

# High Arctic renewable energy: Svalbard as a showcase

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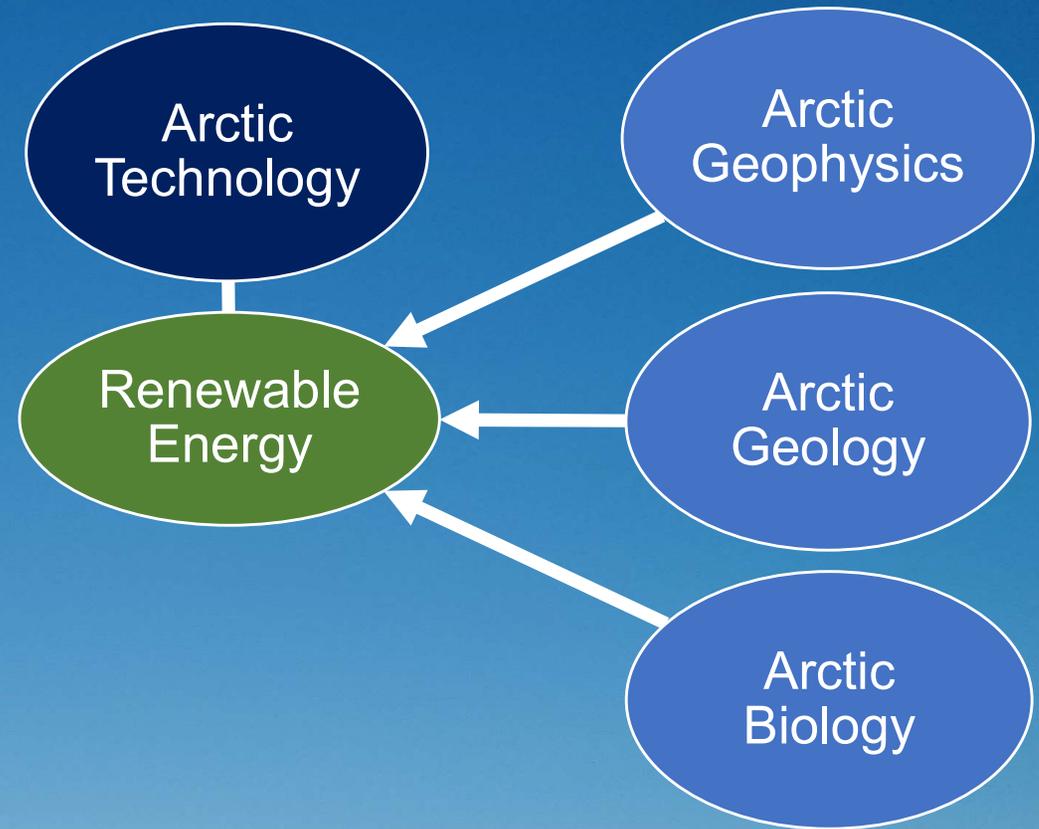
*Matthias Henkies, Arthur Garreau, Jules Boulard (UNIS)*  
*and*  
*Mons Ole Sellevold (Store Norske Energi)*



# The University Centre in Svalbard (UNIS)



- Ca 60 scientific staff (including Ph.D. students)
- Ca 750 students from 45 different countries
- Year-round presence in the High Arctic



# Change in Longyearbyen; From coal to renewable energy

- Coal as an energy source since 1910, ended 19 October 2023
- Now running on diesel
- Gradual transition to renewable energy
- 1,500 other Arctic off-grid societies



# Why do we need research on renewable energy in the High Arctic?

- Urgent solutions needed
- Proven solutions specific for the High Arctic do not exist
- Tested elsewhere does not necessarily mean it will work in all of the Arctic
- Errors are expensive: for example, supply failure, economy and nature



# What research do we need on renewable energy in the High Arctic?

- Understand the Arctic environment
- Test technology
- Adapt technology
- Implement technology

*Local knowledge is the key*



# UNIS research focus

*Wind energy*

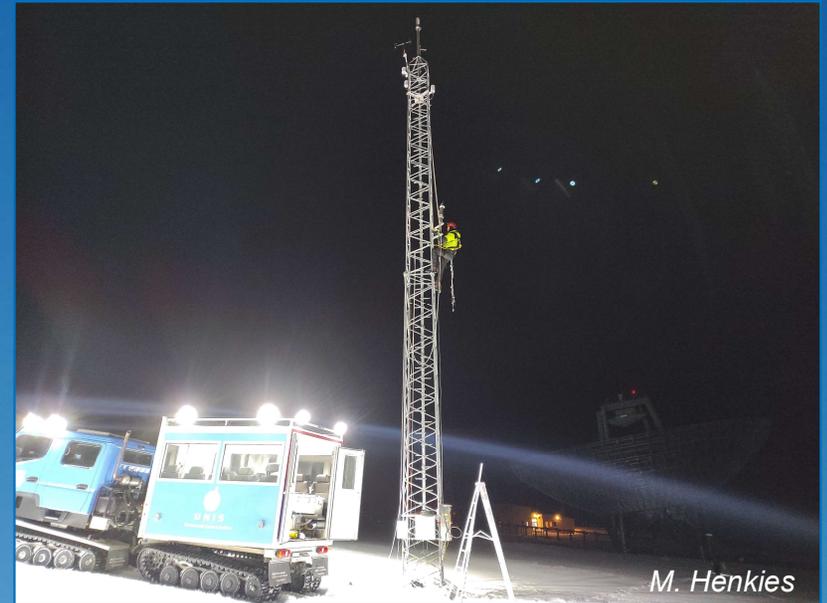
*Solar energy*

*Geothermal energy*



# Specific weather for the High Arctic

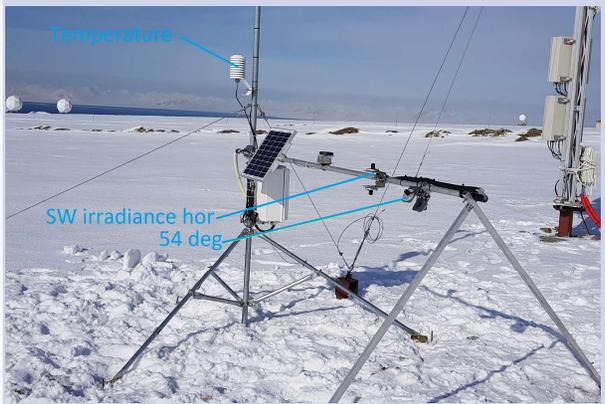
- Very local weather
- Less is known about High Arctic weather
- Long periods with polar night / midnight sun
- Snow drift / icing
- Weather models and forecasts are more uncertain than at lower latitudes



# Adapting solar energy technologies for use in the Arctic



Arthur Garreau,  
Ph.D. candidate

Solar irradiance evaluation	Solar PV potential assessment	Understanding and adapting solar PV for Svalbard and Arctic conditions – Isfjord Radio case
<p>Measurements solar irradiance around Longyearbyen (Paper in preparation)</p>	<p>Evaluating solar PV potential in the High-Arctic setting</p>	<p>Tests at a larger scale to evaluate panel responses to the Arctic's severe weather, including snowdrifts, icing, and wind</p>
		



# Mapping, utilization and forecasting of renewable energy in the Arctic

Weather stations



Credit: Matthias Henkies

Copernicus Arctic Regional Reanalysis



INTERGOVERNMENTAL PANEL ON climate change

**Paper 1:  
Mapping  
Renewable  
Energy  
Potential**

Climate  
models

Different  
emission  
scenarios

**Paper 2:  
Future evolution of  
Arctic's renewable  
energy potential**



Jules Boulard  
PhD Candidate

Webcam or sky camera



Credit: Borealis Panorama 360

Cloud observations

Weather stations

High  
frequency  
variability  
of solar  
radiation

AI model

**Paper 3:  
Very short-term  
solar energy  
forecasting**



# Wind climate of High Arctic complex terrain applied to renewable energy



**Matthias Henkies**

PhD candidate in:

*Wind Climate*



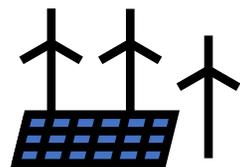
*of High-Arctic*

*Complex Terrain*



*Applied to*

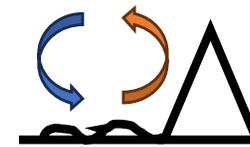
*Renewable Energy*



A. Garreau

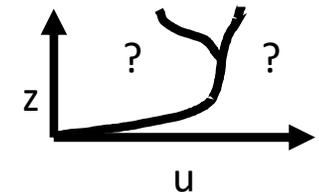
## Current research topics:

- Thermally-driven winds

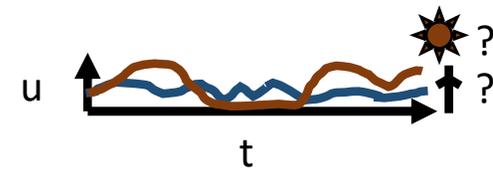


Henkies et al. 2023:  
*The Arctic Fjord Breeze*  
...  
(Bound. Layer Met.)

- Wind profiles



- Low-wind periods



- Snowdrift



M. Henkies



## World's northernmost ground mounted PV park Isfjord Radio, Svalbard

- 6 rows, 10 m spacing, south facing, 45° tilt
- Installed capacity: 198 kWp (360 panels x 550 Wp)
- Annual production: 168 000 kWh (849 kWh/kWp)
- Construction: 2023
- Owner and operator: Store Norske Energi AS



Photo: A. Garreau, UNIS



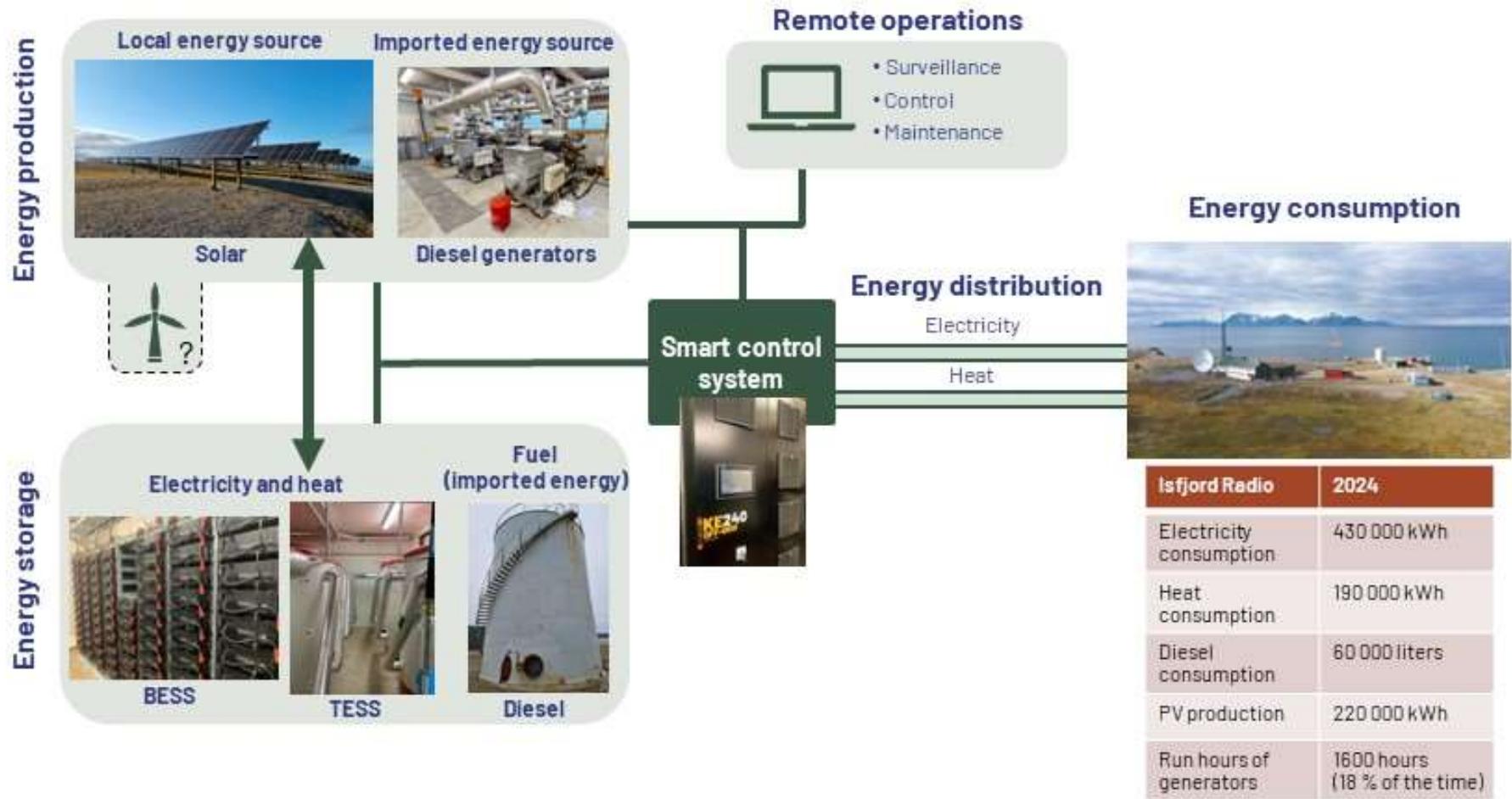
Photo: M. O. Sellevold, Store Norske Energi



Photo: M. O. Sellevold, Store Norske Energi

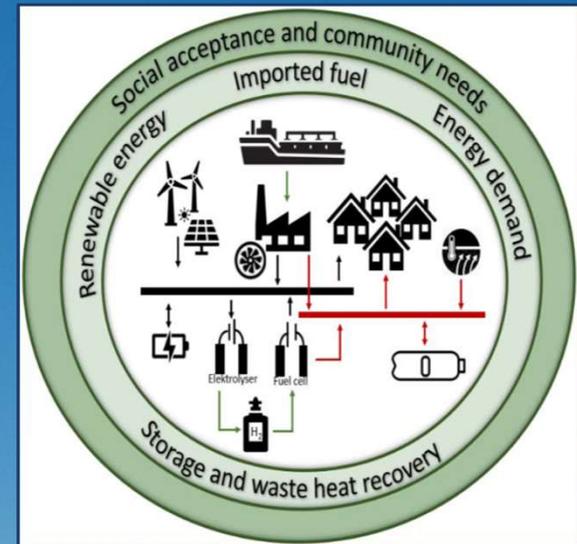


## Off-grid hybrid energy system at Isfjord Radio, Svalbard



# Zero Emission Energy Systems for the Arctic (ZEESA) 2023-2026, RCN + Industry, Ca 20 MNOK

- Thermal-electric integrated energy systems
- Combining meteorological models with field studies
- Investment and design analysis
- Norwegian industry players



<https://www.sintef.no/en/projects/2023/zeesa-zero-emission-energy-systems-for-the-arctic/>



# Future plans of UNIS

- Arctic energy research and test centre
- Co-operation with industry: If solutions work in Svalbard, they can be exported to the whole Arctic, “Tested in Svalbard”
- New courses in cold climate renewable energy (M.Sc. and Ph.D.) from autumn 2024
  - AE-341: Sustainable Arctic Energy Exploration and Development
  - AE-342: Arctic Energy Meteorology
  - AE-343: Arctic Renewable Energy Infrastructure: Construction and Operation



*Svalbard as a showcase for renewable energy and a sustainable society*

Norwegian Prime Minister Jonas Gahr Støre (2023):

*“The first pillar of Norway’s Arctic policy is the green transition, absolutely key. I see this as an opportunity, a game changer, we are moving from the age of petroleum production to renewable energy production. A lot of that will happen in the north”*

