



# RES4LIVE

ENERGY SMART LIVESTOCK FARMING  
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

## Thermal & electrical performance evaluation of a hybrid solar system for a livestock farm in Belgium

AgEng 2024

July 2024 Athens, Greece



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.101000785



ILVO pig farm (9090 MELLE)



# Background

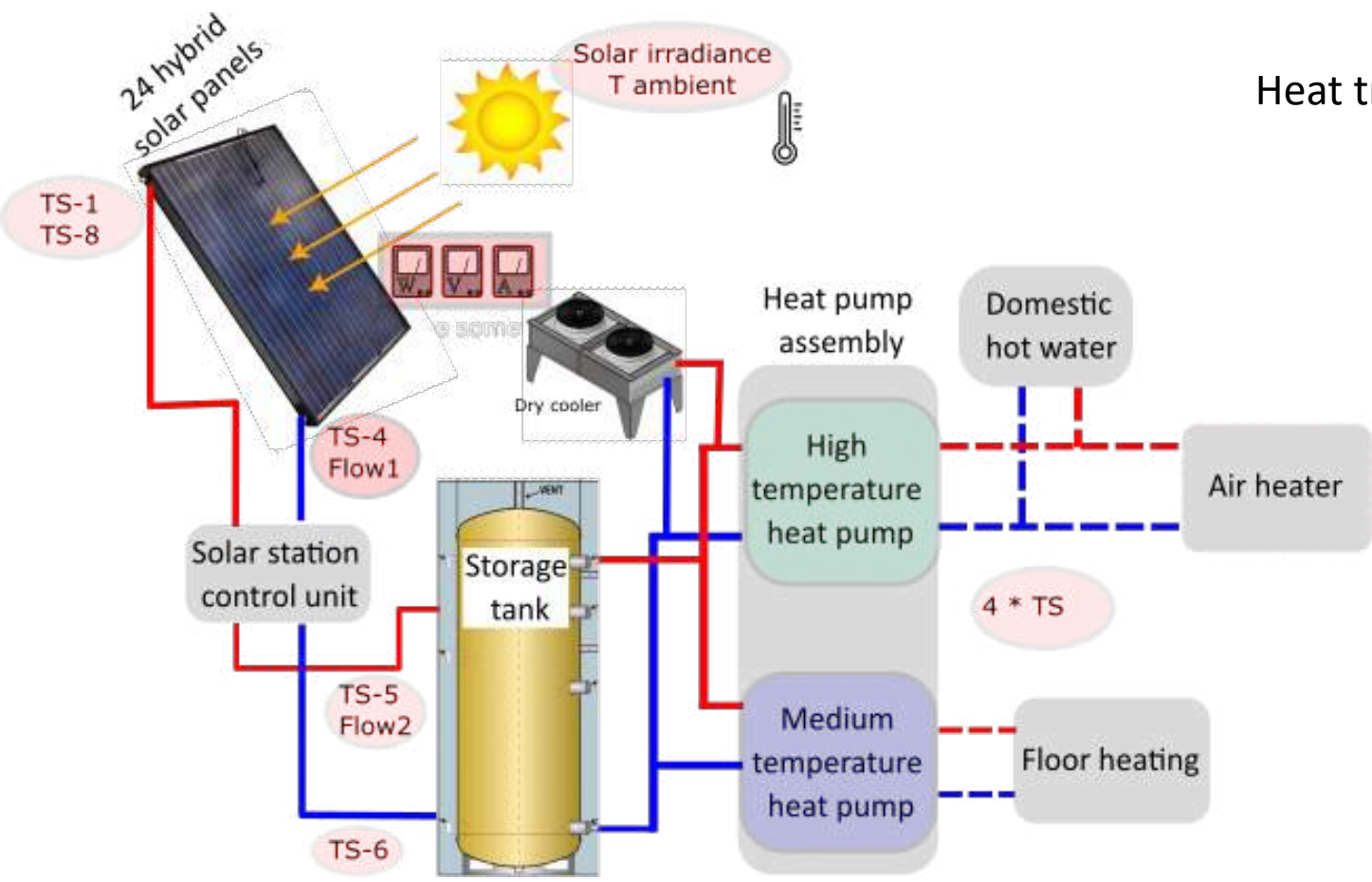
- ILVO pig farm
  - Farrow to finish pig farm
    - 105 sows, 600 piglets, 750 fattening pigs
  - 60 kW gas boiler with 220 MWh per year consumption
  - Heat cannon using 920 liter fuel oil per year
- **RES4LIVE project**
  - Smart energy and ventilation control
  - PVT collectors
  - Two modular heat pumps



# Renewable energy sources installed at the pig farm



# Monitoring & performance evaluation hybrid solar system



Heat transfer fluid (HTF) = 35 % glycol + 65 % water mixture

$$Q_{th} = \dot{m} \rho c_p \Delta T$$

$Q_{th}$  = Heat gain from the PVT [W]

$\dot{m}$  = mass flow rate (1 or 2)  $\left[\frac{kg}{s}\right]$

$\rho$  = density HTF  $\left[\frac{kg}{m^3}\right]$

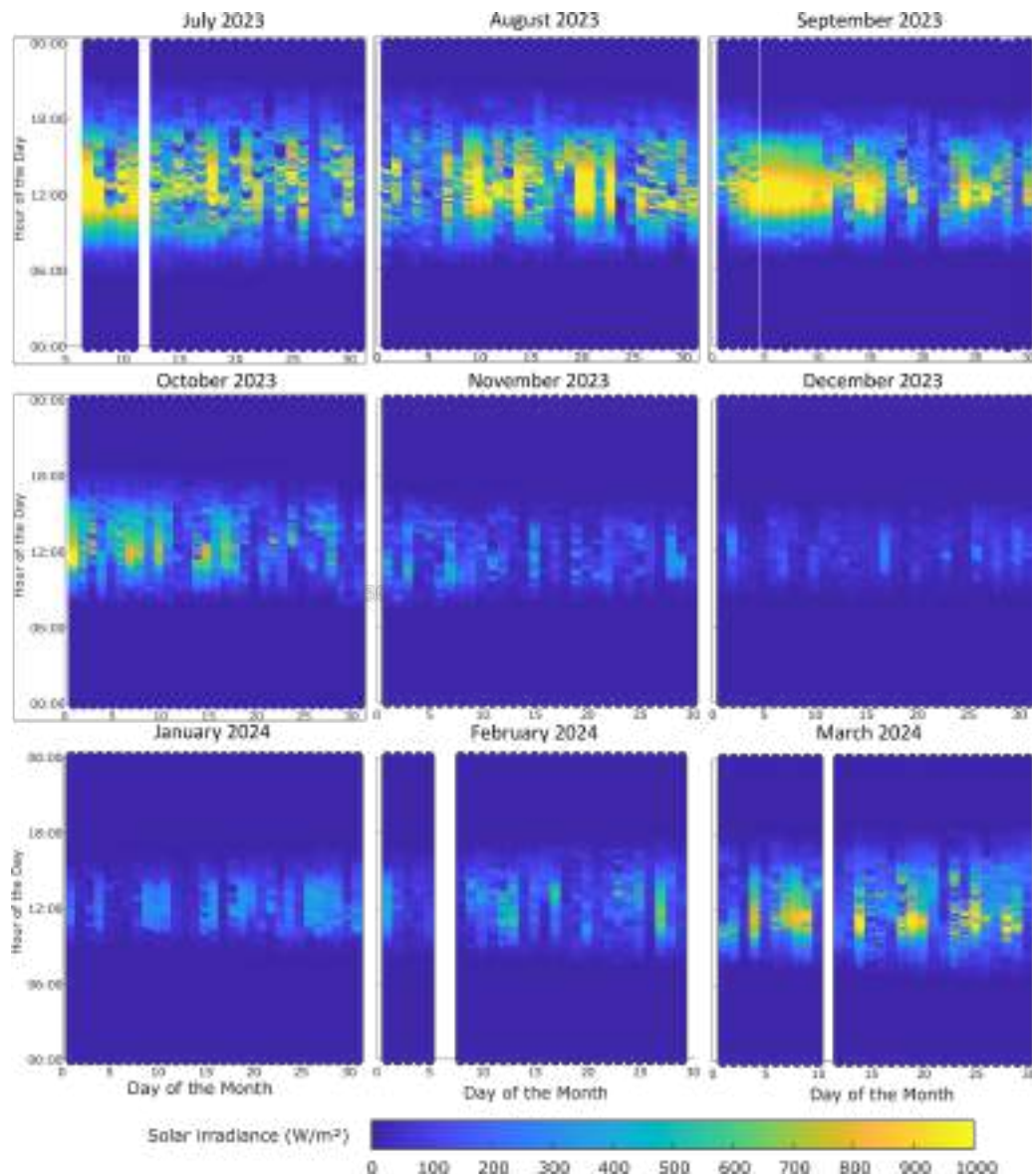
$c_p$  = specific heat capacity HTF  $\left[\frac{J}{kgK}\right]$

$\Delta T$  = temperature difference [K]

$$\Delta T_1 = \left[ \frac{TS1 + TS8}{2} - TS4 \right]$$

$$\Delta T_2 = [TS5 - TS6]$$

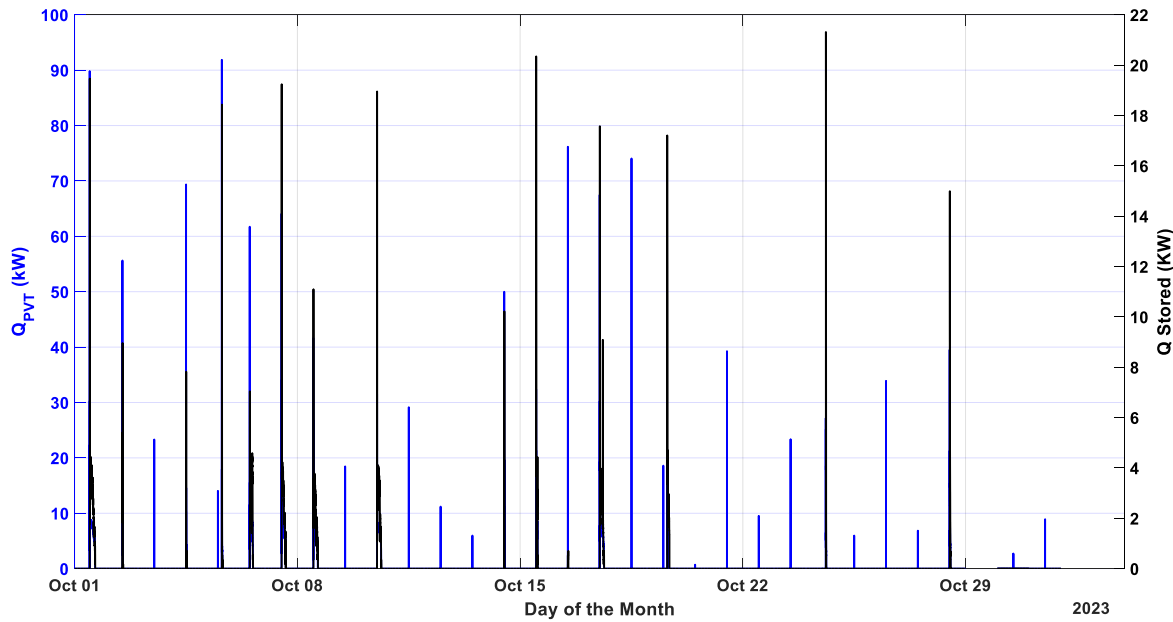




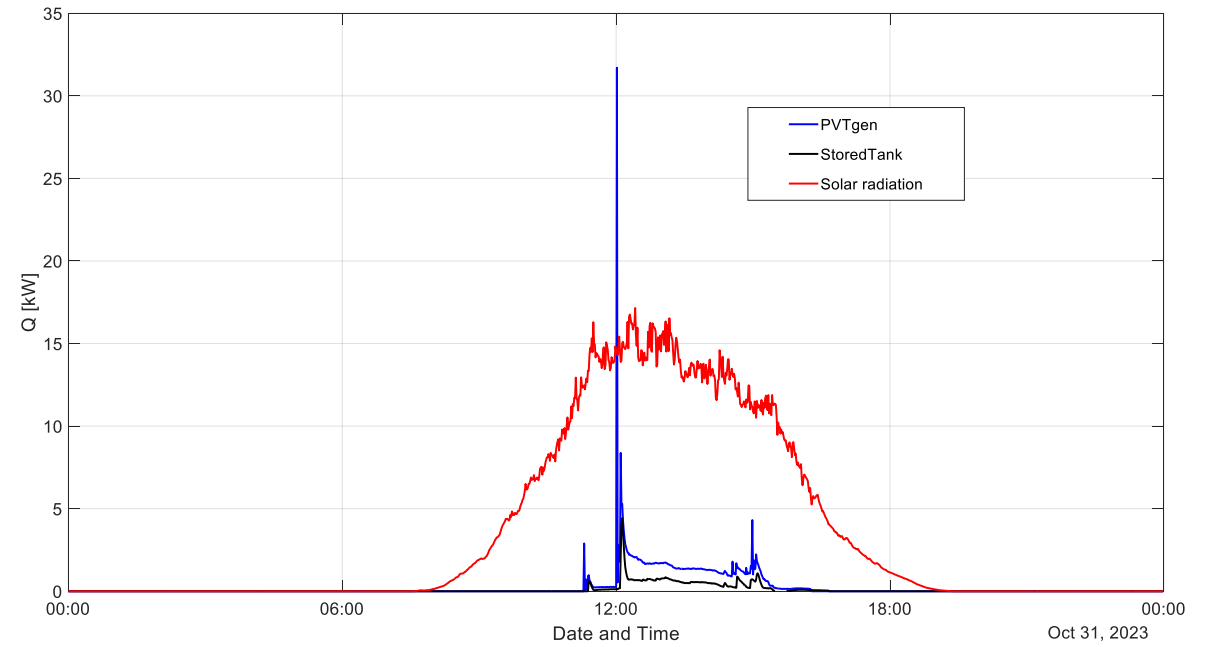
## Daily solar irradiance July 2023 – March 2024

# October 2023 Q<sub>pvt</sub> vs Q<sub>stored</sub>

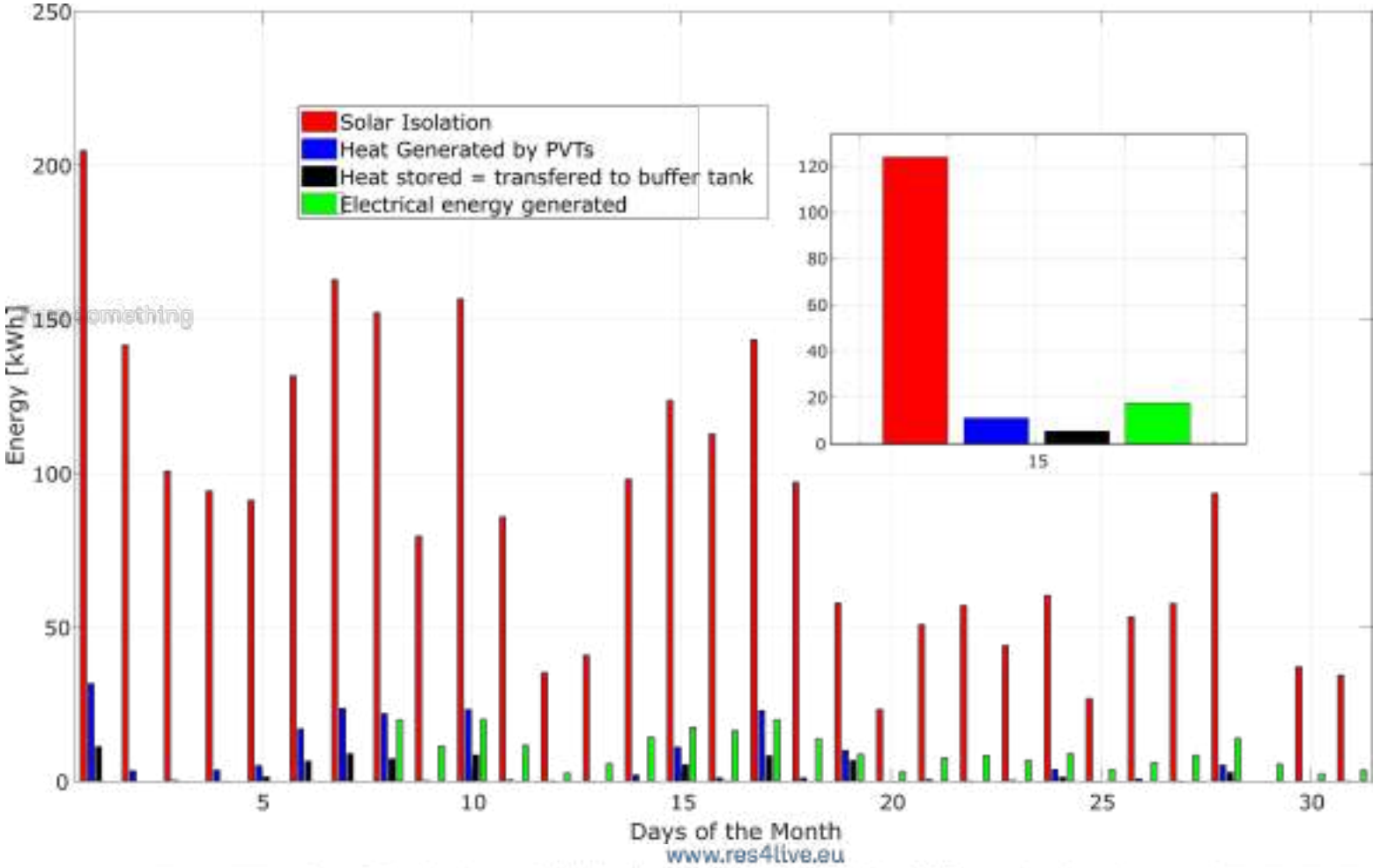
### Daily



### Monthly average



# Renewable energy generated by the PVTs





# Daily average thermal and electrical energy generated with respect to the solar isolation



Month	Daily average Thermal energy generated [kWh] (%)	Daily average Electrical energy generated [kWh] (%)	Daily average Insolation [kWh] 100 %
October	6.4 (7)	10.1 (11)	88.4
November	2.4 (7)	5.6 (17)	33
December	0.0 (0)	2.1 (12)	18
January	4.1 (12)	5.4 (15)	35
February	5.5 (11)	7.4 (15)	50
March	16.6 (16)	15 (15)	103



# Conclusion

- **Electrical performance and thermal performance**
- **System improvement on heat generated and stored**
- **Next**
  - Seasonal performance analysis
  - Integrated thermodynamic performance analysis

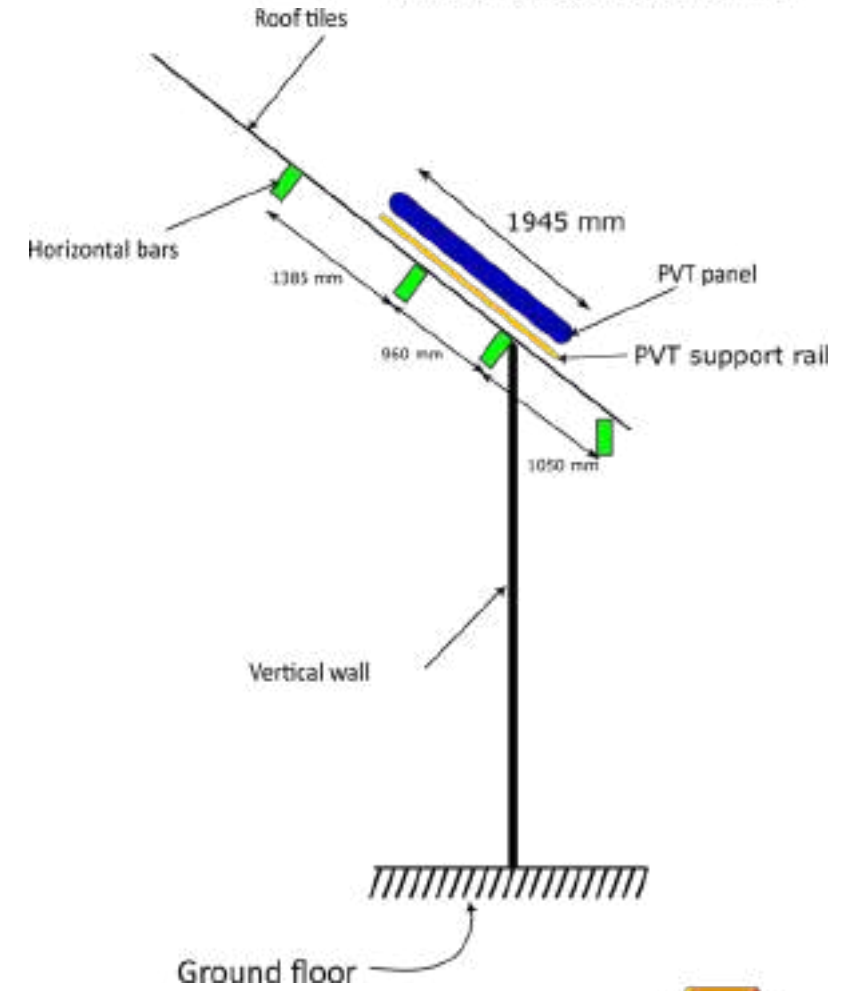
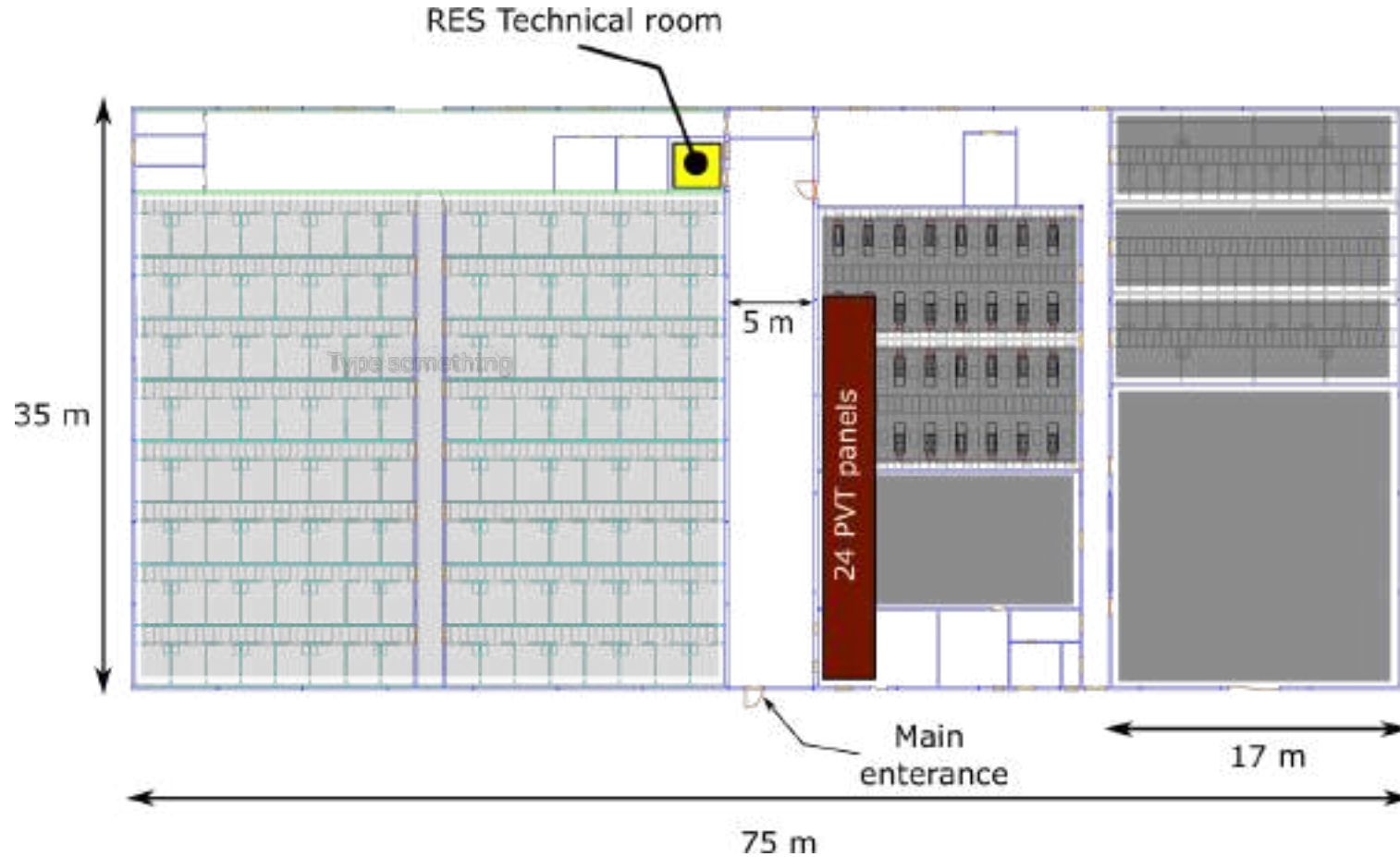




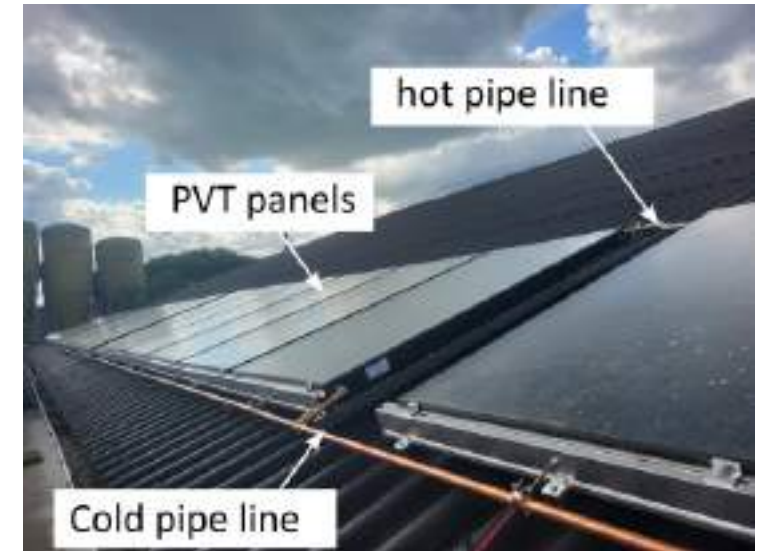
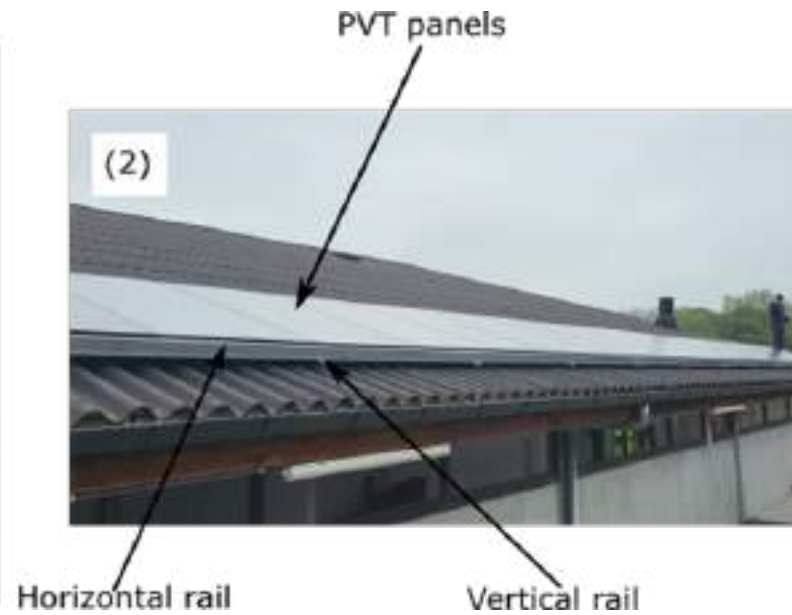
Thank you!



# PVT panels at ILVO



# PVT panels at ILVO



Type something

