STORY

The role of storage systems in industrial and residential environments

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 646426. Project STORY – H2020-LCE-2014-3.

GOAL: added value of storage in distribution systems for a flexible and secure energy system

From May 2015
to October 2020

Budget:
15,8 Mio €

18 partners from
8 countries

6 demonstrations
in 4 countries

Diversity of technology & actors:
TRL 5 to 7,
Interoperability and ICT,
Economic, social and enviromental effects,
Development of innovative business models

PROJECT DEMONSTRATIONS

BE

Aggregation of residential flexibilities, community battery

heat pumps,
EVs, fuel cell,
thermal storage,
neighbourhood battery

ES

Storage in a factory

PV, 50 kW
Li-Ion battery

BE

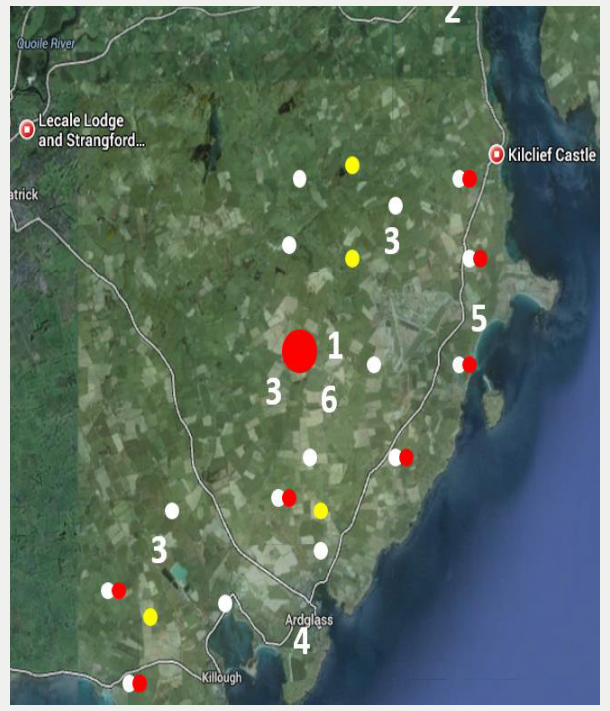
Boiler/ORC + thermal storage in wood processing company

use of waste wood
for electricity
and heat

UK/NI

Small scale CAES/residential setting

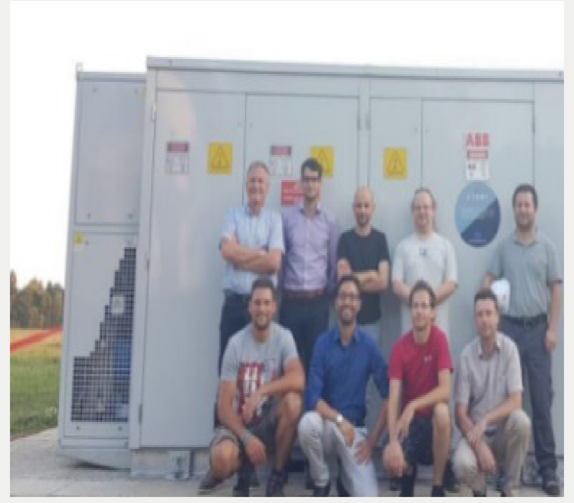
reduction
of wind or
PV curtailment



SI

Community battery in a residential village

implemented by the DSO
Li-Ion, 320 kW, avoidance
of grid reinforcement
services to the grid



THE ROLE OF STORAGE TO INCREASE RES
→ our approach

1

Large-scale simulations represent **a typical European network** with good grid conditions

2

Assessment of demonstration cases featuring **real world constraints**

3

Comparison of simulations with demos from an **environmental, technical and economic viewpoint**

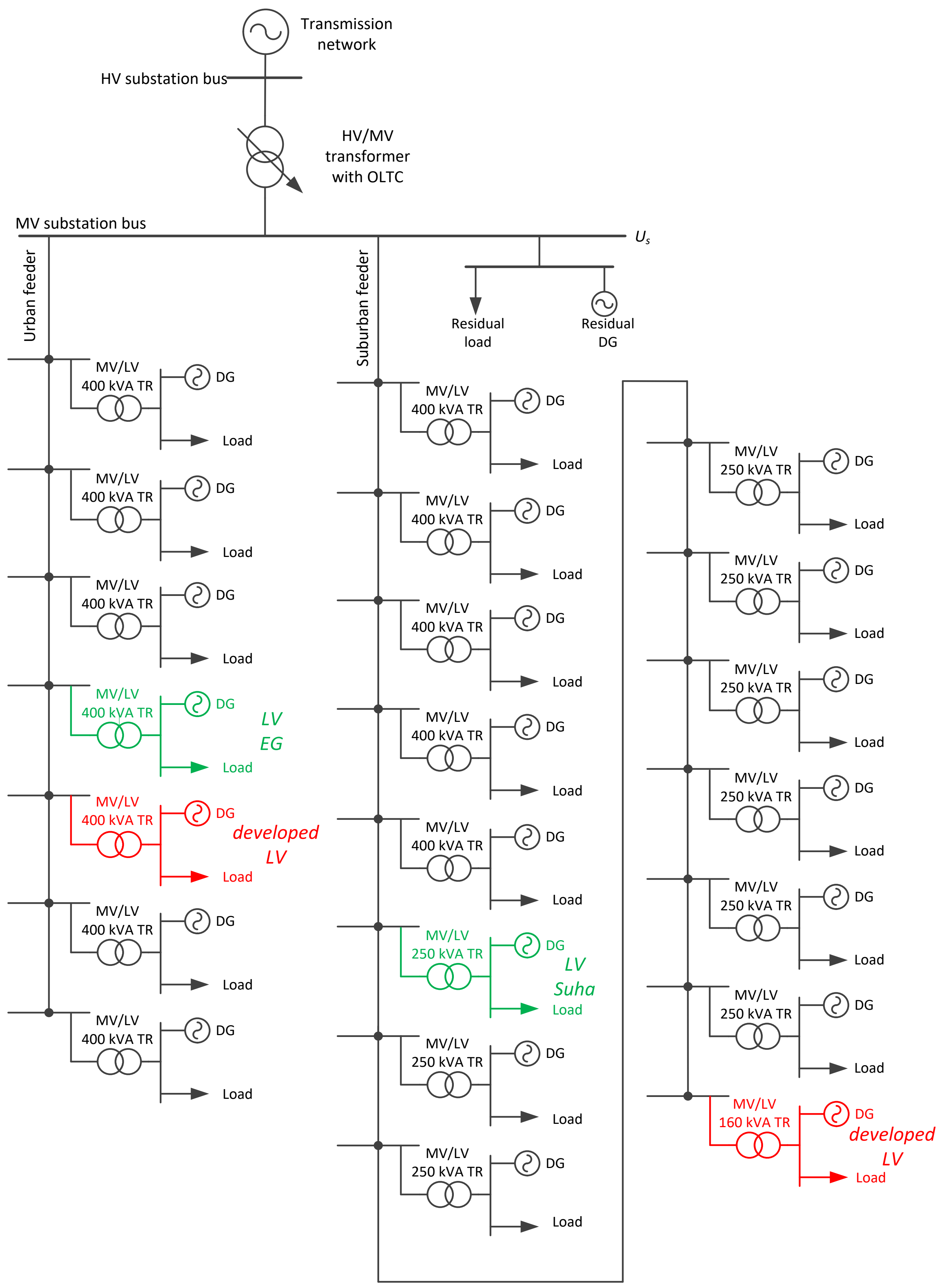
LARGE-SCALE SIMULATIONS
→ of MV network with rural and urban grid sections

VARIATION OF PARAMETERS IN SCENARIOS

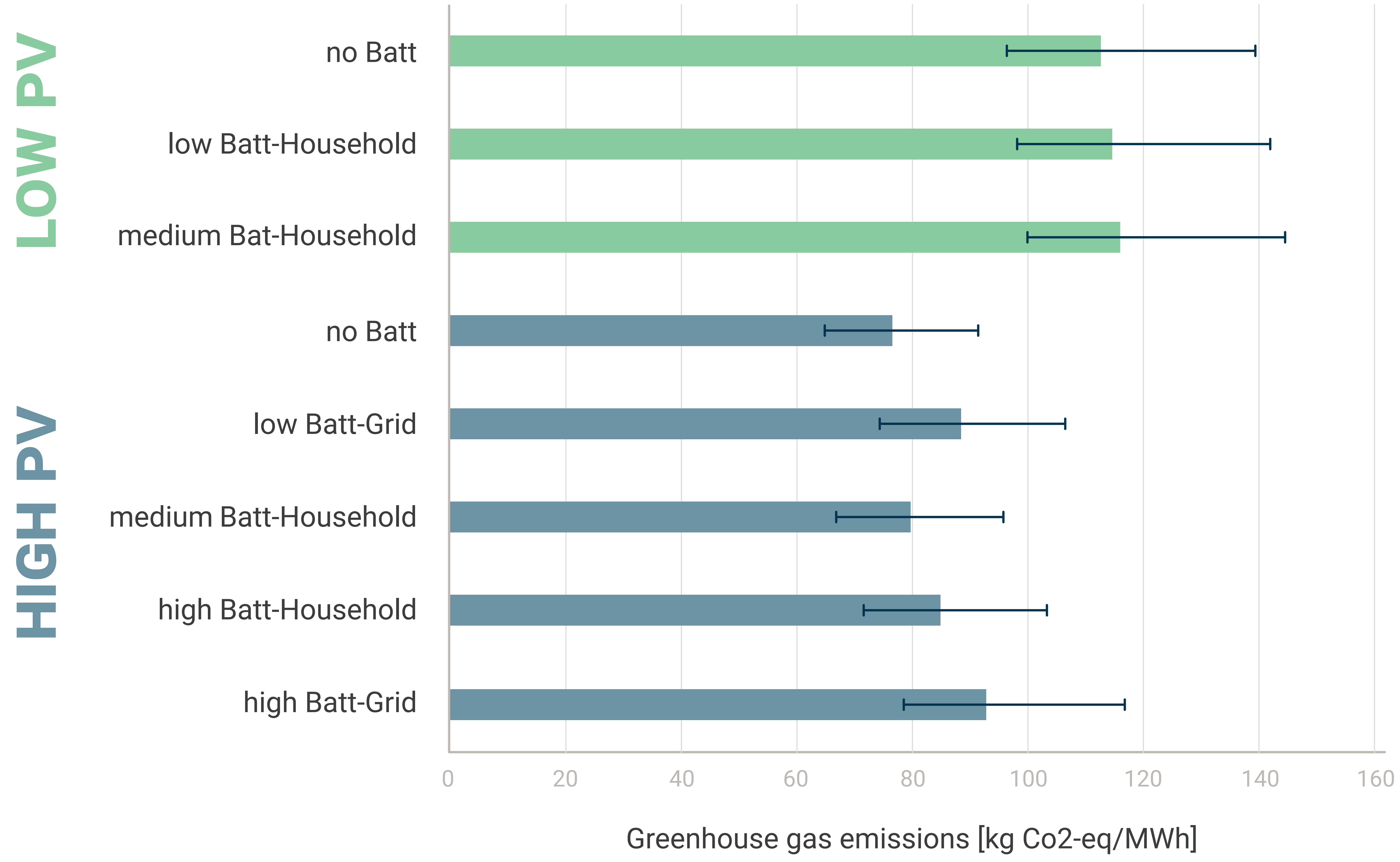
- → Peak power of PV units
- → Power + type of battery storage
  - – Grid
  - – Households

ENVIRONMENTAL IMPACT ASSESSMENT OF 8 SCENARIOS USING LIFE CYCLE ANALYSIS (LCA)

- → Low PV
  - – no Batt
  - – low Batt-Household
  - – medium Bat-Household
- → High PV
  - – no Batt
  - – low Batt-Grid
  - – medium Batt-Household
  - – high Batt-Household
  - – high Batt-Grid

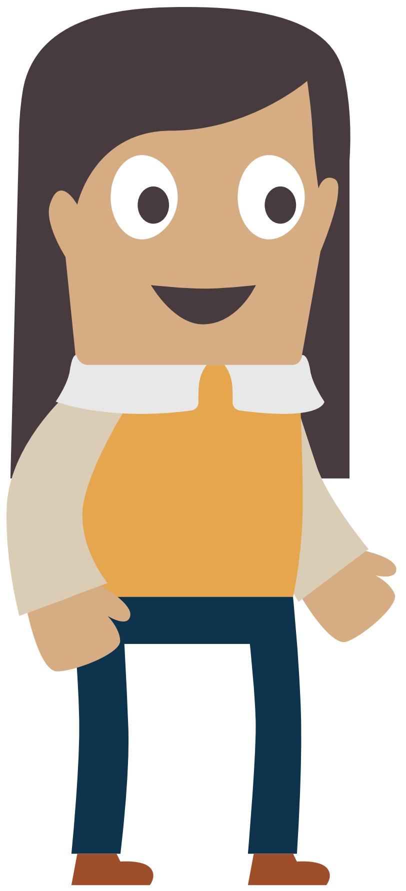


LARGE-SCALE: ENVIRONMENTAL ANALYSIS



DEMO CASE:

STORAGE IN A FACTORY, SPAIN



Pre-project situation

Facility produces professional fridge rooms and requires high power peak values

Installed 113 kWp PV

STORY objectives & technologies

50 kW, 200 kWh Li-Ion to improve the business case

demand charge reduction on the energy bill for industrial sector combining storage/batteries with PV integration

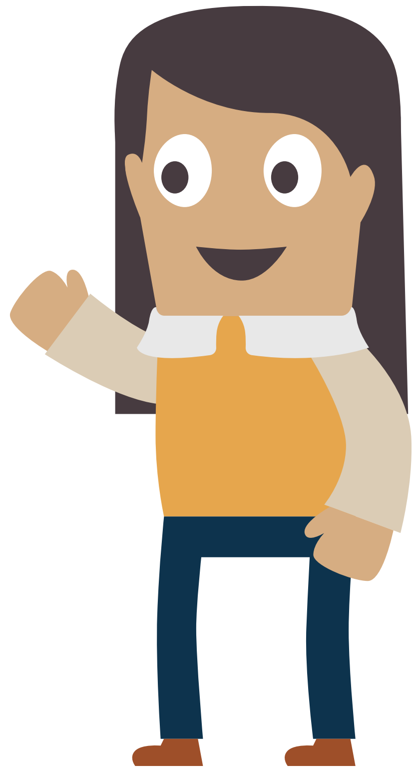
Use Cases

UC0: no PV, no battery

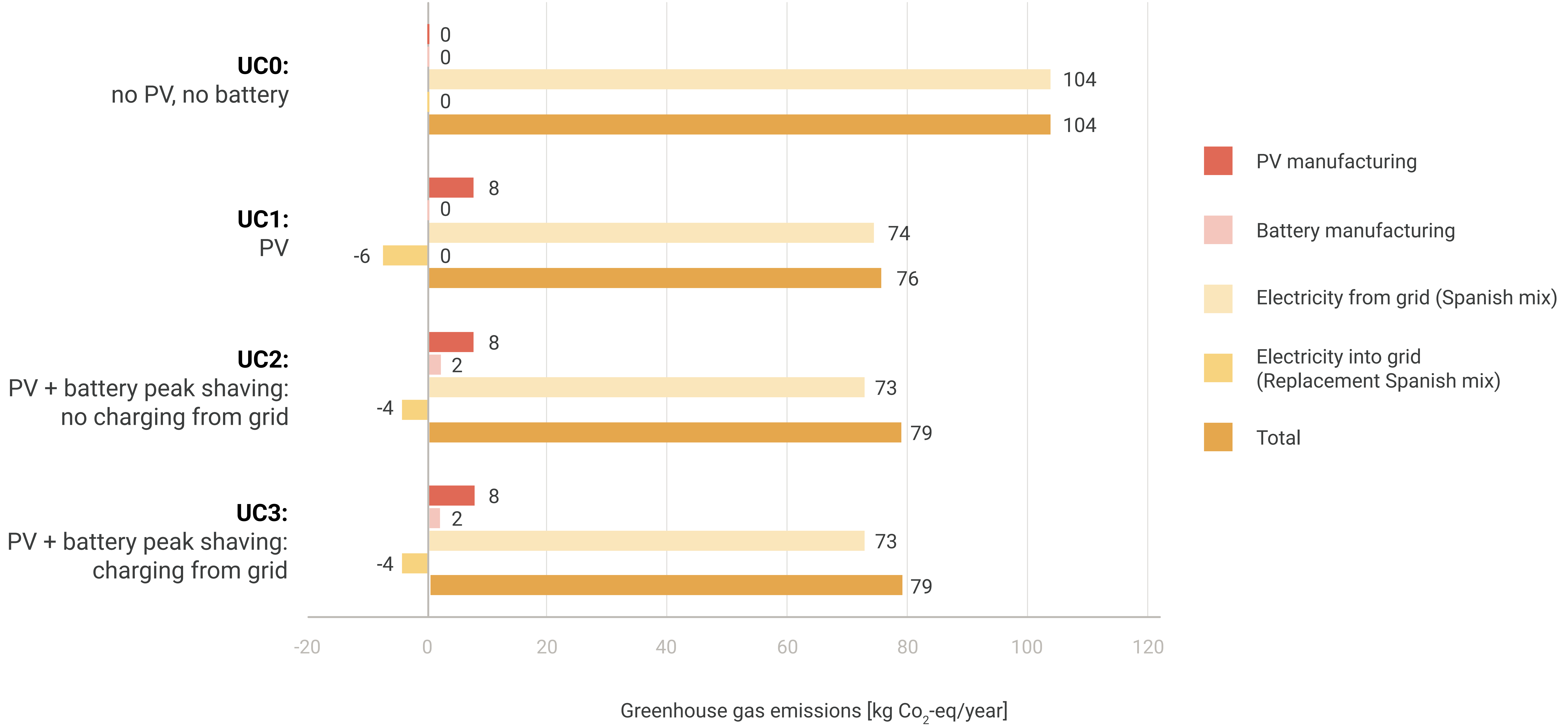
UC1: PV

UC2: PV + battery peak shaving: no charging from grid

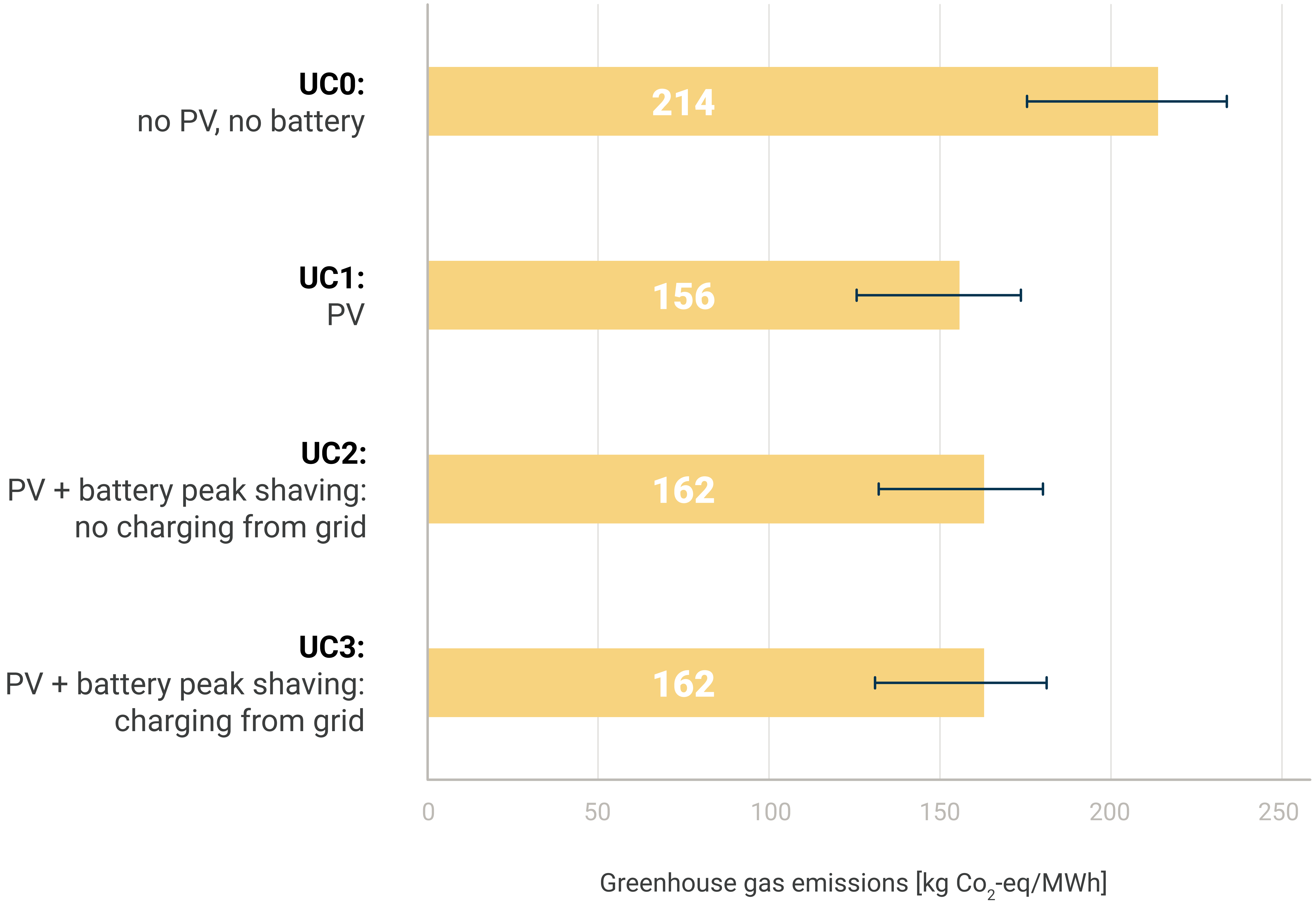
UC3: PV + battery peak shaving: charging from grid



ENVIRONMENTAL ASSESSMENT (1)

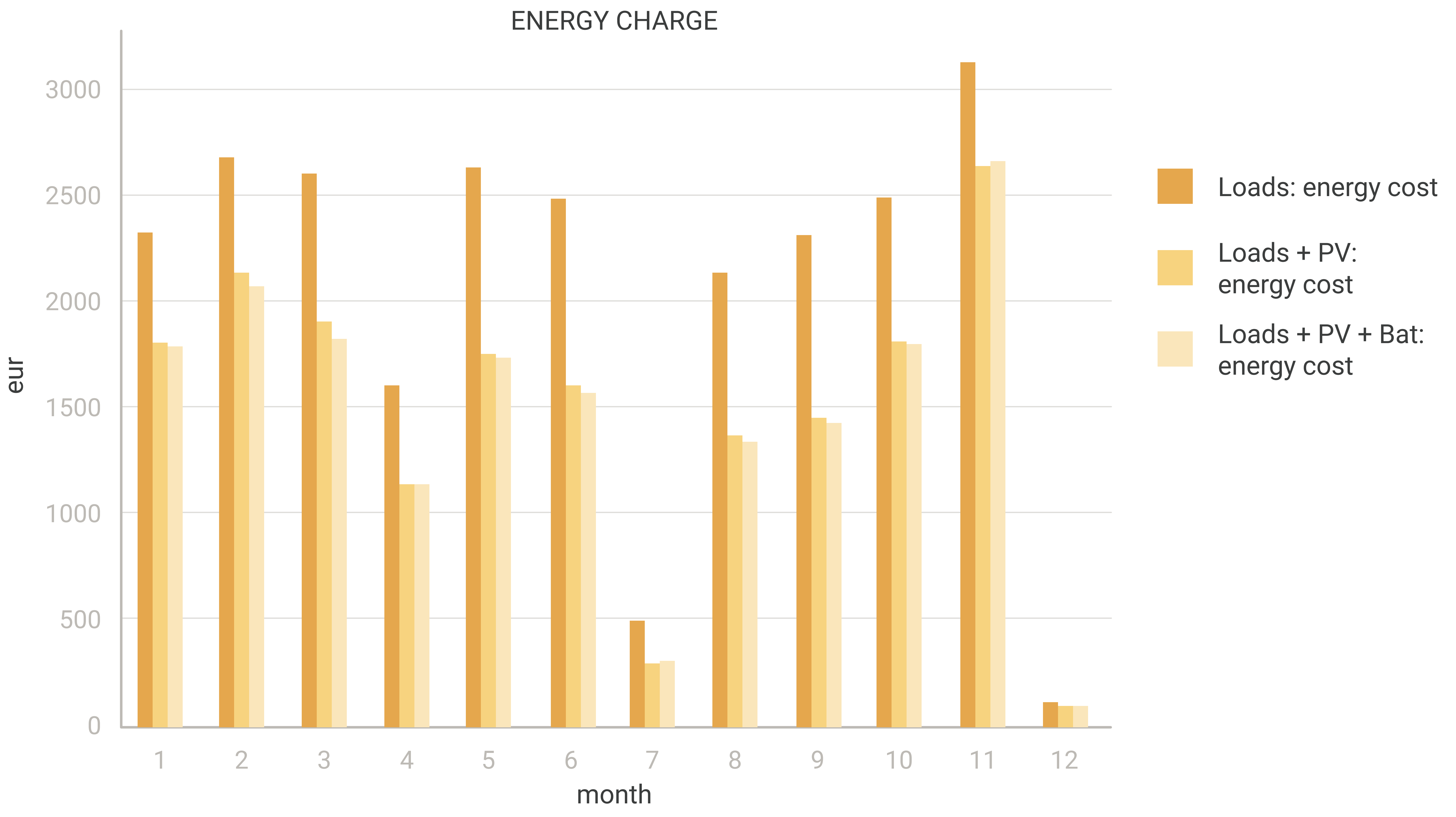


ENVIRONMENTAL ASSESSMENT (2)



ECONOMIC ASSESSMENT

Demand charge reduction	Loads (€)	Loads: PV (€)	Loads: PV + Bat (€)
JAN	384.44	384.44	355.95
FEB	367.34	365.56	357.45
MAR	429.87	428.77	398.91
Average reduction		**-0.24%**	**-5.87%**
SEPT	365.00	264.47	316.13
OCT	447.13	353.26	359.10
NOV	486.00	488.34	488.34
Average reduction		**-14.80%**	**-10.37%**



CONCLUSIONS

1

PV decreases demand charge significantly, in winter the battery further **decreases demand charge**

2

For this use case the battery does **not yet provide a business case**

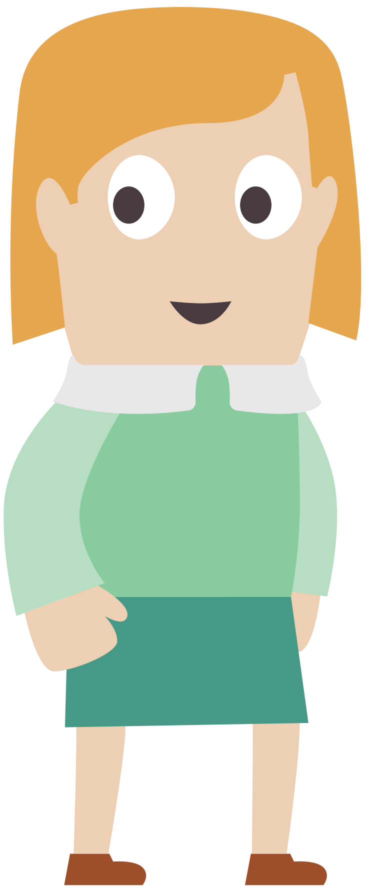
3

GHG emissions increase to a small extent compared to only injecting PV into the grid

DEMO CASE: **STORAGE IN A FACTORY, SPAIN**

DEMO CASE:

RESIDENTAL VILLAGE, SLOVENIA



COMMUNITY BATTERY IMPLEMENTED BY THE DSO

→ Li-ion battery, 320 kWh, 170 kW

Grid issues expected at higher PV levels

Scenario low RES – 210 kWp PV

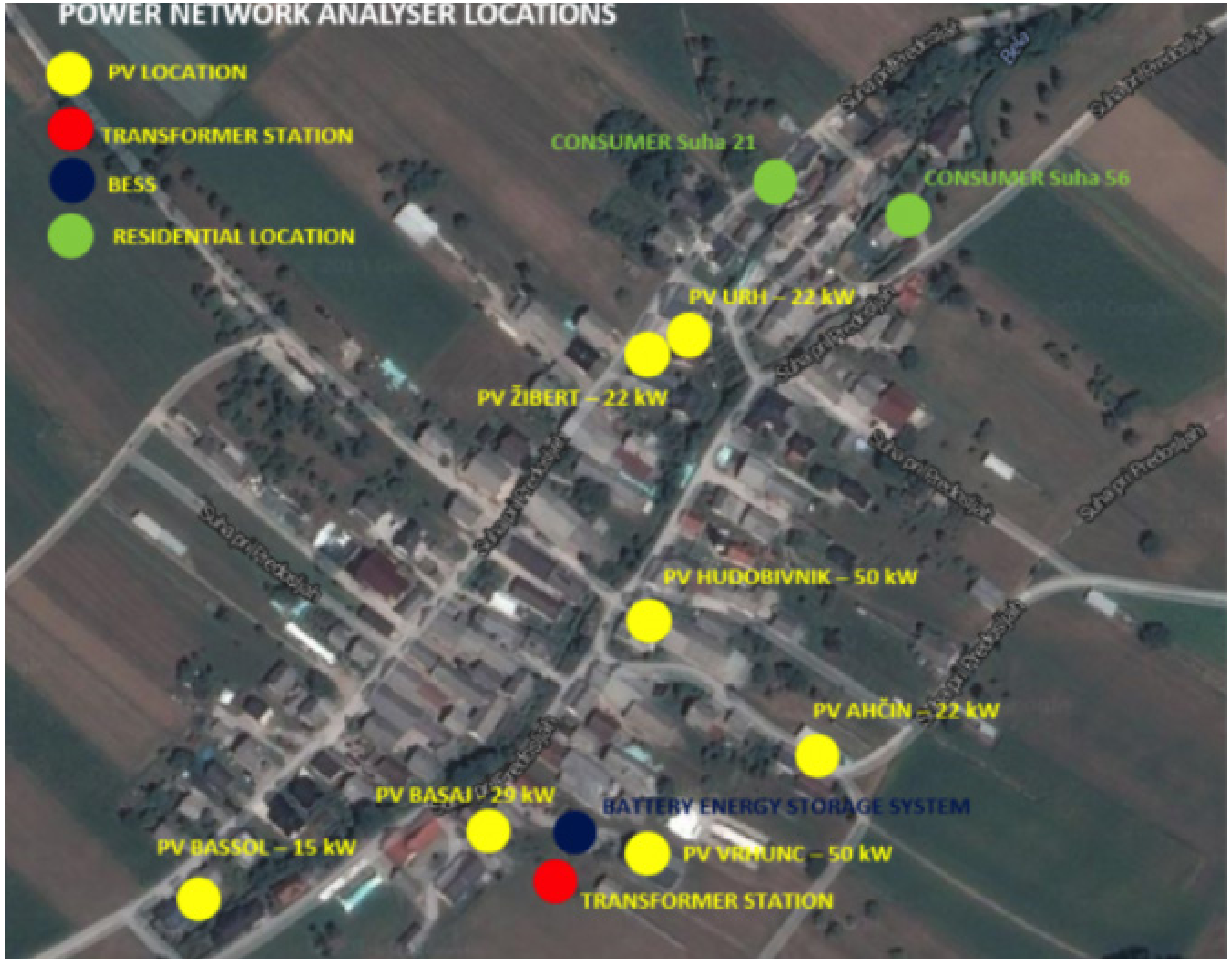
UC1: PV curtailment

UC2: BESS implementation

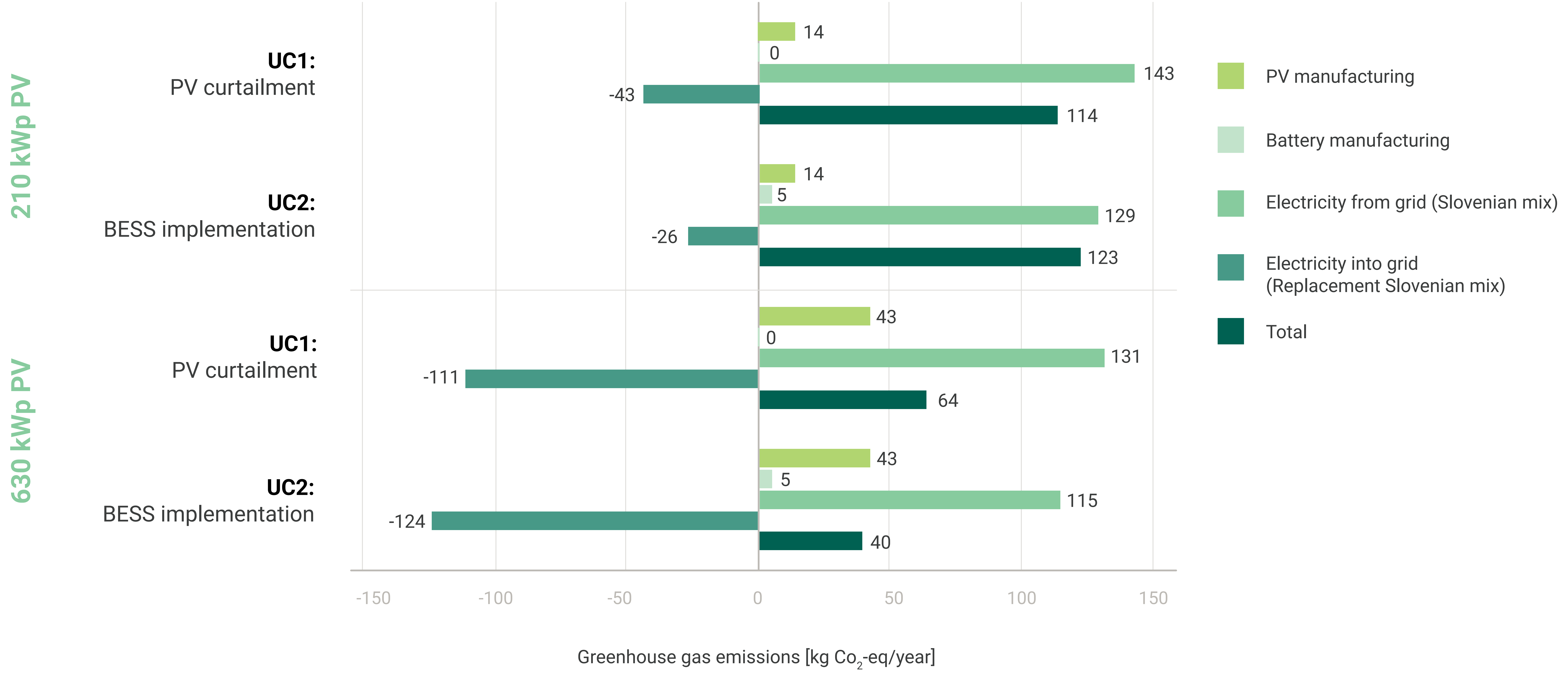
Scenario high RES – 630 kWp PV

UC1: PV curtailment

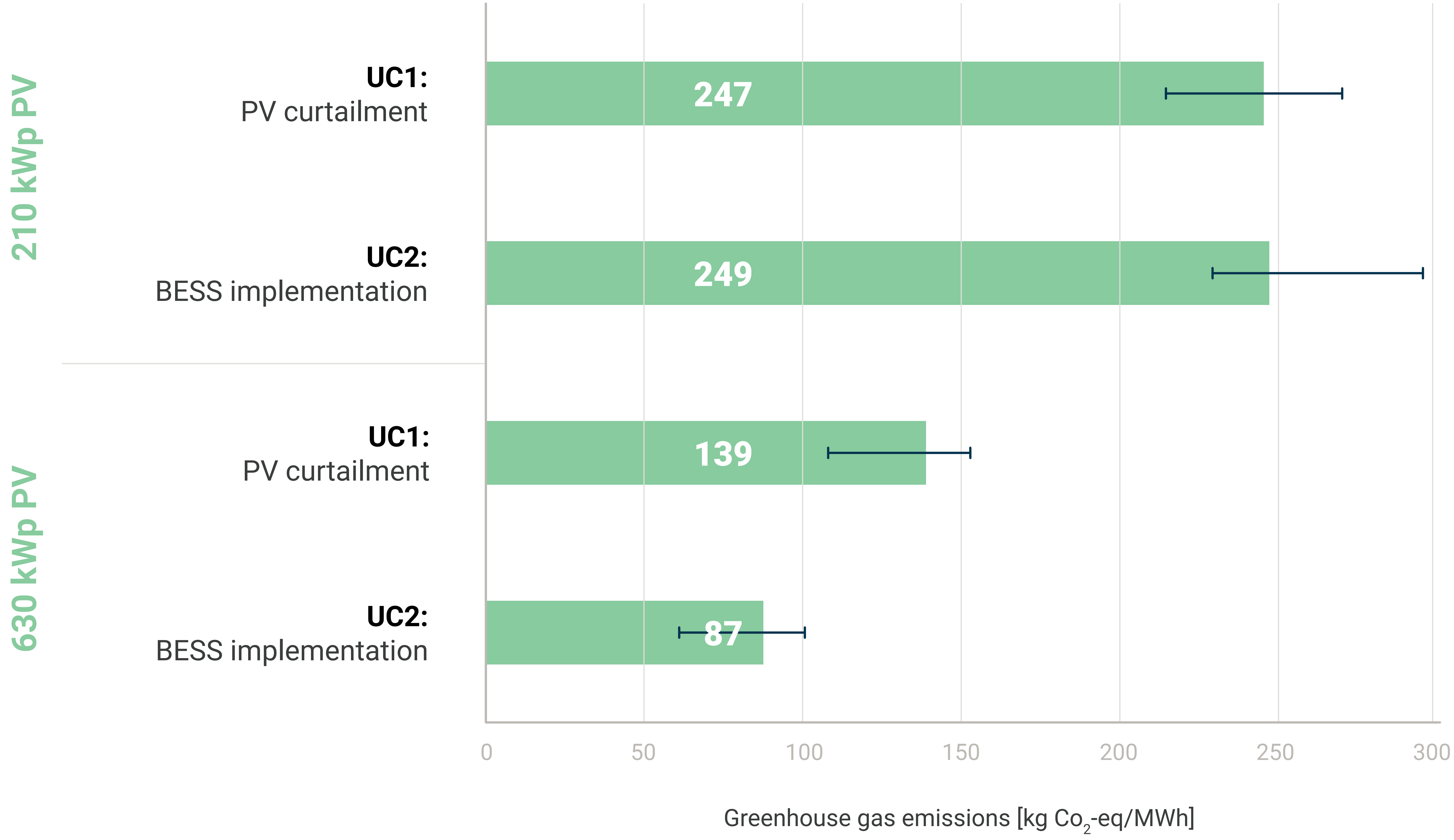
UC2: BESS implementation


POWER NETWORK ANALYSER LOCATIONS
PV LOCATION
TRANSFORMER STATION
BESS
RESIDENTIAL LOCATION
CONSUMER Suha 21
CONSUMER Suha 56
PV URH – 22 kW
PV ŽIBERT – 22 kW
PV HUDOBIVNIK – 50 kW
PV AHČIN – 22 kW
PV BASAJ – 29 kW
BATTERY ENERGY STORAGE SYSTEM
PV BASSOL – 15 kW
PV VRHUNC – 50 kW
TRANSFORMER STATION

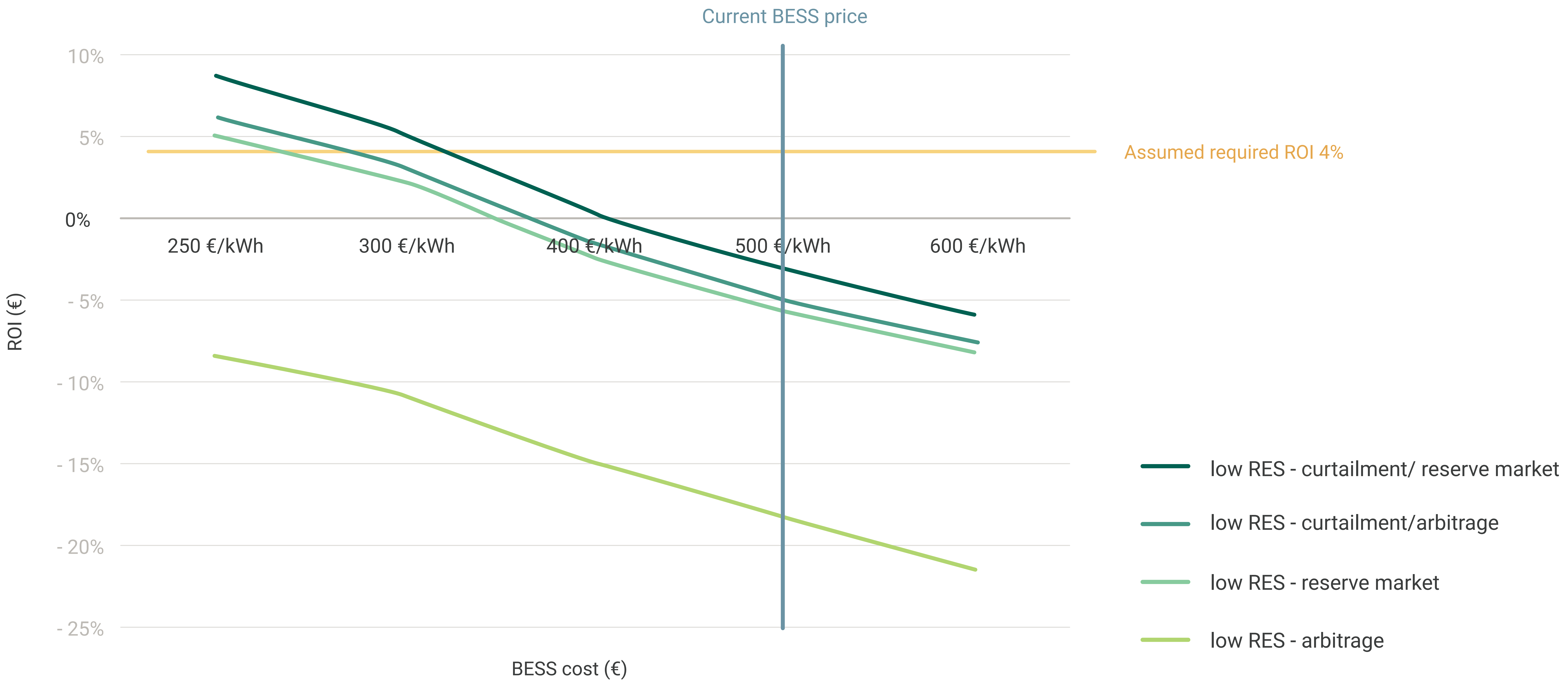
ENVIRONMENTAL ASSESSMENT (1)



ENVIRONMENTAL ASSESSMENT (2)



ECONOMIC ANALYSIS



TECHNICAL ANALYSIS

After BESS installation	Low RES (June)	High RES (June)
Peak power change	- 42%	- 44
Peak to average ratio change	- 40%	- 40%
Grid losses	- 7%	- 21%
Local voltage grid energy consumption	+ 20%	+ 20%

→ **INFRASTRUCTURE UPGRADE CAN BE DELAYED**

CONCLUSIONS

1

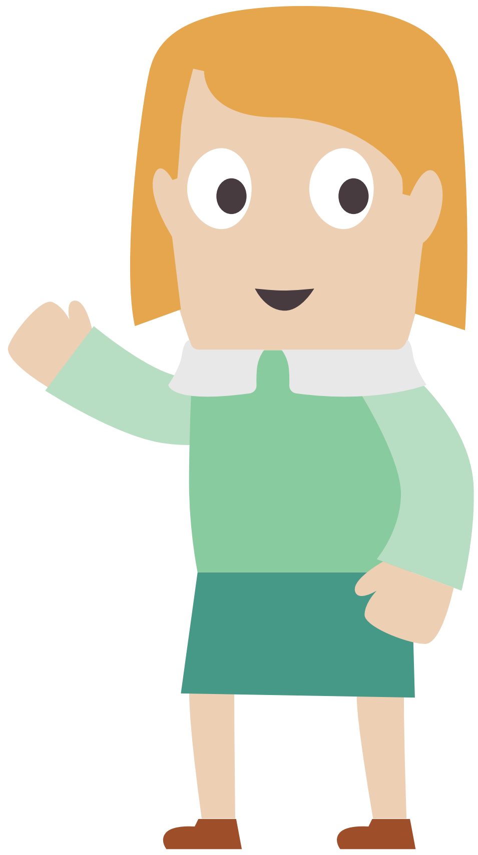
Possible business case with revenues from reserve markets/mitigating local RES curtailment are within reach

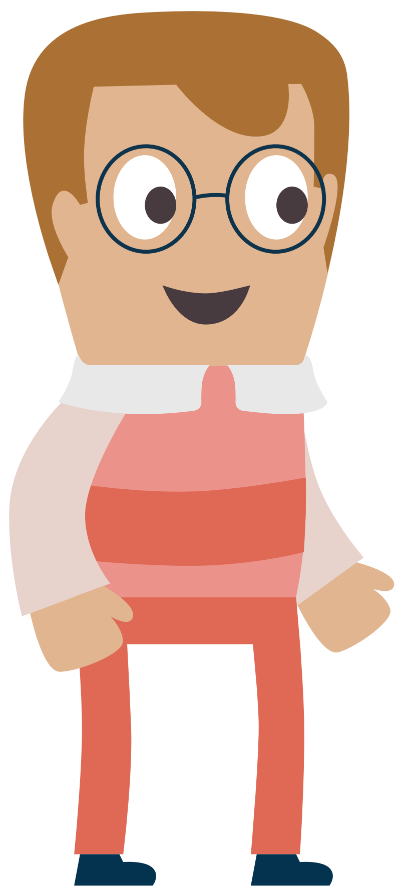
2

Environmental benefits only in case of **mitigating local RES curtailment**

3

Important technical benefits to the DSO by peak reduction, reduction of losses, and increased local RES generation

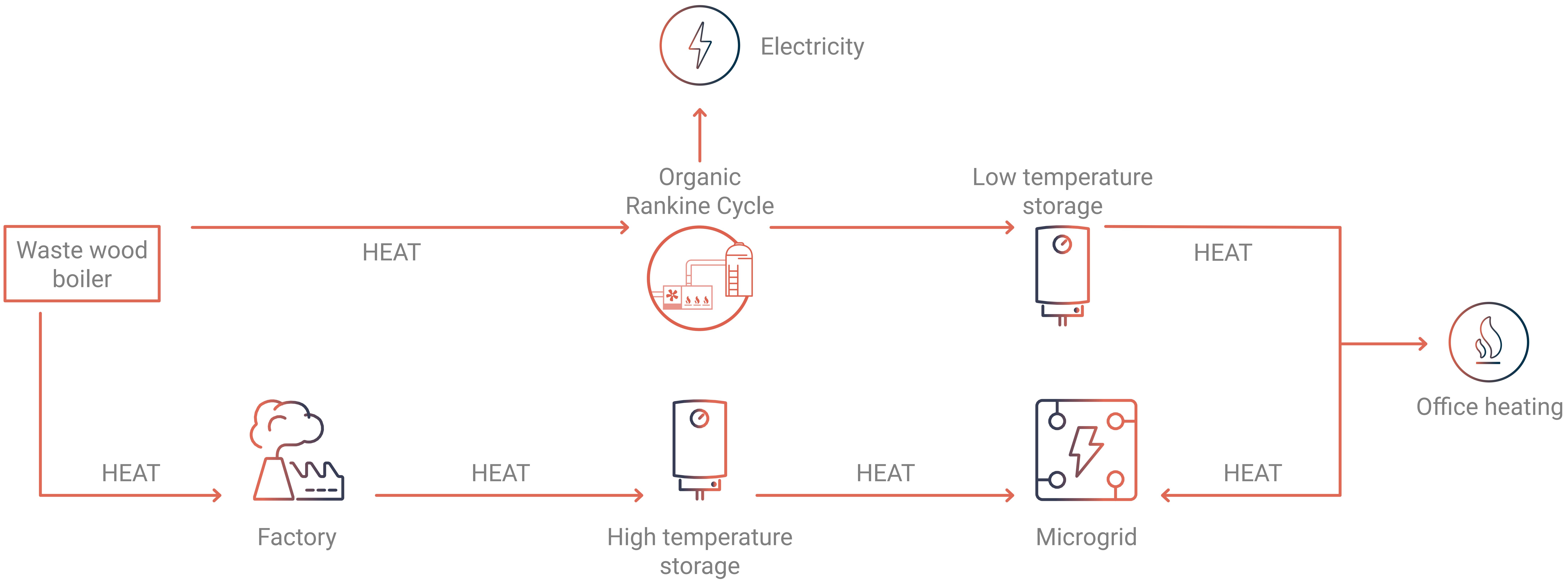


DEMO CASE:

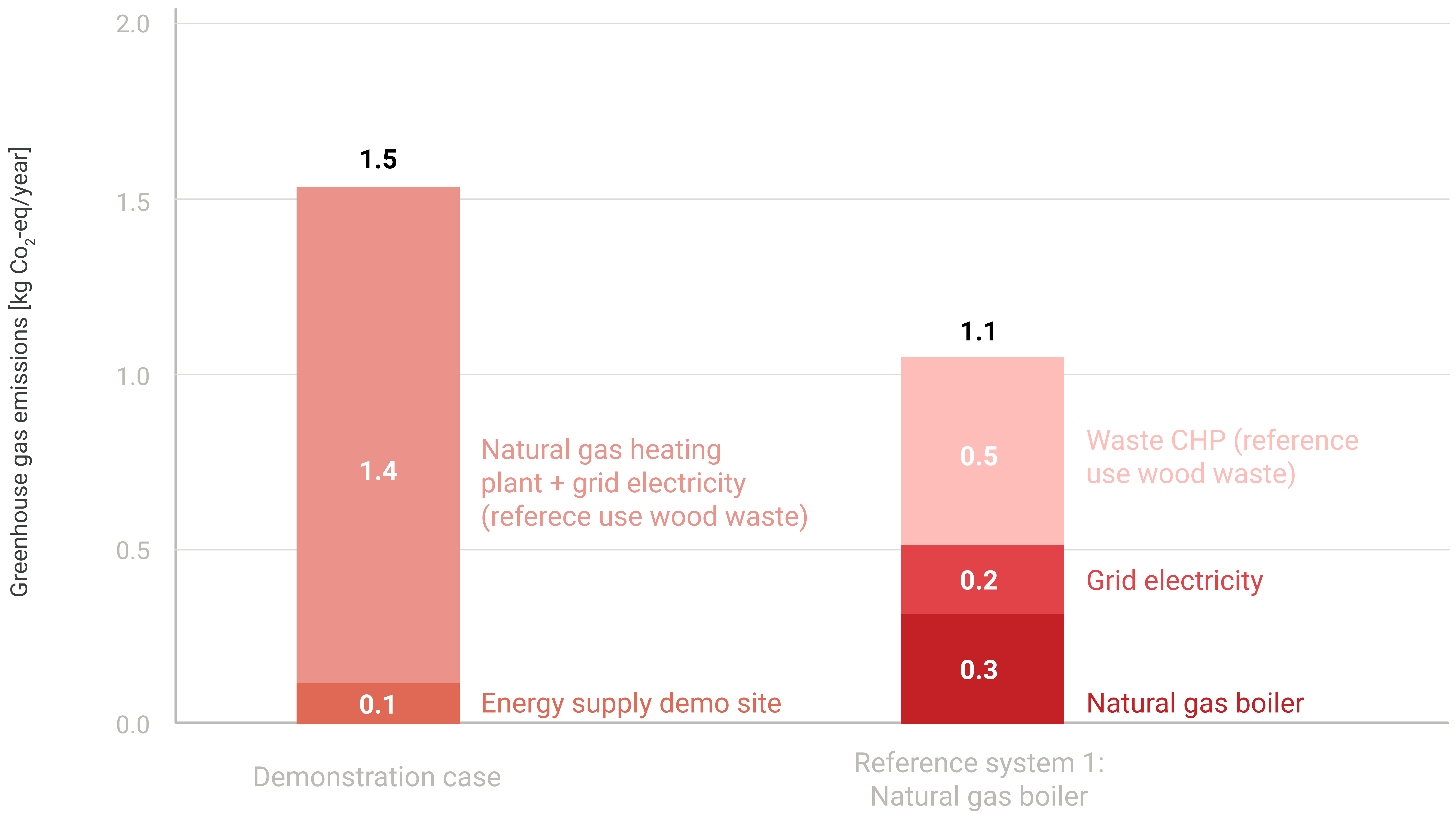
BENEENS MULTI-ENERGY GRID, BELGIUM

BIOMASS BOILER PLUS ORC, AND THERMAL STORAGE

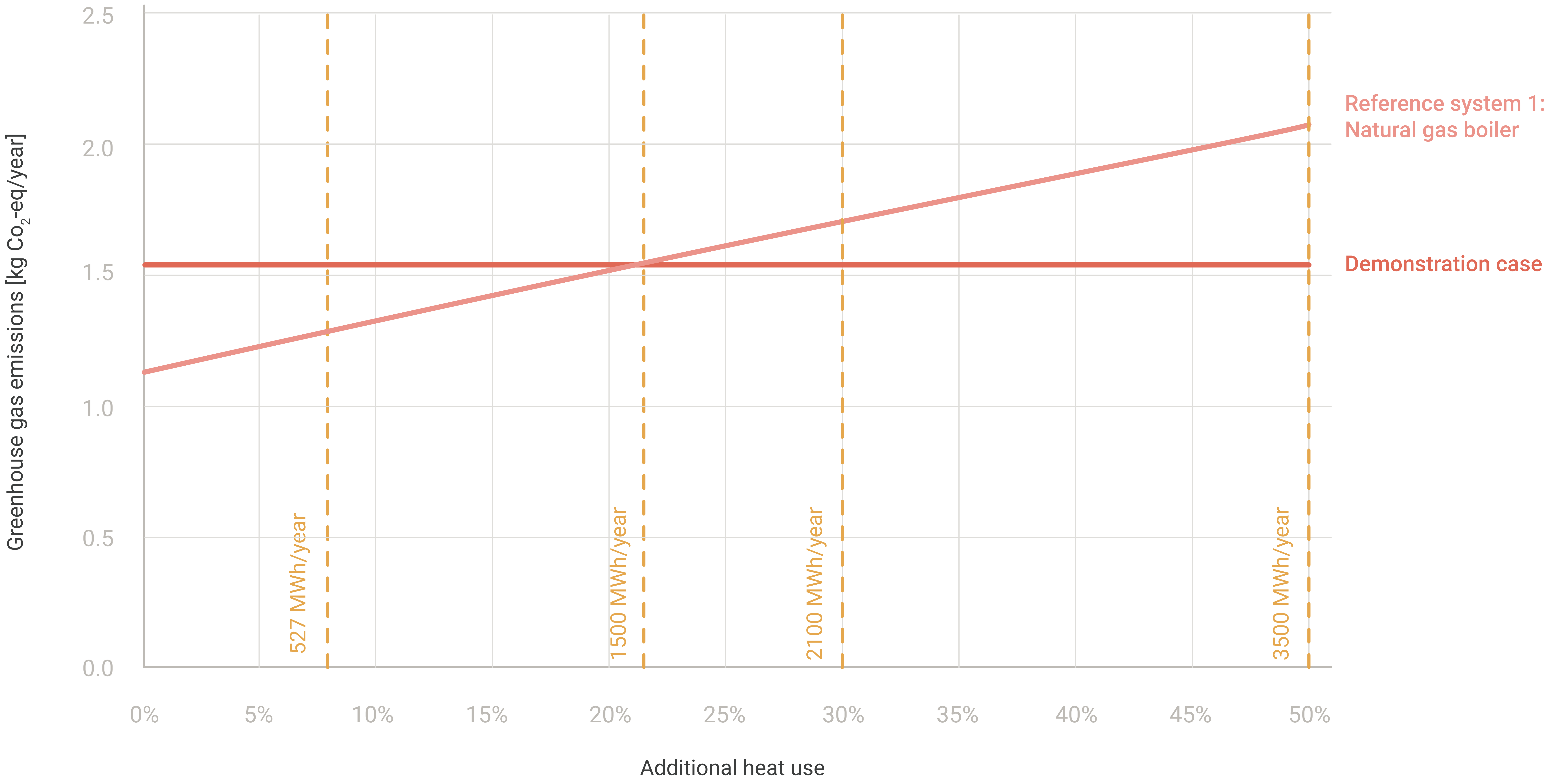
Possible heat supply to neighbors	Active control of the ORC though the use of thermal storage	Reduced peak power demand



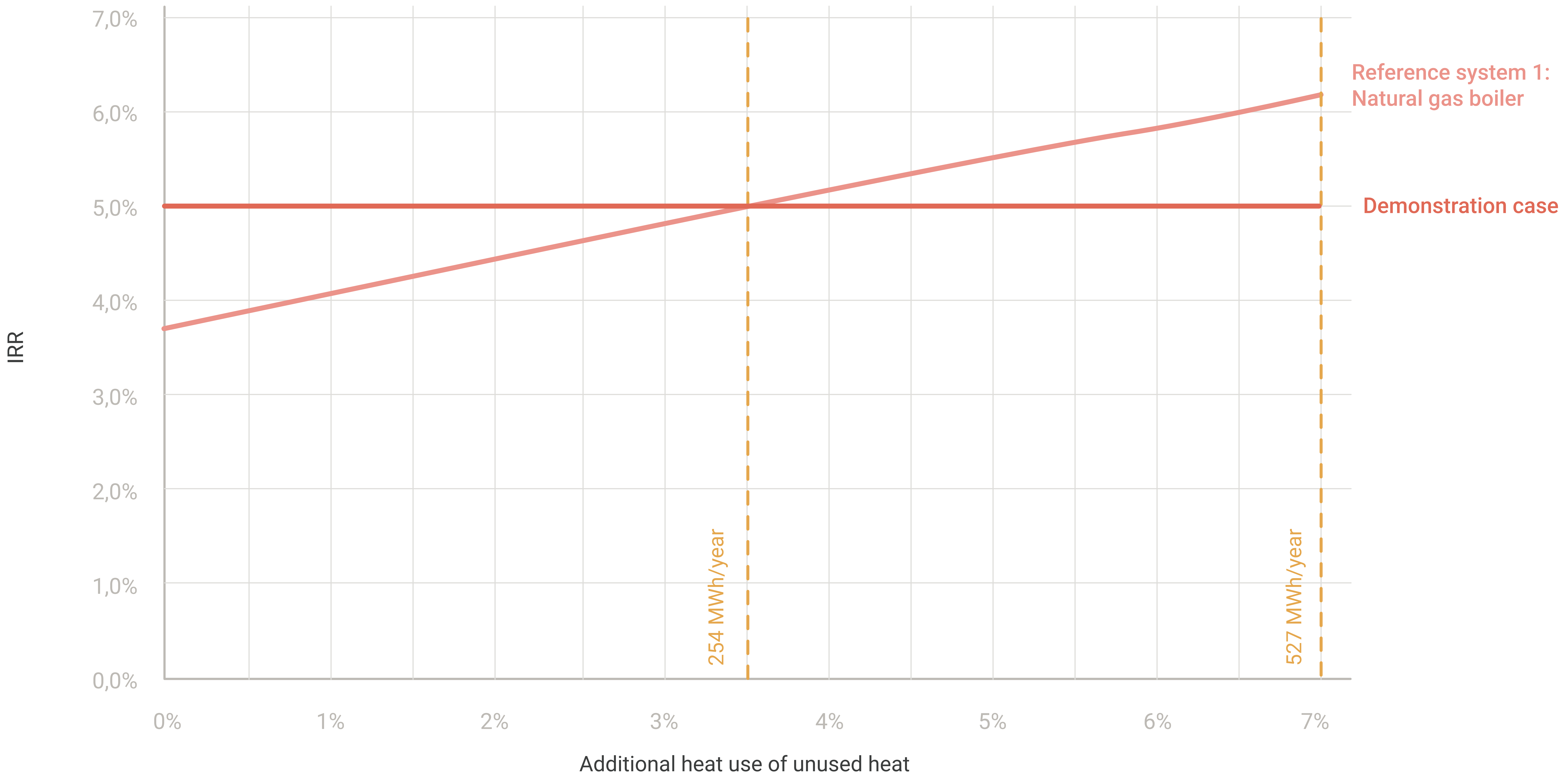
ENVIRONMENTAL ASSESSMENT



ENVIRONMENTAL ASSESSMENT → SENSITIVITY



ECONOMIC ASSESSMENT → SENSITIVITY



CONCLUSIONS

1

Environmental assessment needs to consider entire energy system

Demo alone seems environmentally beneficial

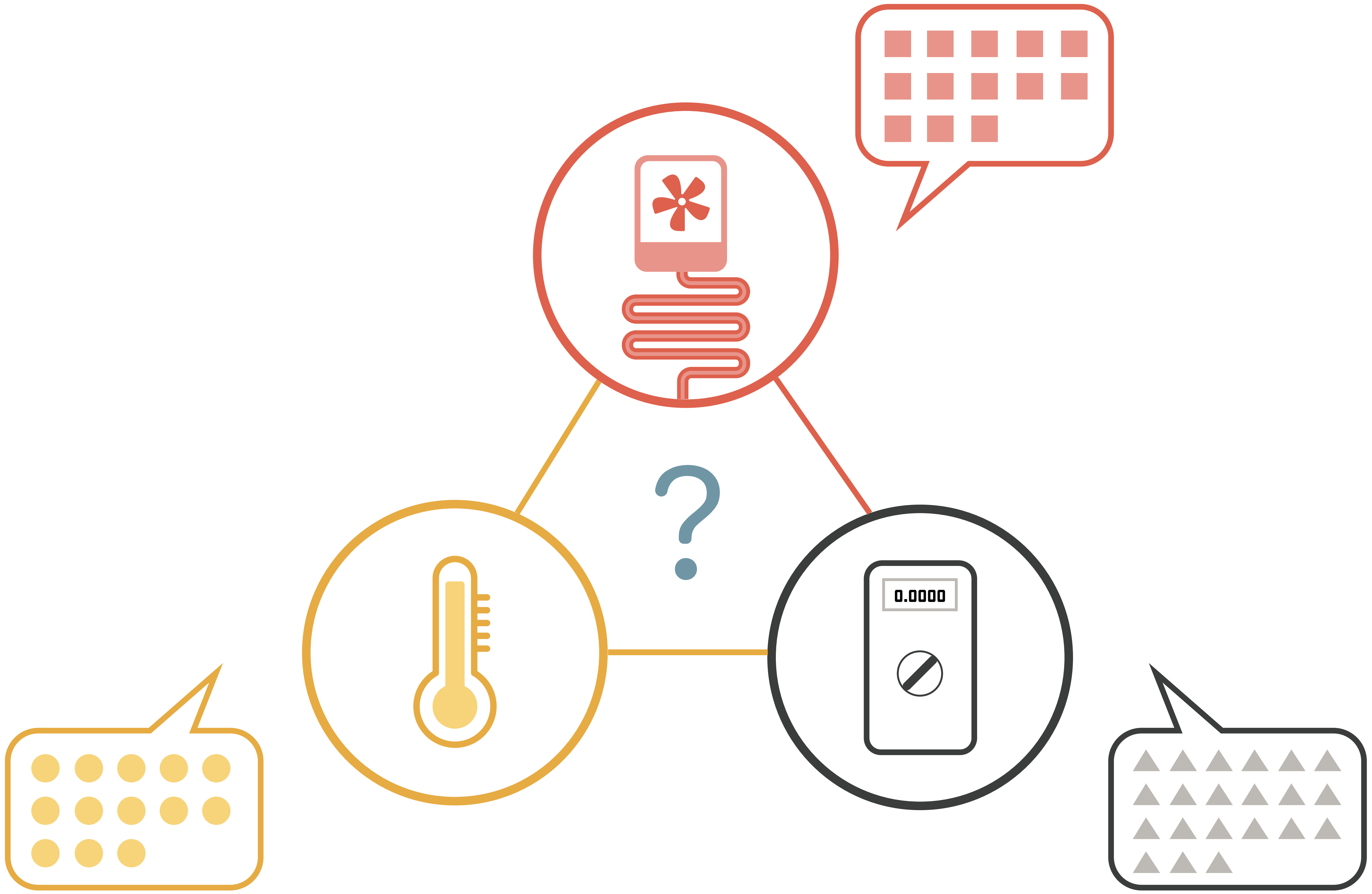
2

Additional heat use: Boiler/ ORC system economically viable earlier than from an environmental viewpoint

Risk of business case that doesn’t lead to decarbonisation


STORY

SMART SYSTEMS INTEGRATION



SMART SYSTEMS INTEGRATION

Control and communication of multiple devices

Interplay between battery, inverter, overall system

↑

ELECTRICAL STORAGE:
Interoperability in IT domain

ELECTRICAL & THERMAL STORAGE:
Interoperability and interplay of devices in energy domain

↓

Lack of technology integrators that can adjust systems to each other

OVERALL ASSESSMENT

Demo	Increased use of local RES	Economic return	Grid value	Smart system integration	Environmental results
Beneens (heat to neighbours)	+ +	+ +	neutral	–	+
Exkal	+	– –	neutral	– –	–
Suha (high RES)	+ +	–	+ +	– –	+ +

CONCLUSIONS

1

Storage needs to be **tailored to specific issues** it should solve, instead of a general roll-out

2

Different break-even points for economic and environmental benefits

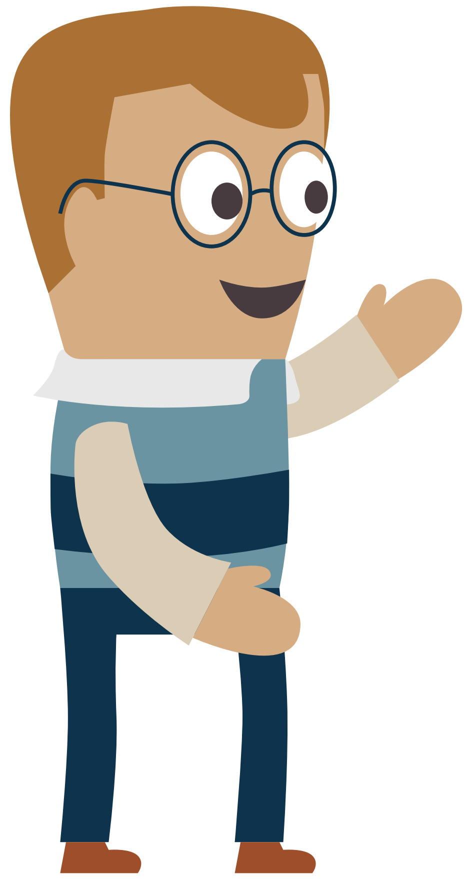
3

Energy system view is important. As long as the grid can act as a storage, this is an environmentally more sound solution

4

RES deployment can be supported by storage in a more indirect way, **by delaying grid infrastructure reinforcements** or improving power quality

THANK YOU!



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