

SIMULATION MODEL FOR RENEWABLE ENERGY SYSTEMS IN LIVESTOCK BARNs

three case studies

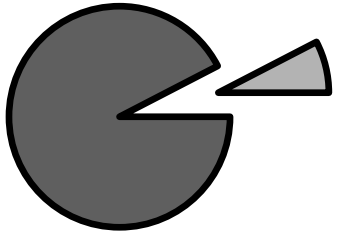
Manon Everaert



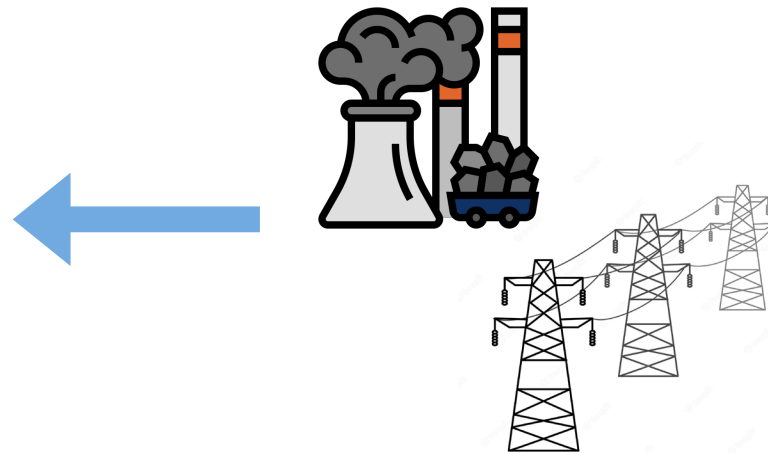
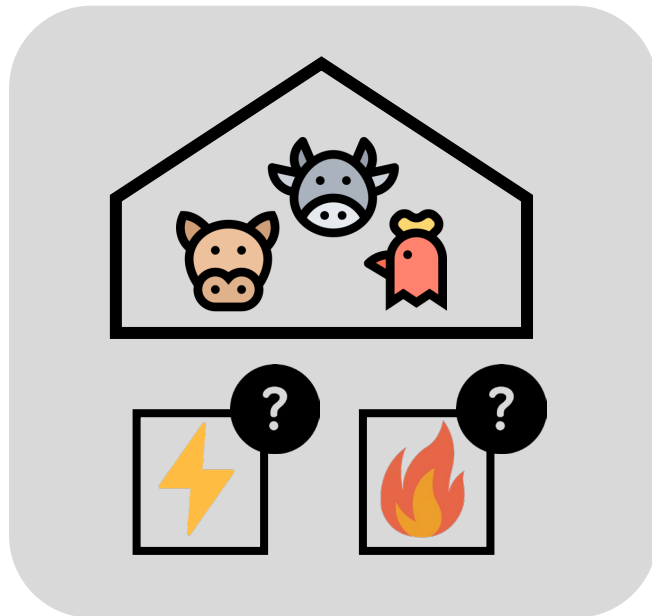
75th EAAP Annual Meeting
Saturday, 19 October 2024

ENERGY PROVISION IN LIVESTOCK FARMS

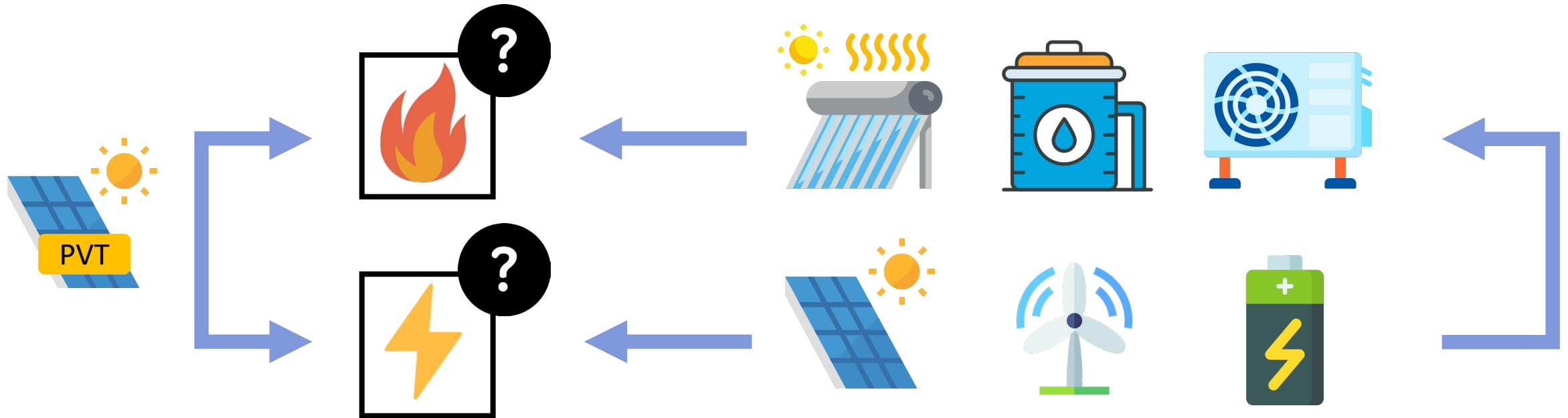
7.6% of GHG emissions are from on-farm energy use

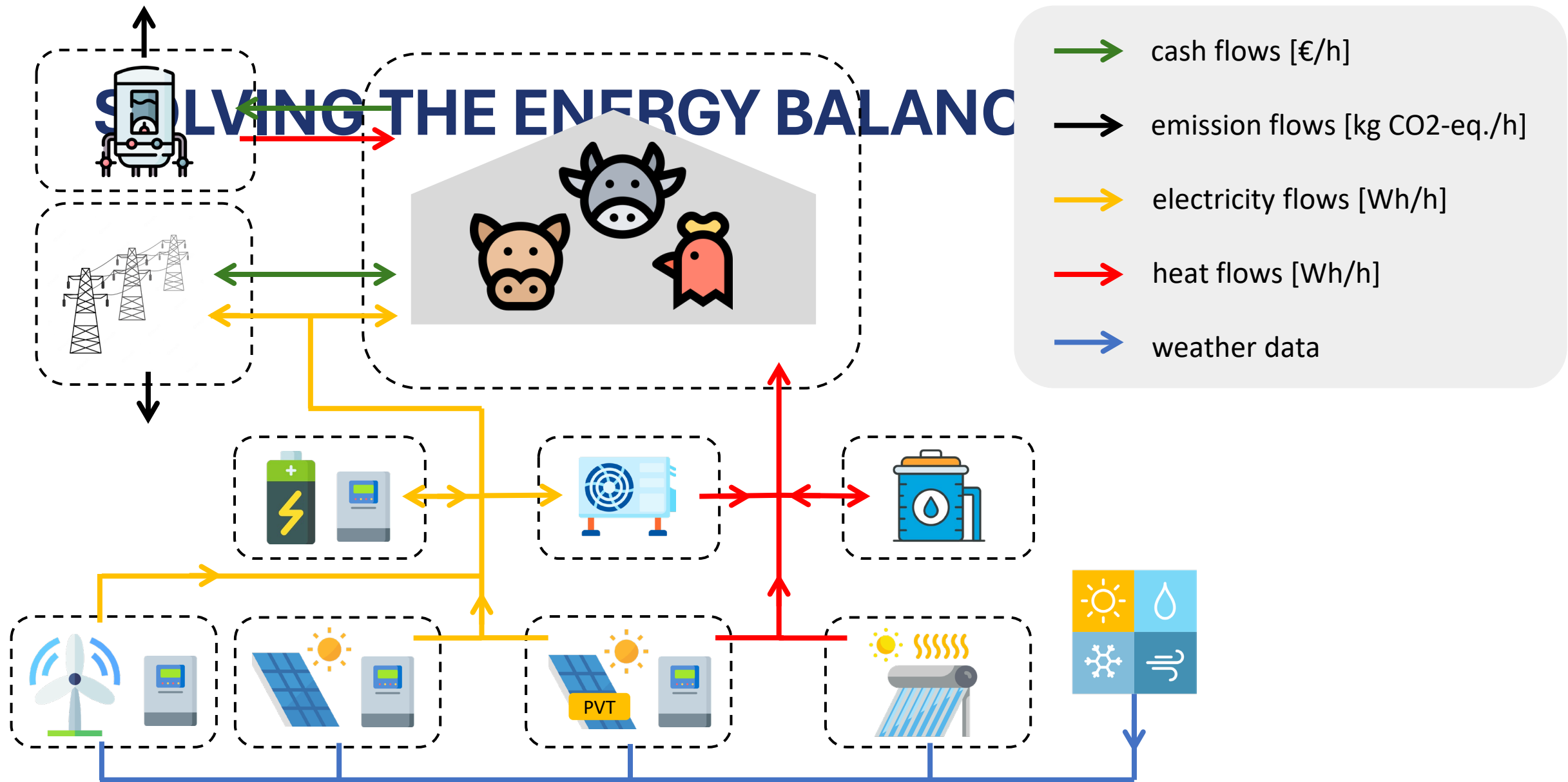


4% from renewable sources



SATISFY THESE ENERGY DEMANDS RENEWABLY



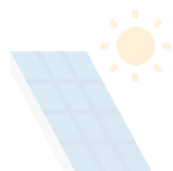


CREATING THE DESIGN SPACE

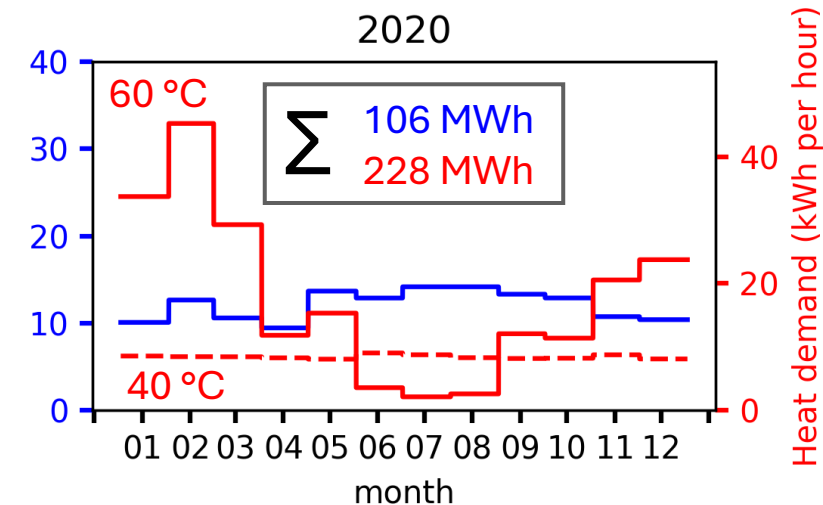
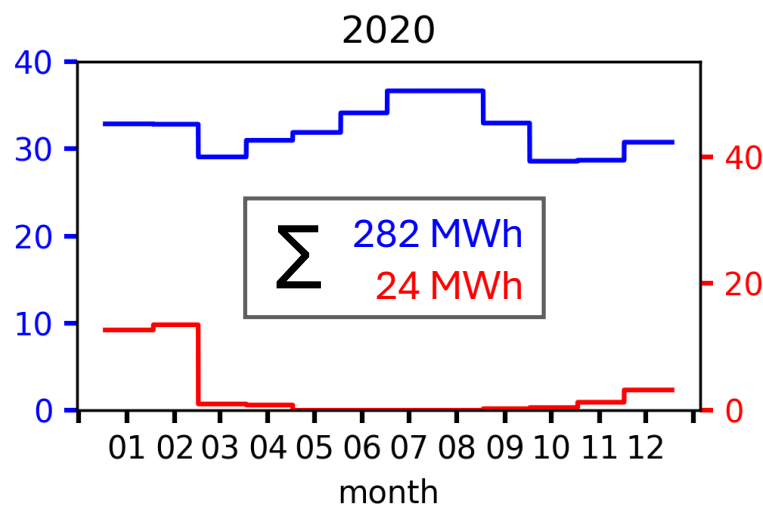
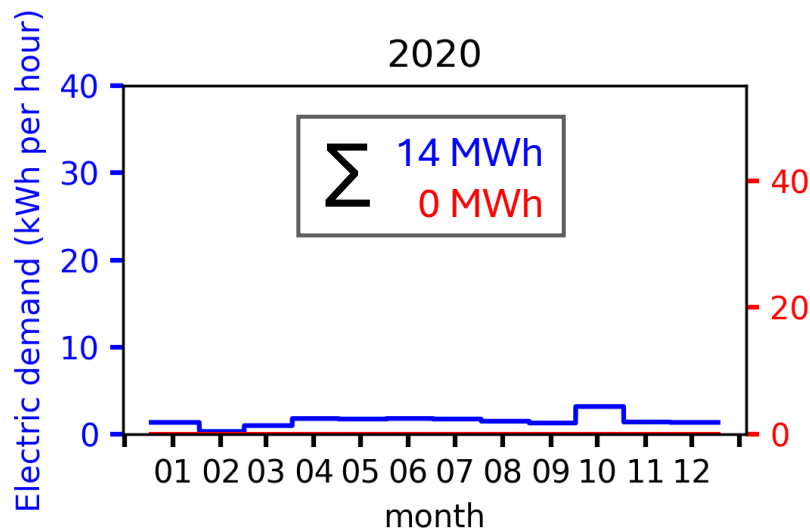
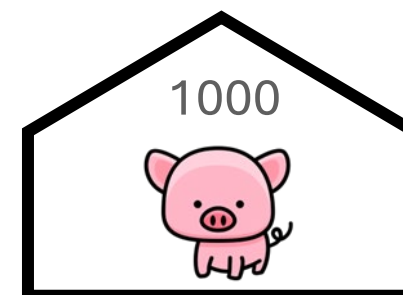
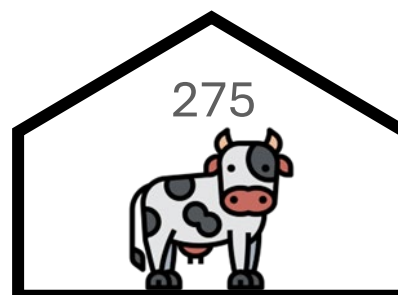
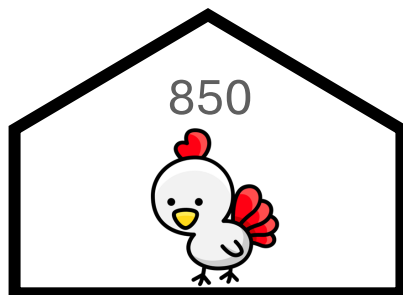
60 000 possible scenarios

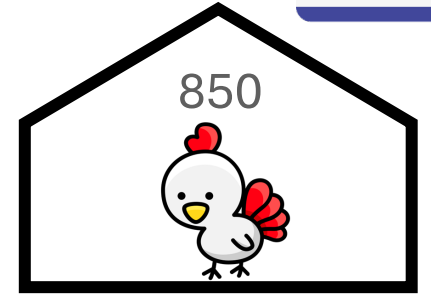
Exclude options containing storage without
renewables (not practical)

57 928 calculations



INPUTS FOR THE FARMS





Let's simulate...

PV: [0, 10, 15, 25, 50, 100]

SC: [0]

PVT: [0]

WT: [0, 5, 10, 30, 60]

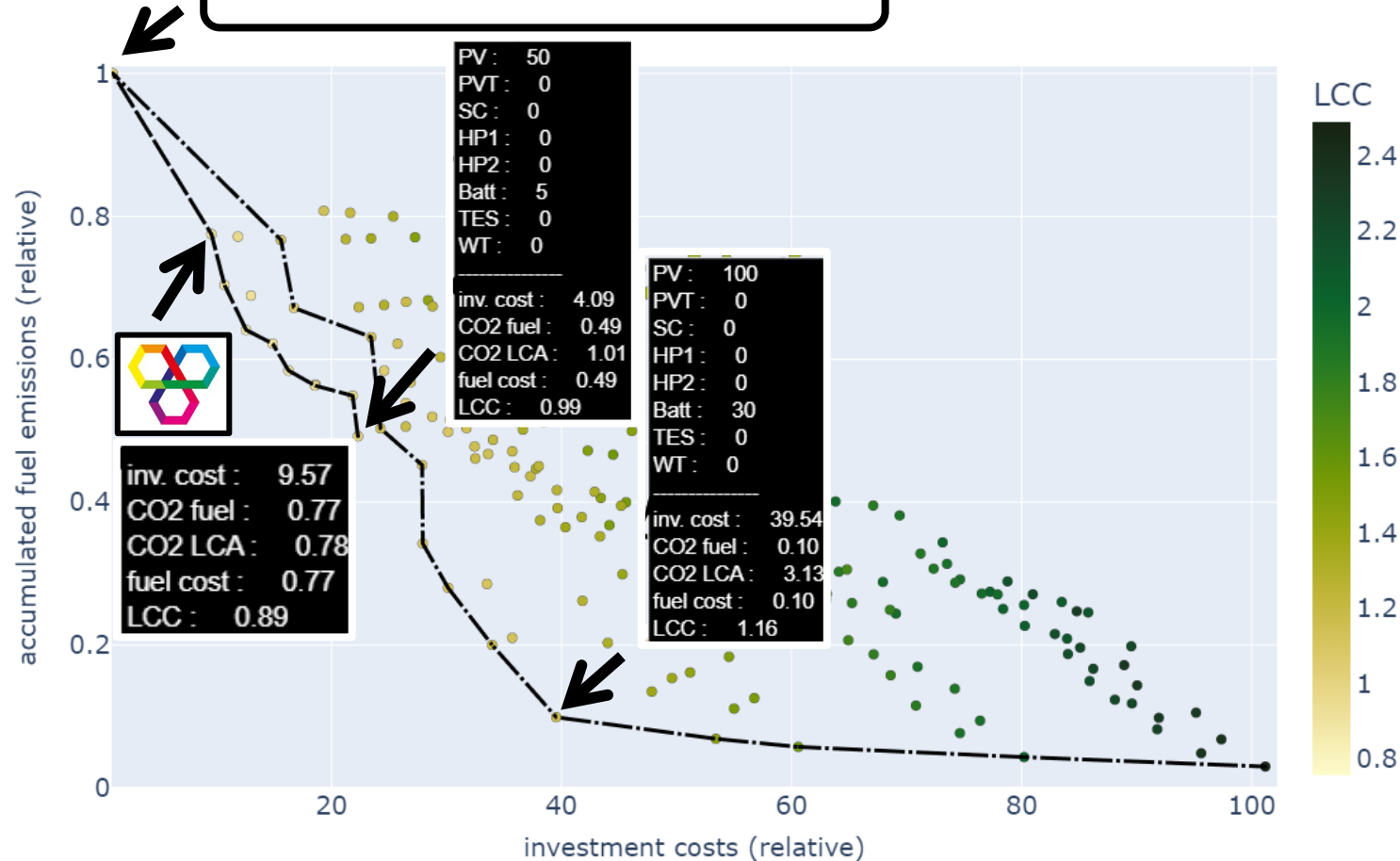
HP: [0]

BAT: [0, 1, 5, 15, 20, 30]

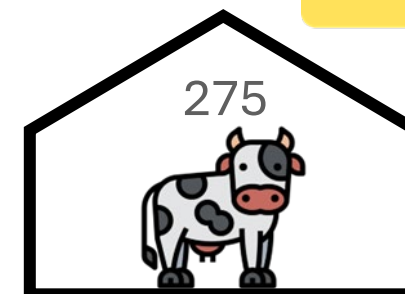
TES: [0]

RESULTS FOR AUA CHICKEN FARM

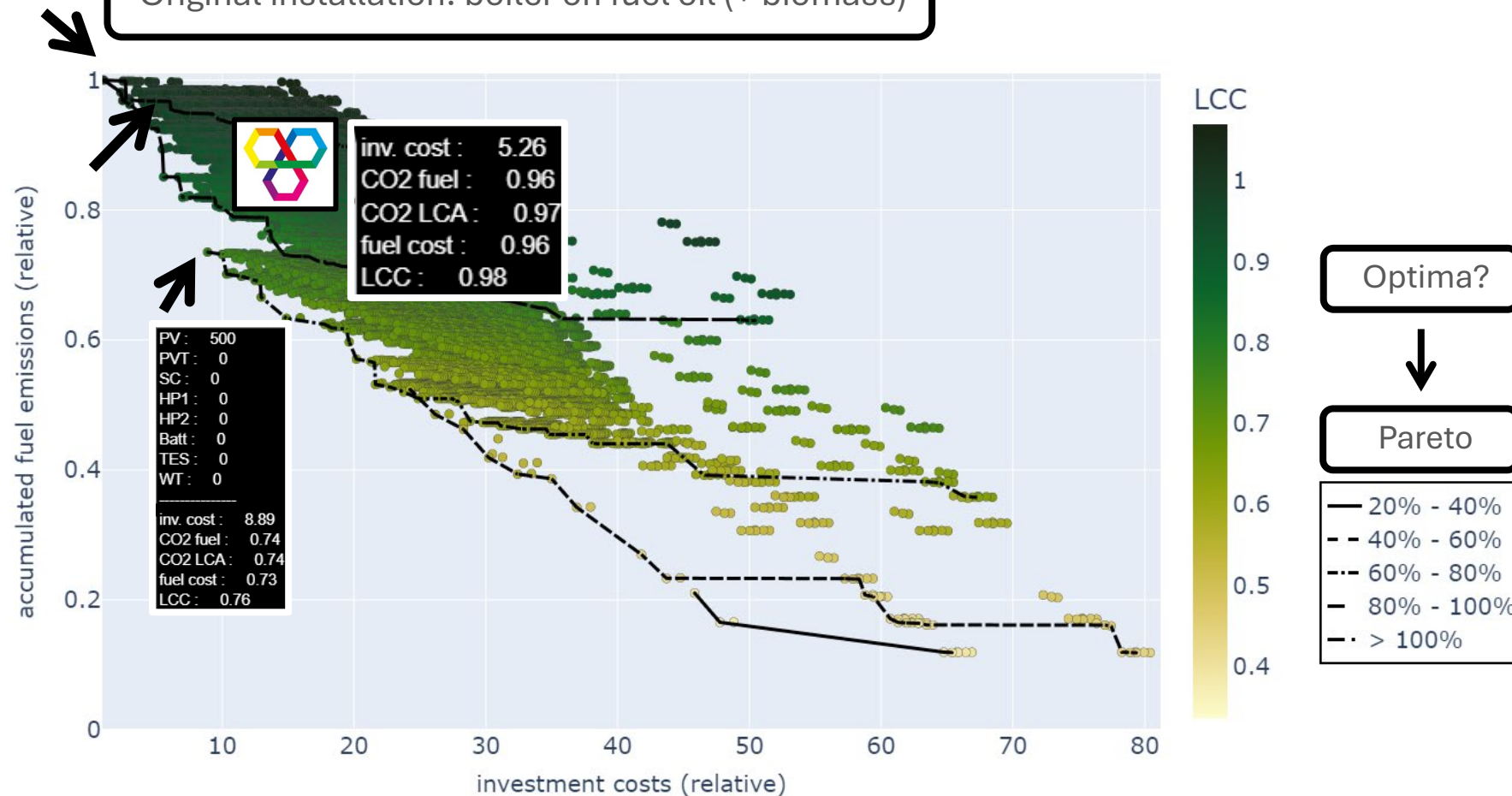
Reference scenario: grid connection



RESULTS FOR LVAT DAIRY FARM



Original installation: boiler on fuel oil (+ biomass)



Let's simulate...

PV: [0, 25, 50, 100, 200, 500, 1000]

SC: [0, 25, 50, 100, 200, 1000]

PVT: [0, 25, 50, 100, 200, 500]

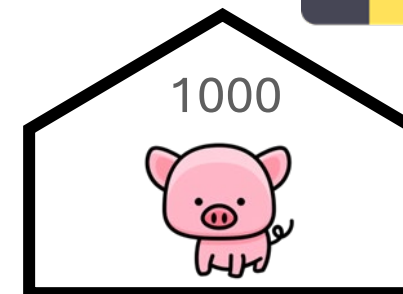
WT: [0, 5, 10, 30, 60, 100]

HP: [0, 25, 35, 50, 60, 100]

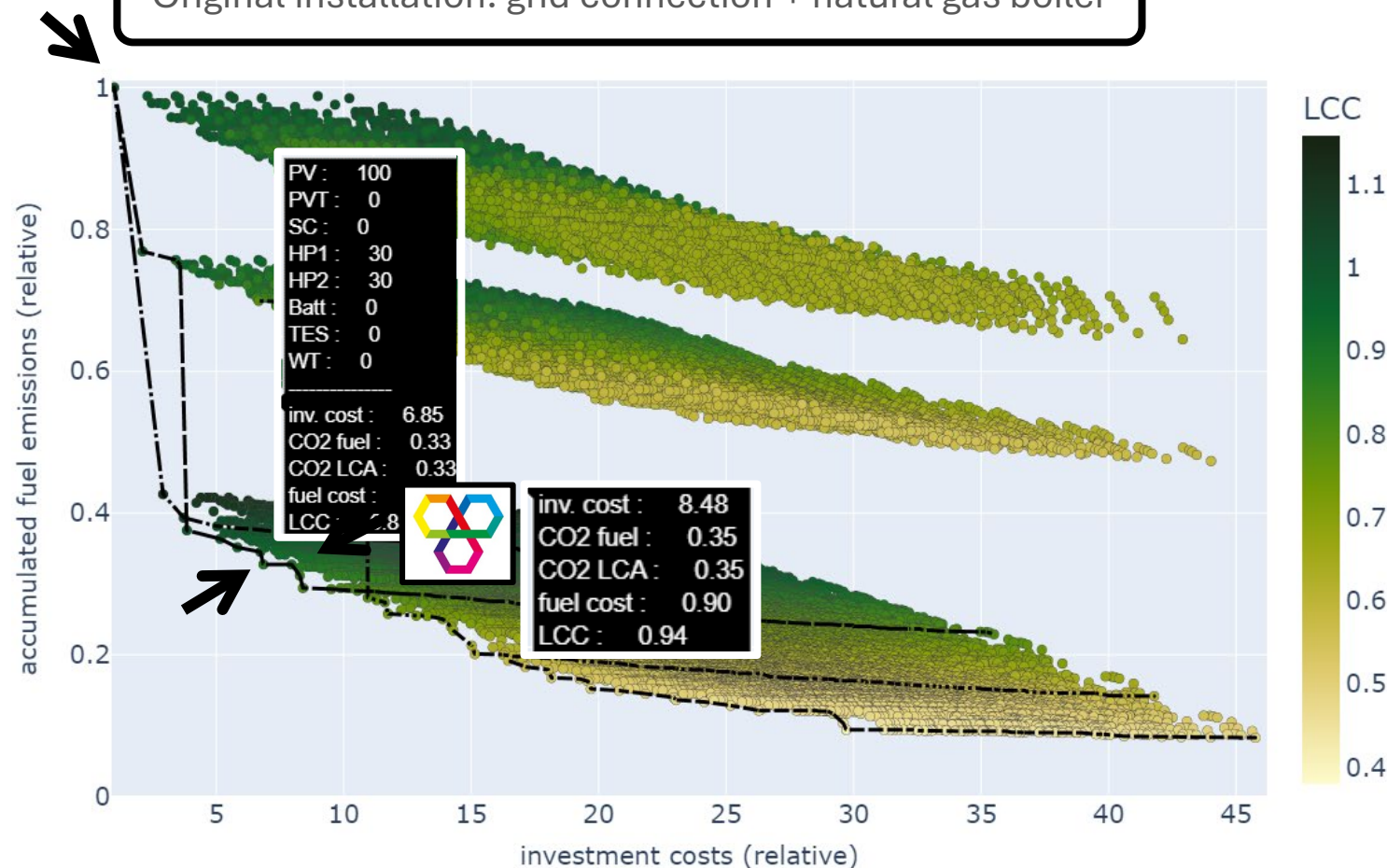
BAT: [0, 5, 15, 30, 100, 500]

TES: [0, 250, 800, 1500, 5000]

RESULTS FOR ILVO PIG FARM



Original installation: grid connection + natural gas boiler



Let's simulate...

PV: [0, 25, 50, 100, 200, 500]

SC: [0, 25, 50, 100, 200]

PVT: [0, 25, 50, 100, 200]

WT: [0, 5, 10, 30, 60]

HP1: [0, 25, 35, 50, 60, 100]

HP2: [0, 30, 50, 60]

BAT: [0, 5, 15, 30, 100, 500]

TES: [0, 250, 800, 1500, 5000]

CONCLUSIONS

- Zero fuel solutions rapidly increase investment cost → trade-off
- The new installations at AUA and ILVO should be beneficial for emission reductions and LCC, but come at an increased investment costs
- At LVAT, the potential of bioCNG was investigated

THANKS FOR YOUR ATTENTION



RES4LIVE

ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

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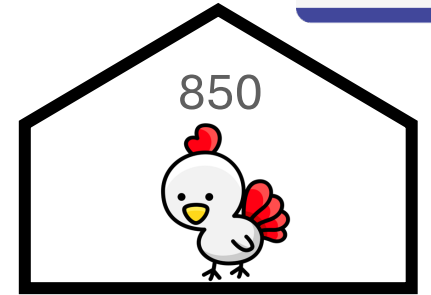
manon.everaert@ilvo.vlaanderen.be

Petros Tegenaw

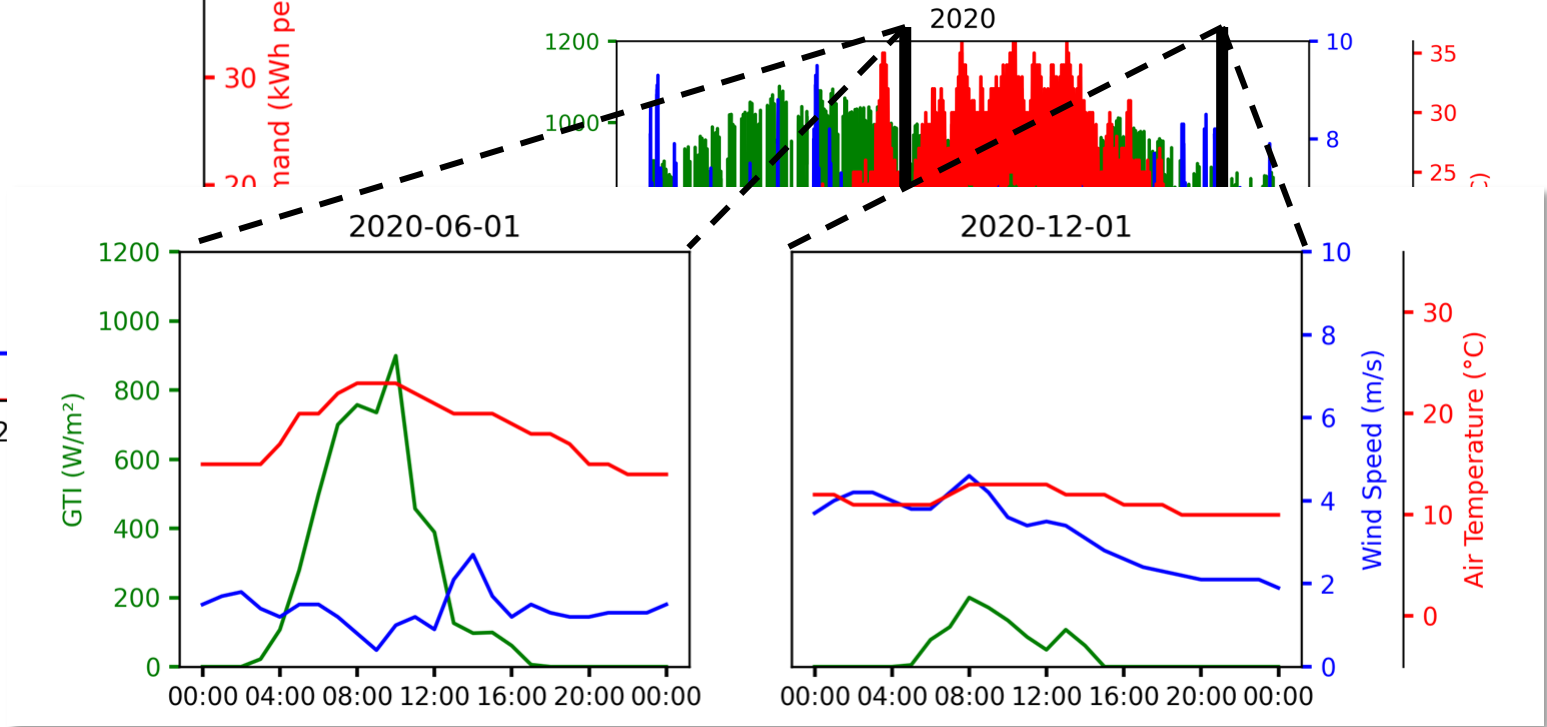
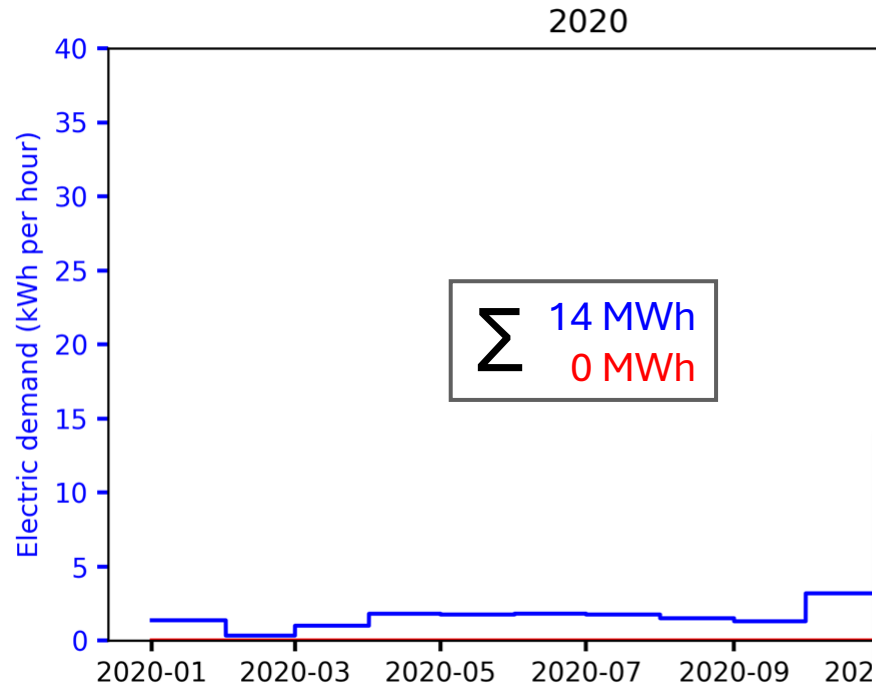
Jarissa Maselyne

Steven Lecompte





INPUTS FOR AUA CHICKEN FARM



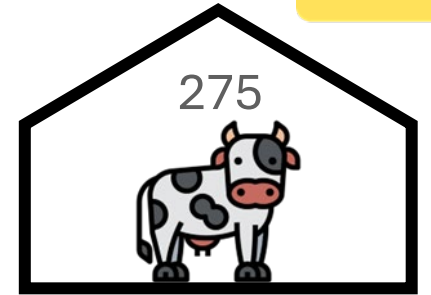
€ 0.233

€ -

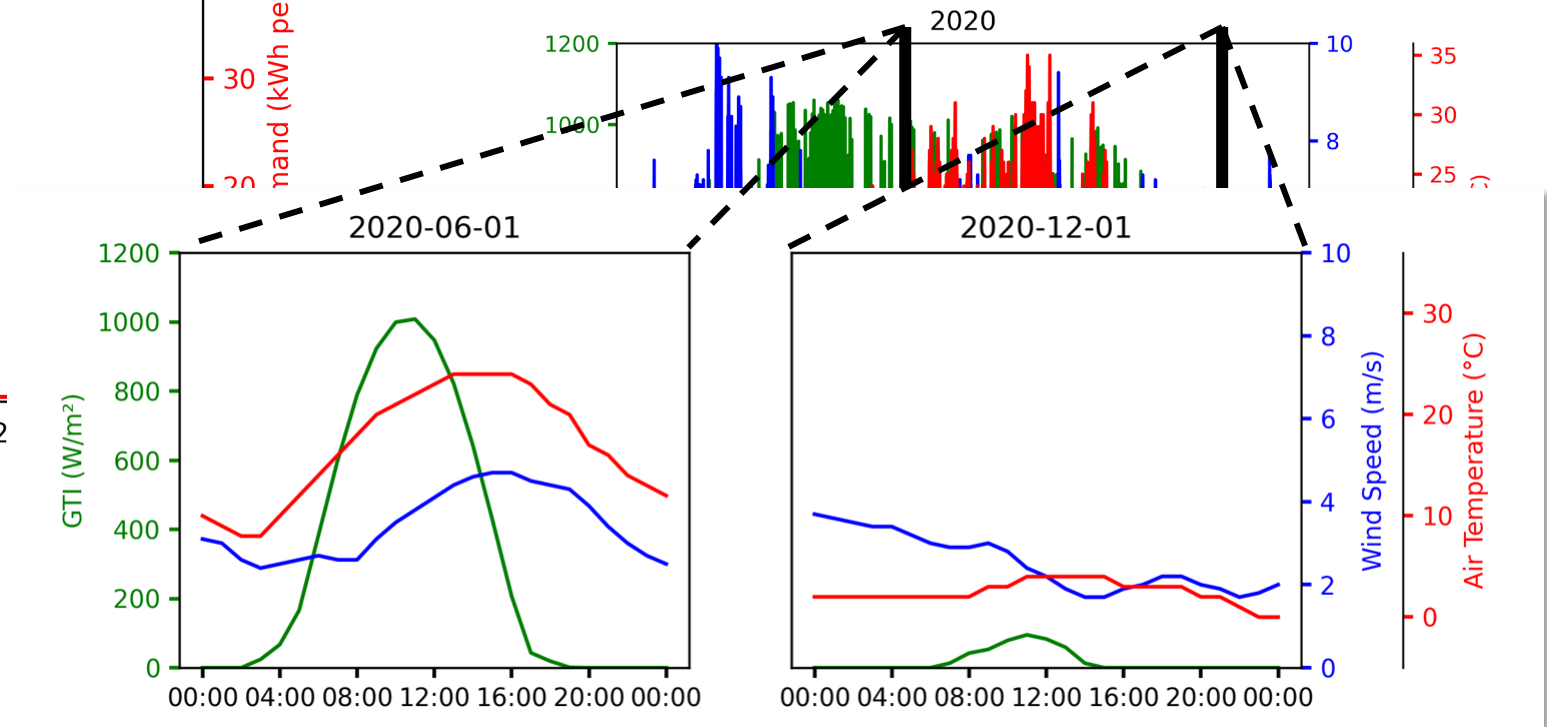
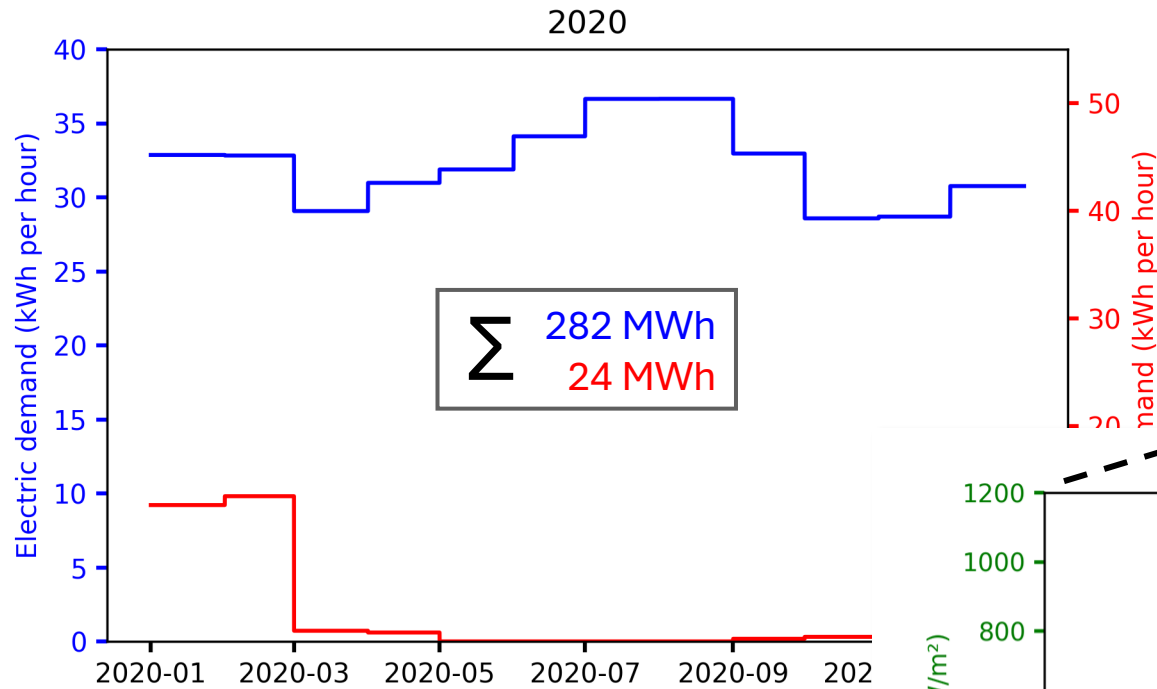


0.416 kg per kWh_{el}

- kg per kWh_{th}



INPUTS FOR LVAT DAIRY FARM



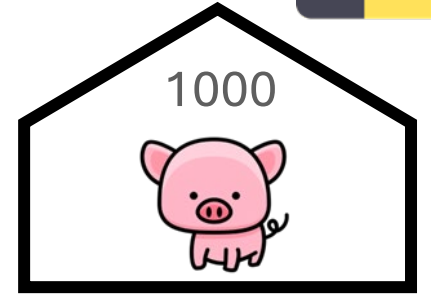
€ 0.4125

€ 0.1511

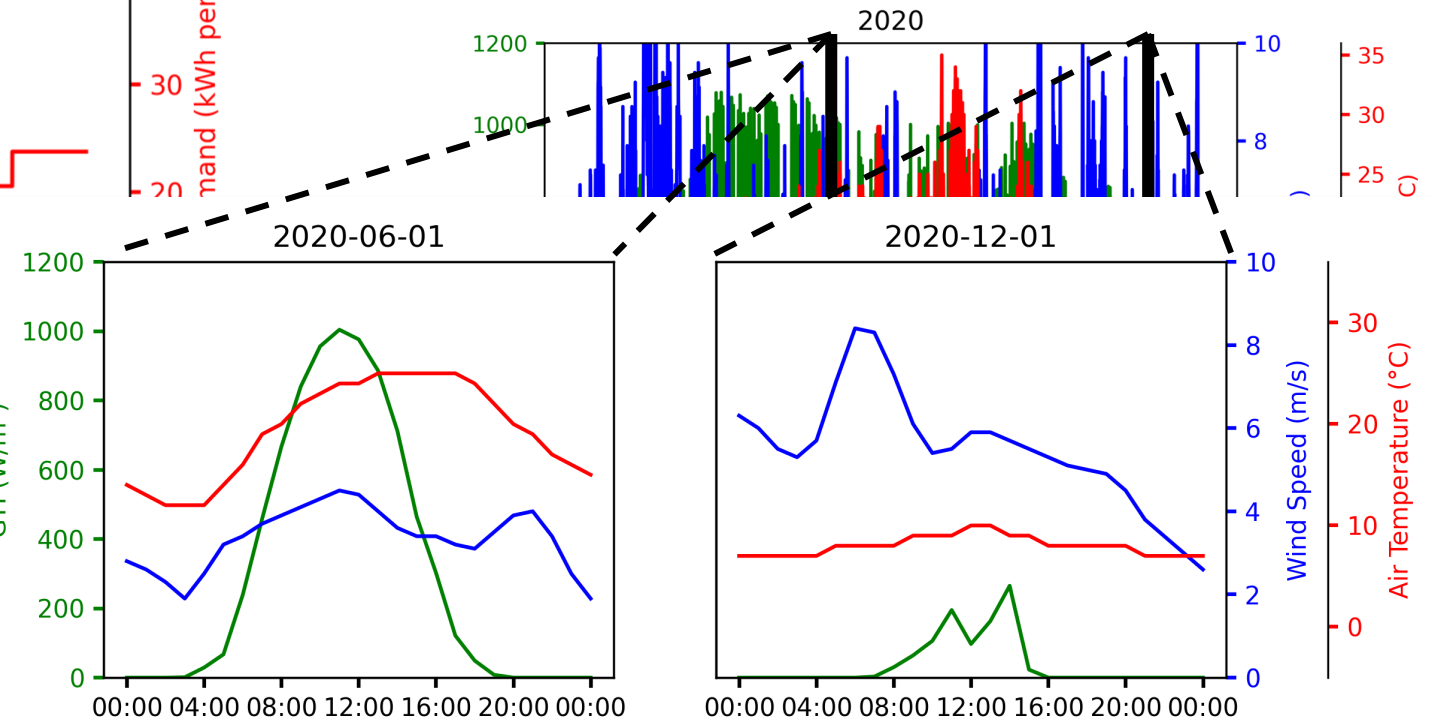
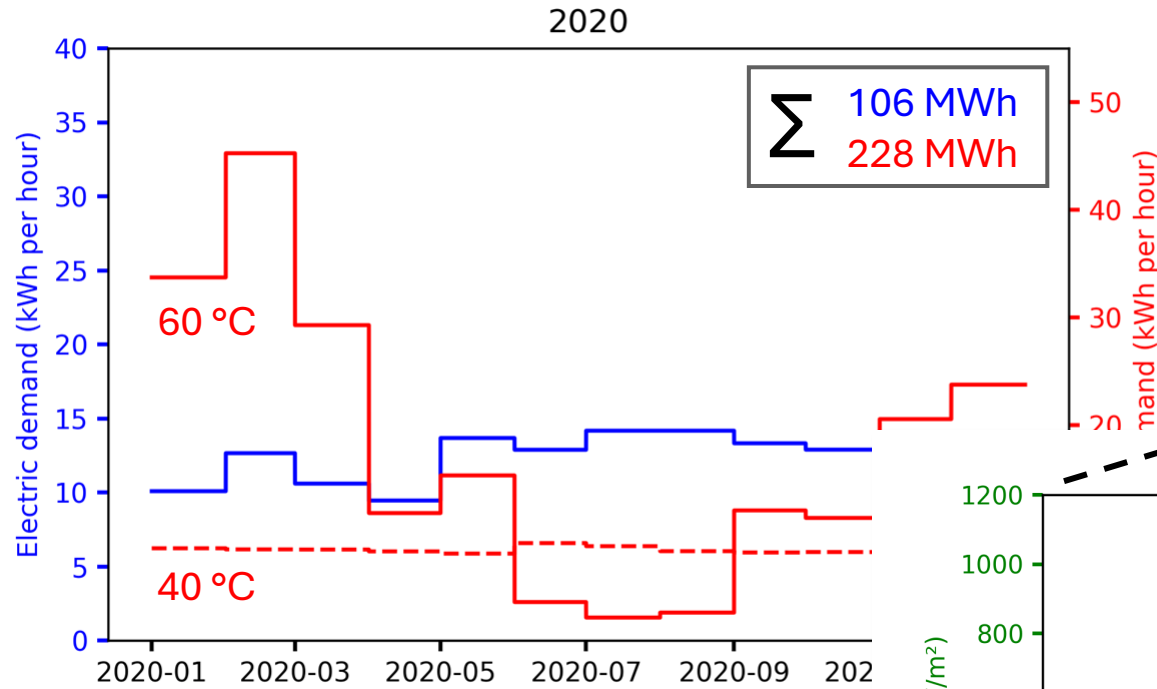


0.366 kg per kWh_{el}

0.213 kg per kWh_{th}



INPUTS FOR ILVO PIG FARM



€ 0.435

€ 0.115

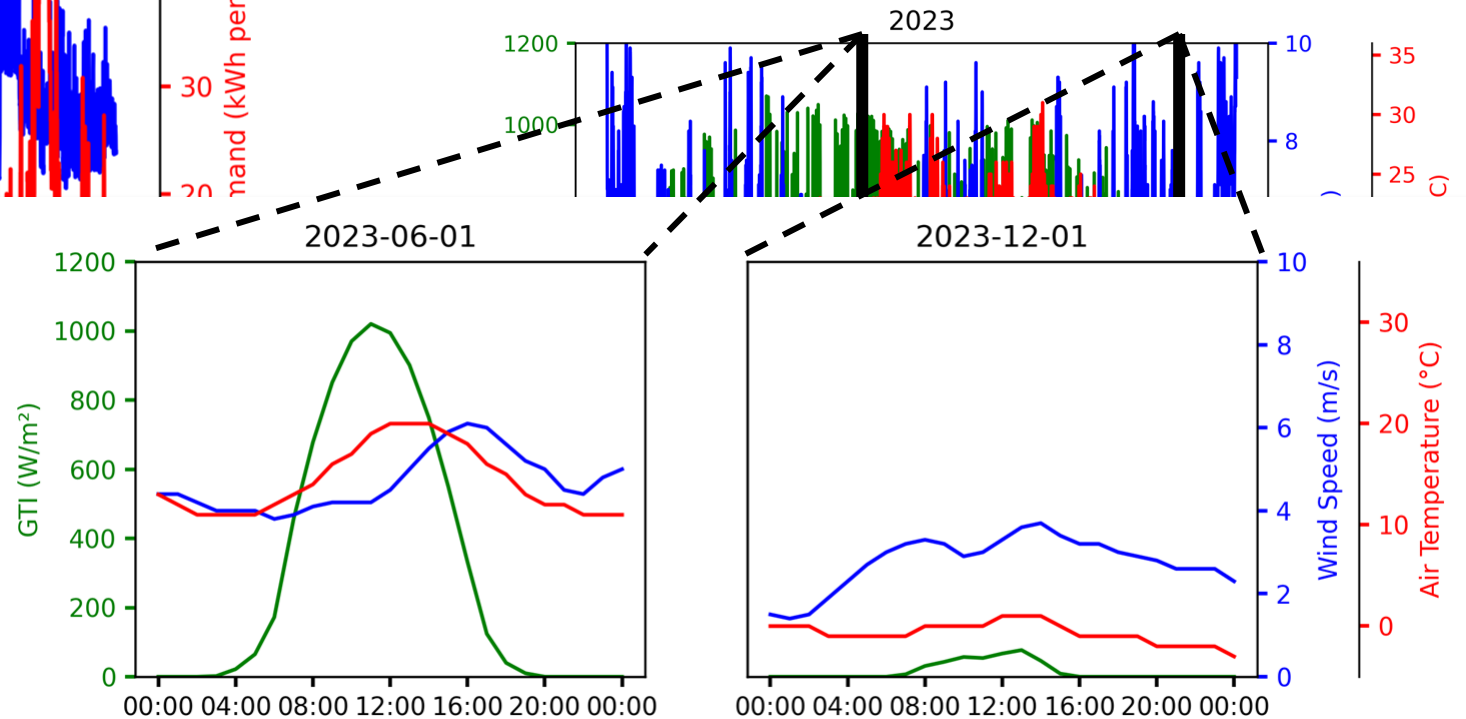
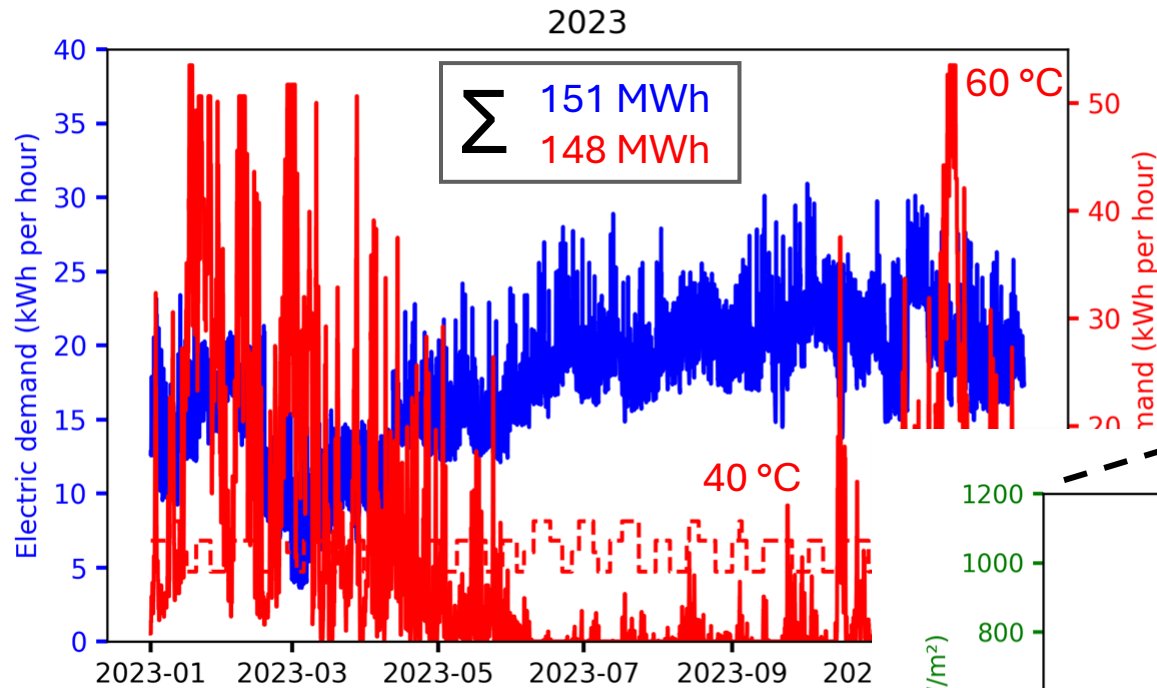
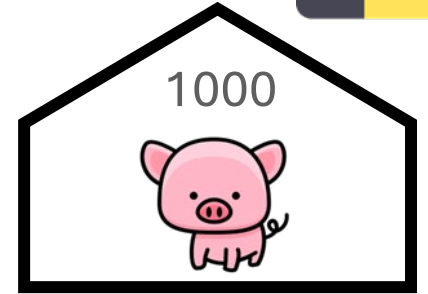


0.145 kg per kWh_{el}

0.180 kg per kWh_{th}



RECENT INPUTS FOR ILVO PIG FARM



€ 0.435

€ 0.115

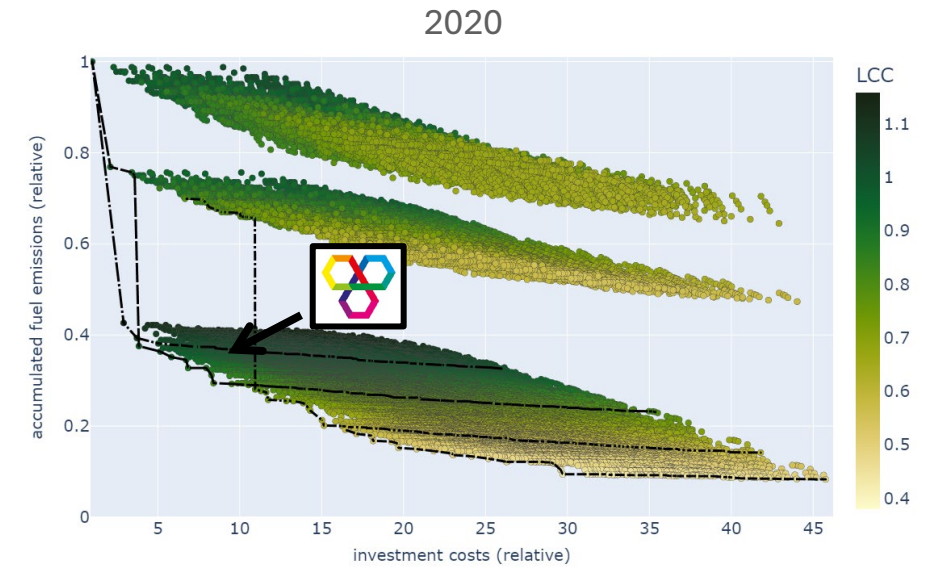
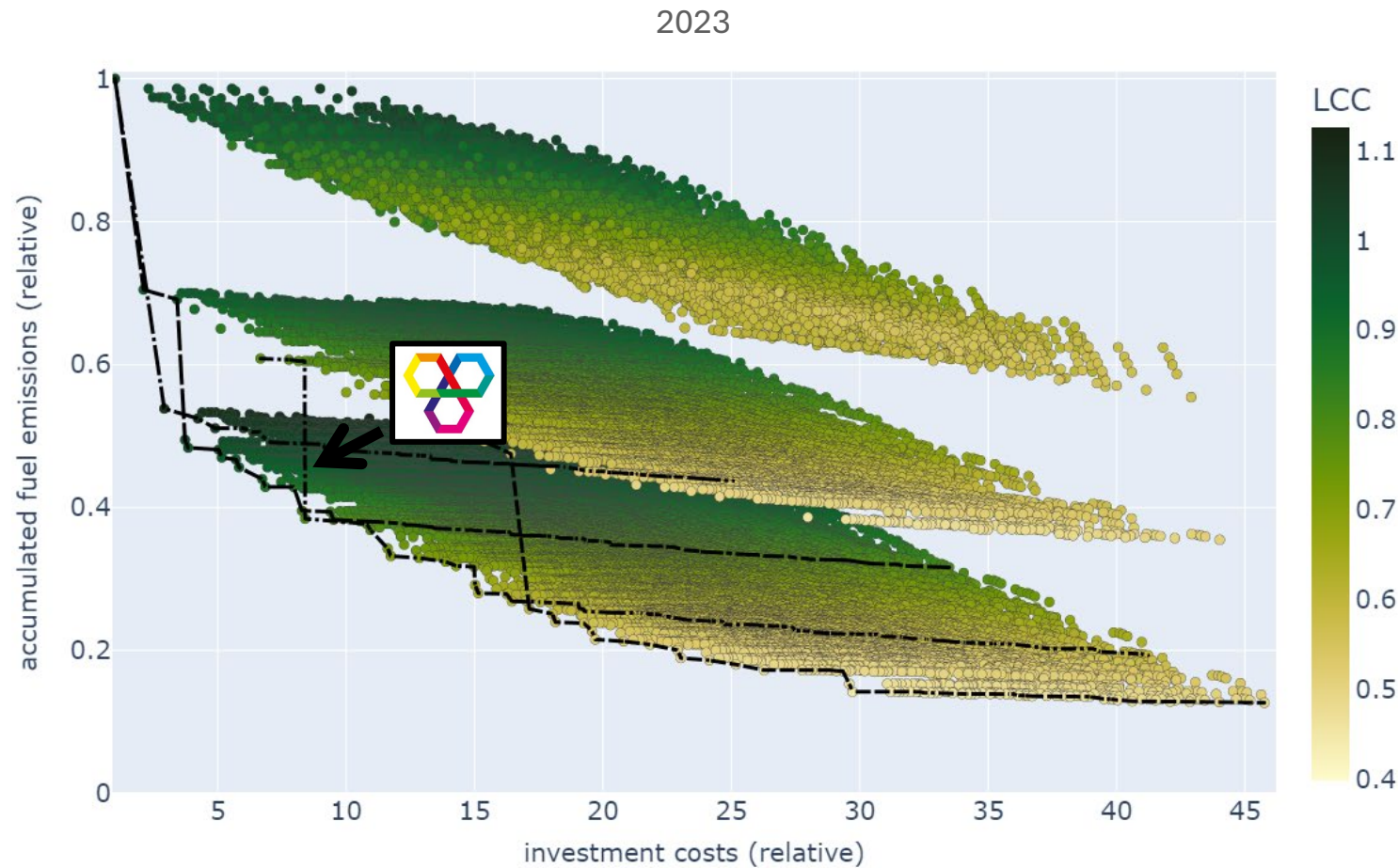


0.145 kg per kWh_{el}

0.180 kg per kWh_{th}



RECENT RESULTS FOR ILVO PIG FARM

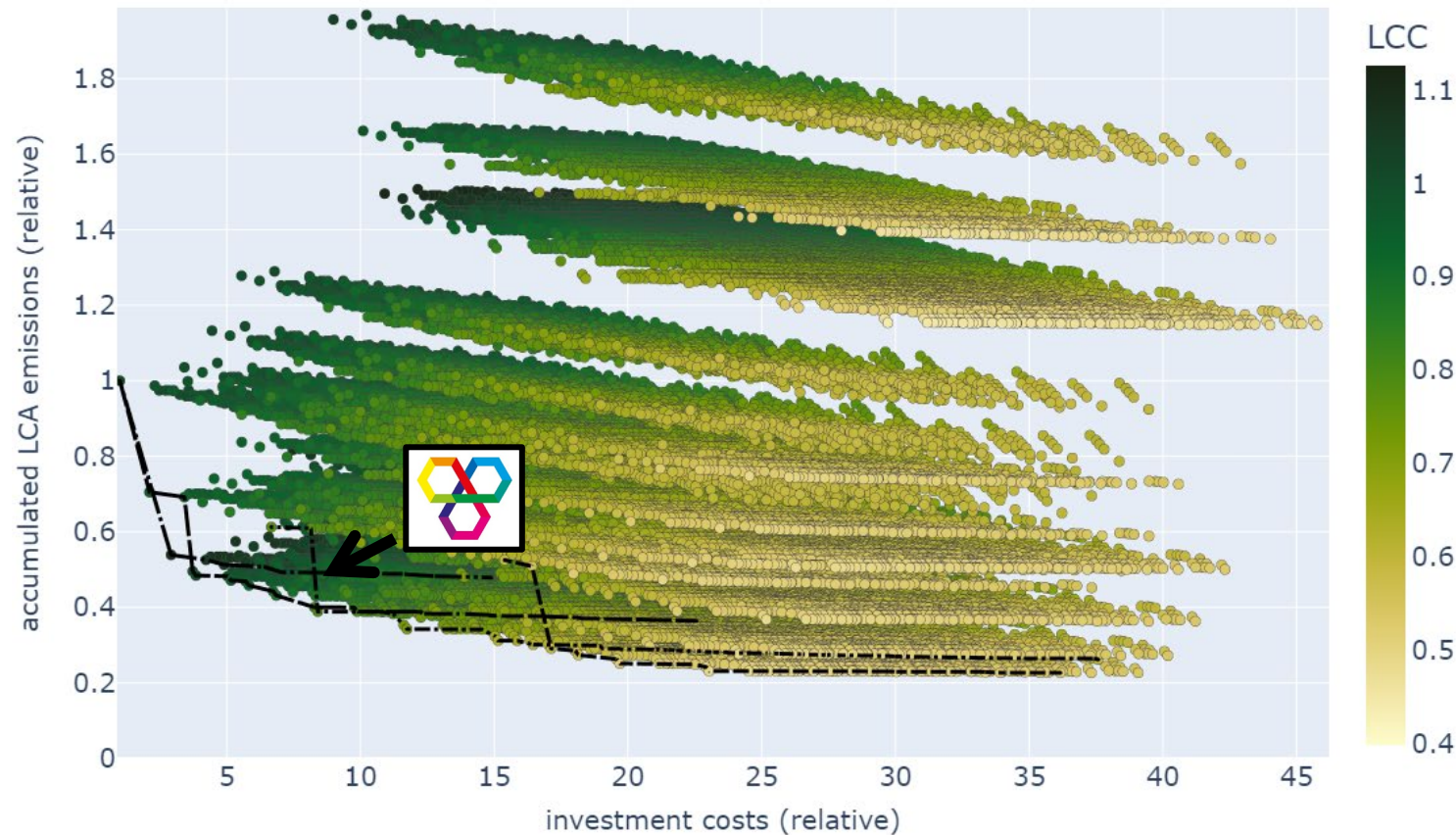


Hourly fluctuations in the demand profiles have a significant influence on the pareto fronts

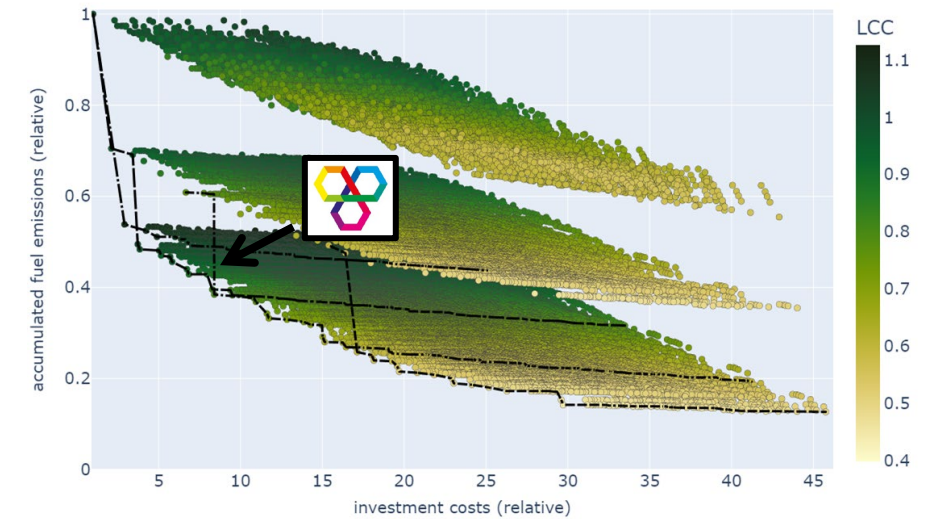


INFLUENCE OF LCA FOR ILVO PIG FARM

2023: including LCA



2023: no LCA



- - 40% - 60%
- · 60% - 80%
- 80% - 100%
- · > 100%

Influence of LCA is detrimental to scenarios with electrochemical batteries