TEKNOLOGISK
INSTITUT

it's all about innovation

Udnyttelse af solcelle-el i enfamiliehus
- Foreløbige resultater

Ivan Katić, seniorspecialist ik@teknologisk.dk

Intro

TEKNOLOGISK INSTITUT

- Projektets baggrund og formål
- Anlæggets opbygning
- Driftserfaringer
  - Lagring i batteri
  - Lagring i termisk lager
  - Styring i forhold til net

LiTHIUM BALANCE BATTERY MANAGEMENT SYSTEMS

NILAN

ELFORSK

Baggrund

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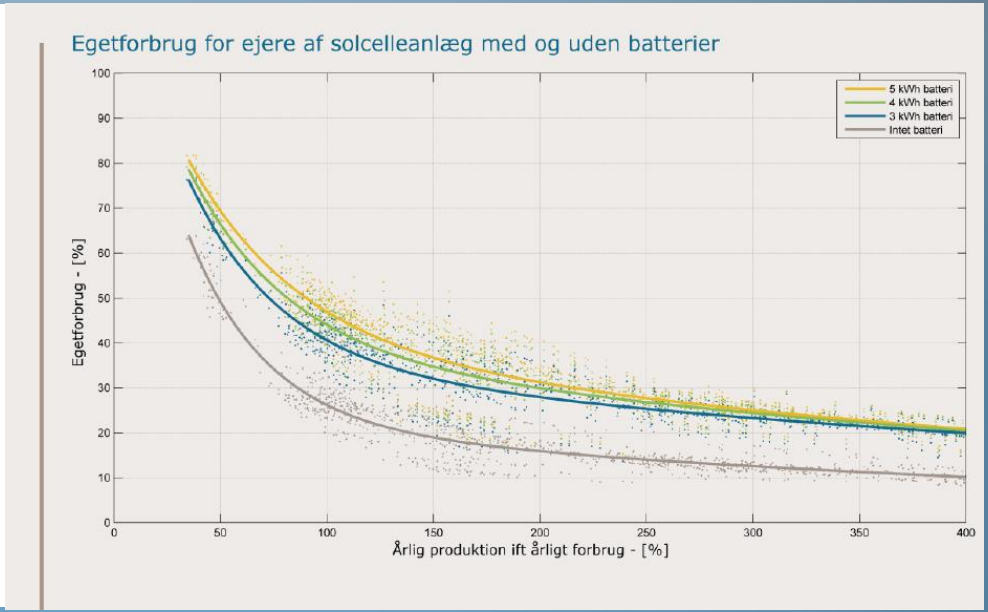
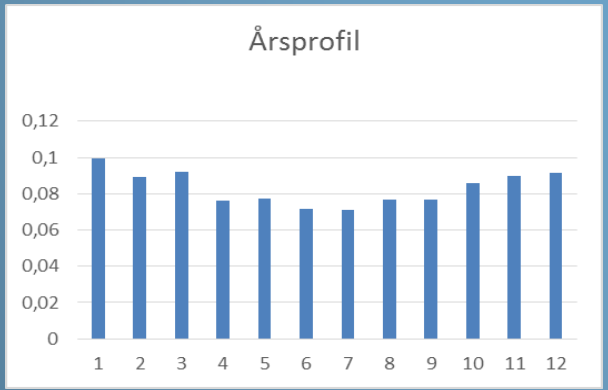
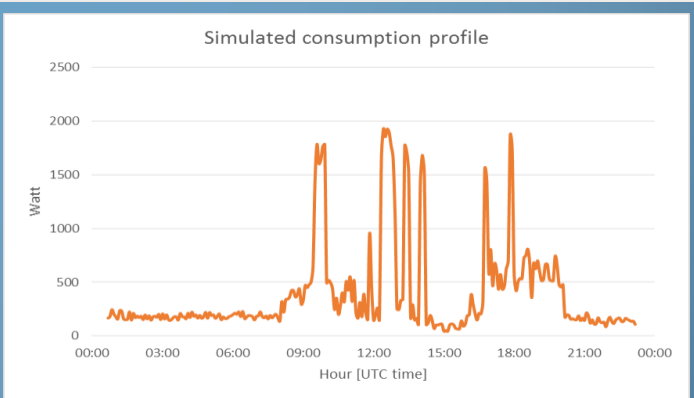
- Faldende afregningspris for egenproducenter
- Billigere batterier, men varmelagring billigst
- Voksende interesse for el-fleksibilitet/smart grid
- Ka' det svare sig?

Produktion vs forbrug

- Ikke to husstande er ens
- Elbaseret varme eller ej?
- Fasesummation?
- Sæson mismatch
- Døgn mismatch

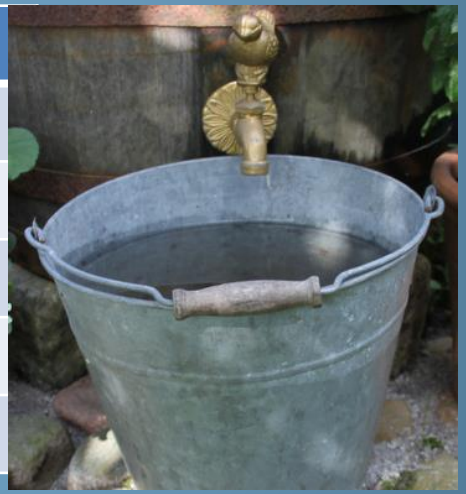






Effekt og effektivitet

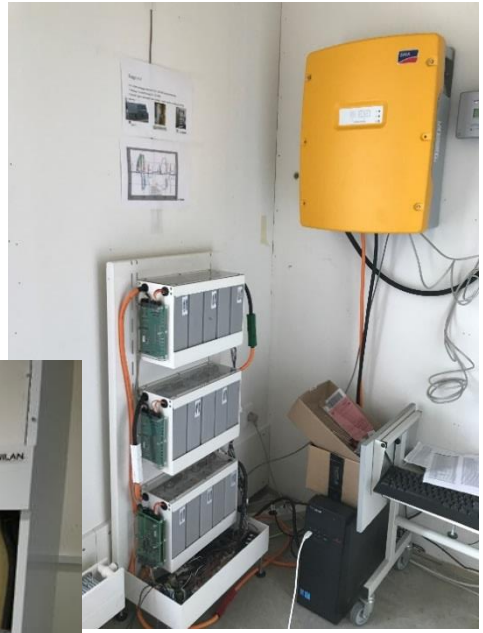
	Batterilager	VVB	Buffer
Cykluseffektivitet	++	+++	+++
Opladeeffekt	++	+	+
Afladeeffekt	++	+++	++
Langtidstab	+	+++	+++
Exergieff.	+++	+	+



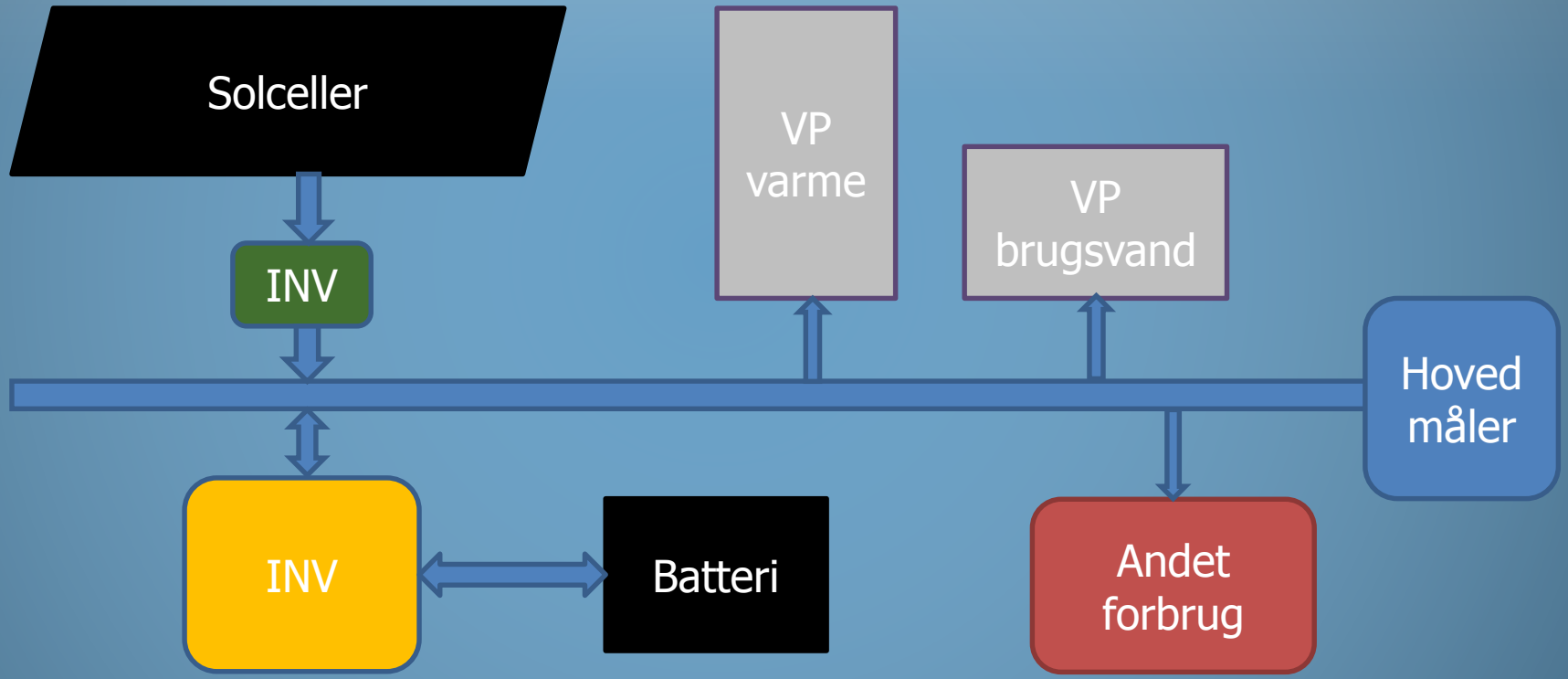
Hvad betydning har det i praksis?

Forsøgsanlægget

- 2 x 3,5 kWp solcelleanlæg
- 4,8 kWh LiFePo batteri
- 2,3 kVA batteriinverter
- 6 kW(T) varmepumpe
- 250 l buffertank
- 180 l VVB med egen VP
- Smart electricity meter
- 2 x WiFi relæer



Principskitse



Smart Grid i praksis

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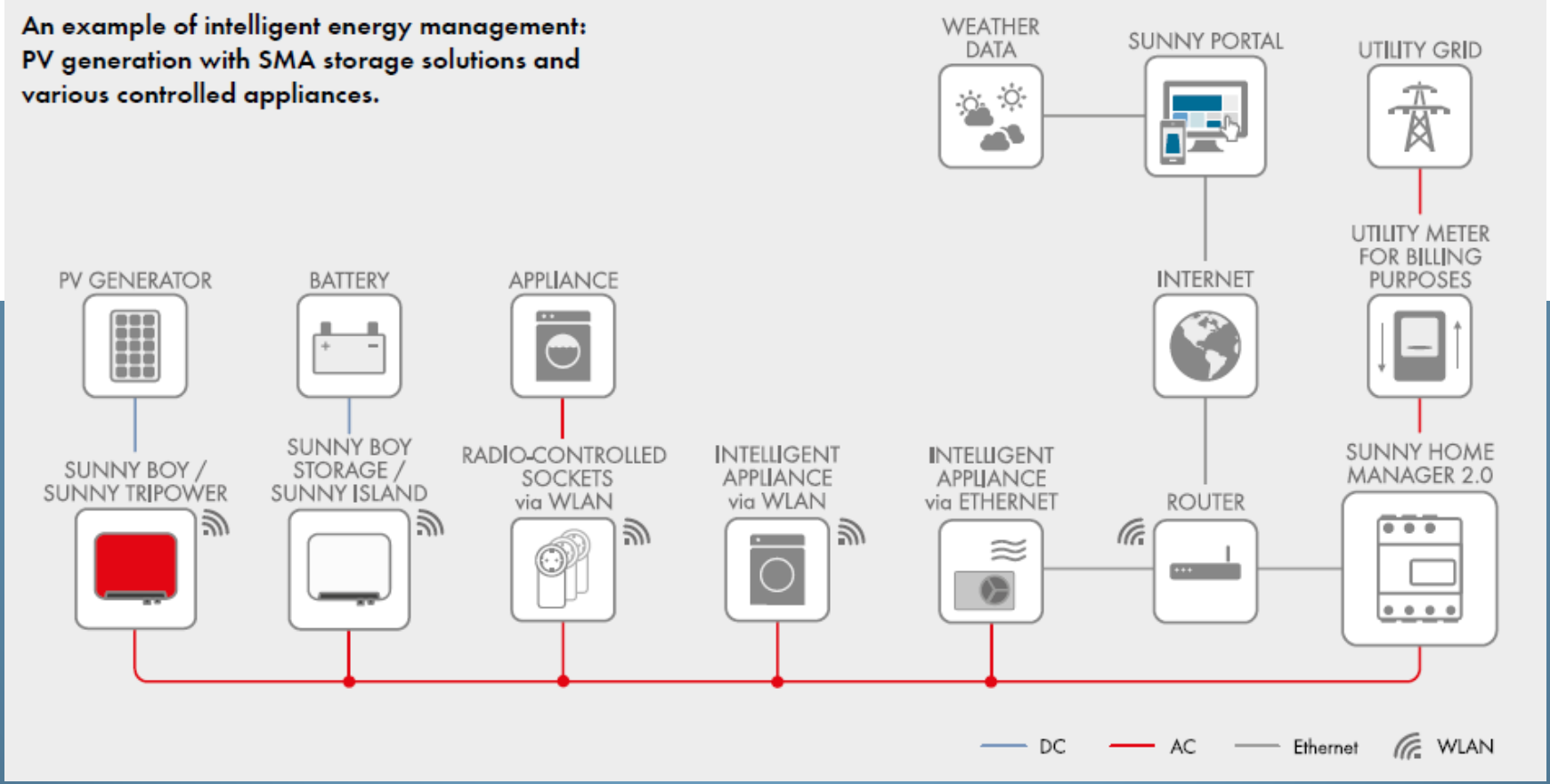
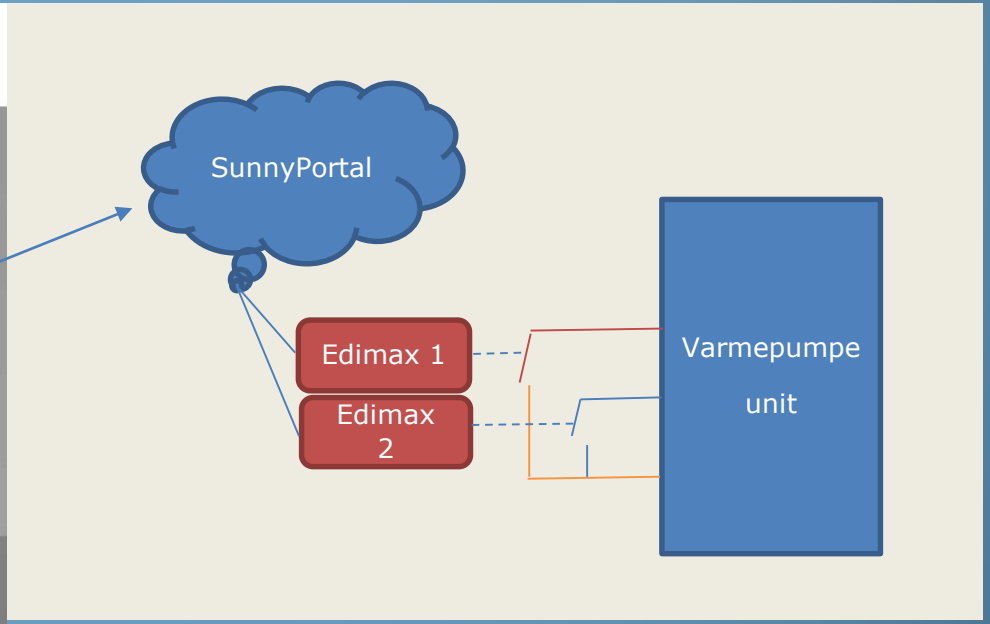


Smart Grid i praksis

- Baseret på SMA Home Manager 2.0



Sunny Portal

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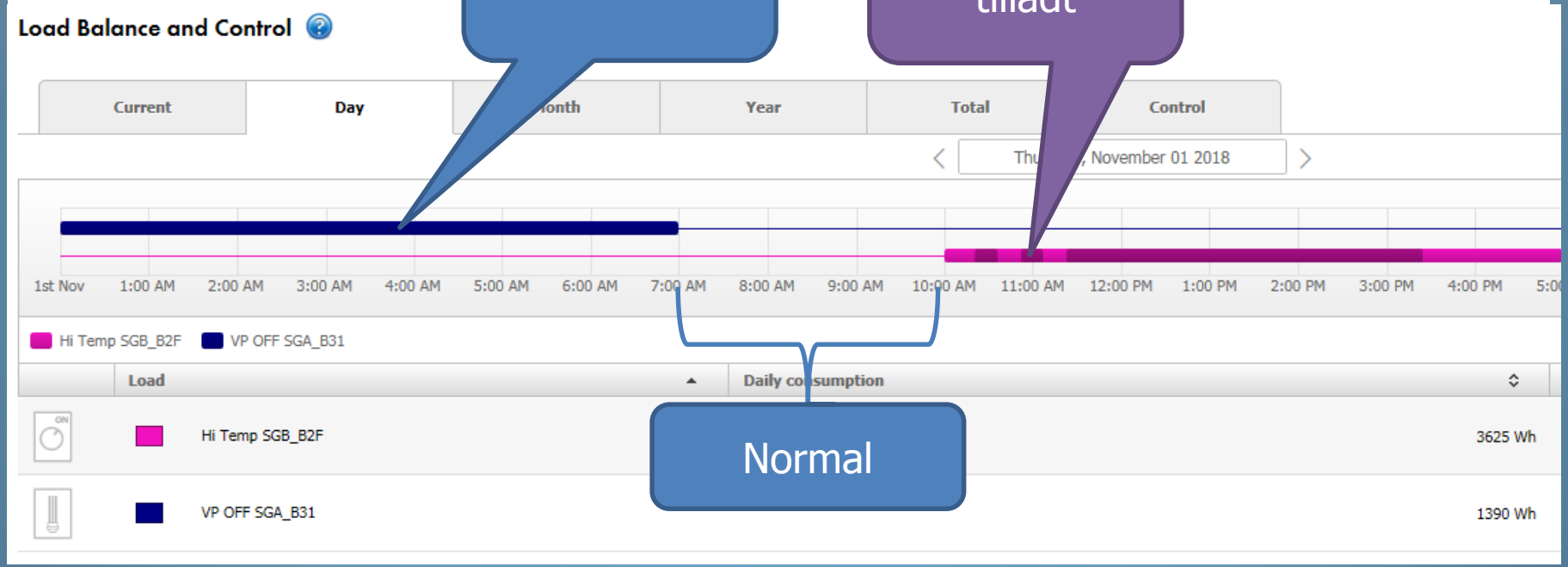
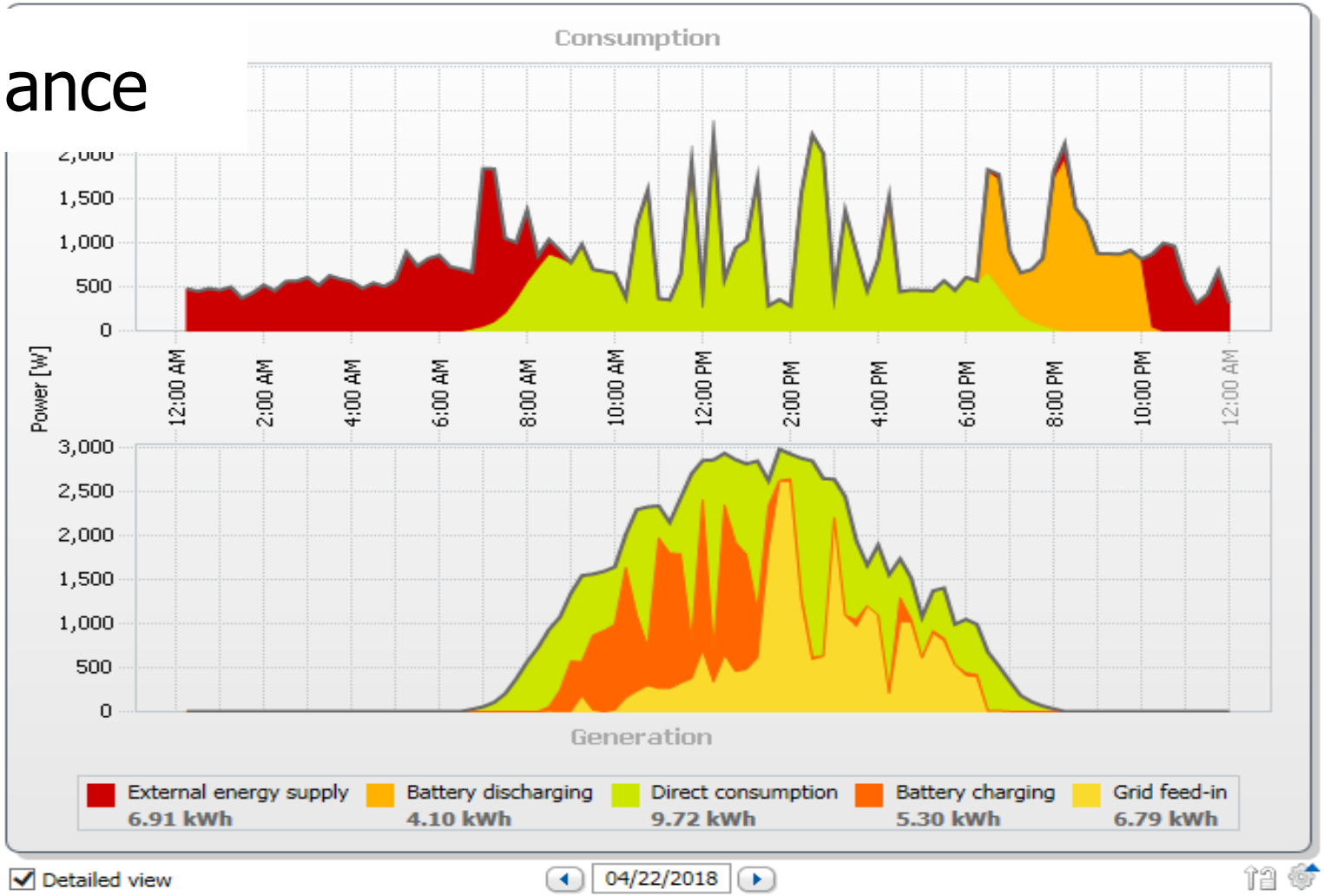


El-balance


Consumption
2,000
1,500
1,000
500
0
Power [W]
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
12:00 AM
3,000
2,500
2,000
1,500
1,000
500
0
Generation
External energy supply
6.91 kWh
Battery discharging
4.10 kWh
Direct consumption
9.72 kWh
Battery charging
5.30 kWh
Grid feed-in
6.79 kWh
Detailed view
04/22/2018

Lagring i batteri

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- Bøvl og mere bøvl når man bruger forskellige komponent-leverandører
- Samlet virkningsgrad under 75% - hvorfor?

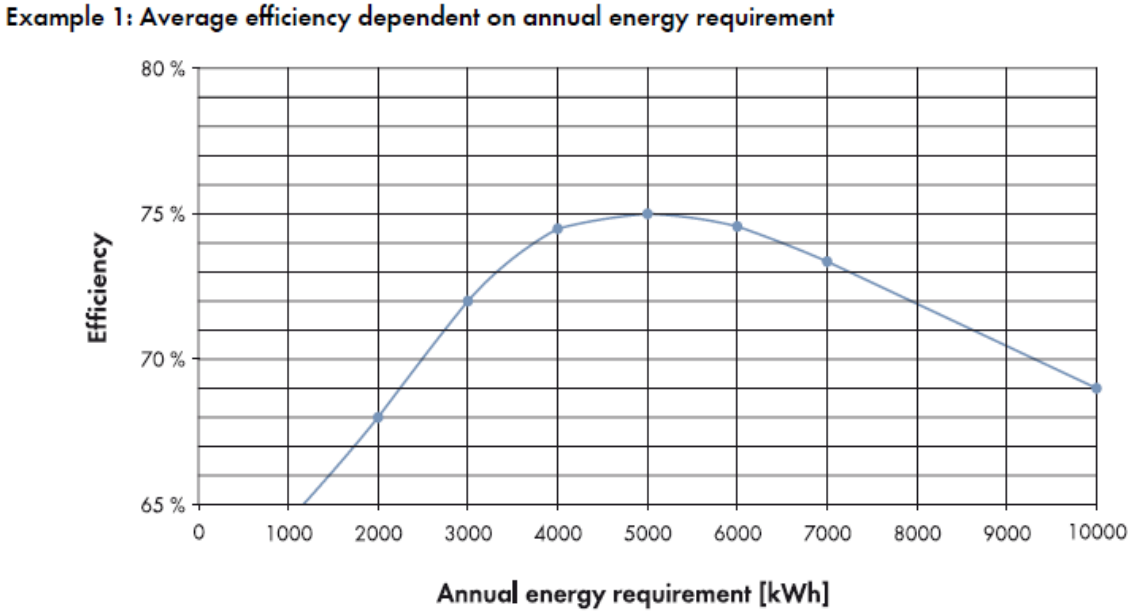

Figure 2: Average efficiency of an SMA Flexible Storage System with a Sunny Island 6.0H, a lead-acid battery with a usable battery capacity of 5 kWh and a PV generation of 5,000 kWh per year

Varmelagring /overslagsberegning

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- Ved SG drift er det muligt at hæve sætpunktet med op til 10 K for såvel buffertanken som varmtvandsbeholderen. Samlet volumen = 250 + 180 = 430 liter.
- Q = M*Cp*dT = 430 kg * 4,186 kJ/kgK * 10 K = 18000 kJ = 5,0 kWh varme
- Gulvets masse = 2300 kg/m3 * 0,1m*100m2 = 23000 kg
- Q = M*Cp*dT = 23000 * 2,38 kJ/kgK * 3 K = 164220 kJ = 45,6 kWh varme
- Fleksibelt elforbrug med VP vil være 15-20 kWh/cyklus

Varmelagring i betongulv

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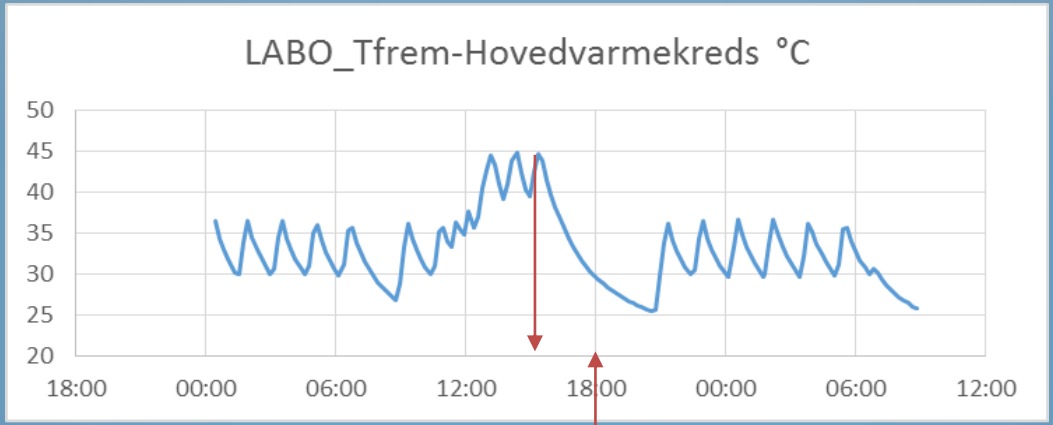

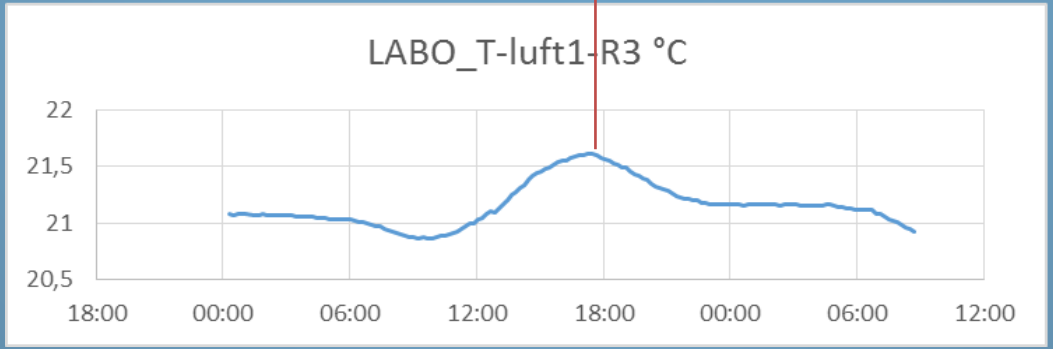

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Vigtige VVS detaljer

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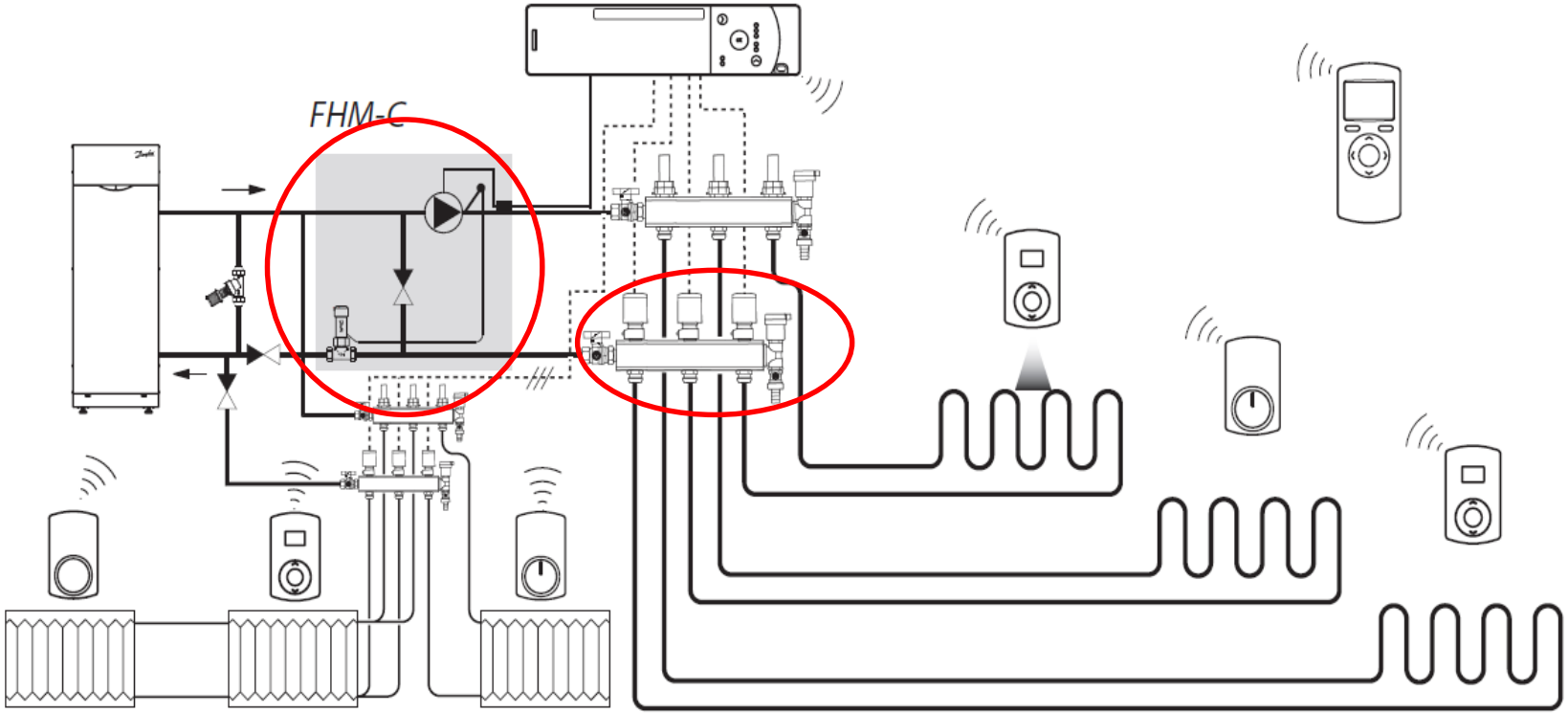
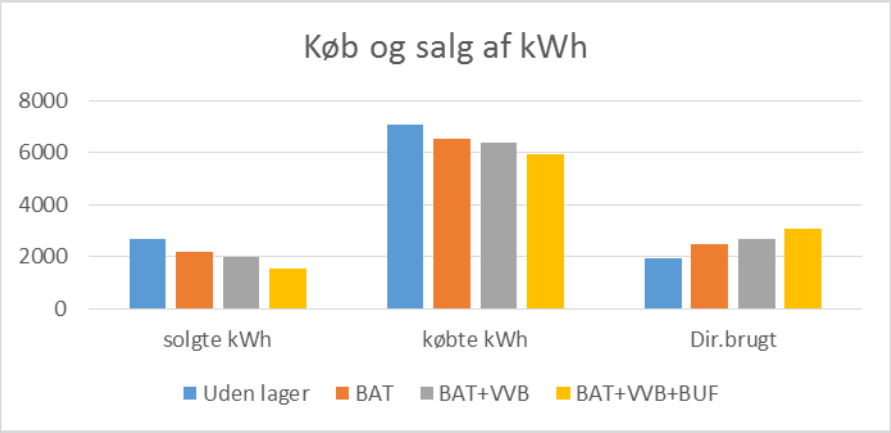


Beregningsværktøj

- Prioriteret anvendelse af egen el:
  - Alm. Forbrug
  - Batteriopladning
  - Forceret VP drift
  - Salg til nettet



Lagerkapacitet kWh		
BAT	2	elektrisk
VVB	2	termisk
BUF	15	termisk

Perspektiver

- Styring af feed-in effekt til nettet
- Reducere spidseffekt fra nettet
- Opladning/varmeproduktion med el fra nettet i lavtarif perioder

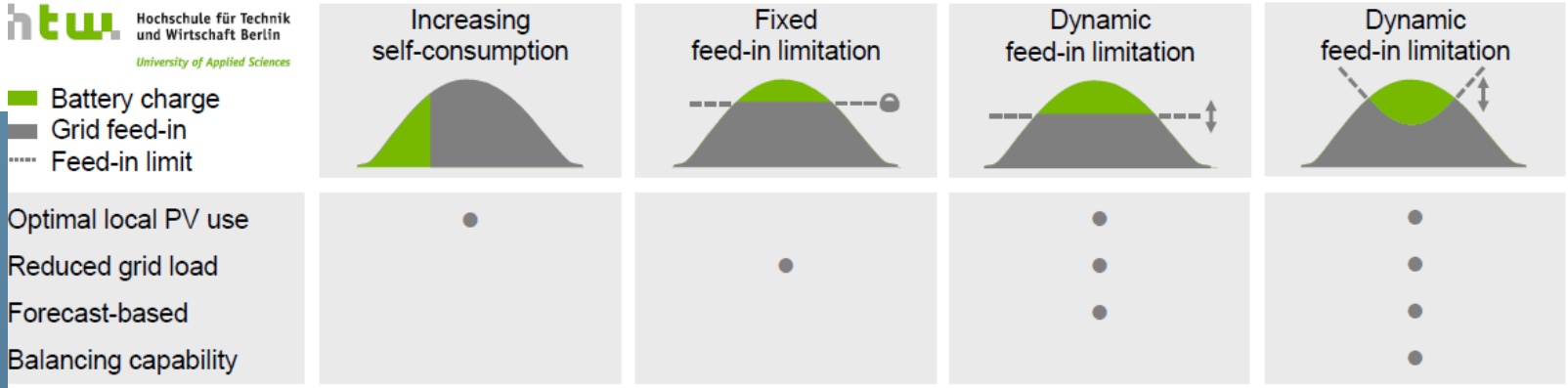


Fig. 9. Schematic representation of different operation strategies of PV battery systems and their properties

Hvad har vi lært?

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- Der er altid uforudsete vanskeligheder med nye koncepter
- Konverteringstabene kan være betydelige, især ved dellast/tomgang
- Selve batteriet har fungeret godt, men der har været problemer med kommunikationen til inverter/lader
- Regulering af batteriet i forhold til import/eksport har fungeret godt
- Inverteren kunne med fordel være mindre (bedre virkningsgrad i gennemsnit)
- Praktiske VVS udfordringer ved varmelagring

Tak for opmærksomheden!

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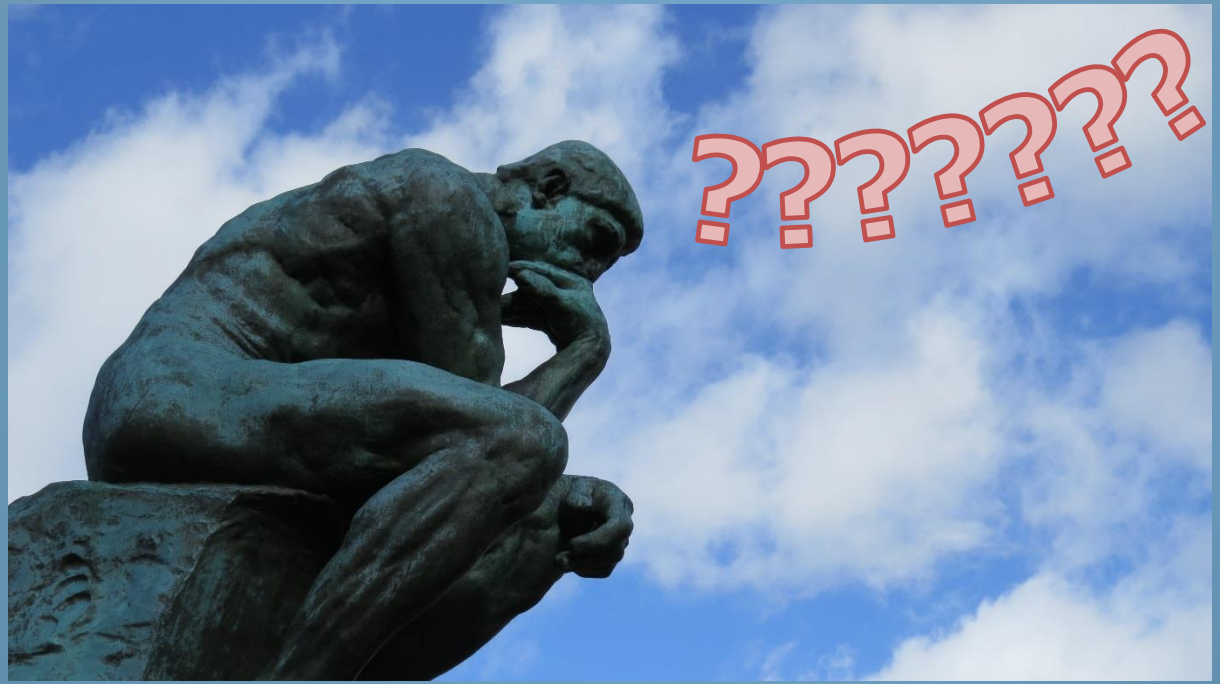
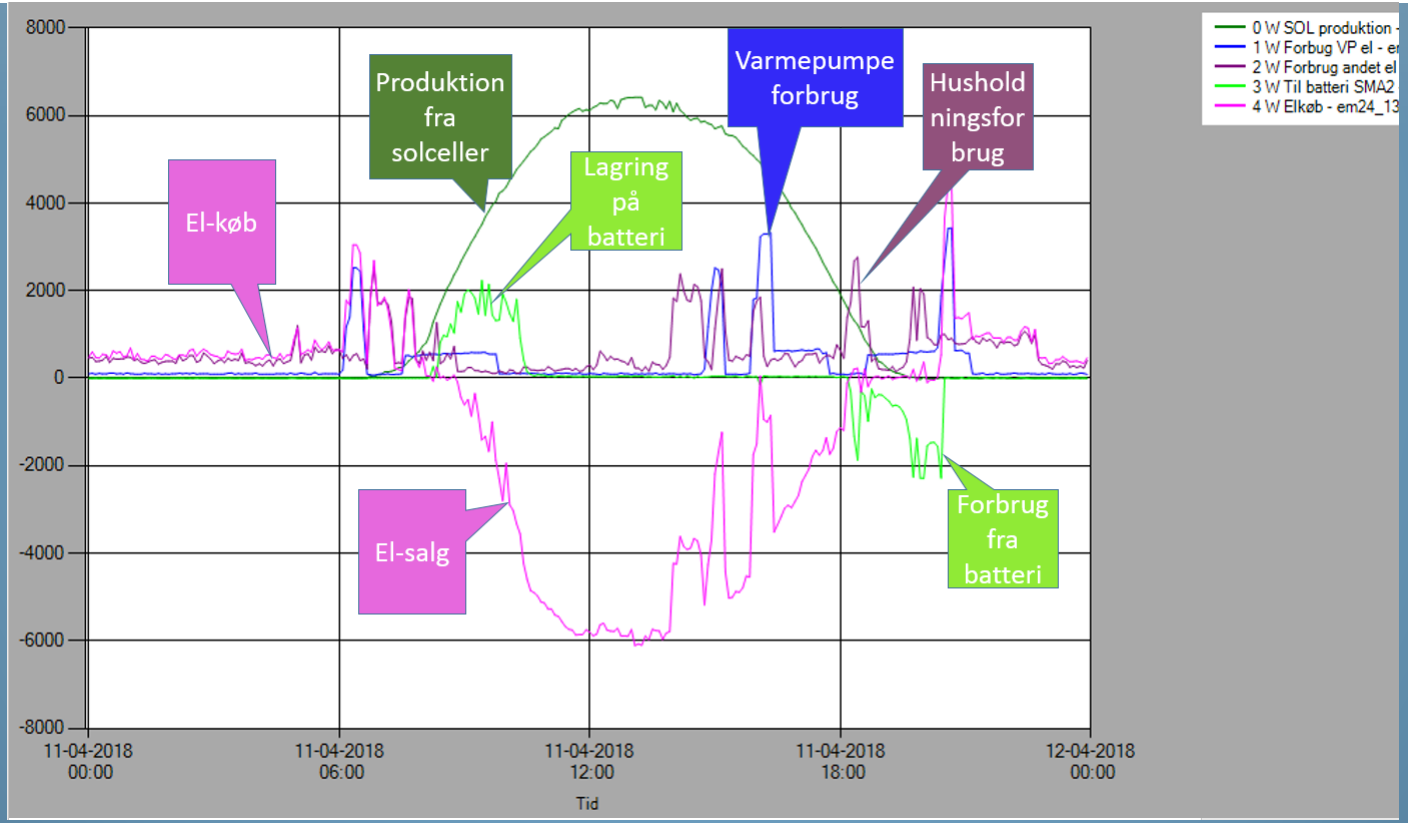


El-målinger

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