  
Group B: Kikiktagruk Inupiat Corporation - Larry Daniels
18:00 Walk to Dinner at Nullaġvik Hotel
20:00 Walk to ATC Dormitory

Friday June 23rd 2017
Kotzebue, Alaska

07:30 Breakfast at ATC
08:00 NANA Regional Corporation - Liz Cravalho
  City & Borough of Kotzebue – Patrick Savok, Mayor Gayle Ralston
09:00 Kotzebue Electric Association (KEA) Presentation – Brad Reeve, Matt Bergan
10:00 Transit from ATC to Power Plant
10:15 Tour of KEA Power Plant – Matt Bergan
12:00 Walk to Lunch at ATC
13:00 Transit to KEA Wind Turbine Site
13:15 Wind Turbine Site tour
14:15 Transit to Kotzebue
  Enroute Drop-in Visits to Landfill & Sewage Lagoon
15:15 Walking Tour of Kotzebue Highlighting Residential and Business Energy Installations and visit Sulianich Art Center & Sample
16:30 Return to ATC Dormitory / Checkout (for those leaving after dinner)
17:00 Dinner at Nullaġvik Hotel
17:30 Transport to Airport (subset of group)
18:56 Flight to Nome / Anchorage (Alaska 153)

Saturday June 24th 2017
Kotzebue, Alaska
07:00  Transport to airport (subset of group)

08:32  Flight to Anchorage (Alaska 154)

08:30  Breakfast at ATC / Pick-up sack lunch

Recreation Day – local site-seeing / rest time
Fishing, National Park Service Visitor Center, Sulianich Art Center, Flightseeing, ...

16:30  Dinner at Nullaġvik Hotel

17:30  Transport to Airport (remainder of group)

18:56  Flight to Nome / Anchorage (Alaska 153)

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Saturday, June 24
Nome, Alaska

7:30pm: Arrive into Nome, host family picks you up & takes you home.

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Sunday June 25th 2017
Nome, Alaska

8:30am: Leave for Pilgrim Hot Springs

12:00pm: Lunch on-site

4:00pm: Leave for Nome

7:30pm: BBQ with host families, location TBD

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Monday June 27th 2017
Nome, Alaska

8:30am  Workshop at Bering Straits Native Corporation boardroom

9:00am  Matt Ganley - development opportunities, impact of energy, deep water port, etc.
<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
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<tbody>
<tr>
<td>10:00am</td>
<td>Rob Bensin solar array presentation, Banner Wind Farm tour</td>
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<tr>
<td>12:00pm</td>
<td>Lunch by Bering Tea</td>
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<td>1:00pm</td>
<td>NJUS plant tour, utility overview and experience with Power Purchase Agreement and Independent Power Producer contracting</td>
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<tr>
<td>2:30pm</td>
<td>NSEDC Seafood Plant Tour</td>
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<tr>
<td>4:00pm</td>
<td>Free time</td>
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<tr>
<td>6:00pm</td>
<td>Dinner at Bering Sea</td>
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Iceland On-site Session – Program Agenda

Agenda

ARCTIC REMOTE ENERGY NETWORKS ACADEMY (ARENA)
Arctic Council’s Sustainable Development Working Group Project
Iceland On-Site Program
June 17-24, 2017

November 5-11 2017
Reykjavik, Iceland

Lectures are given at UNU-GTP in Orkugardur (Energy House), at Grensásvegur 9, Reykjavik.

LSG: Lúdvík S. Georgsson, Director UNU-GTP
EG: Dr. Einar Gunnlaugsson, Chief Geologist, Reykjavik Energy
GTh: Geir Thórólfsson, Chief Engineer, HS Orka.
KVM: Kristín Vala Matthíasdóttir, Head of the Reykjanes Resource Park
MÓ: Málfríður Ómarsdóttir, Environmental Scientist, UNU-GTP
IGH Ingimar Haraldsson, Deputy Director, UNU-GTP
BP: Dr. Bjarni Pálsson, Engineer, Landsvirkjun National Power Co.

Saturday November 4
Reykjavik, Iceland

Arrival of participants, pickup at airport and checking in at Cabin Hotel, Reykjavik.
Welcome dinner at Fabrikkan.

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**Sunday November 5**  
**Reykjavik, Iceland**

10:00-12:00 “Reykjavik: Geothermal Capital of the World”: introductory lecture on the development of geothermal utilization in Reykjavik. (EG and LSG)

12:00-13:00 Packed lunch at Orkugardur.

13:00-17:00 Geothermal and cultural excursion in Reykjavik – including the site of the old Laugardalur hot springs, Laugardalur geothermal wells and pumping station, Perlan storage tanks and exhibition. Ending with geothermal swimming in Laugardalur.

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**Monday November 6**  
**Reykjavik, Iceland**

9:00-09:30 Introduction to geothermal energy (LSG)

9:30-10:45 Surface geothermal exploration (LSG)

10:45-11:00 Coffee break

11:00-12:00 Deep geothermal exploration (LSG)

12:00-13:00 Lunch at Orkugardur

13:00-16:00 Utilization of geothermal energy – development of energy projects (PV)

16:00-17:00 Discussion (PV and LSG)

17:00-18:00 Introduction to geothermal development on the Reykjanes Peninsula (LSG)

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**Tuesday November 7**  
**Reykjavik, Iceland**

*Geothermal excursion to the Reykjanes Peninsula* (LSG, GTh, KVM and MÓ)
9:00-18:15 Field excursion, visiting the Reykjanes geothermal field, visit to the tip of the Peninsula, Haustak geothermal drying factory. Lunch in Grindavík at Sst.Vör. Visit to the Svartsengi power plant (GTh) – the Reykjanes Resource Park (KVM), swimming in the Blue Lagoon.

8:45 Pickup of LSG and MÓ and water etc. at UNU-GTP

9:00 Departure from Cabin Hotel with LSG and MÓ

9:00-09:45 Drive to Reykjanes

9:45-11:15 Stops at the Bridge Between Continents, at coastline at edge of Reykjanes, and at the Reykjanes geothermal field

11:15-12:00 Visit to Haustak fish drying factory

12:00-12:30 Drive to Grindavik – Vör

12:30-13:15 Lunch at Vör

13:15-13:30 Sightseeing in Grindavík

13:30-13:45 Drive to Svartsengi

13:45-15:45 The Svartsengi Power plant (GTh) and the Reykjanes Resource Park (KVM)

16:00-18:00 Swimming in the Blue Lagoon

18:00-18:45 Back to Reykjavik

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**Wednesday November 8**

**Reykjavik, Iceland**

*Assessing low-temperature geothermal resources and possible utilization (PV)*

9:00-12:00 Direct geothermal use – the thermal calculations.

10:30-10:45 Coffee break

10:45-12:00 Weather data for energy calculations discussed and the relation between investment cost and income for a district heating system explained from weather data.
12:00-13:00 Lunch at Orkugardur

13:00-16:00 Production of electricity from low- and medium-temperature geothermal heat.

16:00-17:00 Discussion (PV & LSG)

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**Thursday November 9**  
**Reykjavik, Iceland**

*Geothermal and cultural excursion to the Southern Lowlands (LSG and PV)*

08:00-18:30 Set Pipe factory, Ljósafoß hydropower station in Sog river and associated exhibition, CO2 production from geothermal wells at Klausturhólar. Visiting commercial geothermal greenhouses at Flúdir and Reykholt. The Gullfoss waterfall, Geysir HT field, Thingvellir National Park.

7:45 Pickup of LSG and PV and food/drinks at UNU-GTP

8:00 Departure from Cabin Hotel – pick up

8:00-08:45 Drive to Selfoss

8:50-09:40 Set pipe factory – guided tour and discussion (BE)

9:40-10:00 Drive to Ljósafoß hydropower plant (20 km)

10:00-11:00 Ljósafoß HPP and exhibition – guided tour (LV)

11:00-11:10 Drive to Haedarendi

11:10-12:00 Haedarendi CO2 factory – guided tour (Thorl.)

12:00-12:45 Packed lunch and drive to Flúdir

12:45-13:20 Visit to Melar greenhouse – commercial growing of cucumbers and tomatoes

13:20-13:30 Drive to Reykholt

13:30-14:10 Visit to Espiflót greenhouse – commercial growing of flowers
14:15-14:45 Drive to Gullfoss waterfall
14:45-15:15 Gullfoss waterfall sight seeing
15:15-15:30 Drive to Geysir field
15:30-16:00 Geysir HT geothermal field
16:00-17:00 Drive to Thingvellir NP
17:00-18:00 Sightseeing at Thingvellir
18:00-18:45 Driving back to Reykjavik

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**Friday November 10**  
Reykjavik, Iceland

*Modelling geothermal developments – Hydropower development in Iceland*

9:00-12:00 Modelling geothermal developments (engineering part of group) (PV)  
Numerical calculations of selected examples. The mathematically and physically inclined will take part in a workshop using software packages “Engineering Equation Solver” and “Scilab/CoolProp”.

9:00-12:00 Environmental side and regulatory aspects of geothermal development (managament part of group; MÓ and IGH)

12:00-13:00 Lunch at Orkugardur.

13:00-16:00 Developing hydropower in Iceland – large scale / small scale (BP).

16:00-17:00 Discussion

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**Saturday November 11**  
Reykjavik, Iceland

8:30-13:00 Presentation of projects carried out under the ARENA umbrella.

13:00-14:00 Lunch at Orkugardur.
14:00-15:00 An interactive session on the week in Iceland and ARENA programme.

15:00-16:00 Closing ceremony (LSG, PV, GR, RC, GH, AB)

16:00-19:00 Free time

19:00 Closing Buffet Dinner hosted by the Ministry for Foreign Affairs.

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**Sunday November 12**

**Reykjavik, Iceland**

*Programme from 10:00 to 17:00 with EG, LSG and PV*

9:30 – 09:50 Pickup at Cabin Hotel (LSG and MAGW)

10:00 – 12:00 Lectures on Reykjavik energy and geothermal utilization in Reykjavik (EG)

12:00 – 12:45 Light lunch at Orkugardur from Lemon (MW)

12:45 – 13:45 Wells and pumping station in Bolholt

13:45 – 15:00 Perlan – storage tanks and exhibition

15:15 – 15:45 The washing pools – site of the old Reykjavik hot springs

16:00 – 17:00 Swimming in the Laugardalur swimming pool