Energy model – South Tyrol 2050

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SÜDTIROL KlimaLand

PIANO CLIMA

Energia-Alto Adige-2050

South Tyrol's Climate plan

Target

1,5 tons of CO_2 emissions per person/per year

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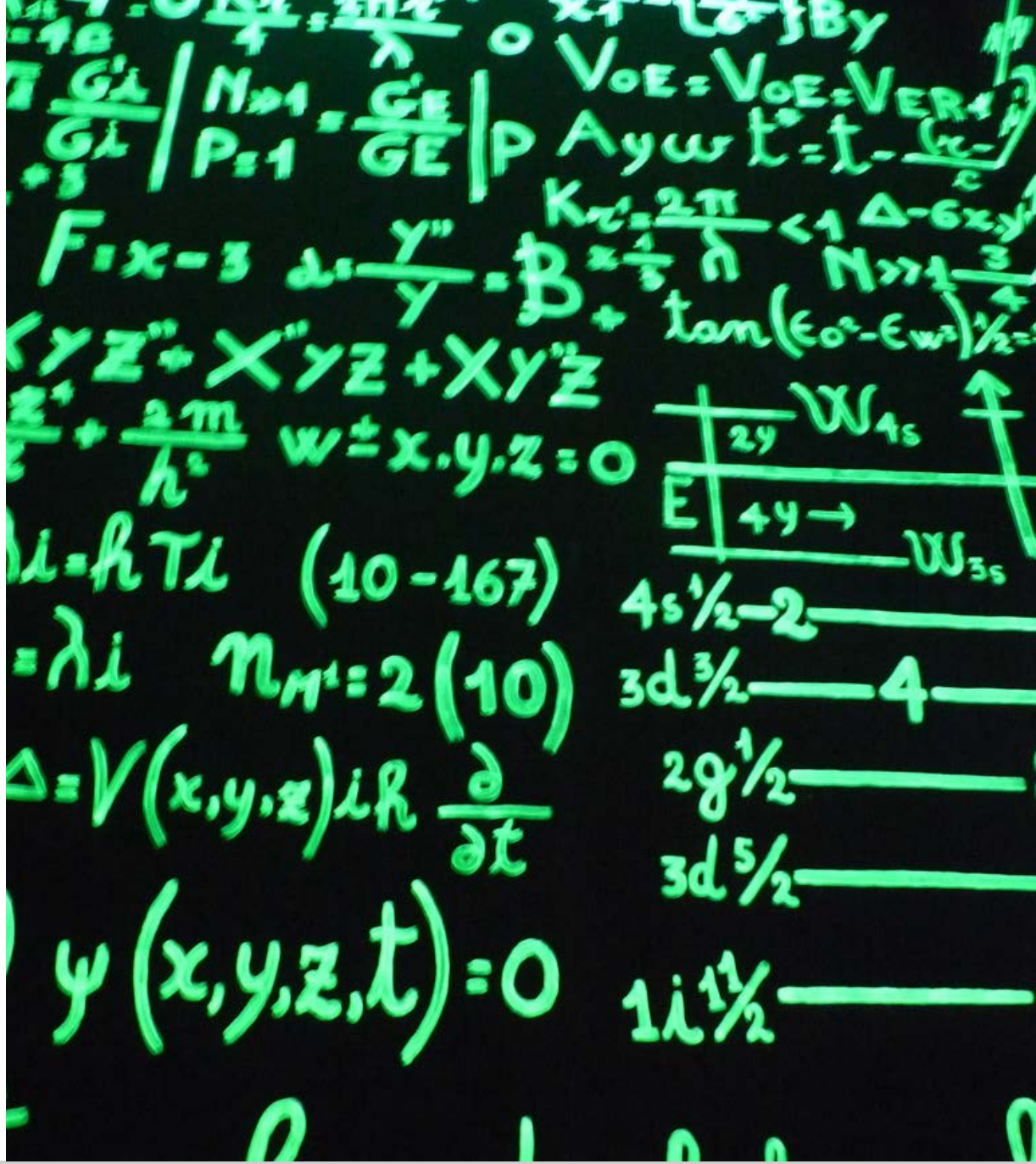
Dipartimento all'urbanistica, ambiente ed energia

Questions:

- Is it feasible to reach the target of the climate plan? If so, which features should the new energy system have?
- How much will the new energy system cost in comparison to the current one?
- How will the financial structure of the energy system change and which main effects will this have on the energy assets in the upcoming years?

What are we talking about

- We are talking about a dynamic model that simulates the hourly energy production and consumption .
- Starting point is a series of data from different sources, internal calculation and assumptions.
- Data accuracy is sometimes limited. Using more accurate data will improve the model accuracy.
- The model takes into account current technologies and natural resources, and their current costs.



What are we not talking about

- We are not talking about seeing in the future.
- The entry of radical new technologies has not been taken into consideration.
- Important variations of the costs of the natural resources and technologies have not been taken into consideration.

Many thanks to…

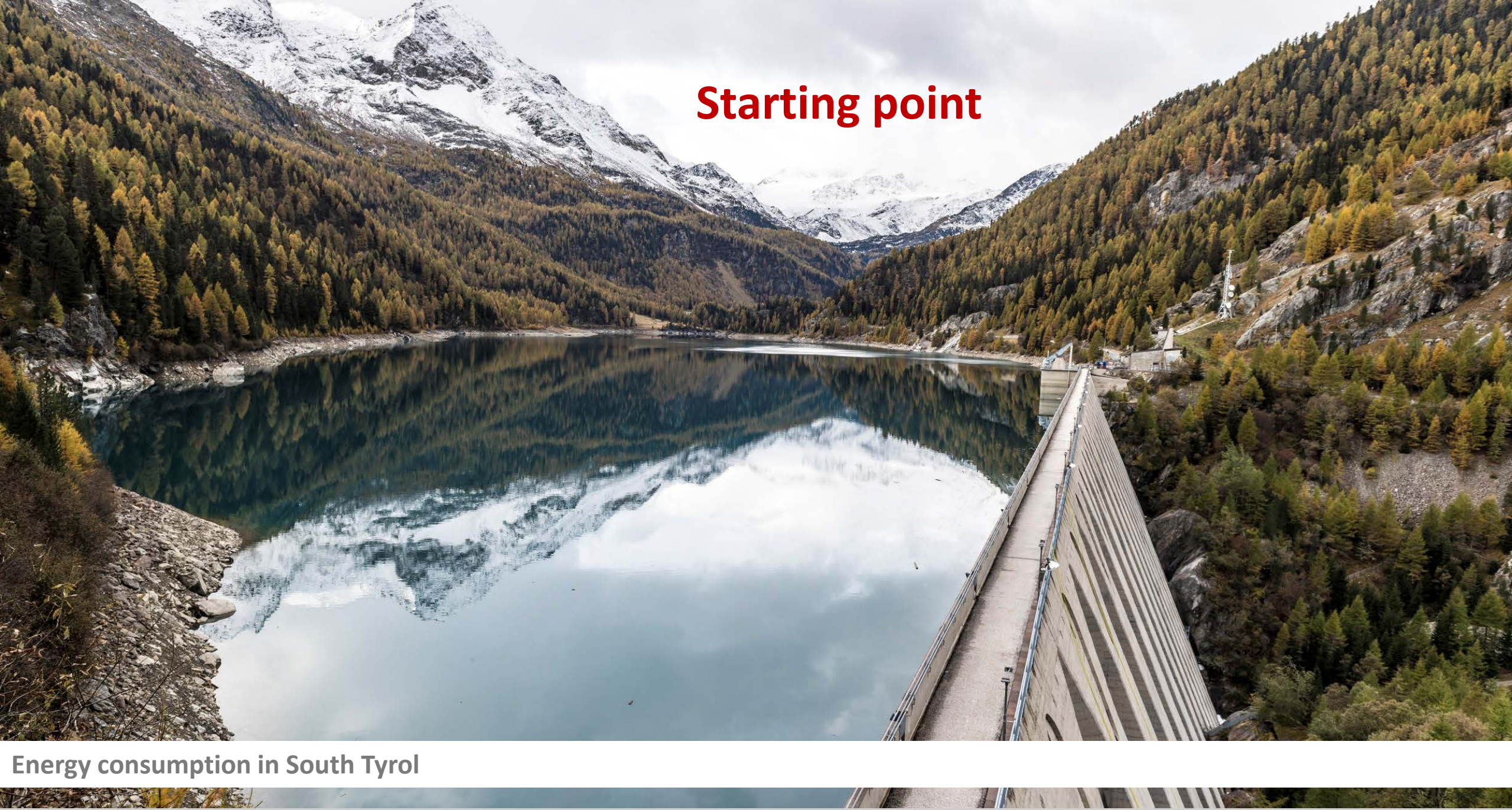
Researchers at Eurac Research, who realized the simulations.

All the partners, who shared with us data and information, like

- **Agenzia provinciale per l'ambiente**
- **Ufficio risparmio energetico**
- **Agenzia per l'Energia Alto Adige – CasaClima**
- **Alperia**
- **Stadtwerke Bressanone**
- **Comune di Bolzano**
- **…**

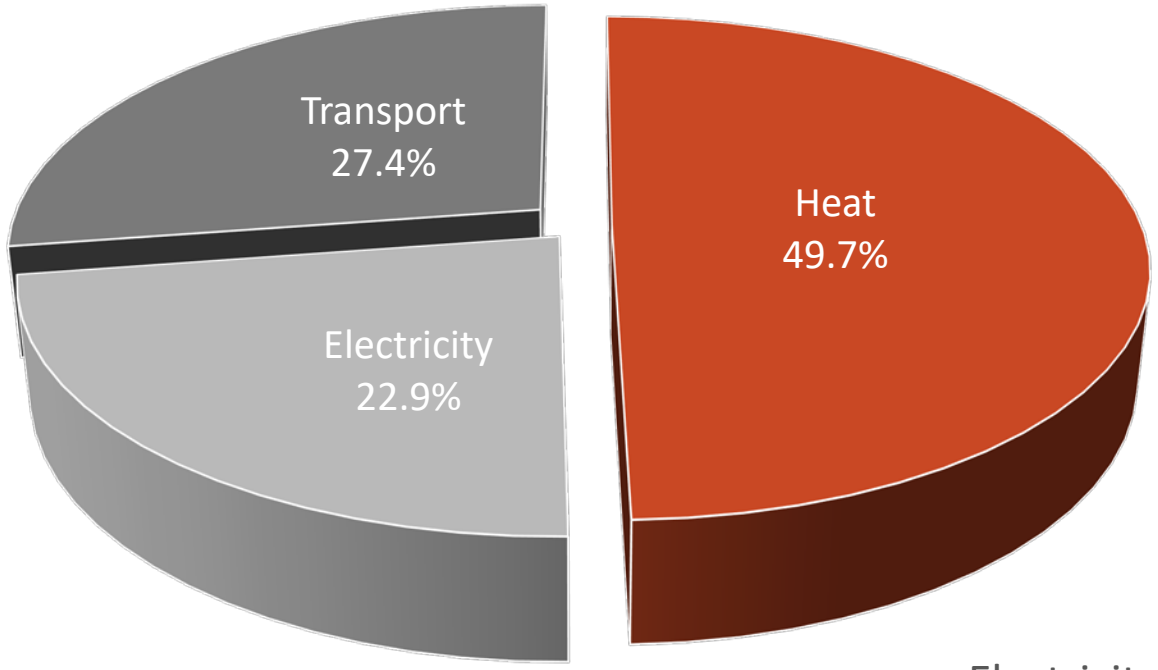
EnergyPLAN team (Aalborg University)

Starting point



Energy consumption in South Tyrol

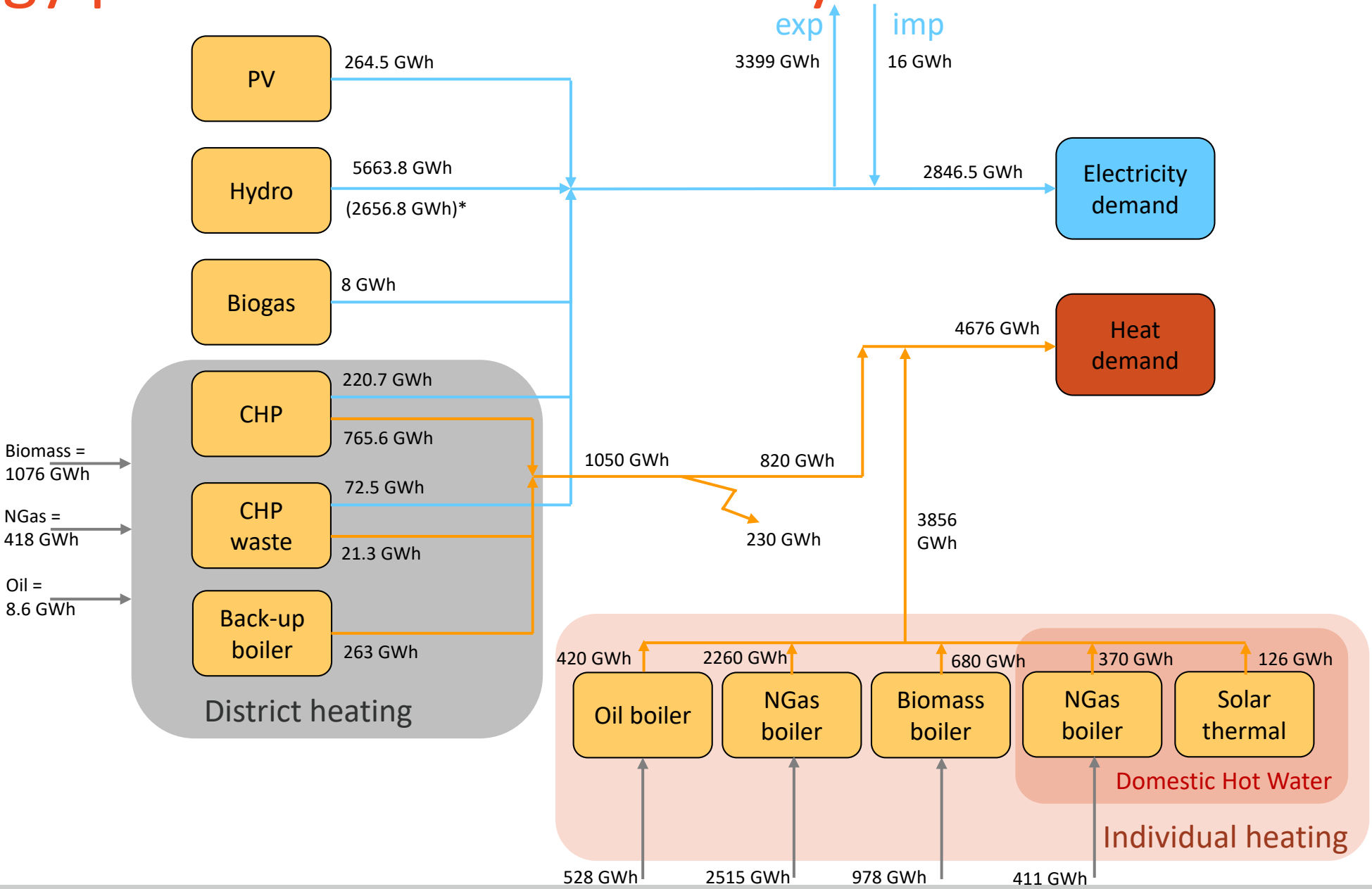
Energy consumption in South Tyrol : 12,4 TWh



- Electricity consumption = 2846.5 GWh
- Heat consumption = 6166.5 GWh
- Transport energy consumption = 3400 GWh

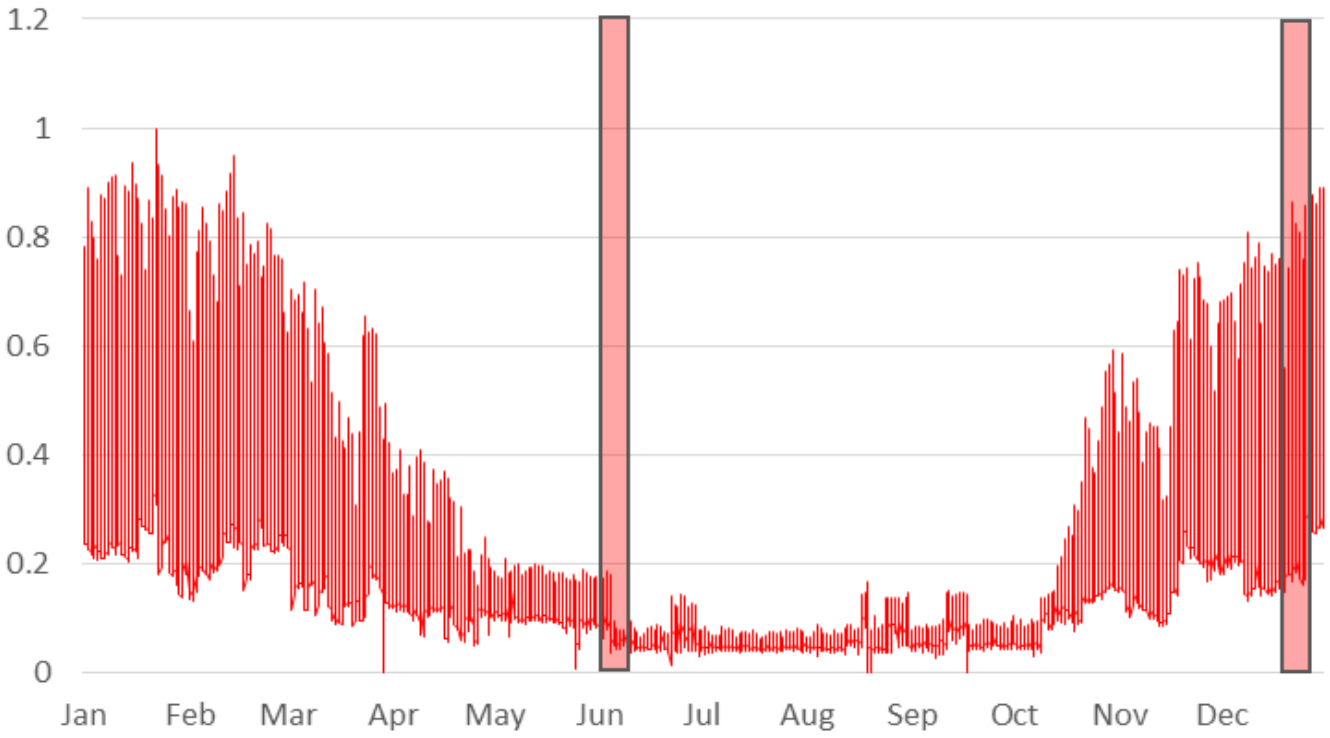
Overall energy consumption in South Tyrol, in the reference year 2014

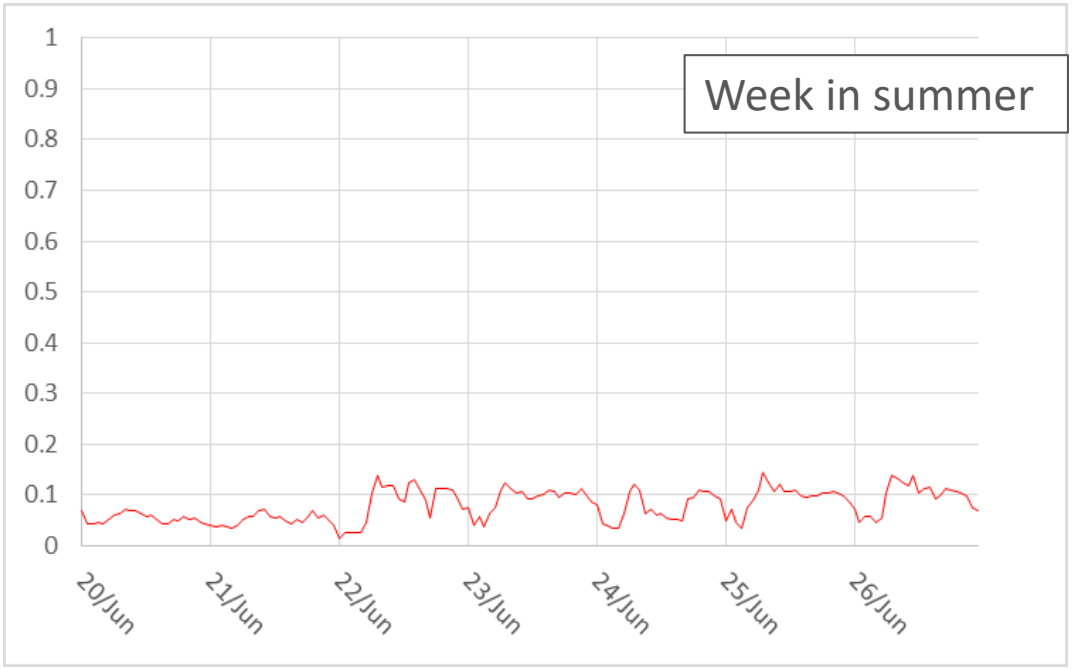
Energy production – reference year

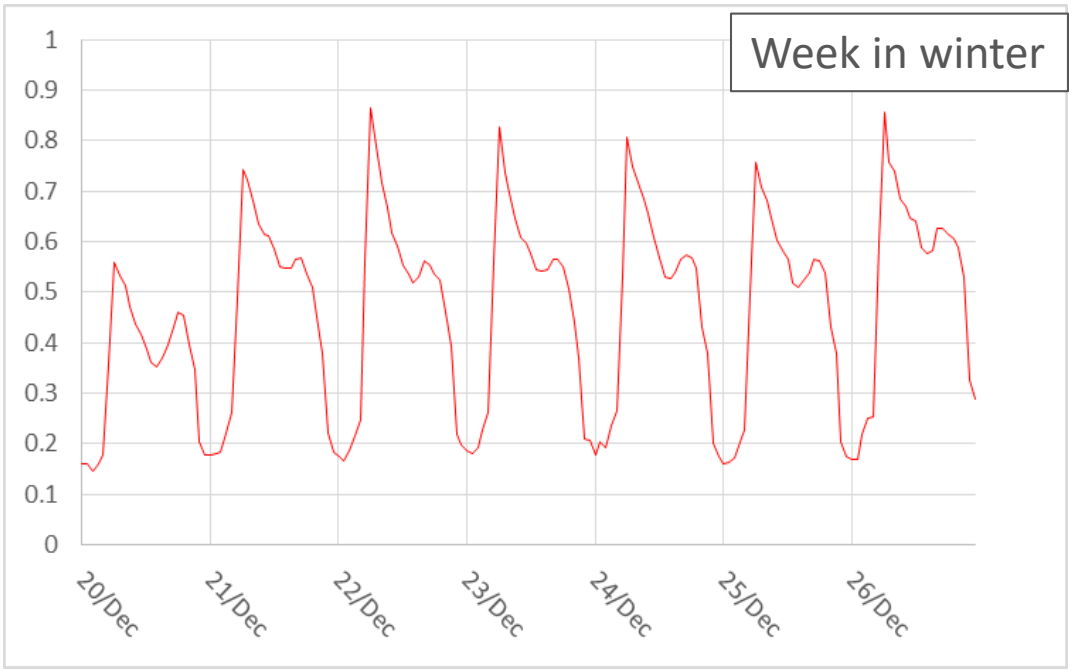


*if only River hydro electricity production is considered within the model

Year profile – heating

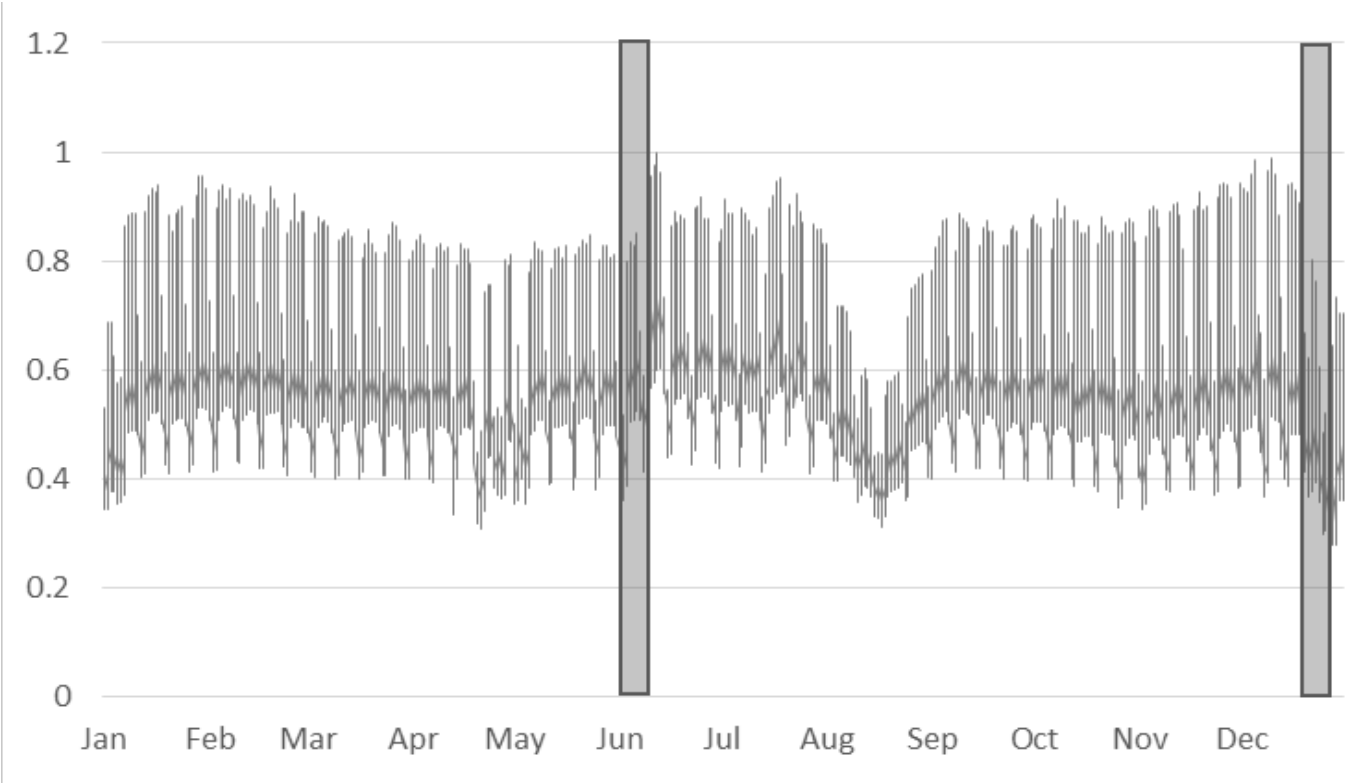


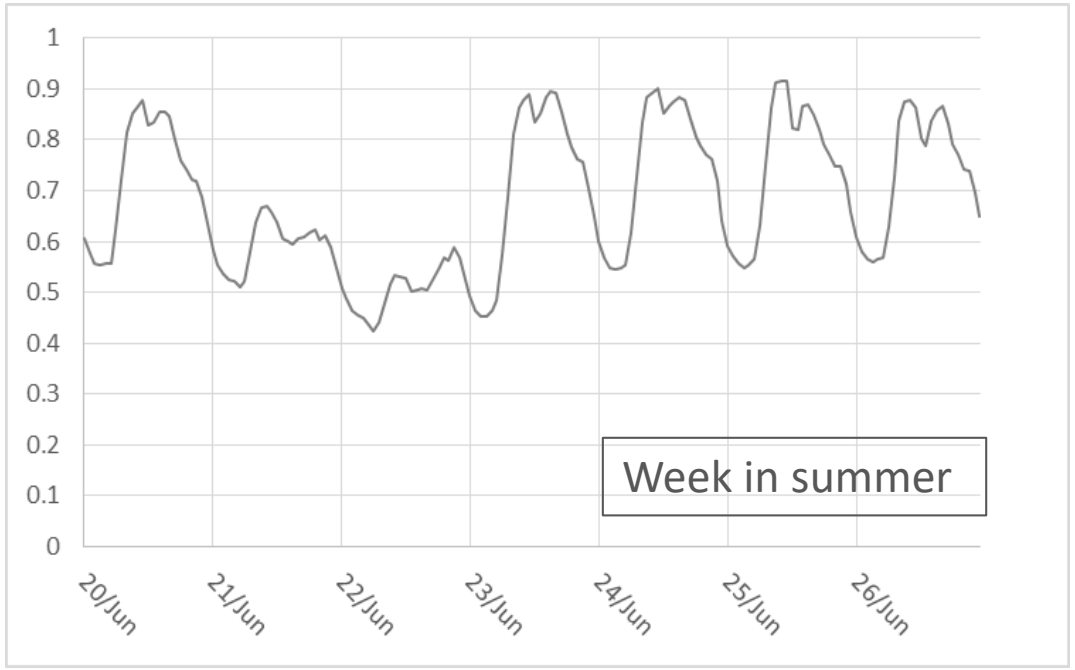


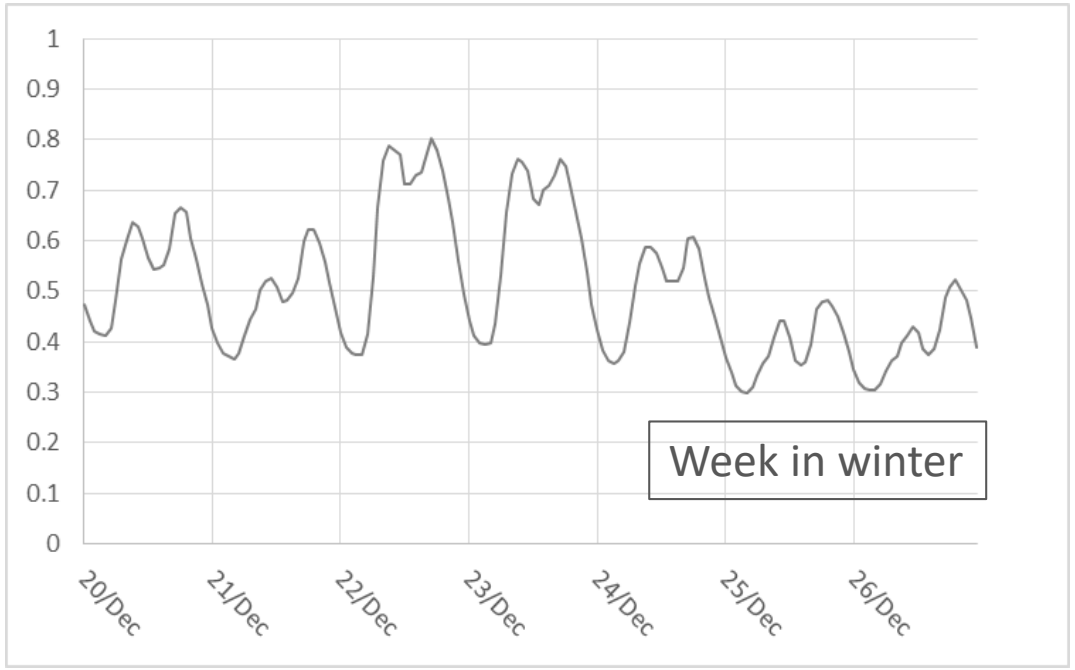


Year profile of the heat consumption from district heating, Bolzano 2014
Source: Alperia Ecoplus

Year profile- electricity

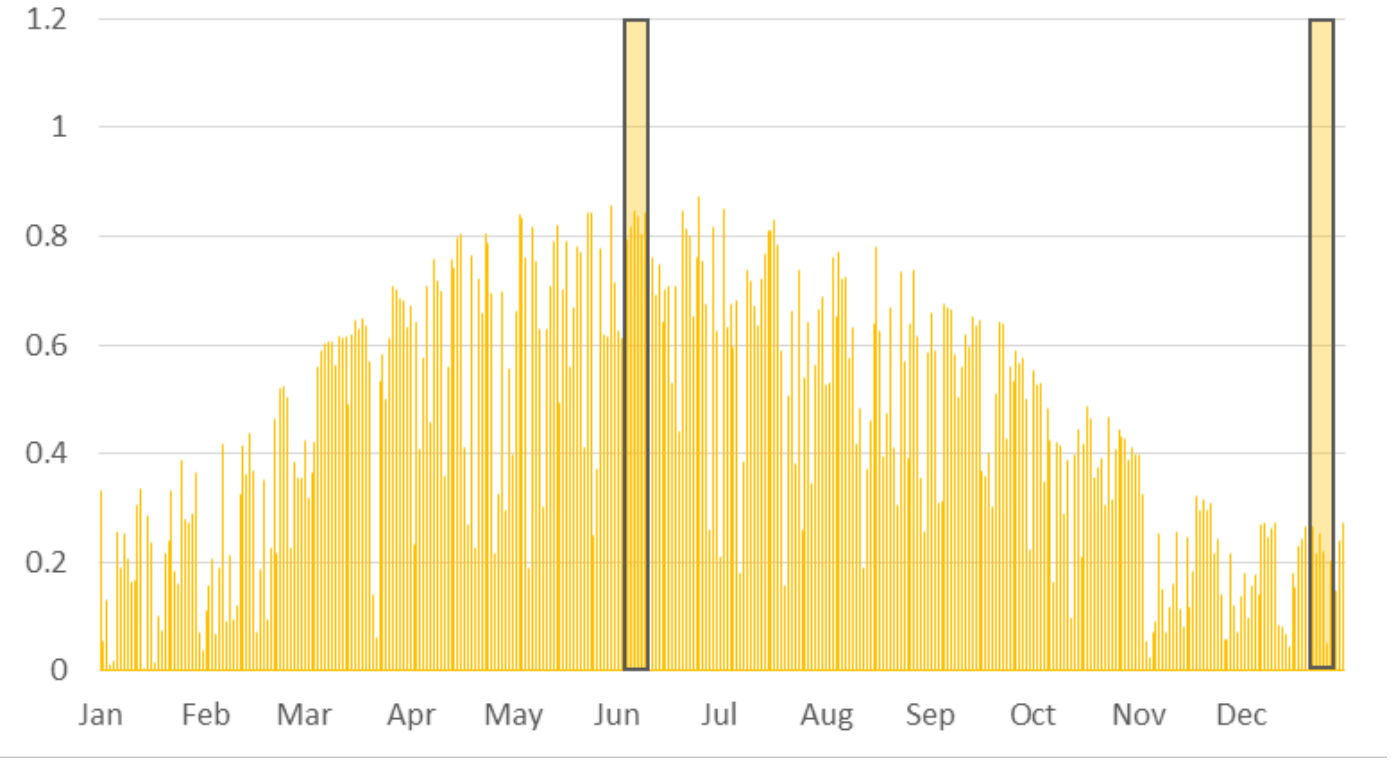


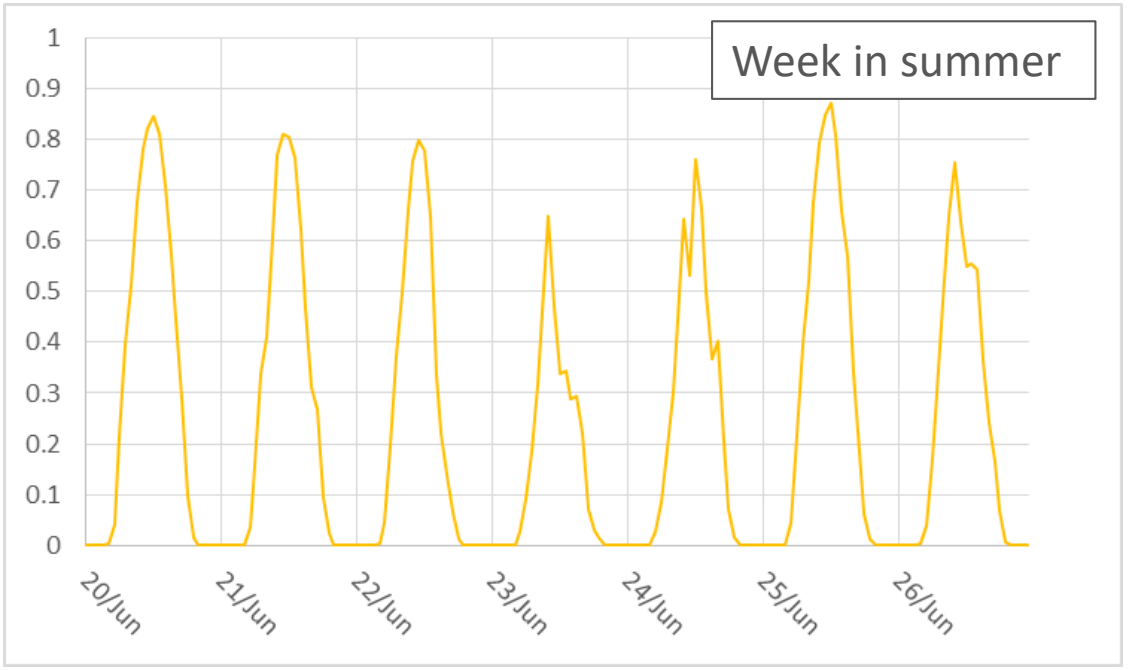


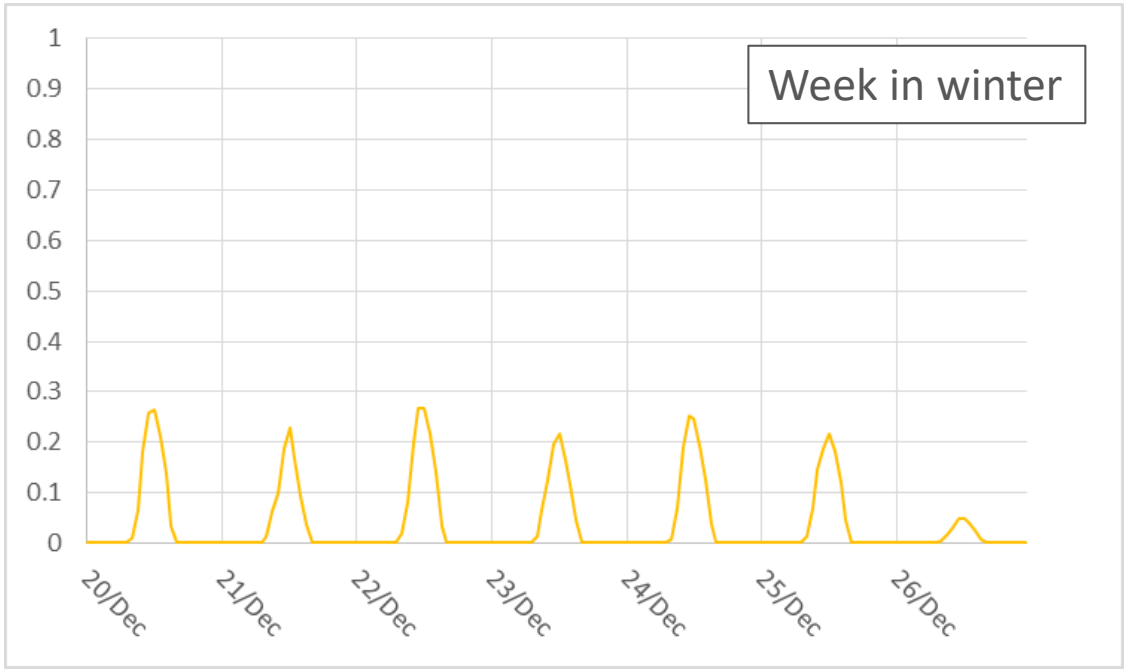


Year profile of the electricity consumption, Northern Italy, source: Terna
Assumption / simplification: the energy consumption in South Tyrol follows this profile

Example – PV production







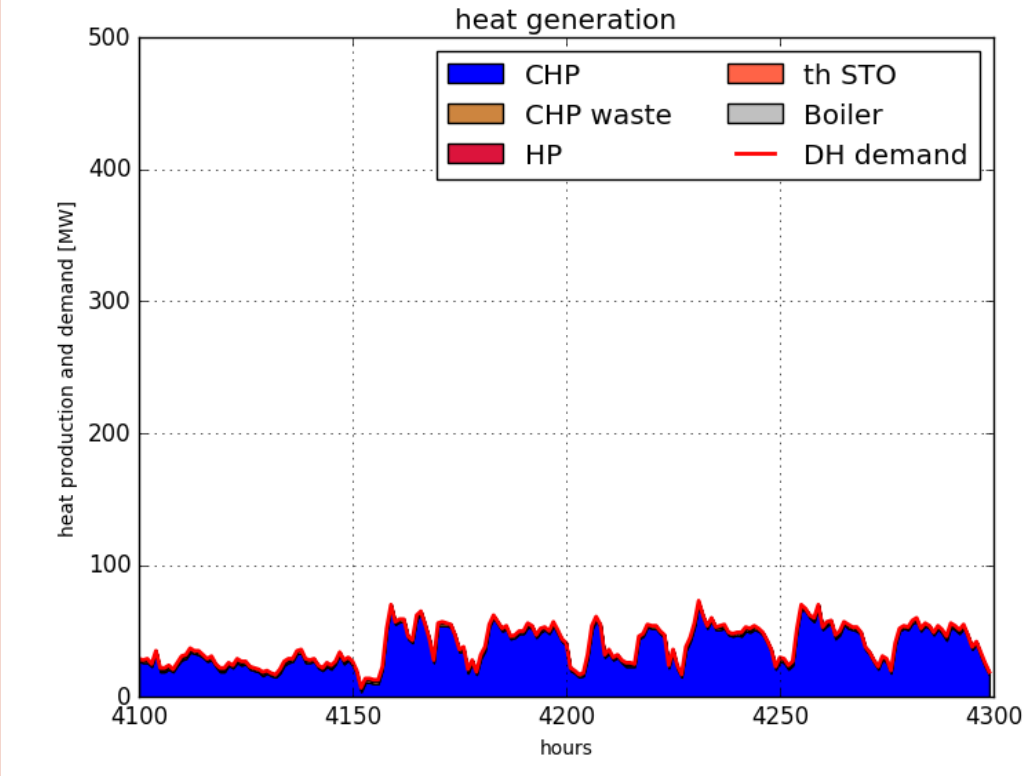
Profile of solar radiation – average hourly data from 13 different locations in South Tyrol. Source: Province of Bolzano/Bozen

The model –
Starting data and assumptions

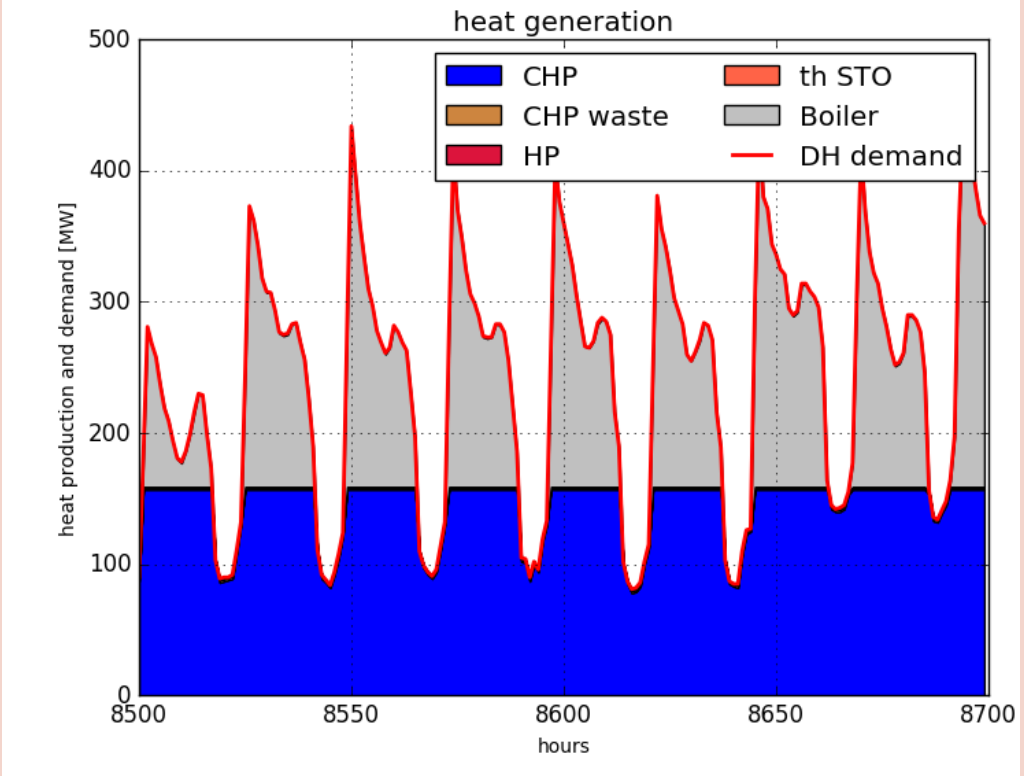
Modelling of the reference scenario – District heating use

District heating

Week in summer



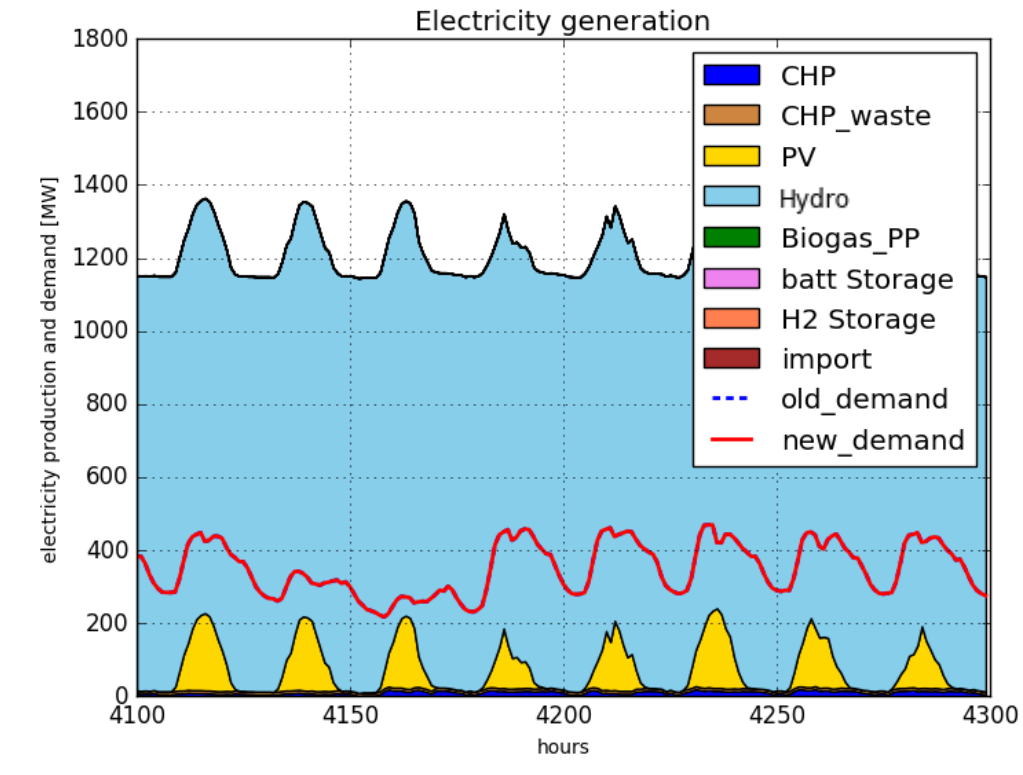
Week in winter



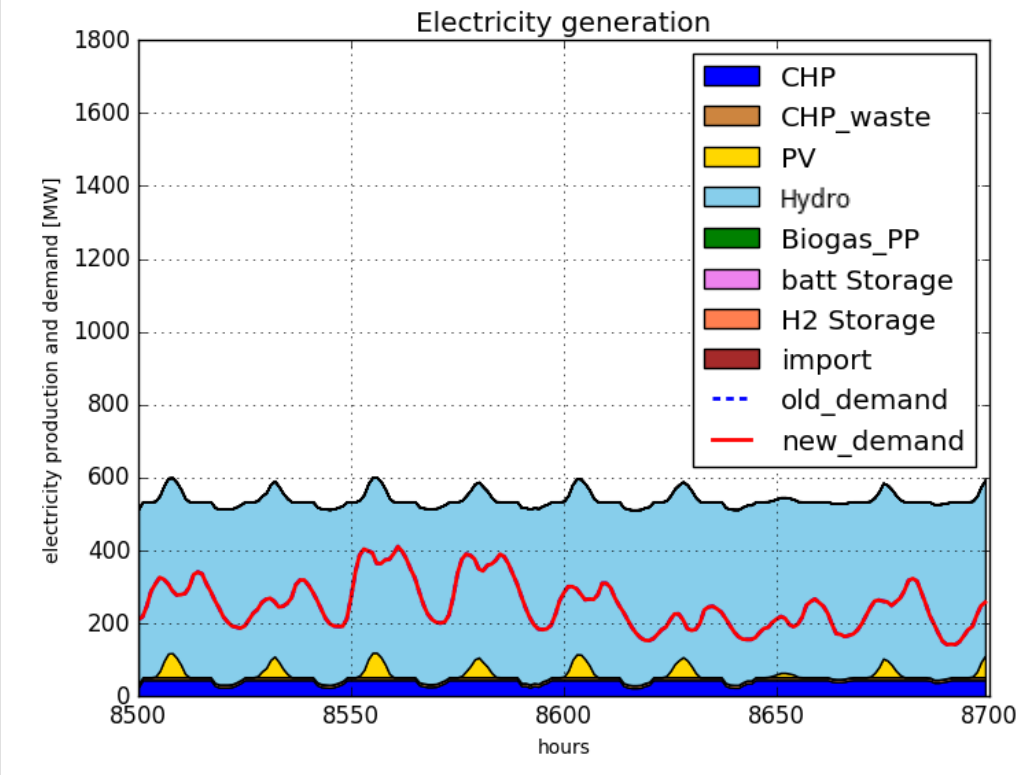
Modelling of the reference scenario – Electricity consumption

Electricity

Week in summer

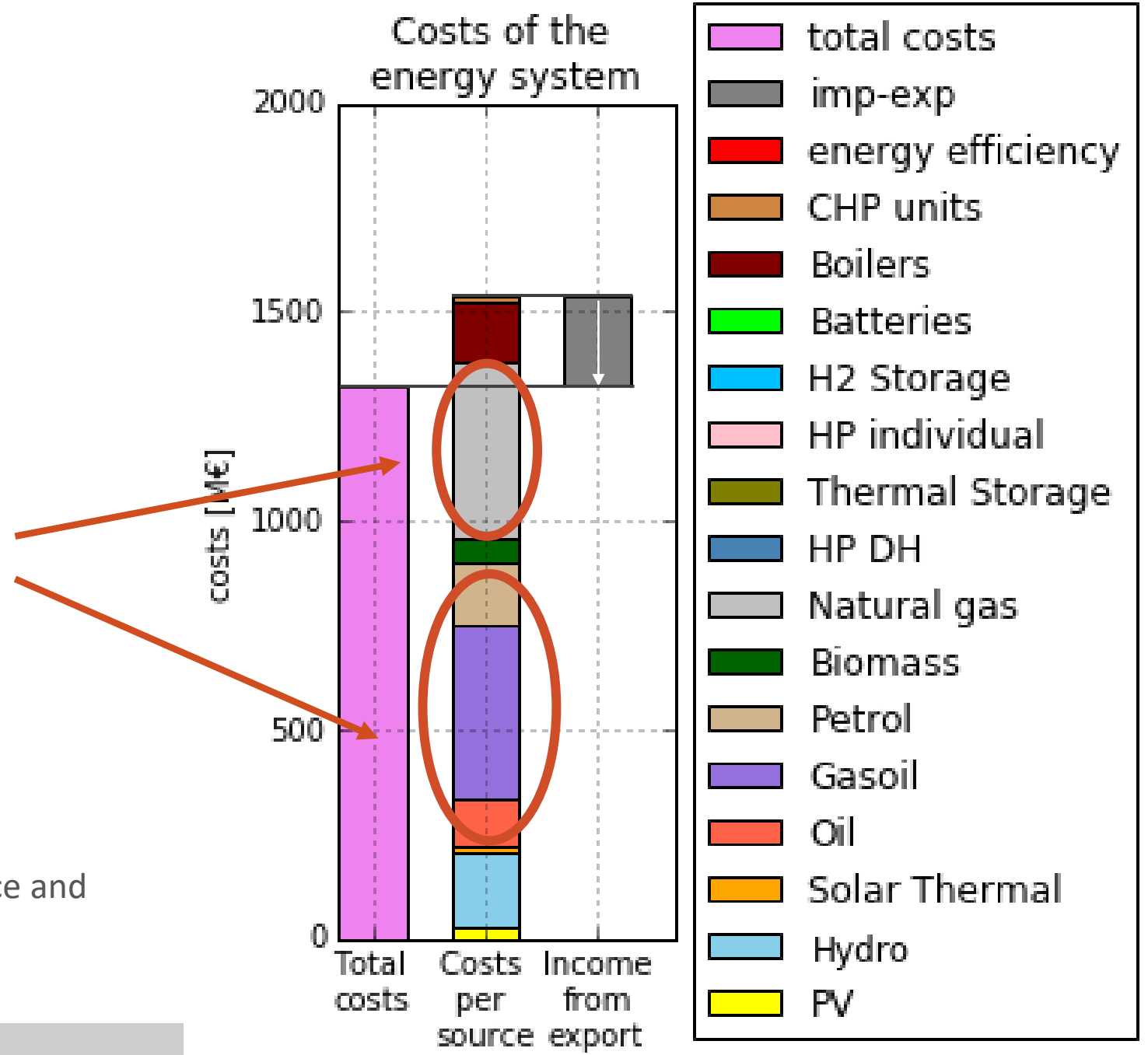


Week in winter



Reference scenario - financial data

Costs for fossil fuels



Annual costs include natural resources, maintenance and investments for each technology.

Optimization model of the energy system

Optimization of the costs compared to CO_2 emissions, varying different parameters.

Model n objectives – Eurac Research

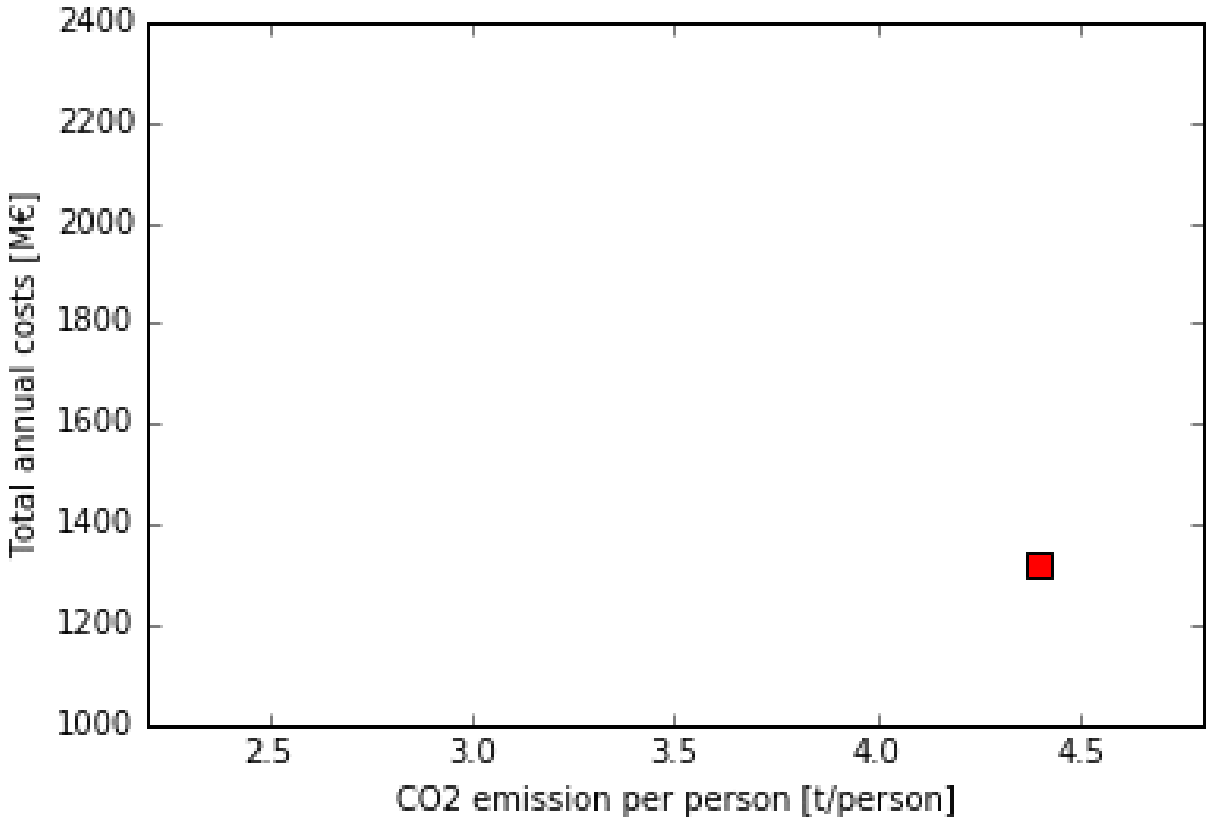
Simulation model

EnergyPLAN (Aalborg University)

\+

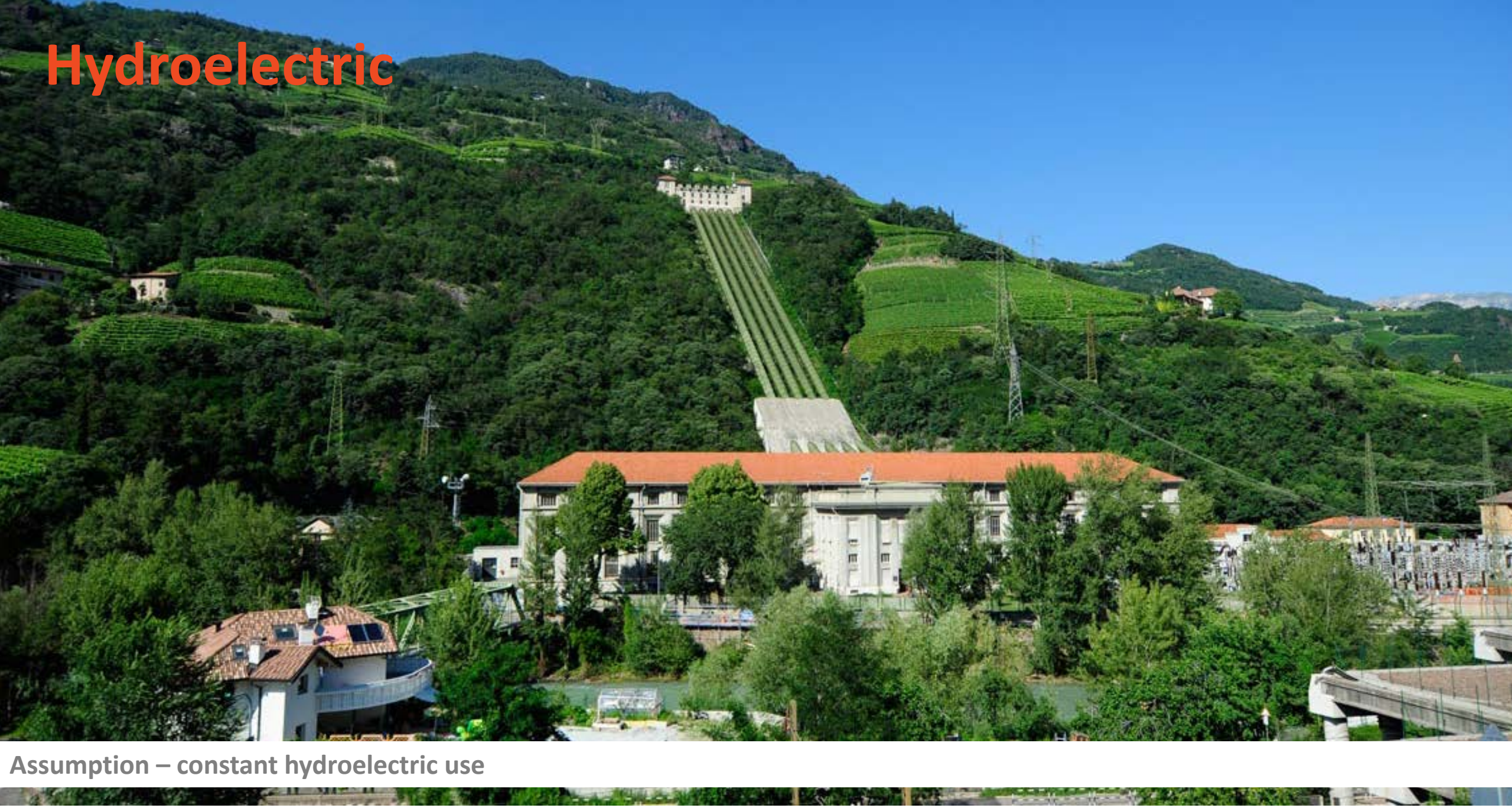
Optimization model

Multi objective evolutionary algorithm MOEA



Each point on the chart shows total costs and CO_2 emissions per each energy system. For each energy system, hourly energy production and consumption have been simulated.

Hydroelectric



Assumption – constant hydroelectric use

Photo: Alperia

PV

Assumption – possible installation of the building rooftops, except in historical centers. No ground use (max. potential 1250 MW, as calculated in the SolarTirol project)

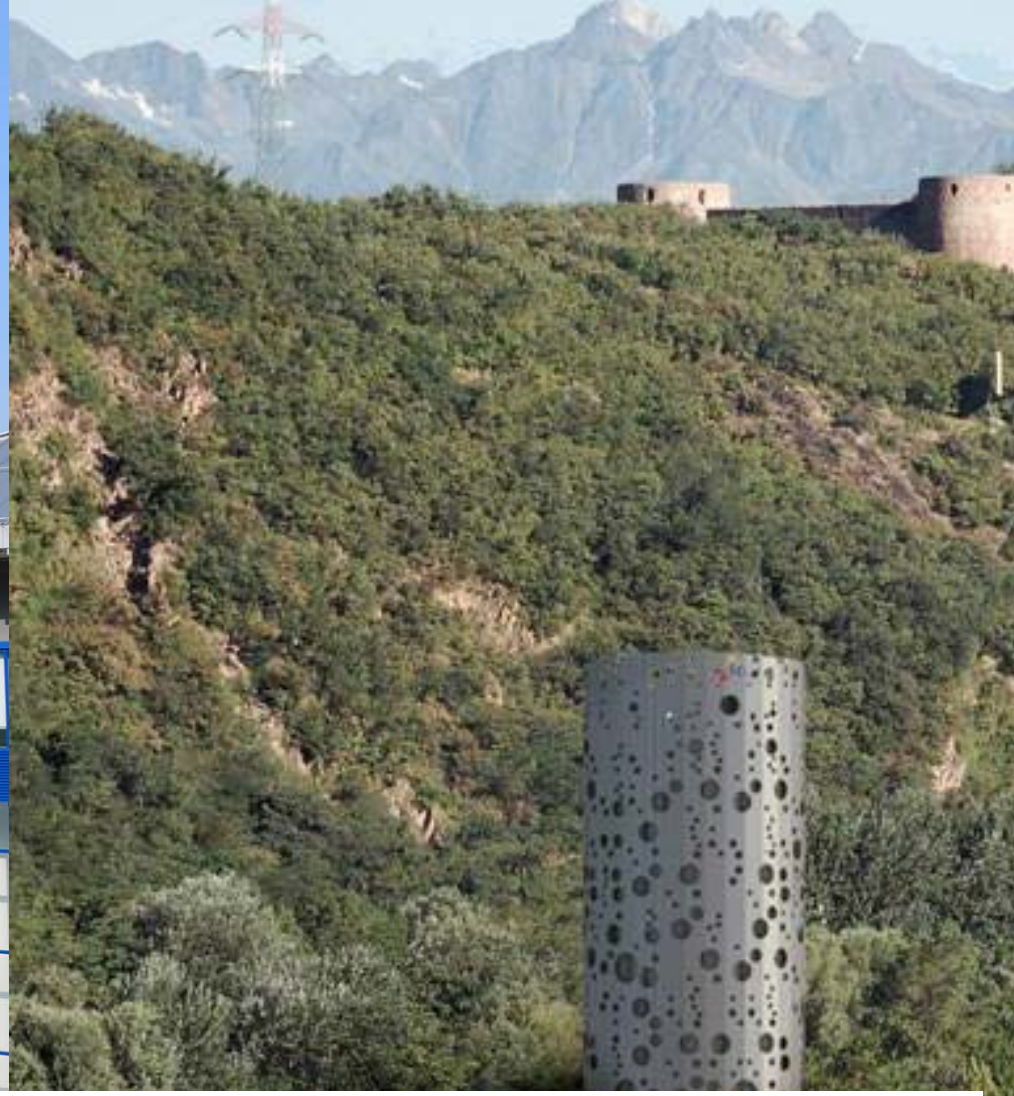
Photo: Quale Energia

Wind power

Assumption – no use of large wind farms in South Tyrol

Photo: Commons Wikimedia

Storage technologies



Assumptions – possible use of energy storage systems such as thermal energy storages, batteries and hydrogen production

Photo: IIT, Alperia

Biomass / Biogas

Assumption – constant use of biomass, no increase in biomass import. Slight possible increase in biogas use.

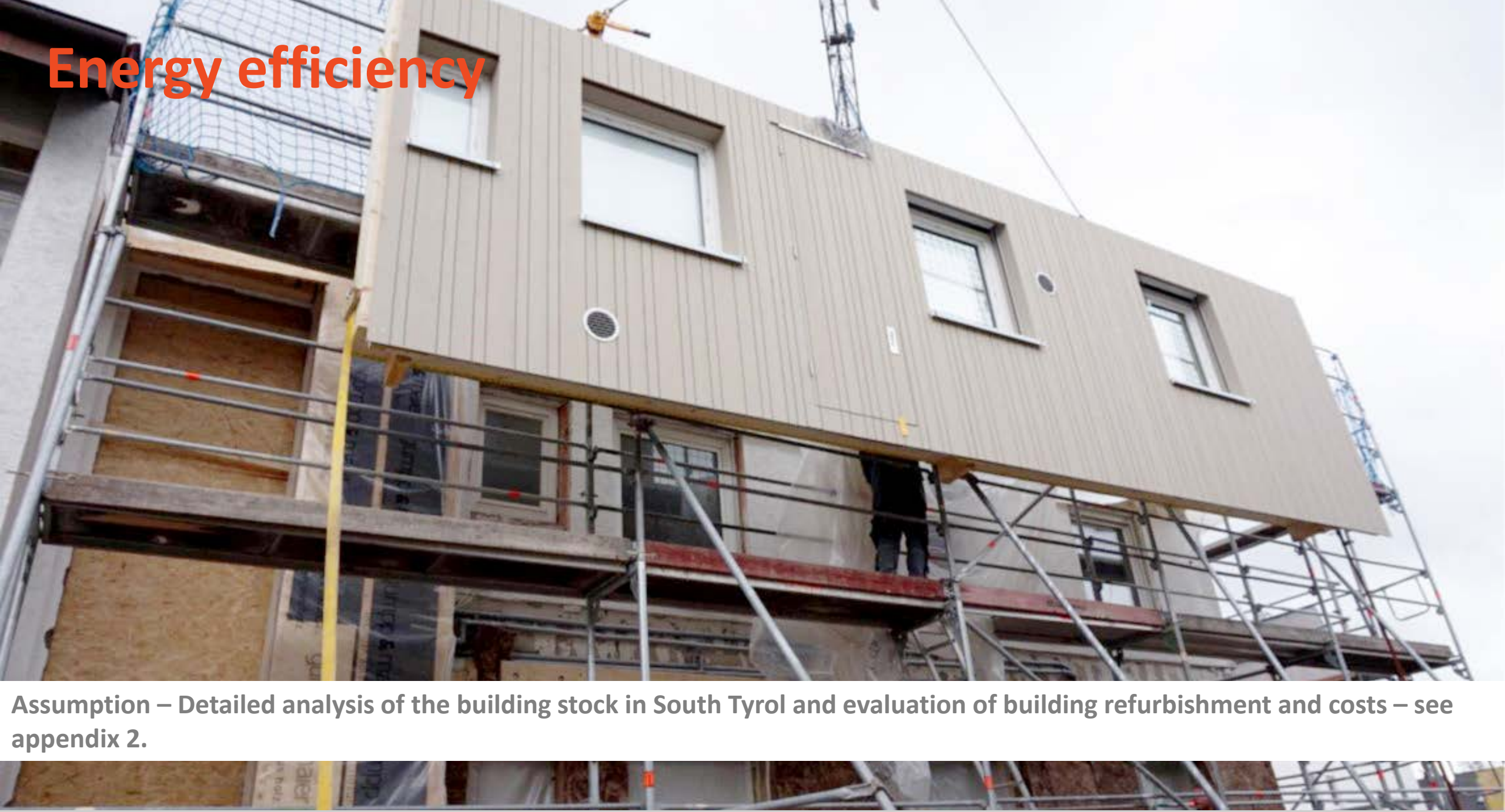
Photo: IIT, Alperia

Solar thermal/ heat pumps

Assumptions – Possible use of solar thermal on rooftops for domestic hot water. Possible use of heat pumps as part of the building‘s heating system.

Photo: Eurac Research, canale energia

Energy efficiency



Assumption – Detailed analysis of the building stock in South Tyrol and evaluation of building refurbishment and costs – see appendix 2.

Photo: iNSPiRe project

Transport

Evaluation of the total energy consumption and CO_2 emissions of the transport sector. Analysis of the needed reduction to reach the target.

Photo: radio nbc

25.000

Different combinations have been simulated to understand which energy systems could have the better features within the given conditions.

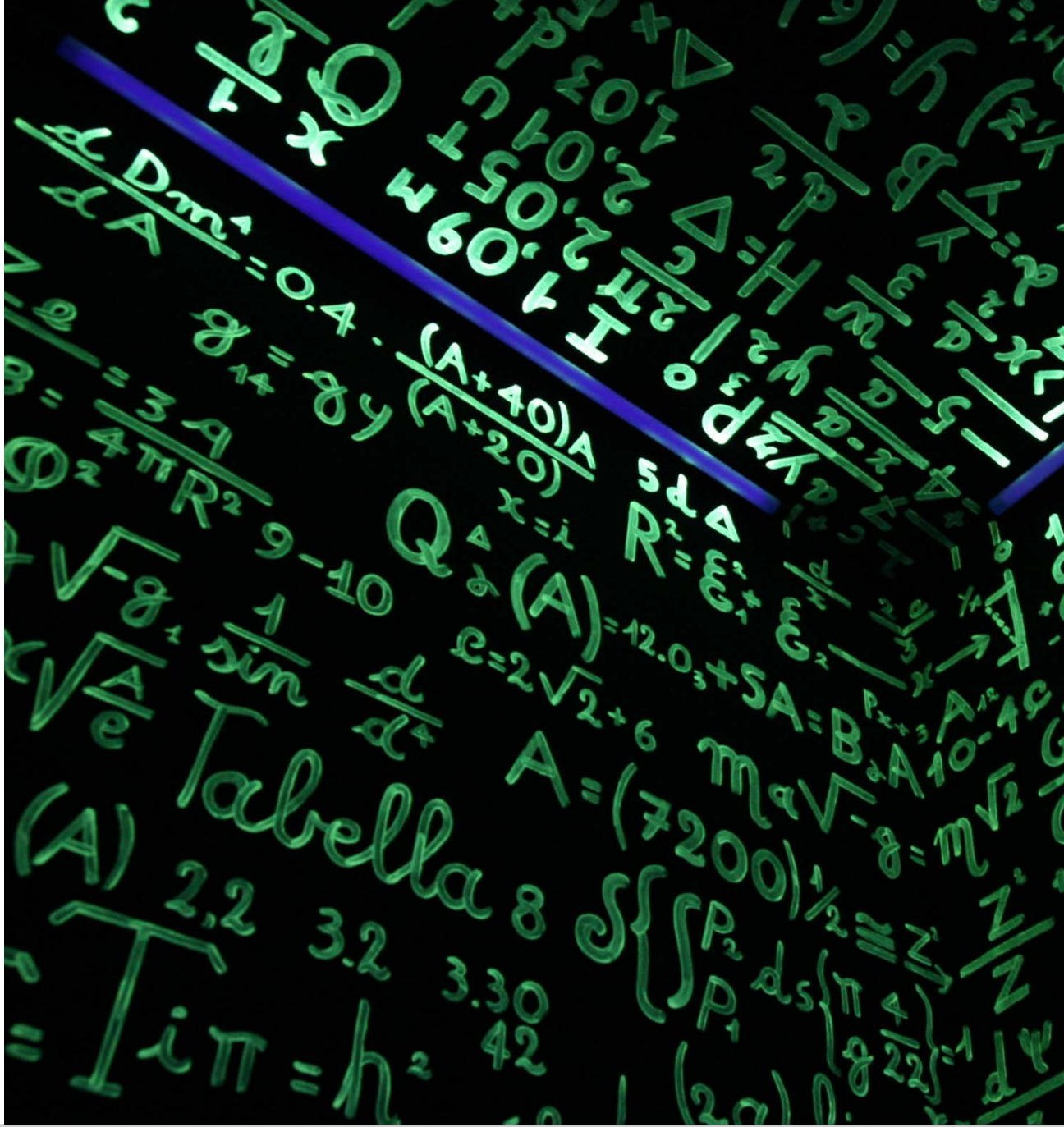
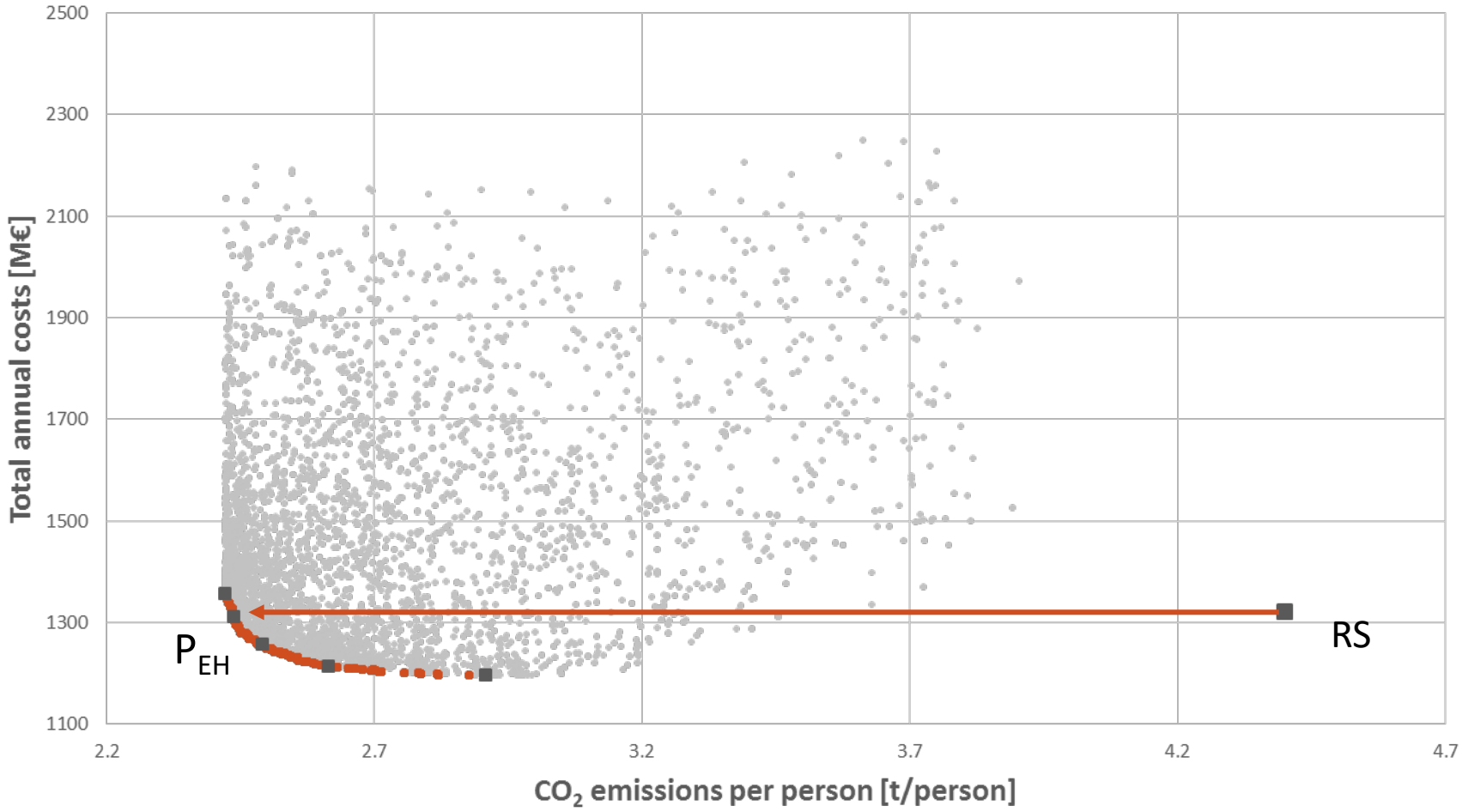


Photo: zibaldoni

Results

Simulation results– electric and thermal energy

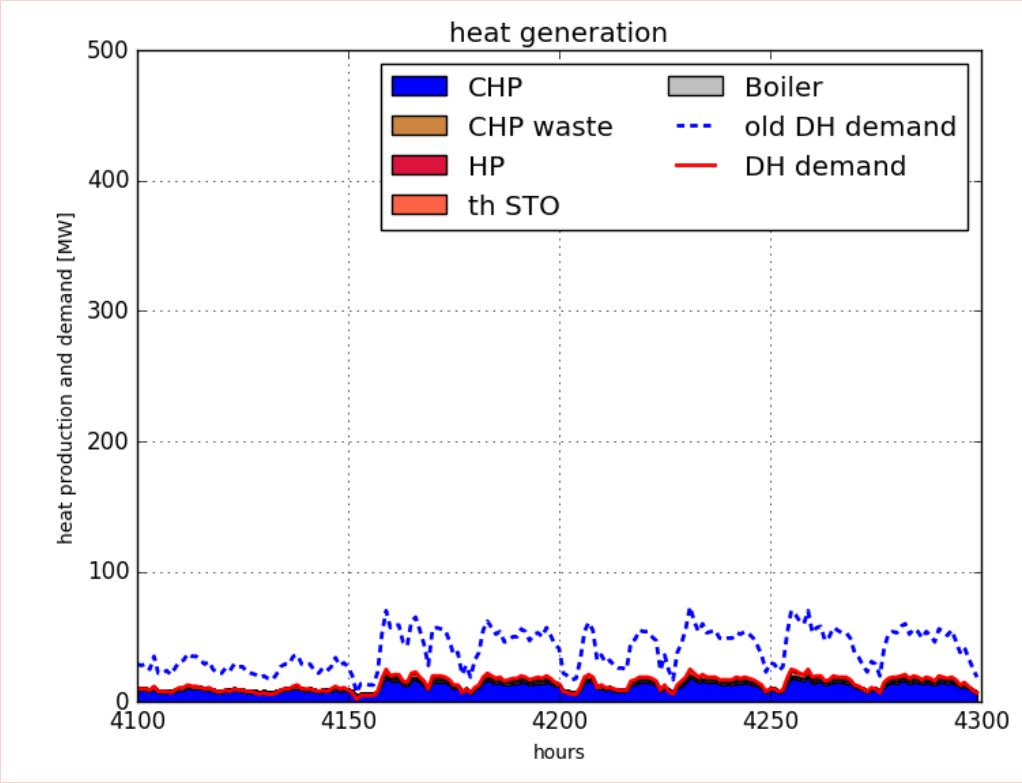


Each point of the cloud represents a specific combination of technologies in the year 2050 with related costs and CO_2 emissions. The P_{EH} scenario represents a combination of technologies with annual costs similar to the reference scenario (current combinatio of technologies), but with heavily reduced emissions.

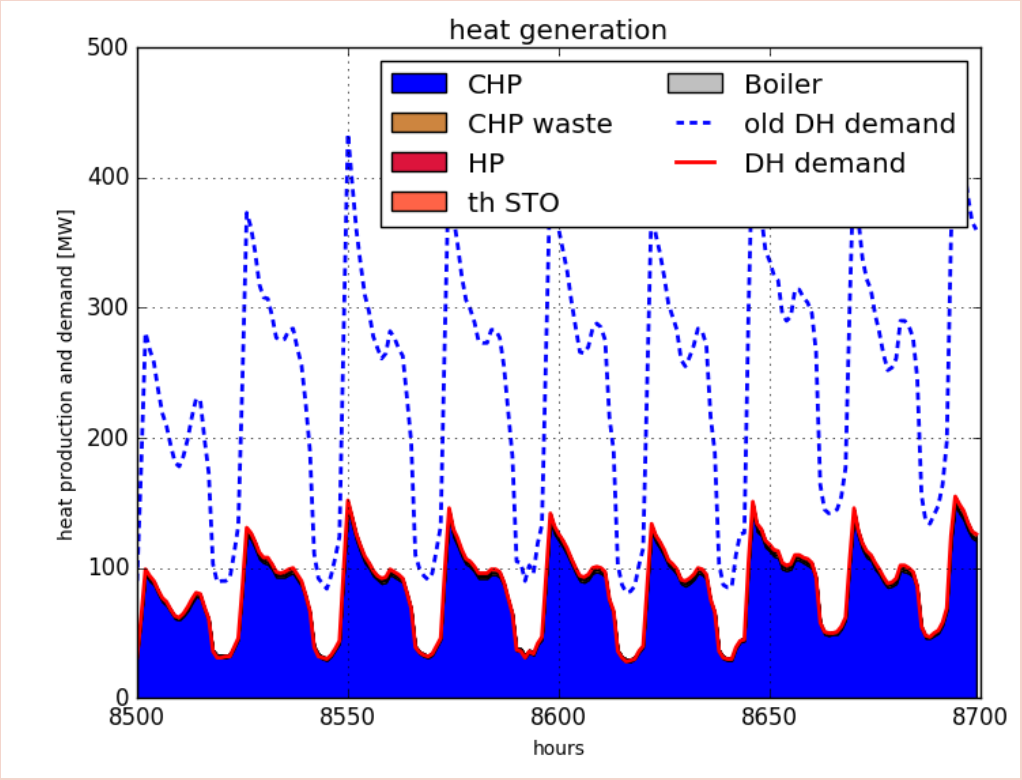
P_{EH} scenario – example district heating

District heating

Week in summer



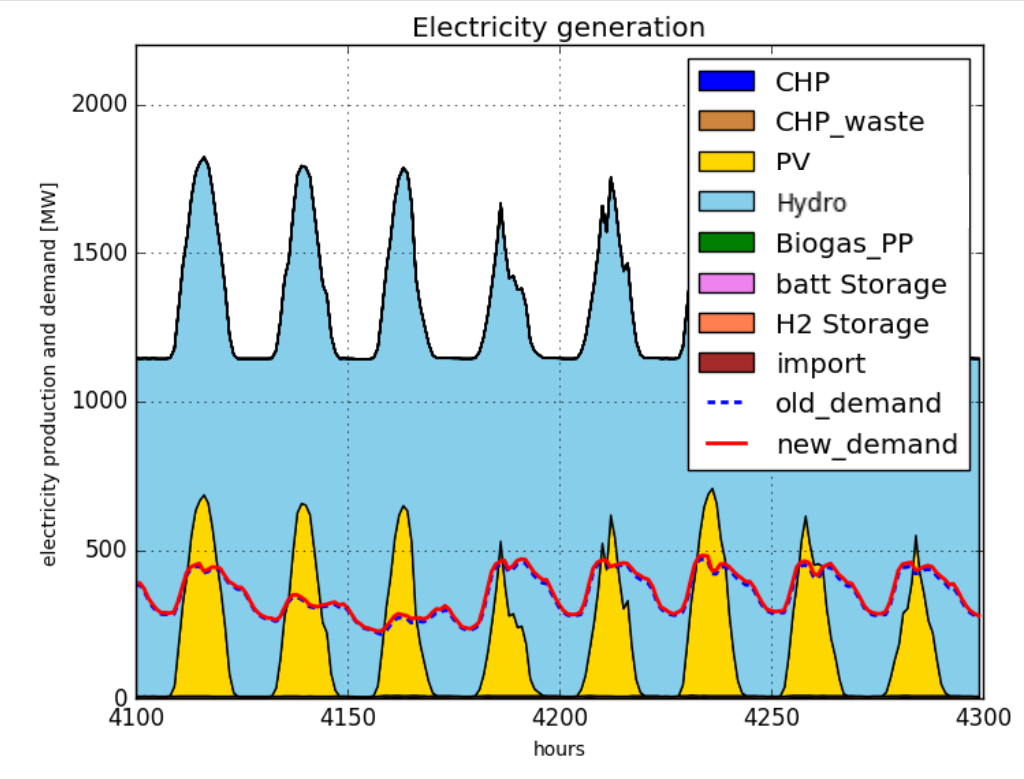
Week in winter



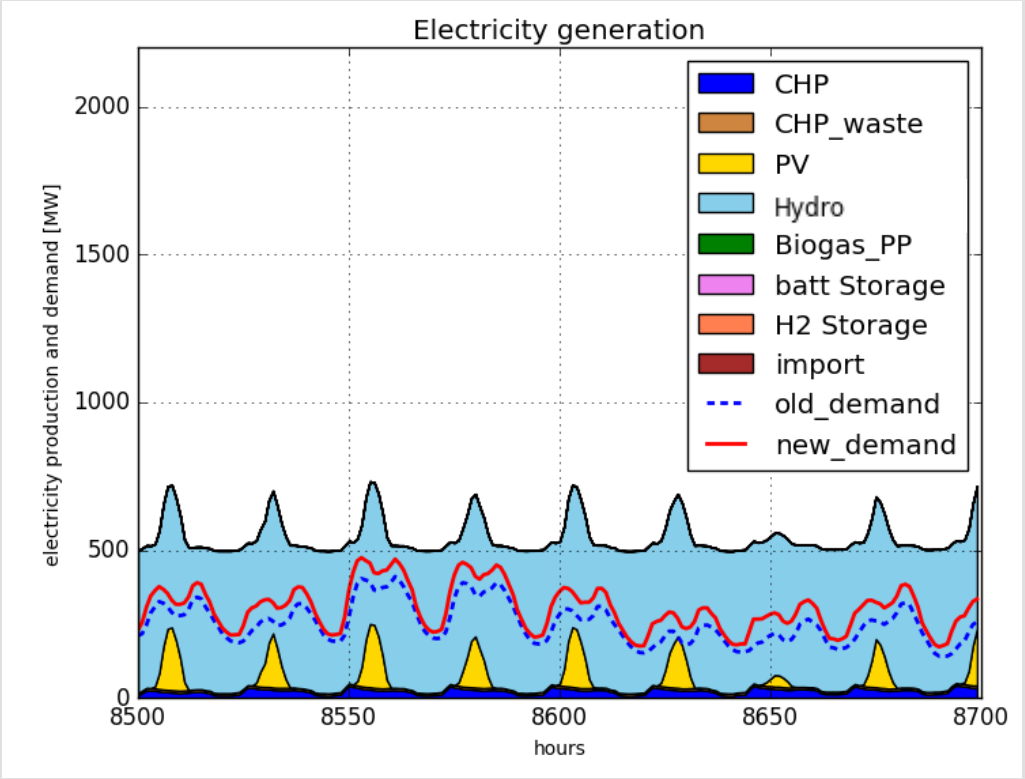
P_{EH} scenario – example electricity

Electricity

Week in summer

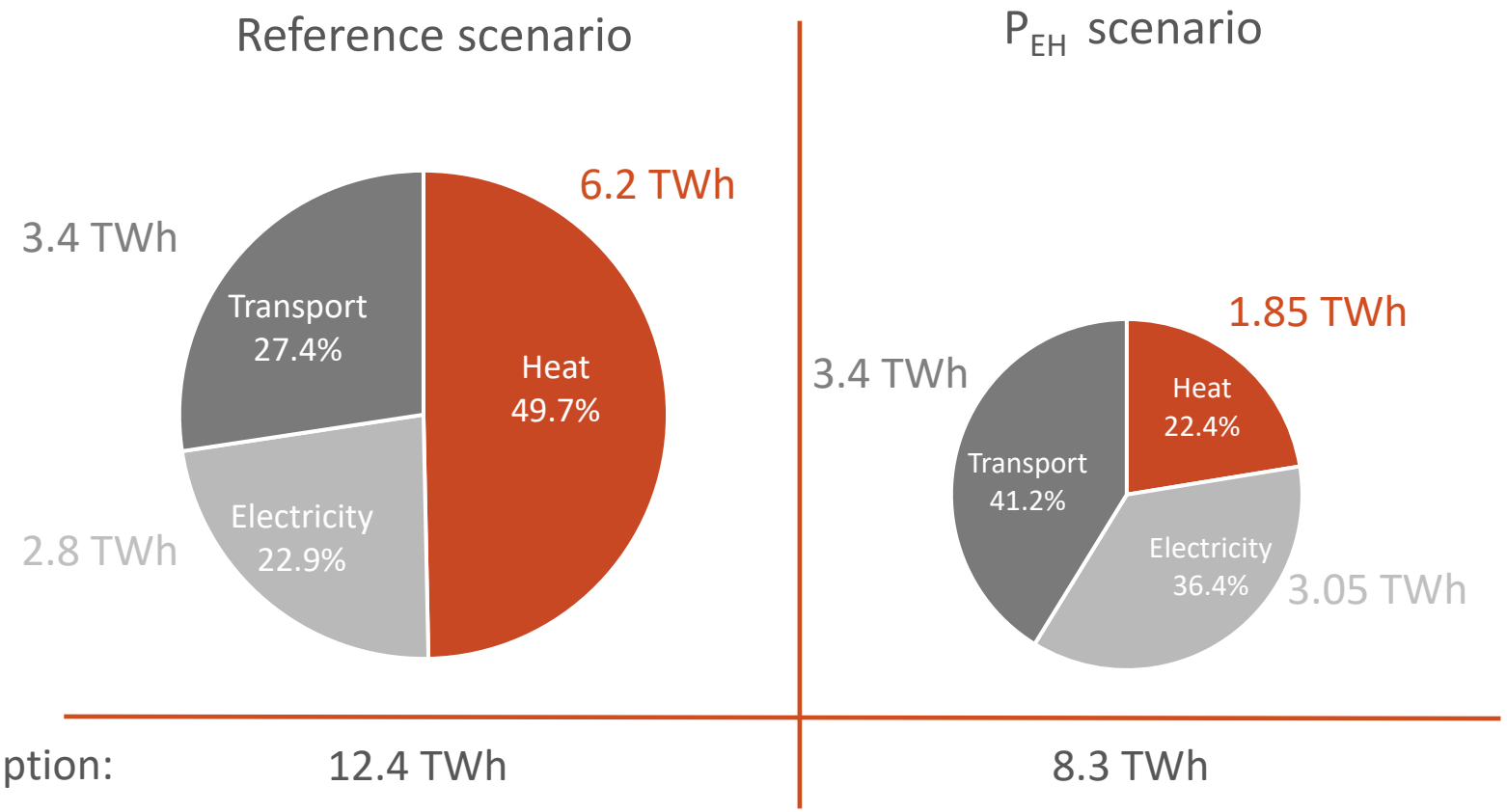


Week in winter

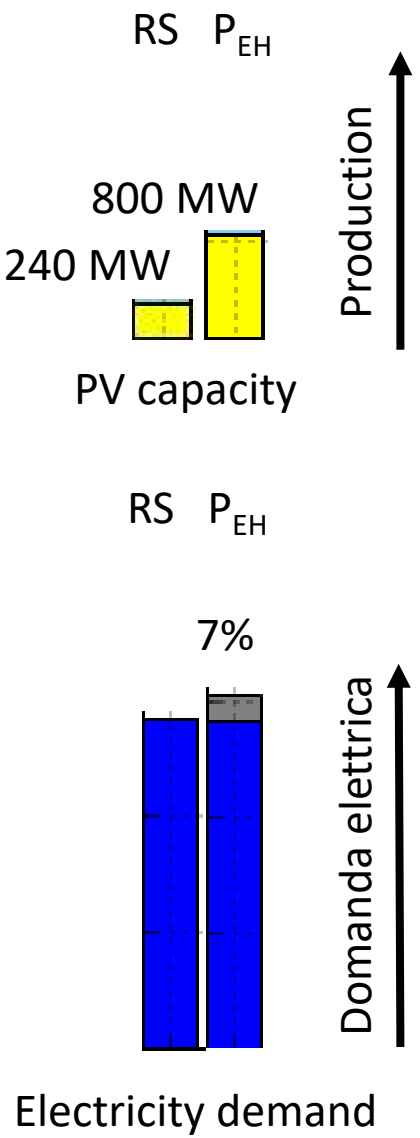


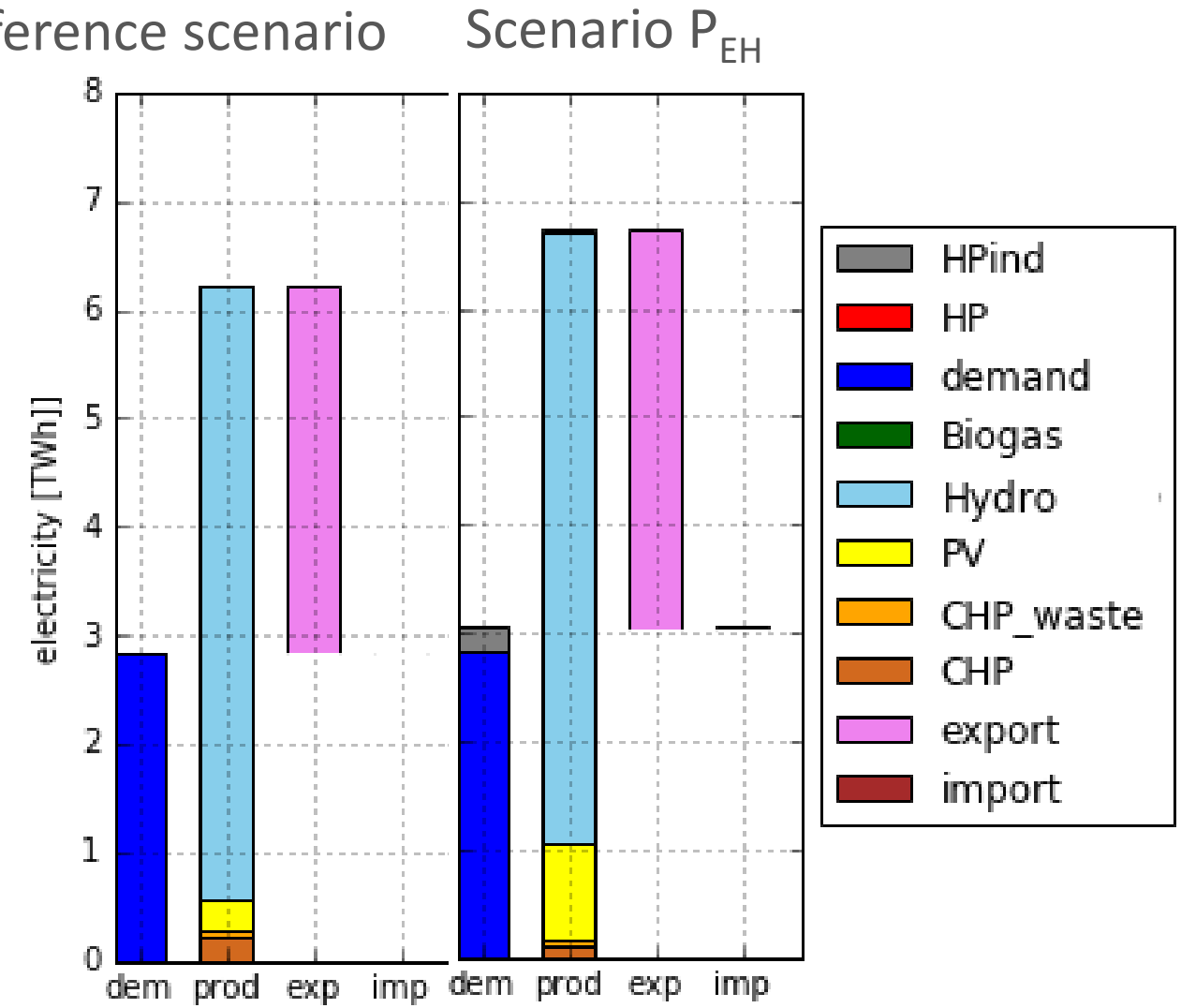
The electricity consumption increases and the profiles changes due to the use of heat pumps

Comparison of the overall energy consumption



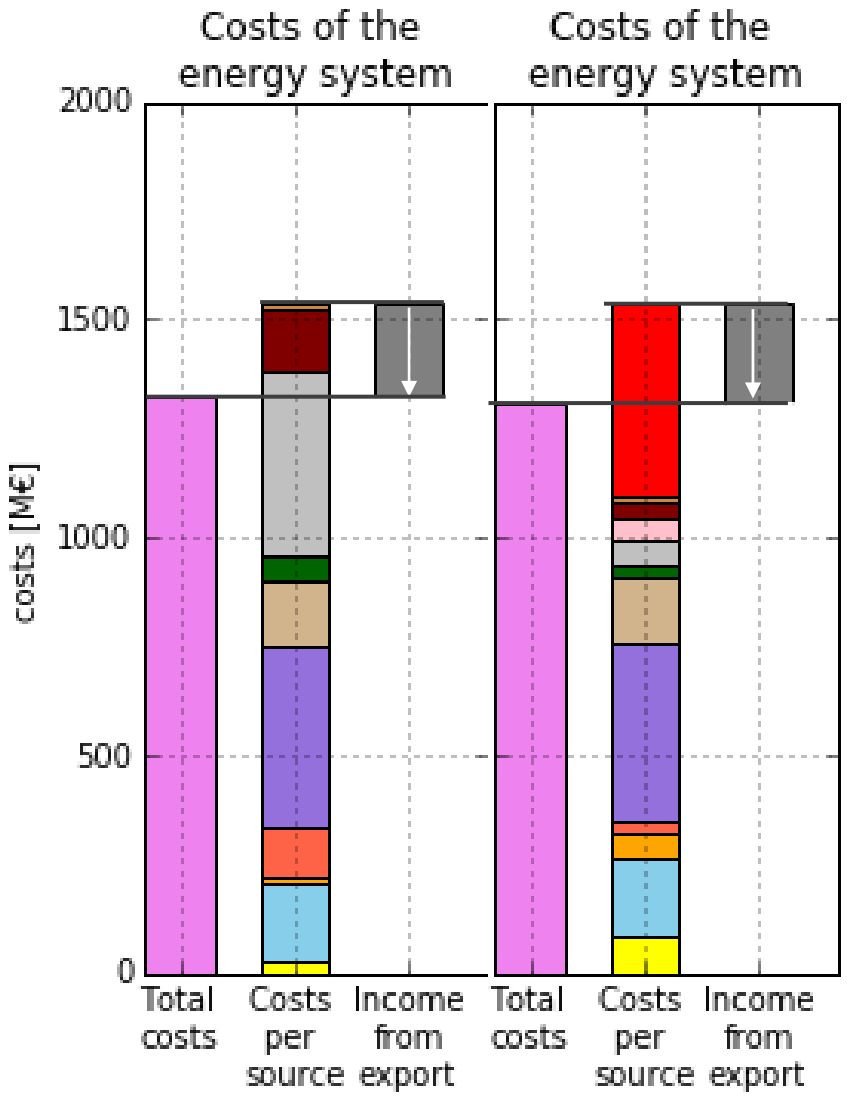
Comparison - electricity

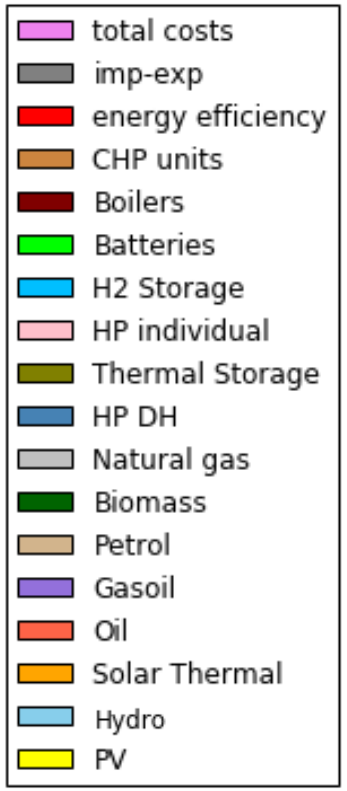




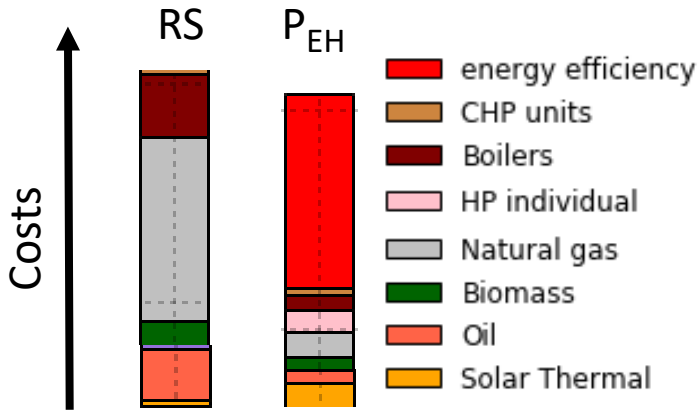
Comparison – financial data

Reference scenario P_{EH} scenario

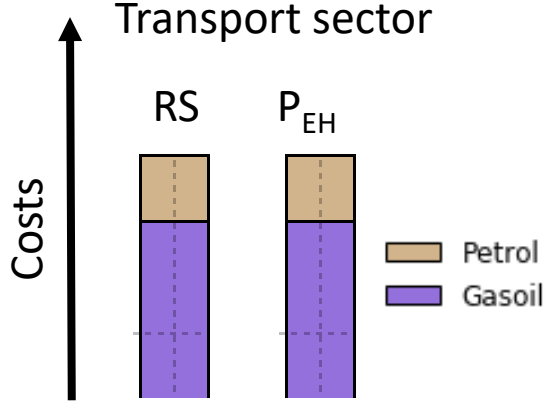




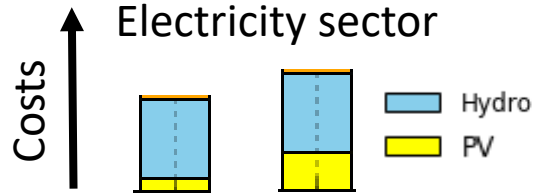
Thermal energy sector



Transport sector

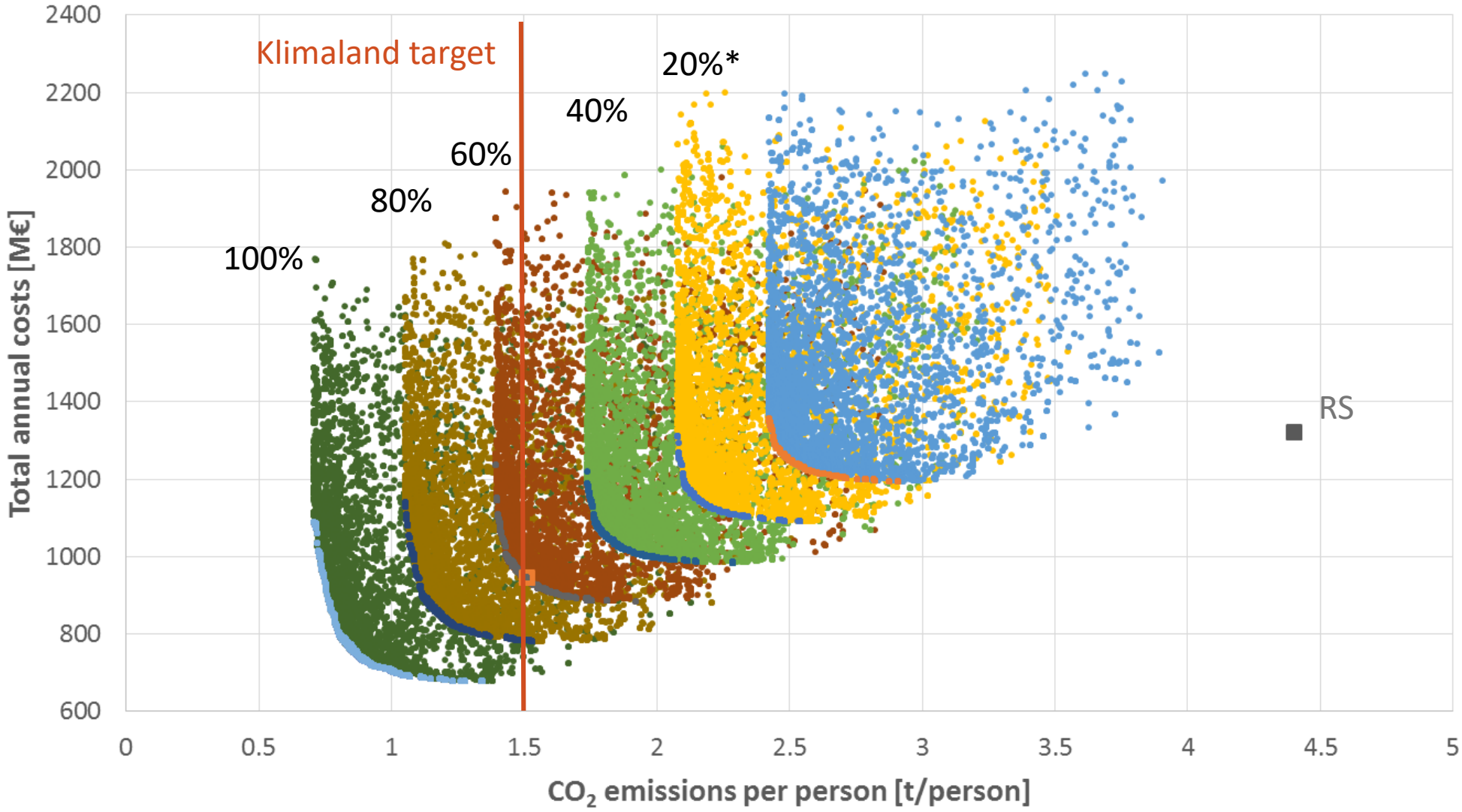


Electricity sector



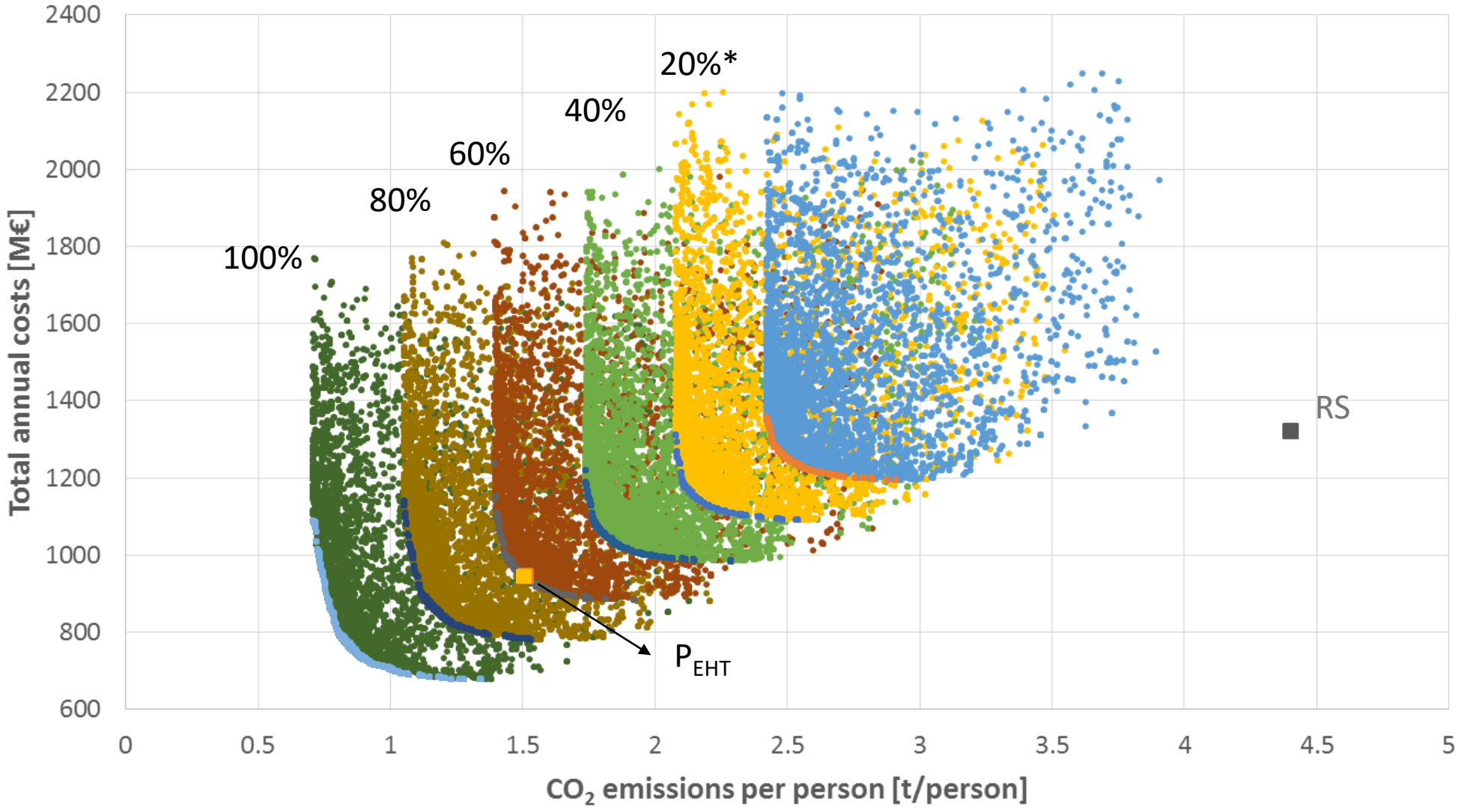
Considering zero emission mobility

% of zero emission mobility

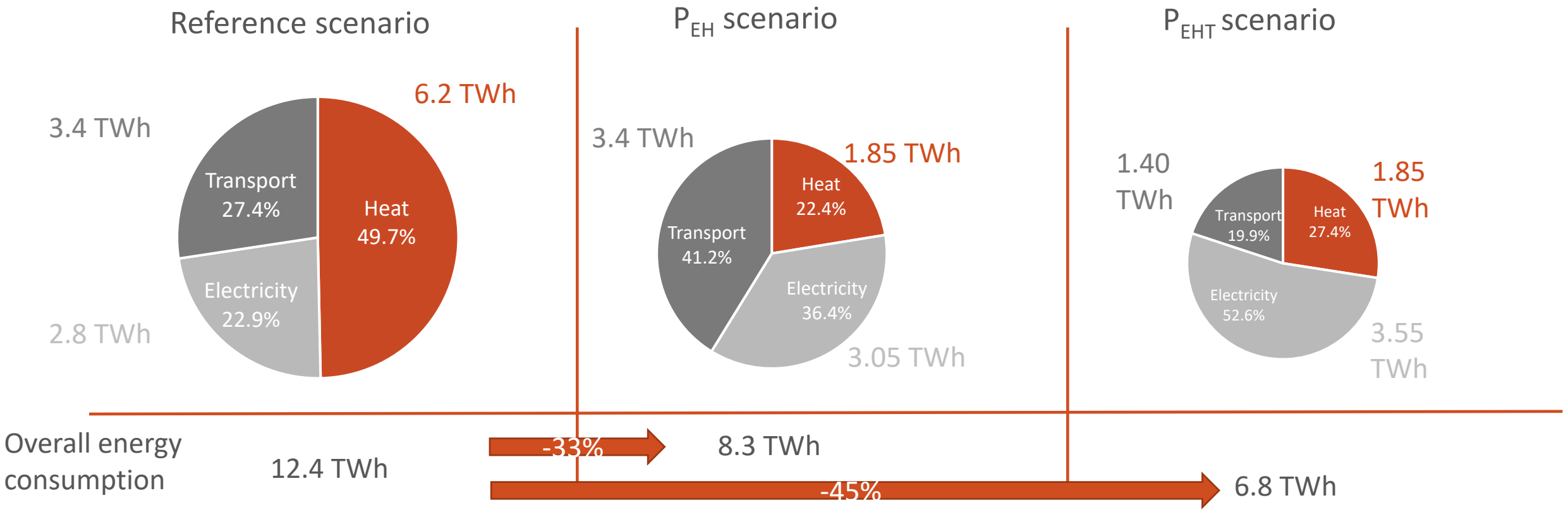


* Penetration percentage of zero emission transport on the overall kilometres covered in the transportation sector

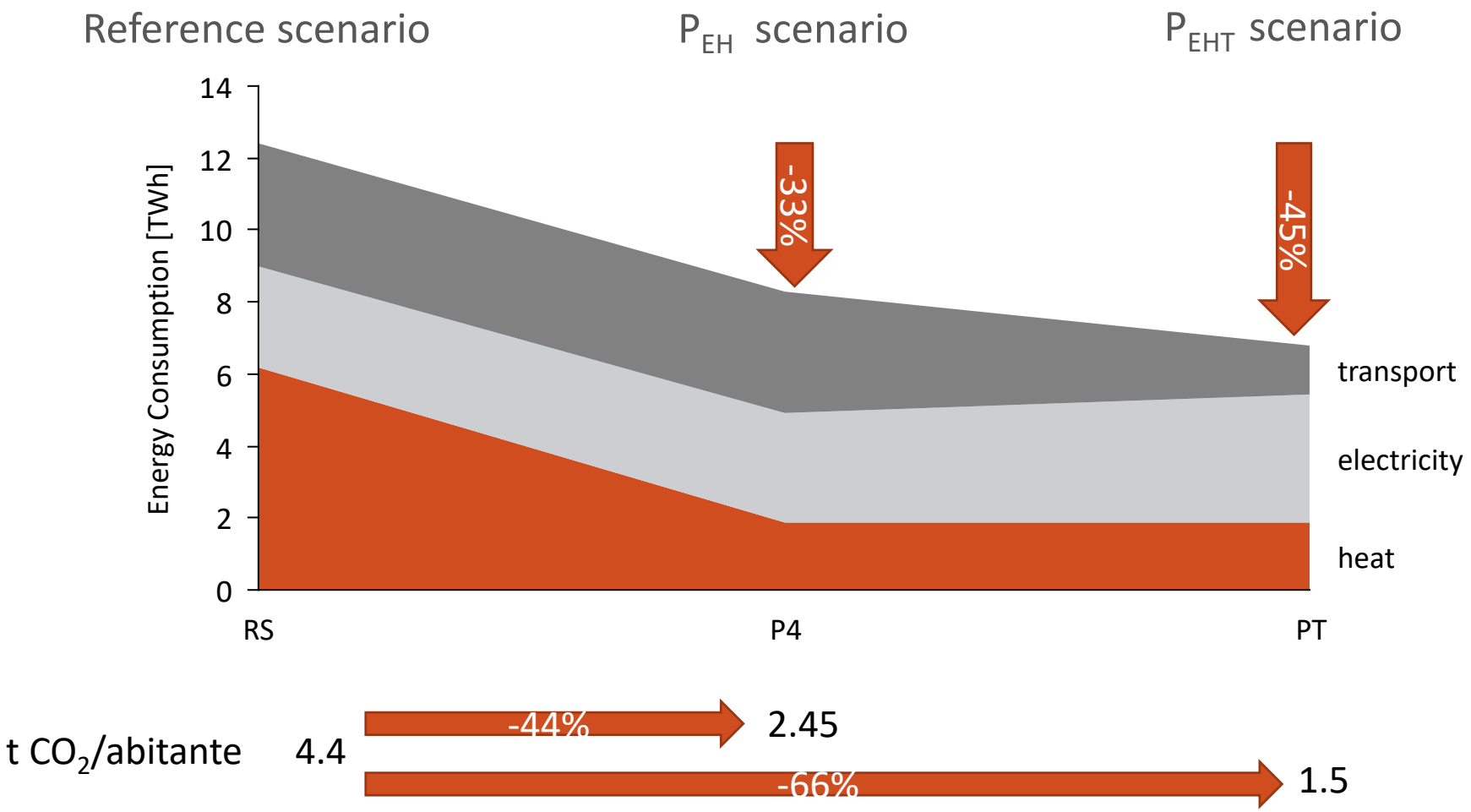
% of zero emission mobility



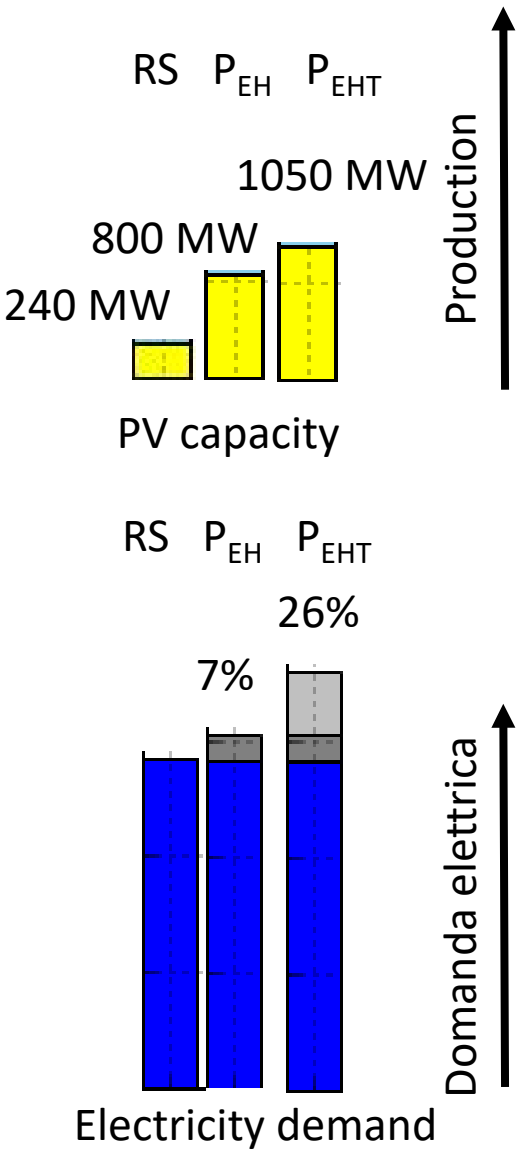
Comparison of the overall energy consumption

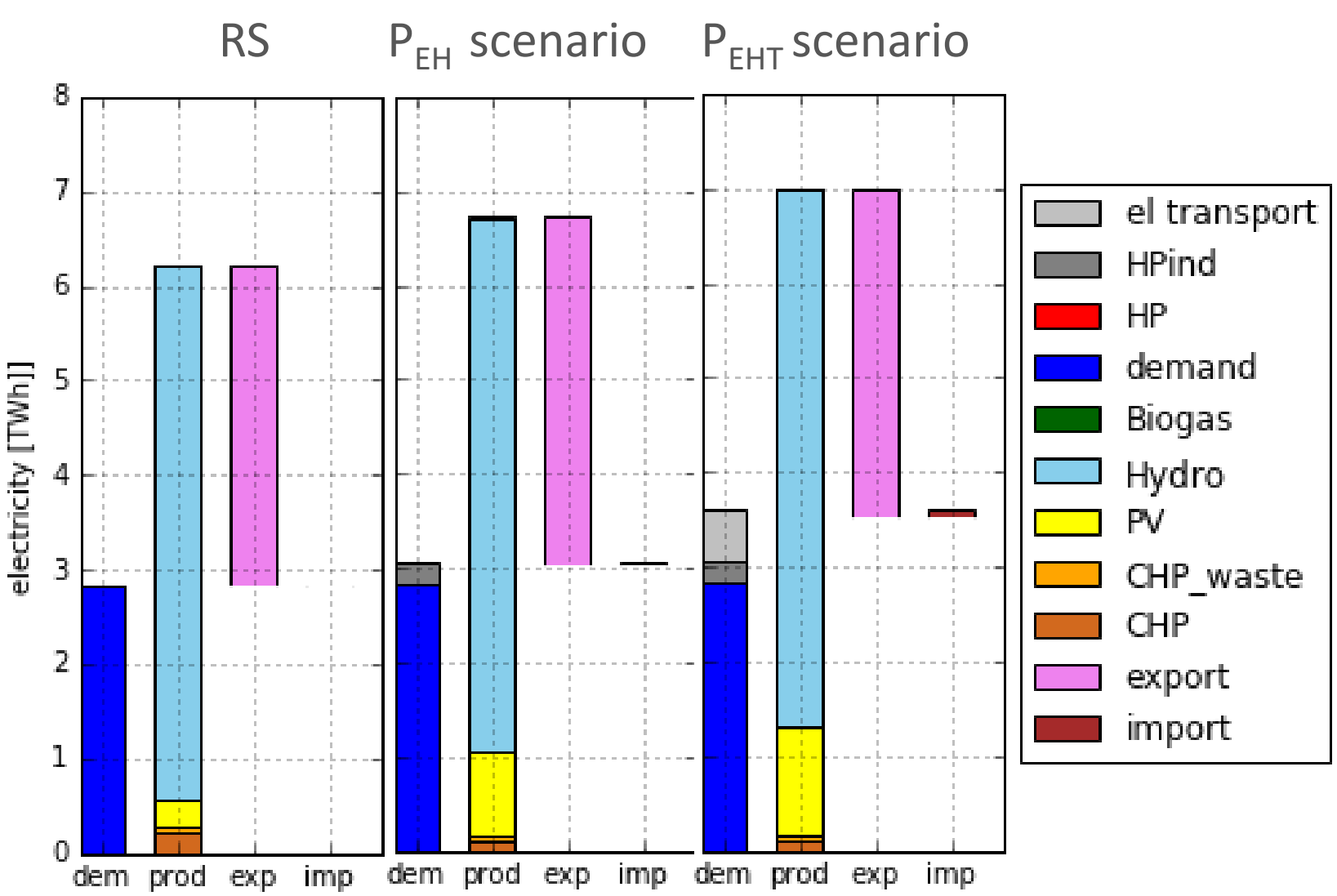


Comparison of the overall energy consumption

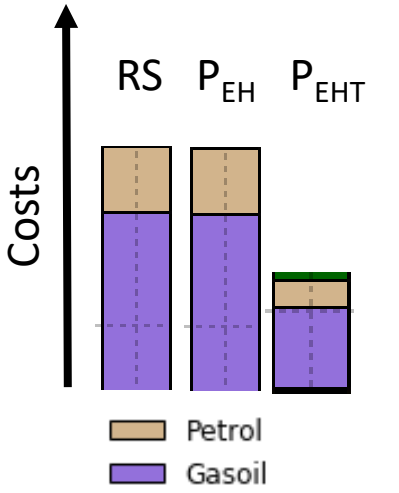


Comparison - electricity

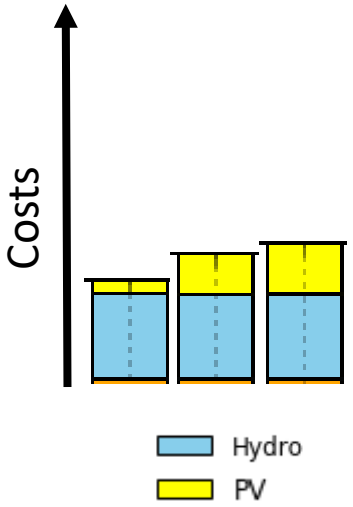




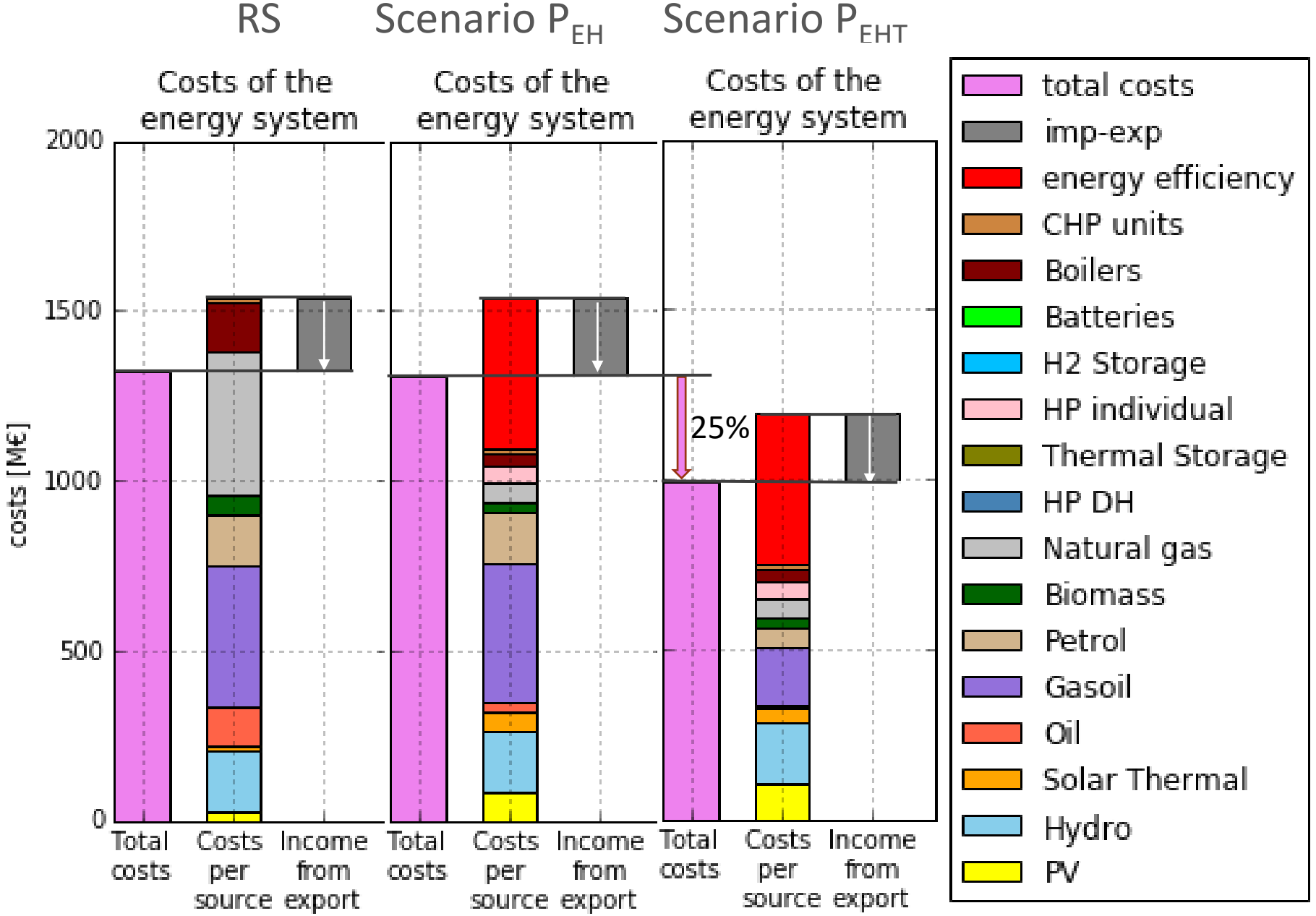
Comparison – financial data



Fuel (mobility) costs



Electricity costs



Key messages

Results:

- Yes, there are different energy systems that allow to reach the climate plan target

- The costs of these energy systems are, according to the model, of roughly the same size of the current energy system. The costs structure changes relevantly though.

- The key transformations are…

Energy retrofit

A LARGE energy retrofit of the building stock is vital to reach the climate targets

Zero emissions mobility

A visible increase of the zero emissions mobility is necessary to reach the targets.

Photo: Tesla, LEAOS

From fossil fuels to a green electric society

The fossil fuels consumption decreases drastically. The electricity consumption increases of more than 20%.

Photo: flickr/Sergio Russo; flickr/ Alessandro Concu

Financial data

Reference scenario

Local investment and O&M costs

220 M€

Fuel costs:
Oil
Gasoil
Petrol
Natural gas

1103 M€

P_{EHT} scenario

Local investment and O&M costs

+

Energy efficiency costs

696 M€

Fuel costs:
Oil
Gasoil
Petrol
Natural gas

294 M€

Thank you for your attention

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