

Insights from MAKING-CITY project: Technology selection assistance tool and Positive Energy Balance calculations for city districts

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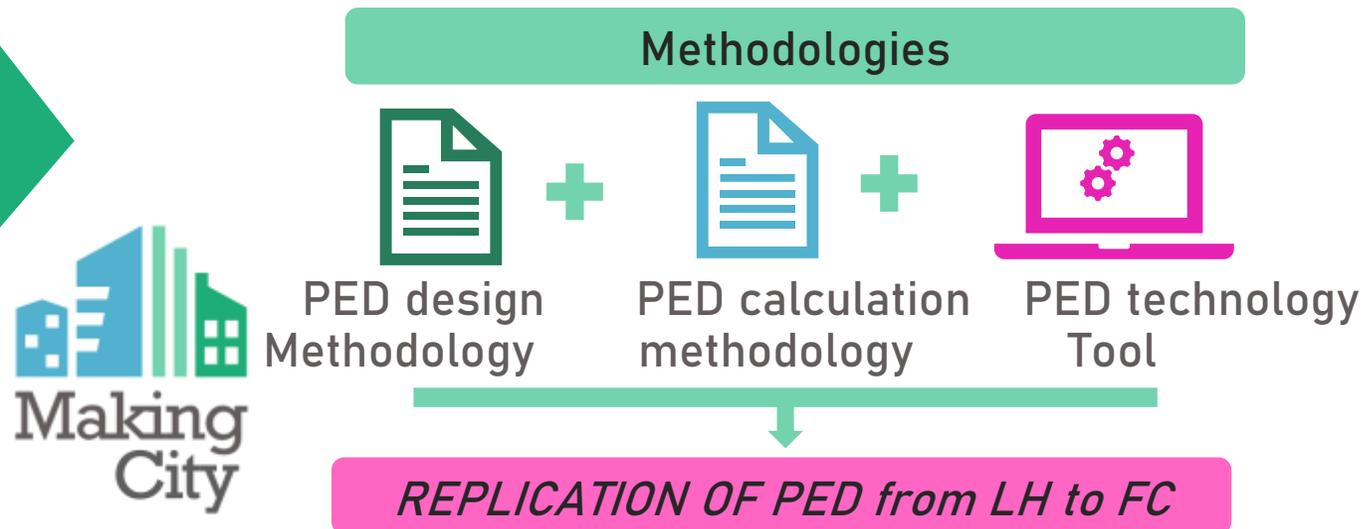
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MAKING-CITY project

- ▶ addresses and demonstrates advanced procedures and methodologies based on the Positive Energy District (PED)

“A Positive Energy District is an urban area with clear boundaries, consisting on buildings of different typologies that actively manage the energy flow between them and the larger energy system to reach an annual positive non-renewable primary energy balance”



How to fulfil City objectives through PED implementation and energy solutions?

- ▶ Currently, over 68% of Europeans live in cities and this number will rise. In 2050, it is expected that 80% of the world population will live in cities. That's why cities are committing to strong city objectives
- ▶ Urban context areas is the place where energy transition needs to happen, based on a strong involvement of all stakeholders and the development of strategies aimed at transforming the urban energy system, such as
 - Nearly zero energy buildings
 - Installation of renewable energy technologies, waste recovery technologies, and innovative storage solutions
 - Local energy communities (which in principle leads to a high involvement of citizens)
 - Suitable (or new) business models to allow all of these transformative solutions
 - **PED is just a combination of the above-mentioned solutions applied in a specific area**



Positive Energy Districts within the city, allows to achieve some positive impacts at district scale



City objectives:

- *Climate neutrality*
- *Good air quality*
- *Descarbonisation, etc.*

PED technology solution tool in MAKING-CITY (+ATELIER)

Procedure to guide cities in the decision-making route for selecting different technical and non-technical solutions that could help cities to achieve a Positive Energy Balance and at the same time, fulfill their city objectives

Ambition
Level/Objective

Self-sufficiency

technologies such as thermal and electric storage are recommended

Concept boundary

Geographical

Big power plants such as wind turbines or hydropower, are not recommended

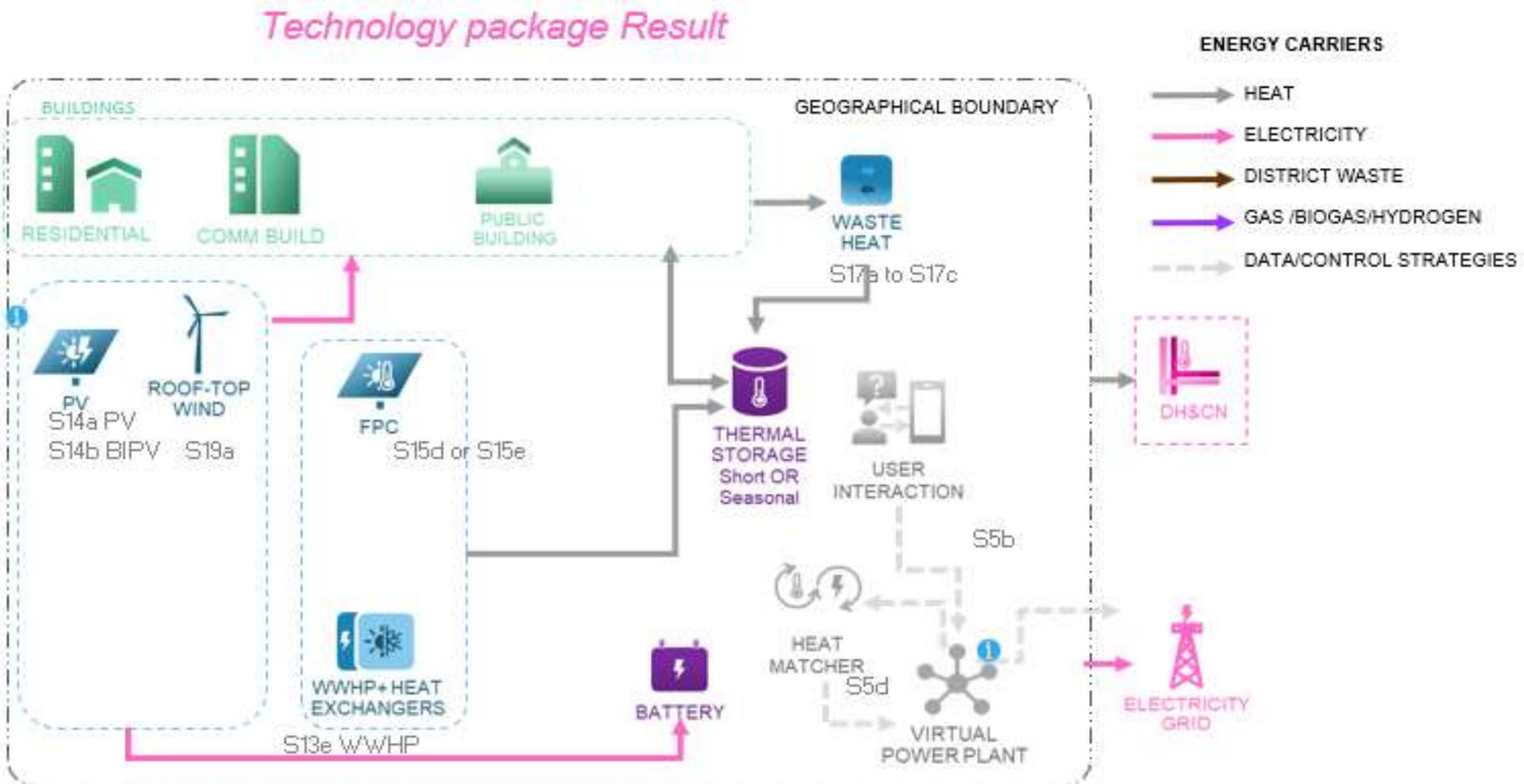
District Context /
Characteristics

Possibilities to install PV on: envelope, roof water surface nearby?

Solar PV on roofs recommended
Solar BIPV recommended

PED technology solution tool in MAKING-CITY + ATELIER

The combination of these technologies will result in a recommend technology package:



PED technology solution tool in MAKING-CITY + ATELIER

- ▶ The recommendations are meant to inform the city about the possibilities of technologies, connections between technologies, buildings, storage, and mobility solutions, and possibly, about non-technical solutions, such as business models could be recommended.
- ▶ The city will be capacitated to prioritize some of the recommended technology packages at step III.
- ▶ At step IV, the city will analyze possible barriers/enablers of the chosen PED solutions (if there are any)
At step V, several scenarios (with possibly different capacities of the supply side) will be generated to assess which one is more suitable for the district to become a PED



At step VI the PED balance calculation is performed...

- ▶ different assumptions and approaches need to be followed when compared to a single building assessment.
- ▶ MAKING-CITY project developed a 8-step methodology to evaluate the district energy balance based on ISO 52000-1:2017 standard, in which the general framework of the Energy Performance of Buildings (EPB) assessment is explained.

- ▶ This standard is based on primary energy as the main indicator, and MAKING-CITY uses the non-renewable primary energy factors, to calculate the balance

DEFINE THE PED BOUNDARY

PED can have virtual, geographical or functional boundaries depending on the spatial and administrative relationship between the final energy consumption and the energy generation units.

CALCULATE THE ENERGY USE

That is the useful energy output of the thermal and electrical generation systems.

ESTIME THE ENERGY DELIVERED

Both the output and input of each system are linked with a source of energy inside or outside the boundary for each energy carrier. Energy imported (in) from outside the boundary or exported (out) to outside the boundary would be identified.

CALCULATE THE ENERGY BALANCE

The primary energy balance is calculated as the difference between the primary energy imported to the PED boundaries minus the primary energy exported outside the PED's boundaries.



CALCULATE THE ENERGY NEEDS

Heating, cooling, domestic hot water and electric energy needs must be identified by monitoring, calculations based on bills, simulation, standards or statistical data.

CALCULATE THE ON-SITE GENERATION

Once the energy systems used to cover the determined energy uses are identified, calculate the useful output of these systems. Then, identify if there is any remaining energy needs to be covered by non-renewable energy systems or external grids.

CALCULATE THE PRIMARY ENERGY

Weight your energy imports and exports per energy carrier using primary energy factors (taken from national or international standards), in order to calculate the primary energy exported and the primary energy imported.

SANKEY DIAGRAM

Once all the steps are finalized, an energy flow diagram can be drawn (known as Sankey diagram), based on the energy flows identified in the previous steps (energy needs, energy uses, energy delivered and primary energy columns).



Interventions in Groningen



Groningen PEDs

- A** Sustainable Heating source (geothermal)
- B** Solarpark Rooderhaan (11 MW)
- C** Solarpark Woldjerspoor (14 MW)
- I** Int. I: Two Nijestee High-rise buildings (7,400 m²)
- II** Int. II: Three terraced private houses (360 m²)
- III** Int. III: Energy Academy Europe (9,636 m²)
- IV** Int. IV: Mediacentrale (14,400 m²)
- V** Int. V: Sports complex Europahal (5,315 m²)
- VI** Int. VI: Powerhouse (7,800 m²)



- ▶ Geothermal energy, PV, digester for heat production, heat pumps and different solarparks
- ▶ Improvement of energy performance of buildings: private houses, offices, high-rise buildings, sport complexes..



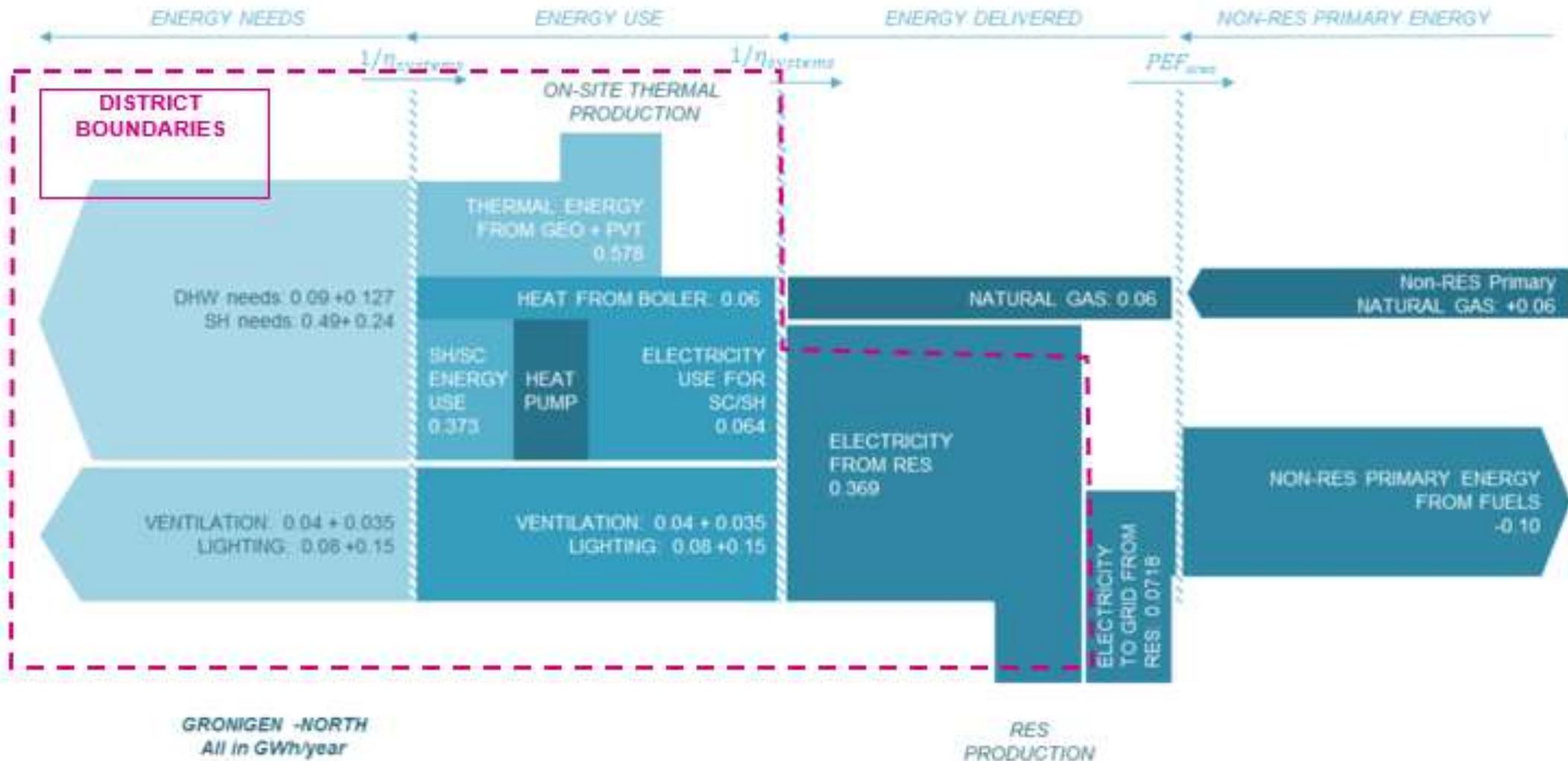
GRONINGEN

Groningen
NORTH

Groningen
SOUTHEAST

Groningen-North

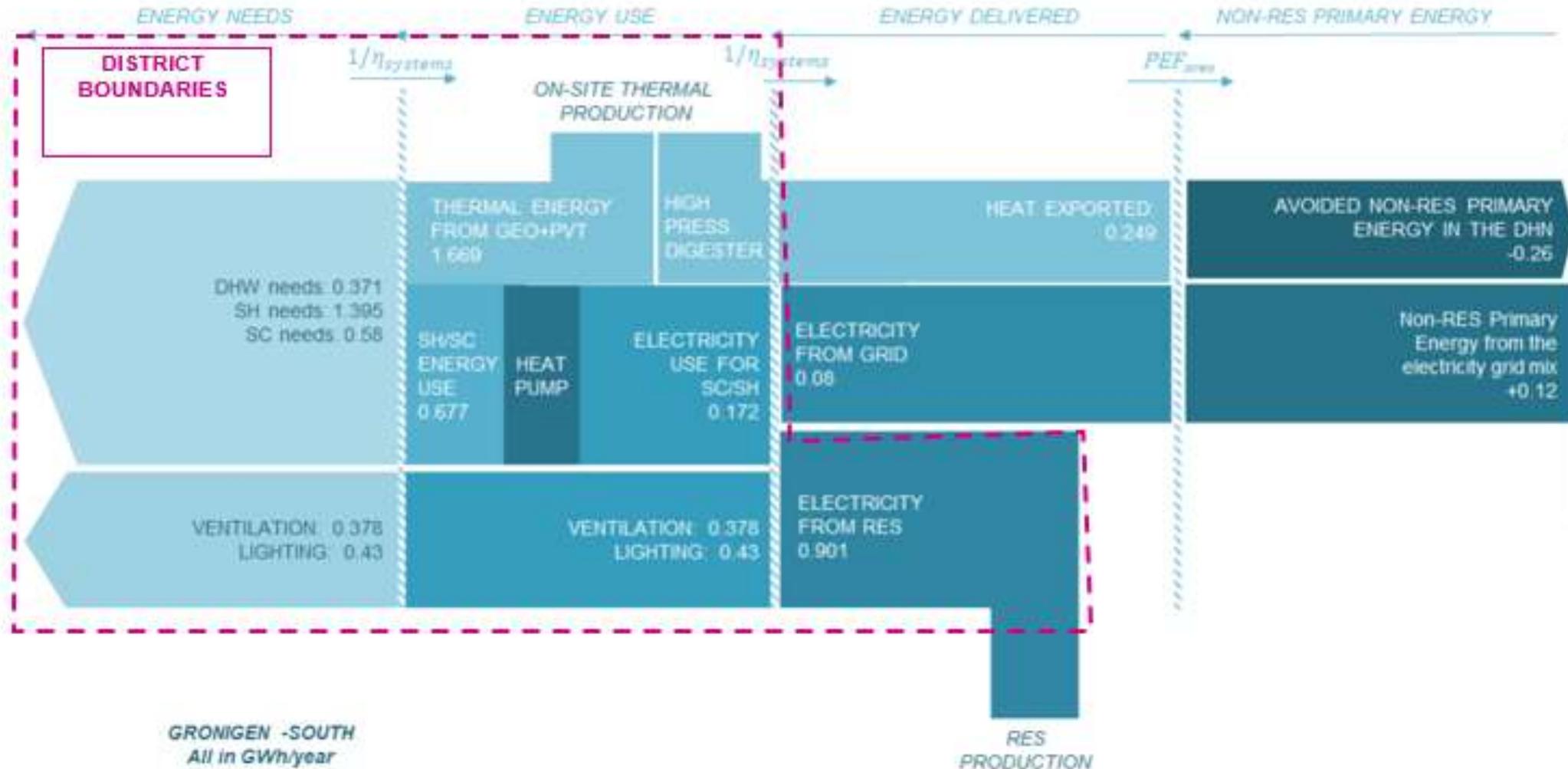
All in GWh/year



Non-RES energy balance calculation: -0.099

Groningen-South

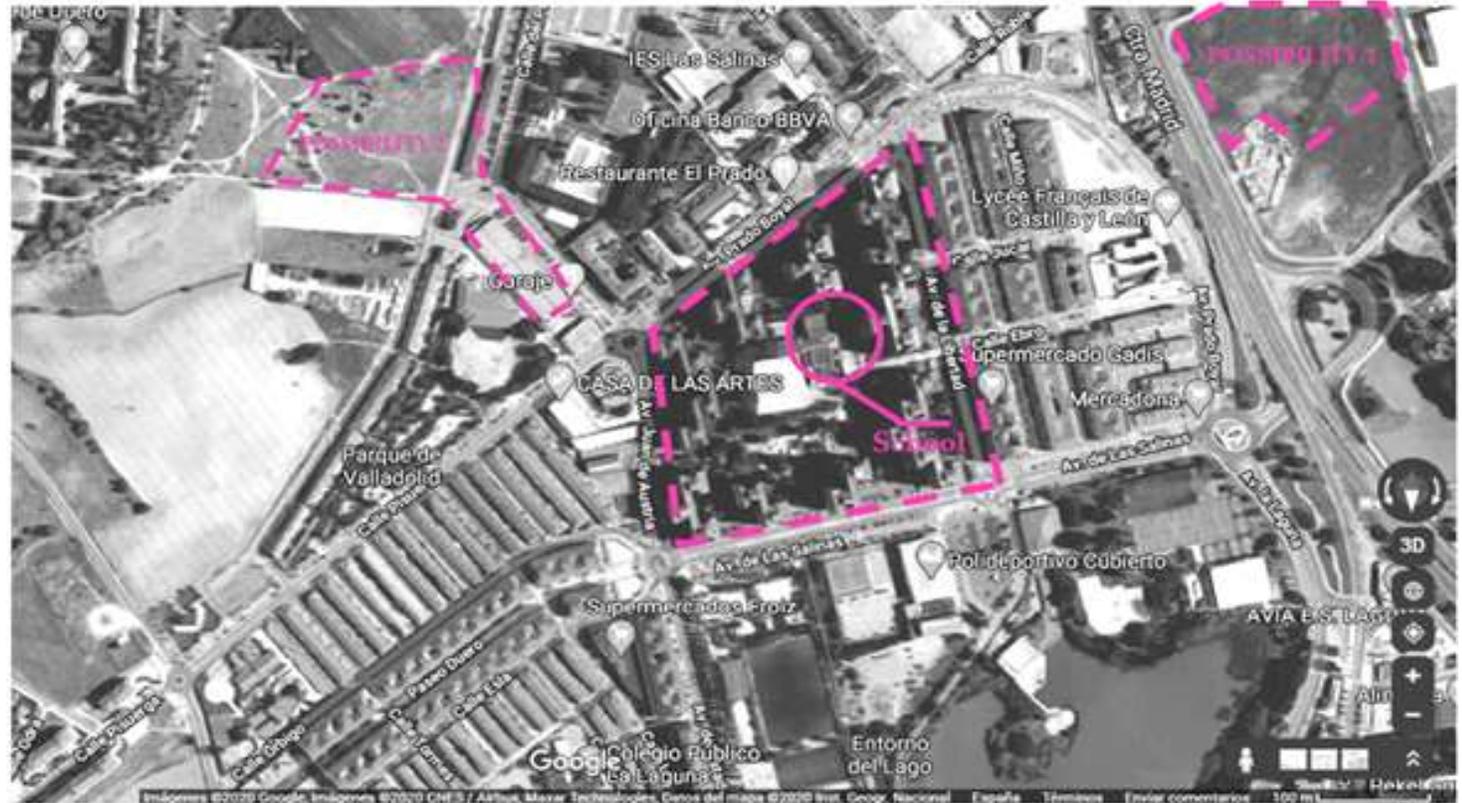
All in GWh/year



Non-RES energy balance calculation: -0.138

Torrelago district

- ▶ Scenario 1: PV + Solar thermal to supply partially the demand of the school and building
- ▶ Scenario 2: PV + 100% biomass supply in the DHN
- ▶ Scenario 3: PV + Replacement of the current DHN to a CHP with 100% biomass supply



Conclusions

- ▶ Project will demonstrate that methodologies can support cities in the decision-making routes of designing and implementing PEDs, like the technology tool
- ▶ PED concept is achieved, mainly when the on-site RES production is higher than what is consumed within the boundaries, so the comparison between production and consumption can be evaluated with MAKING-CITY methodology
- ▶ This methodology has been tested for a case that will be implemented and monitored (Groningen) and for a virtual case, that studies how to transform a NZED into a PED
- ▶ Nevertheless, focusing on energy balances only is not enough.
- ▶ Thus, PEDs need to be considered as a key enabler and a pathway towards the decarbonization of the cities, by helping to empower citizens, balance the main grid and ultimately achieve a positive impact on cities (beyond the calculations)



Thank you

Get in touch for more information!



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