SCORES

SELF CONSUMPTION OF RENEWABLE ENERGY BY HYBRID STORAGE SYSTEMS

Training Course on Thermal Energy Storage for Heating, Cooling and DHW for Buildings

System Simulations

Keith O'Donovan, AEE - AT

ADENE, Lisbon, Portugal, 1st of April 2022

Why System Simulations?

- System Simulations capable of capturing the dynamic behaviour of all SCORES technologies integrated into both buildings were deemed necessary for two main purposes:

  1. To be able to test the predictions and decision making logic behind the BEMS algorithm in a **virtual environment** prior to comissioning of the demonstrators.

  2. To evaluate the expected performance of projected **Scores Future Systems (SFS)** for a number of different system configurations and external market price models.
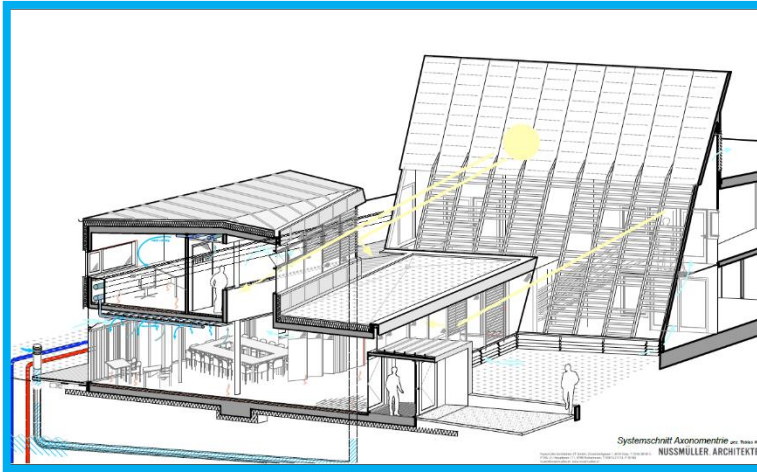
BEMS Testing/Validation

- BEMS makes predictions of PV generation and consumption
- Comparisons made with simulation models for accuracy
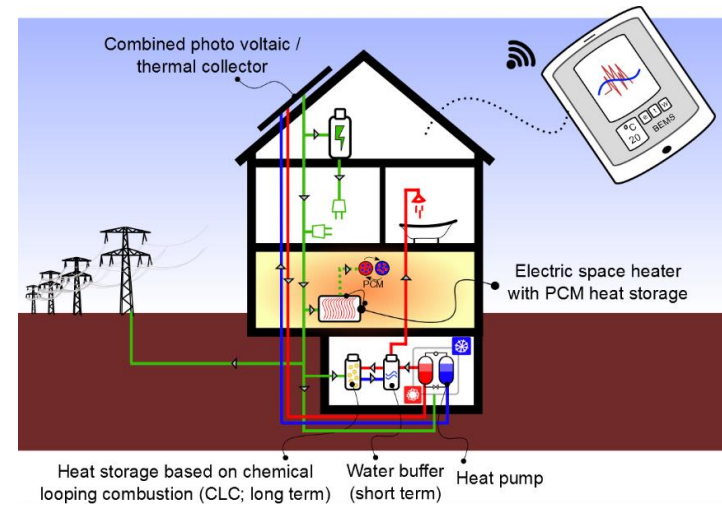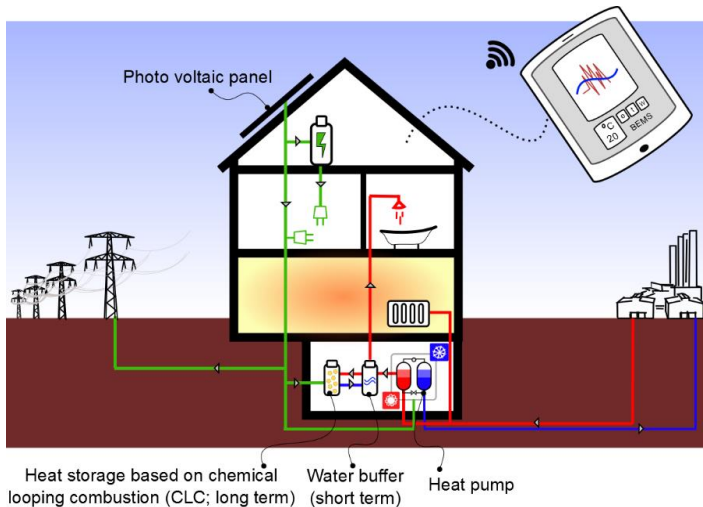- Checks with BEMS decisions (charging/discharging) with existing suplurs in simulation
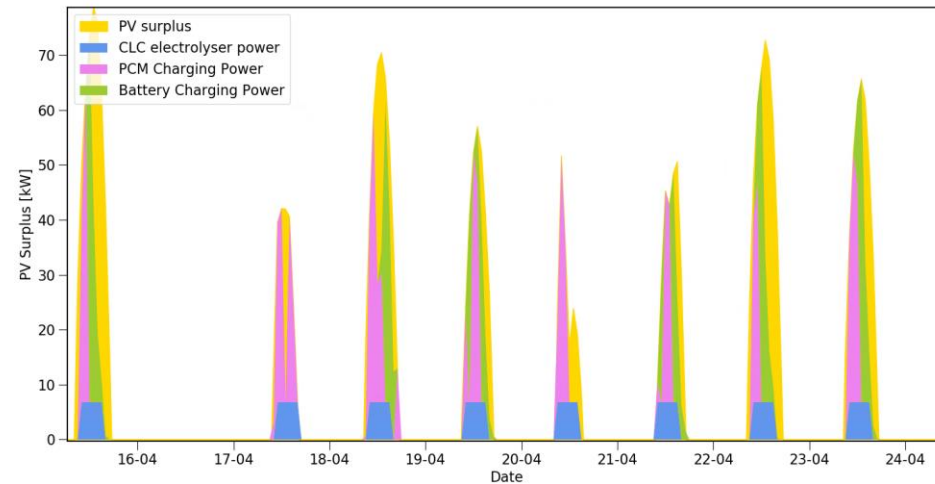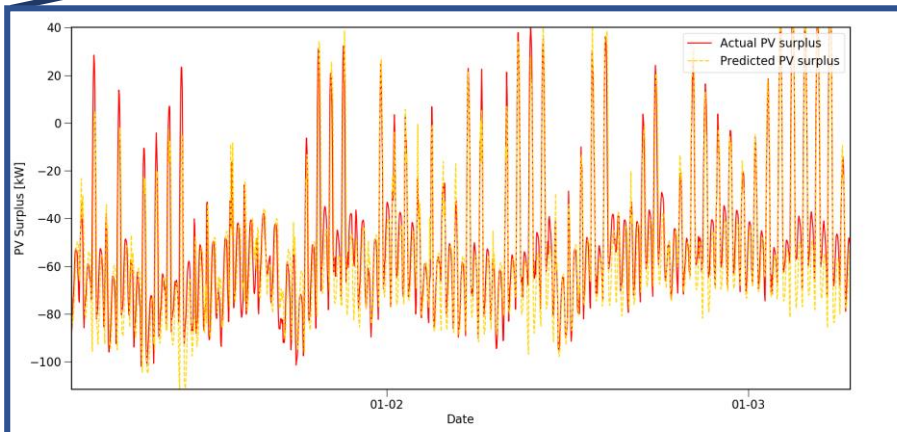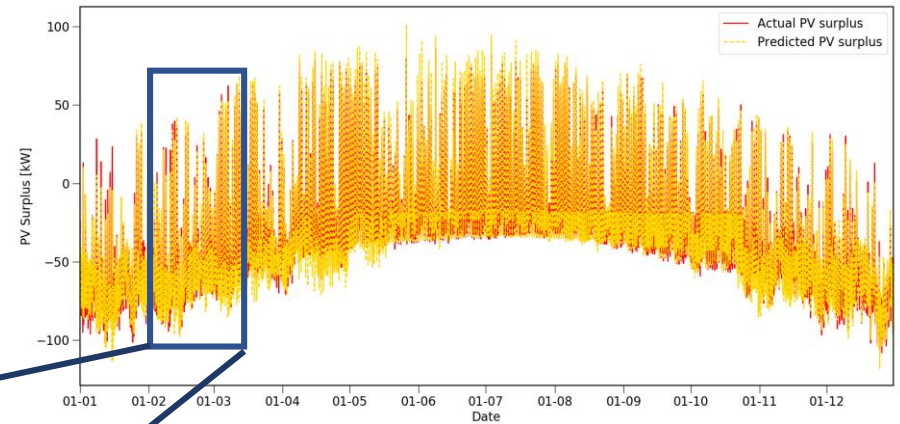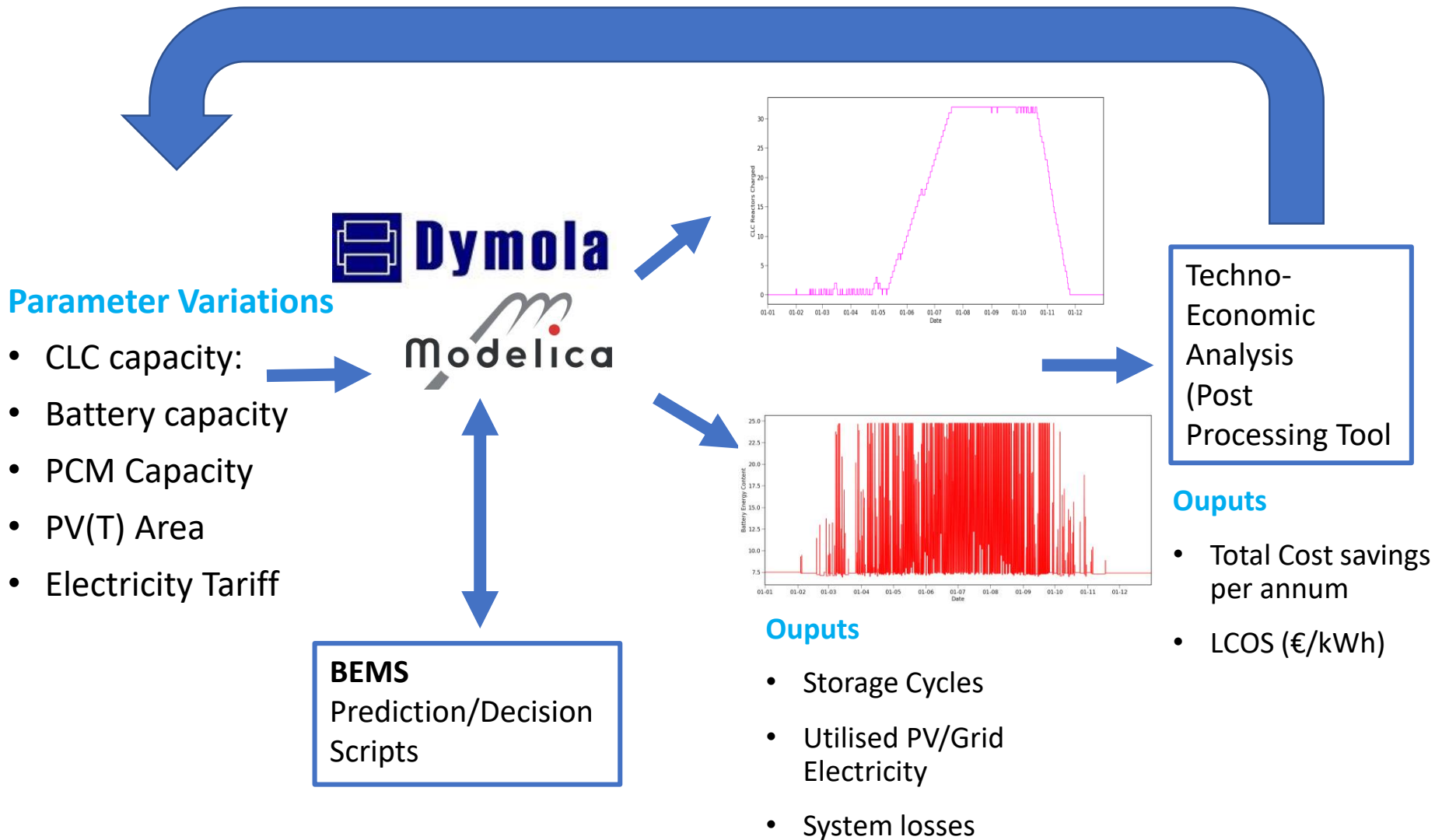
SCORES Systems

Scores System A: Gleisdorf, Austria

Scores System B: Agen, France

Simulation Workflow

Parameter Variations

- CLC capacity:
- Battery capacity
- PCM Capacity
- PV(T) Area
- Electricity Tariff

BEMS
Prediction/Decision Scripts

Ouputs

- Storage Cycles
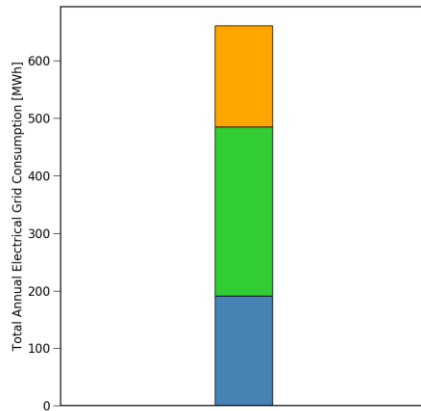- Utilised PV/Grid Electricity
- System losses

Techno-Economic Analysis (Post Processing Tool
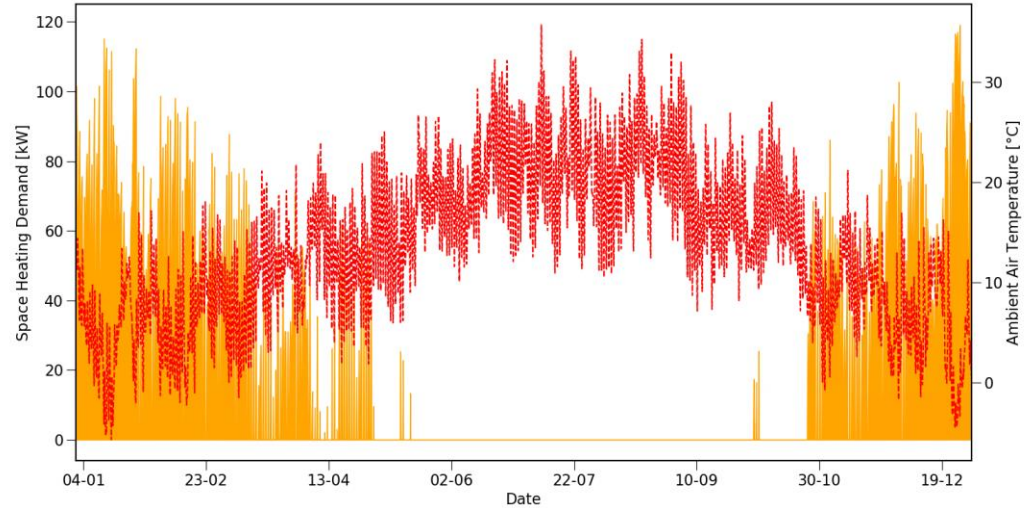
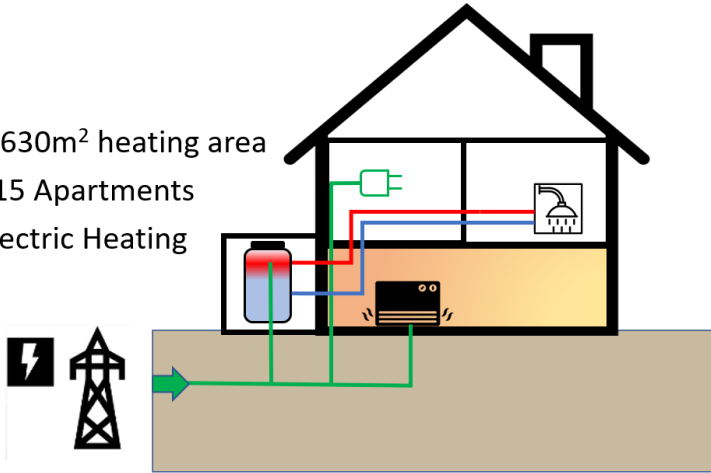**Ouputs**

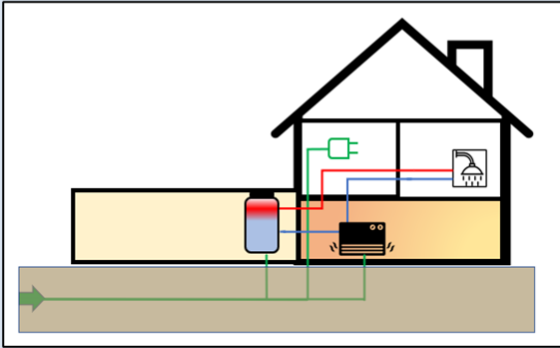- Total Cost savings per annum
- LCOS (€/kWh)

French Building – Reference Case – Ref-B

- 5,630m² heating area
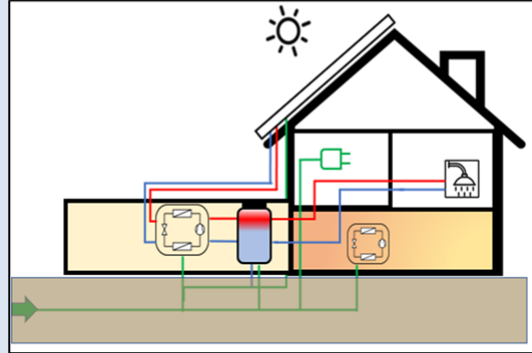- 115 Apartments
- Electric Heating
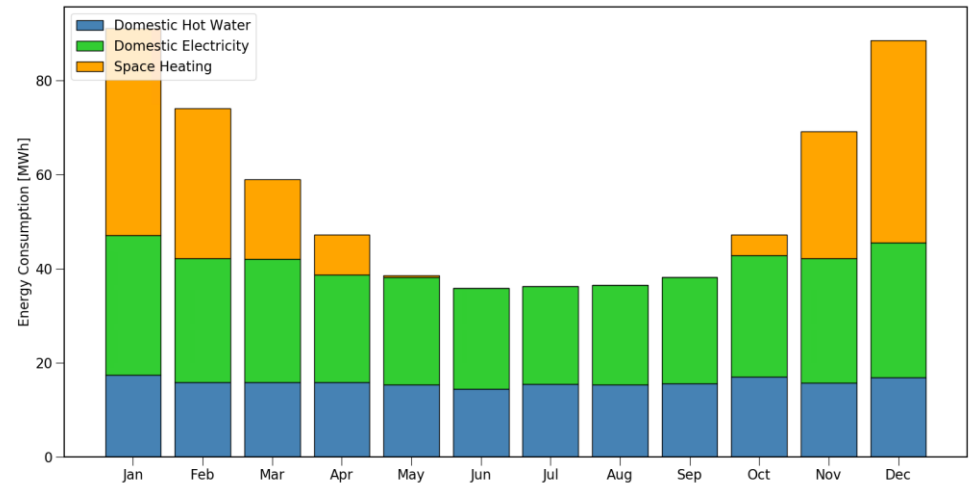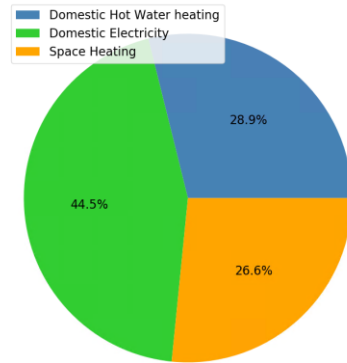
SCORES

SCORES System Comparisons
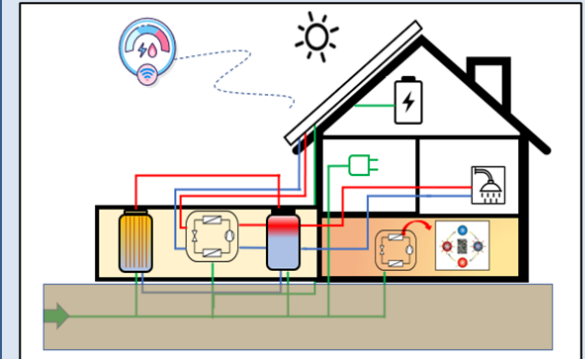

Reference Case
- all electricty from the grid
- electric heaters for heating
- hot water buffers for DHW

Self-Generation Case
- roof mounted PVT (800m^2)
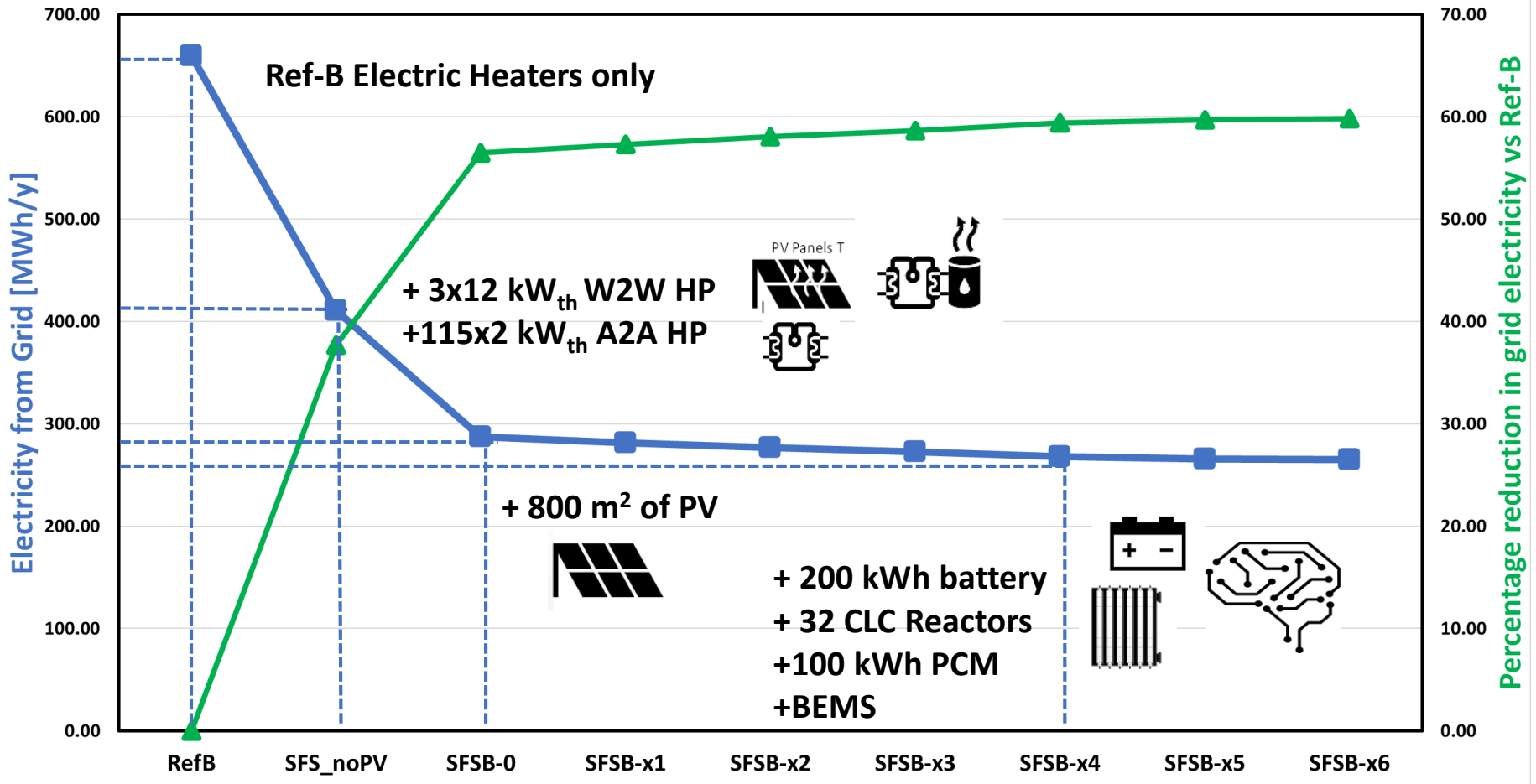- heat pumps for DHW (36kW$_{th}$)
- air-to-air heat pumps for heating
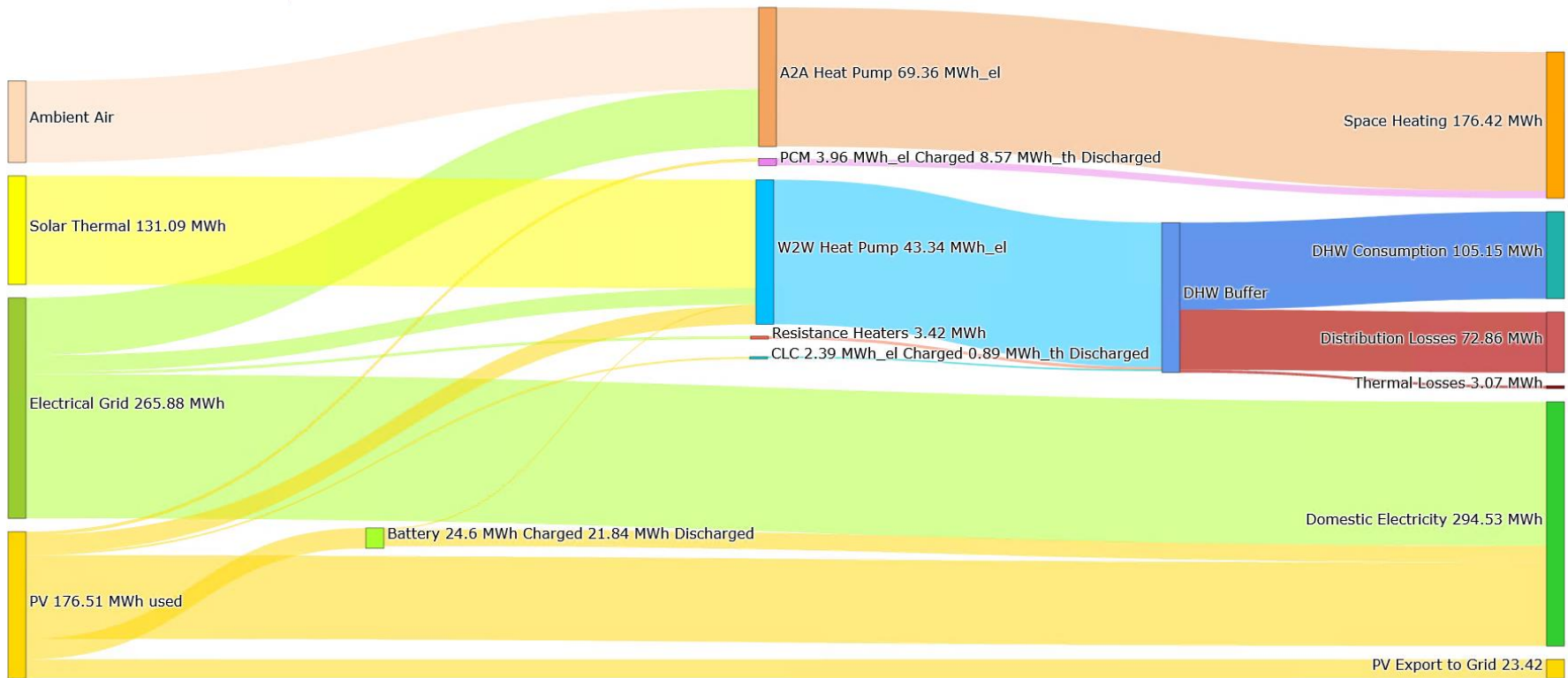
Scores Future System
- Electrical battery storage
- PCM storage in air-to-air heat pumps
- REDOX heat battery
- BEMS control algorithm

SCORES

SFS-B French Building –Parameter Sweep

Electricity from Grid for SFS-B Configurations

SFS-B – 200 kWh Battery – Yearly Energy Flows

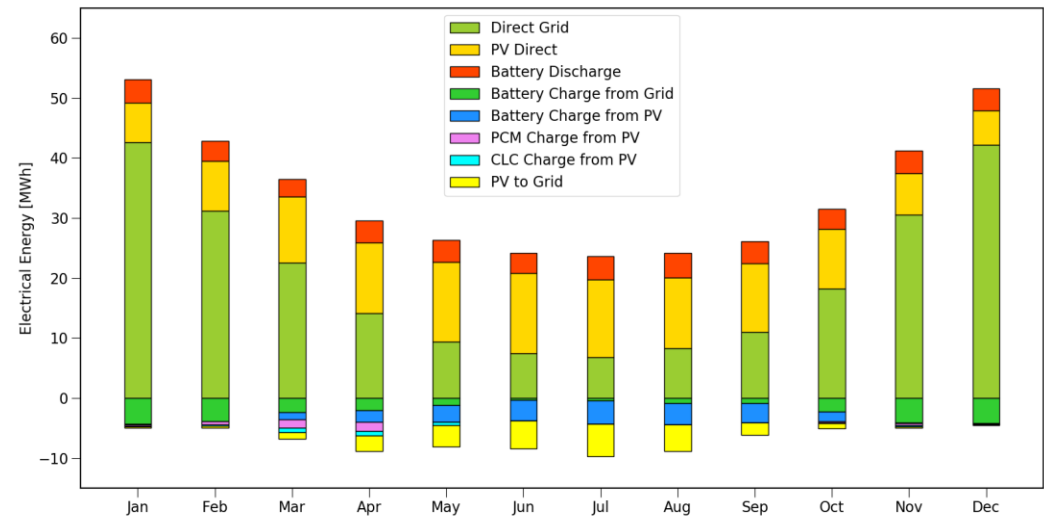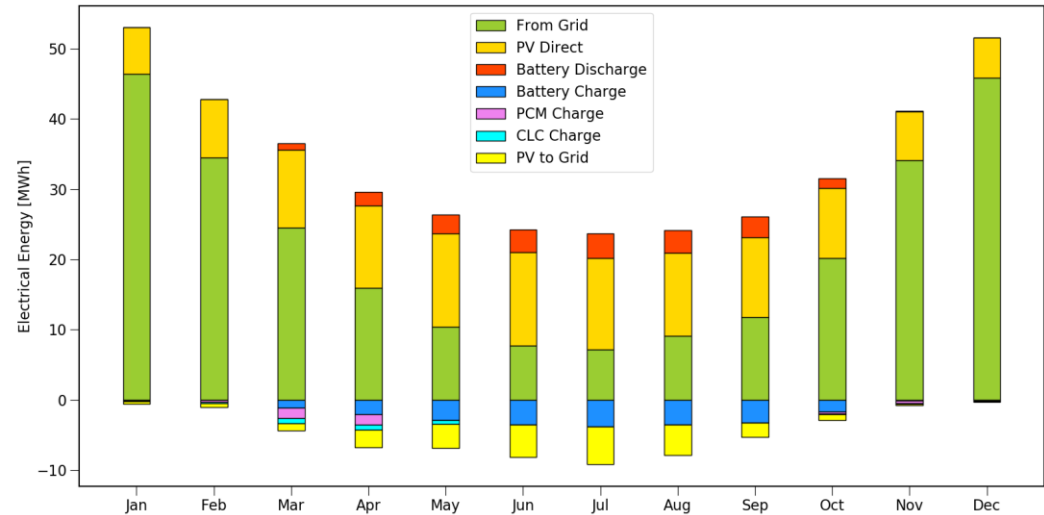Large amount of PV electricity consumed directly by the building

SCORES

SFS-B 200kWh Bat – Two Pricing Signals

- Flat Tarif Pricing:
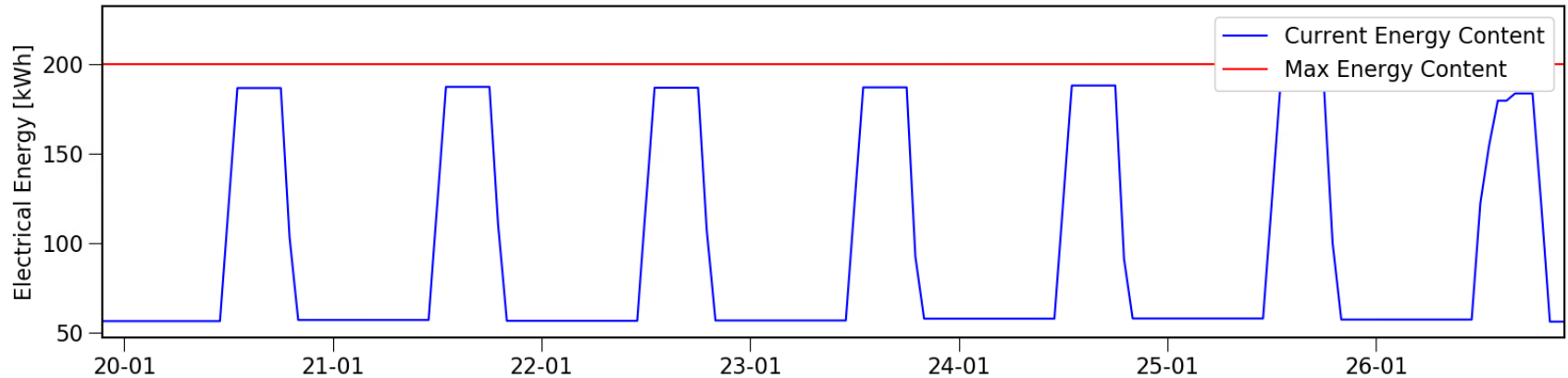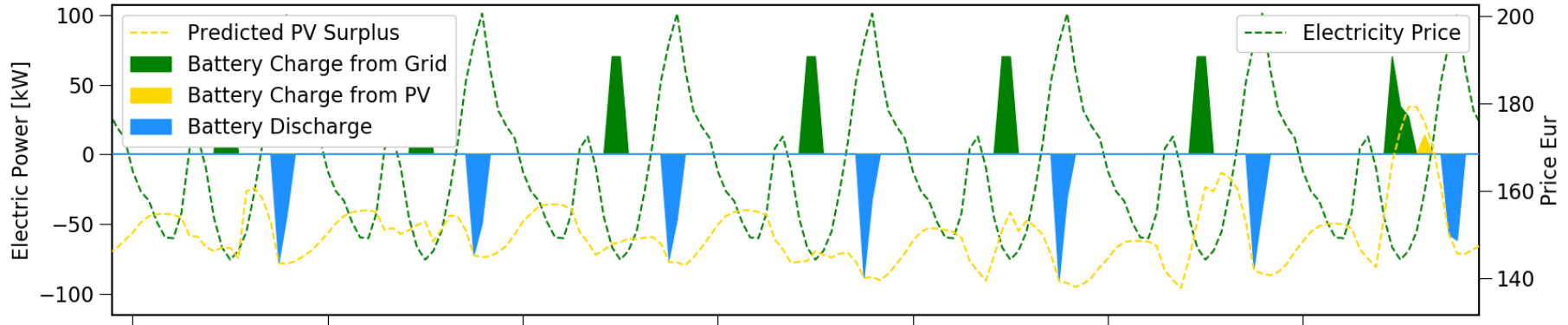 - Total electricity from grid: **268 GWh**
  - PV **25.4 GWh**
  - Battery cycles: 98.5

- Day-Ahead Pricing:
  - Total electricity from grid: **271 GWh**
  - PV exported: **25.5 GWh**
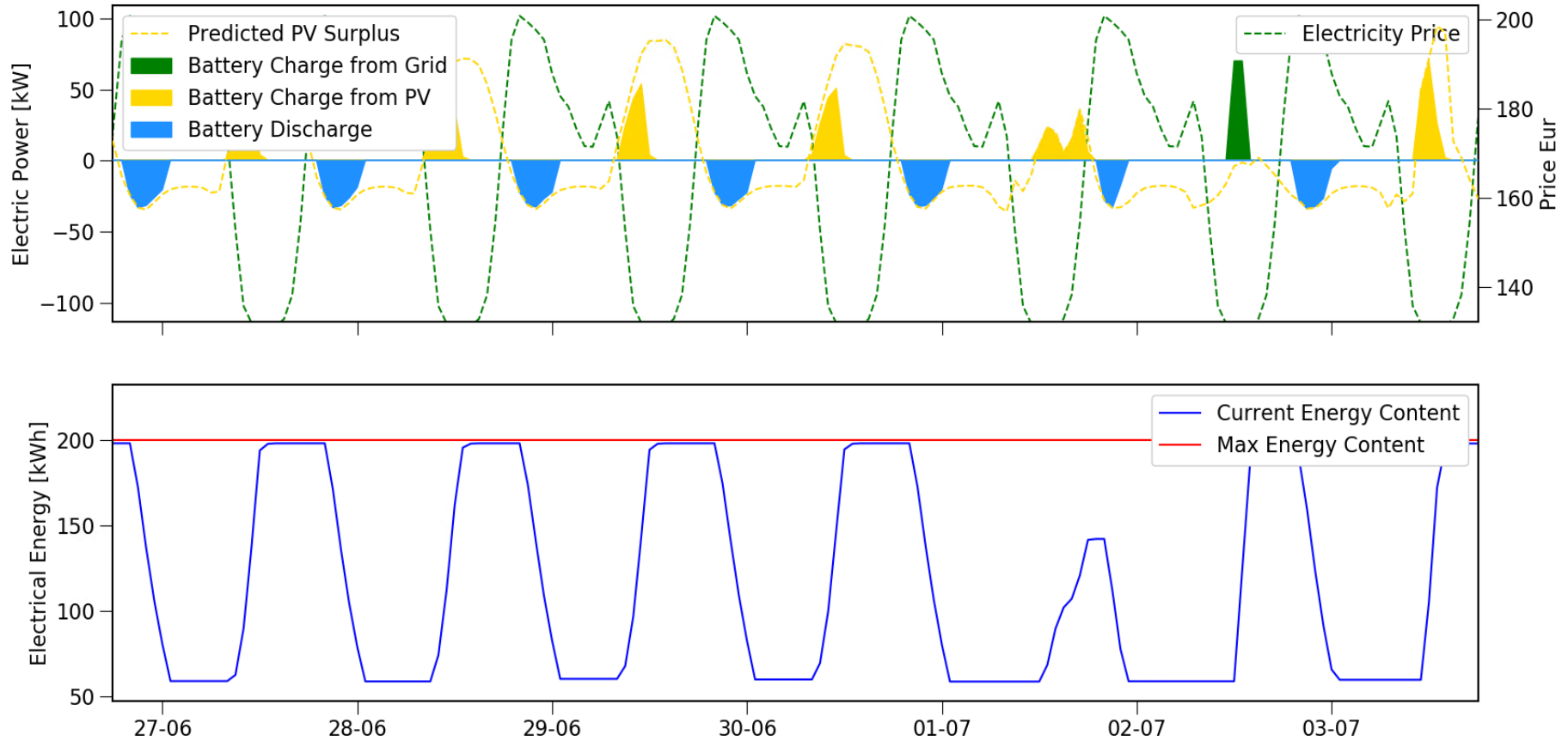 - Battery cycles: 216

www.scores-project.eu

Economic Algorithm

Winter Week (200kWh Battery, SFS-B)

Economic Algorithm

Summer Week (200kWh Battery, SFS-B)

www.scores-project.eu

Austrian Building – Ref Case A

- 1,025m^2 heating area
- 6 Multifamily Houses
- Office Space
- Low Temperature DH

T_{fw} = 45-70°C

T_{ret} = 25-30 ° C
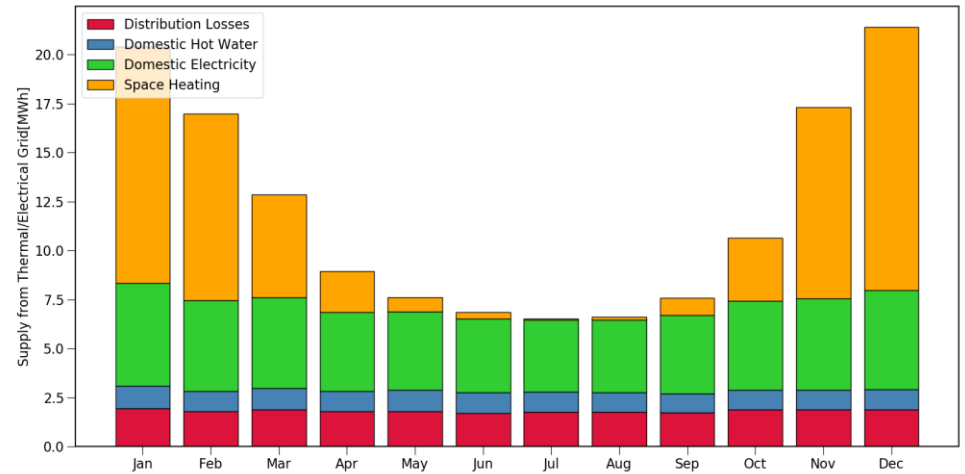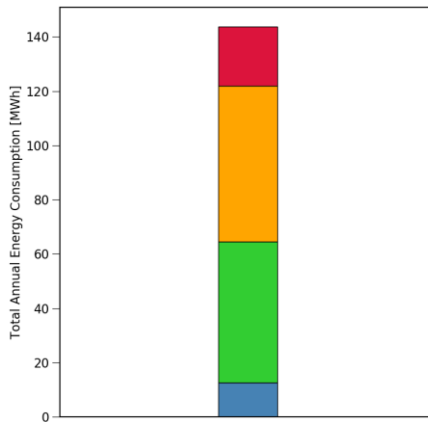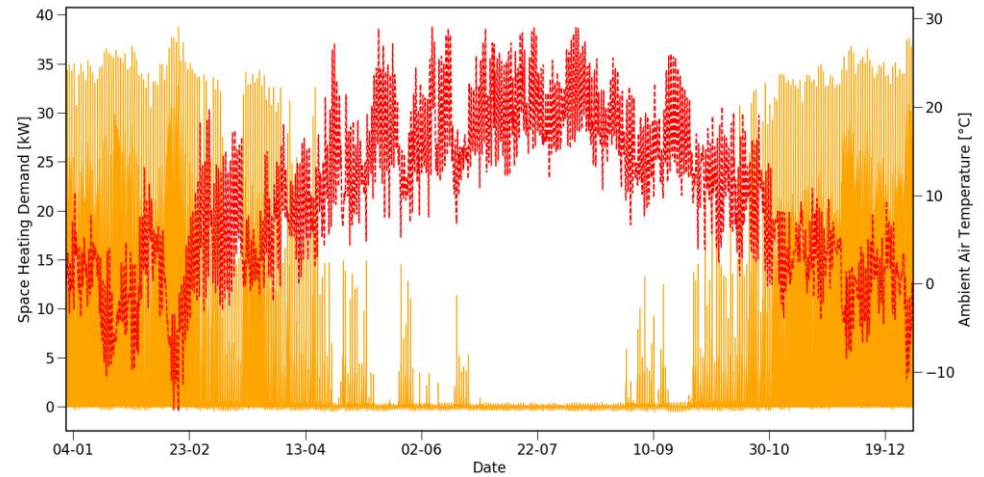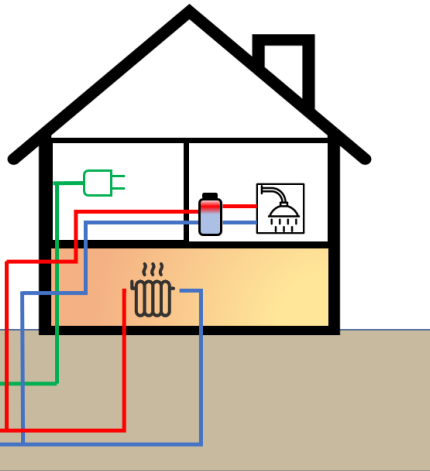
Austrian Building – SFS-A
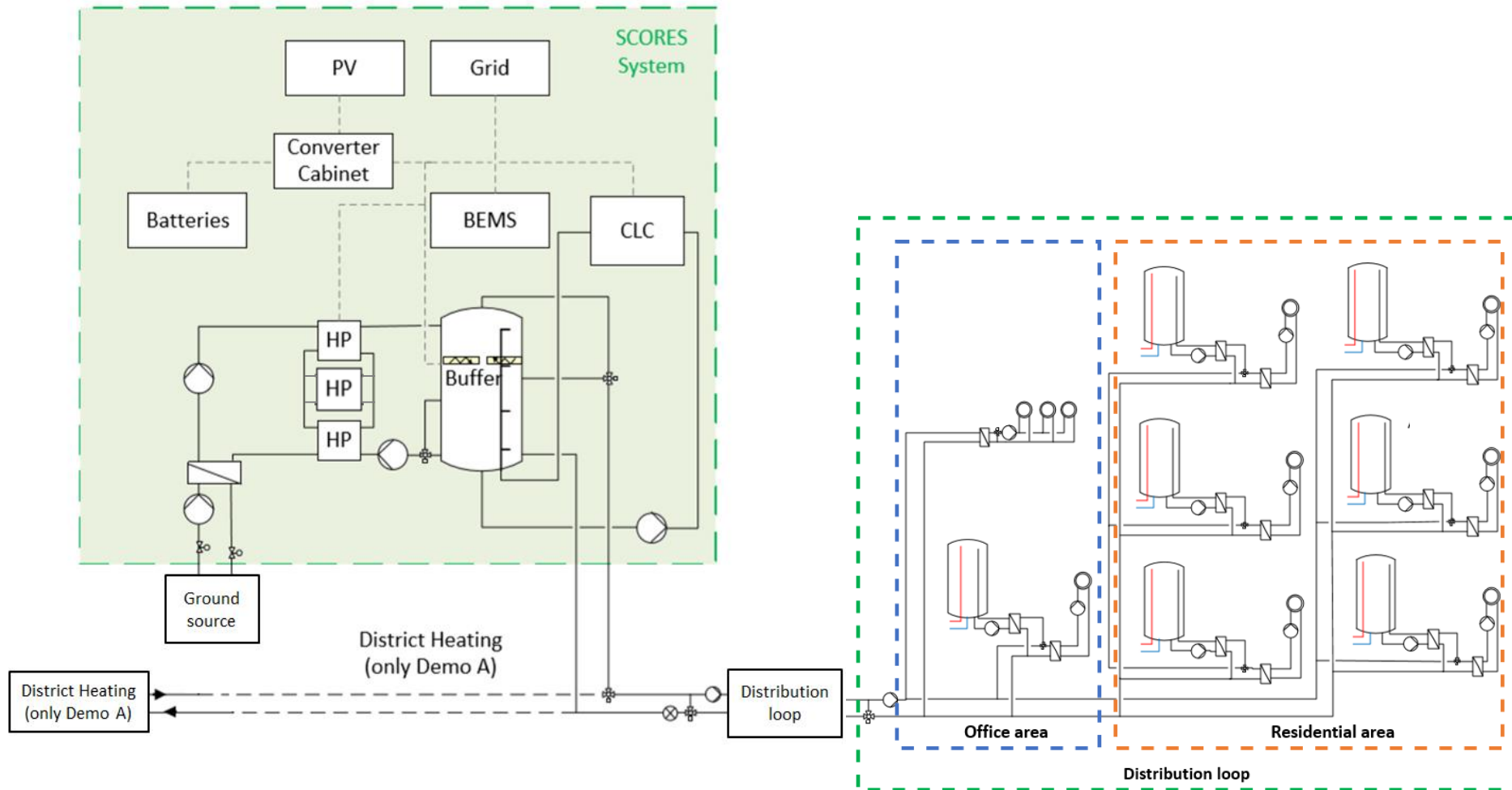
SFS-A Austrian Building – Parameter Sweep

Energy from DH + Electricity Grid for SFS-A Configurations

Ref-A DH only

+ 3x12kW$_{th}$ W2W HP

+ 240 m^2 of PV

+ 150 kWh Battery
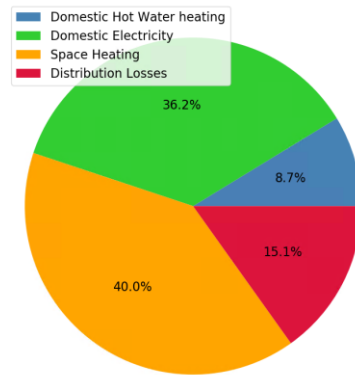+ 32 CLC Reactors
+BEMS

Total Energy from DH + Electric Grid [MWh]

Percentage reduction in grid electricity vs Ref-A

SCORES

SFS-A – 150 kWh Battery – Yearly Energy Flows

SFS-A Yearly Energy Flows Bat 150.0 kWh

Ground Source 61.19 MWh

DH Grid 0.53 MWh

Electrical Grid 51.14 MWh

PV 45.48 MWh

HP Consumption 30.7 MWh

Scores Buffer

Distribution Point

CLC 1.89 MWh Charged 0.55 MWh Discharged

Battery 8.31 MWh Charged 7.01 MWh Discharged

Space Heating 57.56 MWh
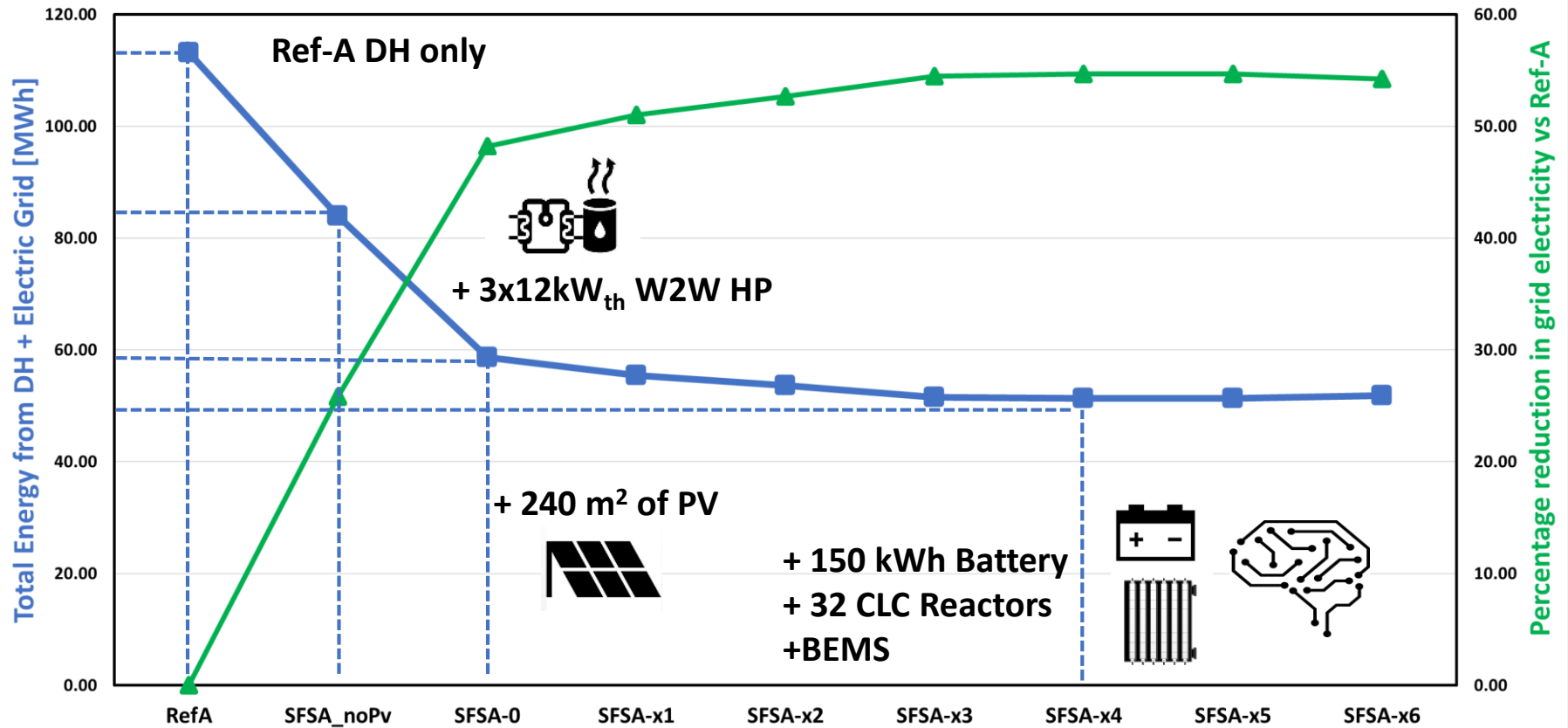
DHW buffers

Distribution Losses Total 25.31 MWh

DHW Consumption 7.7 MWh

Scores Buffer Losses 1.16 MWh
DHW Thermal Losses 0.4 MWh

Domestic Electricity 52.01 MWh

PV to Grid 10.27 MWh

22% more PV consumed through
introduction of battery and CLC
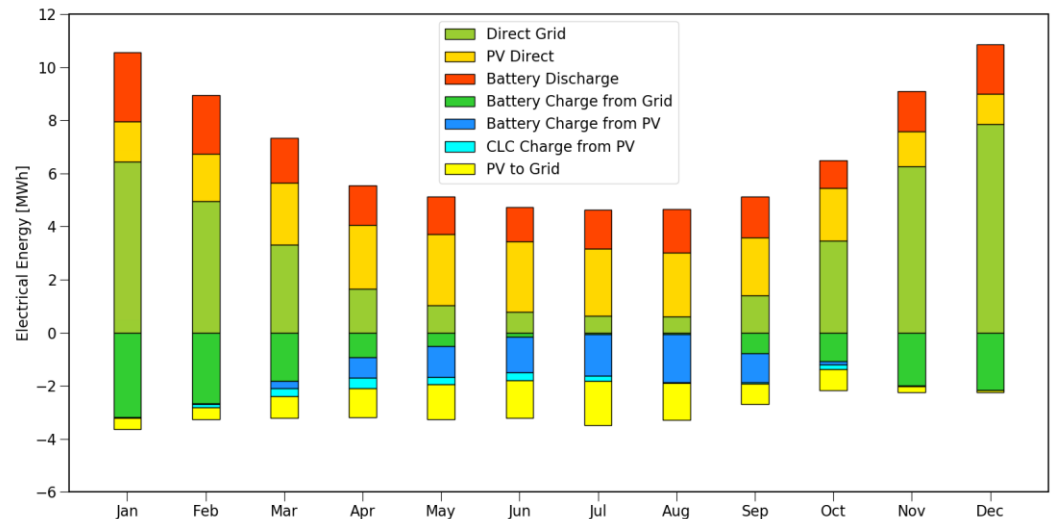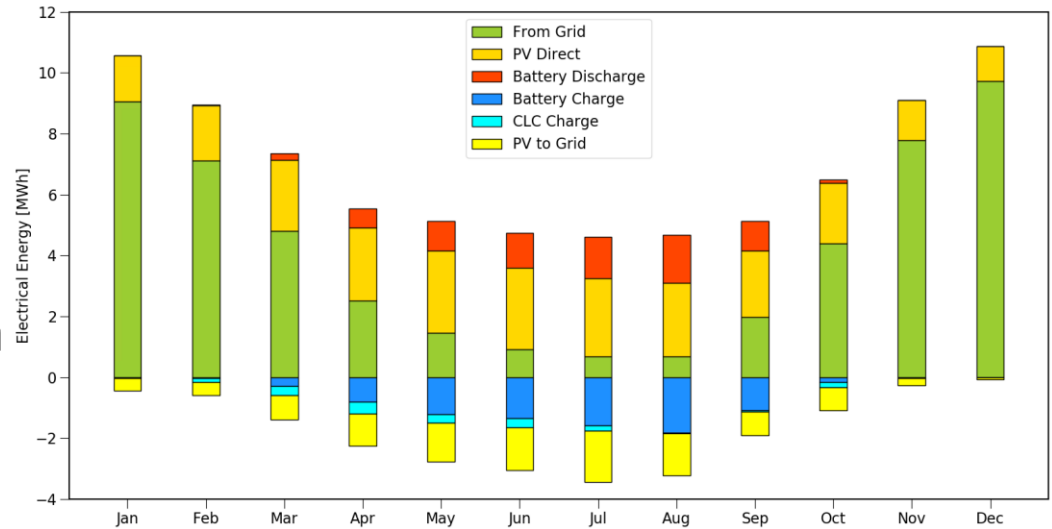
1st April 2022

SCORES

SFS-A 150kWh Bat – Two Pricing Signals

- Flat Tarif Pricing:
  - Total electricity from grid: **51.4 GWh**
  - PV exported **10.27 GWh**
  - Battery cycles: 46.7

- Day-Ahead Pricing:
  - Total electricity from grid: **53.75 GWh**
  - PV exported: **10.4 GWh**
  - Battery cycles: 131

www.scores-project.eu

Concluding Remarks

- System simulations could give an insight into the expected performance of the Scores technologies succesfully integrated in a building.

- Behaviour of physical models and consumption profiles could be successfully replicated with BEMS prediction scripts (actual predictions in the field much harder due to uncertainty of weather predictions and user behaviour)

- Room for improvement regarding optimal control of subsystems – more validations in the field neeed to instill more confidence in results.

SCORES

Thank you for your attention!

Questions? E-mail me: k.odonovan@aee.at