ARCTIC ENERGY OFFICE

ABOUT ENERGY IN THE ARCTIC

The Arctic is geographically enormous –20% of the earth's land mass – but very small from the perspective of its overall population of approximately 4 million people. The majority of its people live in year-round locations, in communities that range in size from fewer than 30 individuals to almost 300,000 in the largest (Murmansk, Russia). There are also multiple people groups that move between sites over the course of the year, in response to seasonal variations in economic opportunities and wild food resources. Climatic, economic, and transportation logistics challenges are present throughout the region.

As a result, the energy systems of the north involve a diverse cross-section of resources, with widespread reliance on fossil fuels of various types (e.g., natural gas, diesel, coal) and a growing amount of renewable energy (wind, solar, geothermal, hydroelectric). Community power levels can range from as little as 35 kW to more than 10 MW. Heat is often the largest type of energy used in residential settings. Remote arctic communities typically experience high energy costs – in some cases exceeding $1 USD per kWh for electricity and $10 USD per gallon of heating fuel, with the result that residents can face energy bills that are over half their disposable income.

The circumpolar Arctic is unique in its wide-spread reliance on a discontinuous electric grid infrastructure. Due to its large geographic size and small, dispersed population, many remote communities in Alaska, Canada, Russia and Greenland are not connected via transmission lines or pipelines to one another or to more populous southern regions of their respective countries. Instead, they rely heavily on imported fuels – primarily diesel – for local heating and power generation via microgrids.

MICROGRIDS

Microgrids can be stand-alone systems that meet the needs of one specific site, or that serve multiple intertied locations. While they vary in size and composition, microgrids have several functional elements in common:

- One or more energy sources, one of which is typically some type of fossil fuel, with diesel fuel being very common. Where there are locally available renewable energy resources that can be harnessed, these are often integrated with the fossil fuel energy system.
- Energy customers – residential, commercial and community – whose needs are served by the system. These loads change in size throughout the day and around the year, sometimes very quickly and unpredictably, and have different levels of importance and sensitivity.
- A transmission and distribution network that connects the energy source, or sources, with the energy users.
- A control system that manages the generation, and sometimes the loads, and often uses one or more types of energy storage (e.g., batteries, flywheels, hot water tanks) to buffer differences between the supply and demand, and to enhance overall system efficiency.

FOSSIL FUELS

In much of the Arctic, there is a strong reliance on fossil fuels. Ironically, in a region where export of its oil, natural gas and coal resources contribute significantly to the regional economy, much of the

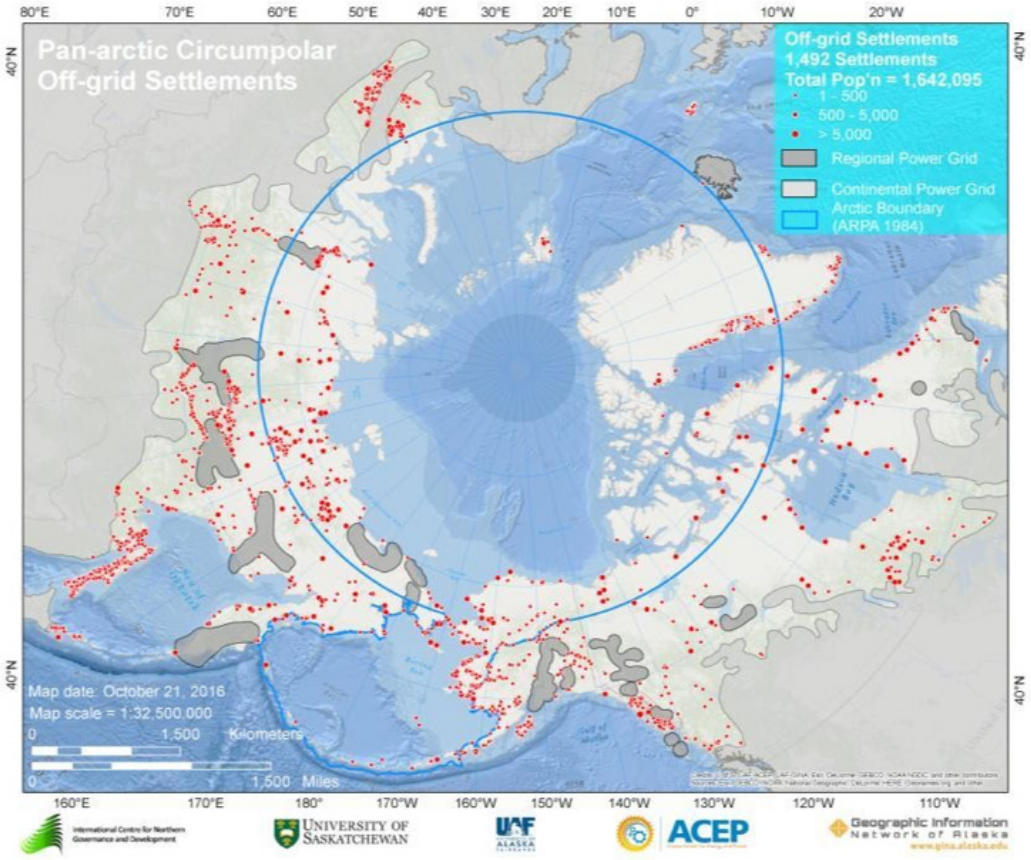
fossil fuel used locally must be imported. Diesel, natural gas and coal are used most widely. In larger locations, combined heat and power systems are used. Energy prices range drastically, depending on the options available for acquiring the fuel. If a pipeline is not economically viable, fuel must be transported to the end user. Often fuel delivery is only possible on a seasonal basis – for example by barge while the ocean and rivers are free of ice, or by tanker truck during only the very coldest months when ice roads that can be constructed and used. In some cases, it must actually be flown in!

RENEWABLE ENERGY

As a whole, the Arctic region can be regarded as a leader in renewable energy development, with more than double the global average in the percentage of power generated from renewable resources. Countries like Iceland and Norway source virtually 100% of their energy for heat and power from renewable resources. The US is actively working with partners across the region to share best practices and enhance the region's overall energy resilience. In an estimated 250 locations, diesel fuel is augmented with local sources of renewable energy such as hydropower, wind, solar, biomass, marine hydrokinetic or geothermal energy. Alaska has played a leadership role in incorporating renewable resources into community-scale microgrids, with over 75 community energy grids that are powered in part by renewable energy, including small hydro, wind, geothermal, biomass and solar systems.

NUCLEAR ENERGY

Nuclear energy has been used as a source of power, heat and transportation in the Arctic. Studies are ongoing regarding possible arctic applications for the evolving field of microreactors and small modular reactors.



Energy grids in the circumpolar Arctic.

The red dots represent almost 1500 remote communities served by microgrids.

The dark grey areas delineate regional grids, and the light grey area represents the extent of the continental grid.

For more information, visit: energy.gov/arctic

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