Sustainable and Green Energy in the Arctic

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On Top of the High North

Our position, on top of the High North, reflects both a geographical fact and an ambition.

We are the northernmost university in the world, at 69° North.

Our location on the edge of the Arctic also implies a mission, as the Arctic is of increasing global importance.

Our ambition is to be on top of all things north. Because if it affects the north, it affects the world.
Arctic Regions

The northern arctic circle crosses at approximately 66° north.

Norway, Sweden, Finland and Russia are in this region together with Alaska, Canada and Greenland.

The area within the arctic circle is however **not very** densely populated.

The changing scenarios

- Climate
- Political
- Economic

are offering unique challenges and opportunities.
Opportunities in the Arctic-1

These changes are facilitating unique access to the region leading to activities:

- Resource Developing
- New settlements
- Transportation infrastructure
- Energy needs
Dealing with Energy Needs & Environment

As the energy usage within the region increases the environmental impact will also increase because:

• Conventional fuels are fossil fuels
• Conventional Technology for energy conversion is combustion
• Combustion results in CO2 and other harmful emissions such as SOx and Nox depending on the fuel used

Need to find alternatives!!
Other Challenges & Opportunities in the Arctic

Challenges

- Arctic communities are sparse and at many places not connected to the grid
- Much of the population in the arctic also identified with tribal subsistence lifestyle and their cultural preservation is prioritised in all regions
- Preservation of the environment

Opportunities

- Implementation of green and sustainable technologies
- Innovative Technological developments
Energy R&D at UiT

Department of Building, Energy and material, Narvik

- Bioenergy
- Hydrogen
- Energy storage system
- Wind Energy

Other departments at UiT

- Solar, Sea-algae
- Hybrid systems
- Micro grids & smart grids
Green and Sustainable Energy-1

Renewable energy generation
Possibilities in the Arctic for Power generation

Wind Energy:

- Arctic climate has huge potential for wind and many activities are underway
- There are number of arctic related issue needs to be addressed thus offer potential for further research

Solar

- Electricity generation in the unexploited arctic region
- For research potential cold climate issues; measurement and predictions.
Measured Irradiation (kWh/m²) at Pitea, Sweden. As seen in the arctic there is a potential for solar energy also as it is not dependent on latitude.
Possibilities in the Arctic for transport sector

Biofuels from waste or biomass: By biological or thermochemical conversion of biomass to produce biogas, bio diesel (which can be used in conventional vehicles without much adjustments or hydrogen)

Electric vehicles

Hydrogen (fuel cell vehicles)
Renewables hybrid energy systems

Due to intermittent nature of energy from solar, wind and wave it is essential that the excess energy is either put back to the grid or other energy storage options sought.

However for new installations the micro sytsems can be explored to fulfil energy needs for the small sparse communities.

Hybrid energy systems (combining wind, solar and storgae)

Particularlry for transportation needs like electric and FC vehicles appropriate strorage solutions are selected and integrated within hybrid systems.

E.g. fuel cell cars will also require hydrogen supply network
Hydrogen supply evolution studied by NorWays

The organic growth of early user centres (Oslo, Grenland, Bergen, Trondheim, Stavanger) towards their surroundings can be seen due to higher population density in these areas) Further deployment of new regions (Tromsø, coastal regions).

From 2040 the whole area is supplied

There is potential to establish projects for hydrogen supply and refueling stations in the north

Not only cars but other vehicles can use hydrogen like snowmobiles
Some recent research example
# Fuel Cell & Hydrogen Technologies

- PEM fuel cell design, material and manufacturing issues
- Control system for fuel cell for dynamic demand for different applications
- Fuel cell testing and characterisation
- Hydrogen economy: technical and financial implications
- Collaboration with Hydrogen Norway, Glomfjord hydrogen project
An example: Hydrogen refueling station 150m north of the polar circle at the Arctic driving Centre in Finland, by H2Logic A/S operated by Oy Woikoski Ab
Other form of Renewable energy in the arctic

Wind Energy:
• project relating to performance of wind turbines in very cold conditions; icing issue and mitigation strategies; wind turbine siting problem in hilly terrain.

Bioenergy:
• Logistic and planning of waste management strategies, biological, thermochemical treatment of waste.

Current projects:
• Studying the reaction kinetics of gasification of different stocks and optimisation for maximum yield

Design characteristics for Micro CHP and integration with FC, Smart grids for
Sustainable and Green Energy

Adapting and implementing technologies for the arctic conditions research and developing new technologies are essential to meet the changing energy demand in the arctic and to preserve the environment and cultural heritage.
At UiT we look for partners to collaborate in

- Power generation from renewable sources such as Hydro, Wind, Solar
- Bioenergy: various waste and biomass
- Energy storage and Utilisation
- Small grids, batteries, hydrogen production & storage and supply
- Small bio CHP
- Fuel cell: design, material and manufacturing issues for transport and small CHP plants
Reasonable man adjusts to the environment but unreasonable man changes the environment to suit himself

-Bernard Shaw