

# Energy use and indoor environment in new and existing dwellings in arctic climates

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## Agenda

- Background
- Project content
- Expected results

## Background · Project content · Results

- Energy consumption of Greenlandic dwellings is very high over 400 kWh/(m<sup>2</sup>·yr)
  - Extreme weather conditions
  - Poor insulation
  - Leaky constructions
  - User behaviour
- Poor IAQ which affects occupant's health
  - Moisture related problems (moulds, fungi)
  - Cold draft
  - High CO<sub>2</sub> concentration
  - Tobacco smoke

## Background · Project content · Results

- To decrease the energy consumption and thus CO<sub>2</sub> emissions the existing dwellings need to be renovated.
  - Tightening the constructions
  - Increasing the insulation thickness
  - Changing the windows
  - Controlled ventilation with heat recovery
- The good IAQ must be ensured.
- The advanced low energy technologies may not be suitable for the Arctic.
  - Extreme climate (freezing problems of the heat exchangers)
  - Maintenance (need for special parts, tools, skills)

## Challenge

To provide the inhabitants with good and energy efficient IAQ

To apply low energy technologies in the Arctic

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Background · **Project content** · Results

- The purpose of the project is to investigate:
  - The energy consumption
  - Indoor air quality
  - User behaviour
- Old dwellings
  - To investigate the ways in which the conditions can be improved by renovation.
- New dwellings
  - To determine which technologies, well known from more moderate climates, can be used in the Arctic climate.

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Background · **Project content** · Results

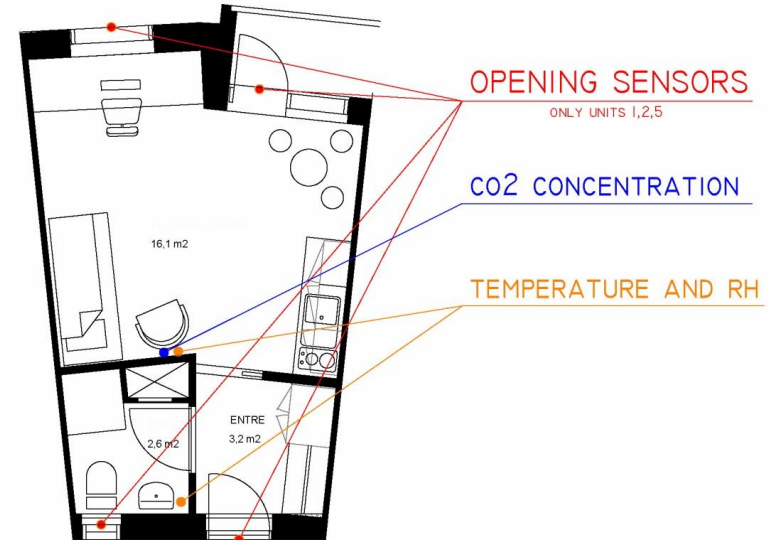
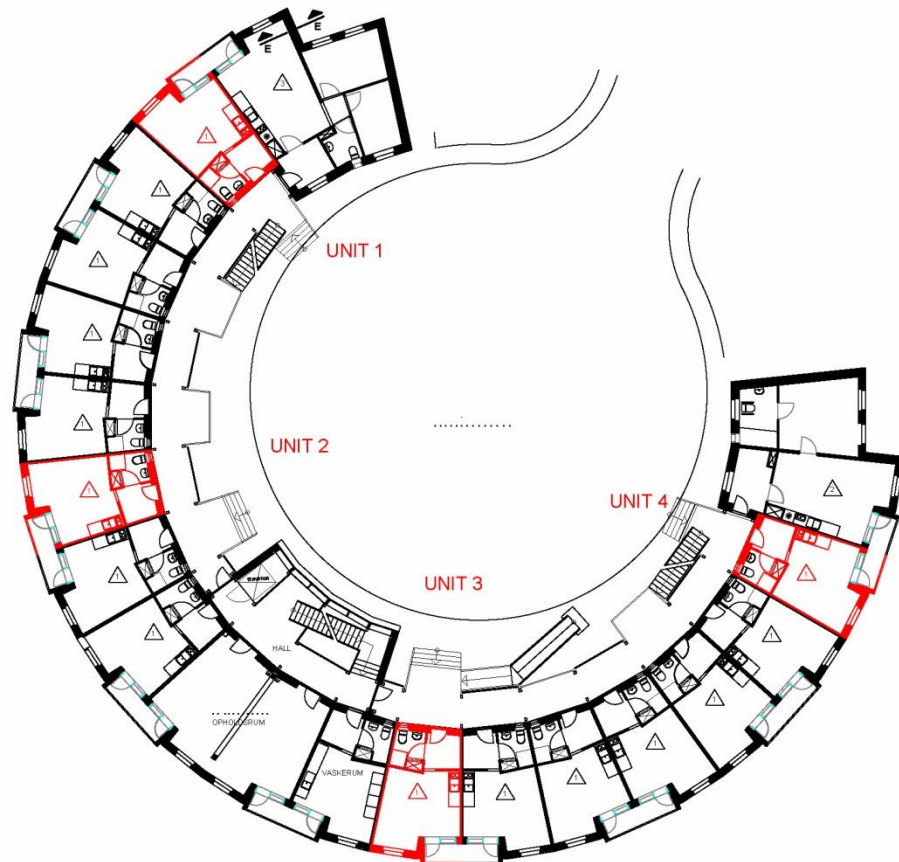


## Apisseq

- Brand new Engineering dormitory in Sisimiut
  - 1.414 m<sup>2</sup> heated area
  - 40 students mostly in single units
  - $U_{\text{constructions}} = 0,13-0,15$  (W/m<sup>2</sup>·K)
  - $U_{\text{windows}} = 1,8$  (W/m<sup>2</sup>·K)
- Technologies uncommon in Greenland
  - Ventilation with high efficient heat recovery
  - Hydronic floor heating
  - Tubular solar collectors (38 panels x 12 tubes)
- Advanced monitoring system

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Background · **Project content** · Results



## • MONITORED VALUES

- Temperature and RH
- CO<sub>2</sub> concentration
- Doors / windows opening
- Energy consumption (11 energy meters)
- Sunshine pyranometer
- Electricity consumption
- Heat exchangers

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Background · **Project content** · Results · Collaboration

- Cross-sectional questionnaire
  - Over entire Sisimiut
    - App 10% of entire Greenland
  - It would give us a great overview of dwellings and their inhabitants
    - Health problems related to buildings
    - Energy consumption
    - Moisture related problems
    - Smoking
    - Behaviour
    - Habits
  - The study might be extended also to another cities

- Cross-sectional study
  - Large number of dwellings divided into four groups
    - Old type houses
    - Renovated type houses
    - Old apartments
    - Renovated apartments
  - Deep investigation and monitoring
    - IAQ, energy consumption, user behaviour
  - Analysis and renovation plan
  - Product development and testing
    - Ventilation system
  - Renovation of some of the old houses according to our suggestions and under our supervision
  - Continuation of measurements

## Uniqueness

The only project of its kind and range

The user behavior has rarely been studied at all

It is expected to:

- Provide new knowledge about optimal operation and performance of low energy technologies
- Map the IAQ, energy consumption and user behaviour
- Design a cost effective packet of solutions reducing the energy consumption and improving the IAQ
- Design effective ventilation system

**Thank you  
for your attention!**

**[www.IAQarctic.com](http://www.IAQarctic.com)**