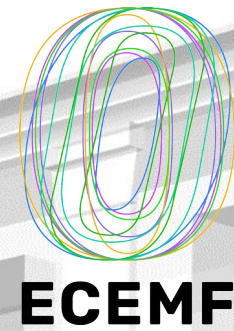




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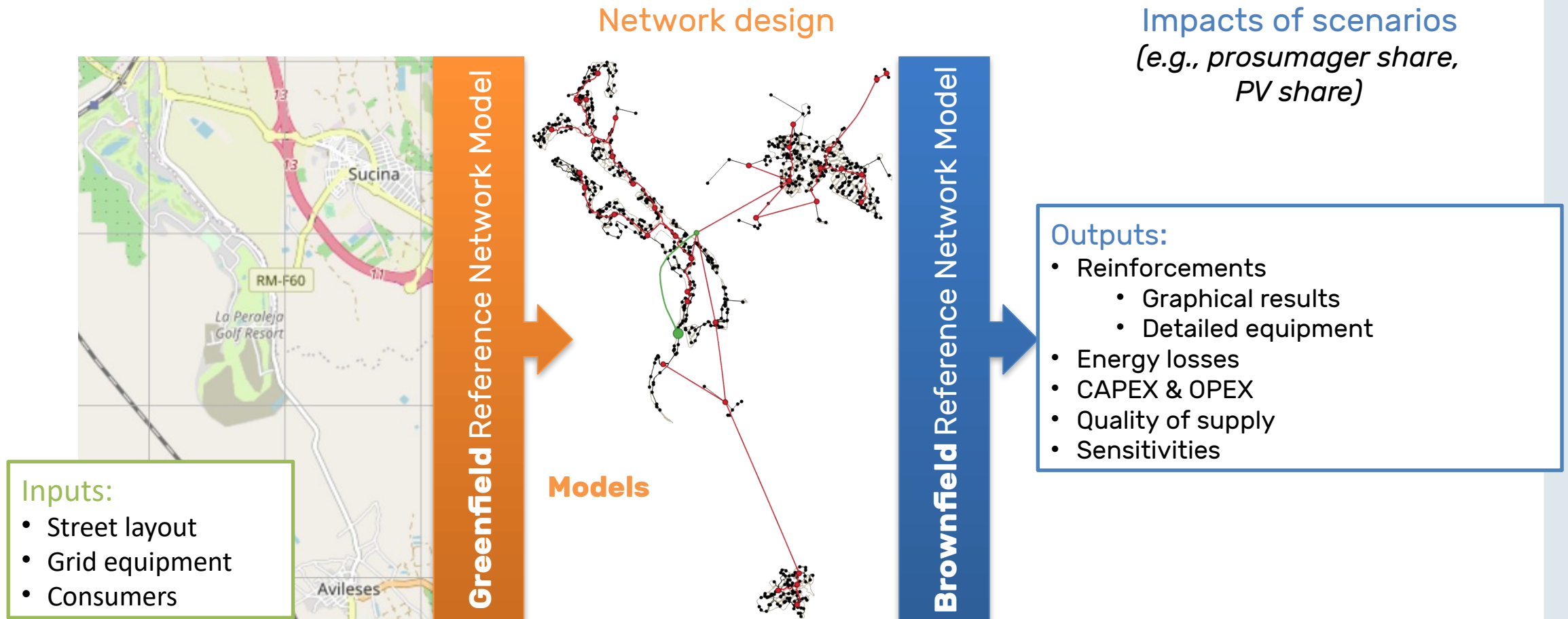


Estimating the impact of building technologies on grid infrastructure cost

Philipp Mascherbauer

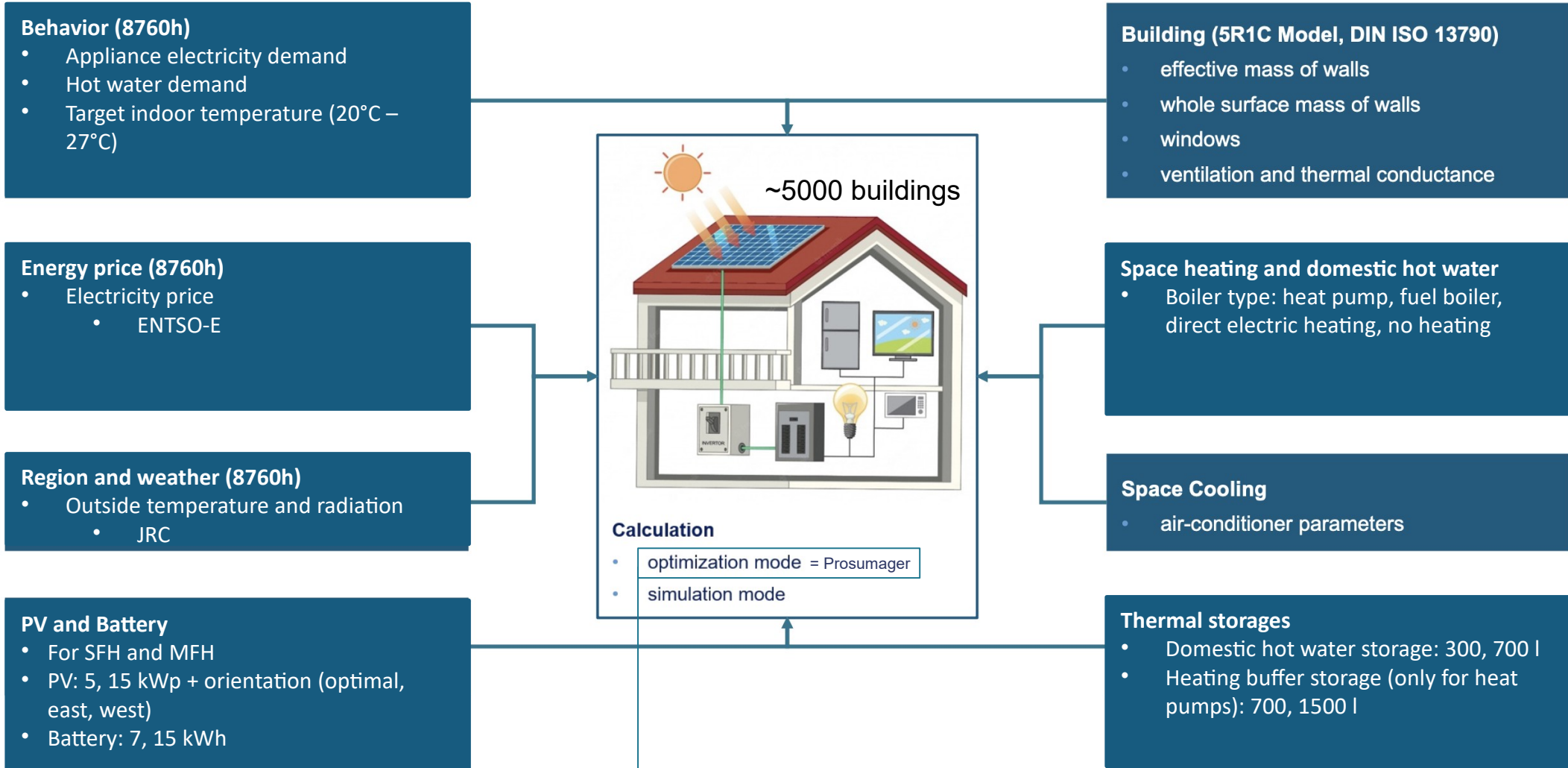
Overview

How does the grid investment cost change if the buildings are equipped with different technologies?
 (heat pumps, photovoltaic, storage (thermal, electrical), smart energy management system)



1. Model to calculate electricity demand on hourly level for every building
2. Prosumager
3. Building data
4. Baseline scenario
5. Preliminary results from first sensitivity analysis
6. Conclusion + next steps

Calculate electricity demand on hourly level



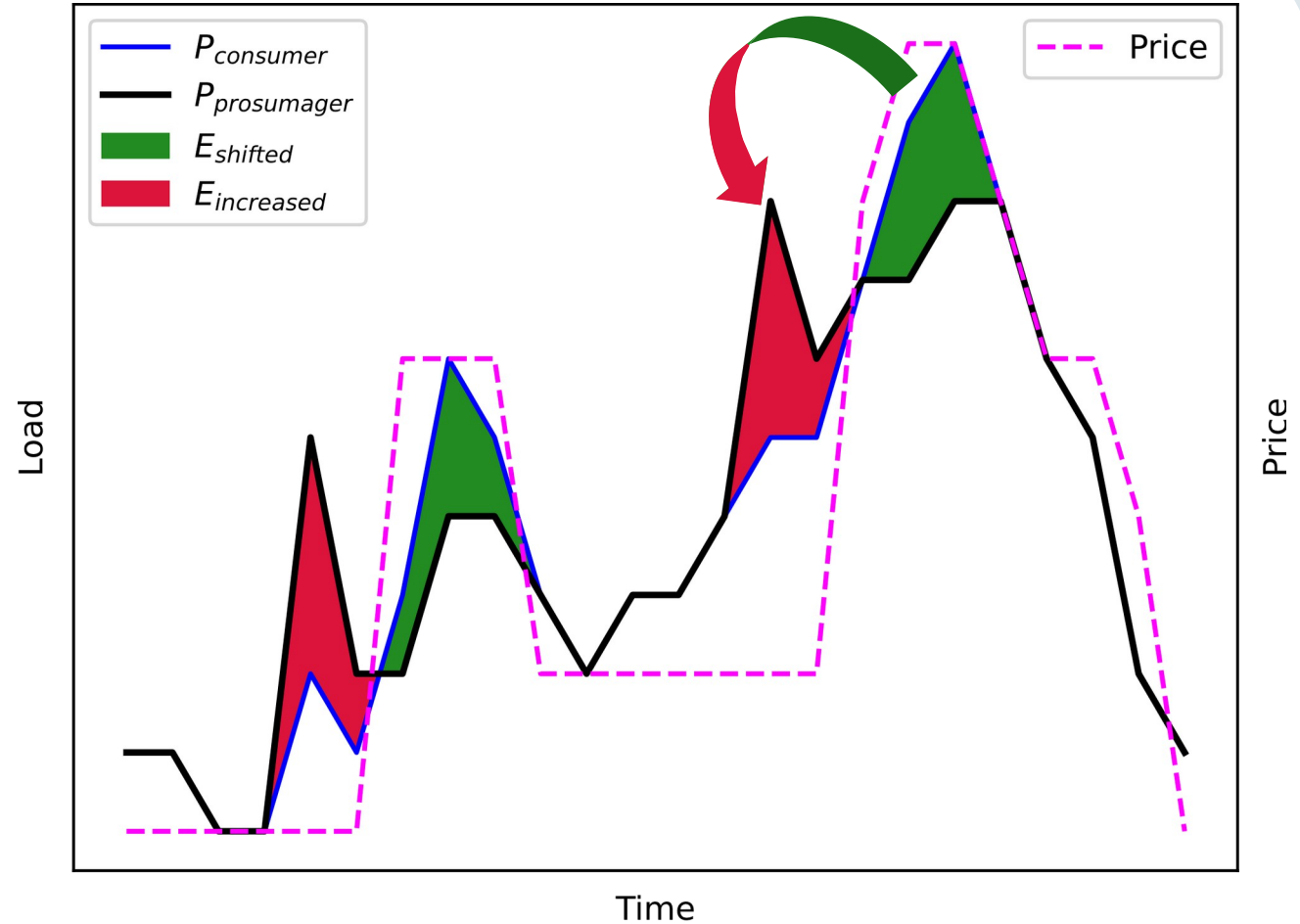
Only buildings with heat pump can become *Prosumagers*

Prosumager:

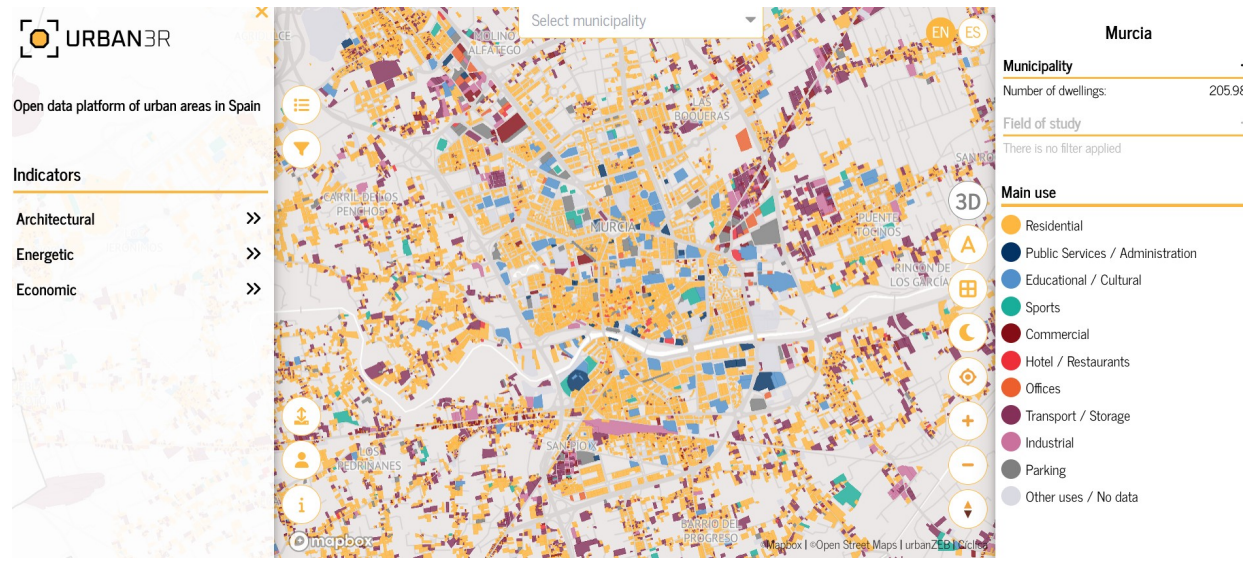
- Controls heating (heat pump) and cooling
- Controls storage utilization
- Perfect price forecast

Objective function:

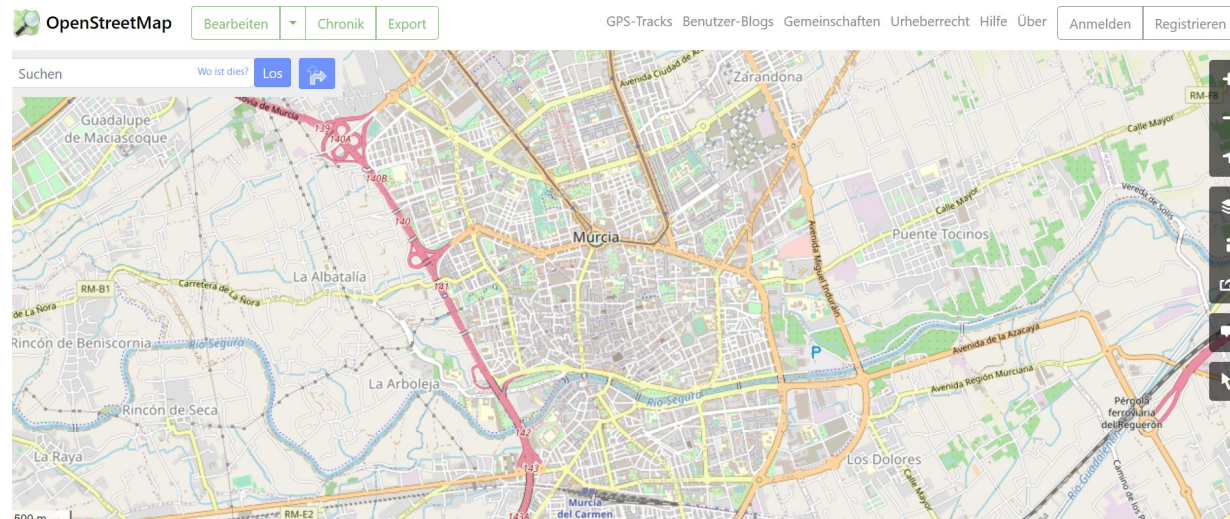
$$\min \text{Cost} = \sum_{t=1}^{8760} EP_t \times EC_{grid,t} - FiT \times ES_{pv2grid,t}$$



- Murcia:
 - Urban3R
 - Building age
 - Building type (SFH, MFH, industrial)
 - Number of storeys
 - Norm heat demand (kWh/m²)
 - Polygon (inaccurate)





- Open Street maps
 - Polygon shape
- Invert database:
 - Building types
 - Building age
 - Heat demand (kWh/m²)
 - Building parameters (u-values etc..)

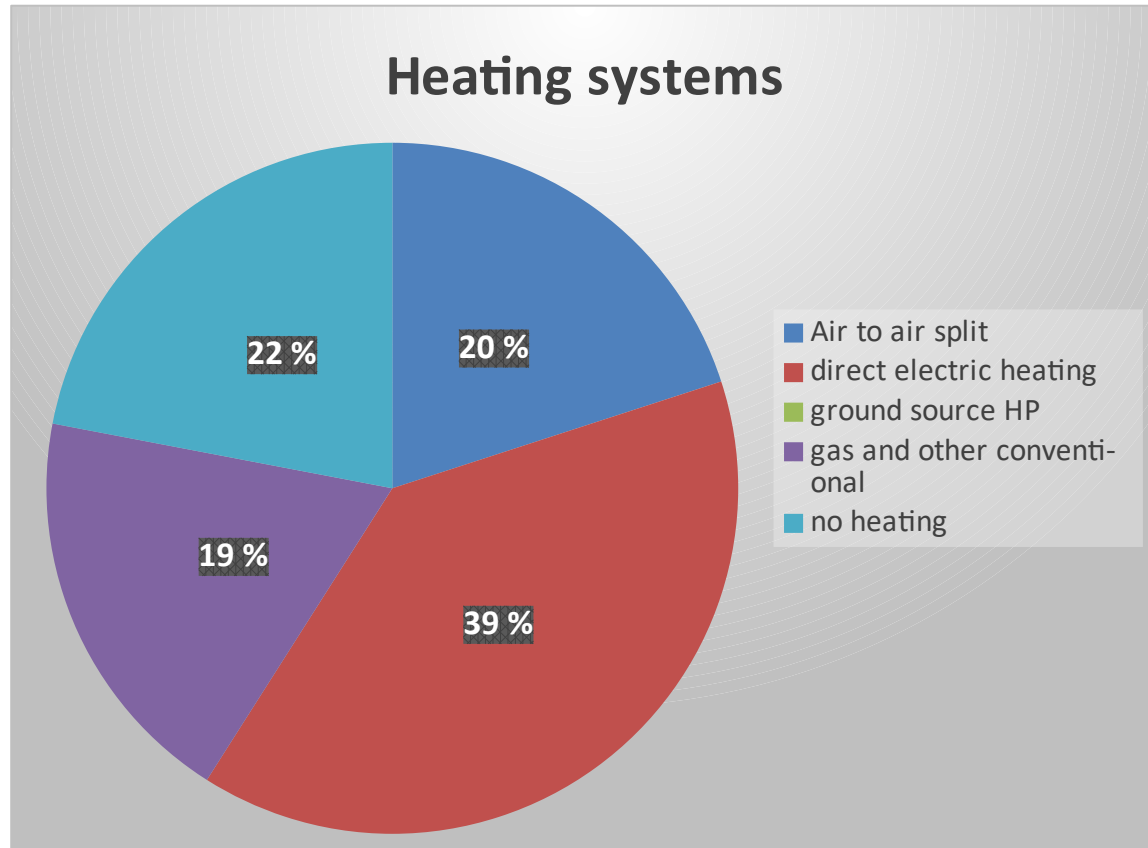


Building data

- Building shapes are used from Open Street Maps (OSM)
- Building information is taken from URBAN3R
- Percentage of connected wall-area is calculated
- Window-wall ratio and length to width ratio is taken from Invert
- 5R1C parameters are selected and recalculated from Invert based on:
 - Building Age
 - Building type

-  Merged OSM + URBAN3R
-  URBAN3R





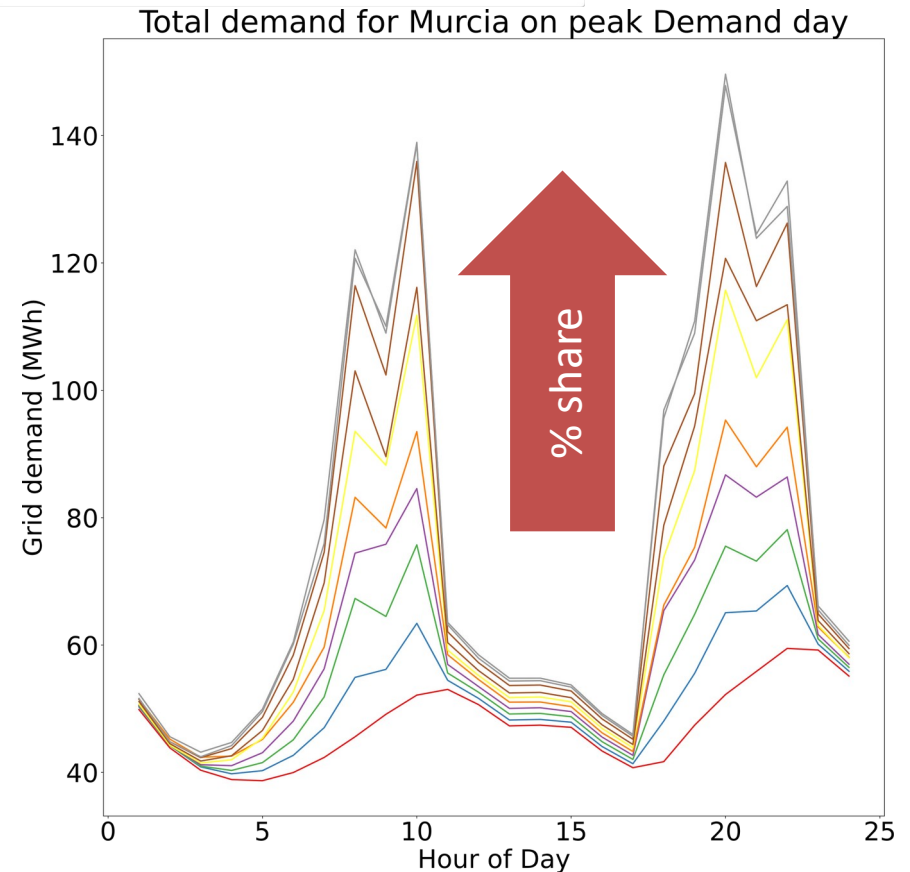
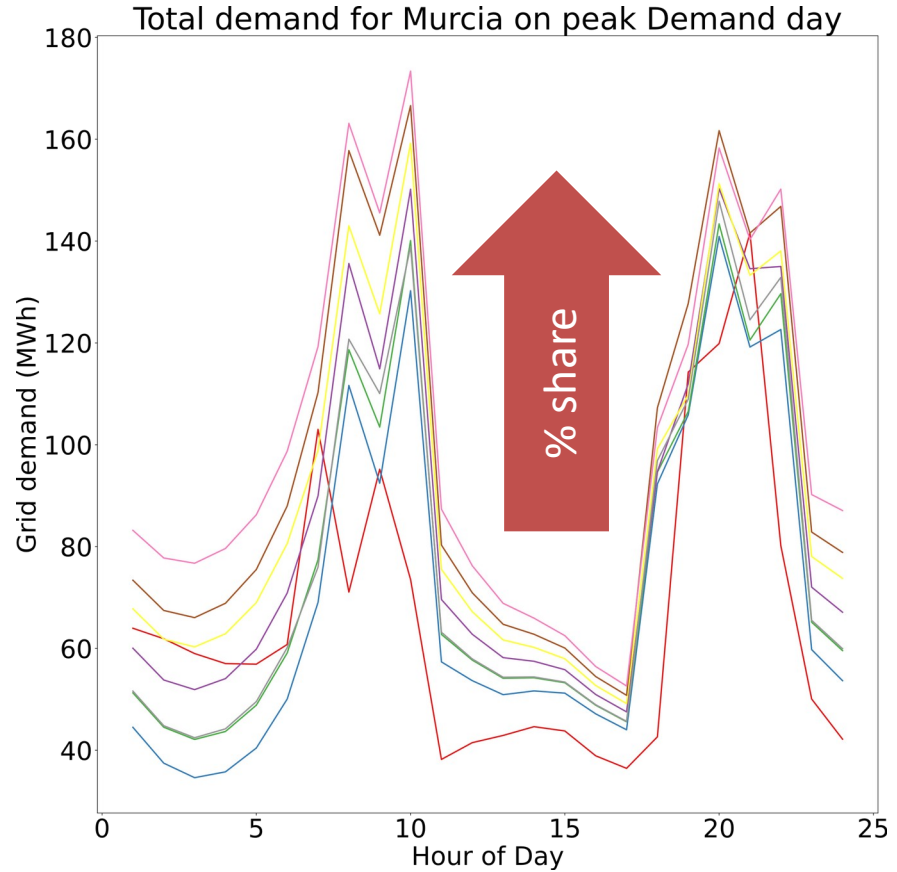
- 1.5% of buildings have PV
- 10% of buildings with PV have battery
- 50% of buildings have AC
- 50% have DHW tank
- 0% have buffer heating tank
- 0% are prosumagers

Supply temperature for heat pumps is estimated with 38°C

Preliminary results - impact of heating system

- air hp percentage 0 %
- air hp percentage 10 %
- air hp percentage 20 %**
- air hp percentage 30 %
- air hp percentage 40 %
- air hp percentage 50 %
- air hp percentage 60 %
- baseline

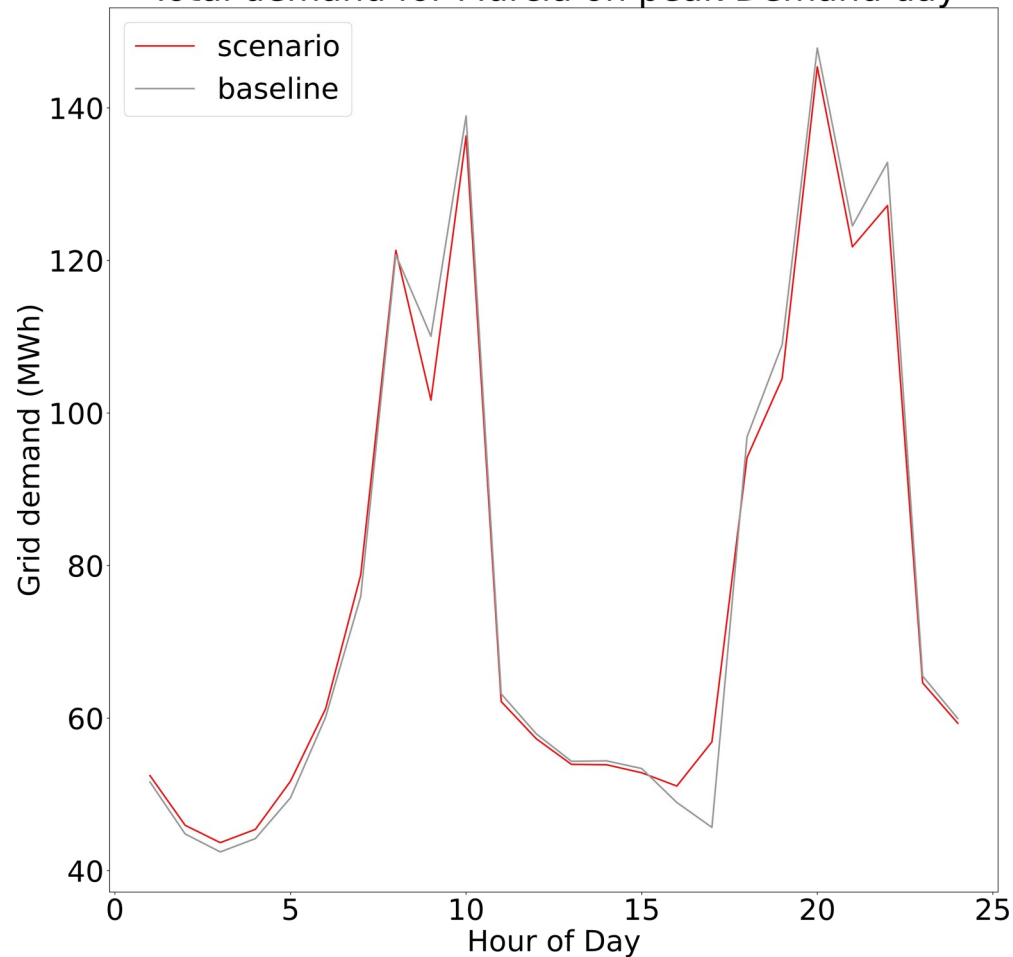
- direct electric heating percentage 0 %
- direct electric heating percentage 5 %
- direct electric heating percentage 10 %
- direct electric heating percentage 15 %
- direct electric heating percentage 20 %
- direct electric heating percentage 25 %
- direct electric heating percentage 30 %
- direct electric heating percentage 35 %
- direct electric heating percentage 40 %**
- baseline



Preliminary results - impact of Prosumager

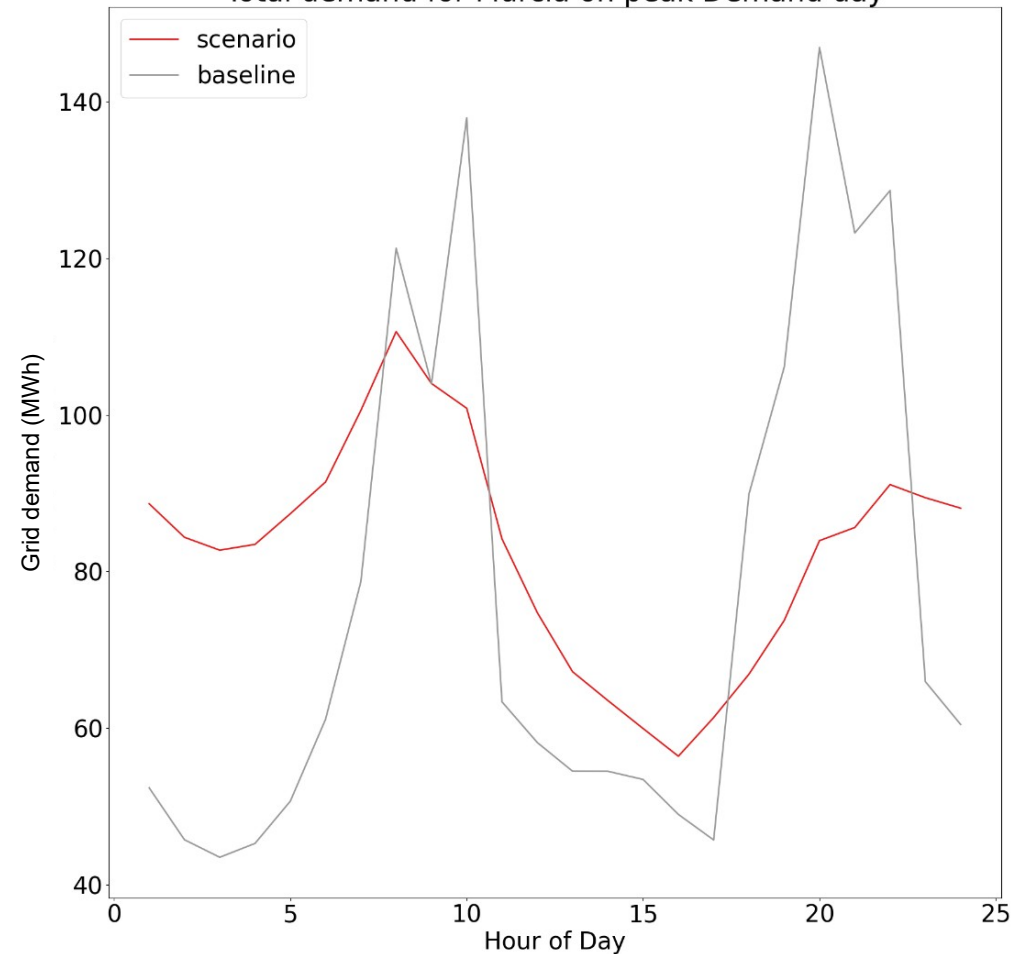
- █ 100% Prosumager
- █ 0% Prosumager

Total demand for Murcia on peak Demand day



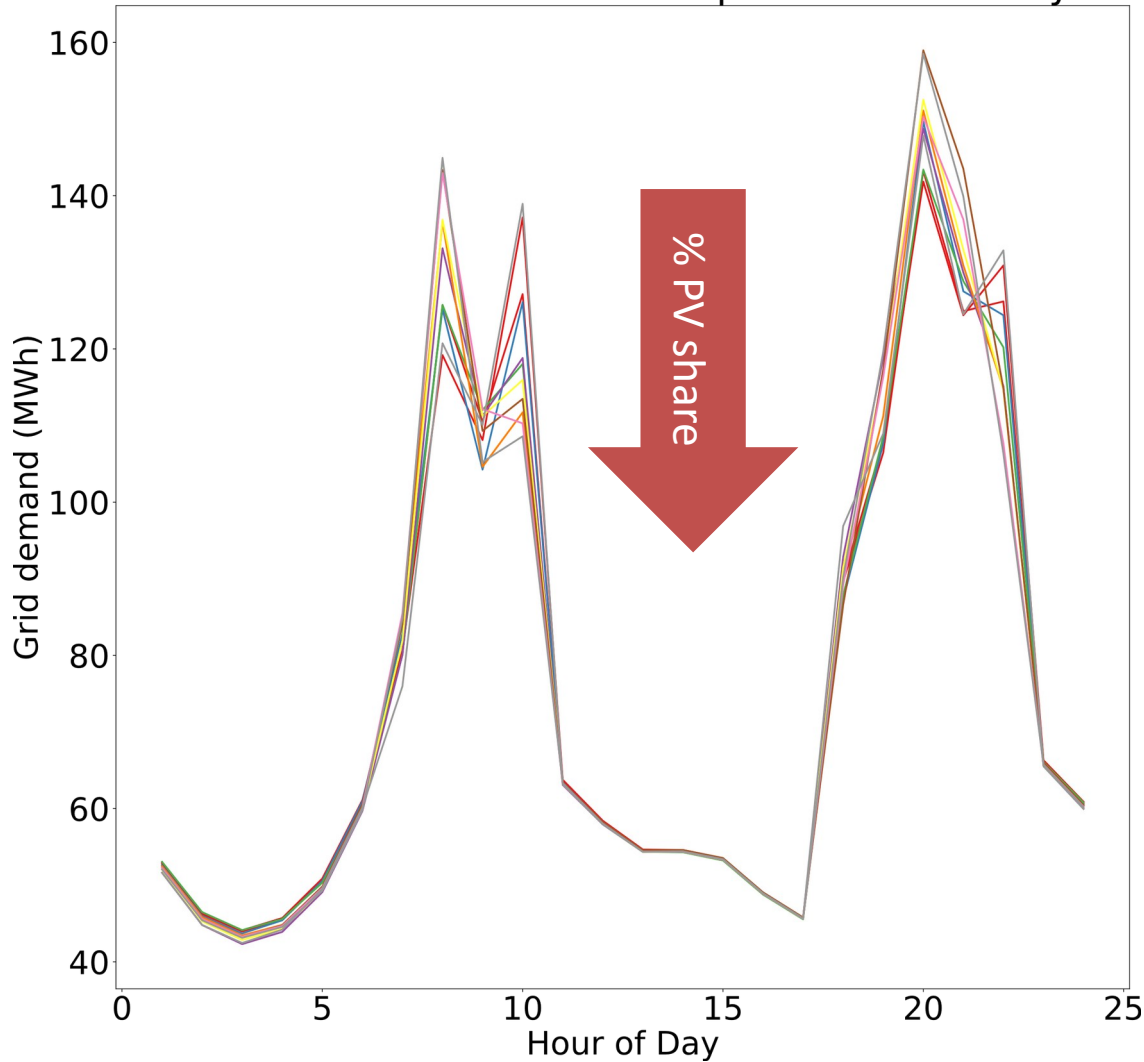
Modified heating system setting

Total demand for Murcia on peak Demand day

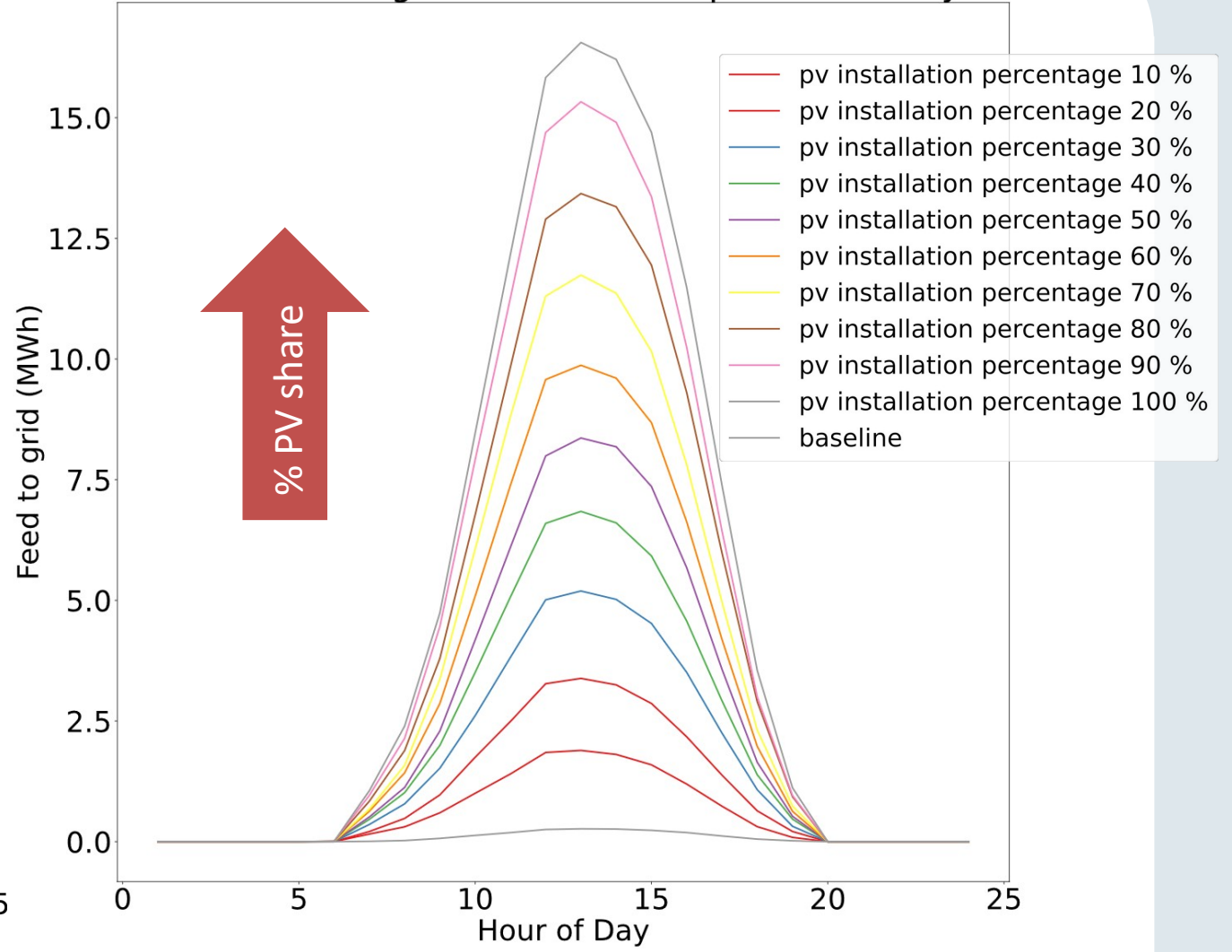


Preliminary results - impact of PV

Total demand for Murcia on peak Demand day



Total feed to grid for Murcia on peak Feed day



- pv installation percentage 10 %
- pv installation percentage 20 %
- pv installation percentage 30 %
- pv installation percentage 40 %
- pv installation percentage 50 %
- pv installation percentage 60 %
- pv installation percentage 70 %
- pv installation percentage 80 %
- pv installation percentage 90 %
- pv installation percentage 100 %
- baseline

No heating/cooling need, relative high solar radiation

Conclusion + next steps

- PV installations have no negative effect on grid cost in an southern **urban** area even if 100% of buildings are equipped with PV
- Direct electric heating systems have the highest impact in the baseline scenario on grid stress
- Prosumagers have low – no impact due to low number of HP and storage possibility

Next steps:

- Calculate the grid investment costs – Comillas
- Analyze Leeuwarden
- Calculate scenarios with higher HP penetration

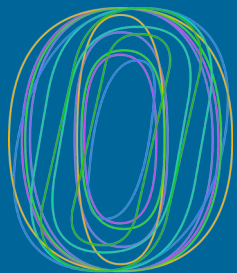




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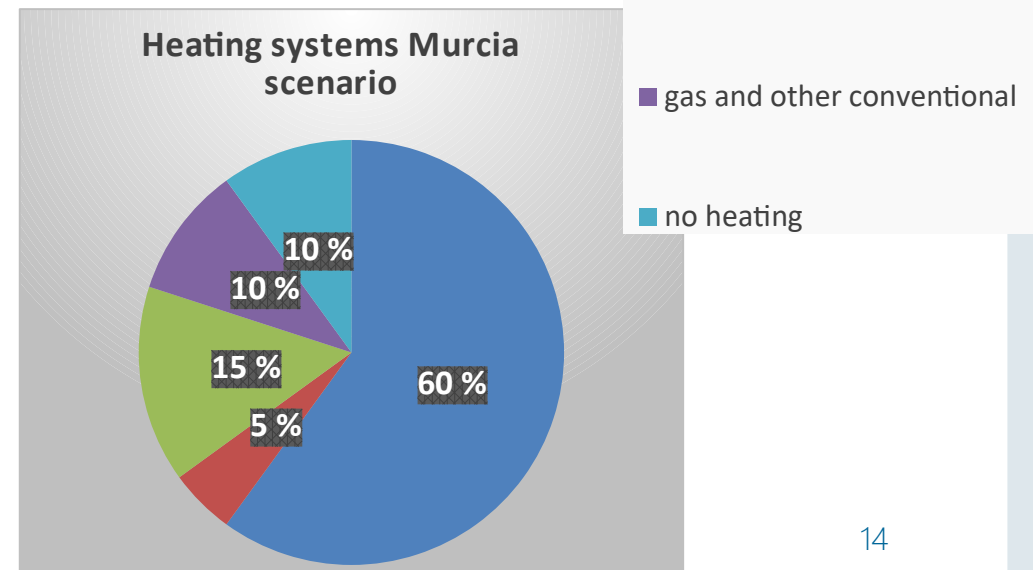
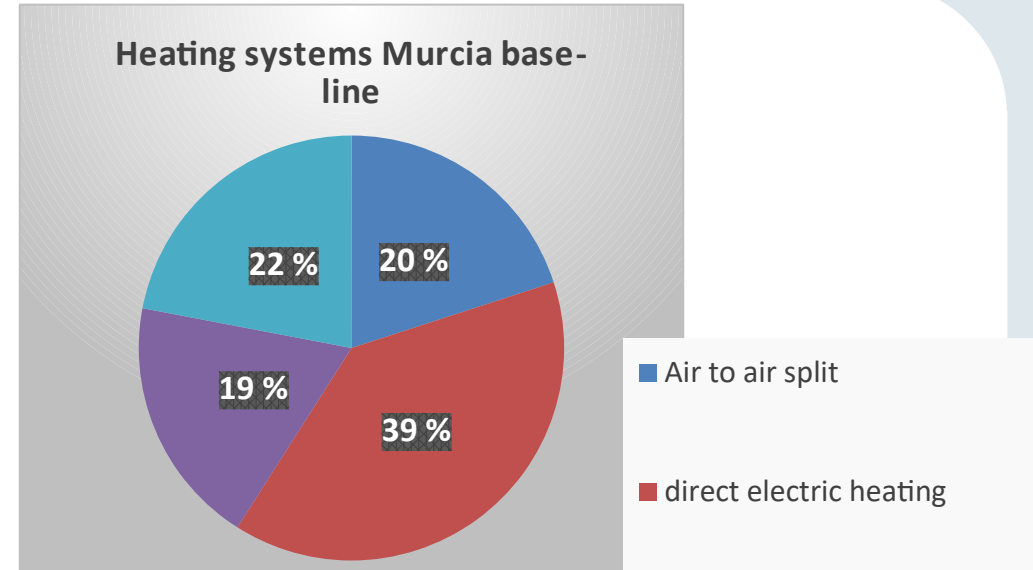
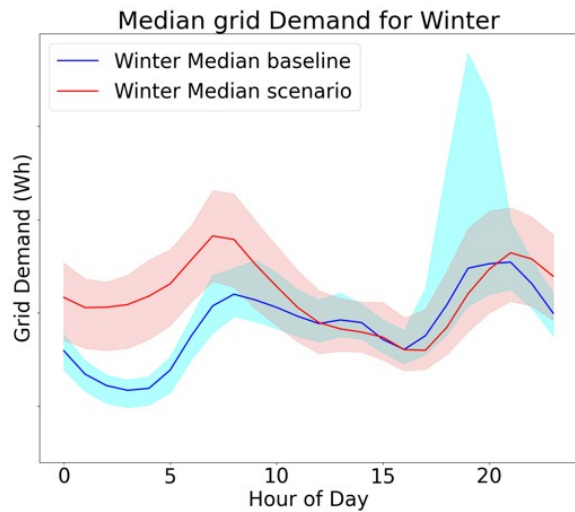
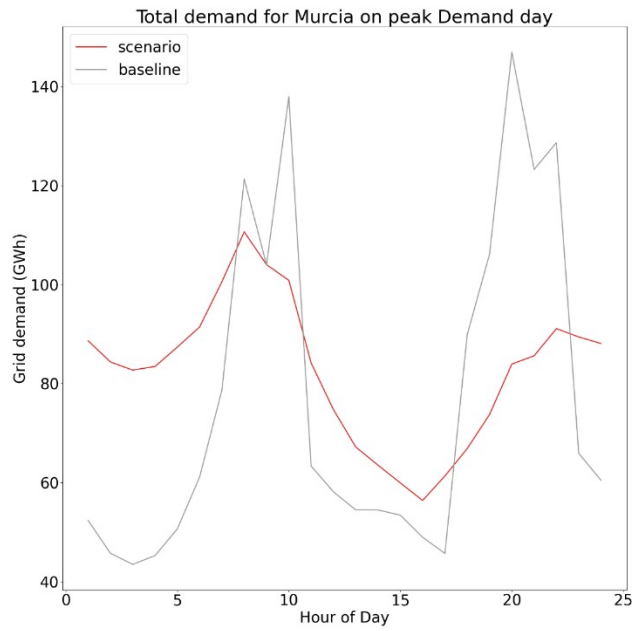


Thank you for your attention

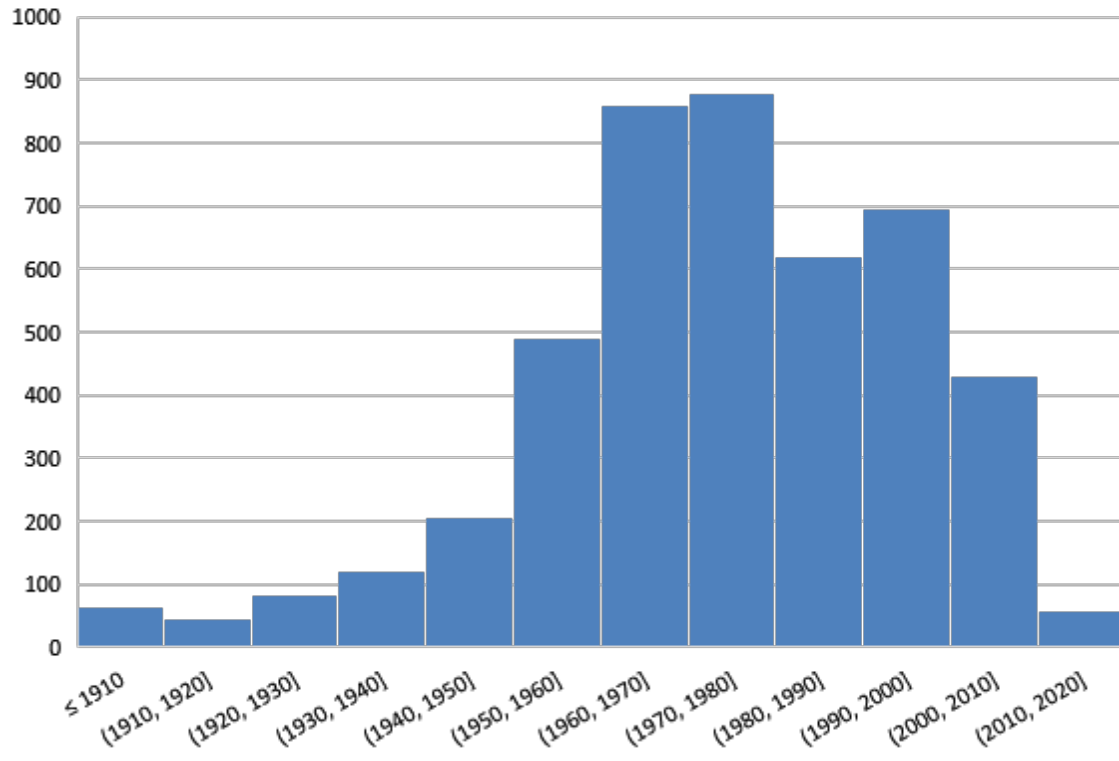


ECEMF

Preliminary result



Number of buildings per construction period



Norm heat demand

