

**UiO** • **Department of Technology Systems**  
University of Oslo

**Energy Modelling - Master Thesis at ITS - Nov2022**

# **Communication and Modelling for a Sustainability Future**

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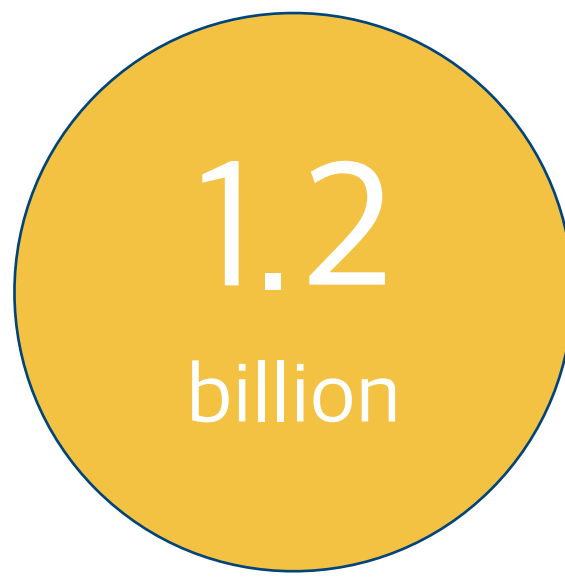
# Energy & Digital, enablers for the SDGs

7 AFFORDABLE AND CLEAN ENERGY

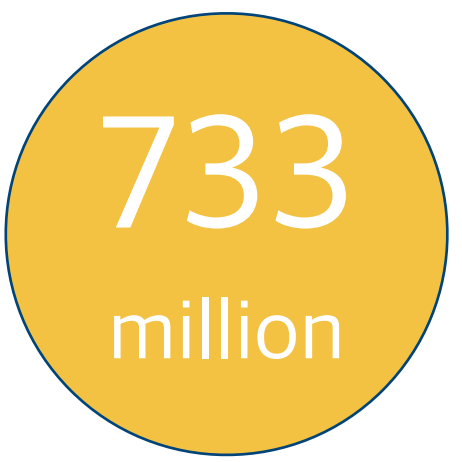


## People without electricity

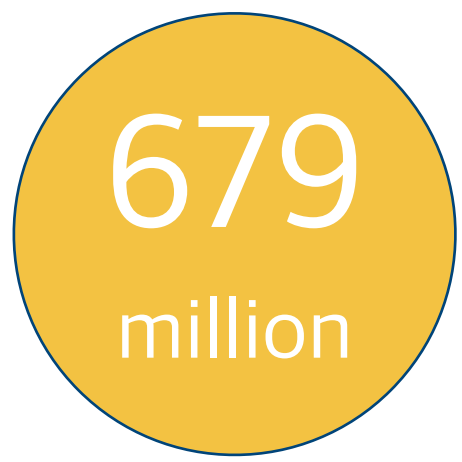
SDG 7.1 calls for universal access to ... energy by 2030



2010



2020



2030 (trend)

[WorldBank 2021]

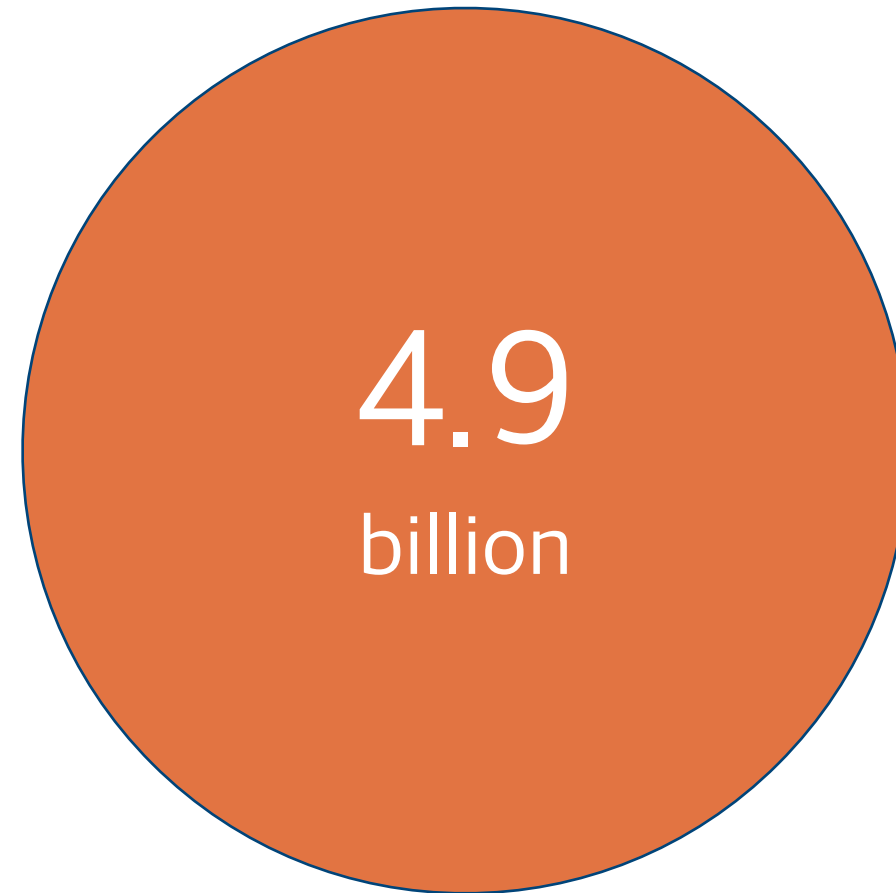
<https://www.worldbank.org/en/news/press-release/2021/06/07/report-universal-access-to-sustainable-energy-will-remain-elusive-without-addressing-inequalities>

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

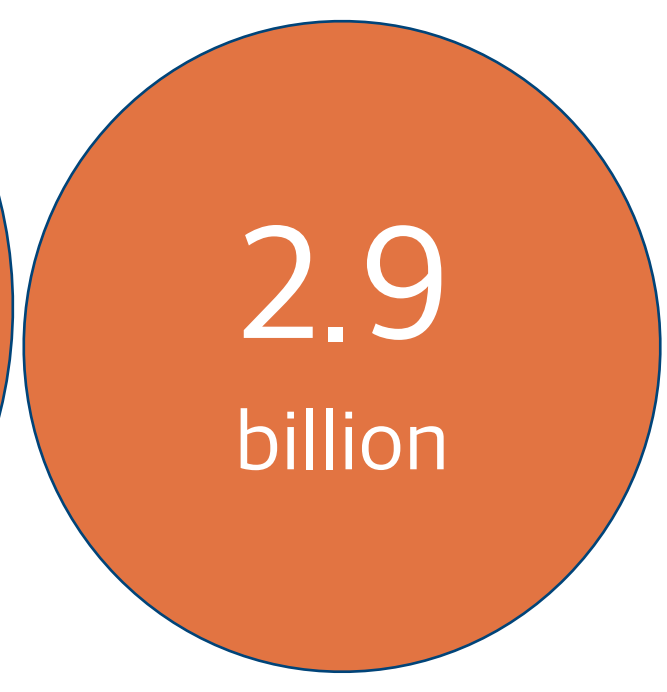


## People not using Internet

SDG 9c calls for universal, affordable internet access by 2020

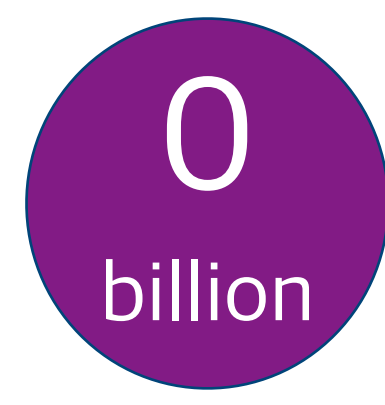


2010



2021

96% in dev countries



2030 (hope)



WSIS Forum 2022

[ITU 2010, 2021]

<https://www.itu.int/hub/2021/11/facts-and-figures-2021-2-9-billion-people-still-offline/>



# Africa "Connect The Future"



[https://  
www.mylifeelsewhere.com/  
country-size-comparison/  
tanzania/norway](https://www.mylifeelsewhere.com/country-size-comparison/tanzania/norway)

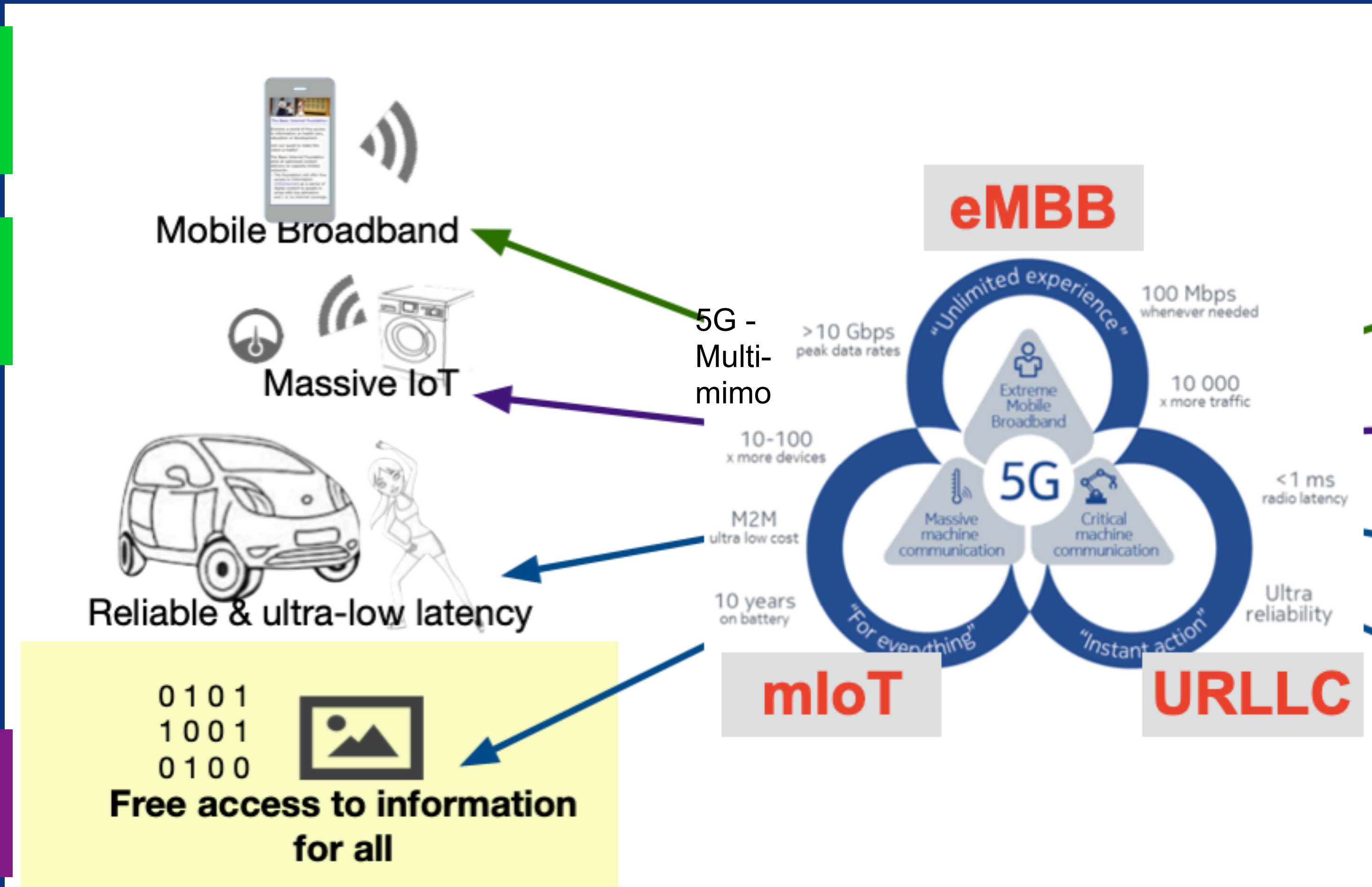


# What do we need to change?

Road model: pedestrians & cyclists

Internet: text & pictures

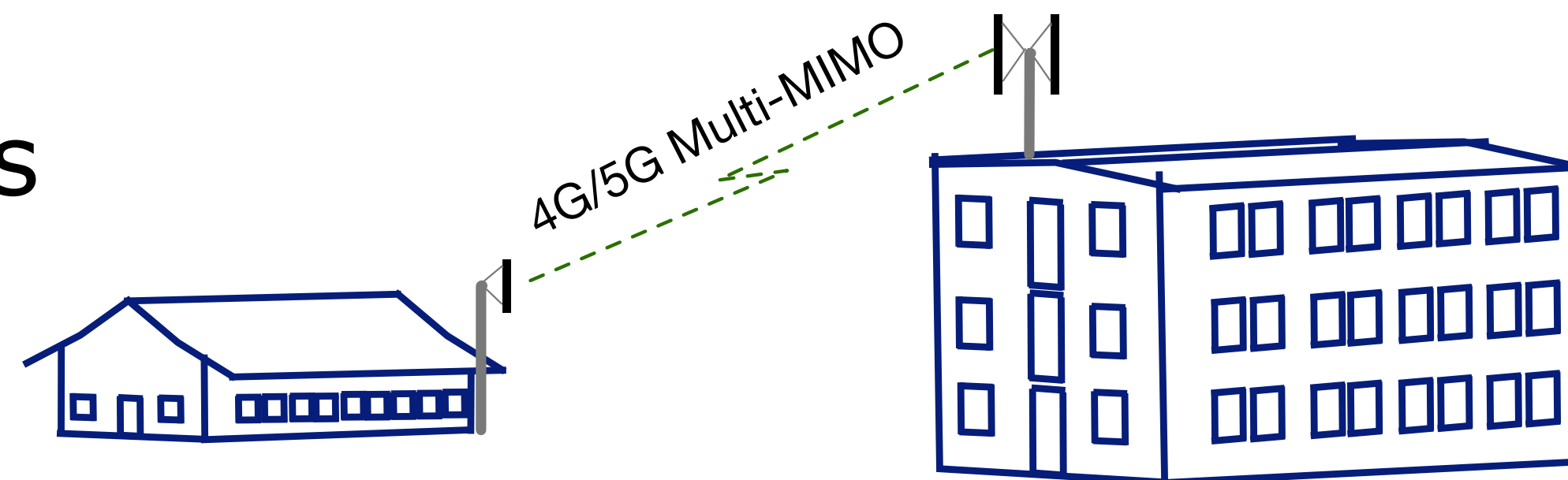
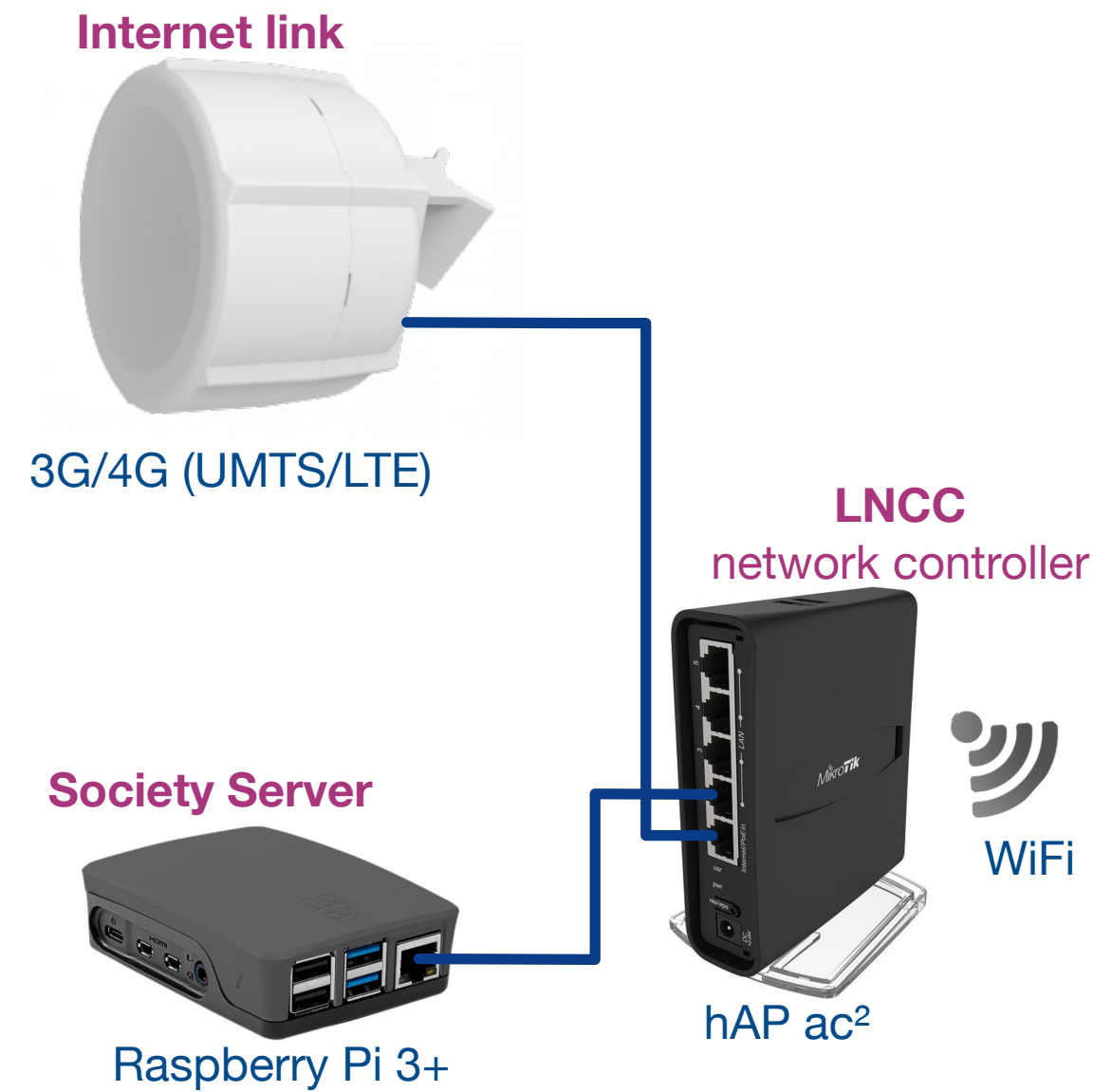
Internet Lite





# Solving the Challenge of Access

- ➔ Wireless information spot (InfoSpot)
  - Reaching out >20 km to 3G/4G network
  - Affordable solution: OPEX <20 USD/month
  
- ➔ Next: 5G access
  - University to schools





# Electrical systems

- Device level: Sensor, Mobile phone,
- Micro-grid:
  - House, Shed
  - Village-/Neighbourhood network
  - Industrial system (Power box)
- Region/country/international grid
  - Nordic Net

## Hospital – Galkayo, Somalia

Project: Hospital Size (kWp): 36,0 System: Energy Save



## Waterpump – Mwingi, Kenya

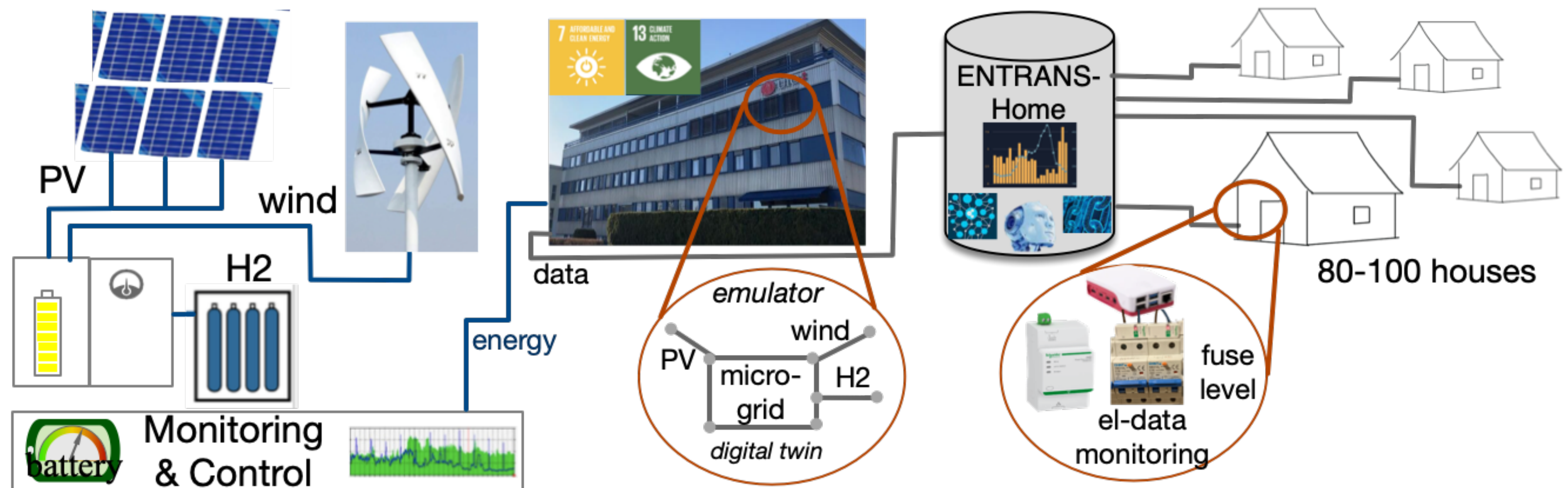
Project: Waterpump Size (kWp): 2,7 System: Off-grid





# Distributed Energy System and Security Infrastructure (DESSI)

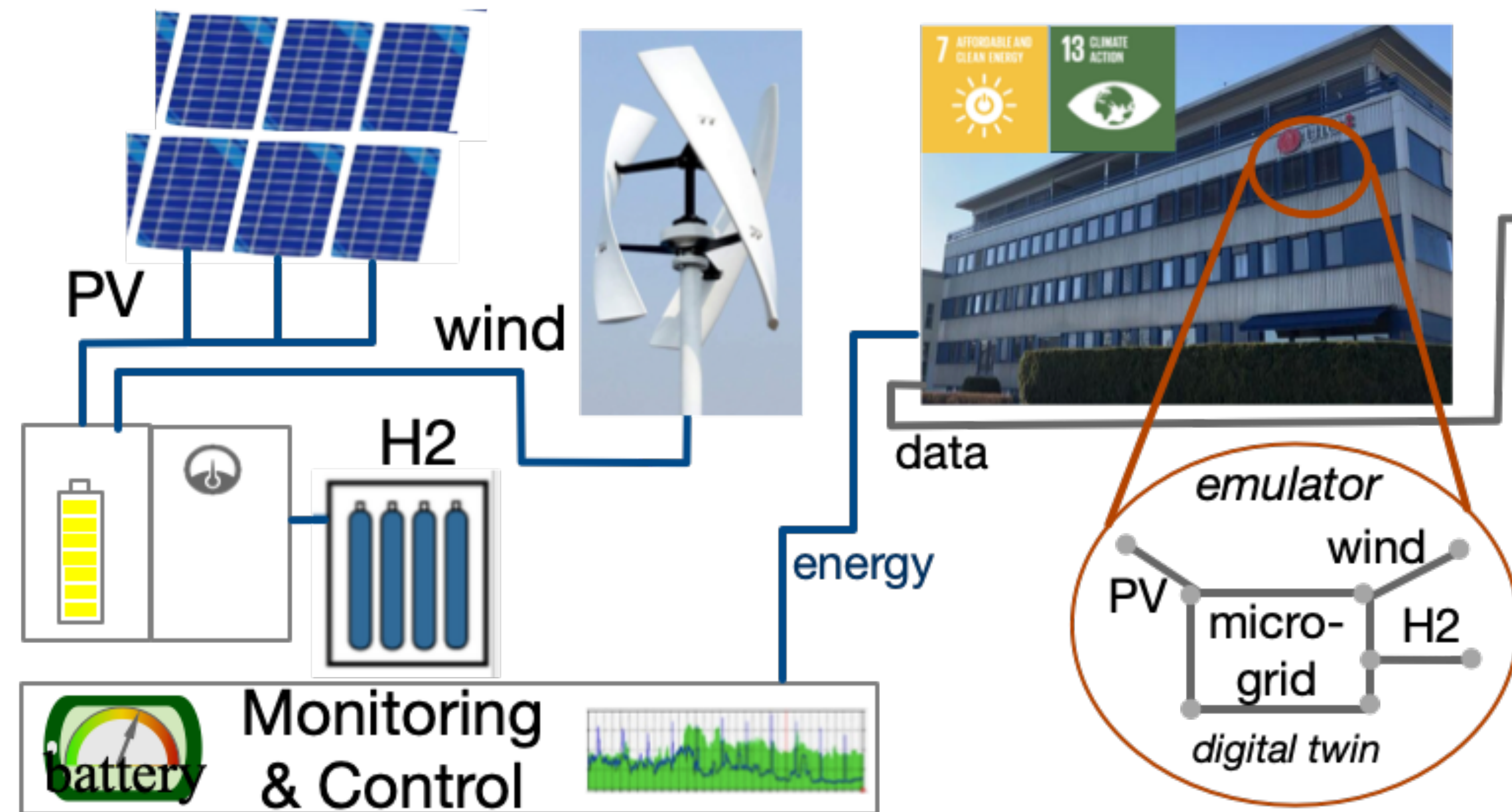
- Physical infrastructure (PV, H2, wind)
- Digital Twin (Simulator)
- ENTRANS-Home scientific database





# Physical infrastructure & Digital Twin

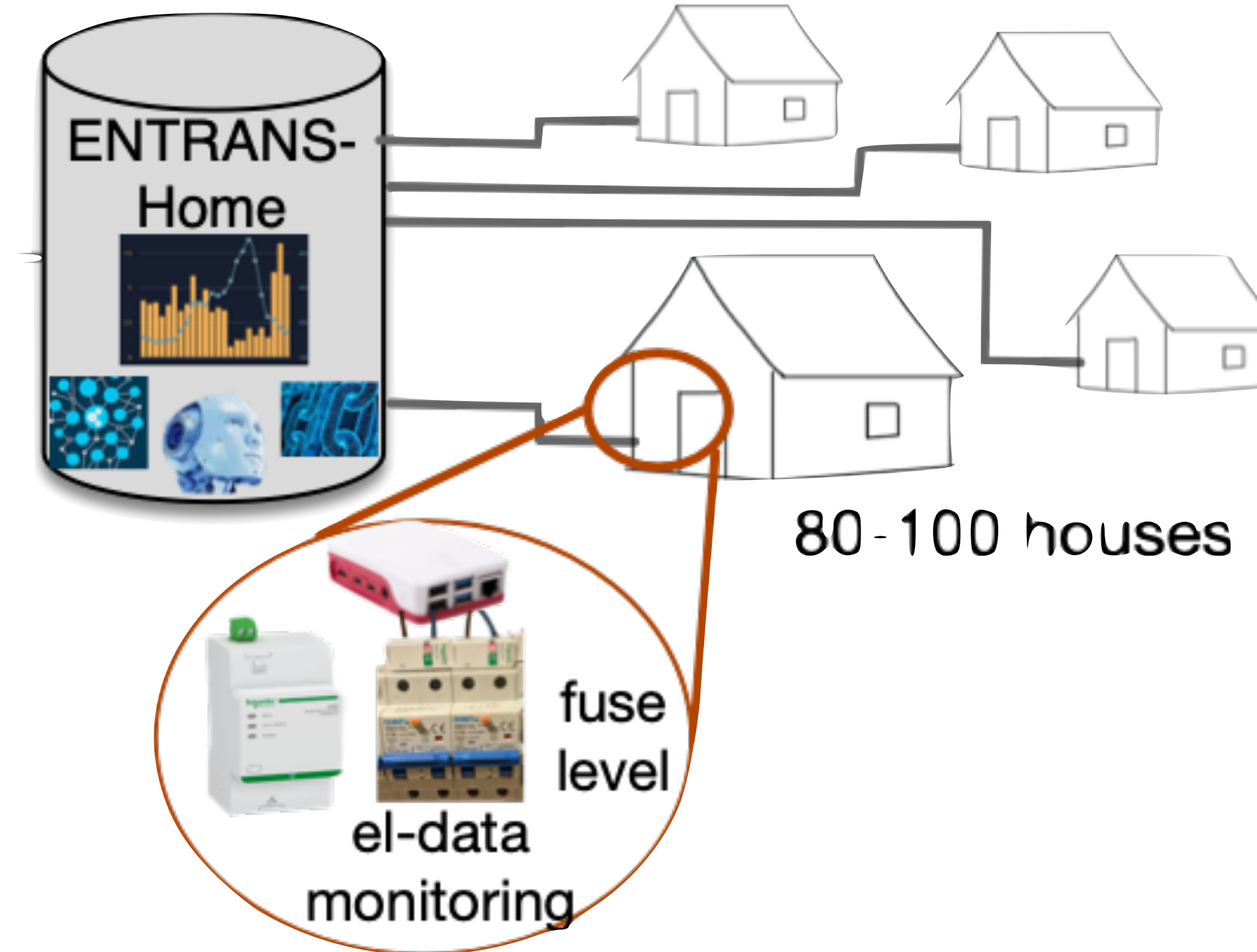
- ➔ Physical infrastructure
  - understanding real data
  - weather (effect)
- ➔ Simulator lab
  - Digital Twin
    - SFF: *Twins4Life: The Science of Digital Twins* (322299)
  - Simulate
    - Climate effect
    - daily/seasonal variations
- ➔ Outcome
  - Education & research
  - Recommendations & public





# ENTRANS-Home scientific database

- ➔ Unique Scientific database
  - high-resolutions electricity data
  - every 10 s, per fuse
  - commercial actors (tibber, homely,...)
- ➔ Outcome
  - Recruitment: VGS Oslo-Viken (Nittedal, Strømmen, Ullern,... Elektrofagdag)
  - Research:
    - privacy awareness (10 s, 1 min, **15 min, 1 h...**)
    - H2020 unique database
  - Recommendations: “*Nettleiemodell*”



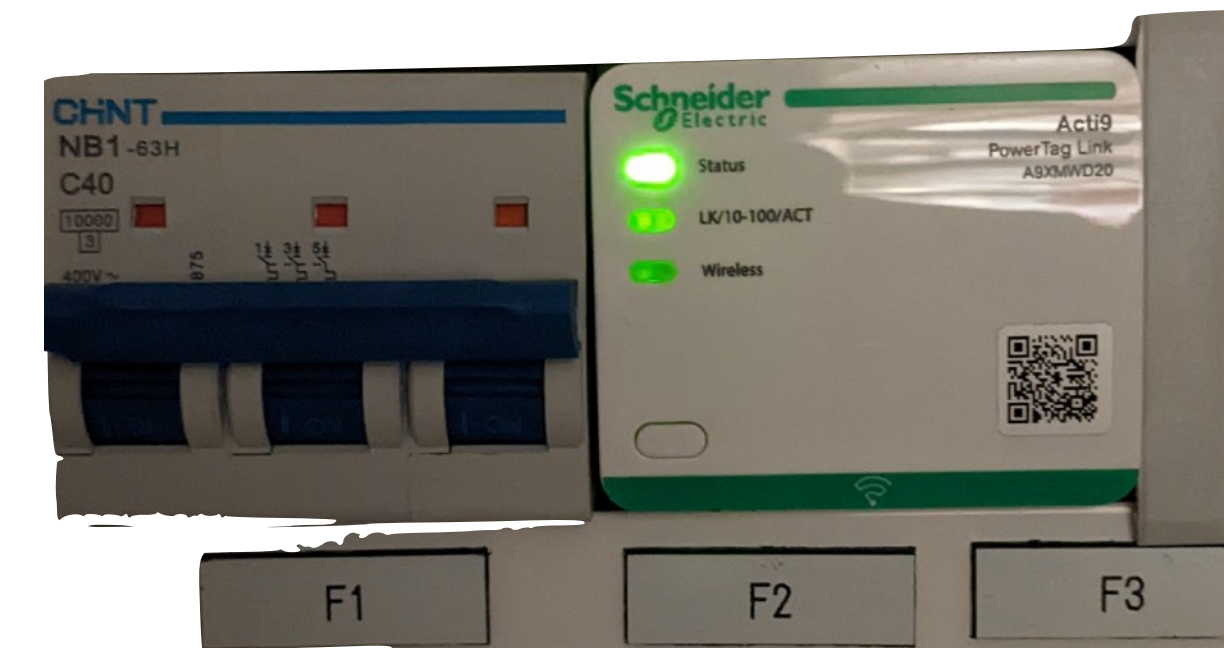
*Bruk aldri vaskemaskin, tørketrommel eller andre husholdningsapparater når du ikke er til stede eller sover.*

[Source: <https://www.elvia.no/nettleie/alt-du-ma-vite-om-ny-nettleie-for-2022/>]



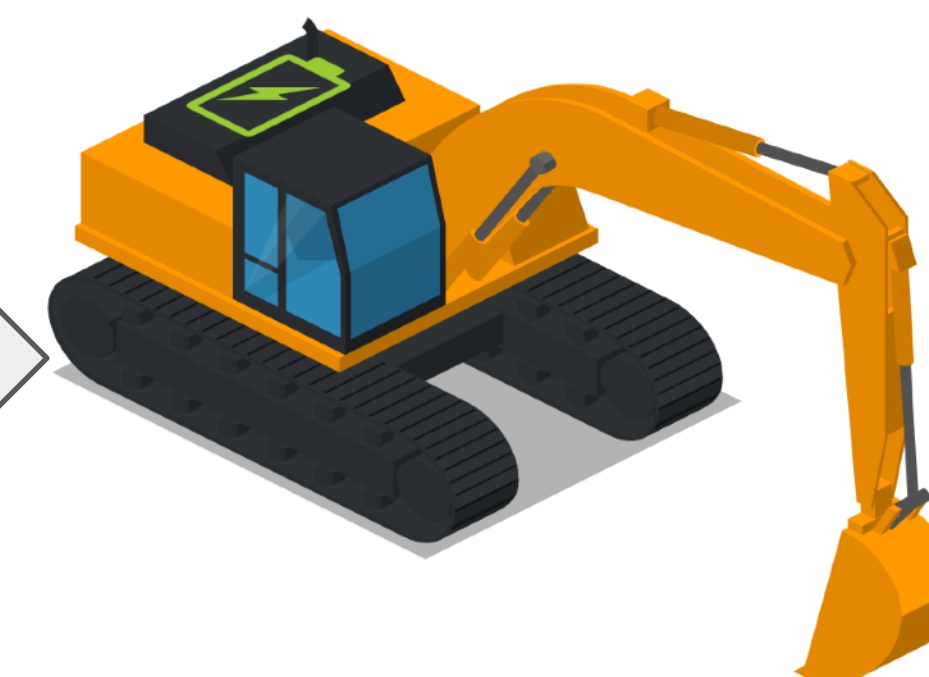
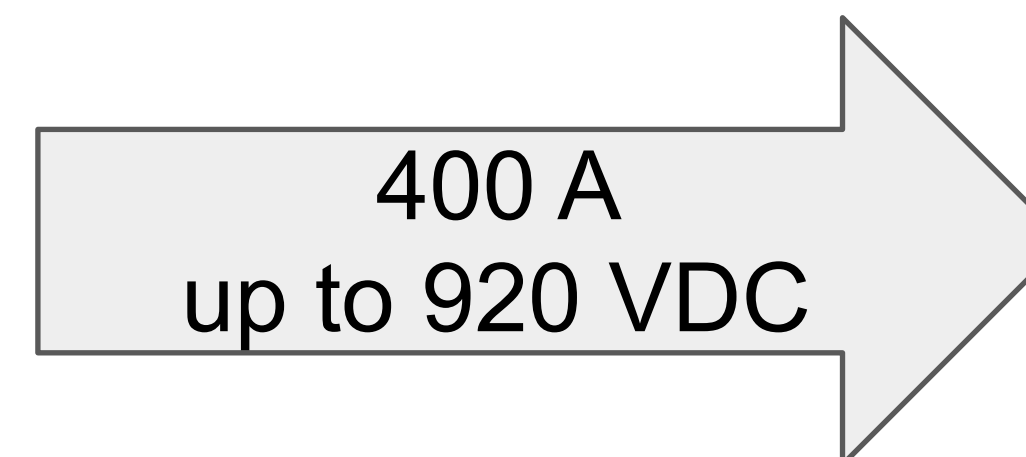
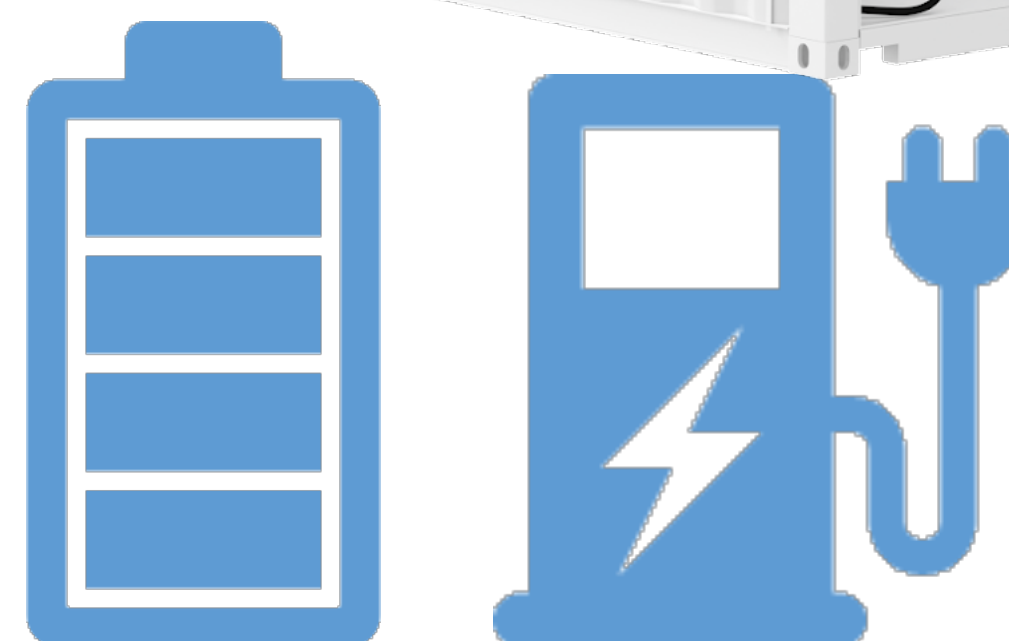
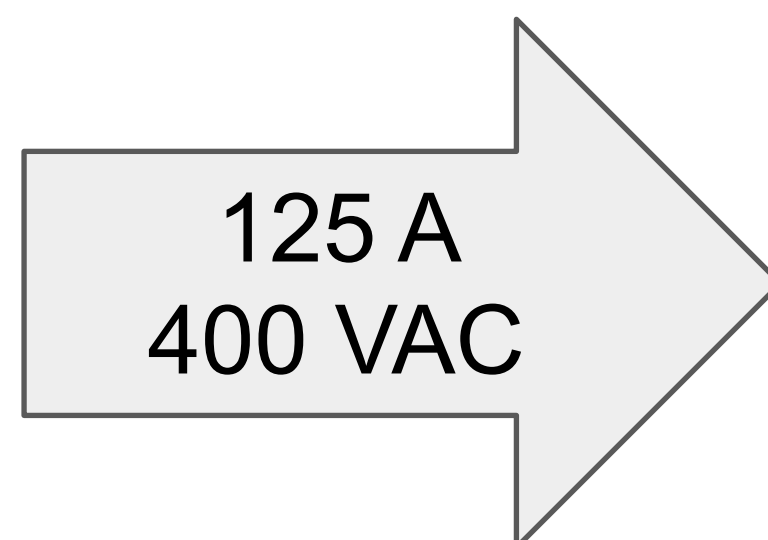
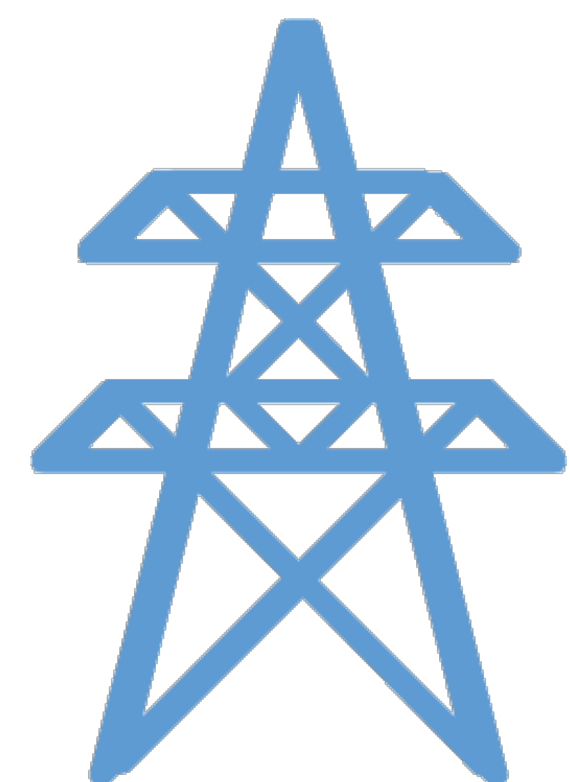
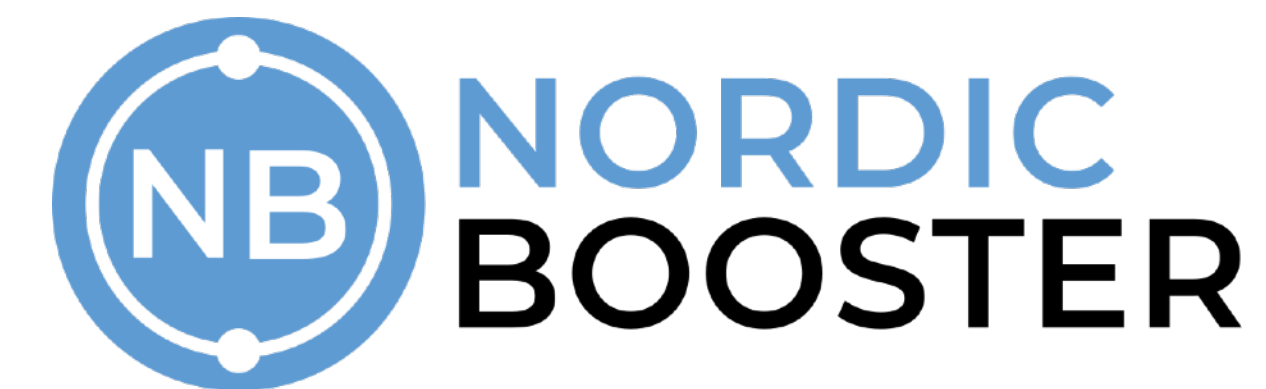
# Home infrastructure

- Grid-stabilisation
  - frequency stabilisation through battery or home demand
  - given grid demand and solar-/wind-variation
- Home monitoring & control
  - Integrated solutions using Raspberry Pi
  -





# Løsningen



No more diesel engines



Mobile and reusable solutions

[NordicBooster.com](http://NordicBooster.com)



# Topics for Project or Master Thesis

- Construction: PhD Machine Learning - optimisation - "enough energy"
  - National vehicle market: trucks and busses - "charging modules"
  - delivery, range, -> optimisation of charging infrastructure (Bama...)
    - combine with power availability (Glitre, ..., Elvia)
- Grid vs flexible energy solutions (Utsira)
- Sensor (temp, hum, ...) for energy controlling (Nordic Booster, Siemens, ABB, Schneider,...)
- Container heating (depending on usage profile and expected temperature)
- Daily, Weekly, Monthly energy storage
- Fast-frequency response market
  - mid-European countries (e.g. UK 50% wind)
  - long transmission line (DSO), due to inductance on the line (V, f drop)
  - willingness from TSO/DSO for battery to compensate



# Conclusion - Master Thesis opportunities

## Digital for Sustainable Internet Connectivity

### → Communications

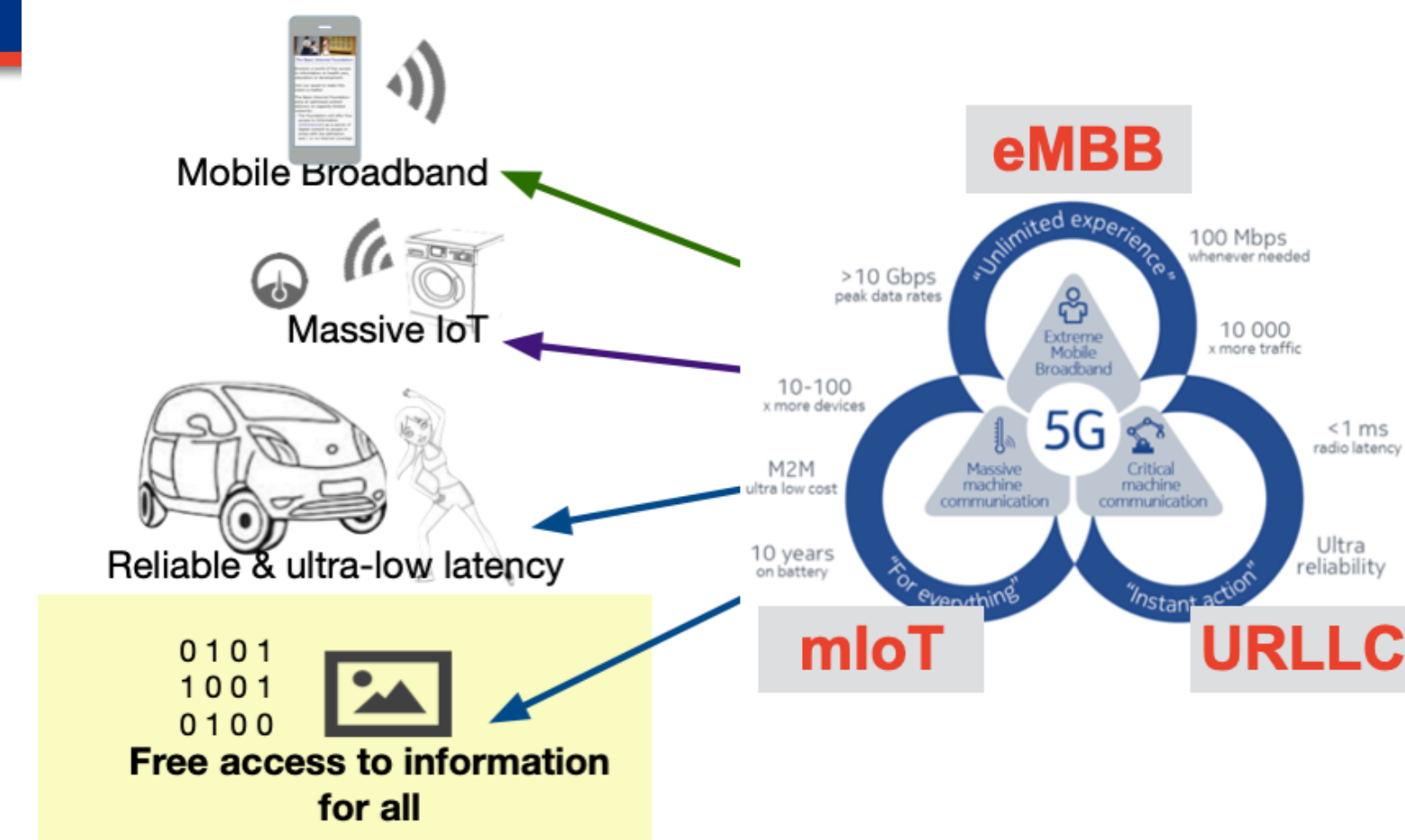
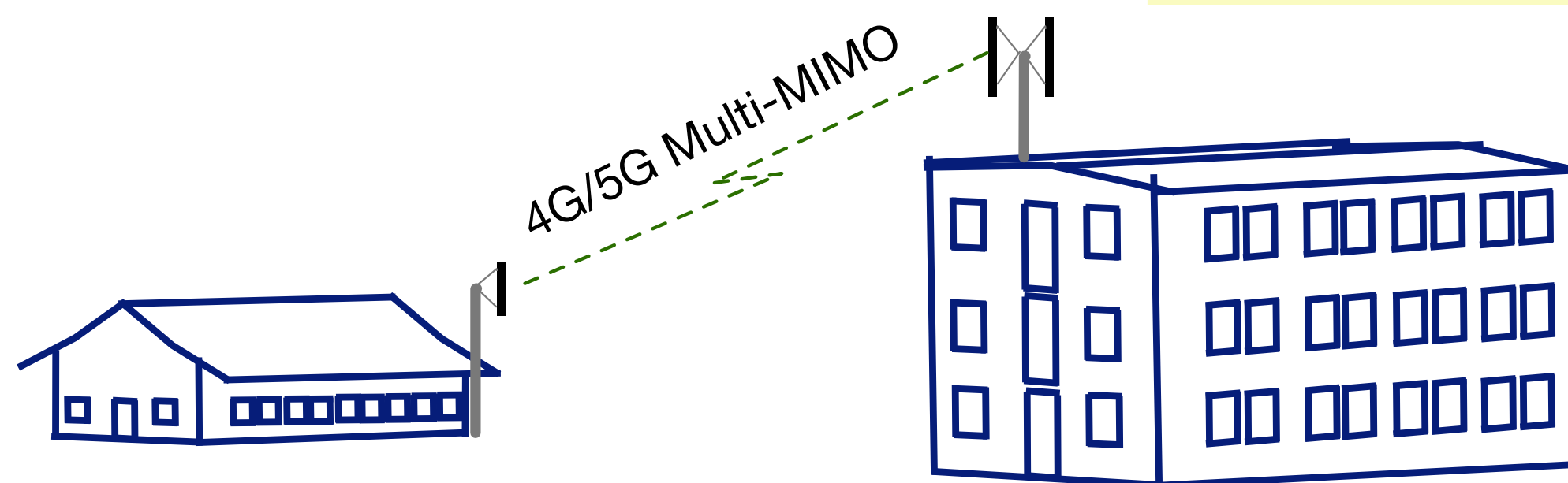
- Internet Lite - "Digital Pedestrians & Cyclists"
- 5G InfoSpot - Universities connecting schools

### → Energy Modelling

- physical infrastructure (H2, wind, solar)
- digital twin

### → Home automation

- Scientific database
- machine learning



Interest in a Master Thesis,

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slides: <https://its-wiki.no/images/2/26/Masteroppgaver-ITS-No2022.pdf>

