UNIVERSITETET I OSLO

PriTEM workshop, 12Dec2023

The green shift

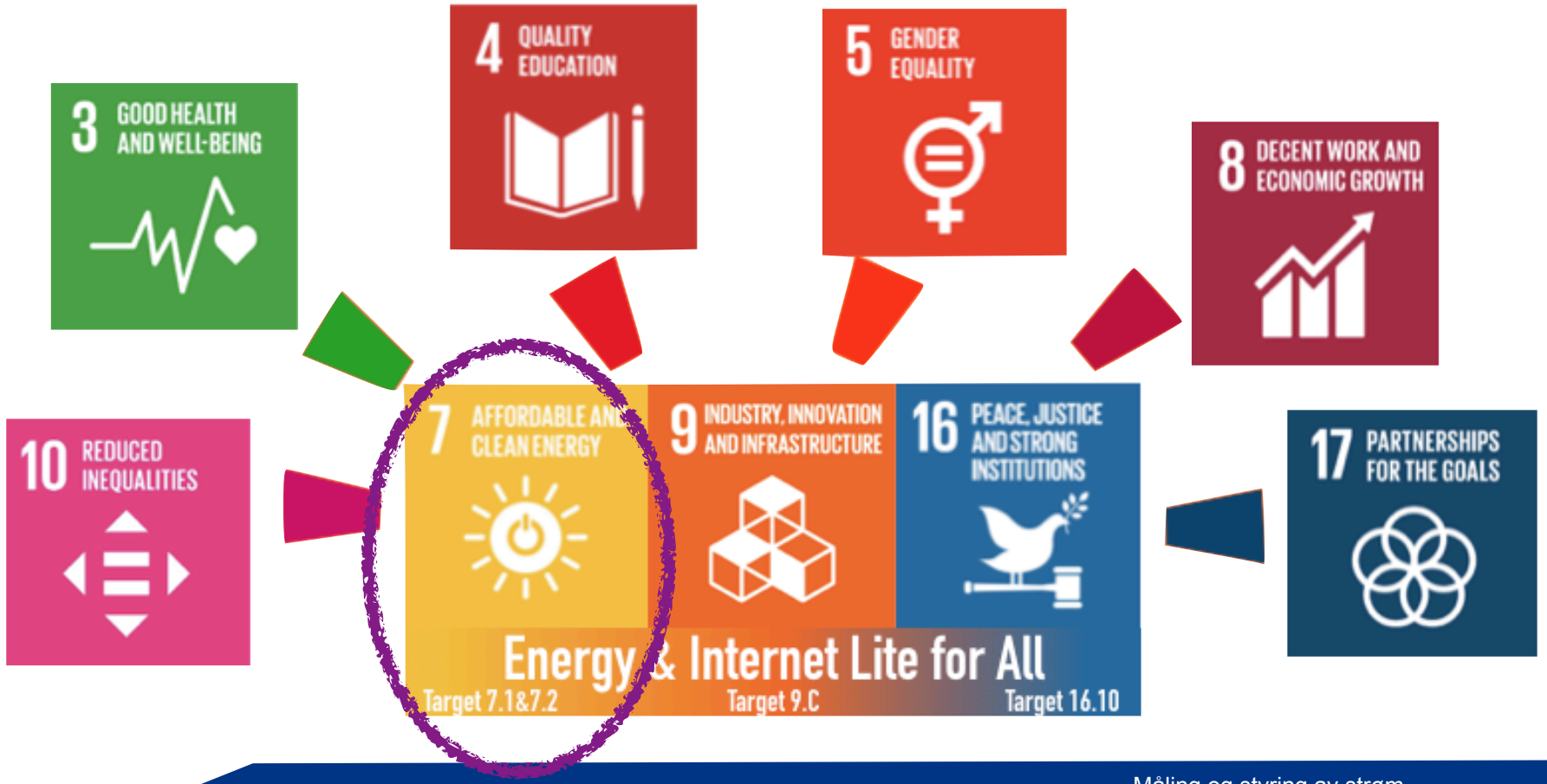
drives the digital shift at the edge

Josef Noll

Vi må omstille energisystemet vårt og produsere store mengder ny fornybar kraft, skriver Ole Erik Almlid. *Foto: Terje H.T. Andersen*

"we need participation of all people if we want to succeed with the green transition - and municipalities are the key to success"

Bærekraftig utvikling
hva er katalysator for Bærekraftsmålene (SDGs)?



SDG 1.4 Equal access to basic services

SDG 4.A Education facilities for effective learning for all

SDG 5.B Use of enabling technologies

SDG 9.C universal and affordable access

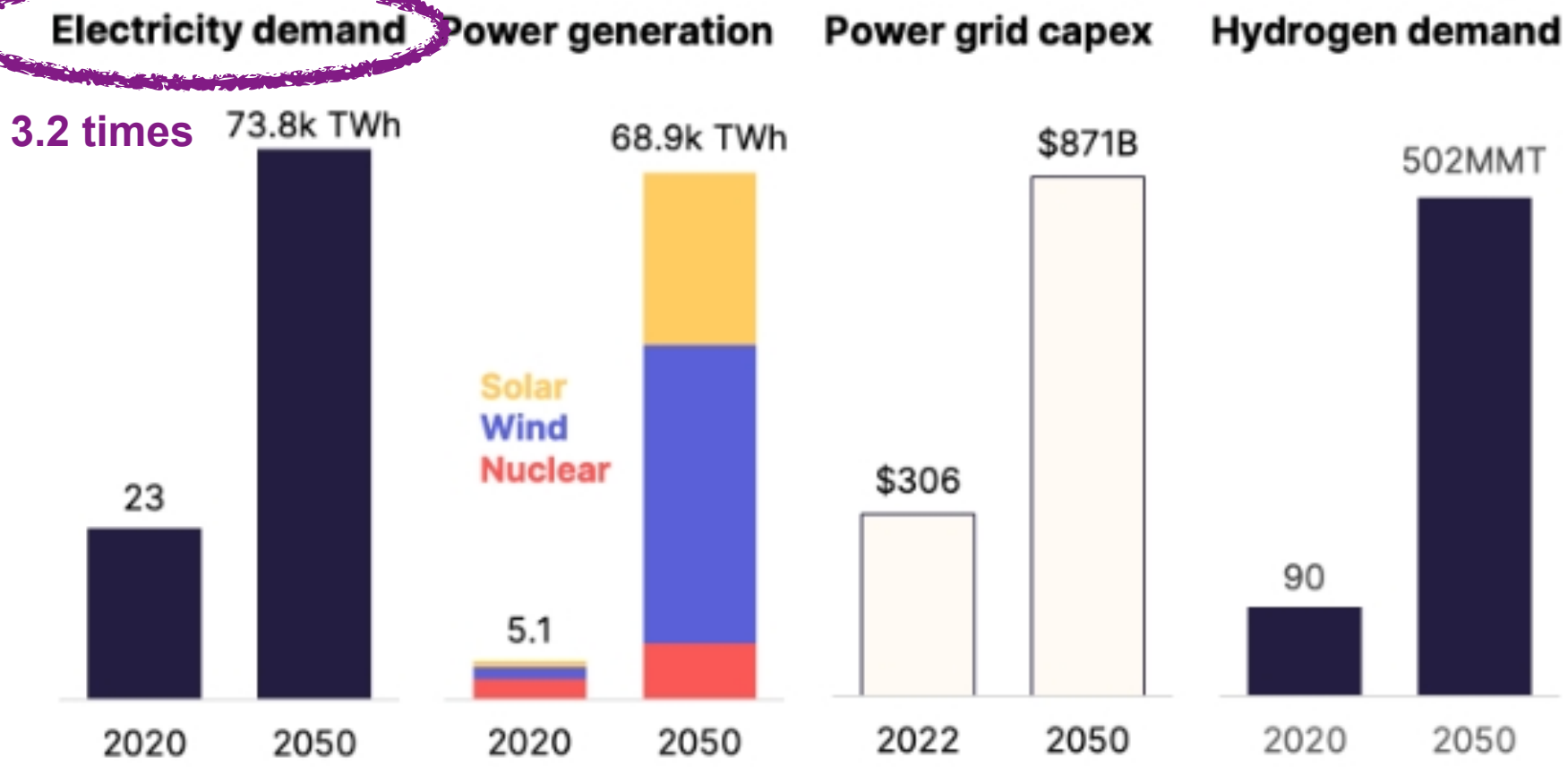
SDG 16.10 ensure public access to information

SDG 17 Partnerships for the Goals

Energiforbruk

Net zero means much more energy

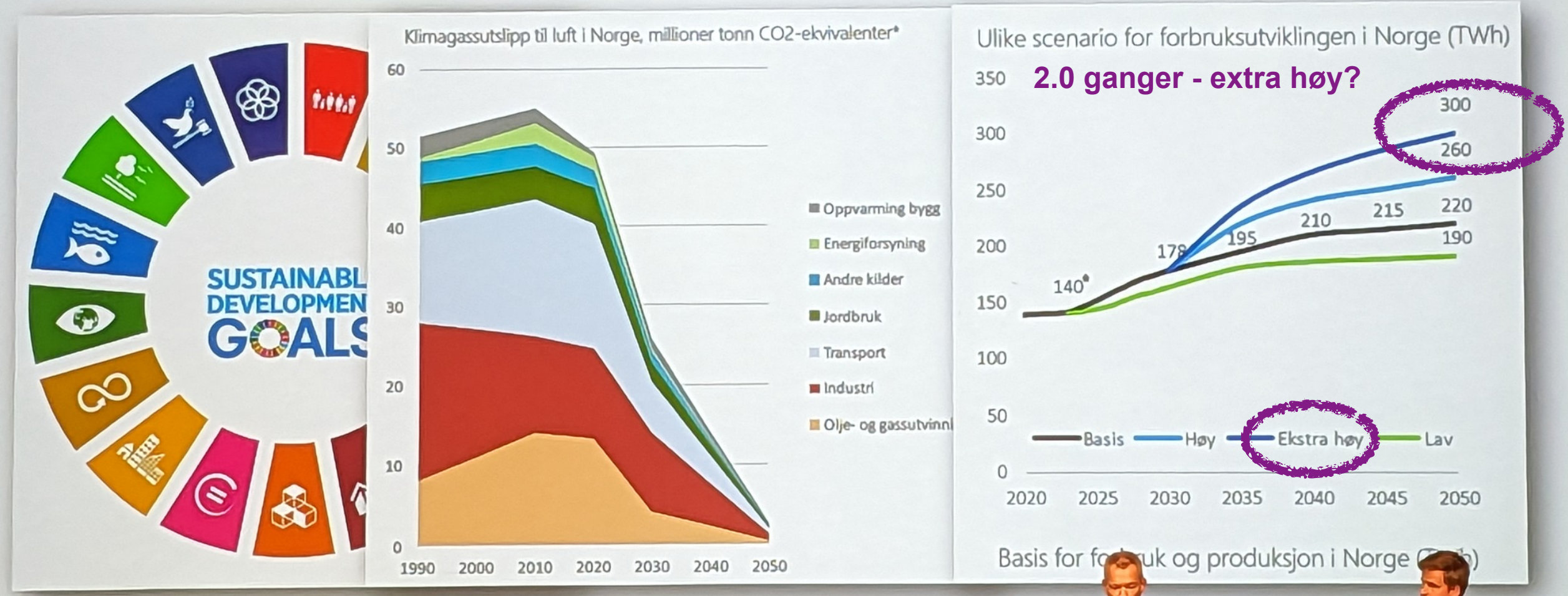
Power demand and grid capex triple; hydrogen demand grows more than 5x



[Source: NathanielBullard.com/presentations - Jan2023]

Sustainability and electrification

Source: Statnett LMA 2022

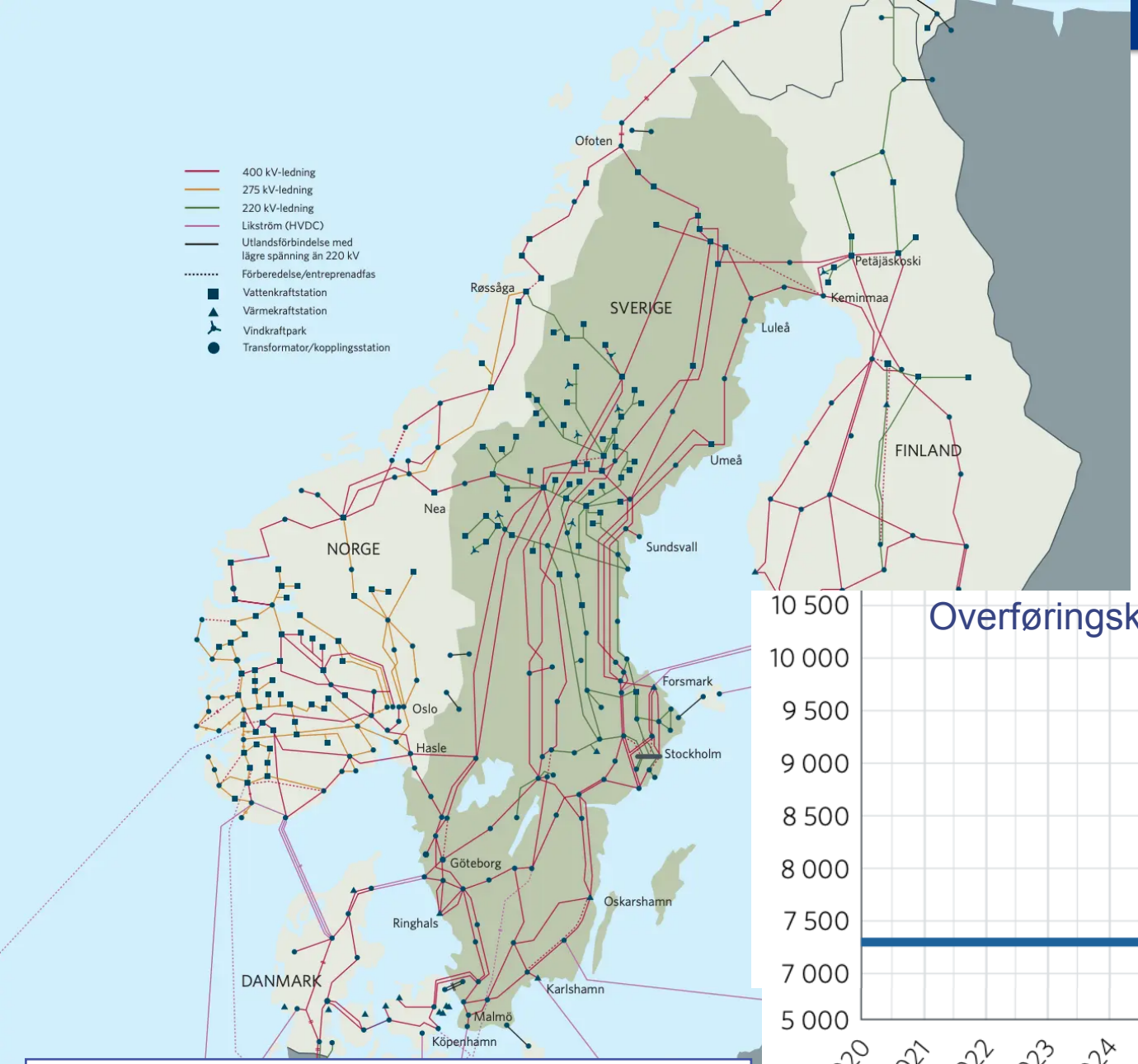


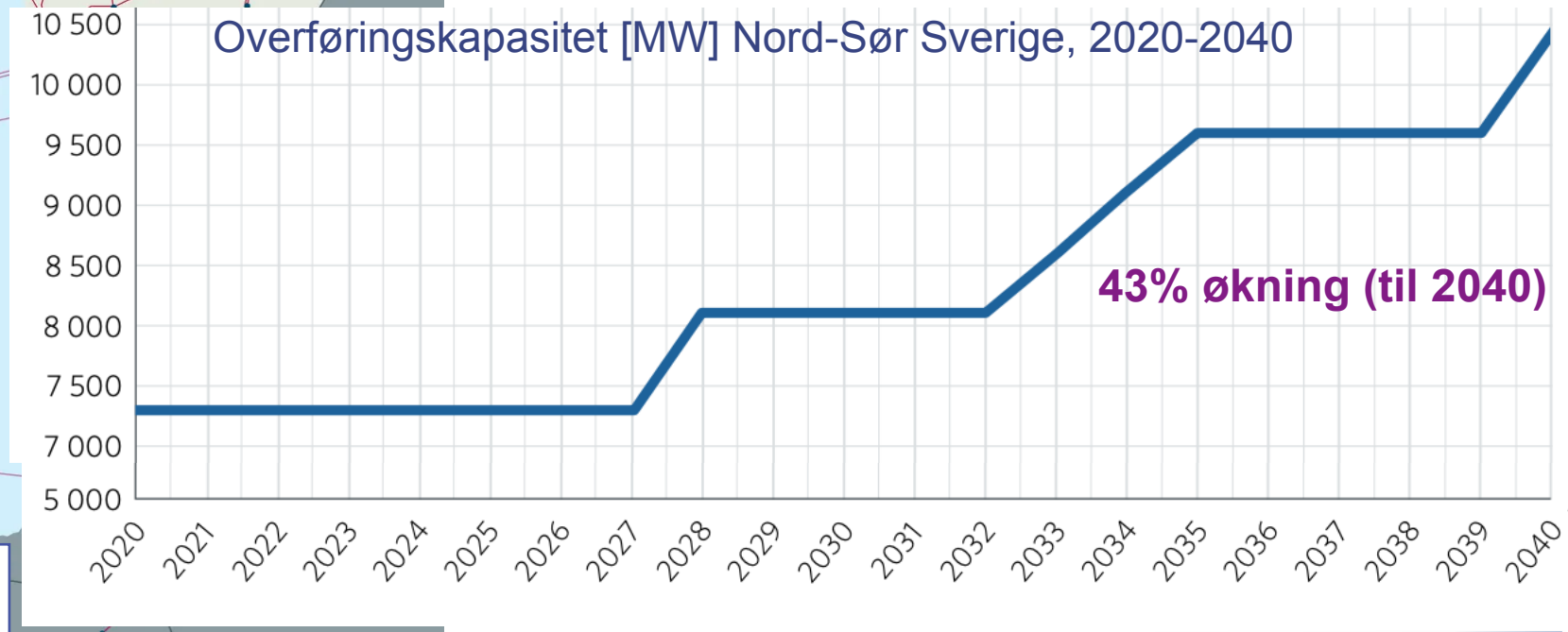
[Source: SmartGrid Conference 27Sep2023]

Per-Oddvar Osland
GlitreNett.no

Simon Koopmann
Envelio.com

Grid utviklingen





https://www.aftenposten.no/norge/politikk/i/z7vWJw/statnett-vil-ha-mer-flyt-av-kraft-mellom-nord-og-soer-men-det-vil-ikke-sp-og-sv-ap-er-i-tenkeboksen

https://www.svk.se/siteassets/om-oss/rapporter/2021/svk_systemutvecklingsplan_2022-2031.pdf

The Power is in the Edge

of the grid

The power is at the edge
of the grid

The green transition
of society is about reducing greenhouse gas emissions, preserving and restoring nature, reversing environmental degradation and ensuring that the energy of the future comes from renewable sources.

The digital transition
of society consists all processes at all levels in society producing and applying infrastructure, services, applications and human behaviour that depend on digital representation of knowledge and computer power.

and municipalities can empower citizens to participate

Cross-sectorial Participatory Transition

Hypotheses:

- We need to involve people in the “fit for 55” transition
- Participatory transition requires a cross-sectorial approach

Means:

- Human-centric decision-making, engagement
- Upscaling from the edge, societal involvement
- Mediator between Use Cases and Research
- Psychology, Law, Sociology, Politics, …
- Municipalities, SMEs, Industry & Research
- Knowledge- and Innovation-Ecosystem

International Labour Organization

Just Transition

1.
In tackling critical environmental challenges like climate change, pollution and plummeting biodiversity, nations and businesses must transition towards greener, resilient and climate-neutral economies and societies.

2.
A Just Transition is greening the economy that is as fair and inclusive to all, creating decent work opportunities and leaving no one behind.

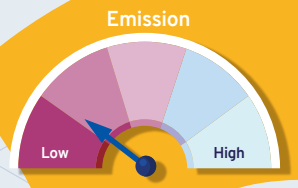
3.
A Just Transition maximizes economic opportunities of climate action, minimizes and manages challenges – It does this through effective social dialogue among all stakeholders impacted, and respects fundamental labour principles and rights.

4.
Ensuring a Just Transition is key for all countries, rural and urban communities at all levels of development as well as all economic sectors – not only limited to energy supply chain.

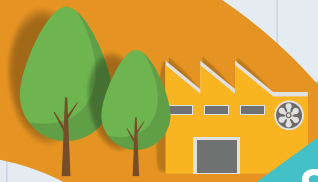
5.
A Just Transition is both a process and a goal to undertake climate change actions that equally advance: **job creation, social justice and fair transitions for workers, enterprises and communities** on an equal footing.

Green Jobs

6.
Green jobs limit greenhouse gas emissions, minimize waste and pollution, protect and restore ecosystems, improve energy and raw material efficiency, and support the adaptation to the effects of climate change.



7.
Green jobs propel the preservation and restoration of the environment across sectors such as agriculture, manufacturing and energy.



8.
Decent jobs, are a co-benefit of a green and just transition due to the fact that such jobs entail practices such as cleaner production & consumption and energy efficiency that improve occupational safety and health (OSH) in the workplace.

9.
At the enterprise level, green jobs can produce goods and services that benefit the environment, for example green buildings or clean transportation.

10.
Green jobs also contribute to more environmentally friendly processes. For example, green jobs can reduce water consumption or improve recycling systems.

11.
Green Jobs are jobs that are good for people, good for the economy and good for the environment.

Digital Empowerment

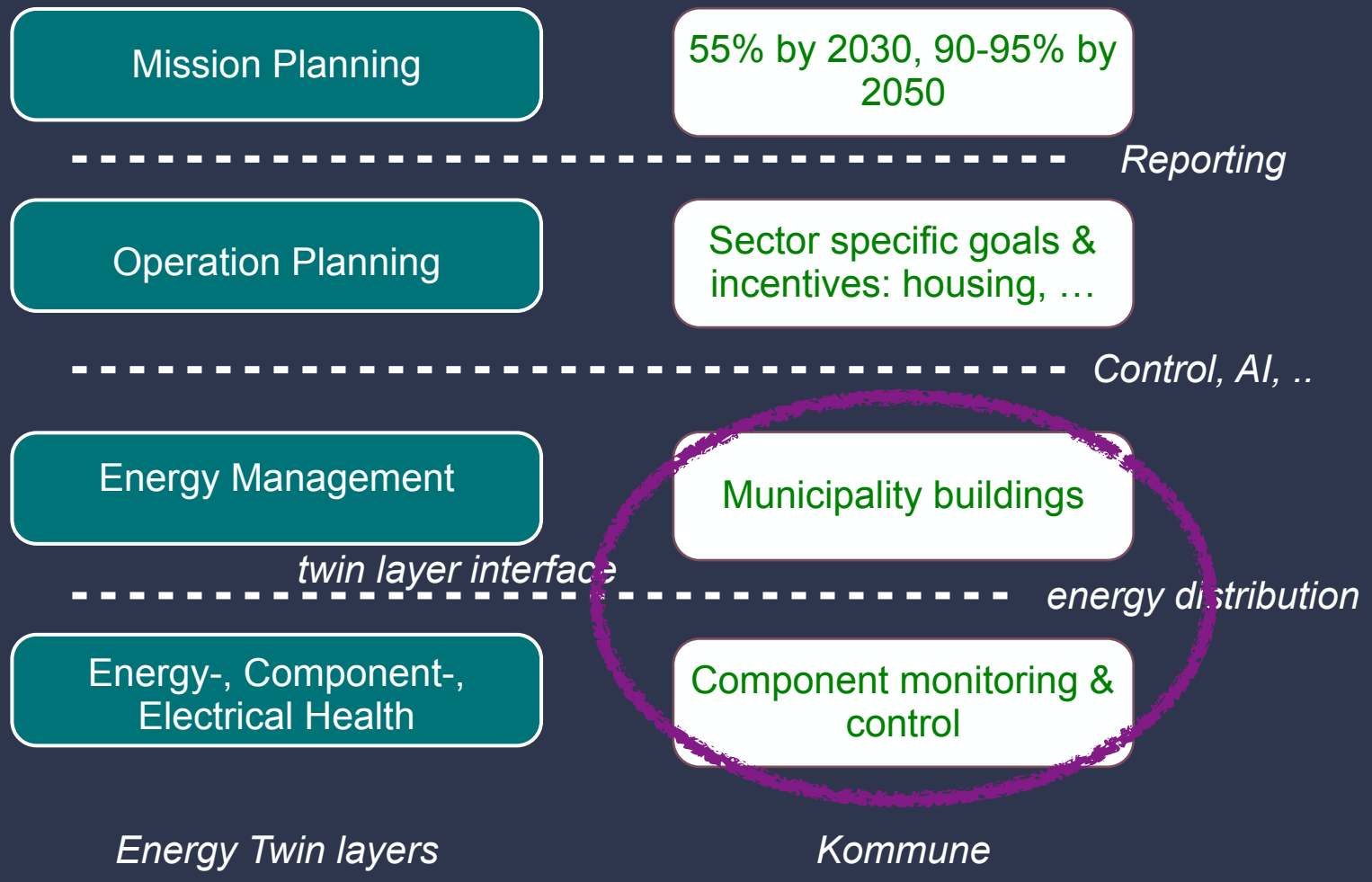
Participatory transition

Market place

Neighbourhood

Measuring and Control
at the edge of the grid

Energy Twins struktur og deltagelse



Verdineutral reduksjon
- *value-based transition*
- *normative integrity of energy transition*

Kommune profil
- hightech
- green
- justice
- rettferdighet

ESG - environment, social, governance

Topics for Discussion

Mapping the needs

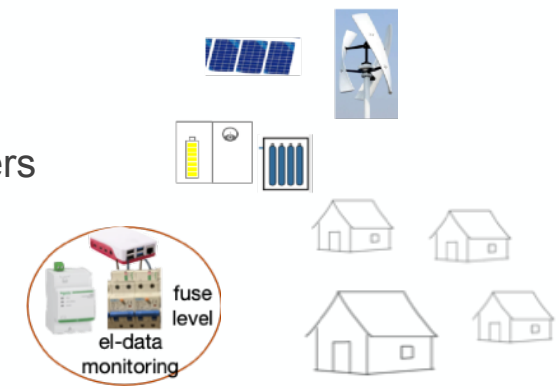
- Mission Planning
- Operation Planning
- Energy Management
- Energy-, Component-, El. Health

Energy-efficient buildings and Neighbourhoods

- Industrial buildings (Lillestrøm municipality)
- Neighbourhoods (new Kjeller)
- Households (participatory contribution)

Novel energy solutions

- Neighbour-hood trading, prosumers
- Frequency trading, grid stability



What we'd like to achieve

1. Towards a Data-Driven Municipality
2. Identify areas of common interest
3. Master Thesis with Lillestrøm kommune
4. Innovation projects/ Public PhD
5. ….
6. …

Electrical transition as driver for data-driven municipalities (Jonas)

Contribution of PV-empowered municipality buildings

Digital Twins for large scale car charging infrastructures

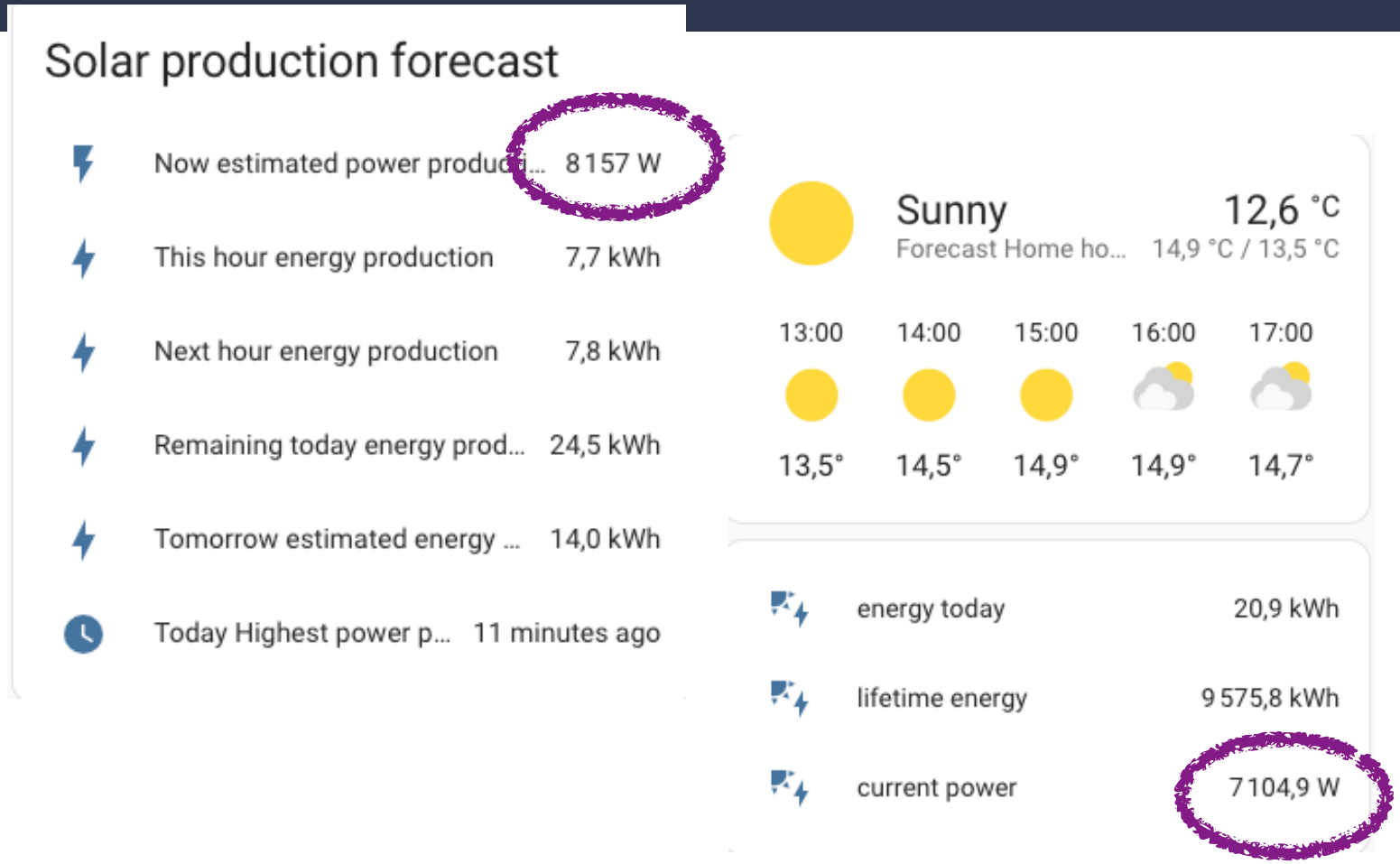
Fostering the energy transition of homes

Electrical transformation of municipal buildings, using schools and nursing homes

From Energy Information to Energy Monitoring & Control

Models for solar production forecast
- Weather forecast
- Energy Monitoring

Empower through knowledge



DESSI implementations

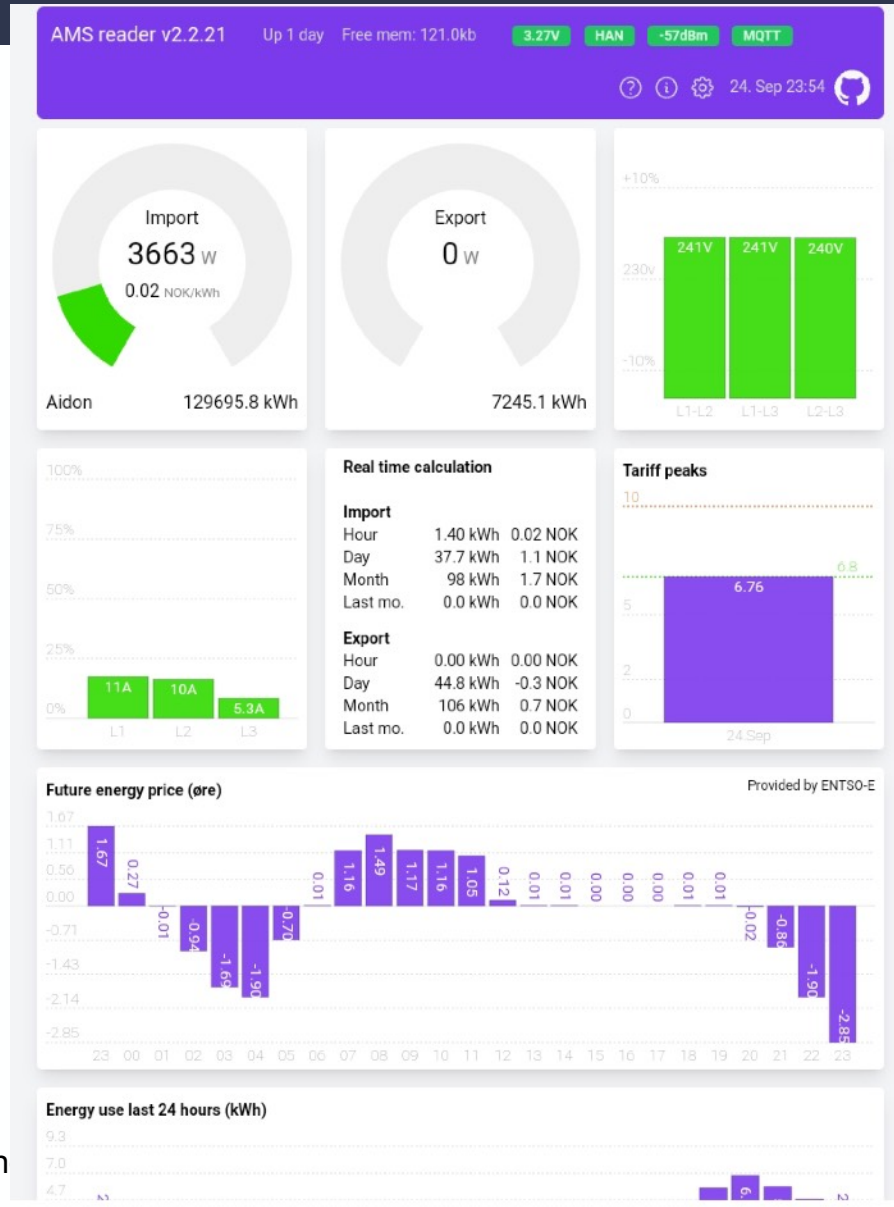
Private Home Empowerment

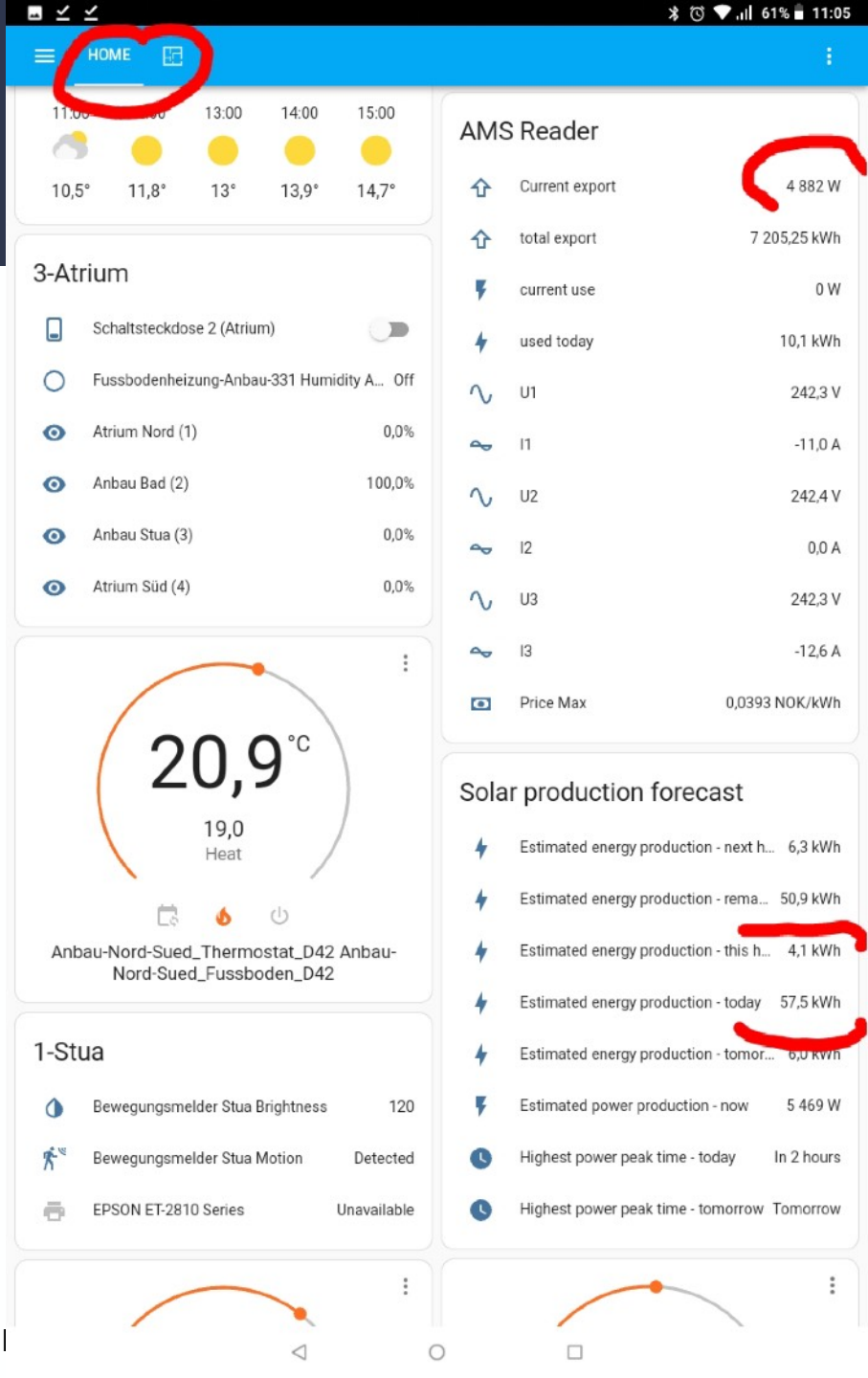
Minimum Viable Product (MVP)

- AMSleser.no (900 kr)
- Raspberry Pi (1400 kr)
- Home Assistant App

Student work

UiO: Scientific Database





UiO inviterer:

Vil du være med?

Kontroll over strømforbruk i ditt hus

UiOs studenter og forskere vil hjelpe deg å forstå energi i huset

Utstyr (dekket av UiO for de første 100 kunder)

- Strømmåler (900 kr)
- Raspberry Pi (1400 kr)
- Home Assistant App

Hva ønsker vi fra deg?

- anonymiserte strømdata til vitenskapelig arbeid

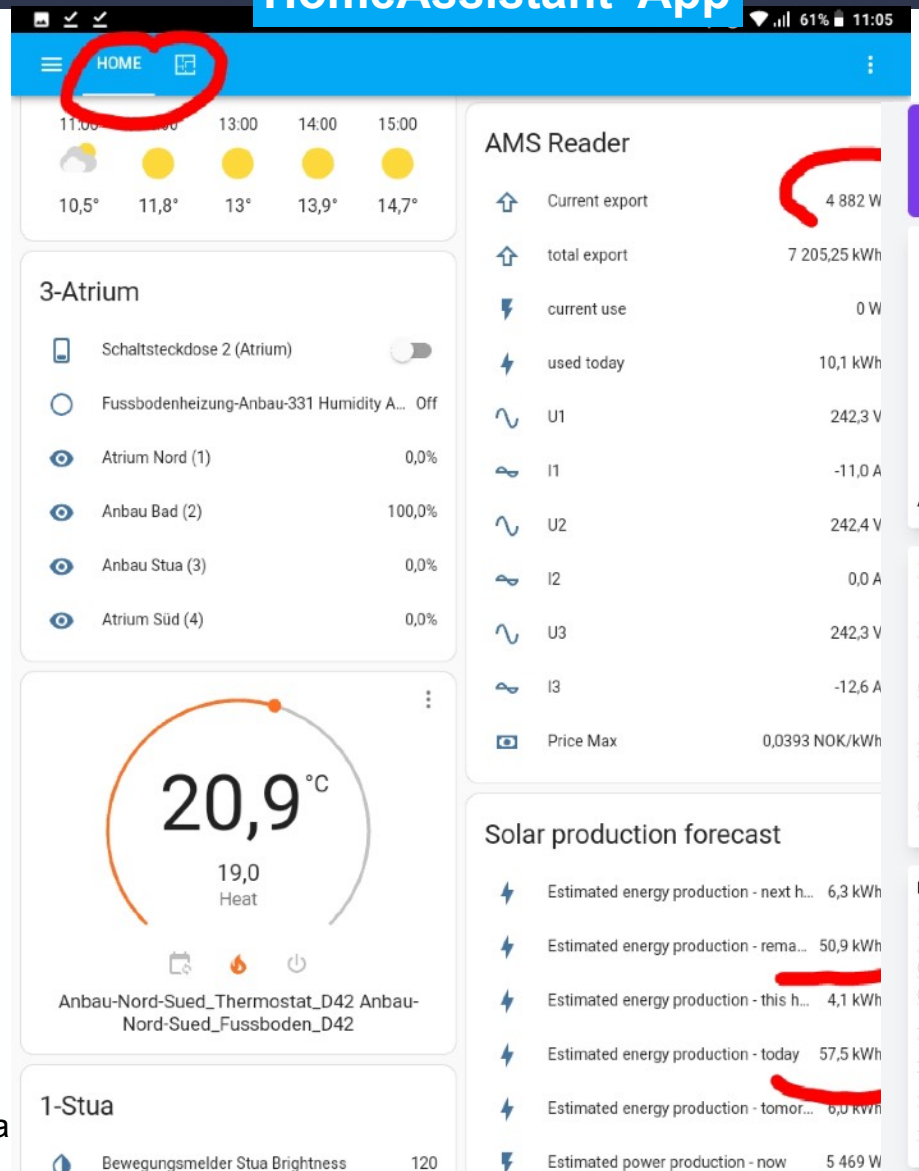
Interessert?

http://DESSI.its-wiki.no

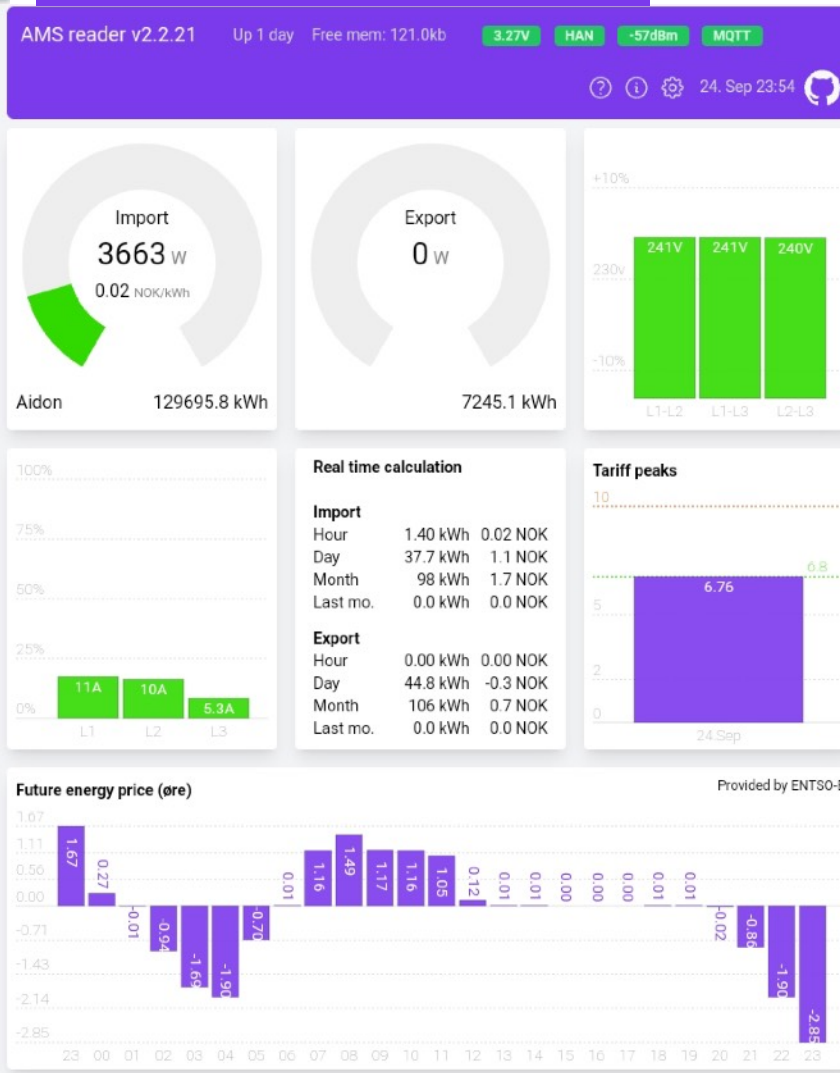
Er Lillestrøm kommune med?

Energy tra

HomeAssistant App



AMSleser data fra ditt hus



Ongoing work

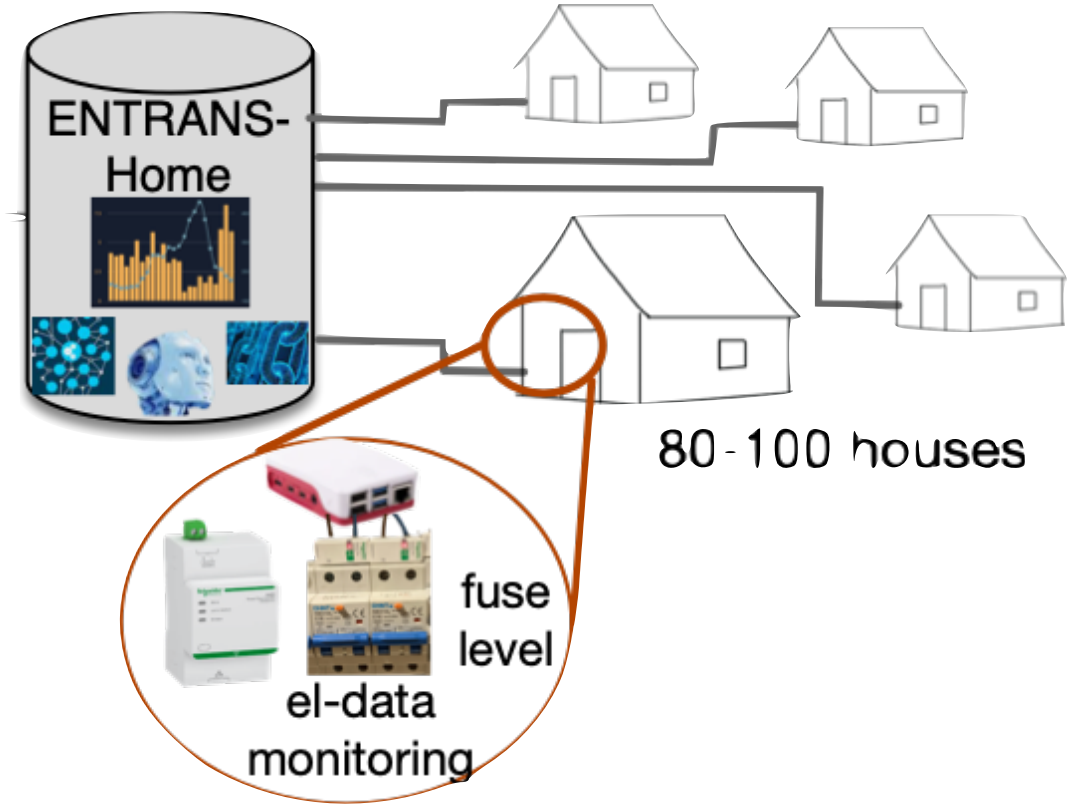
Group Topics

- 1. RPI monitoring of fuses
- 2. RPI monitoring of HAN port
- 3. Optimise control for weather forecast
- 4. Optimise electricity tariffs for prosumer home
- 5. RPI controlling and switching

1. RPI monitoring of Fuses

- how much energy does each of my appliance use? What is the characteristics of my appliance? Perform a classification of energy consumers in the home. Find out if the freezer is ruined, or the lock is open - or if a window is open, or a malfunction of an electricity system.

- Goal: monitoring the energy consumption per fuse, and store it into an SQLlite files (1 file per day).

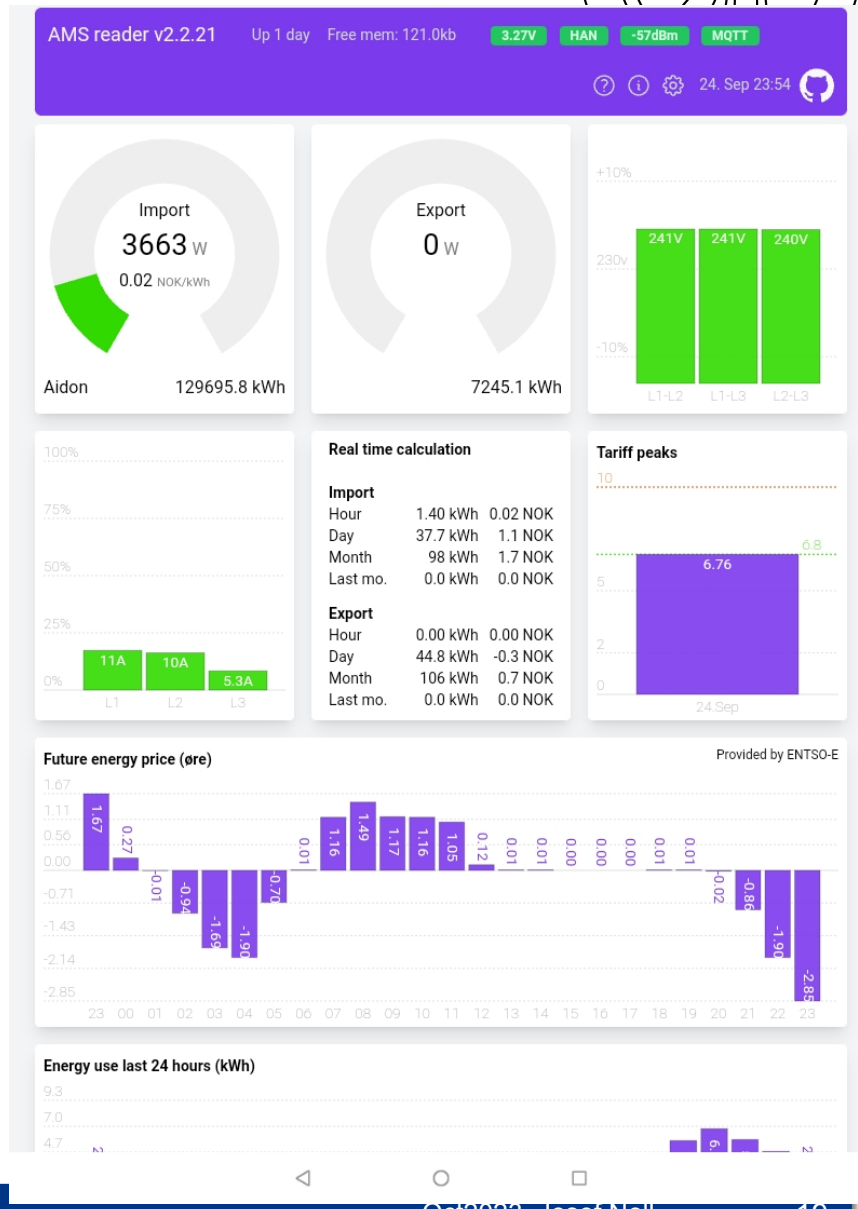


2. HAN port reading with AMSleser.no

- Use the HAN port reader from your smart home to receive the current energy readings, and integrate in HomeAssistant
  - read the energy consumption from the AMSreader and export to SQLite files
  - see other application examples and see what is possible to implement (direct MQTT access)

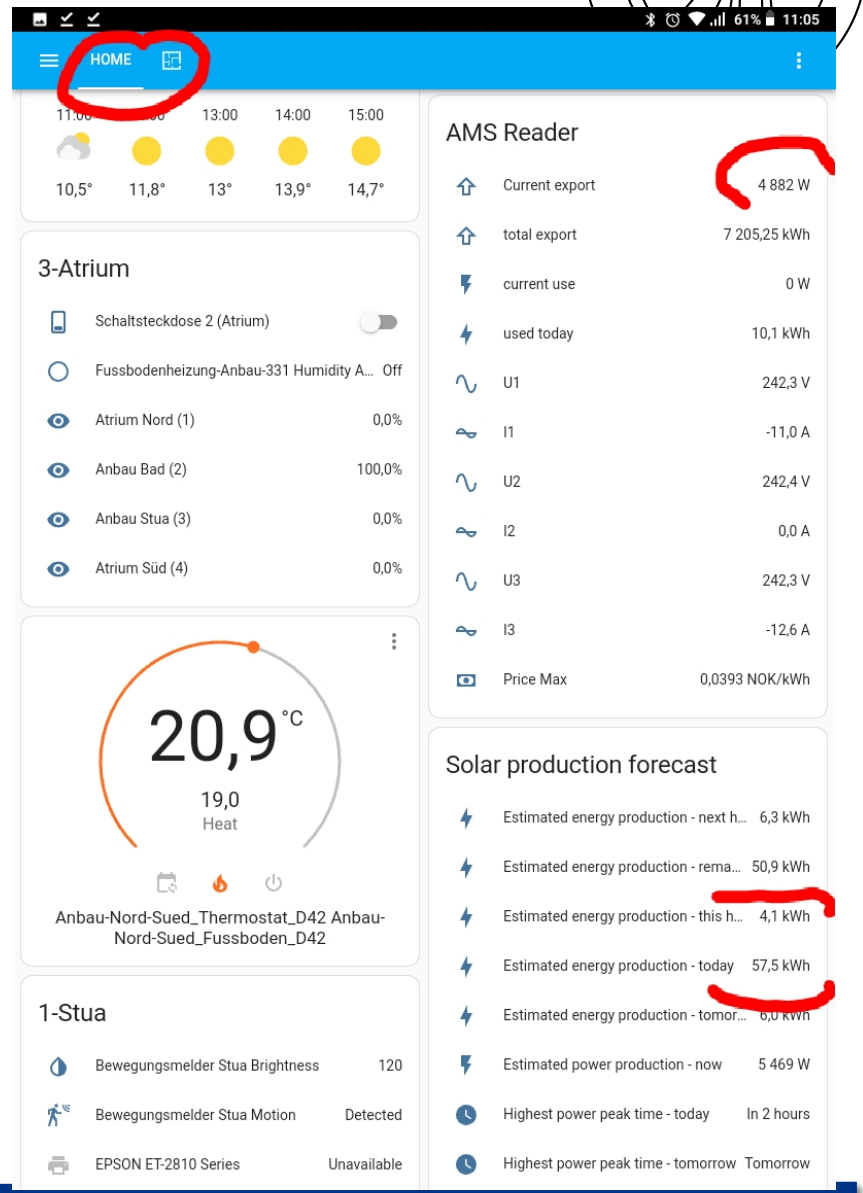
- Integrate the AMSleser into Home Assistant (Package for RPI): Home Assistant med Pow-K (amsleser.no) (video) and Homey-integration (wiki, Homey-integrasjon (amsleser.no))

- Examples of applicability are on BLOG (amsleser.no), e.g. the hardware reset Emergency factory reset (amsleser.no)



3. Optimisation control for weather forecast, price level and "home latency"

- Optimize your home based on grid tariff (0-3, 3-5, 5-10 kW max per hour) & price (every day at 12 h the electricity costs are published for the next day)
  - In case of a heat pump and a water-based heating system, weather prediction helps you in getting a better temperature control in the home, thus increase to convenience.
  - Assume that your floor heating has a 6 h delay, it means that increase heating will come in 6 hours. Thus, if outside temperature is expected to rise, there might be no need for heating.
  - My passive house has a 12 h delay before getting cold, the understanding of the outside temperature variation will help you with a better control of the inside temperature.
- Input: price, outside temp, inside/floor temp, warm water consumption (shower, washing, ...), hot-water temperature (45....90 deg), heat loss in W/m2/K
- Output: max comfort, min cost (based on heat-pump, warm water needed)
- Description of a model, examples



4. Optimise electricity tariffs for prosumer home

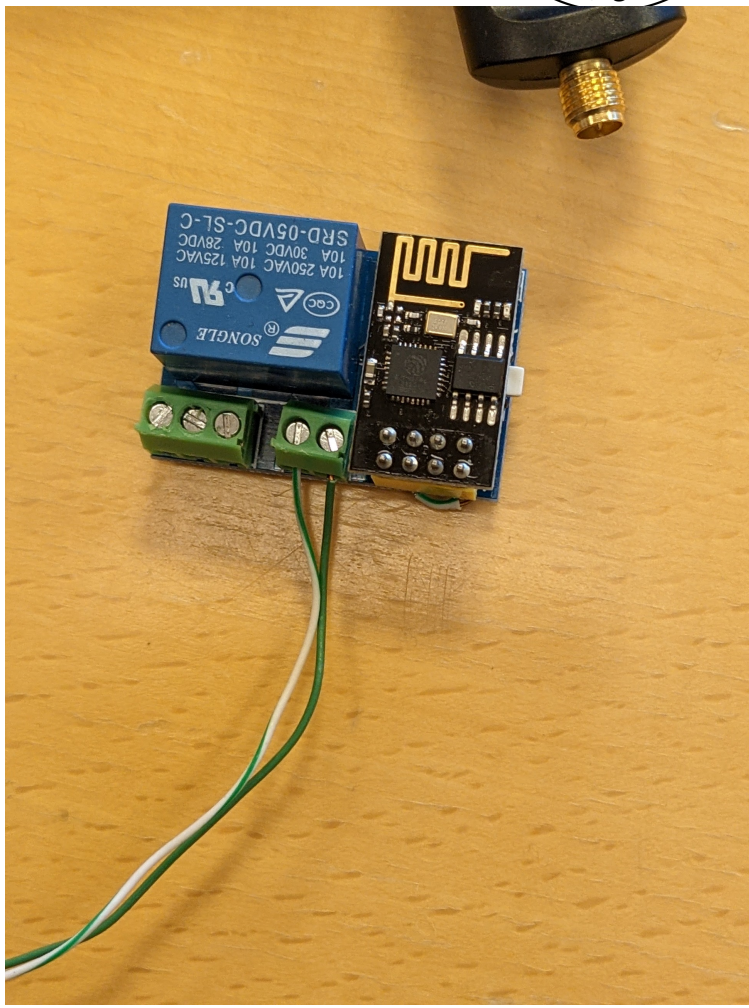
- Given the Energy production, consumption and sales as presented in Canvas / Stromdata / Energy_108x...xlsx, address
  - a) the earning given different energy tariffs
  - b) the impact of a virtual battery ("solbanken")
  - c) dimension a battery for the home

- Provide a model for the energy consumption, production and sales based on the available .xlsx data, and evaluate the alternatives.

	Oct2023		832,0	Sep2023		1068,4	Aug2023		943,6	Jul2023		895,6	Jun2023		984,6	May2023		1266
Day	buy	sell	prod	buy	sell	prod	buy	sell	prod	buy	sell	prod	buy	sell	prod	buy	sell	prod
	609,6	362,1	584,5	726,5	816,1	1158	582,1	1119,9	1481,4	408,0	1421,8	1909,4	422,2	1958,9	2521,3	644	1737	2358
1	24,1	18,1	32,4	23,8	45,0	59,2	7,5	43,1	53	20,5	56,4	76,7	10,0	78,4	97,7	35,6	0,0	71,9
2	18,9	21,8	34,9	18,1	43,4	60,7	8,0	47,1	57,3	19,7	15,9	35,4	11,8	88,9	107,0	30,5	0,0	71,9
3	29,8	25,5	38,6	23,8	27,9	38,2	11,2	61,8	71,8	16,0	43,5	58,7	17,5	79,7	98,3	35,1	35,3	71,9
4	28,3	33,2	46,6	12,6	65,1	75,9	12,0	41,2	51,1	31,6	11,2	35,7	13,2	82,5	106,8	28,2	56,7	71,9

5. RPI controlling and switching

- Controlling electrical equipment from a Raspberry, e.g. switching the hot-water heater (OSO)
  - digital thermostats
  - switches
- Analyse existing solutions on the market
  - Tibber: Electricity company switching appliances in the home, concentrating on a) car charger and b) the warm water heater
  - Homely



Potential Mastertopics with Municipalities

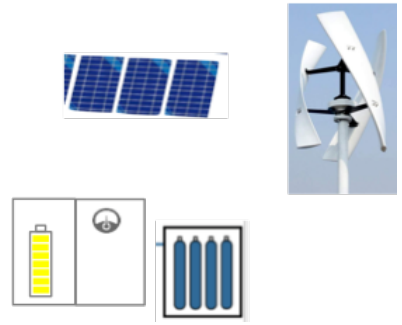
Topics for Master Thesis

- Electrical transition as driver for data-driven municipalities (Jonas)
  - ➡digital infrastruktur for el. monitoring og kontrolle
  - ➡ forbedringspotensialet
  - ➡
- Contribution of PV-empowered municipality buildings
  - ➡analysere dagens modeller for PV energy
  - ➡ sammenligne med utvalgte bygninger i Lillestrøm
- Digital Twins for large scale car charging infrastructures
  - ➡ Eksempel: 83 stasjoner i bygning til Lillestrøm kommune
  - ➡ Vehicle-to-Grid (V2G) standard (ISO…): hva er potensialet
  - ➡ muligheter med dagens bilpark, og framtidsperspektivet

Thema til Masteravhandlinger

- Contribution of swimming pools to the flexibility market
  - ➡ Utgangspunkt: kommunale bygninger med svømmebasseng (f.eks. skoler)
  - ➡ modellering av potensialet basert på real-life verdier

- Fostering the energy transition of homes
  - ➡ fra "Minimum viable product" (MVP) til controlled infrastruktur
  - ➡ økonomisk optimalisering i forhold til investering, batteri, oppgradering av el
  - ➡bruk av app og "low-cost" infrastruktur



- AI-based assessment of quality of houses/buildings (A-G) from energy monitoring
  - ➡ hvilken verdier kan vi hente direkte
  - ➡ hvordan øker vi kunnskapen gjennom "rapportering" (Norge: egenrapporteringsskjema om husholdningens kvalitet)