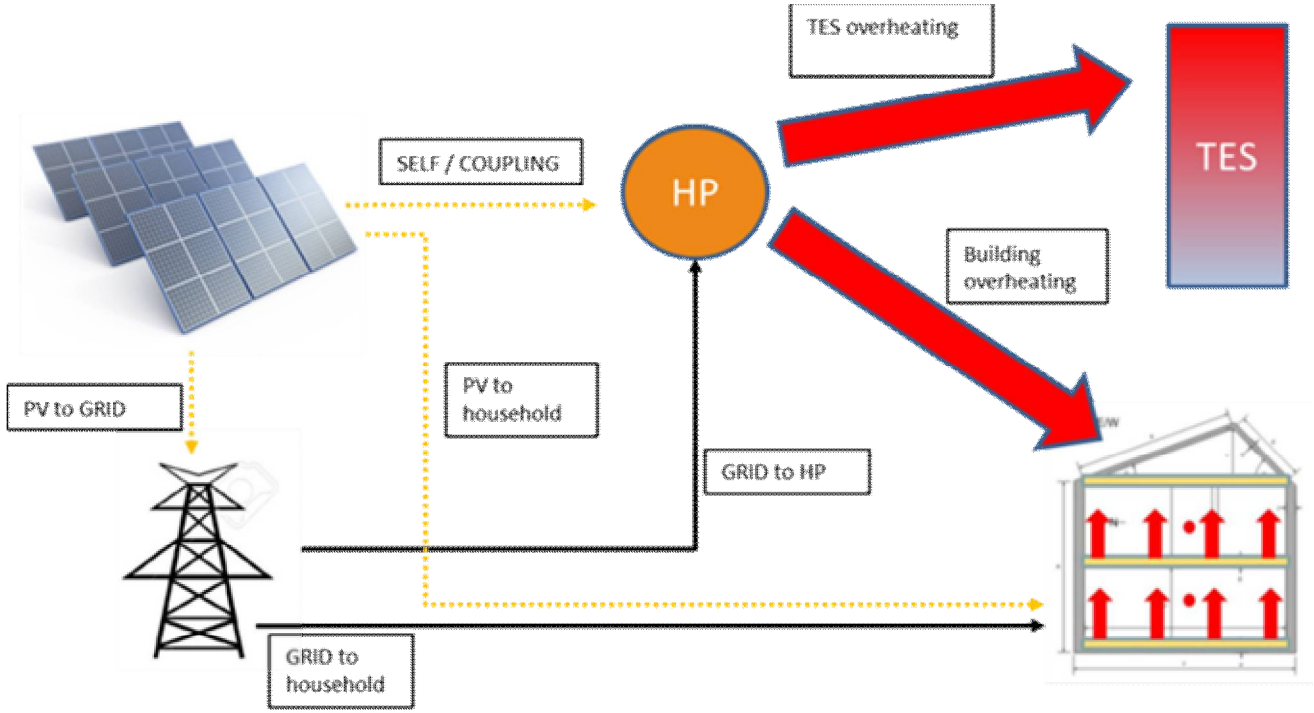
TheBat

PV coupled with HP

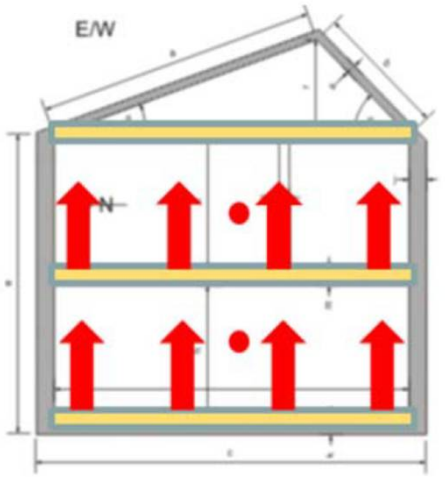
Building mass or a water store as **THE**rmal **BAT**tery

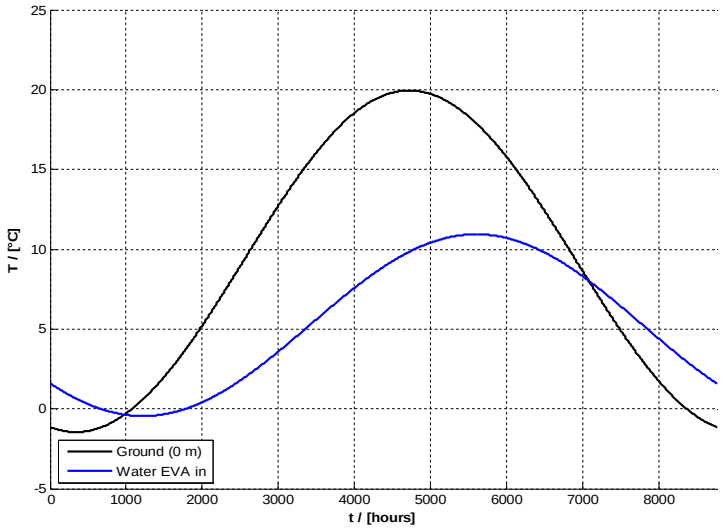


Alexander Thür, Toni Calabrese - University of Innsbruck

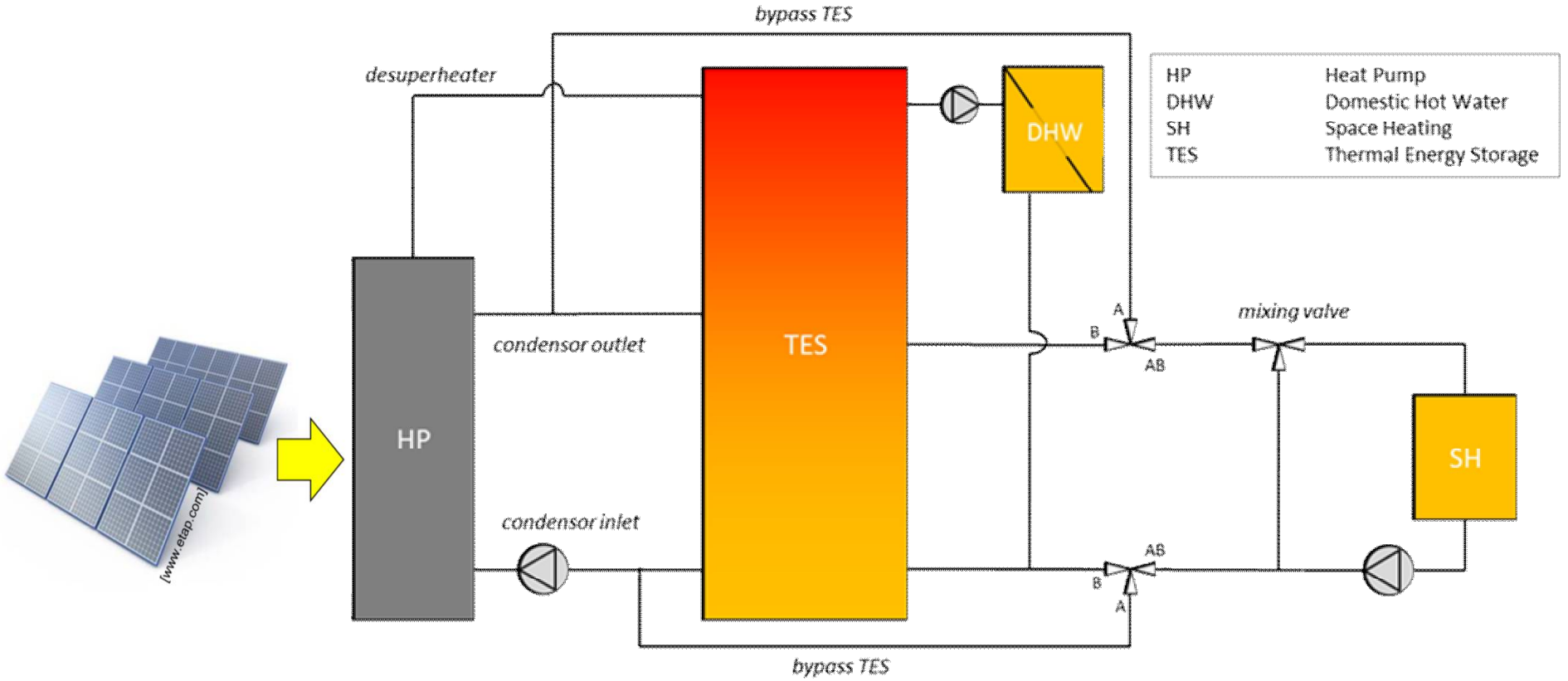
Single Family House – Building model

- Based on IEA SHC Task44
- detached SFH with **two floors heated**: ground floor (EG) and first floor (OG)
- Total living area of **140 m²**
- Unheated attic
- Two thermal zones (EG and OG) implemented in TRNSYS
- Ideal heating demand (HD) of **45 kWh/ (m² a) (RES 45)**
- Daily occupation profile and electrical gains (based on IEA SHC Task 44)
- **Ground temperature** modelled using the Kasuda model (Type 77)
- Water temp. into evaporator: **T_WATER_HP = T_soil – 4°C**





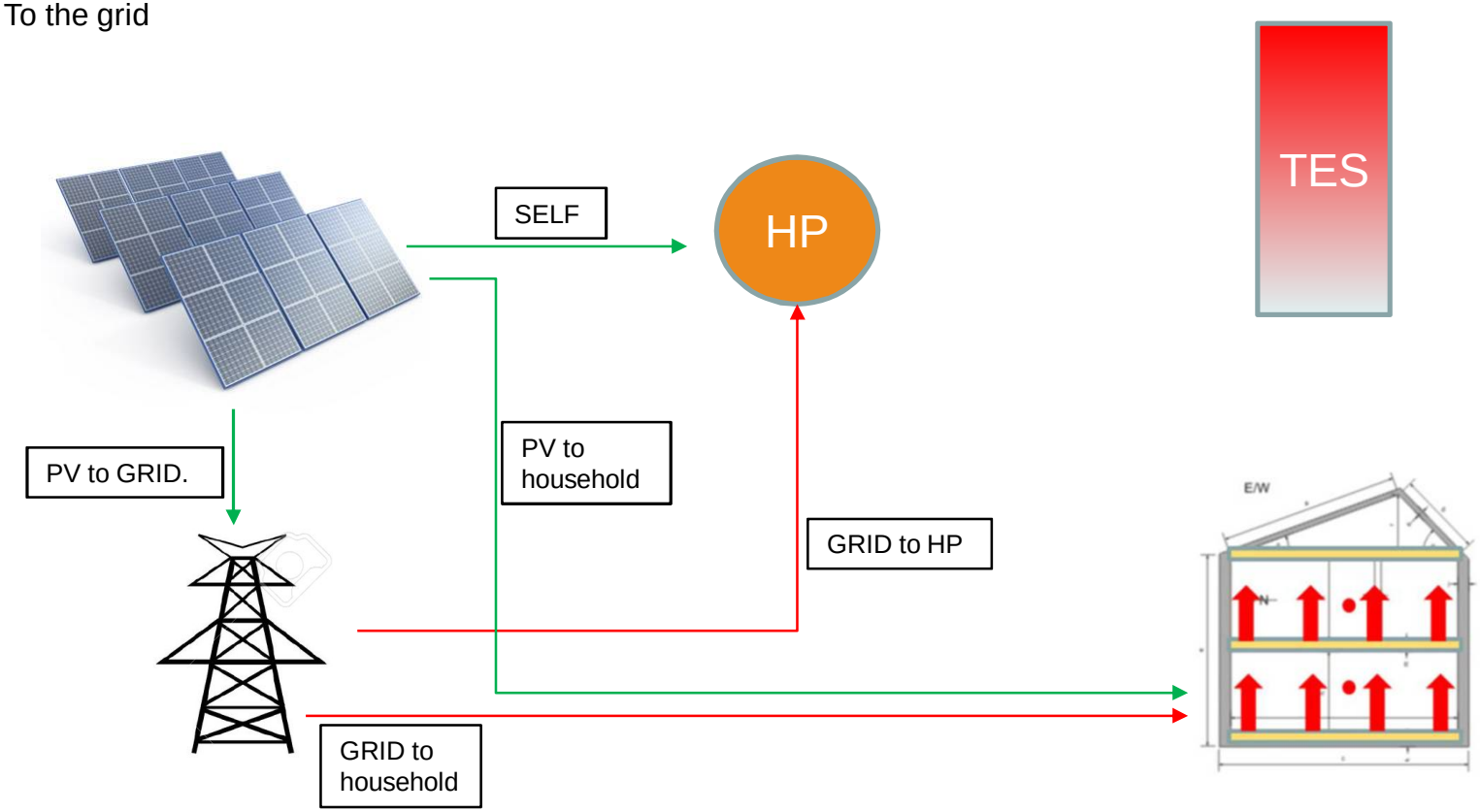
System design



New control strategies: Self consumption

The PV electricity goes:

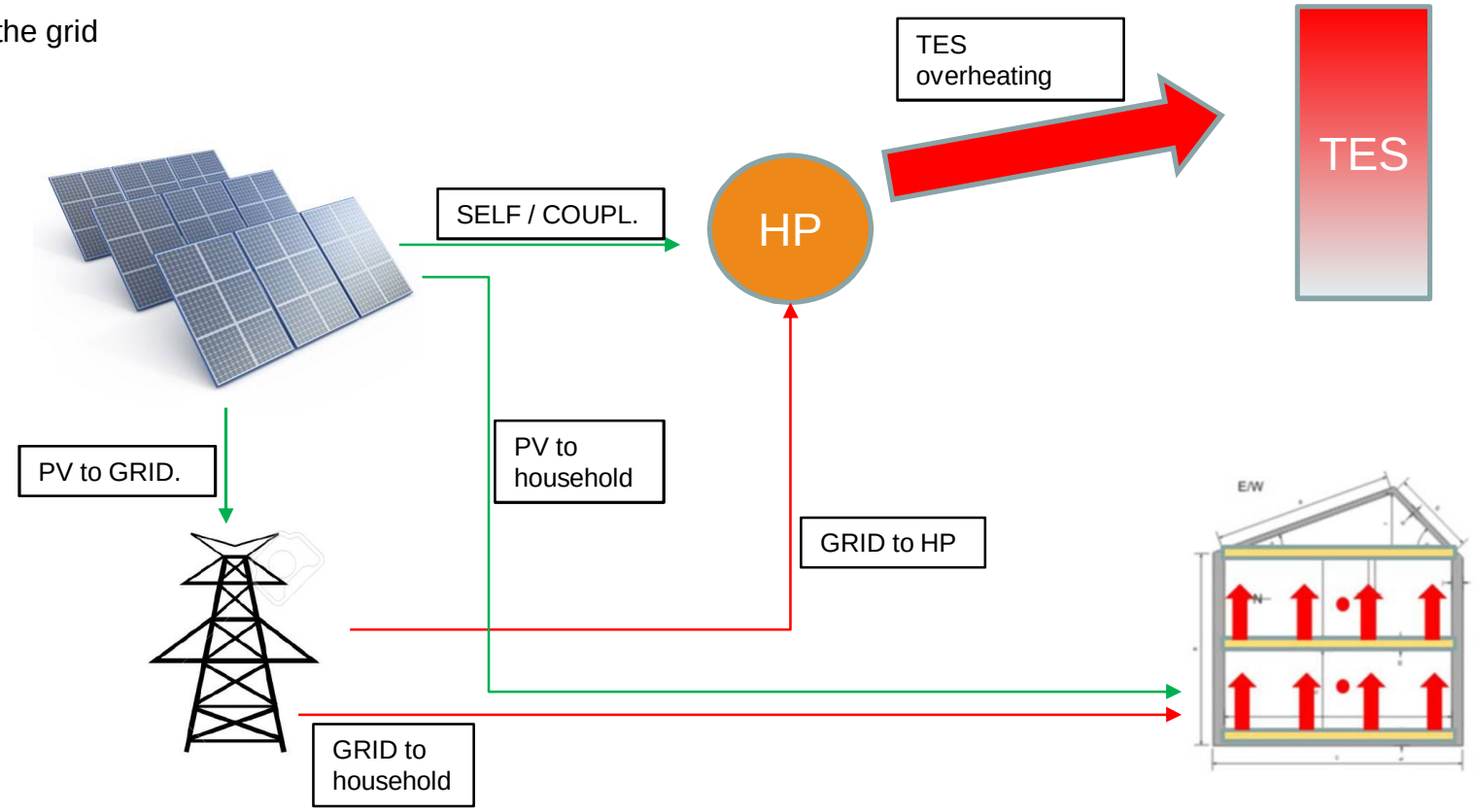
1. To the heat pump **[SELF]**
2. To the building for the household electricity **[HH]**
3. To the grid



New control strategies: Overheating of the TES

The PV electricity goes:

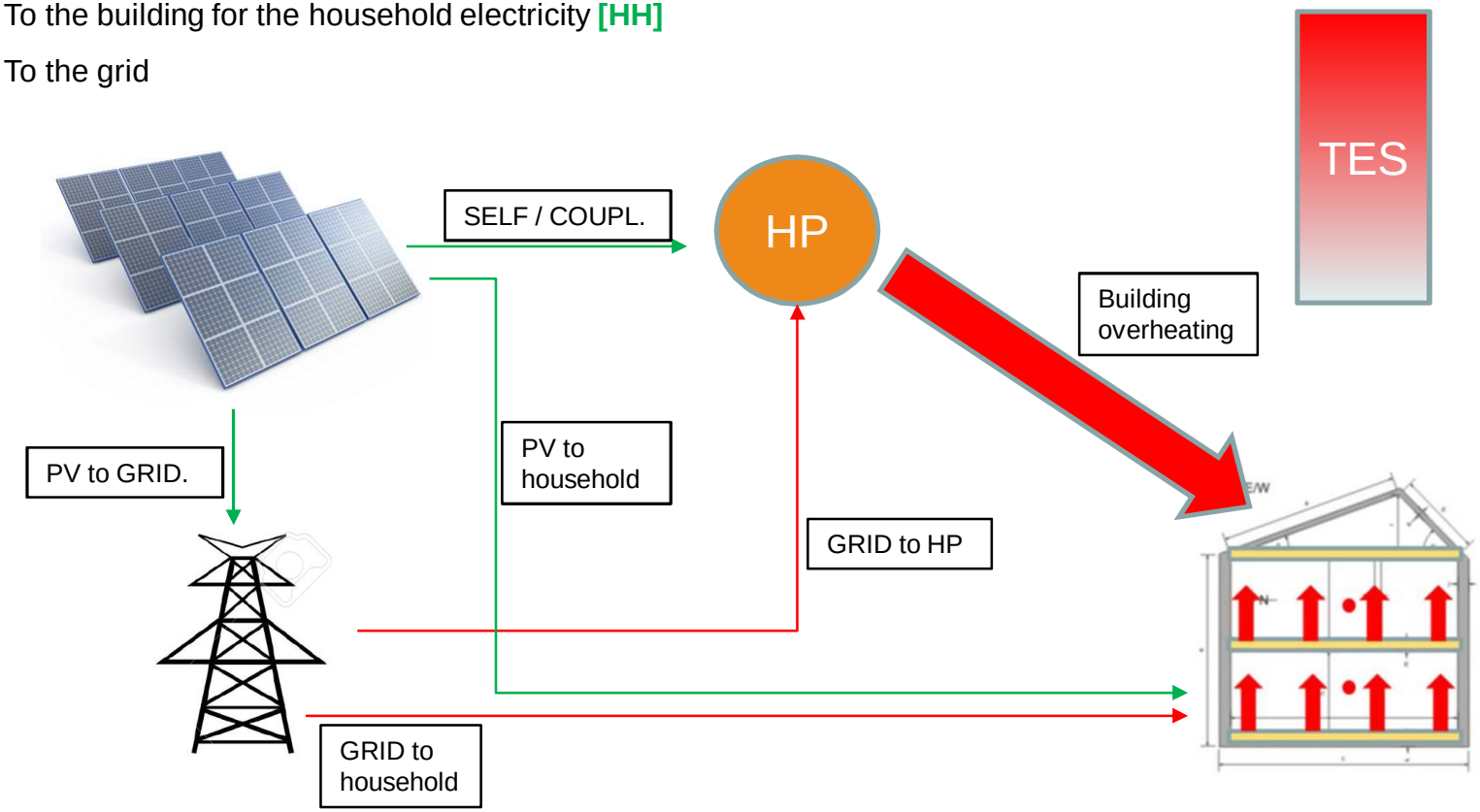
1. To the heat pump in modality **[SELF]** or in modality [COUPL] to **overheat the whole TES** (until 60°C) **[COUPL_TES]**
2. To the building for the household electricity **[HH]**
3. To the grid



New control strategies: Overheating of the building

The PV electricity goes:

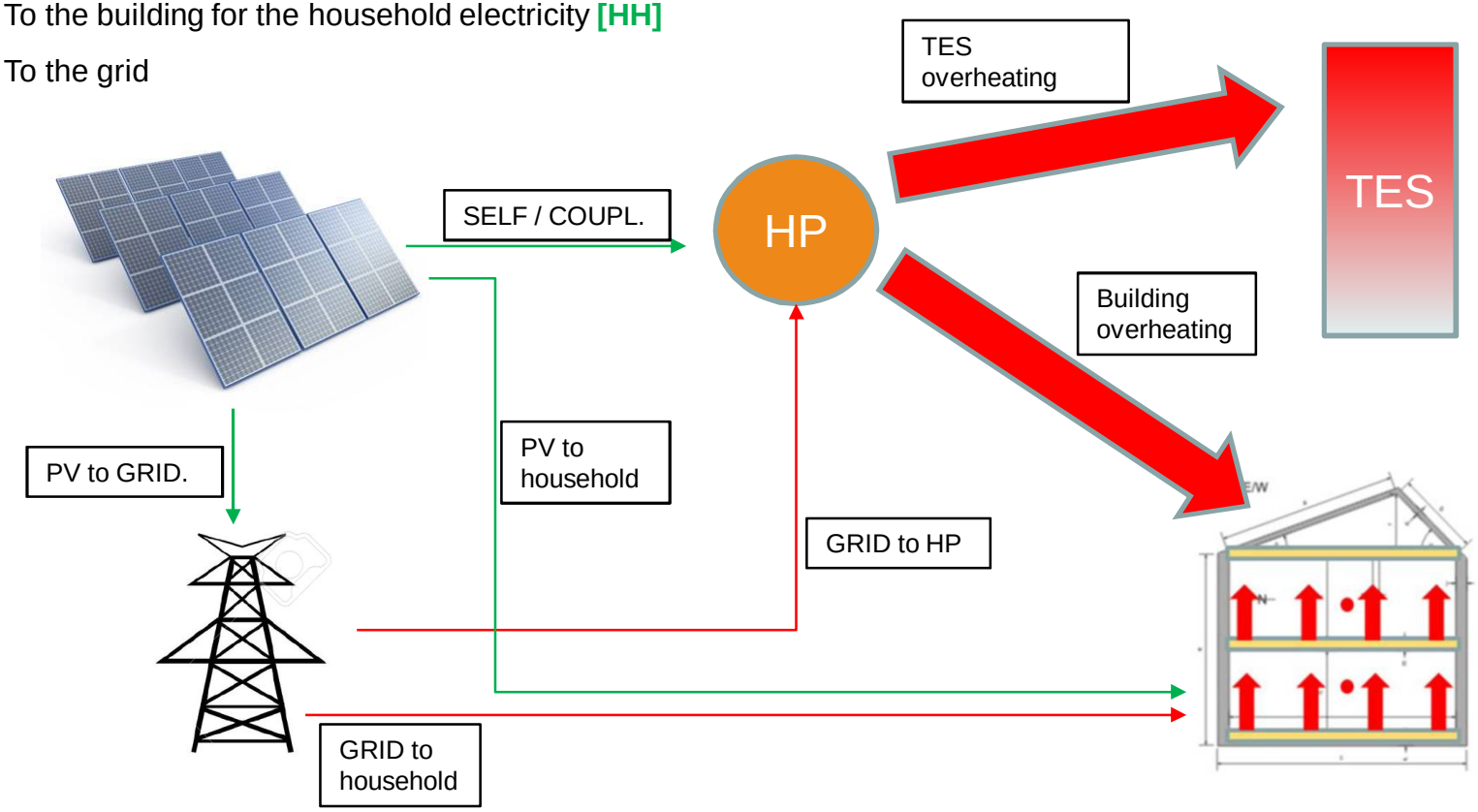
1. To the heat pump in modality **[SELF]** or in modality [COUPL] to **overheat the building during the heating season** (until 26°C) **[COUPL_bui]**
2. To the building for the household electricity **[HH]**
3. To the grid



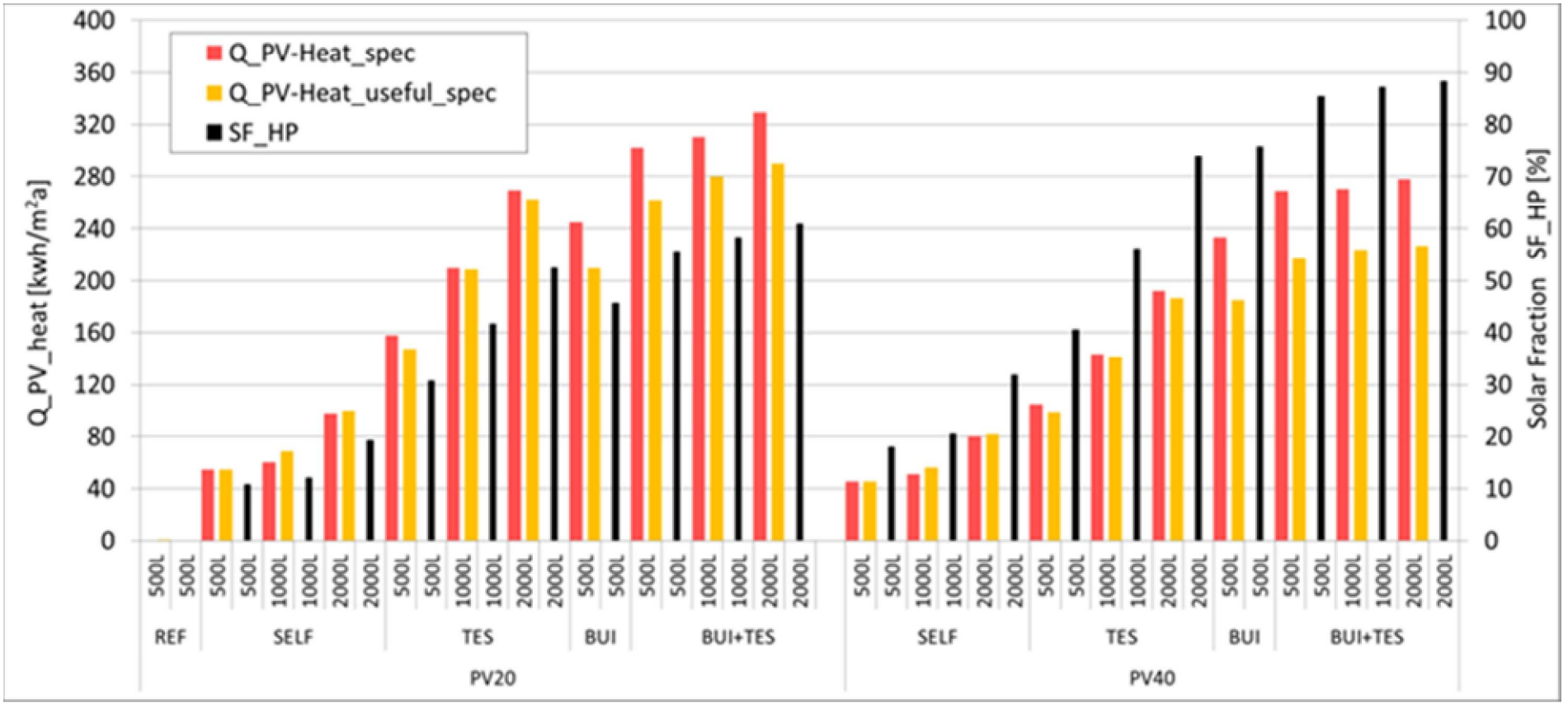
New control strategies: Overheating of the building and of the TES

The PV electricity goes:

1. To the heat pump in modality **[SELF]** or in modality [COUPL] to **overheat firstly the building (during the heating season, until 26°C) [COUPL_bui] and then overheat the TES (UNTIL 60°C) [COUPL_TES]**
2. To the building for the household electricity **[HH]**
3. To the grid

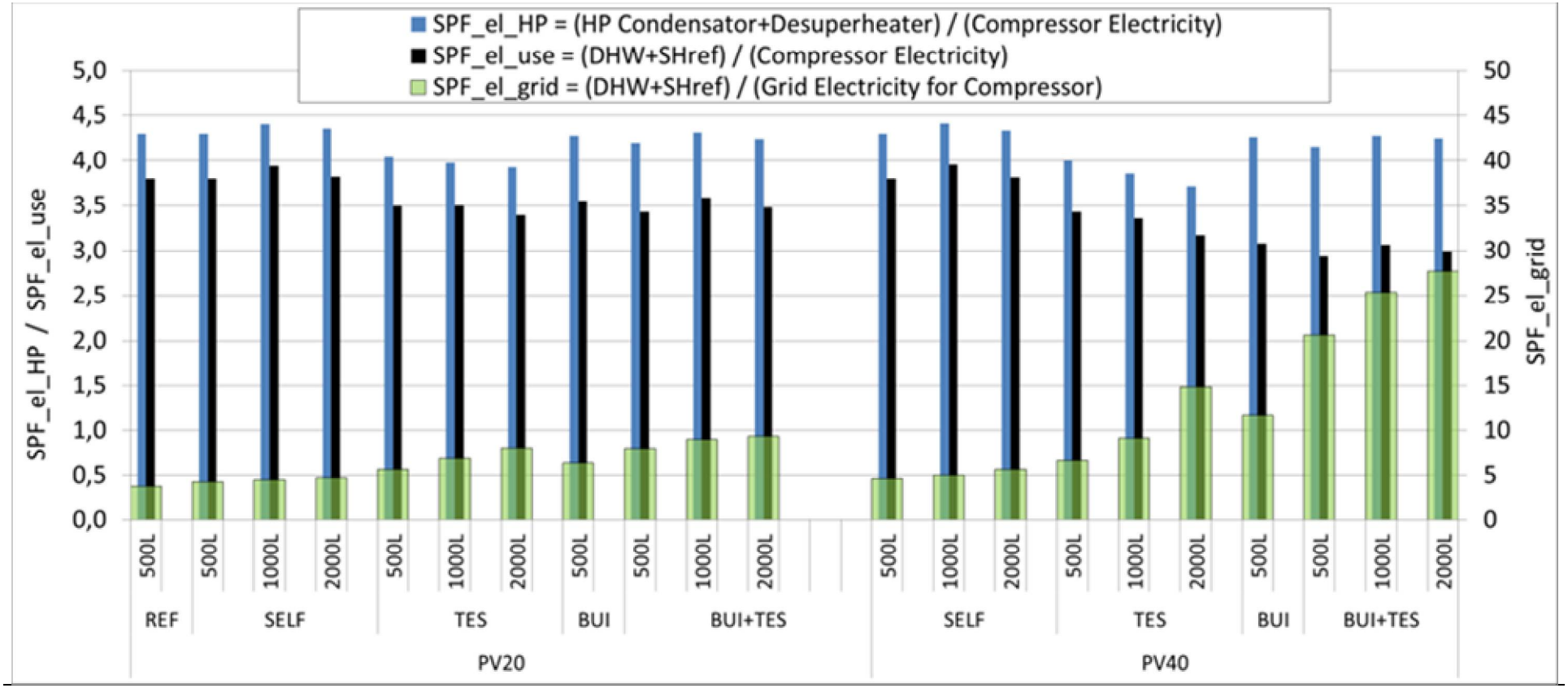


Solar fraction (**SF_HP**), heat (**Q_PV-Heat_spec**) and useful heat (**Q_PV-Heat_useful_spec**) produced by heat pump using PV electricity depending on control algorithm and PV area.

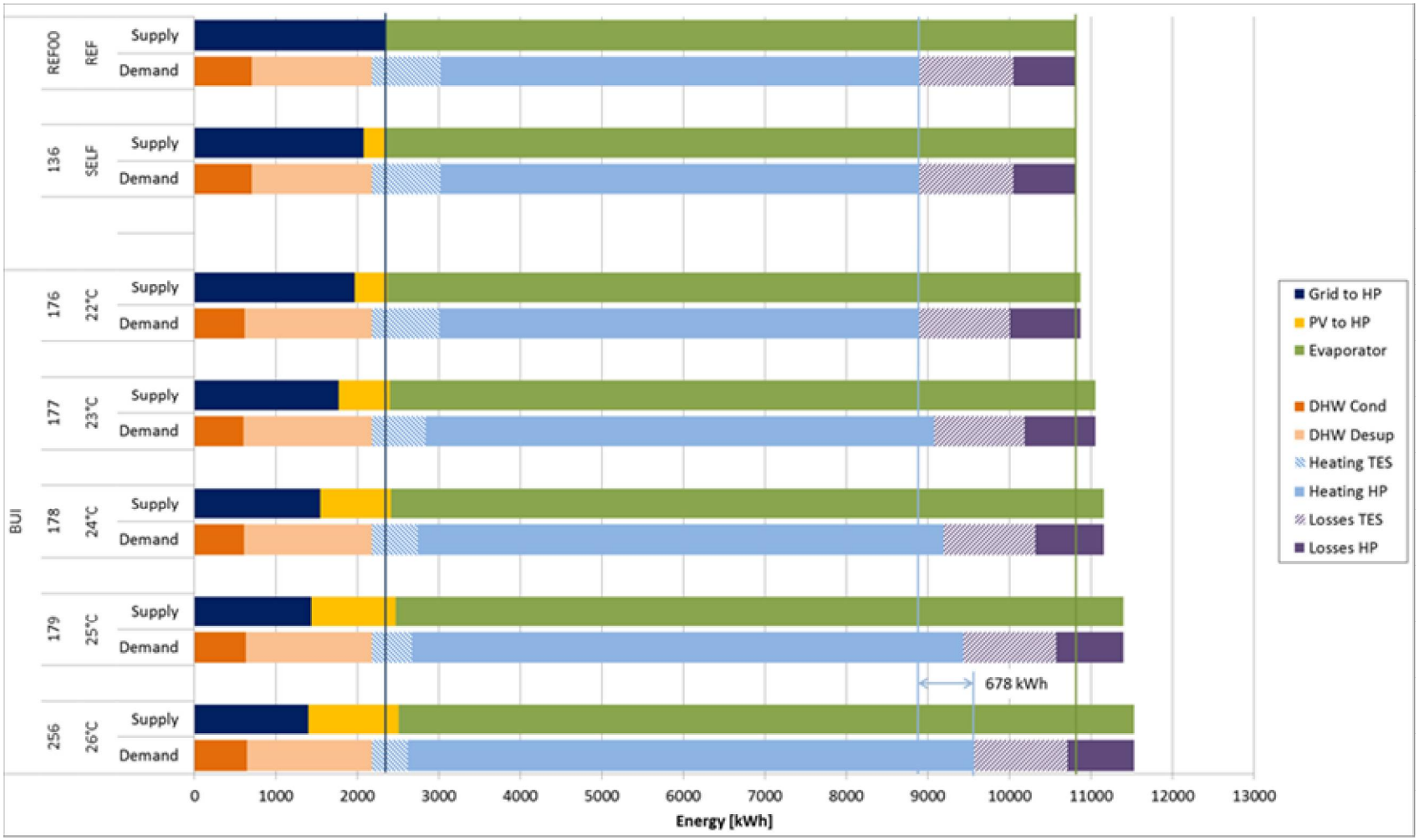


Seasonal performance factor - SPF:

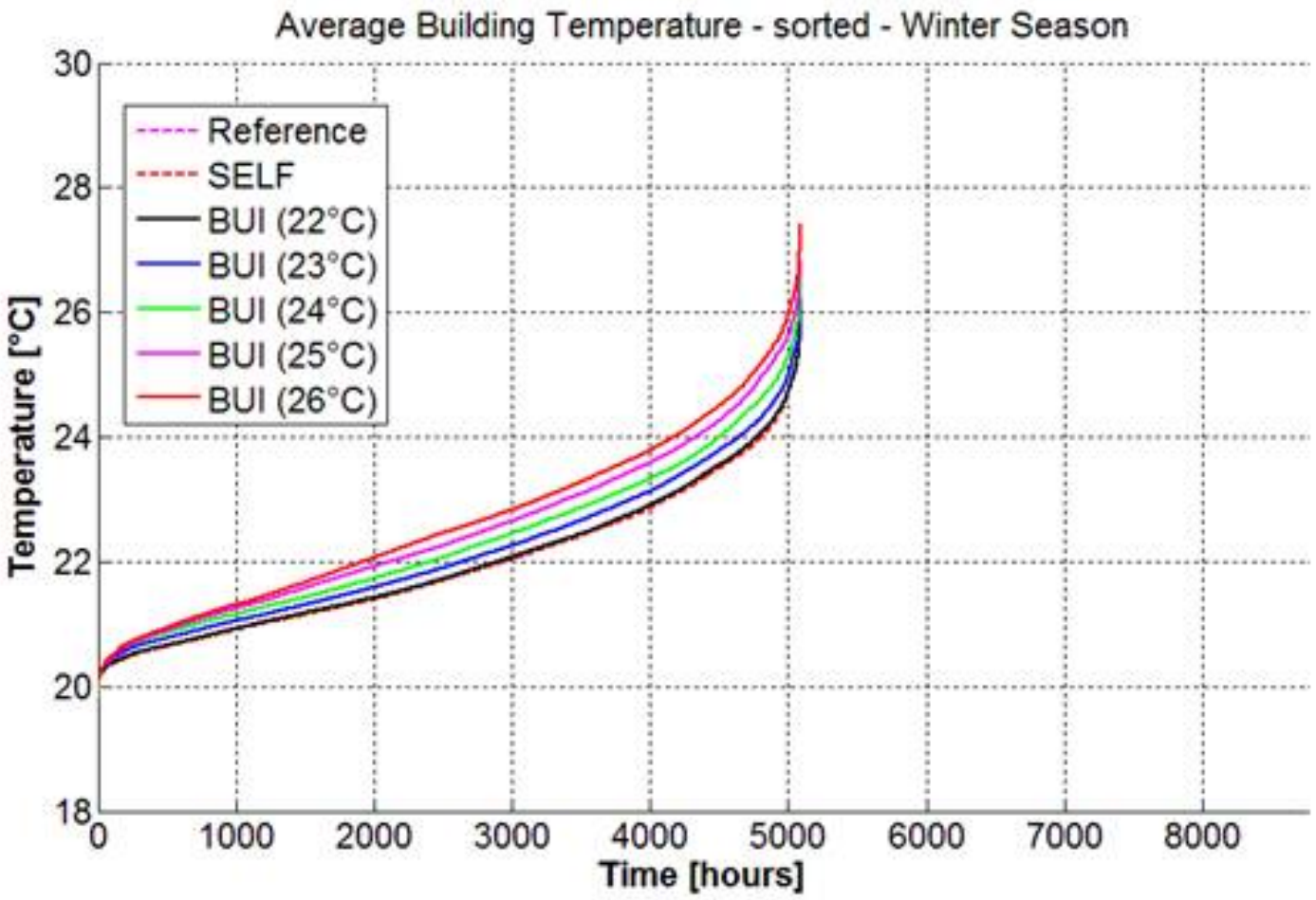
- for the heat pump itself based on compressor electricity consumption (**SPF_el_HP**)
- for the reference used energy (domestic hot water and space heating consumption of REF) based on compressor electricity consumption (**SPF_el_use**) and
- for the reference used energy based on grid electricity consumption (**SPF_el_grid**).



Energy balance of RSE45 building with control concept BUI and different building overheating set temperatures of 22°C up to 26°C.

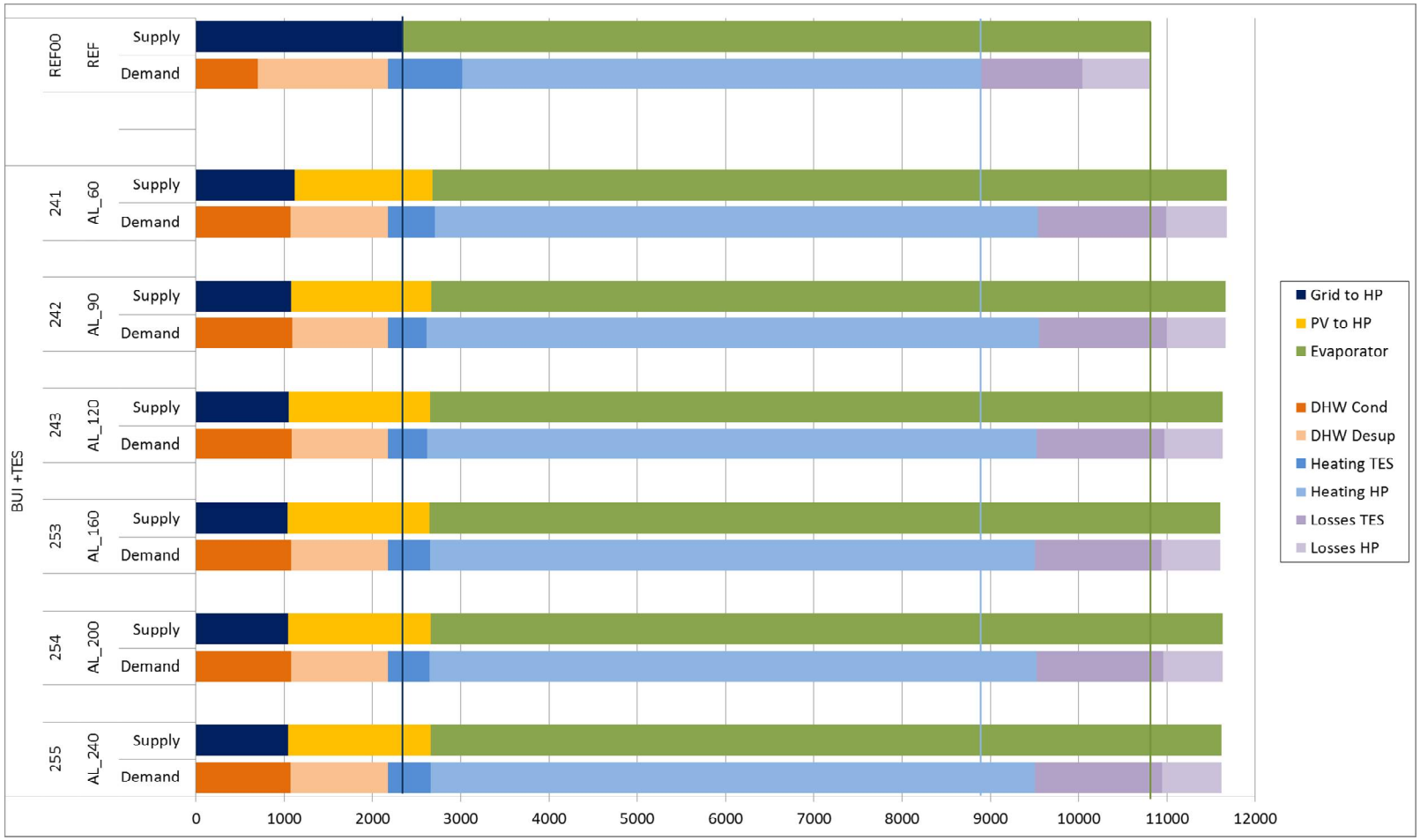


Energy balance of RSE45 building with control concept BUI and different building overheating set temperatures of 22°C up to 26°C.



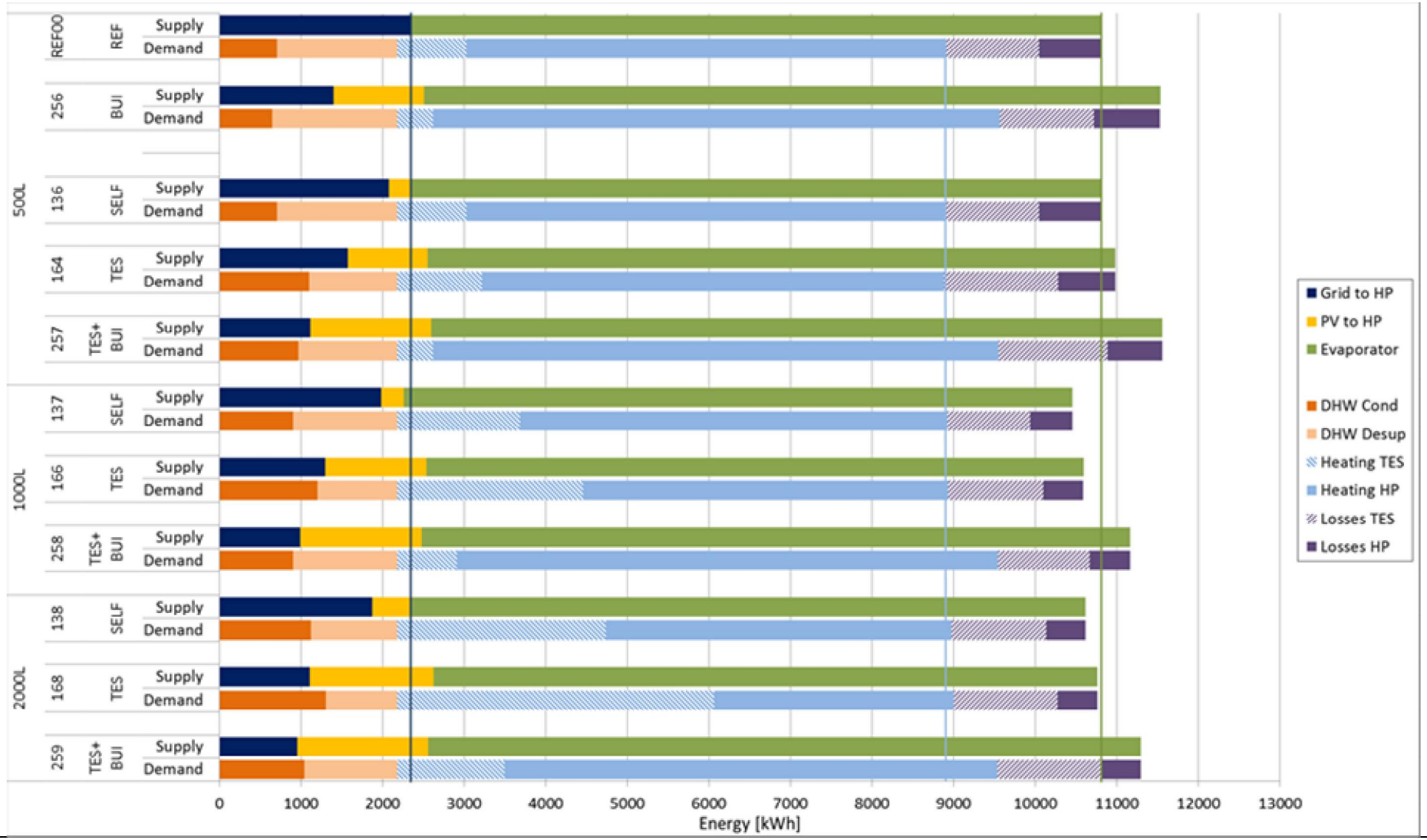
New control strategies: thickness of active layer (RES45, TES 500) -- BUI + TES

Thicknesses of active layer (60, 90, 120, 160, 200 and 240 mm) are investigated to check the influence on the simulation results



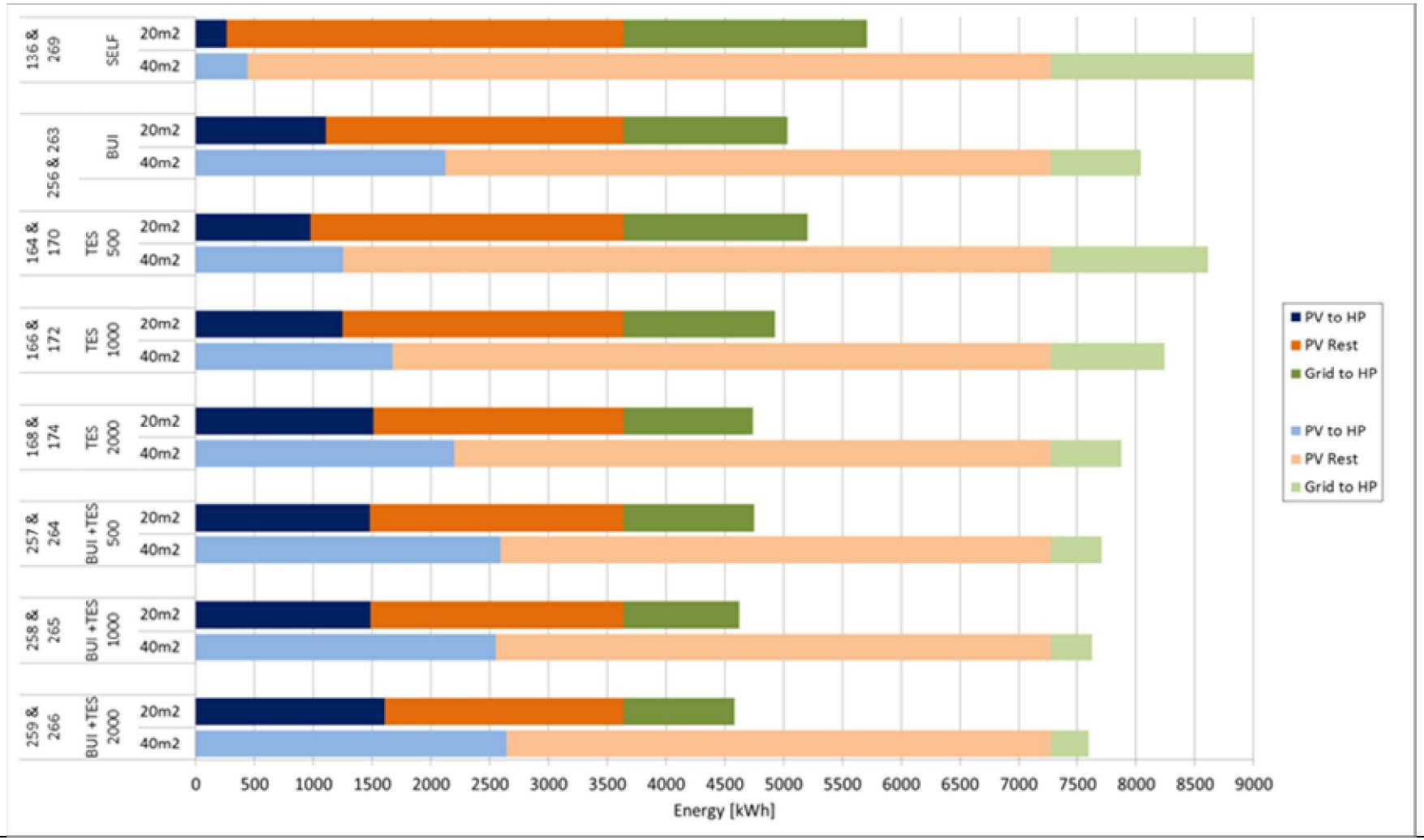
- the **thickness of the active layer** has no significant influence on the results

PV20, Control concepts: SELF, BUI, TES, BUI+TES (TES volumes: 500, 1,000 and 2,000 liter)

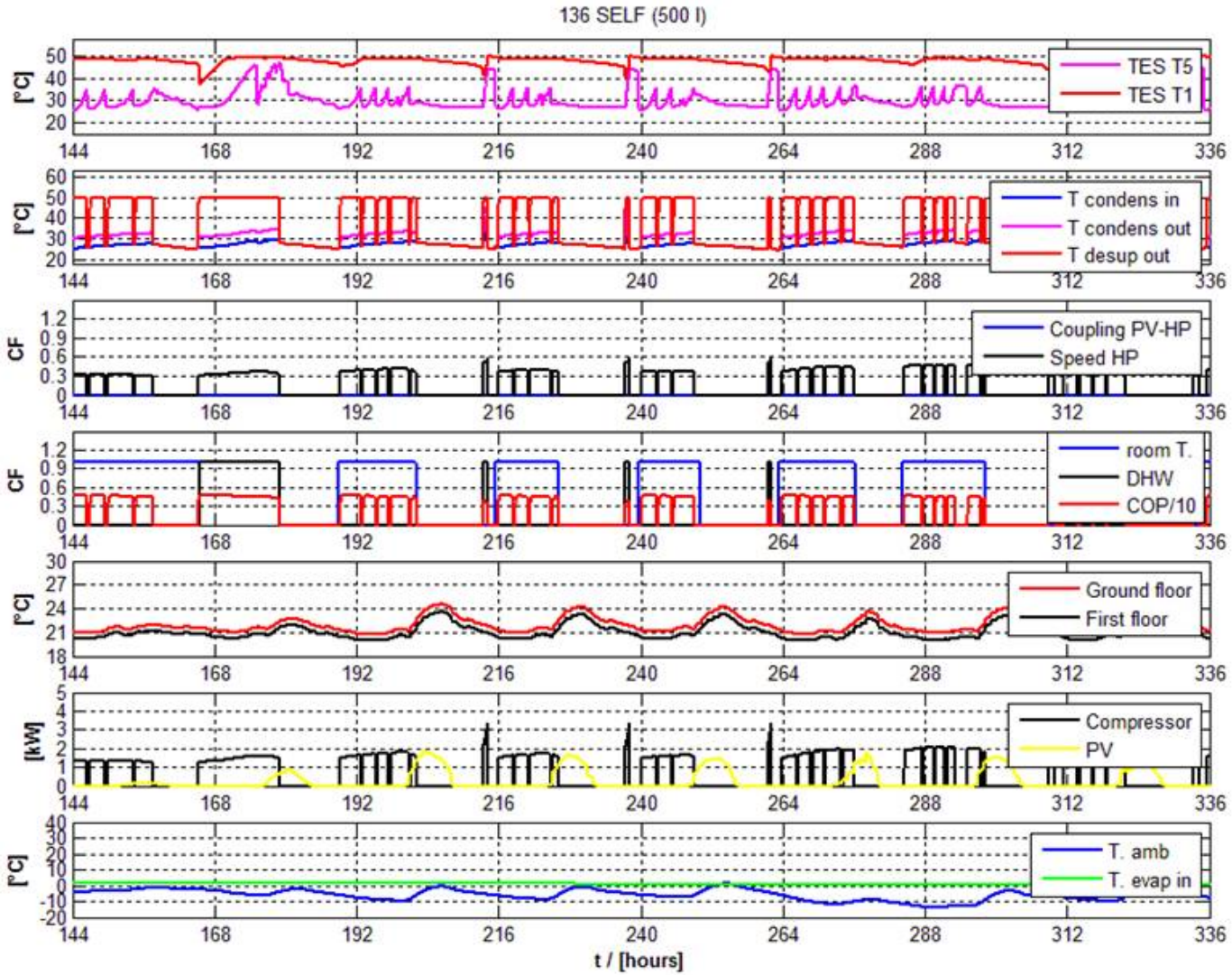


PV20, Control concepts: SELF, BUI, TES, BUI+TES (TES volumes: 500, 1,000 and 2,000 liter)

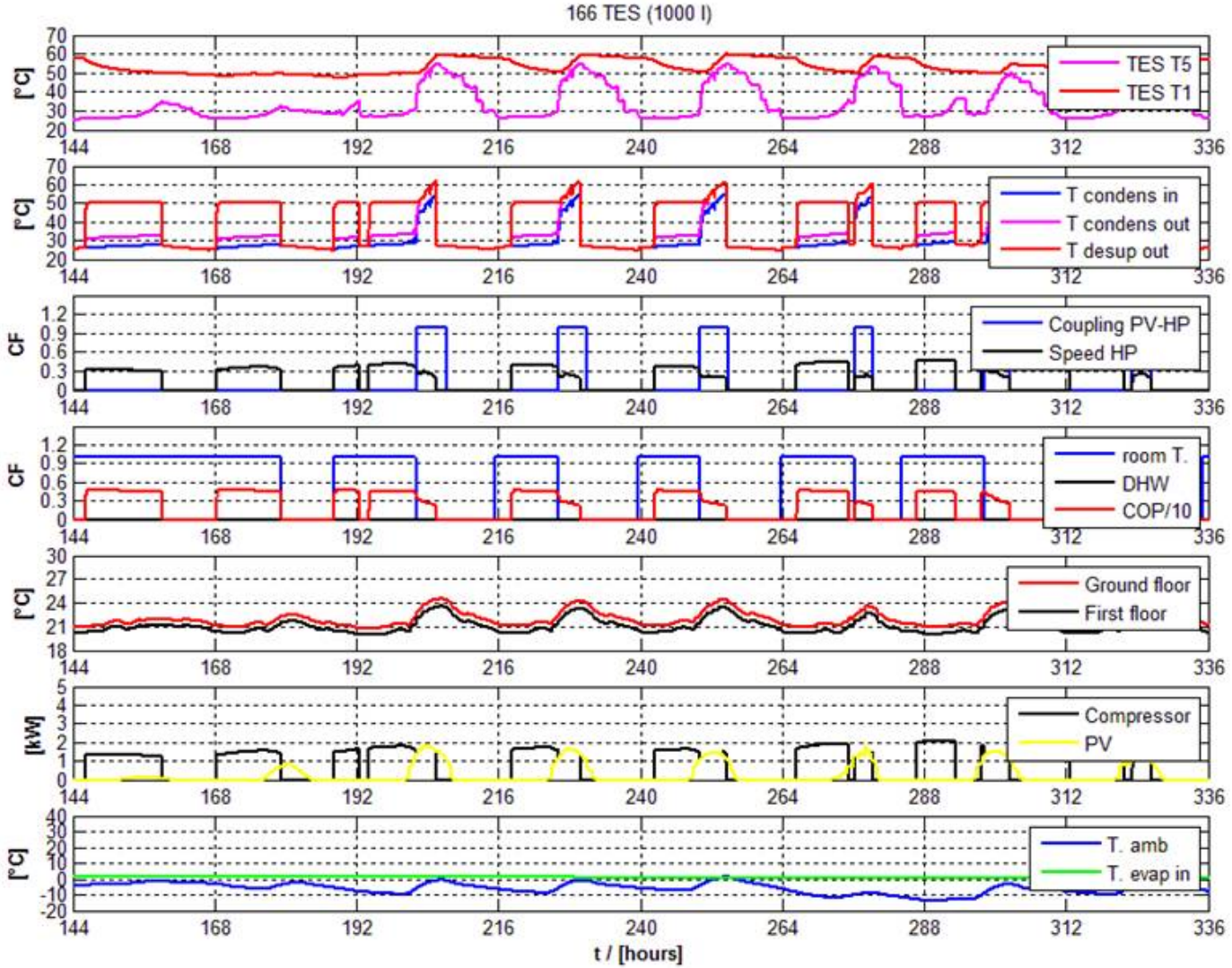
„PV to HP“ + „PV Rest“ = total PV production



PV20, Control concepts: SELF (TES volume: 500 liter)

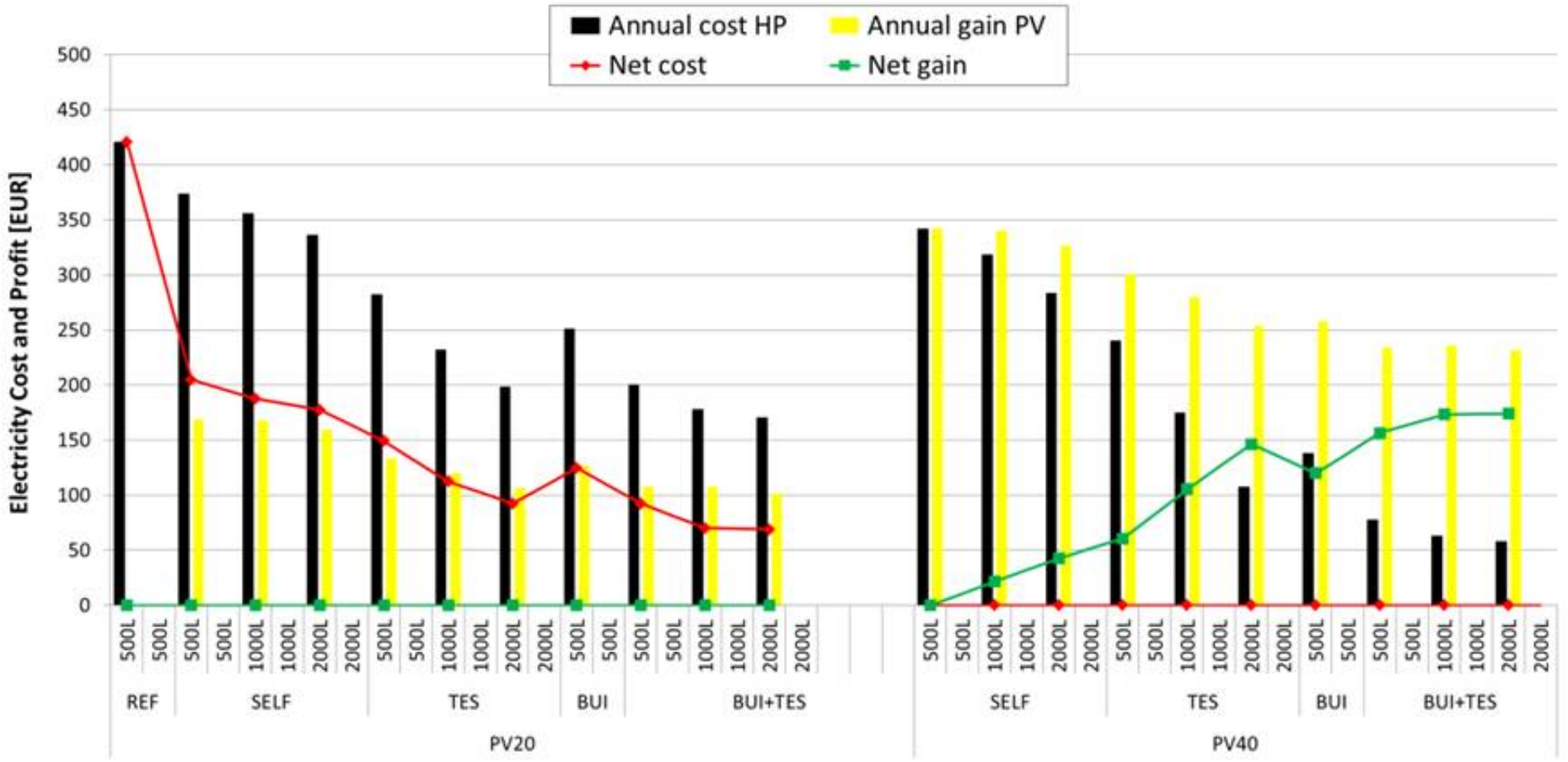


PV20, Control concept: TES (TES volume: 1,000 liter)



Operating cost for the RES45 building with a heat pump in combination with 20 m² (left) and 40 m² (right) PV area.

Grid cost = 18 EUR-cent/kWh ⇔ Feed in Tariff = 5 EUR-cent/kWh



Thank you for your attention !