eurac research

Energy transition - Possibilities for Regional (Energy) Development

Wolfram Sparber

Credits: BLS – NOI TechPark Bolzano

Bolzano / Bozen

Credits: IDM Alto Adige/Clemens Zahn

Eurac Research is a private research centre founded in 1992 in Bolzano (South Tyrol).

Eurac Research
Institute for Renewable Energy

NOI TechPark - Bolzano

Team of the Institute for Renewable Energy

A picture taken in autumn 2017 during the scientific advisory council meeting

~ 100 collaborators

~ 50 projects and consultancies

7 labs

eurac research

We study and execute **products**, **technologies** and **solutions** for private businesses, utilities, public administrations, researchers and professionals working in **several sectors**.

Sustainable Heating and Cooling Systems

Photovoltaic Energy Systems

Energy efficient buildings

Energy Retrofit of Historic Buildings

Urban and Regional Energy Systems

Our indoor and outdoor labs

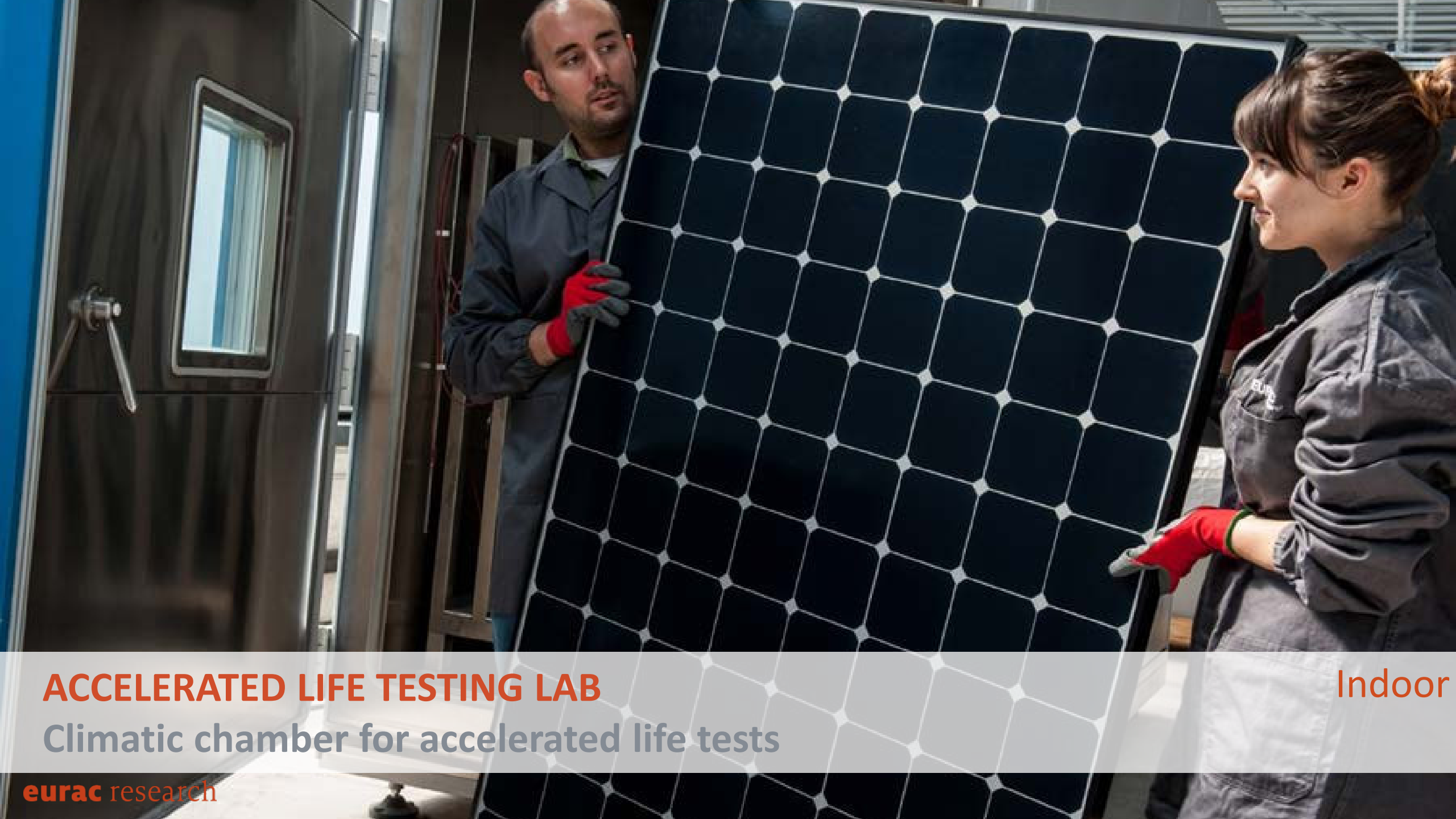
At the Institute for Renewable Energy we conduct our studies within our **7 laboratories** dedicated to the collaboration with industrial partners and to ongoing research.

SOLARE PV LAB

Sunsimulator for photovoltaic modules

Indoor

eurac research



ACCELERATED LIFE TESTING LAB

Indoor

Climatic chamber for accelerated life tests

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MULTIFUNCTIONAL FACADE LAB

Indoor

Laboratory for performance characterization of multifunctional facades

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ENERGY EXCHANGE LAB

Outdoor

Facility for tests on advanced district heating and cooling networks

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PV INTEGRATION LAB

Outdoor

Facility for the integration of photovoltaic systems in buildings and grids

eurac research

Photovoltaic Test Field

Outdoor

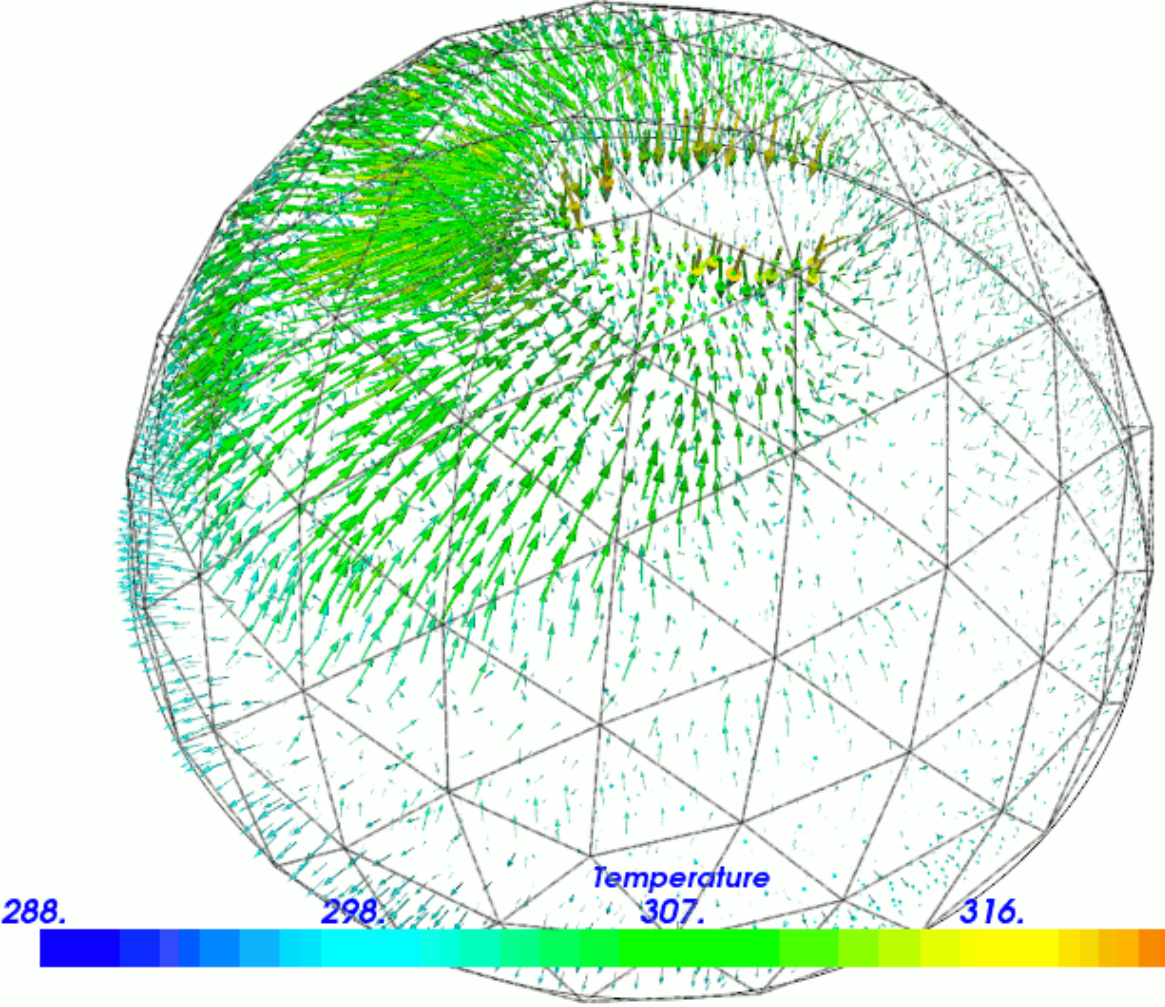
Installed at the airport of Bolzano including different PV technologies and mounting systems

HEAT PUMPS LAB (opening in 2018 in NOI Techpark) Indoor

Laboratory for heat pump systems test

FACADE SYSTEM INTERACTIONS LAB (opening in 2018 in NOI Techpark) Outdoor

Facility for evaluating facade system and indoor environment interactions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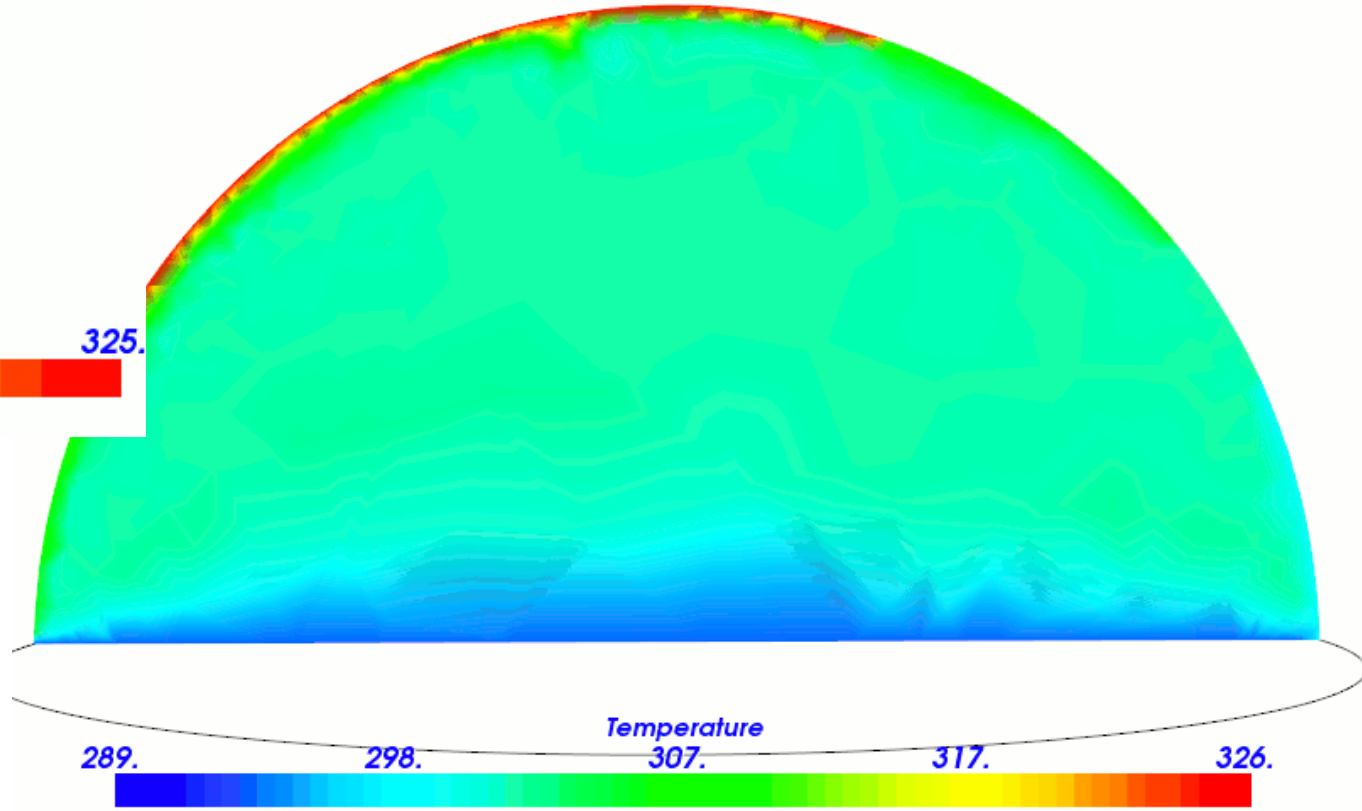
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Latest News

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SHC

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

TASK 55: Integrating Large SH Systems into DHC Networ

The Task aims to develop technical and econ requirements for a commercial market introduction of district heating and cooling (DHC) in a broad rang coun

[MO

- About IEA SHC
- SHC Members
- Solar Heating & Cooling
- Research Projects (Tasks)
- Solar Academy
- Events
- News
- Publications & Online Tools
- Videos

IEA Solar Heating & Cooling Programme

The Solar Heating and Cooling Programme (SHC) was established in 1977, one of the first programmes of the International Energy Agency, to promote the use of all aspects of solar thermal energy. The Programme's work is unique in that it is accomplished through the international collaborative effort of experts from member countries and the European Union.

The benefits of this approach are:

- accelerates the pace of technology development
- promotes standardization
- enhances national R&D programmes
- permits national specialization
- saves time and money

Upcoming Events

Green Expo 2017 Exhibition & Forum
November 14-16, 2017 - Doha Exhibition and Convention Center (DECC), Doha, Qatar

IEA SHC - 82th ExCo Meeting and IEA PVPS 50th ExCo Meeting
November 28-December 1, 2017 - Plumbing Industry Climate Action Centre, Brunswick,

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wir sind
südtiroler
energie
siamo
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Erster Industrieplan Al
Primo Piano Industrial
2017 - 2021

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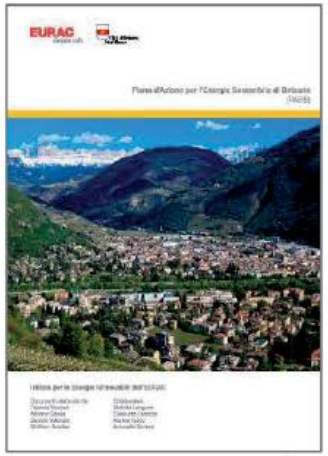
Die Ziele der Aktionäre



Comune di Bolzano
Stadtgemeinde Bozen

AUTONOME
PROVINZ
BOZEN
SÜDTIROL

PROVINCIA
AUTONOMA
DI BOLZANO
ALTO ADIGE

STADTGEMEINDE MERAN
COMUNE DI MERANO

Ziele 2020: - Emissionen 2,1Mio. Tonnen CO_2
- Ultraschnelles Breitband für die Mehrheit der Bevölkerung

Energy model – South Tyrol 2050

www.eurac.edu

W. Sparber, D. Moser, M. Prina, U. F. Oberegger,
R. Pernetti, G. Garegnani, R. Vaccaro, M. Cozzini

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

AUTONOME PROVINZ BOZEN - SÜDTIROL
Ressort für Raumordnung, Umwelt und Energie

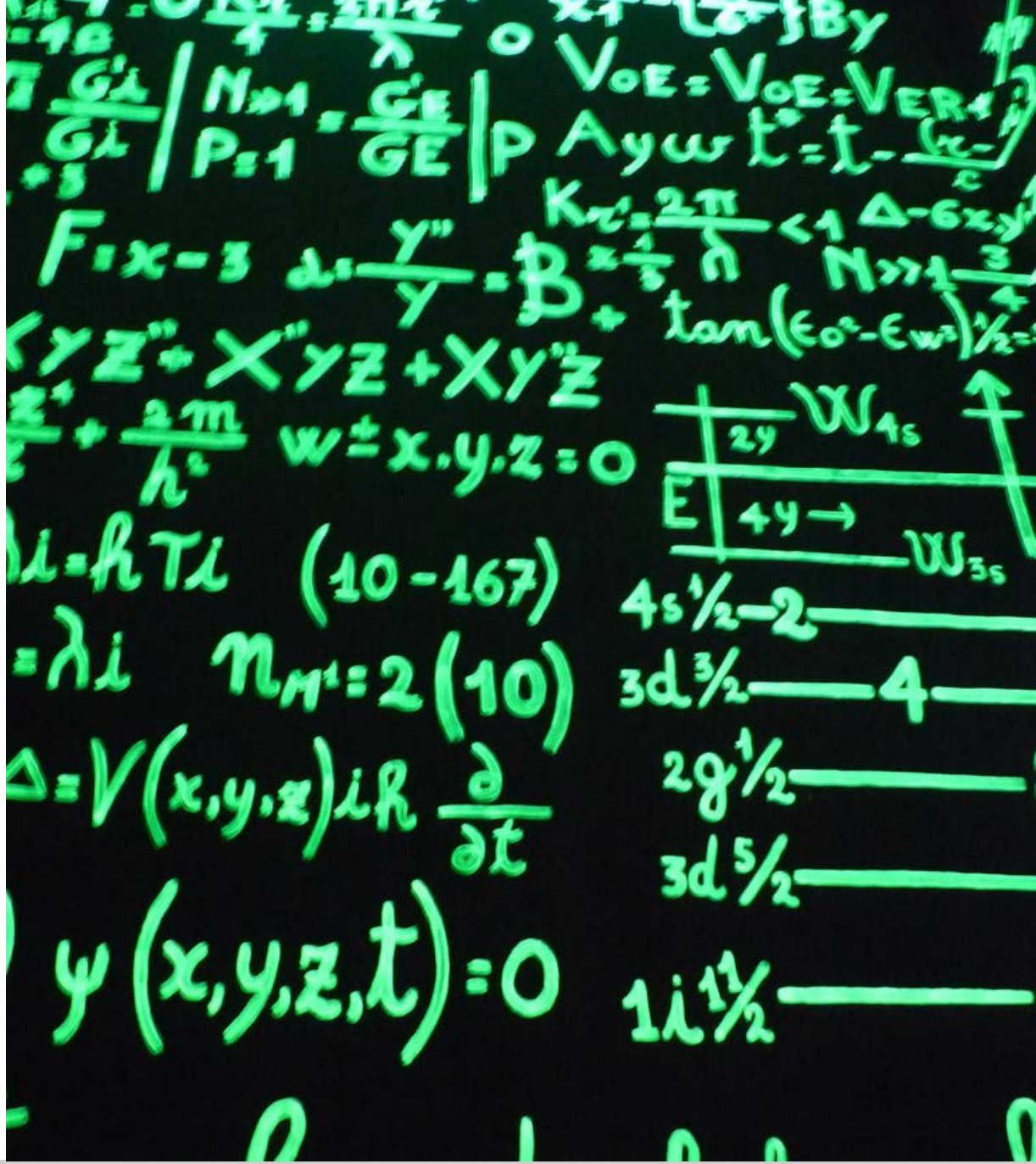
PROVINCIA AUTONOMA DI BOLZANO - ALTO ADIGE
Dipartimento all'urbanistica, ambiente ed energia

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**
- **…**

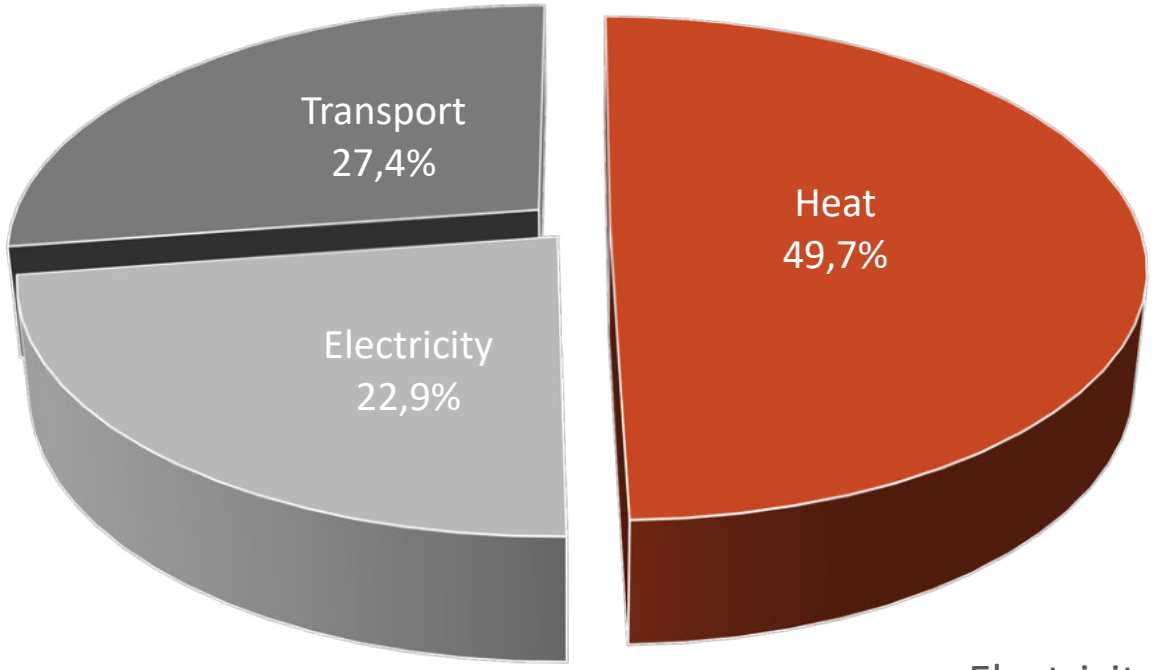
EnergyPLAN team (Aalborg University)

Starting point

Energy consumption in South Tyrol

Photo: Alperia

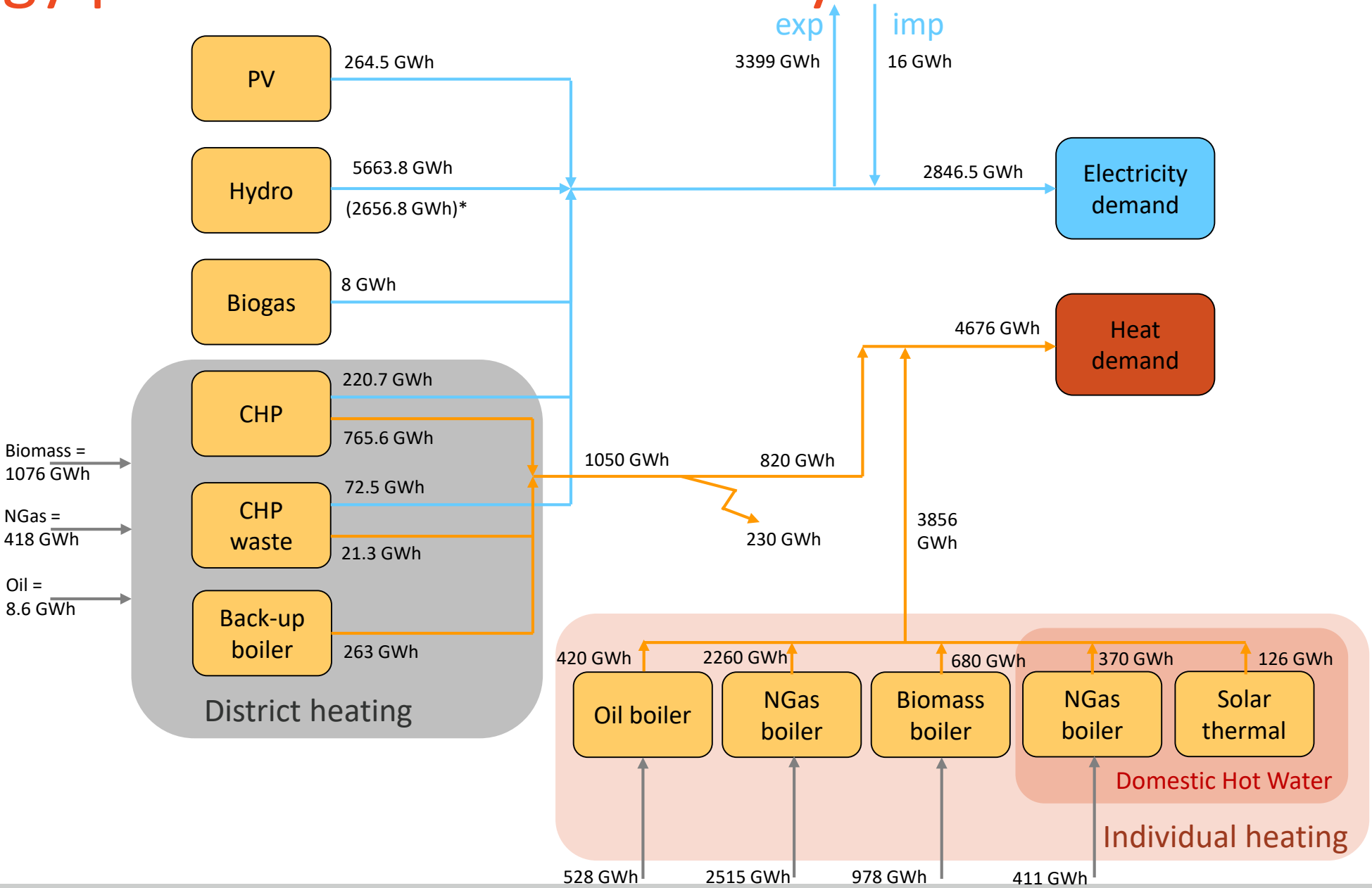
Energy consumption in South Tyrol : 12,4 TWh



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

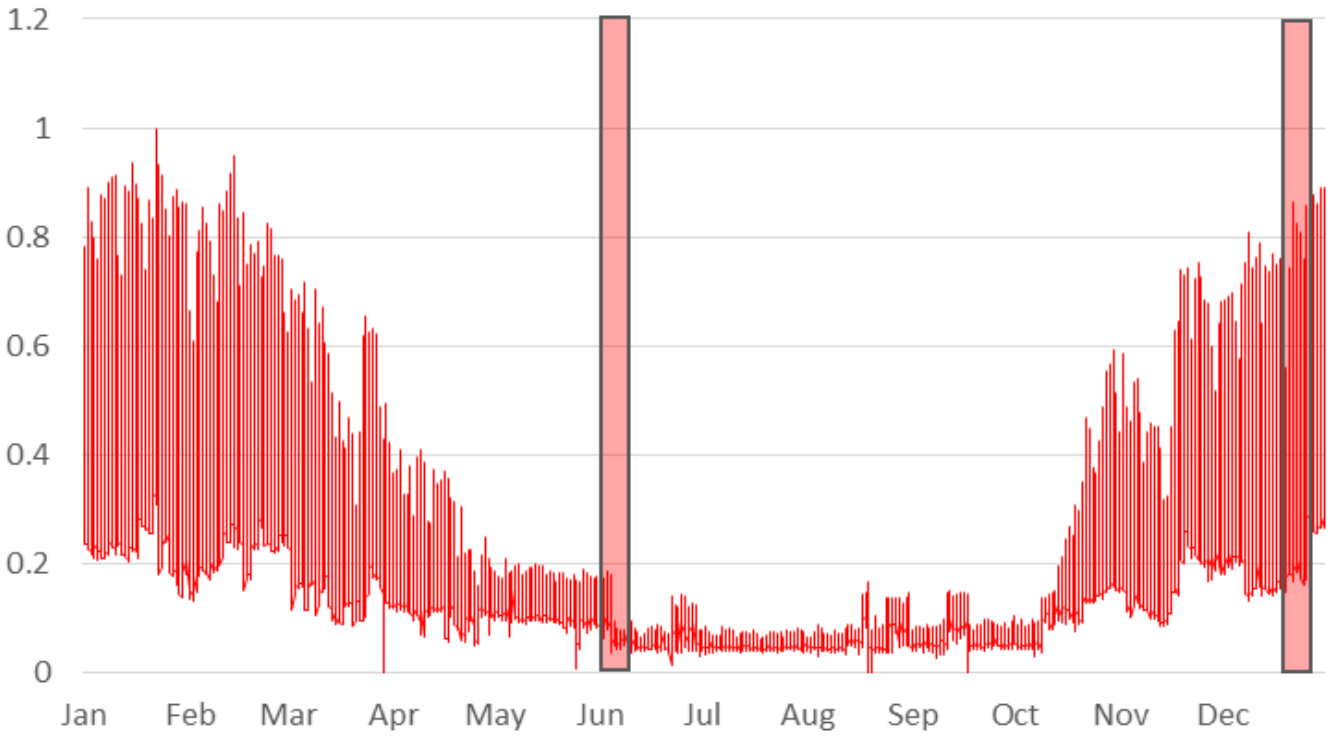
Overall energy consumption in South Tyrol, in the reference year 2014

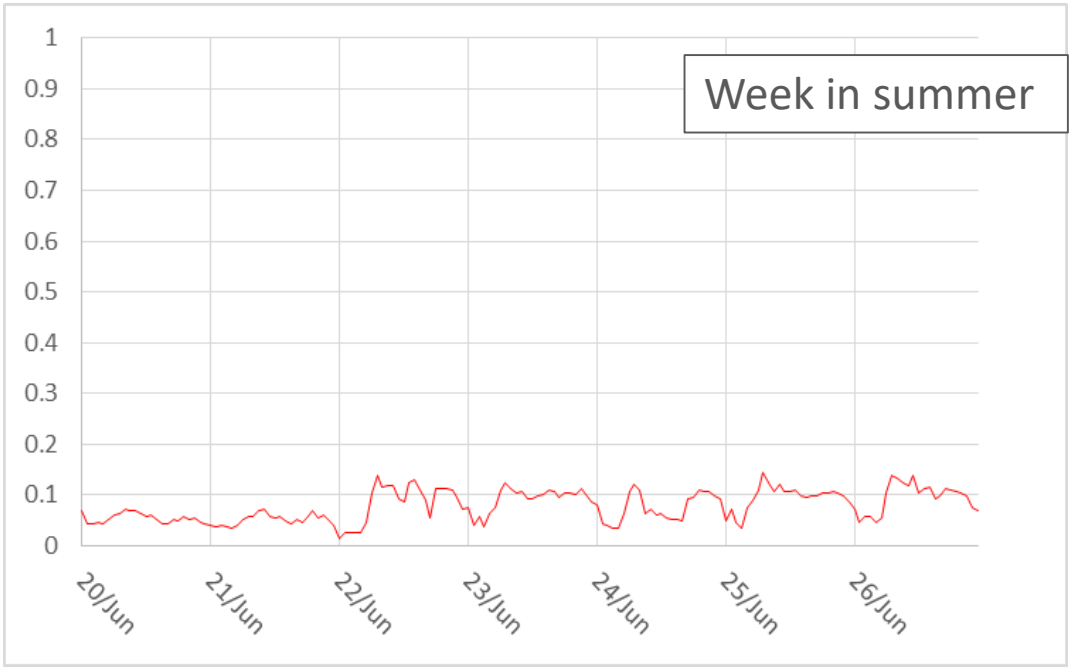
Energy production – reference year

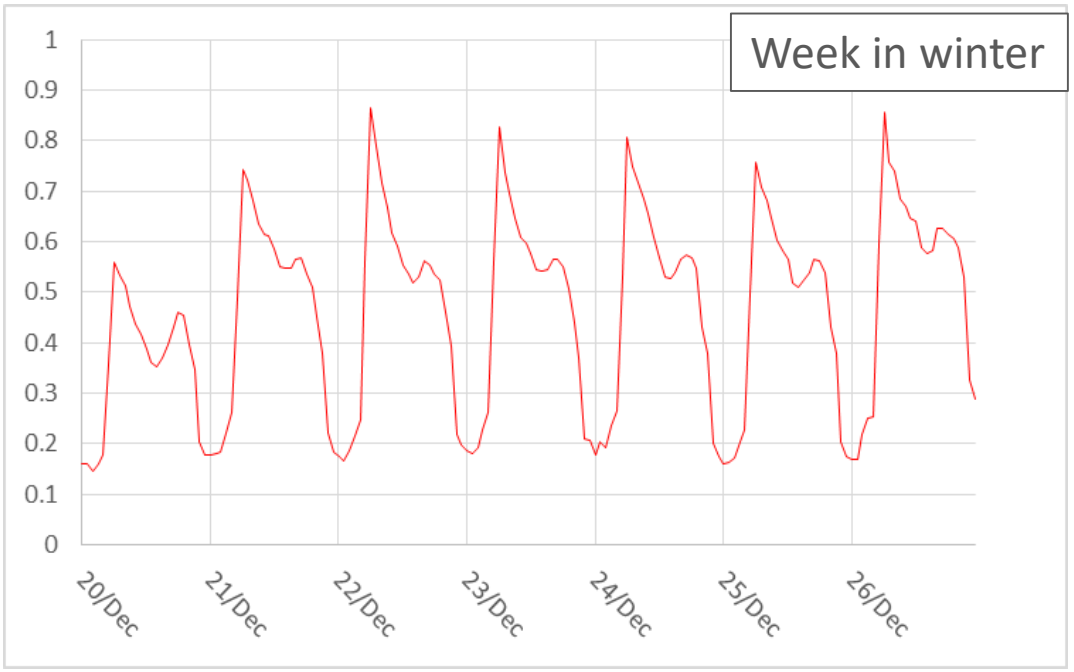


*if only River hydro electricity production is considered within the model

Year profile – heating

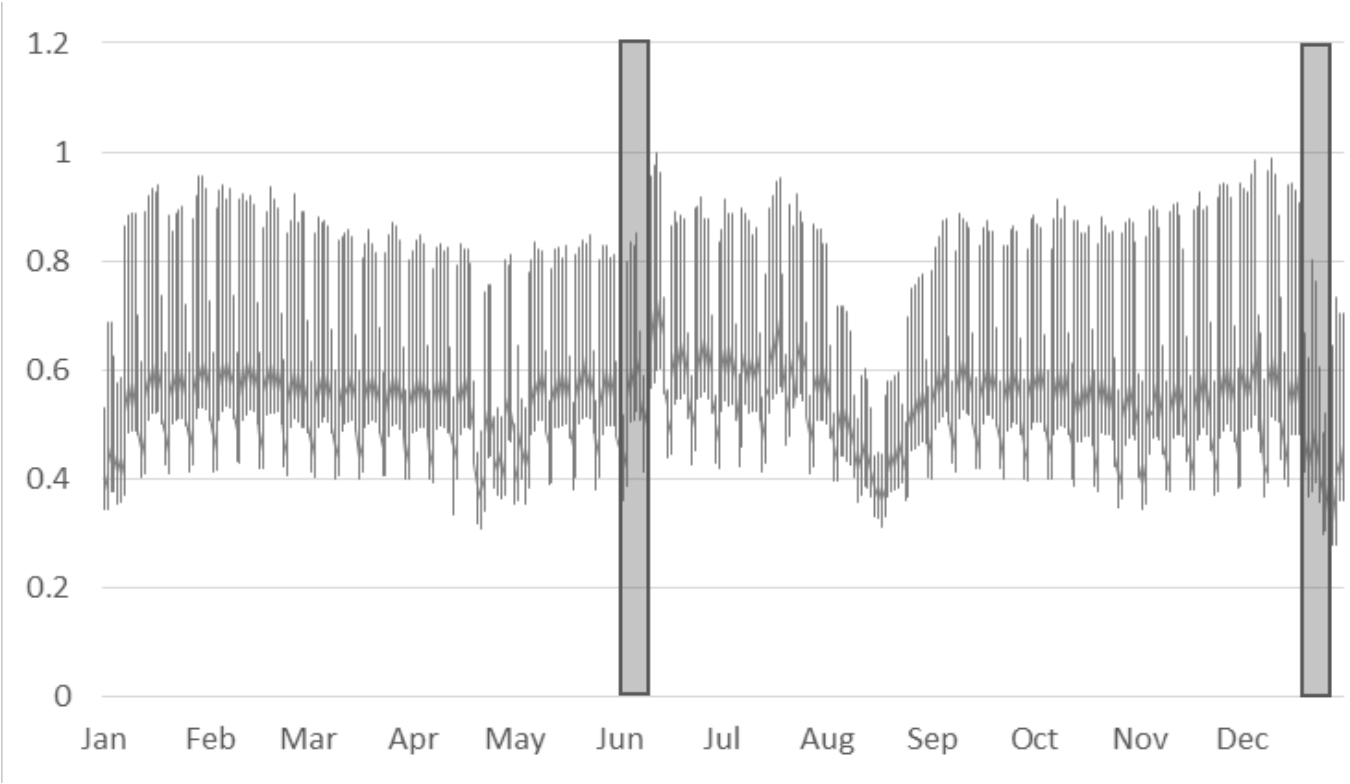


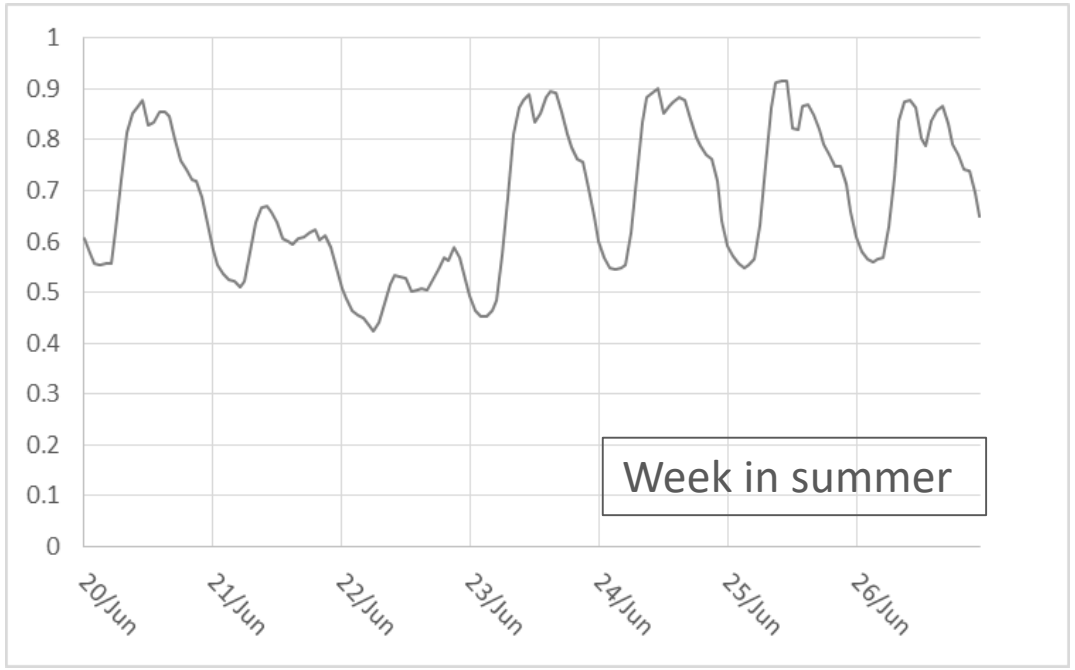


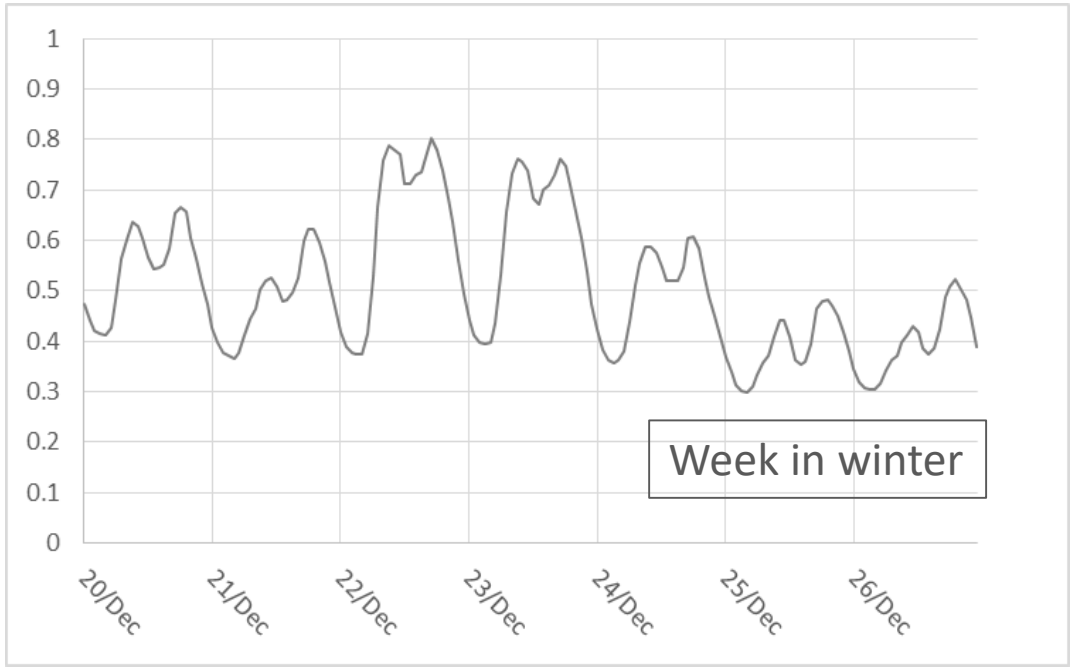


Year profile of the heat consumption from district heating, Bolzano 2014
Source: Alperia Ecoplus

Year profile- electricity

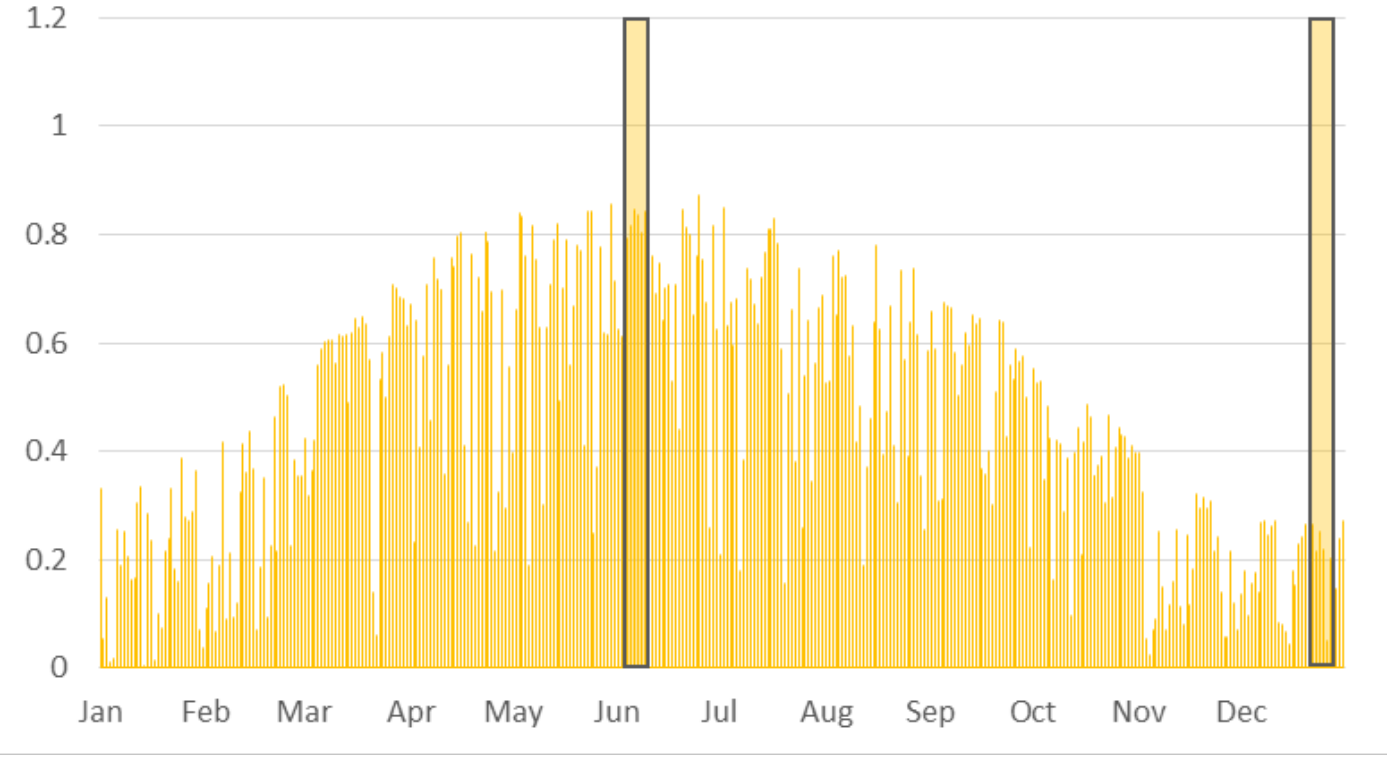


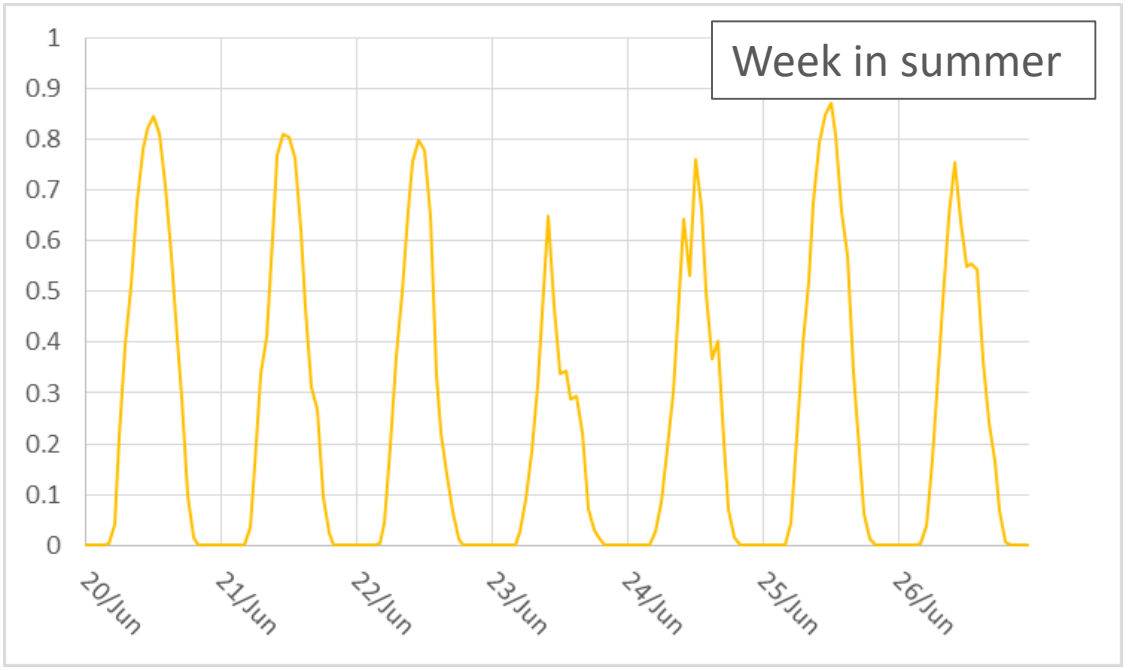


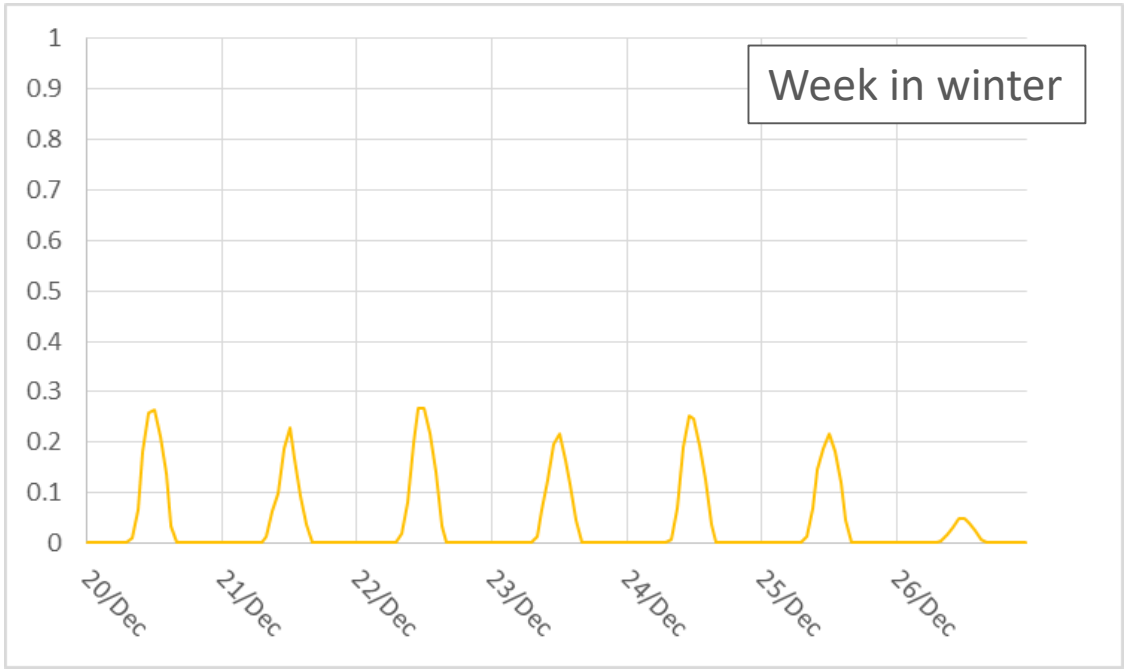


Year profile of the electricity consumption, Northern Italy, source: Terna
Assumption / simplification: the energy consumption in South Tyrol follows this profile

Example – PV production







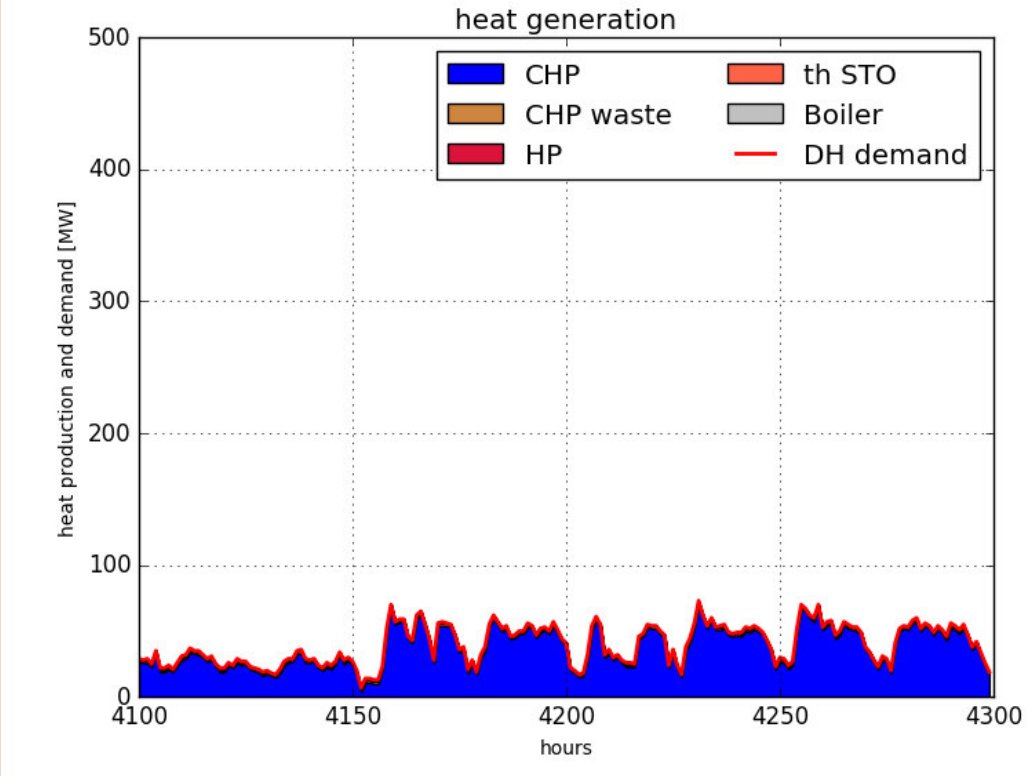
Profile of solar radiation – average hourly data from 13 different locations in South Tyrol. Source: Province of Bolzano/Bozen

The model –
Starting data and assumptions

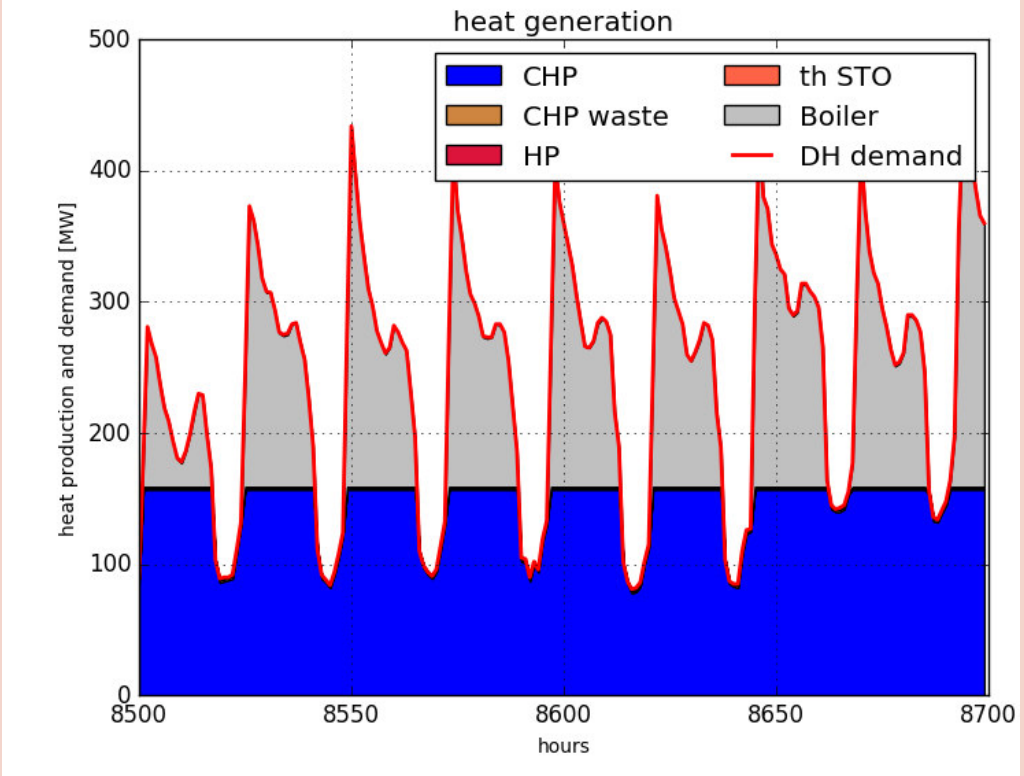
Modelling of the reference scenario – District heating use

District heating

Week in summer



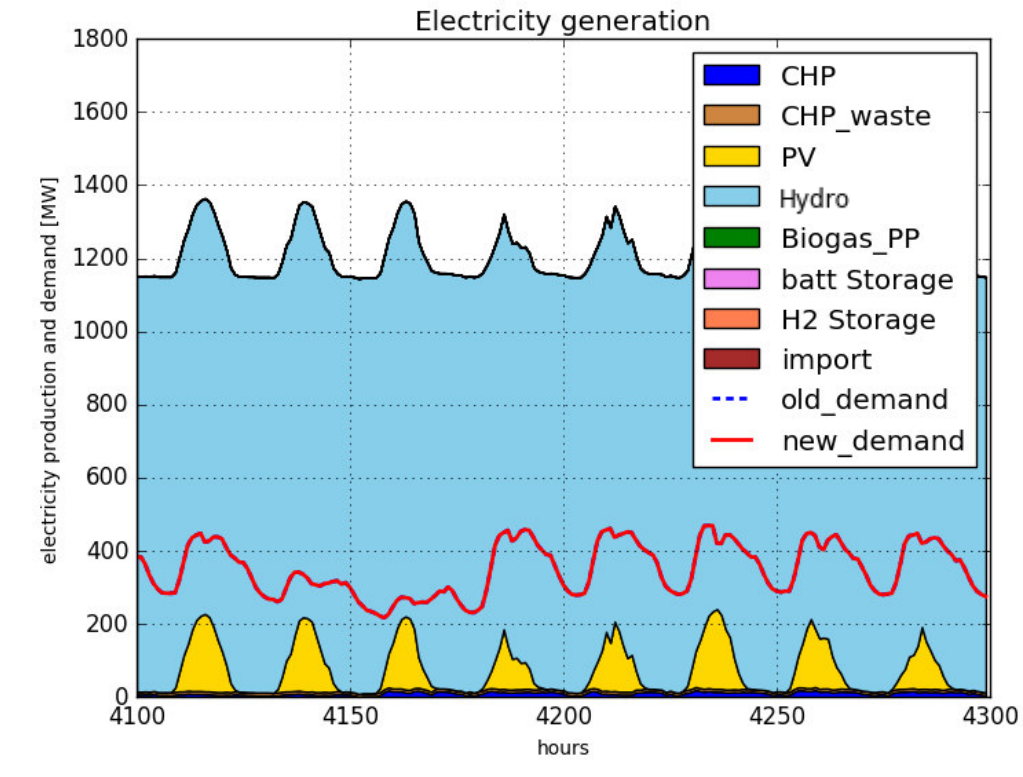
Week in winter



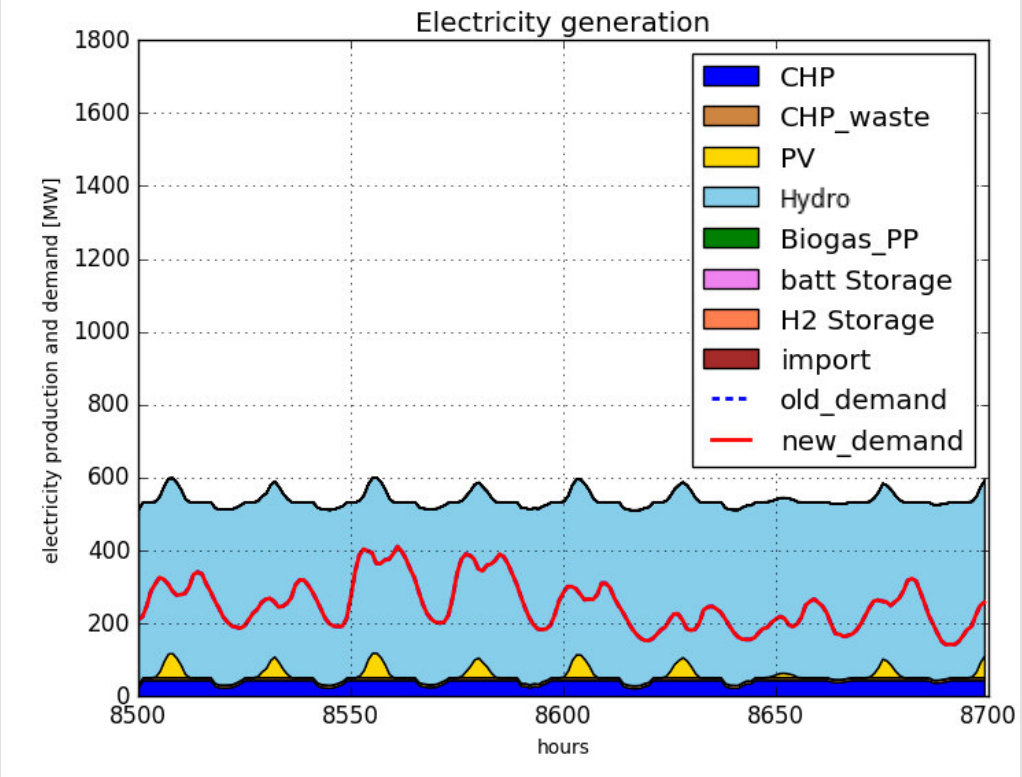
Modelling of the reference scenario – Electricity consumption

Electricity

Week in summer

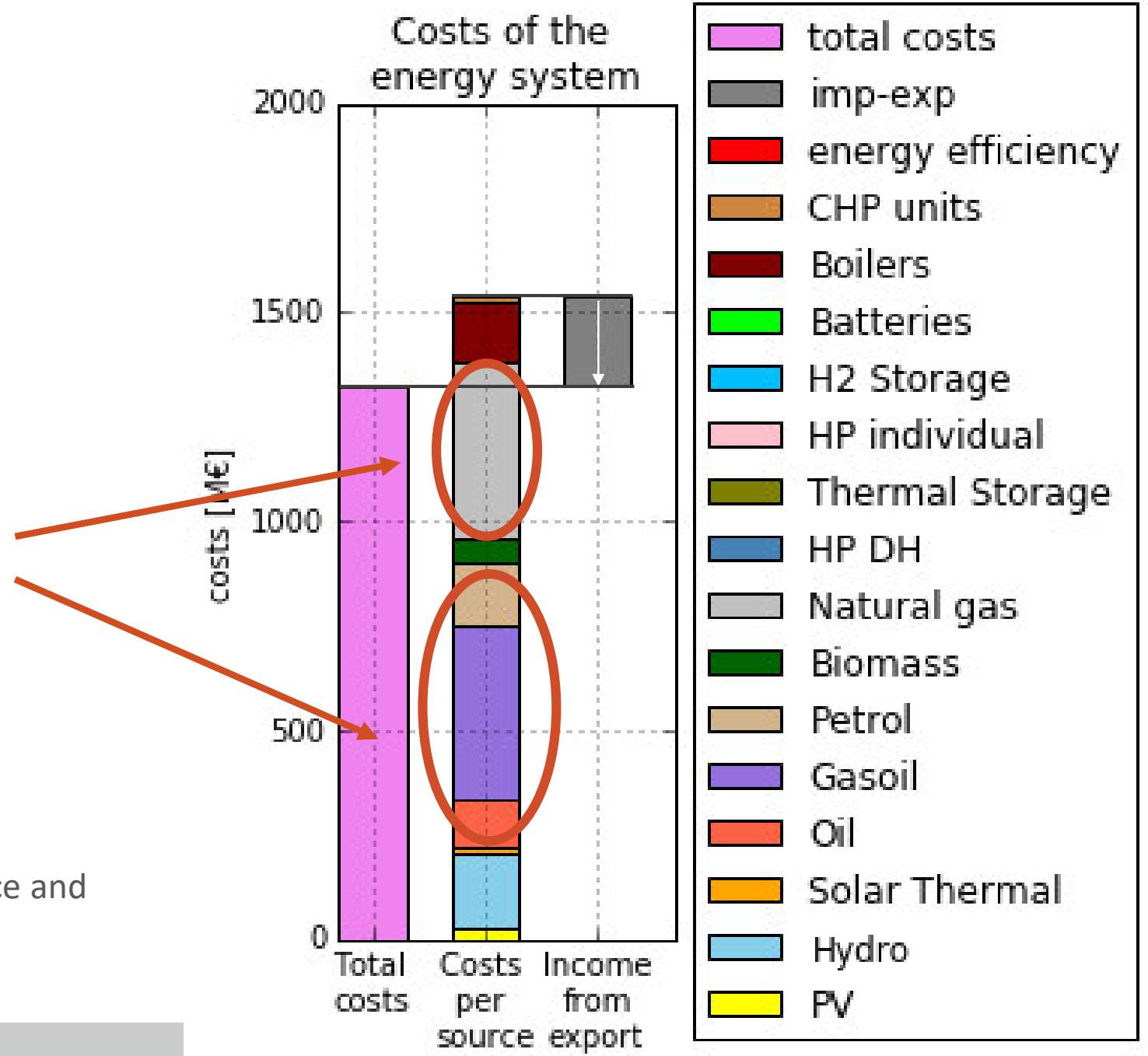


Week in winter



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

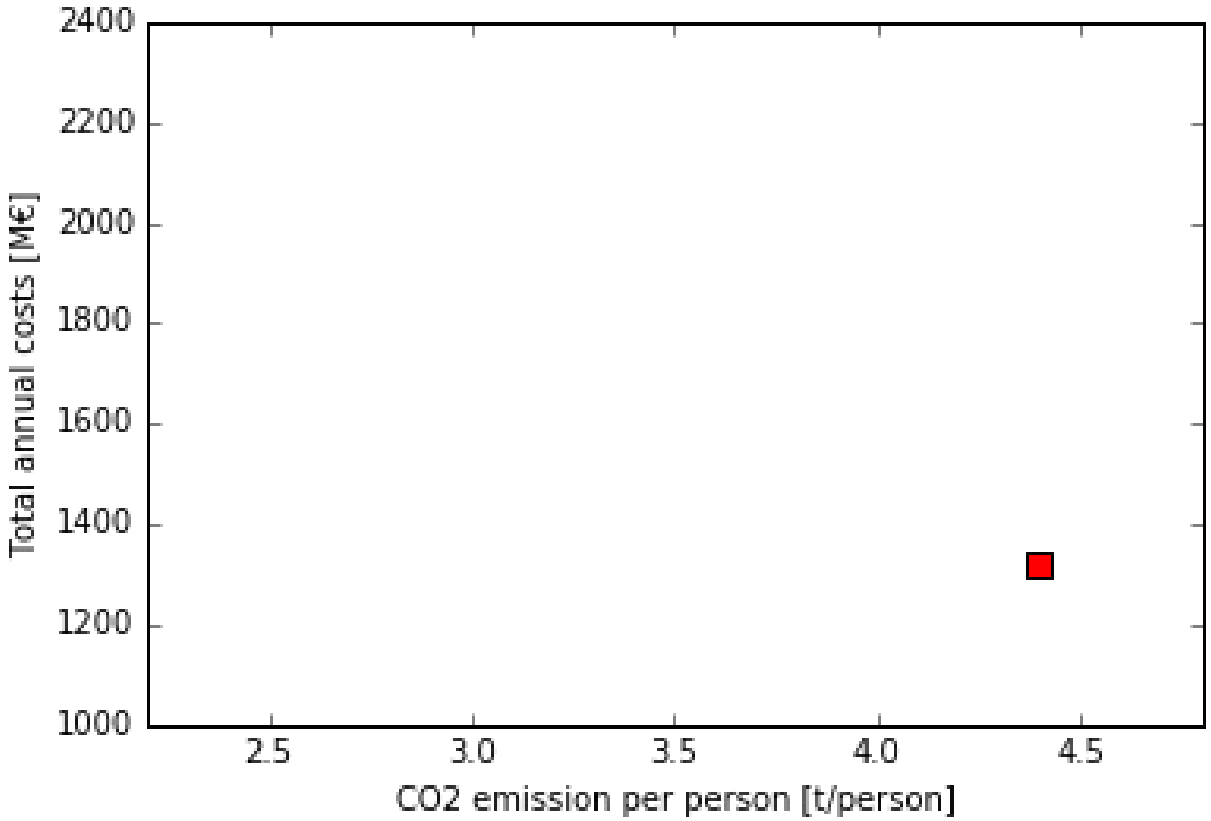
Simulation model

EnergyPLAN (Aalborg University)

\+

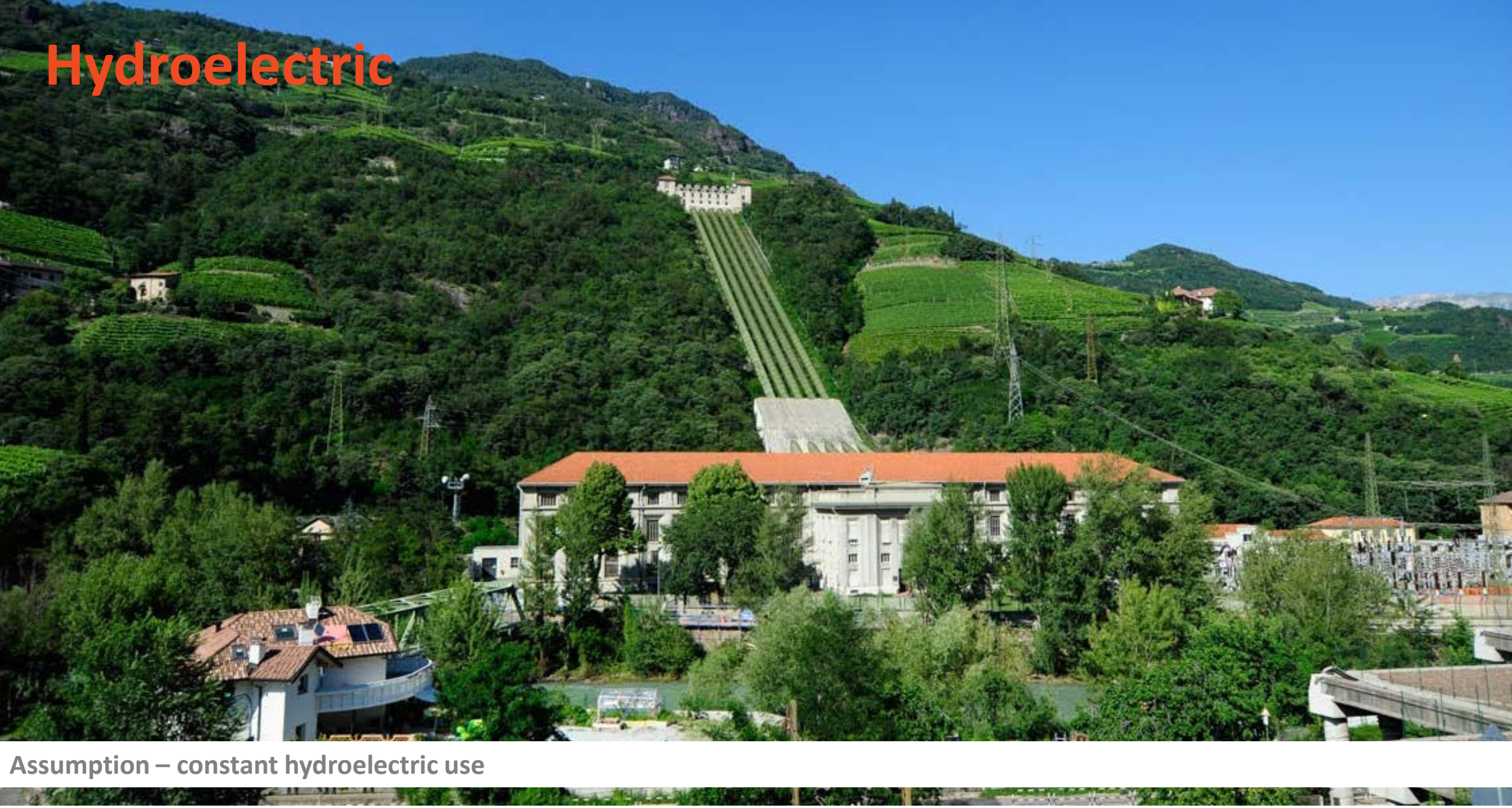
Optimization model

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)

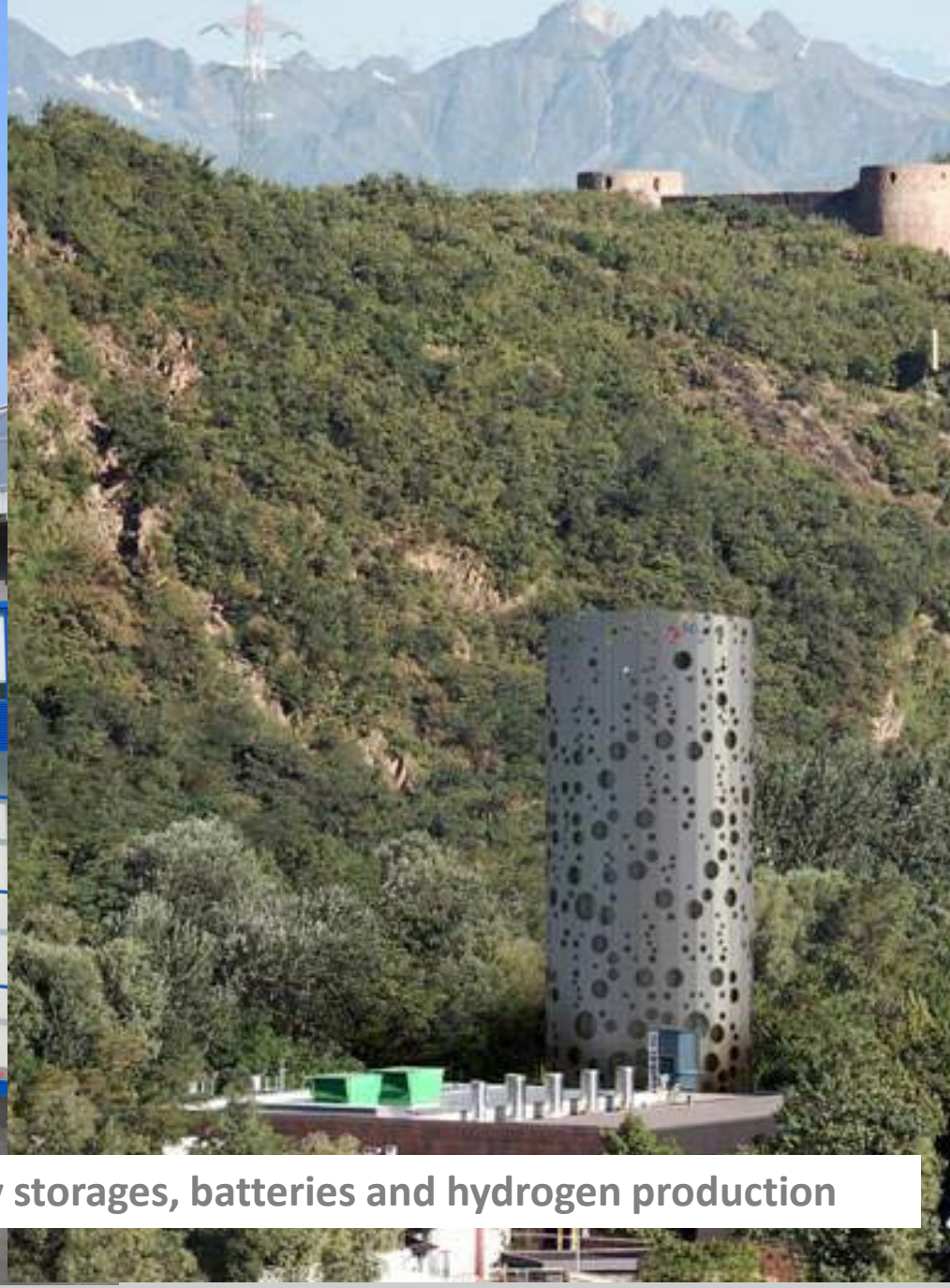
Photo: Quale Energia

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

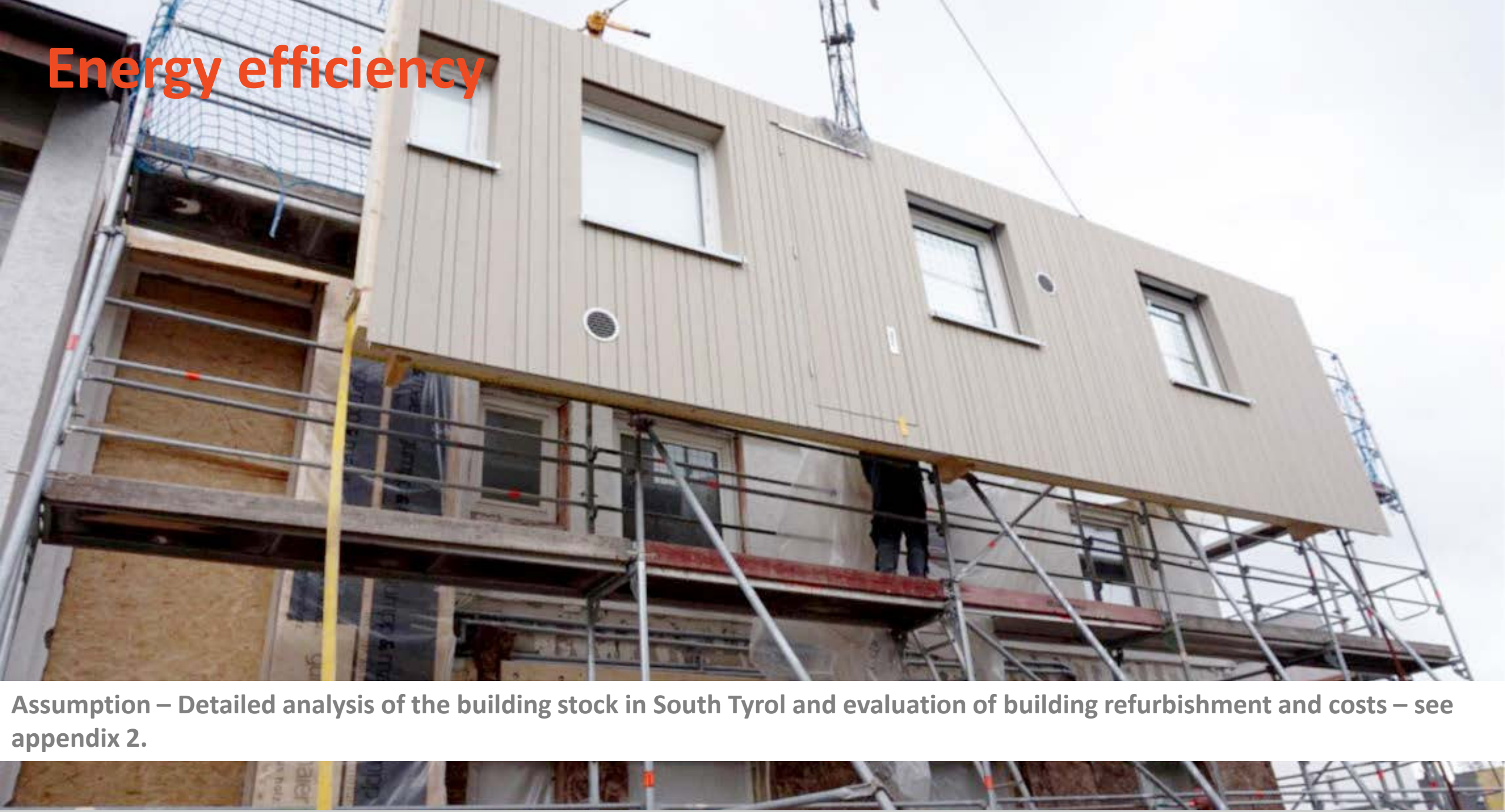
Assumption – constant use of biomass, no increase in biomass import. Slight possible increase in biogas use.

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

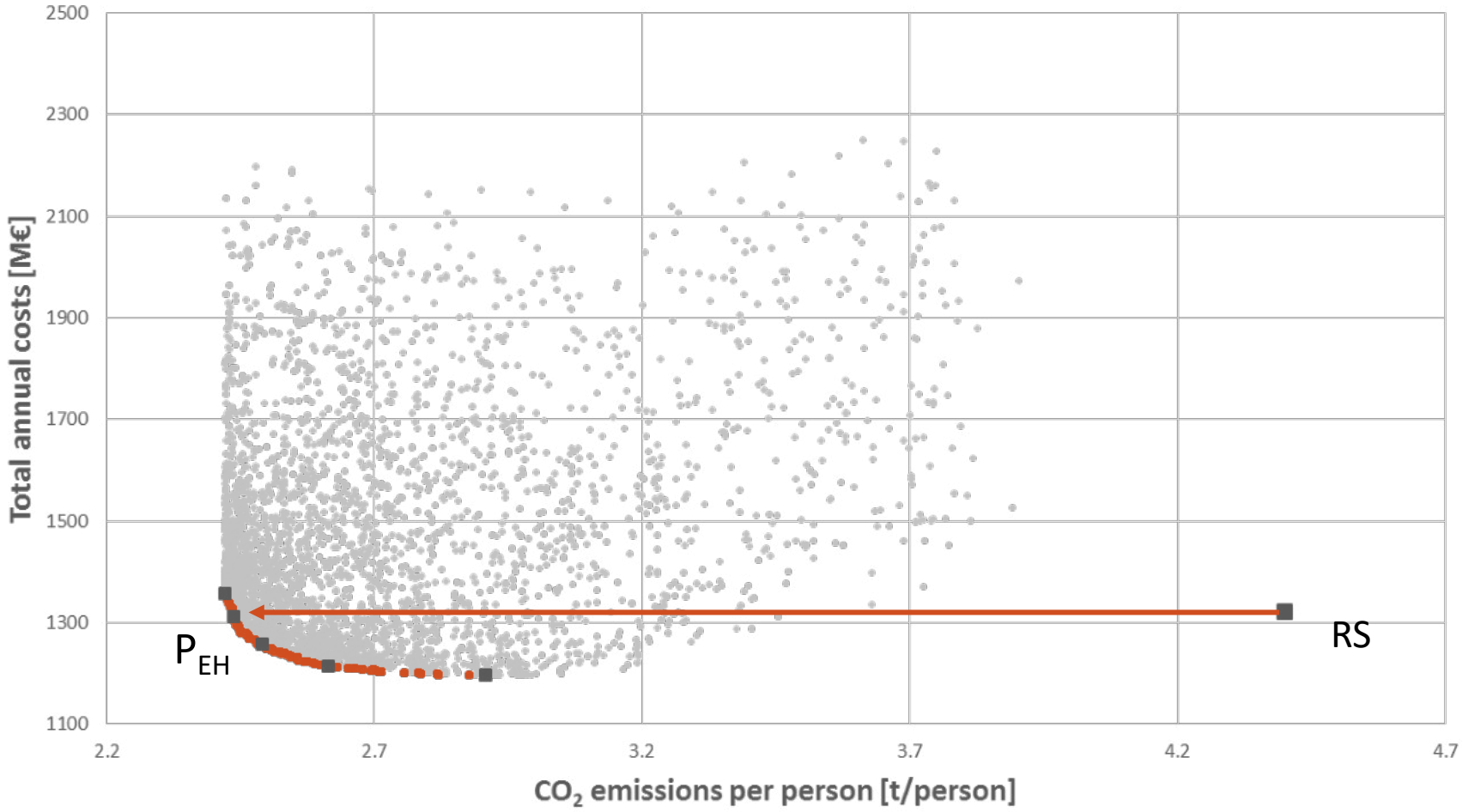
25.000

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

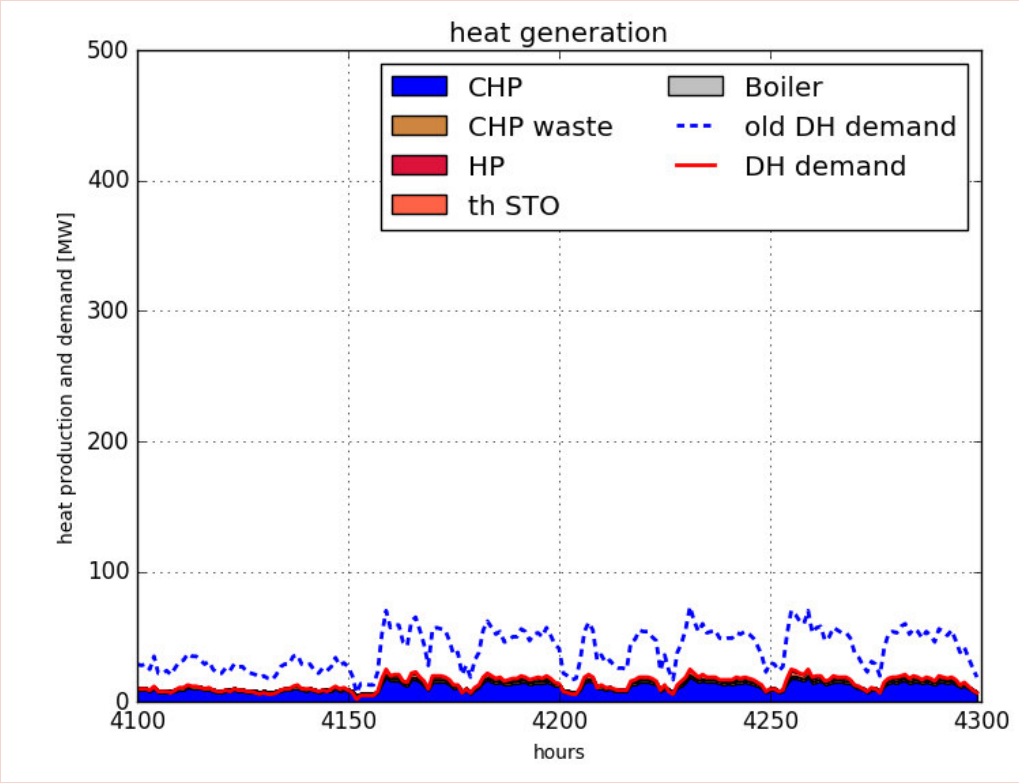


Each point of the cloud represents a specific combination of technologies in the year 2050 with related costs and CO_2 emissions. The P_{EH} scenario represents a combination of technologies with annual costs similar to the reference scenario (current combinatio of technologies), but with heavily reduced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

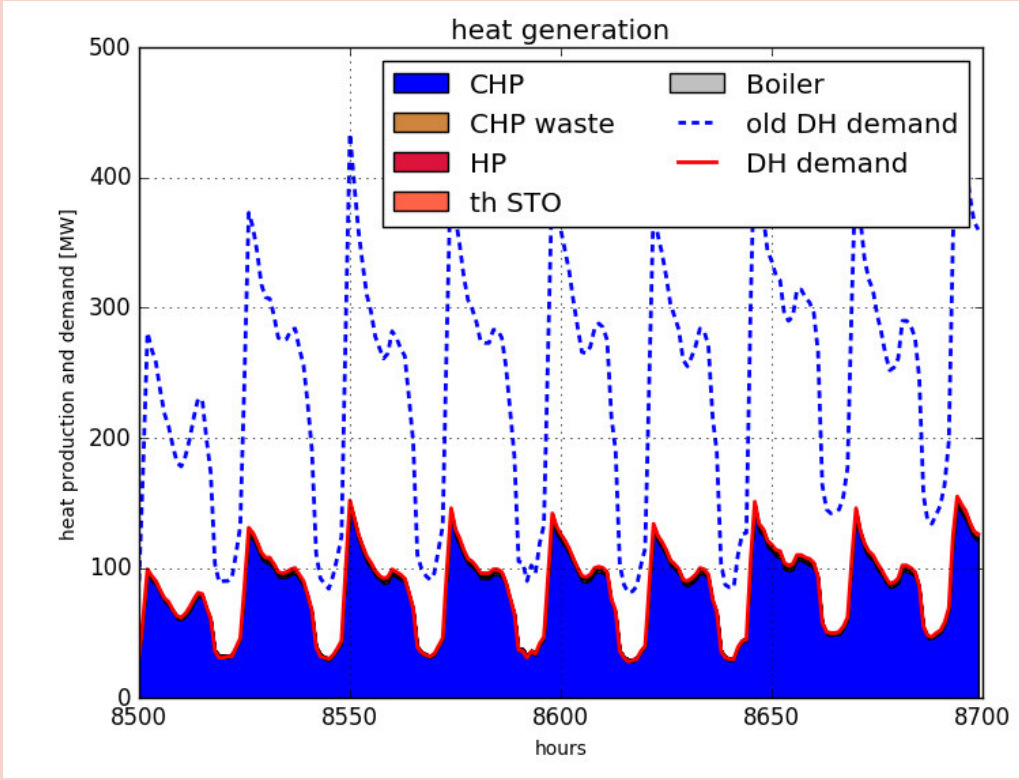
P_{EH} scenario – example district heating

District heating

Week in summer



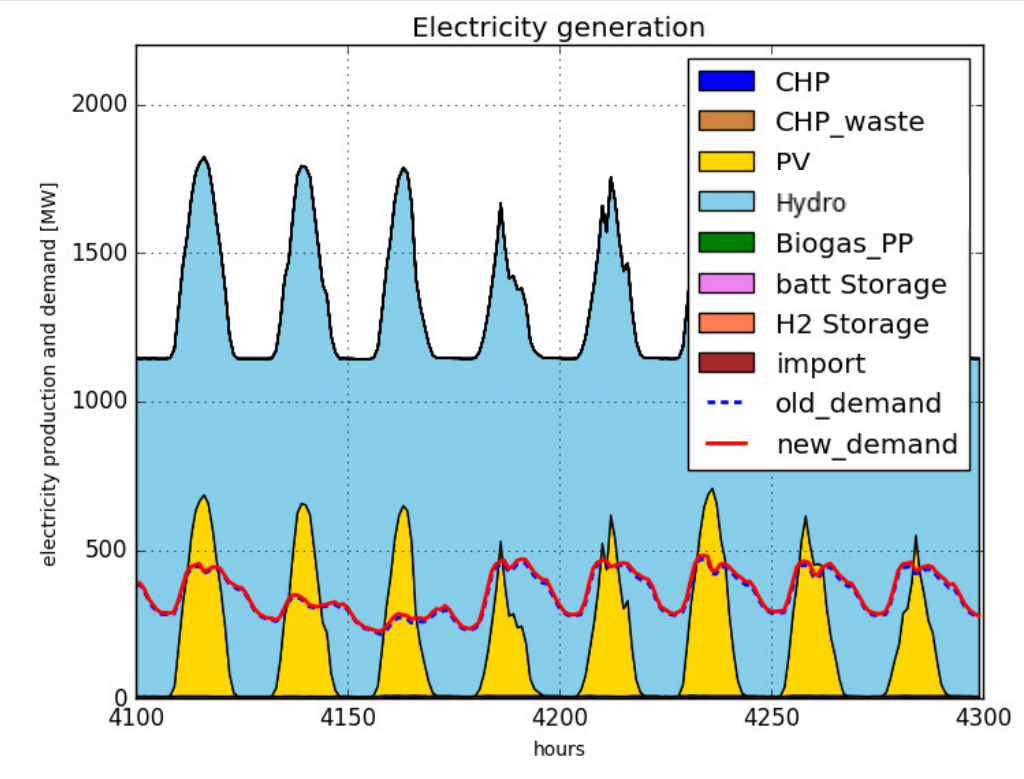
Week in winter



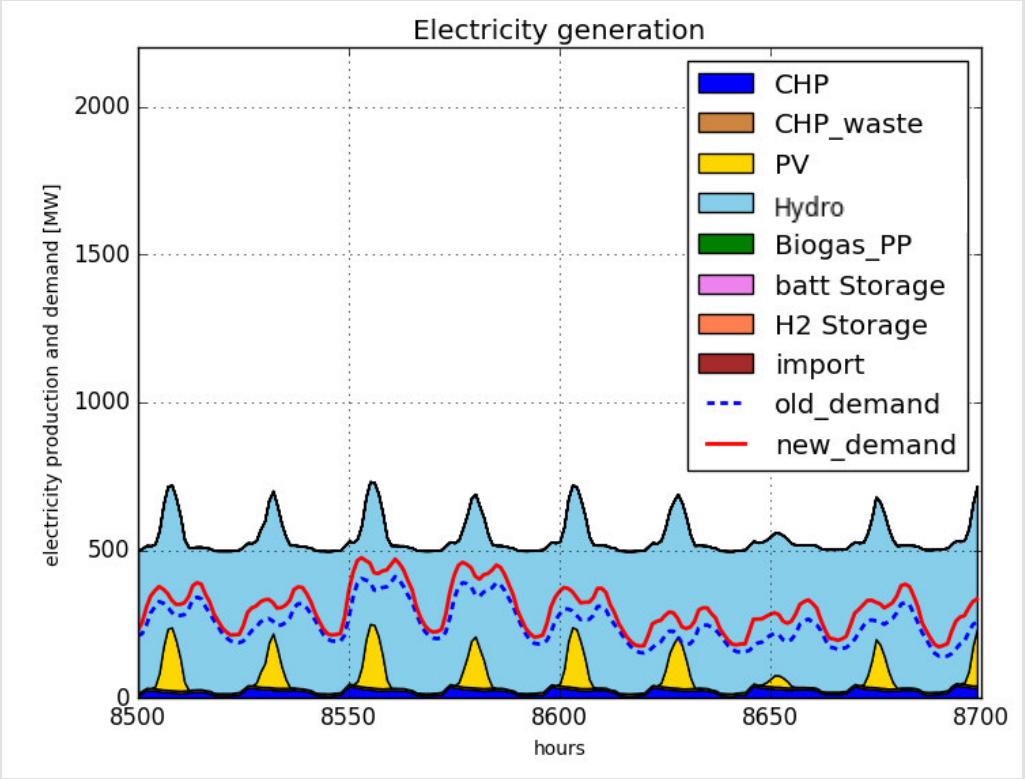
P_{EH} scenario – example electricity

Electricity

Week in summer

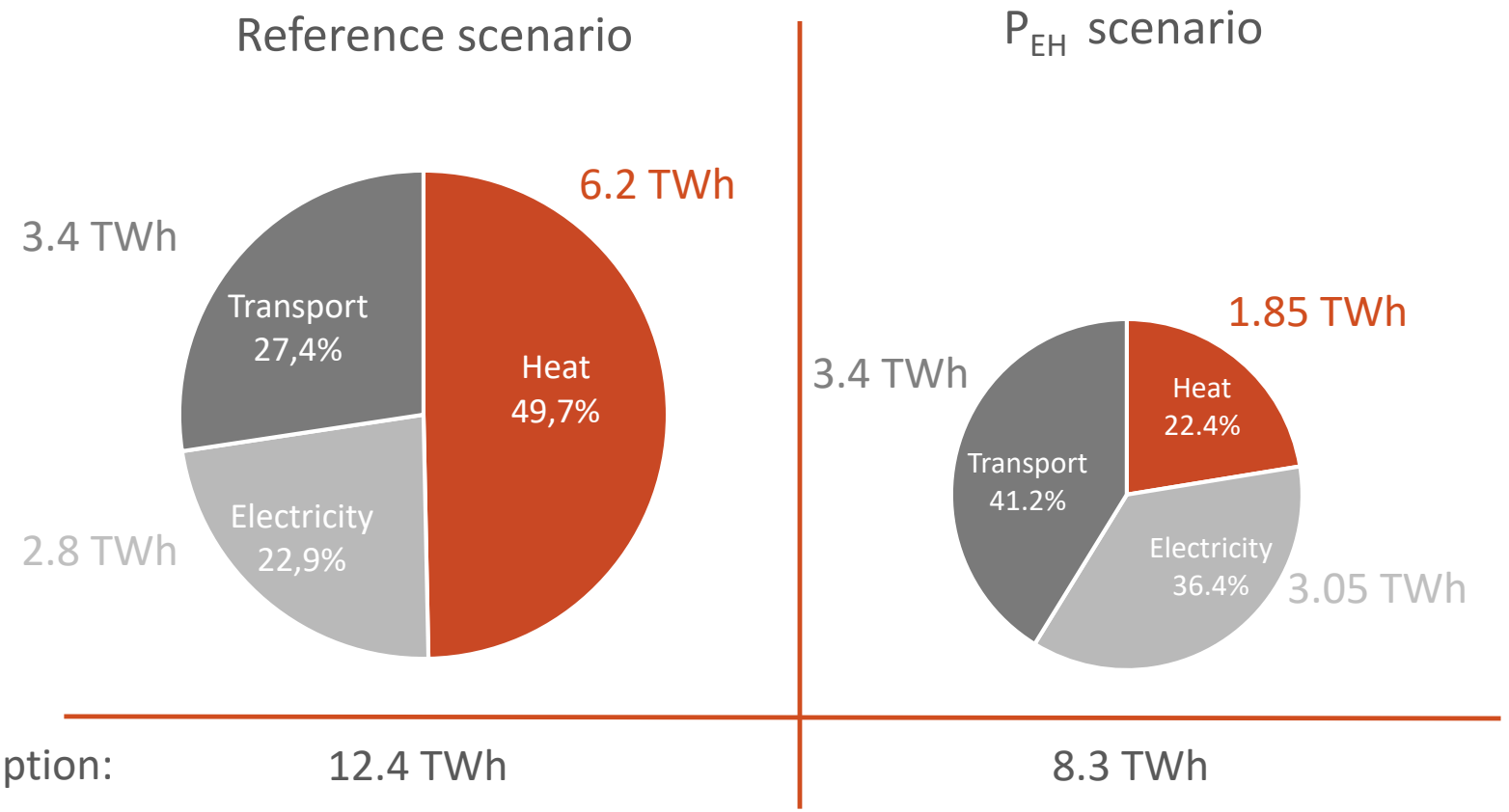


Week in winter

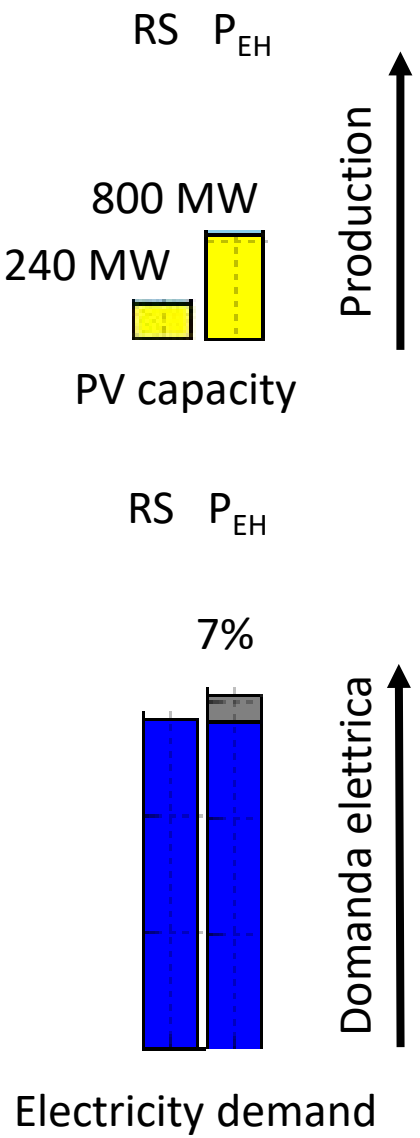


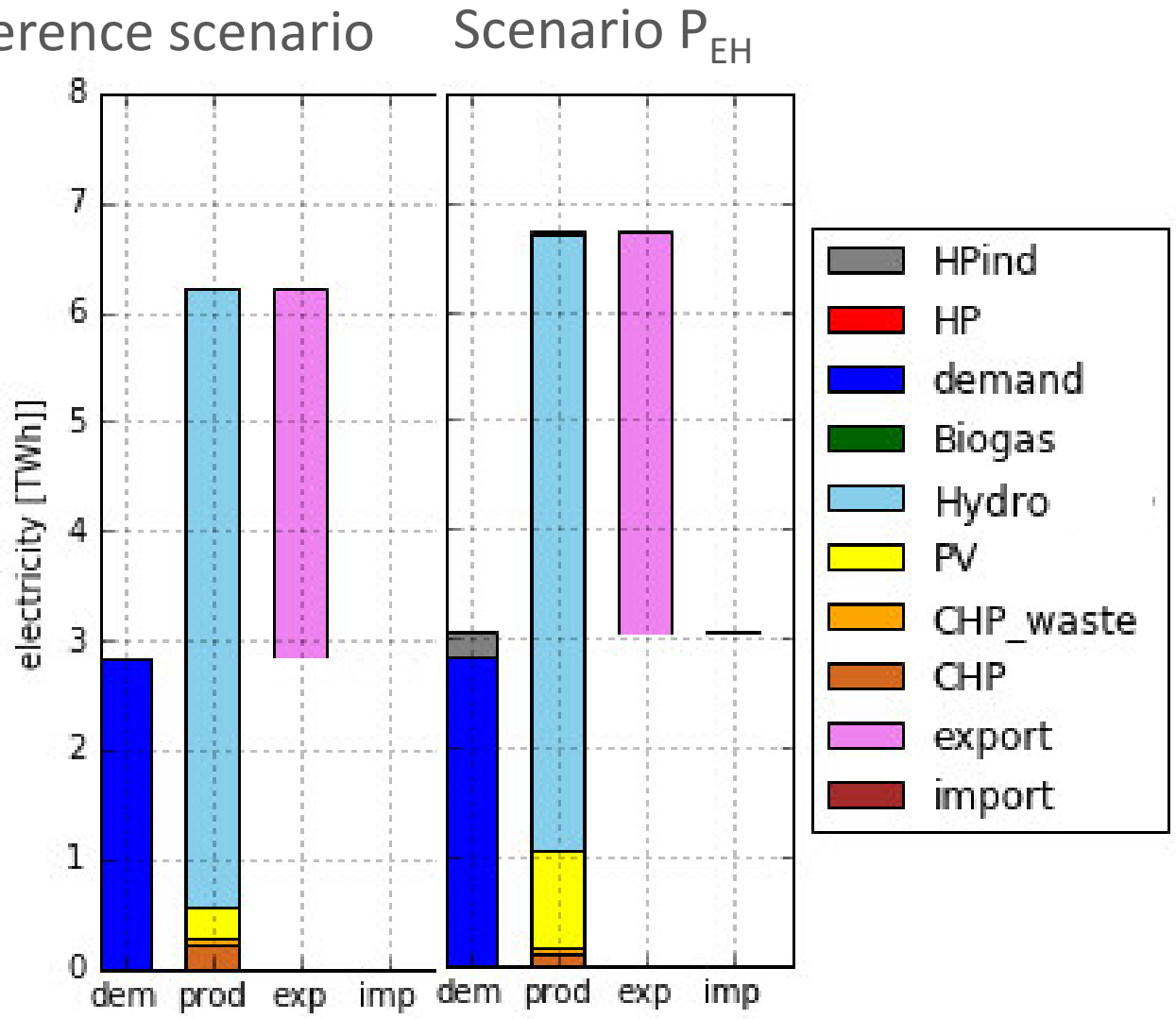
The electricity consumption increases and the profiles changes due to the use of heat pumps

Comparison of the overall energy consumption



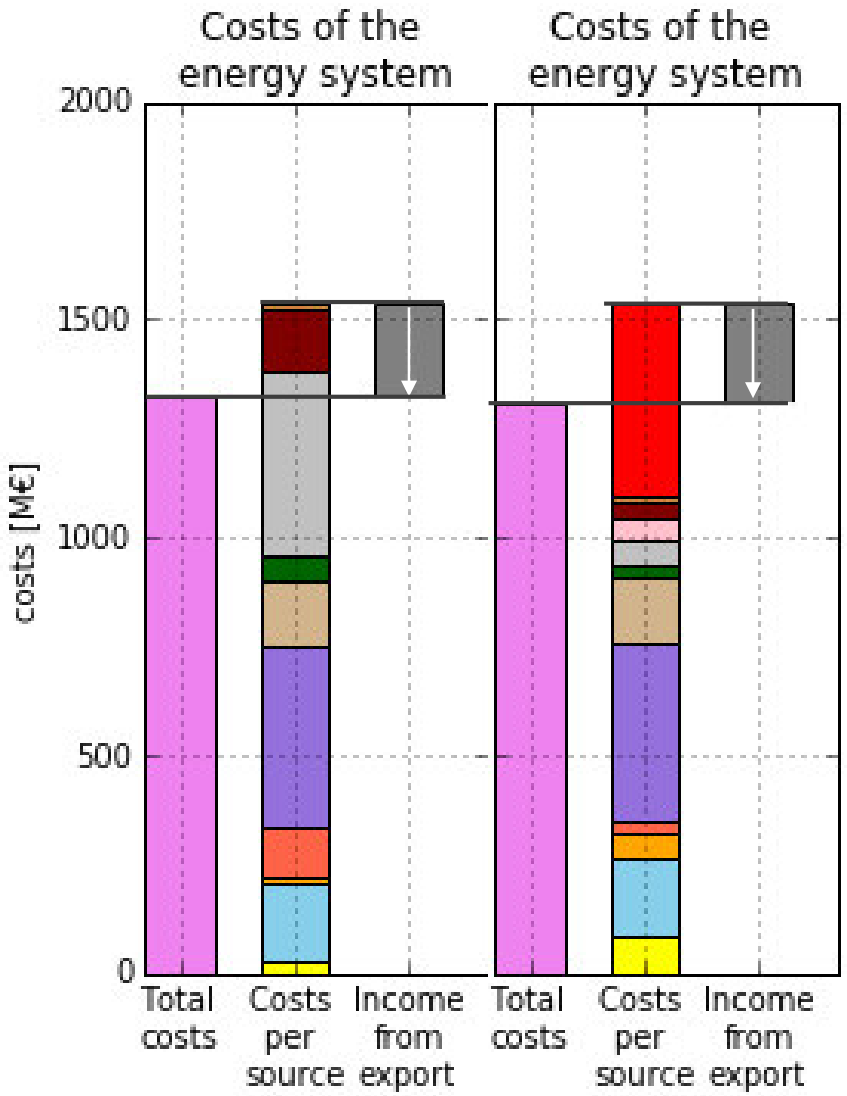
Comparison - electricity

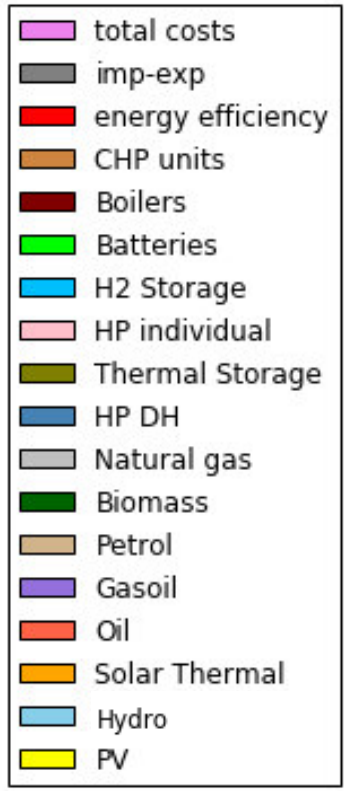


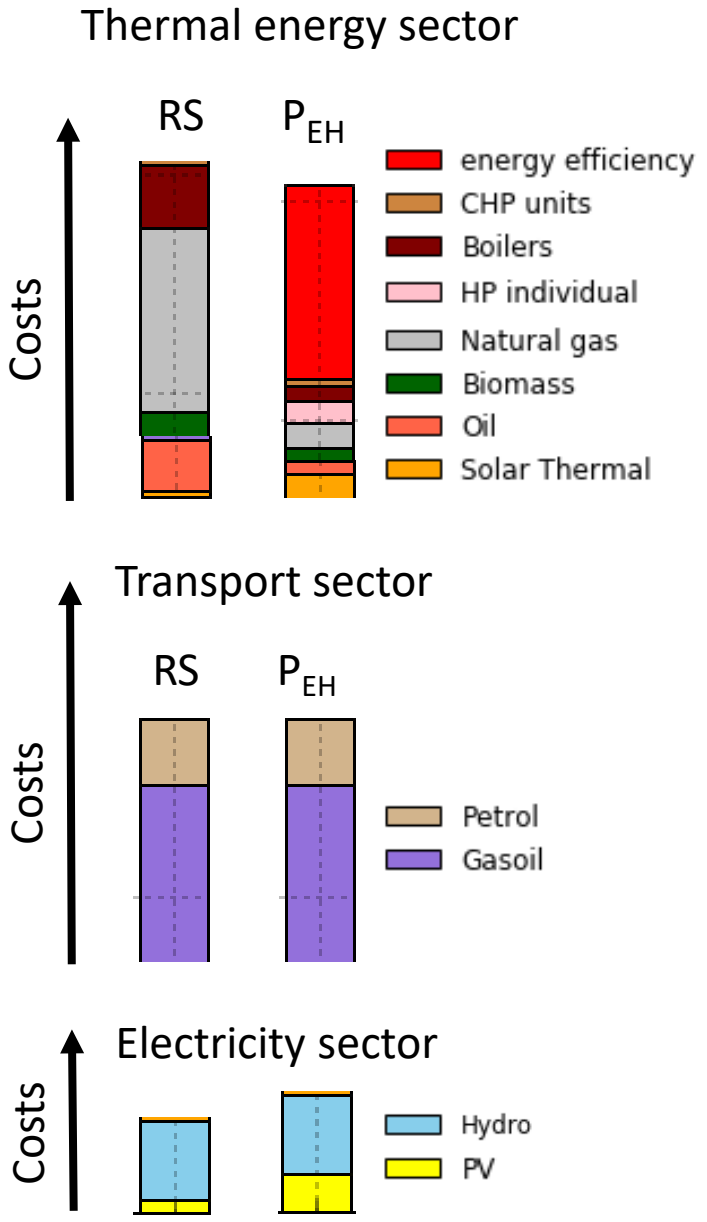


Comparison – financial data

Reference scenario P_{EH} scenario

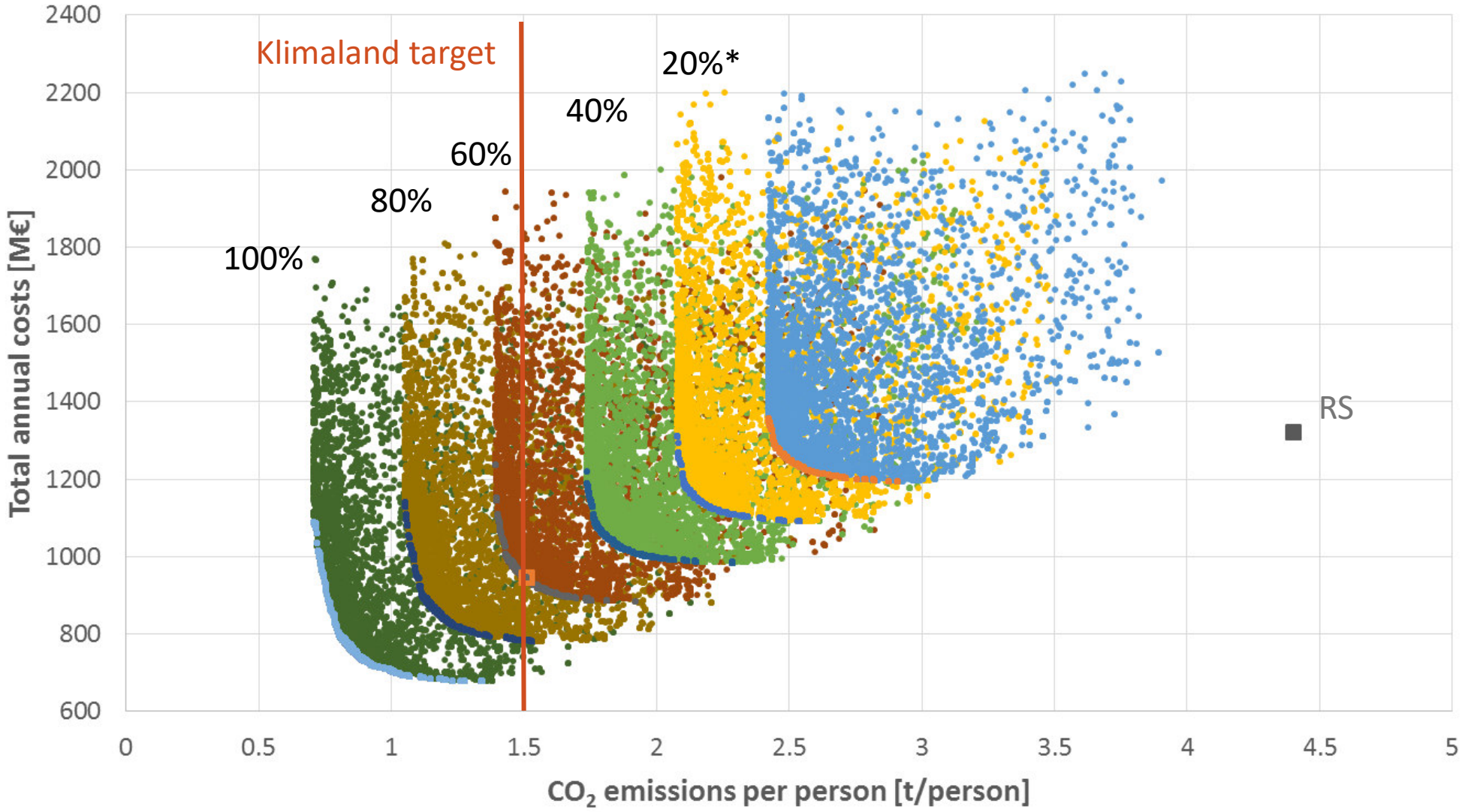






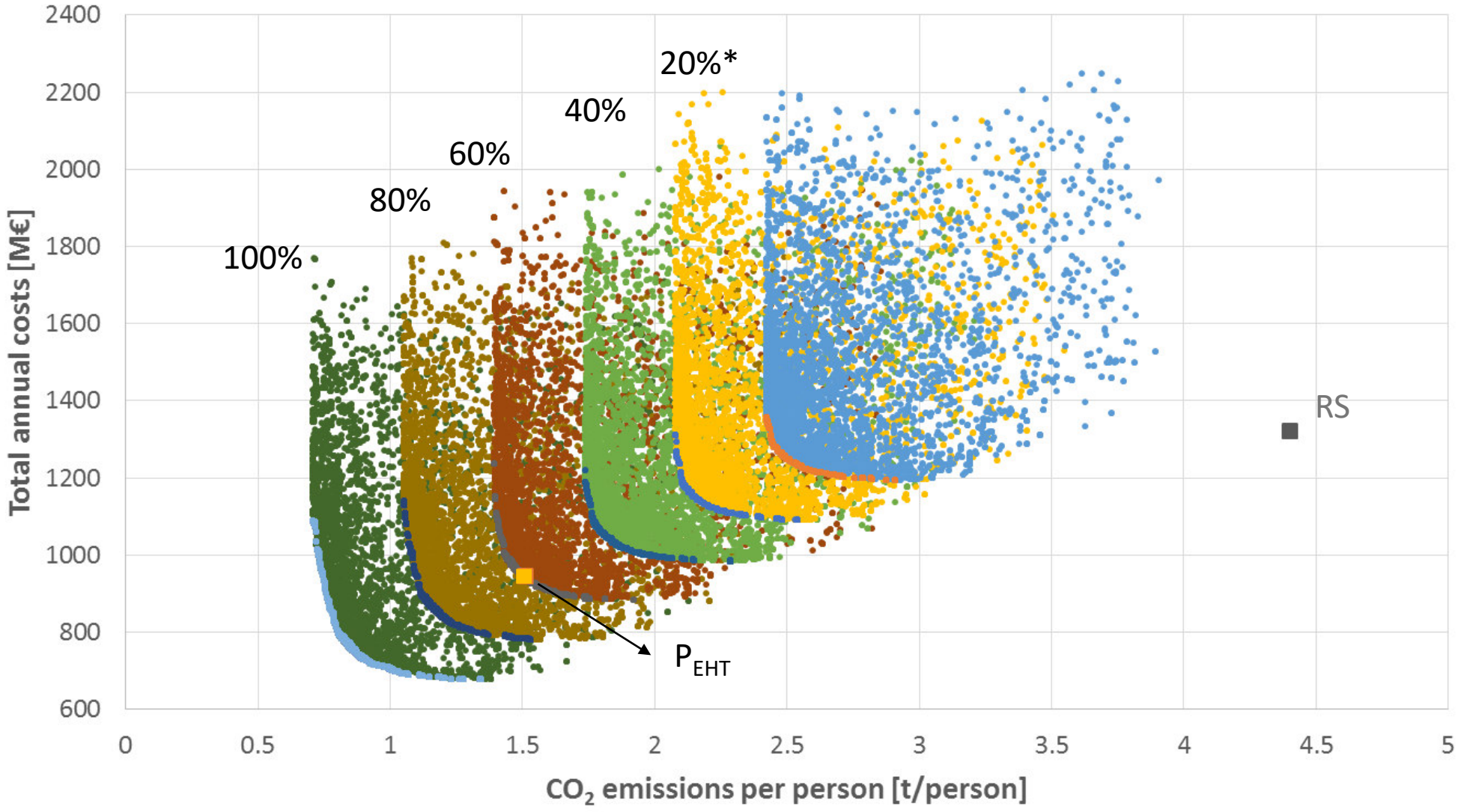
Considering zero emission mobility

% of zero emission mobility

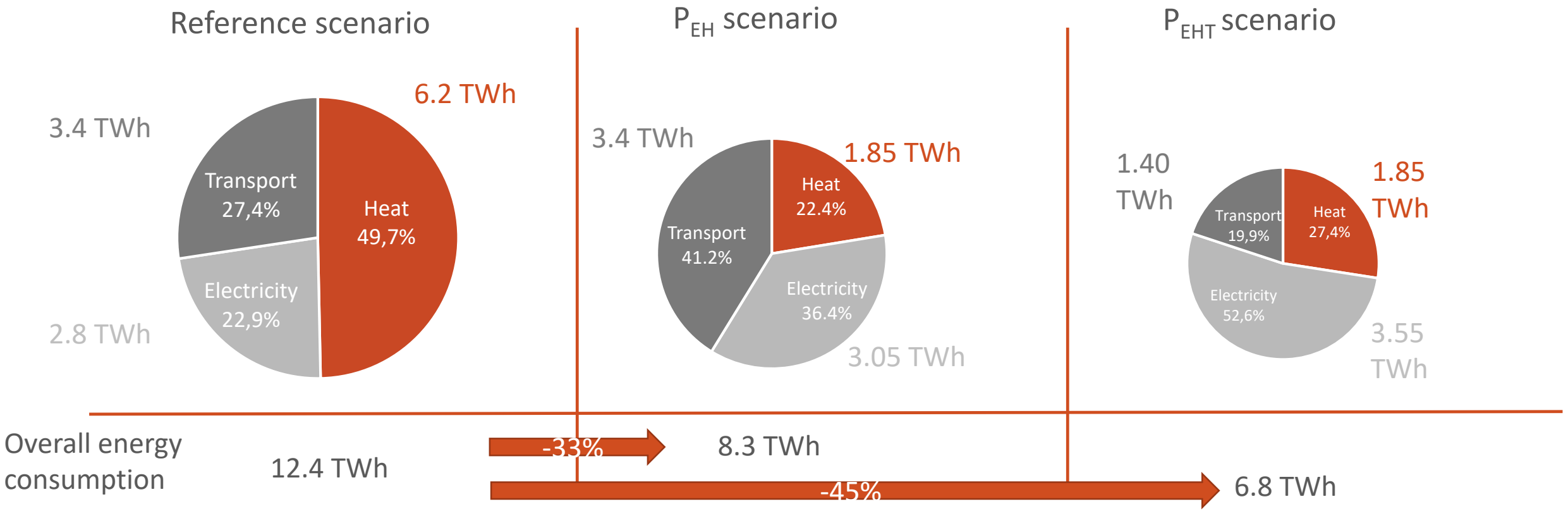


* Penetration percentage of zero emission transport on the overall kilometres covered in the transportation sector

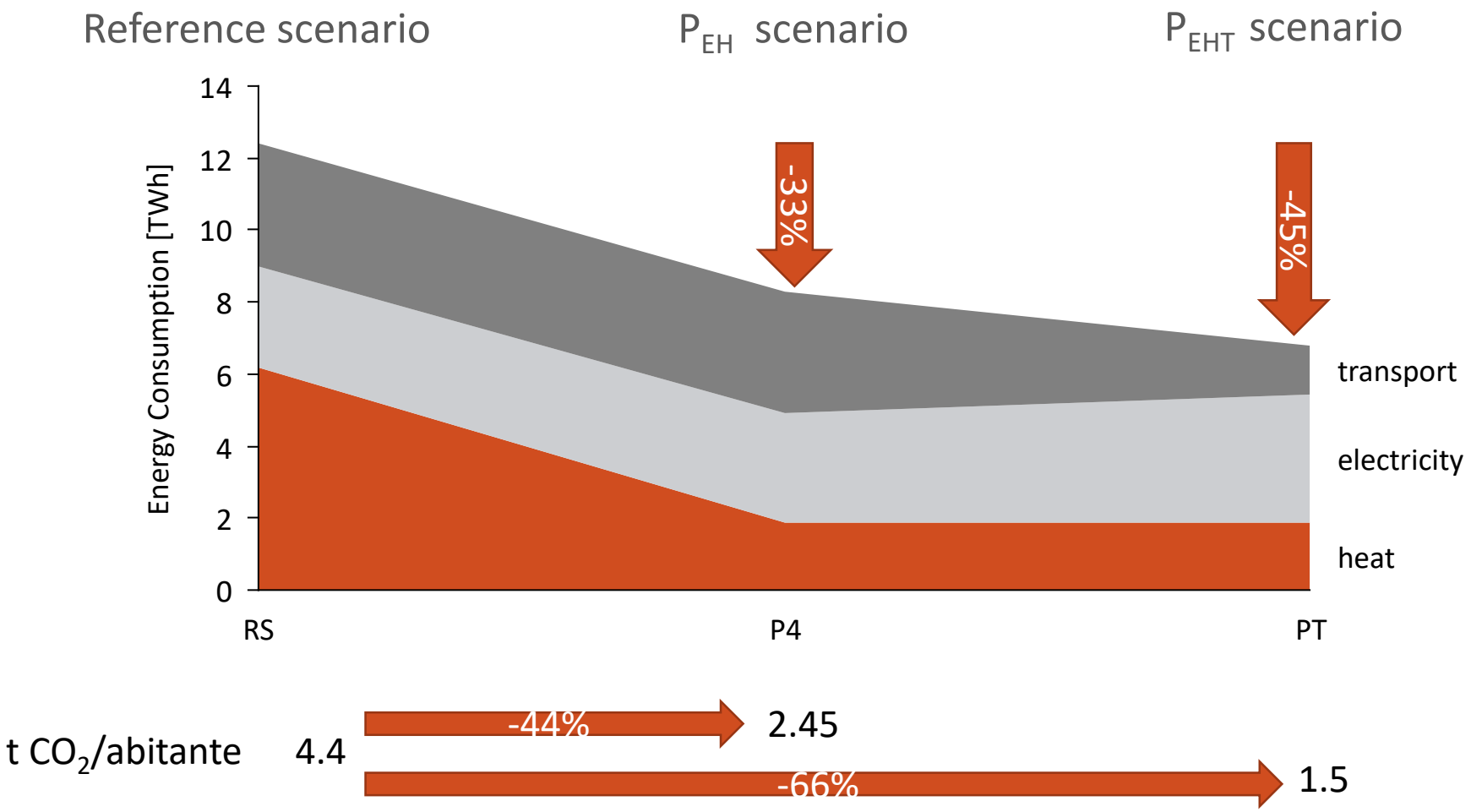
% of zero emission mobility



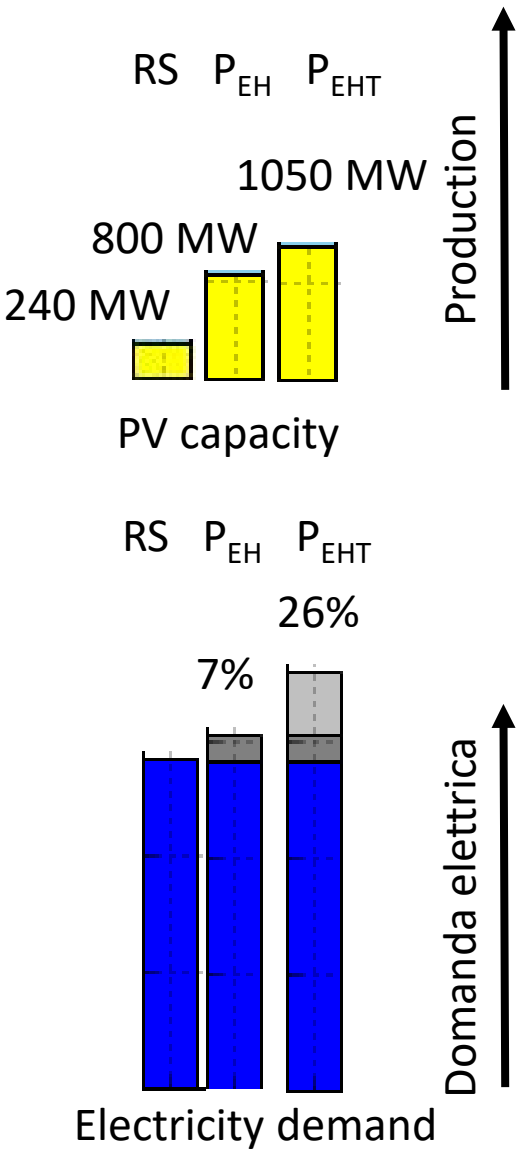
Comparison of the overall energy consumption

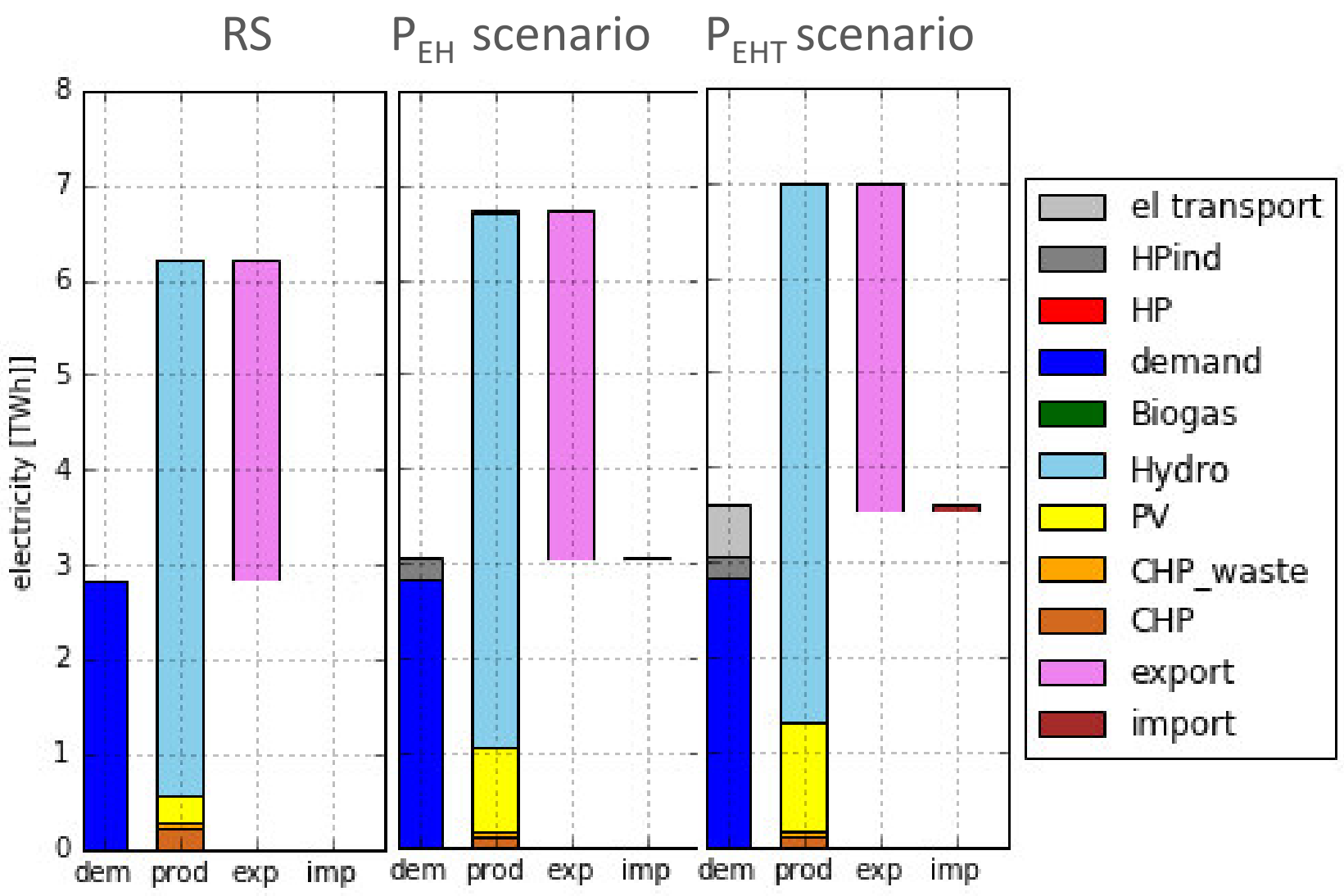


Comparison of the overall energy consumption

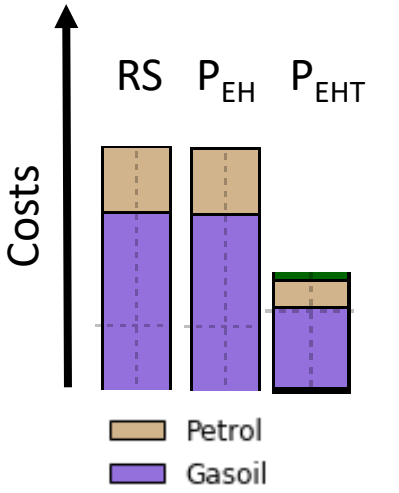


Comparison - electricity

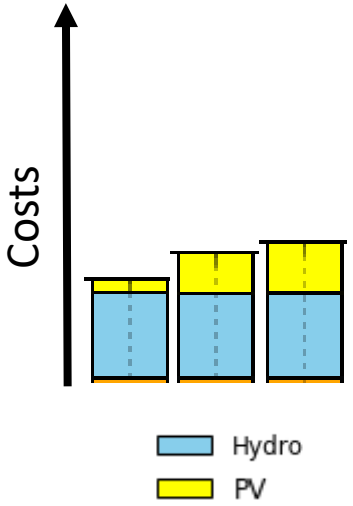




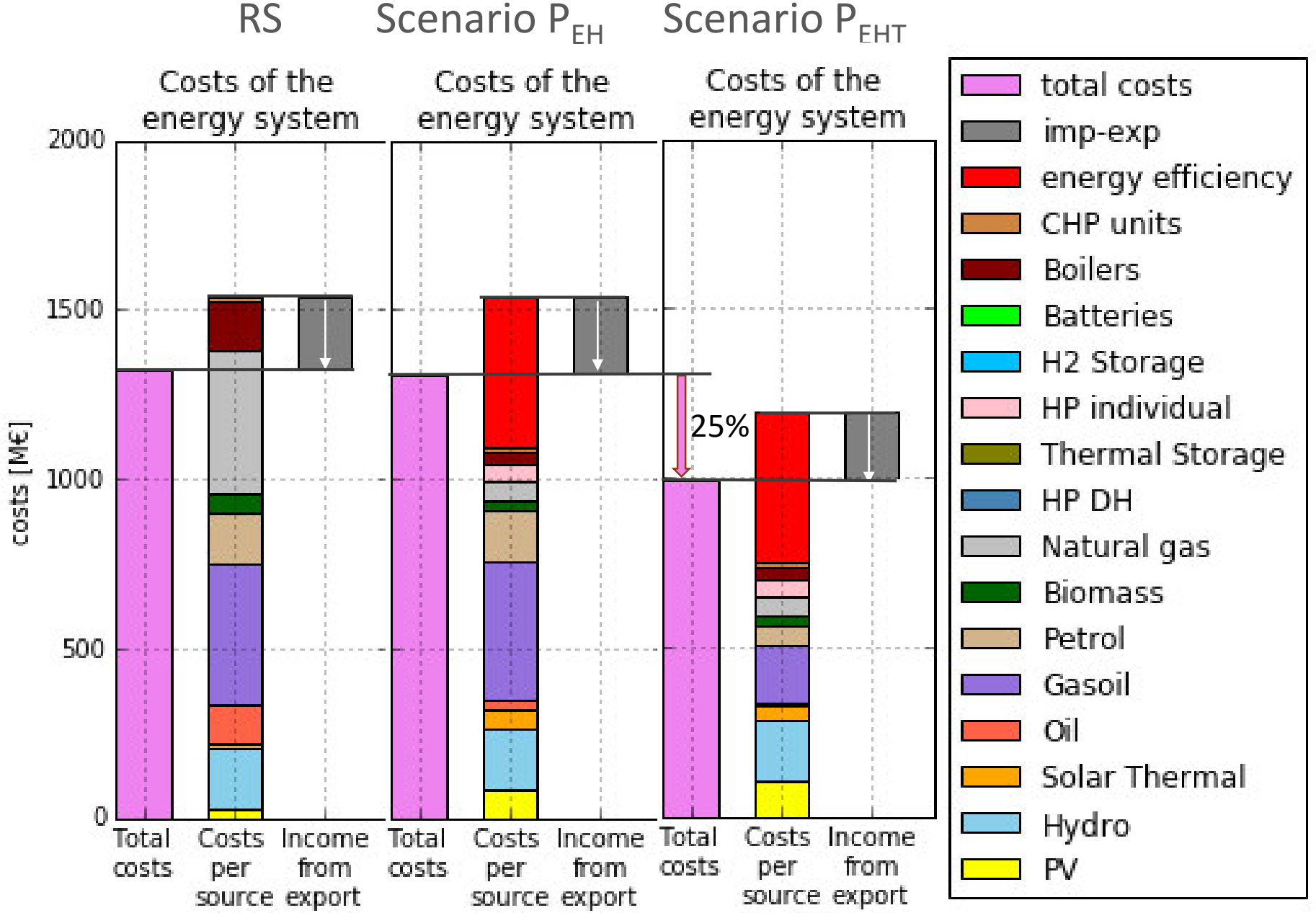
Comparison – financial data



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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R. Pernetti, G. Garegnani, R. Vaccaro, M. Cozzini

www.eurac.edu

Under the following

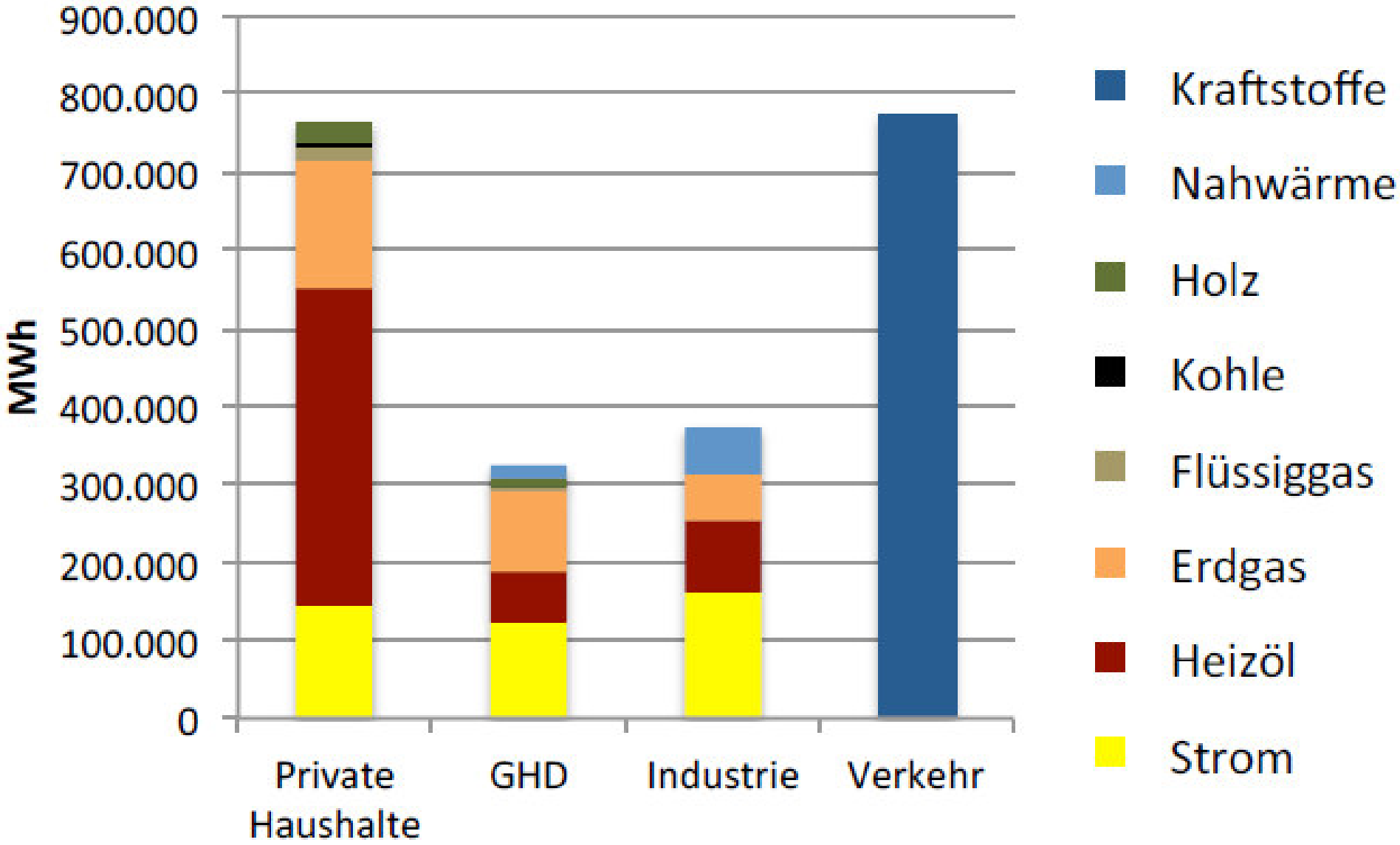
DEUTSCHSPRACHIGE GEMEINSCHAFT BELGIENS

Wuppertal Institut
für Klima, Umwelt, Energie
GmbH

BET

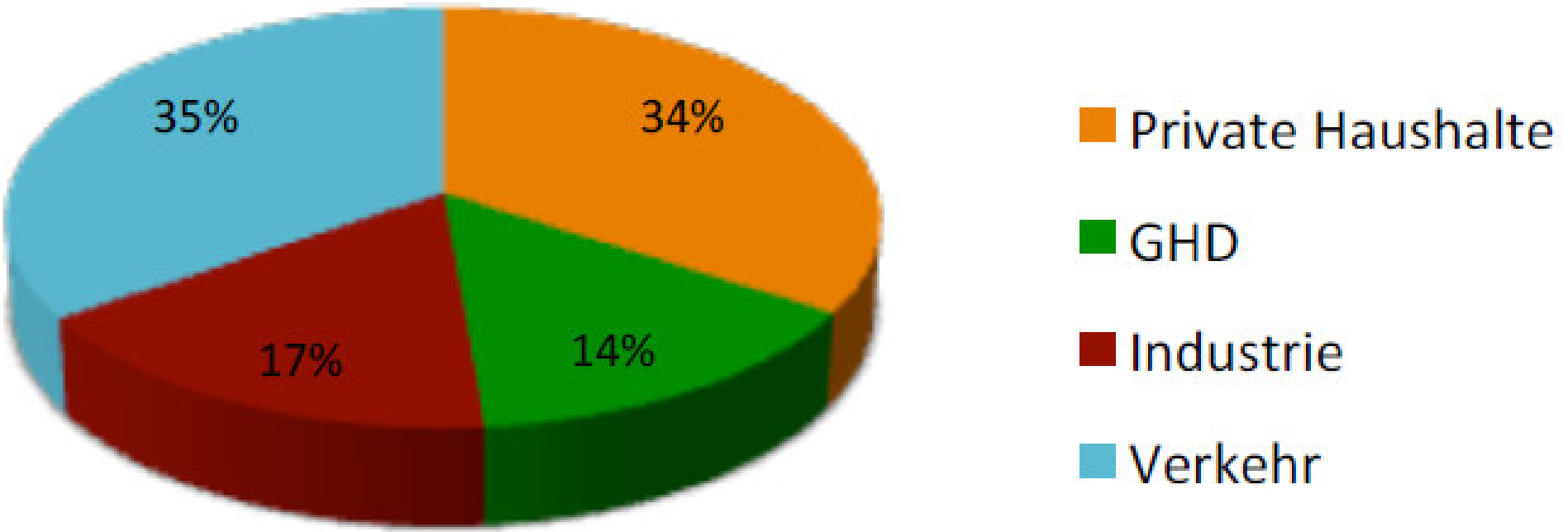
Energieleitbild

für die Deutschsprachige Gemeinschaft Belgiens



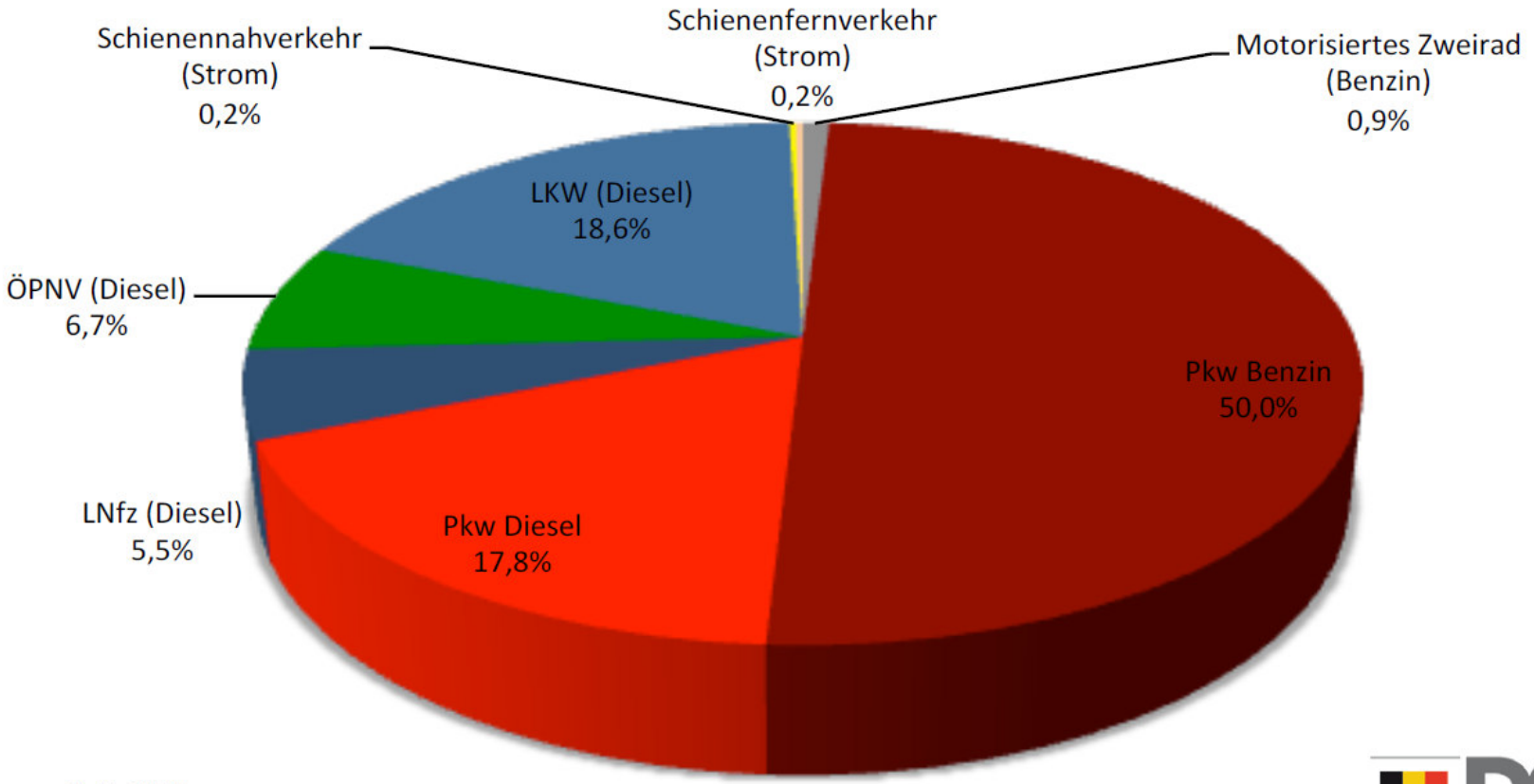
Quelle: Berechnung Wuppertal Institut

Abbildung 7: Energieverbrauch nach Anteilen je Sektor in der DG 2010



Summe: 2.243 GWh

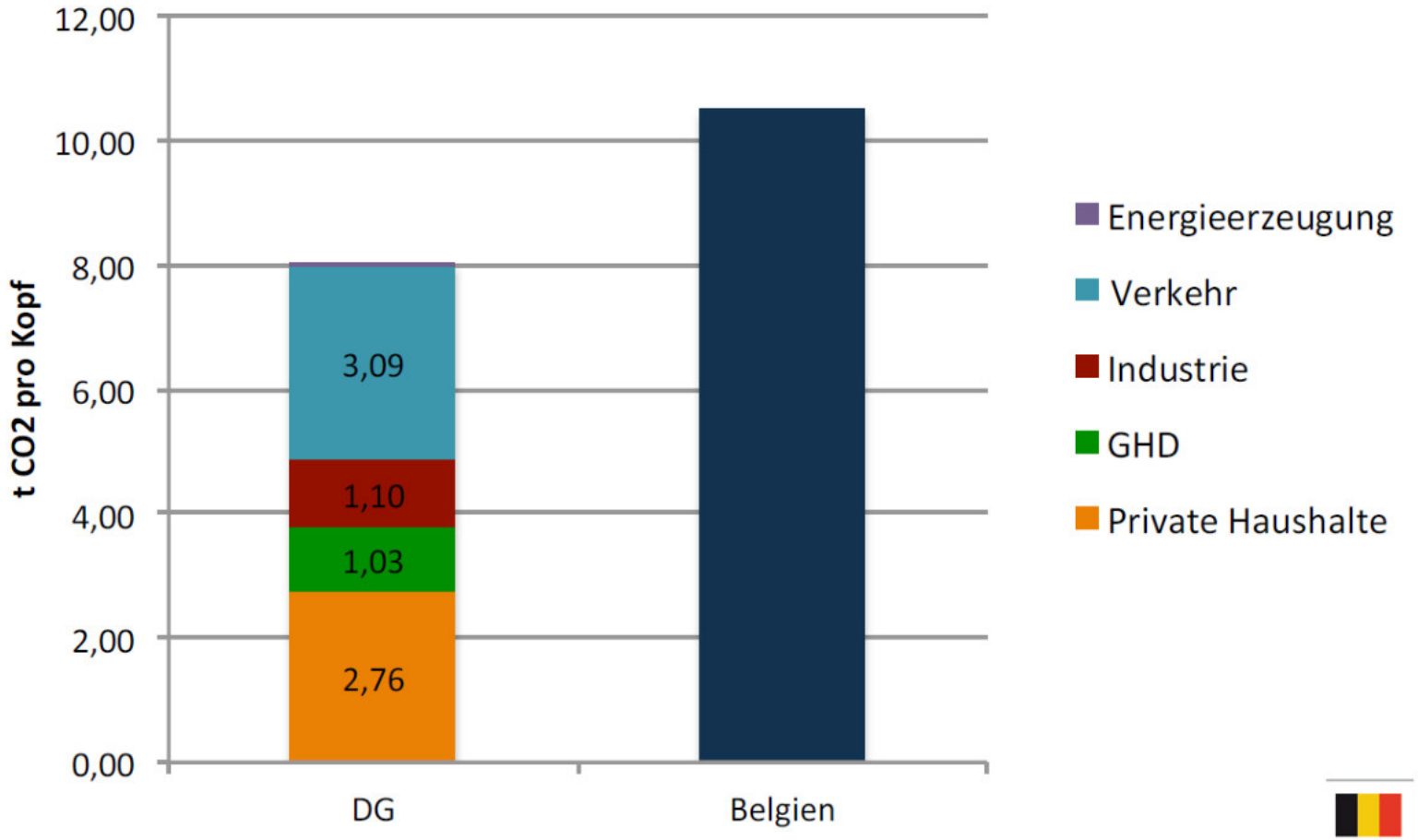
Abbildung 8: Endenergieverbrauch nach Verkehrsmitteln in der DG 2010



Summe: 776 GWh

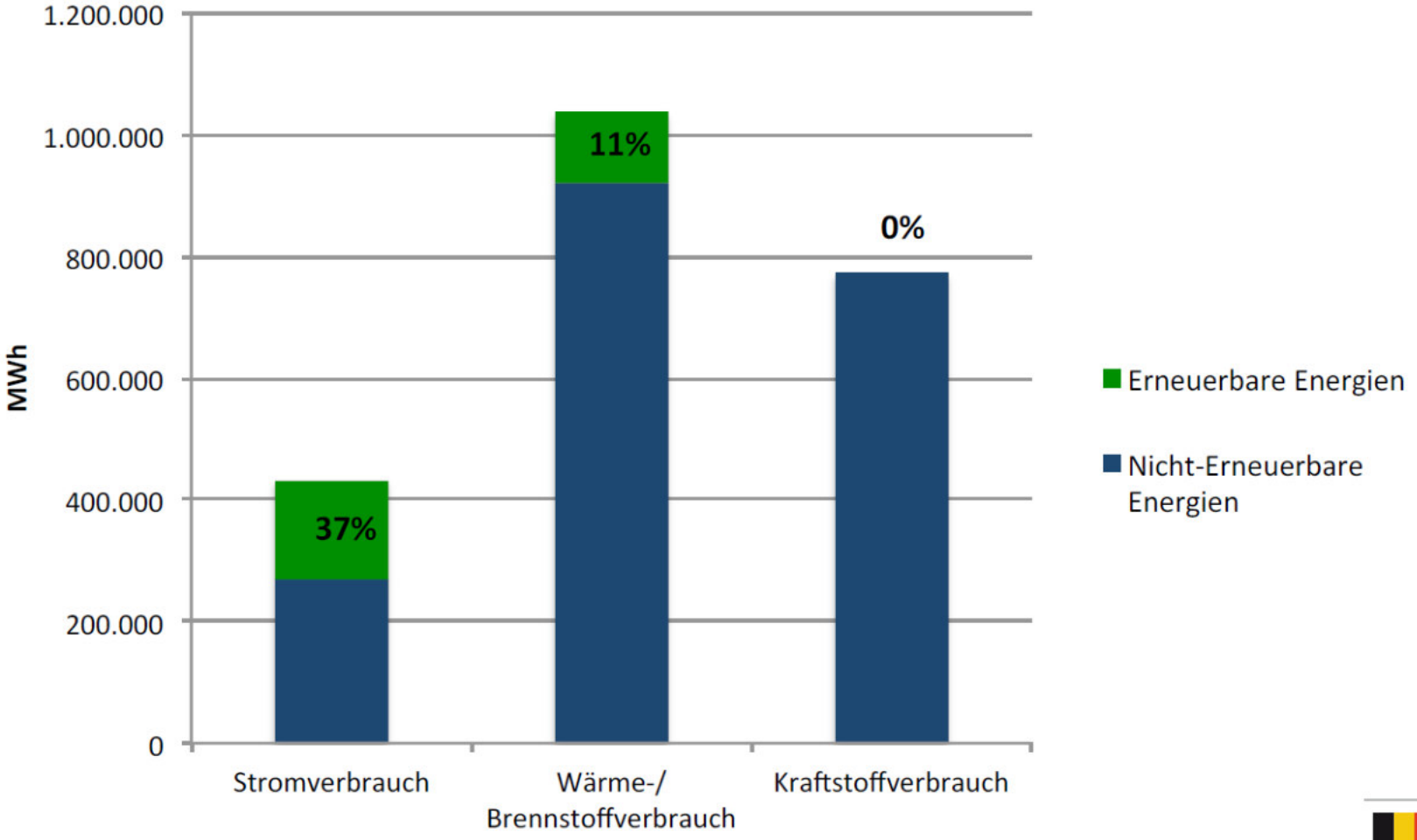
Quelle: Berechnungen Wuppertal Institut

Abbildung 9: CO_2-Emissionen in der DG und Belgien im Vergleich 2010



Quelle: Berechnung Wuppertal Institut, www.unfccc.int

Abbildung 10: Anteil erneuerbarer Energien am Strom-/Wärme-/Kraftstoffverbrauch in der DG im Jahr 2010



Quelle: Berechnung Wuppertal Institut

Heat

- Energy efficiency
- Renewable Energy


Jupiler

Refurbishment of existing buildings

Città di Bolzano
Stadt Bozen

PRIMA

264*
kWh/m²
year

DOPO

26
kWh/m²
year

Credits: AREA architetti

Via Aslago - Bolzano

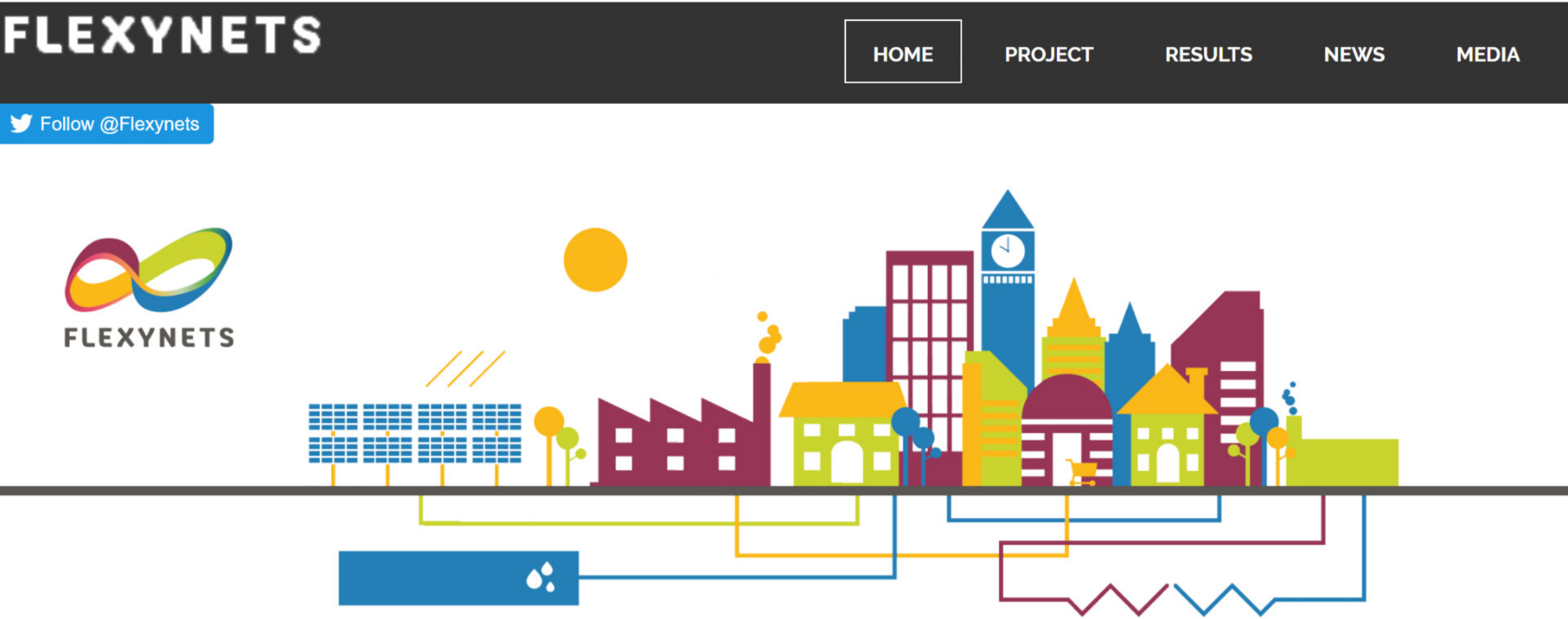
*questi e i dati seguenti includono riscaldamento, acs e illuminazione

Alperia – district heating Bolzano, energy tower

Alperia – district heating Sesto, utilization of (local) biomass

Britannica.com – Geothermal powerplant for heat and electricity


Euroheat.org - solar district heating



EU Project Flexynets – Low temperature district heating systems

Solar thermal as on roof application (example social building Bolzano)

WOBI IPES

Electricity

- Energy efficiency
- Renewable Energy

Alperia – district heating Chiusa, combined heat and power

Commons.wikimedia, Geothermal heat and power, Garching (Munich)

Atzwanger.net – waste incineration of Bolzano

Ostbelgiendirekt.be – Windenergie und Photoltaik

Transport

- Energy efficiency
- Renewable Energy

Thank you for your attention

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