IPS Connect
2022

GREENLAND Heat Recovery

Niels Erik Hagelqvist
MSc. Civil Engineer – Energy and Technical Installations
Technical Special Advisor Renewable Energy

Cordova, July 26-29, 2022

NUKISSIORFIIT

Outline of the presentation

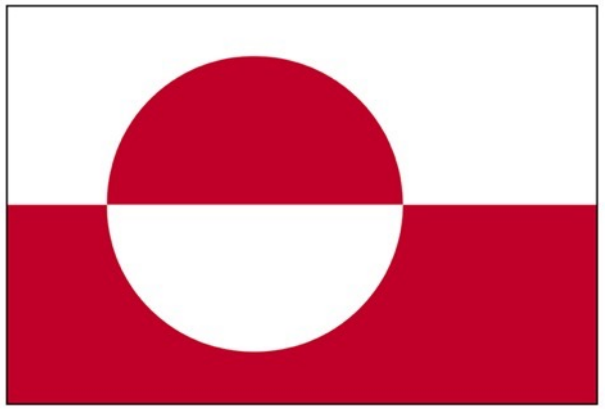
- Organisation
- Supply in general
- Nukissiorfiit’s energy supply versus Greenland's total energy consumption
- Supply of Heat
- Heat Recovery
- Advantage and Challenges with heat recovery
- Technical solutions for heat recovery
- What does the implementation of renewable energy mean for heat recovery
- Hybrid plant in Eqalugaarsuit

Organization

Nukissiorfiit

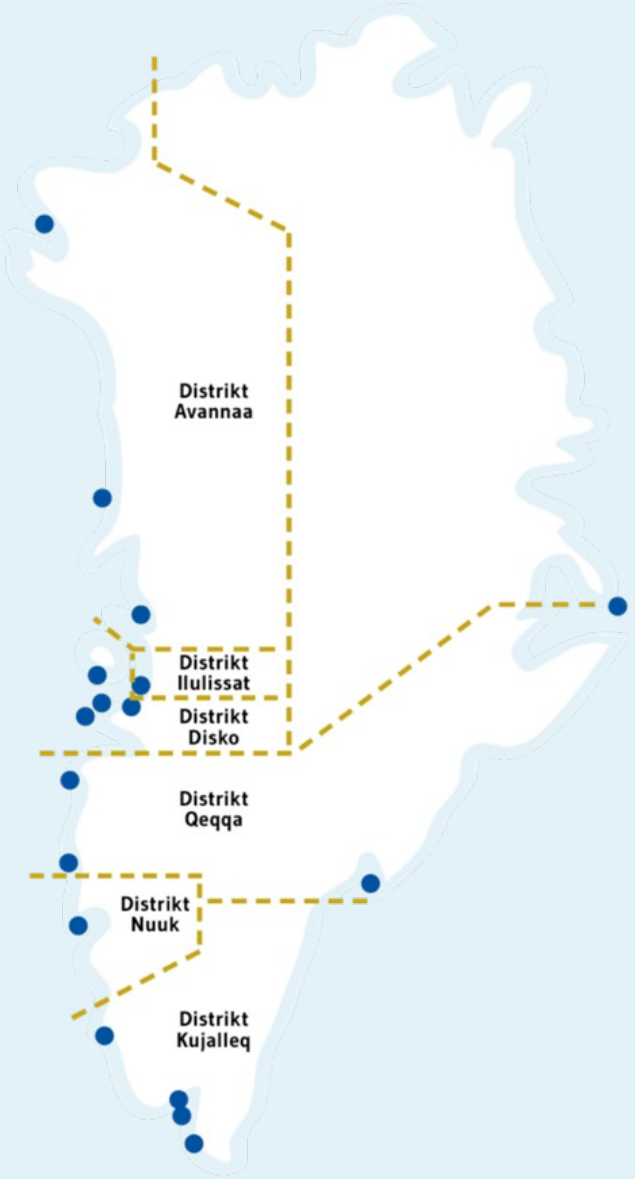
- A Utility Company that produce and supplies electricity, water and some places heat to the consumers
- We are 100% owned by the Government of Greenland, and we are referring to the Ministry of Agriculture, Self-Sufficiency, Energy and Environment
- We are responsible for the supply of approx. 20.000 customers
- We have to supply 17 towns and 51 settlements with electricity, water and some places heat

Supply in general



- Greenland is the world’s biggest island
- Greenland is still a part of the Kingdom of Denmark
- Greenland have now Self-Government
- Greenland is divided into 68 small “Islands”
- Greenland have 68 Isolated Grids and Power Systems

Supply in general



Nukissiorfiit

Head Office i Nuuk

6 districts:

District Kujalleq

District Nuuk

District Qeqqa

District Disko

District Ilulissat

District Avannaa

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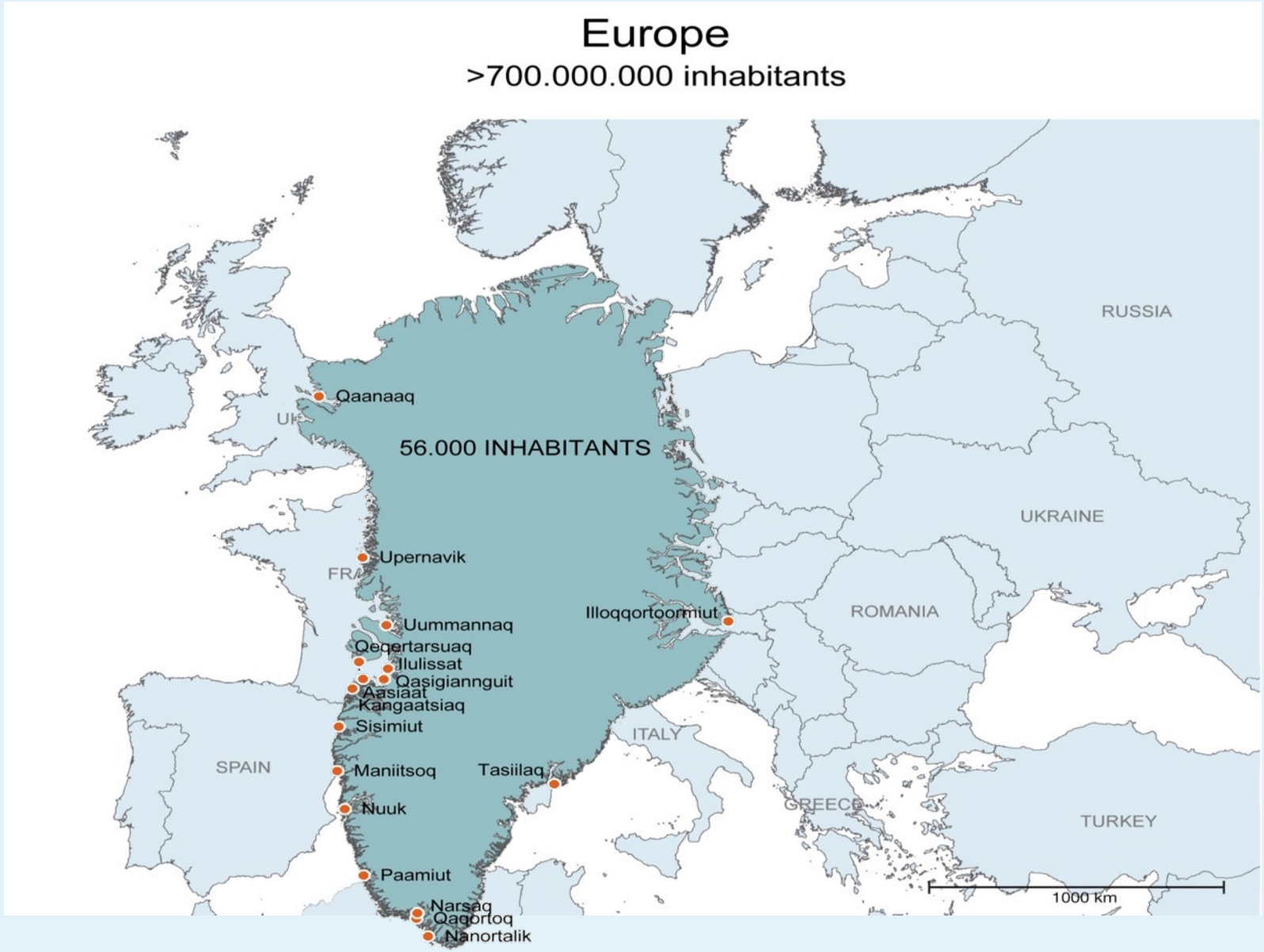
Supply in general



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Supply in general

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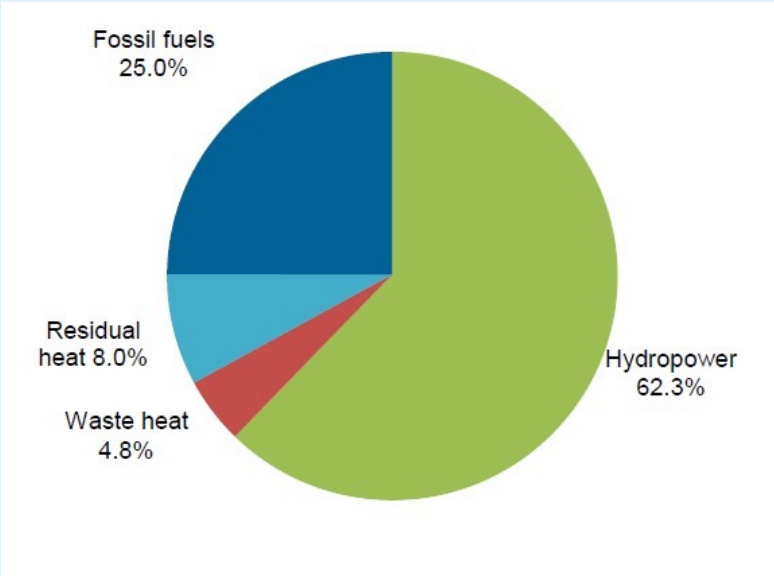
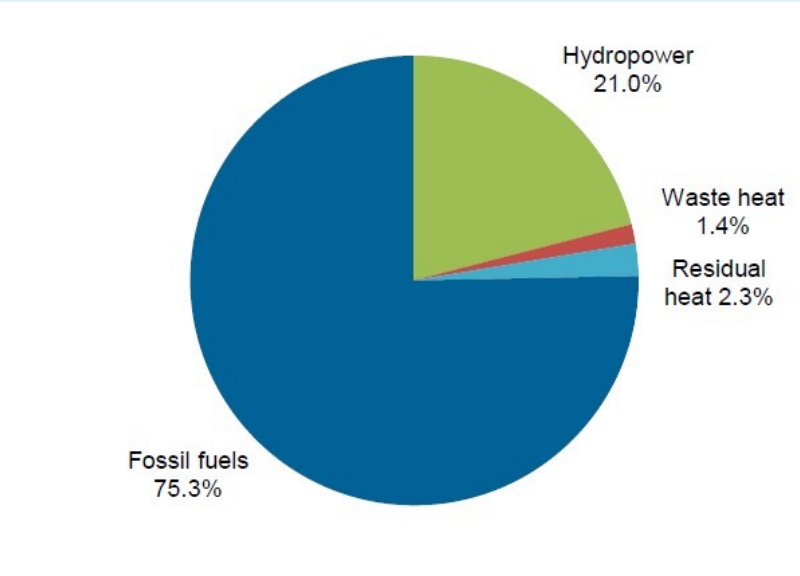
Nukissiorfiit’s energy supply versus Greenland's total energy consumption



Public energy supply:

Nukissiorfiit’s sales of electricity and heat

broken down by energy source



Public and private energy consumption:

Total energy for Greenland's total consumption for electricity and heat broken down by energy source

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Supply of Heat

- Nukissiorfiit supplies heat in 16 towns
- District heating from both diesel-fired and Hydro Power plants
- Direct electric heating from Hydro Power plants
- Electric boilers with diesel-fired boilers as backup in Hydro Power towns
- Residual heat / recovered head from diesel-fired power plants
- Interruptible electric heat in some Hydro Power towns

Where comes the residual heat from?

- Diesel-fired electricity production
- The electrical efficiency for a diesel generator is about 40%.
- A diesel generator needs cooling and the cooling water can be used for district heating. Here we can recover another 20% of the energy
- The exhaust gas from the engine, running the diesel generator have a temperature of approx. 330 degrees celcius. Here we can recover another 30% of the energy

Conclusion

- By recovering the heat from the diesel electricity production Nukissiorfiit can achieve an energy efficiency of about 90 percent. This means approx. 50 percent of the energy can be recovered as heat.

Heat Recovery

Nukissiorfiit sells recovered heat for USD 100,- per MWh

Nukissiorfiit sells recovered heat in the following 10 diesel fired towns:

Nanortalik

Qaqortoq

Paamiut

Maniitsoq

Ittoqqortoormiit

Aasiaat

Qasigiannguit

Uummannaq

Upernavik

Qaanaaq

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Heat Recovery

- Nukissiorfiit have to supply all towns and settlements in Greenland, in total 68 locations.
- 6 towns are fully or partially supplied from Hydro Power. This means Nukissiorfiit still have 60 diesel fired location where we have residual heat.
- Nukissiorfiit only have heat recovering in 10 towns!
- What about the remaining 50 locations?
- Why do we not have heat recovery in all the locations?

Challenges with heat recovery

- Lack of customers
- Lack of bigger buildings that needs heating
- Long distances between the buildings
- High construction costs for district heating:

  One meter of district heating pipes costs USD 2.700,-
- Some municipalities require the pipes buried, which means blasting:

  One cubic meter of blasted rock costs USD 1.000,-
- Very cheap fuel prices:

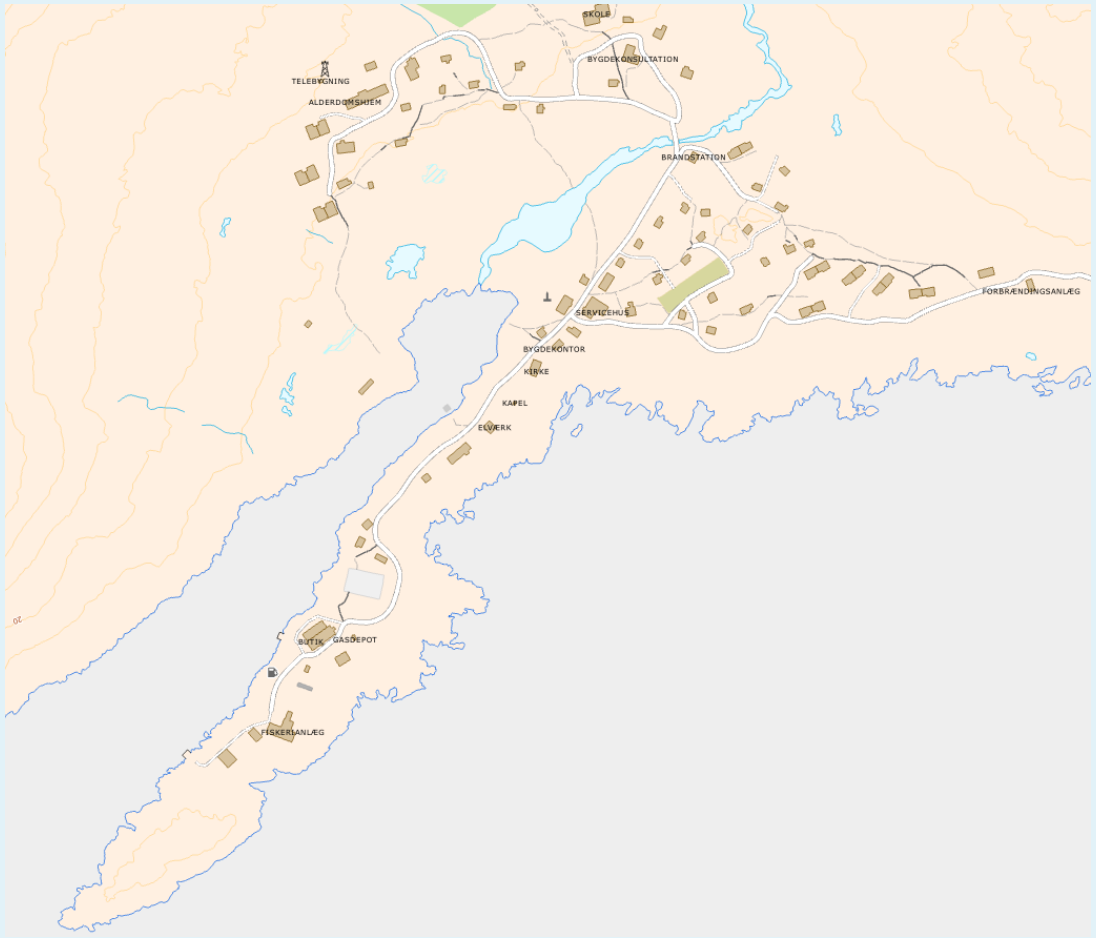
  One liter of petrol/gasoline costs USD 0,62

  One liter of diesel costs USD 0,64

Advantage and Challenges with heat recovery

Paamiut

Eqalugaarsuit



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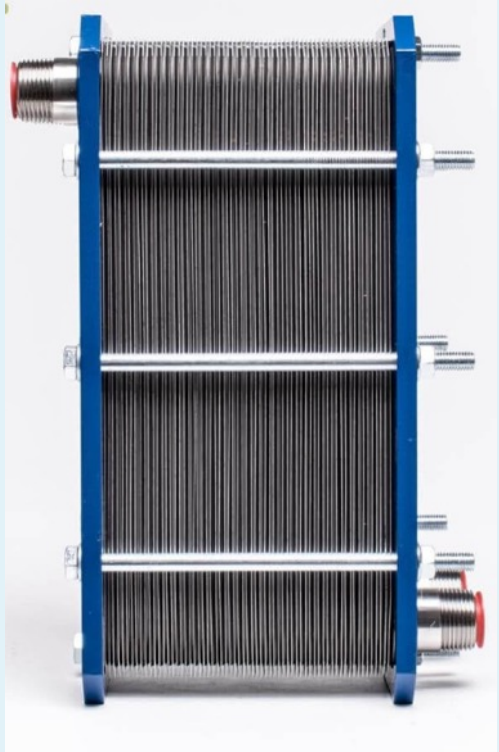
Heat Recovery from waste incineration

- Why is this option not mentioned before?
- The answer is that waste incineration in Greenland is operated and owned by the municipalities – Not by Nukissiorfiit.
- A few years ago, the Greenlandic municipalities entered into an agreement to centralize waste incineration. It was decided to build two new waste incinerators, one in Sisimiut and one in Nuuk.
- The waste incinerator in Nuuk is expected to be completed in 2023 and the waste incinerator in Sisimiut is expected to be completed in 2024.
- All waste from Greenland will be shipped to Sisimiut and Nuuk.
- In 2020, Nukissiorfiit entered into a cooperation agreement with the Greenlandic municipalities to buy as much as possible of the energy from the two waste incinerators when they are completed.

Technical solutions for heat recovery

Heat recovering from cooling water



Technical solutions for heat recovery

Heat recovering from exhaust gas

What does the implementation of renewable energy mean for heat recovery

- Installing solar and wind energy with a battery storage means fewer operating hours for the diesel generator sets
- Fewer operating hours means less or no residual heat
- The diesel generator sets in the best hybrid systems only run 2 hours daily during the summer and that’s only for keeping the engine warm and for recharging the standstill heating circuit. The battery storages have still power.
- Many places in Greenland have a heating demand also in the summer. If Nukissiorfiit can’t deliver heat in the summer, the customer needs to have a back up heating system and who is going to pay for this?

Hybrid plant in Eqalugaarsuit

Solar panels 68 kWp – Wind turbine 6 kW - Battery Energy Storage 167 kWh -
Two 64 kW diesel generator sets

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Hybrid plant in Eqalugaarsuit

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Hybrid plant in Eqalugaarsuit

Solar panels 68 kWp – Wind turbine 6 kW - Battery Energy Storage 167 kWh -
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Heat Exchanger

Heat Exchanger

Standstill heating circuit

Heat Recovery