eurac research

Sinfonia

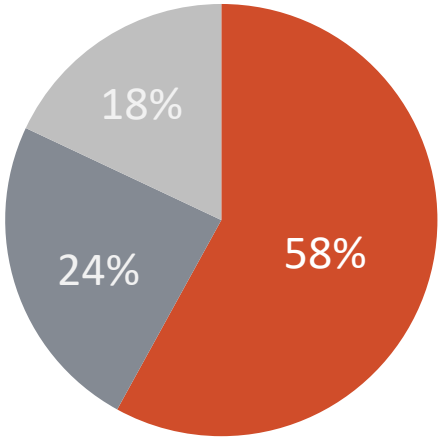
Sustainable development – is it worth it?

Experiences from Bolzano and Eurac Research

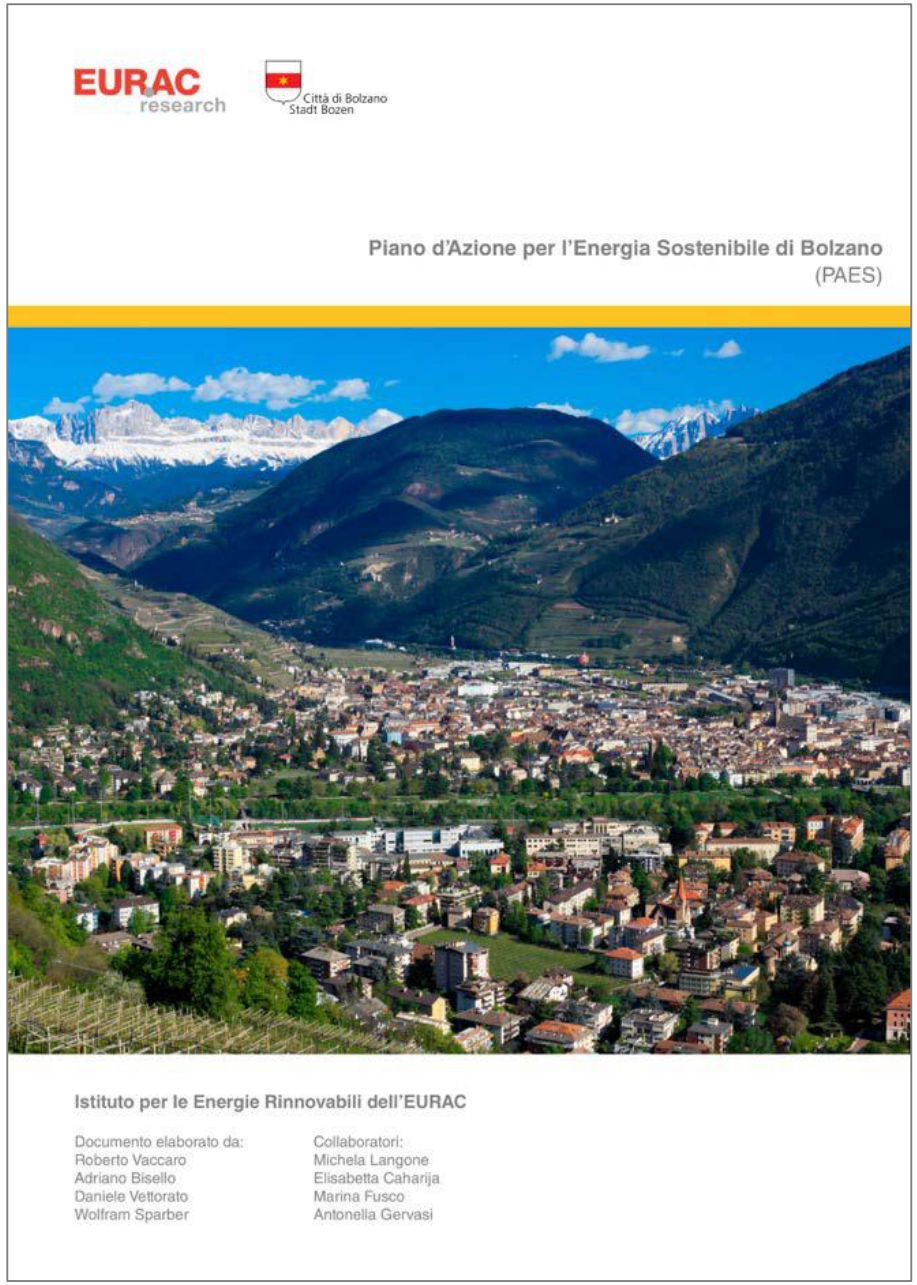
W. Sparber, A. Zubaryeva, A. Segata, D. Vettorato

Bolzano
– Energy Action Plan

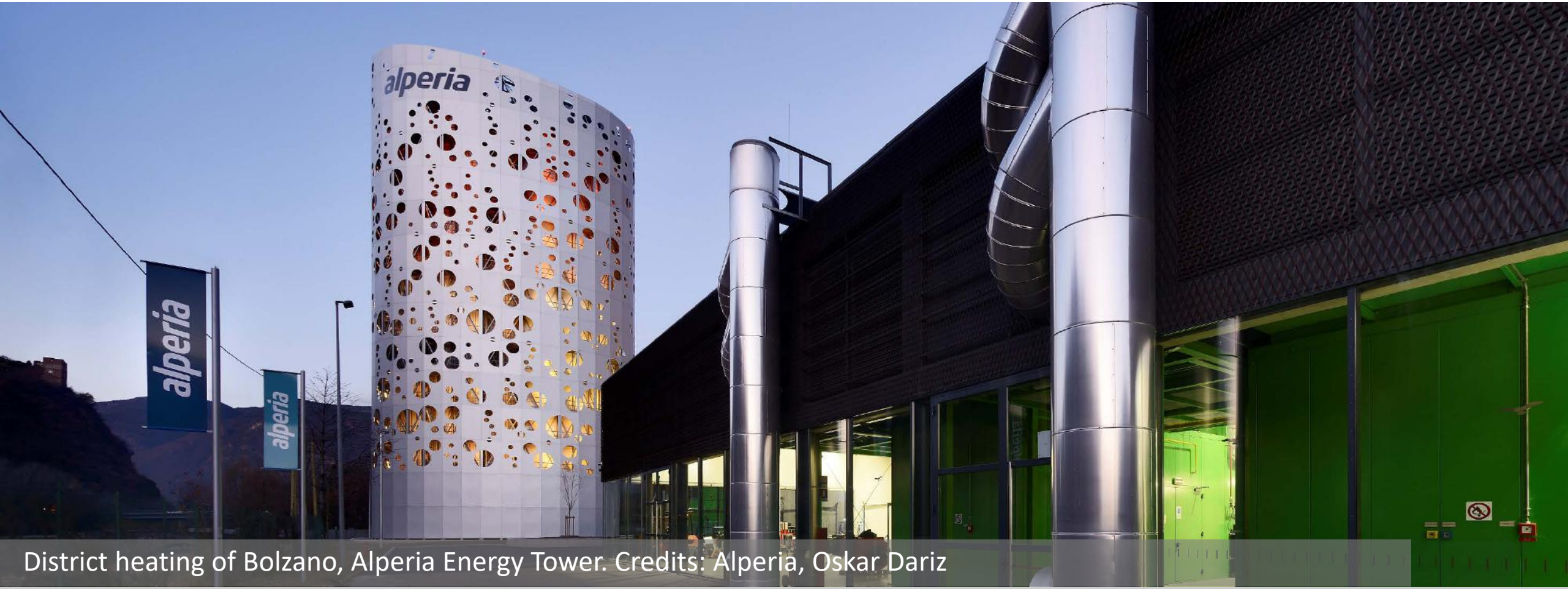
In 2010 the overall energy consumption was 1.919 GWh distributed as follows …



- Thermal energy
- Electrical energy
- Mobility and transport



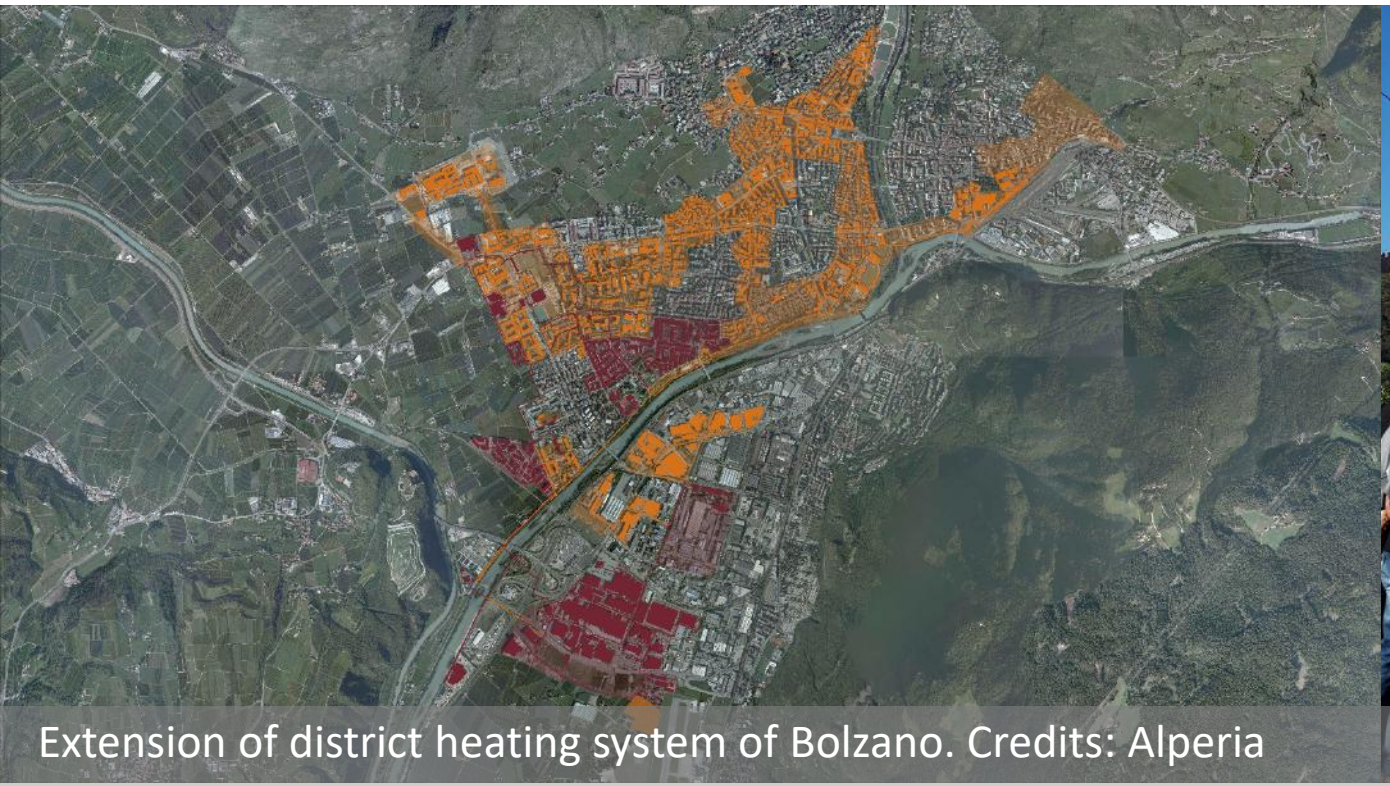
Alperia - district heating Bolzano



District heating of Bolzano, Alperia Energy Tower. Credits: Alperia, Oskar Dariz

Alperia – extension and optimization of district heating

Within the time frame of the project Alperia enlarged strongly the district heating system. Several of the project buildings where connected and a grid optimization and modelling was established.



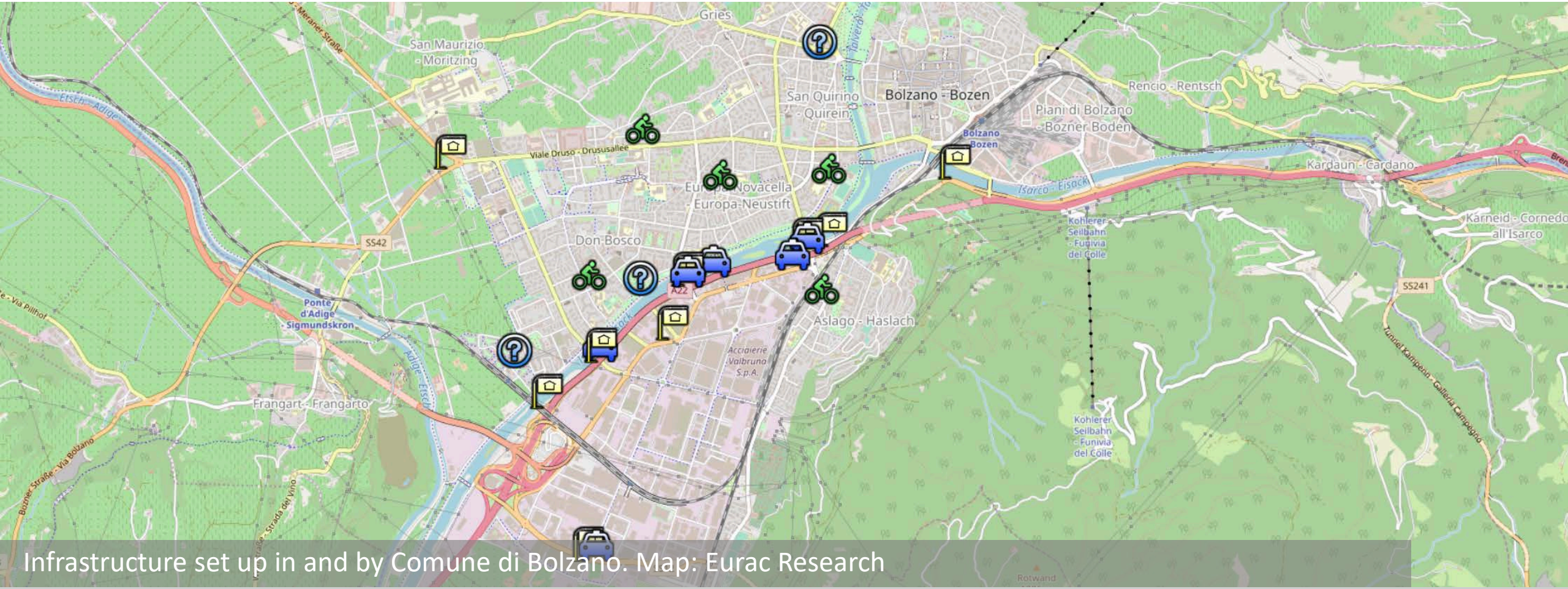
Extension of district heating system of Bolzano. Credits: Alperia

Alperia – experimentation of hydrogen co-firing

Within the project experiments have been executed to co-fire hydrogen within the existing natural gas cogeneration units. Results show possibilities of NO_x reduction of up to 40%.

Hydrogen delivery to the district heating system of Bolzano. Credits: Alperia

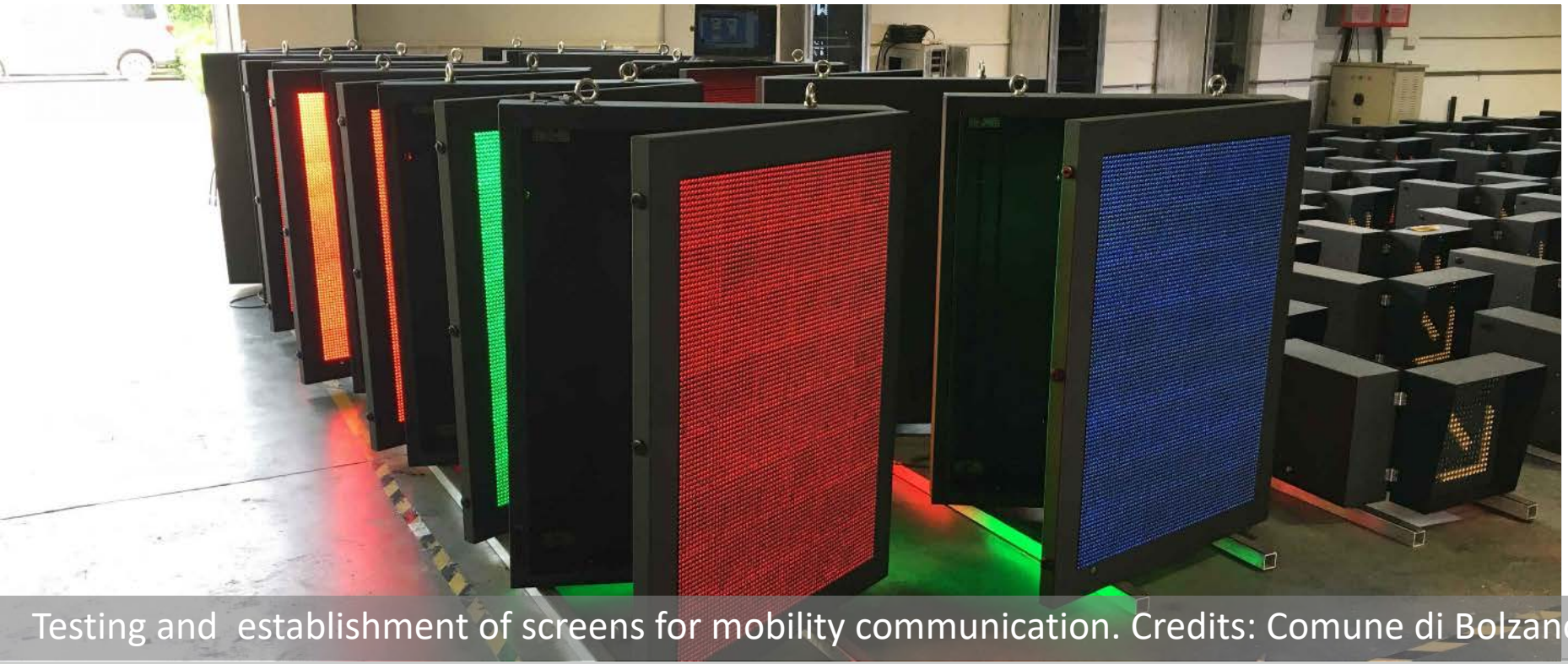
Sensors, smart points, totems in Bolzano



Infrastructure set up in and by Comune di Bolzano. Map: Eurac Research

Traffic information and sensors …

In the city have been / will be installed 6 traffic monitoring stations, 12 variable-message signs, 6 bicycle counters and 2 air quality monitoring stations.



Testing and establishment of screens for mobility communication. Credits: Comune di Bolzano

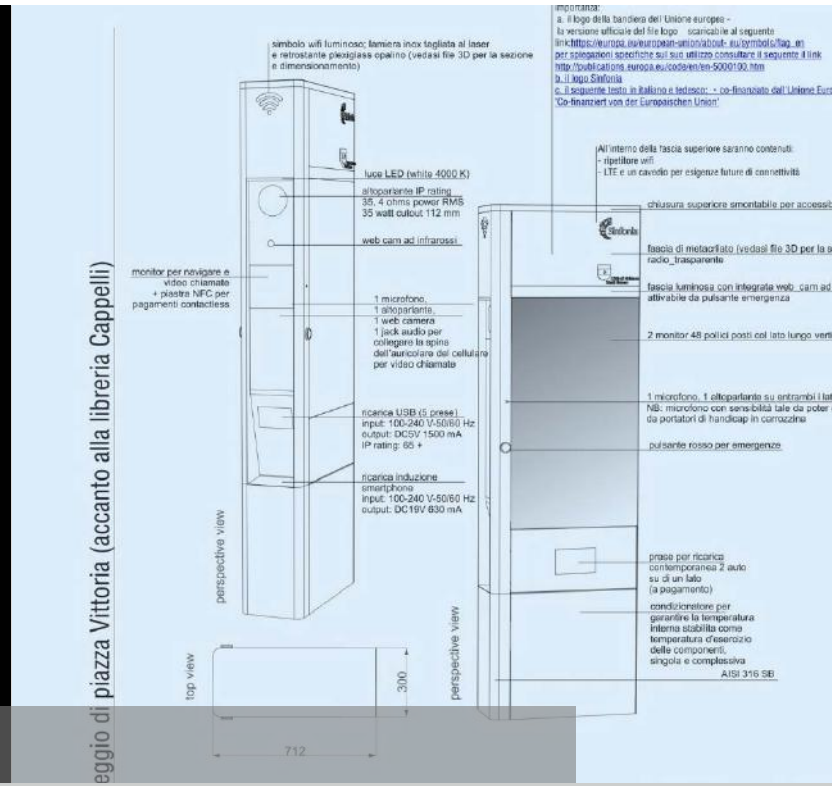
Totems – public service points for citizens

3 totems will be installed at strategic positions of the city in order to serve the population as multiservice points for information, safety, data transmission and electric charging.

Example of information to be given to citizens. Credits: Eurac Research

Totem - implementation

The totems have been developed, designed, conceptualized and produced within the project and will be installed in spring 2019. They include services such as communication, information, safety, e-charging.

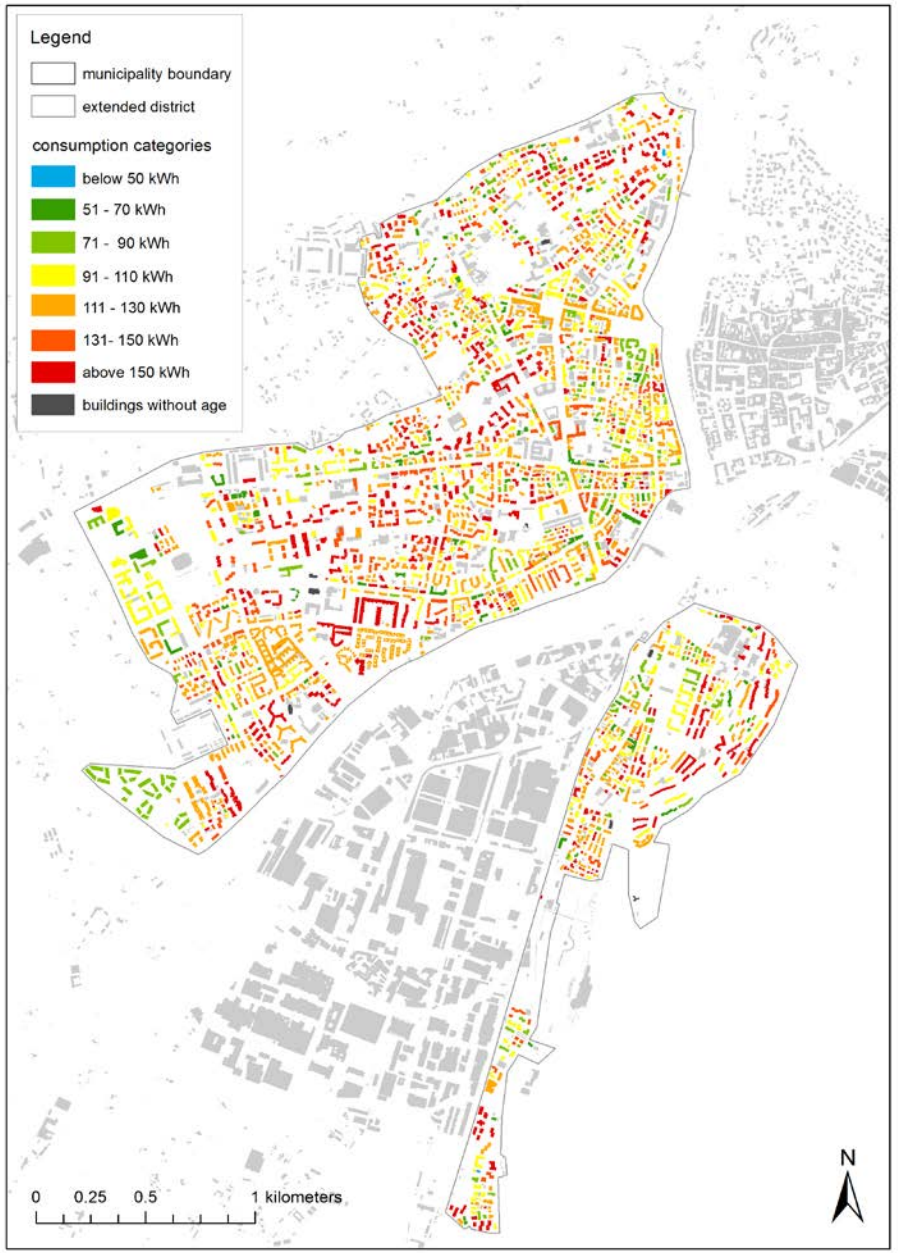


Credits: Comune di Bolzano e IUAV

Building refurbishment …

On the roof of a building by Comune di Bolzano in Via Aslago. Credits: Eurac Research, Ivo Corrà

The thermal (in)efficiency of the buildings of Bolzano



Thermal energy consumption of the buildings in single districts in Bolzano. Credits: Eurac Research

Refurbishment of 5 social housing complexes

5 building complexes

> 30 000 m^2

Credits: Eurac Research

Actors implementing the refurbishment activities …

The refurbishment activities led to important constructions sites in and around the buildings.

The results shown in the following slights were only possible thanks to many **dedicated collaborators** of the **project partners**, **architects**, **engineers** and many **construction companies**.

In the annex the main ones are listed.

We would like to thank all for their contribution!

A city is changing

Building Passeggiate dei Castani, Comune di Bolzano. Credits: Eurac Research

Comune di Bolzano: Passeggiata dei Castani

236 kWh/m² year

Credits: IDM, Michelangelo

Before refurbishment

22 kWh/m² year

Credits: Studio Mellano

After refurbishment

The shown figures include energy consumption for heating, domestic hot water and lightning and consider renewable energy production onsite after refurbishment

Passeggiata dei Castani building after refurbishment, Comune di Bolzano. Credits: Eurac Research

Comune di Bolzano: Via Aslago

264*
kWh/m²
year

Credits: IDM, Ivo Corrà

Before refurbishment

26
kWh/m²
year

Credits: Area Architetti Associati

After refurbishment

The shown figures include energy consumption for heating, domestic hot water and lightning and consider renewable energy production onsite after refurbishment

Via Aslago in an advanced phase of refurbishment, Comune di Bolzano. Credits: Eurac Research

IPES: Via Brescia-Cagliari

220 kWh/m² year

Credits: IDM, Ivo Corrà

Before refurbishment

48 kWh/m² year

Credits: Studio Tecnico Vettori

After refurbishment

The shown figures include energy consumption for heating, domestic hot water and lightning and consider renewable energy production onsite after refurbishment

Via Brescia after refurbishment, IPES. Credits: Eurac Research

IPES: Via Similaun

211 kWh/m² year

Credits: AREA Architetti Associati - Andrea Fregoni - Roberto Pauro

Before refurbishment

45 kWh/m² year

Credits: AREA Architetti Associati - Andrea Fregoni - Roberto Pauro

After refurbishment

The shown figures include energy consumption for heating, domestic hot water and lightning and consider renewable energy production onsite after refurbishment

Via Similaun in advanced phase of refurbishment, IPES. Credits: Eurac Research

IPES: Via Palermo

204 kWh/m² year

Credits: Eurac Research, Ivo Corrà

Before refurbishment

47 kWh/m² year

Credits: Laboratorio di Architettura

After refurbishment

The shown figures include energy consumption for heating, domestic hot water and lightning and consider renewable energy production onsite after refurbishment

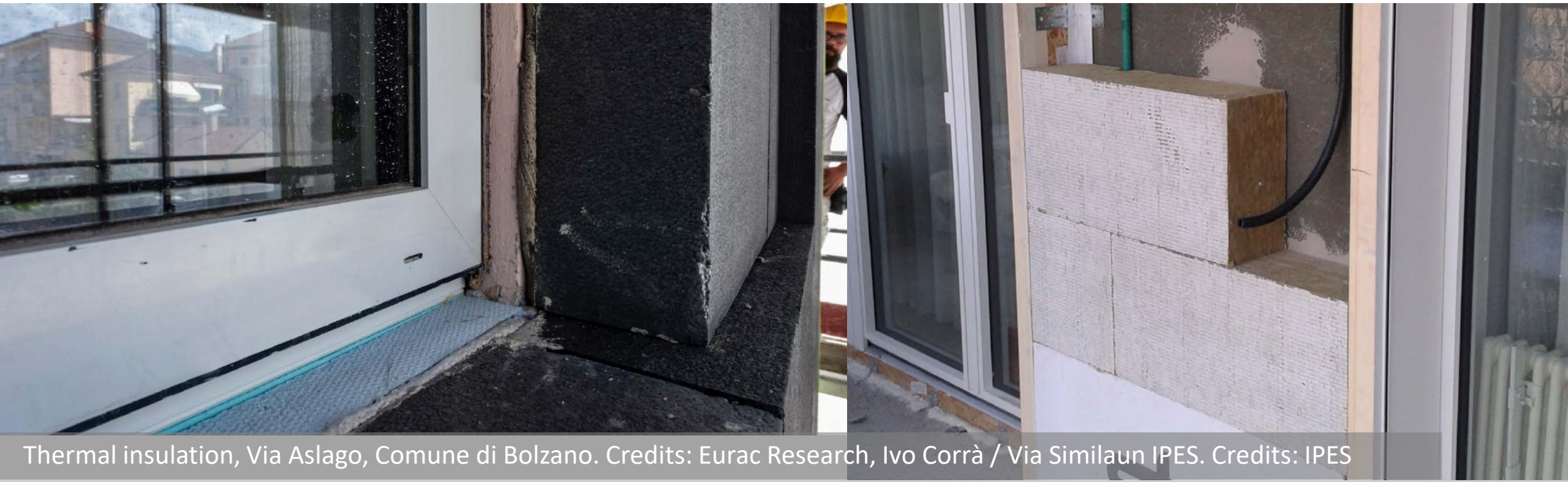
Via Palermo refurbishment works ongoing, IPES. Credits: Eurac Research

Sustainable development – Is it worth it?

1.) The impression of the refurbished buildings and their city quarters is changing drastically leading to a completely different aesthetics.

Added value – energy efficiency and comfort

All buildings have been deeply refurbished leading to a strong reduction in thermal energy consumption and a relevant enhancement of thermal comfort for tenants.



Thermal insulation, Via Aslago, Comune di Bolzano. Credits: Eurac Research, Ivo Corrà / Via Similaun IPES. Credits: IPES

Thermal insulation with all details

Although being the shape of the buildings quite linear, many details have to be considered for an all around thermal insulation avoiding thermal bridges.

Roof and balcony insulation, Via Brescia, IPES. Credits: Studio Tecnico Vettori

Added value – enhanced natural lighting and high quality windows

In all buildings, windows have been changed. Balcony structures have become lighter after refurbishment and in specific cases the window surfaces have been expanded enhancing natural illumination.

Credits: Adobe Stock, Robert / Window exposition in demo apartment. Credits: Eurac Research

Ventilation systems for enhanced comfort and energy efficiency

In all buildings decentralized ventilation systems with heat recovery have been installed in order to assure a high standard of indoor air quality in an energy efficient way.

Details of the ventilation system, Passeggiate dei Castagni and Via Aslago, Comune di Bolzano. Credits: Eurac Research

District heating replacing gas boilers

Where available the buildings have been connected to the Bolzano district heating system managed by Alperia. Leading to enhanced efficiency and eliminating emissions on site.

Heat exchanger, district heating Bolzano, Alperia. Credits: Alperia

Renewable energy on site - geothermal + heat pump

Passeggiate dei Castani is not in the actual district heating area.

In order to allow as well there a significant share of renewable energy a geothermal + heat pump system has been implemented for heating and domestic hot water.

Drilling of the geothermal system. Credits: Arch. Manuel Benedikter

Renewable energy on site – solar thermal

In most buildings solar thermal systems have been installed on the roof for domestic hot water applications. In Via Brescia as well a pre-fabricated solar thermal southern façade has been applied.

Via Brescia building, IPES, solar thermal on roof and facade. Credits: Studio Tecnico Vettori / Eurac Research

Renewable energy on site – photovoltaic systems

In all buildings rooftop PV systems have been installed, dimensioned in a way to cover electricity consumption of general appliances of the building.

Photovoltaic system on the roof of Via Similaun, IPES. Credits: IPES

Sustainable development – Is it worth it?

1.) The face of the refurbished buildings and their city quarters is changing drastically leading to a completely different aesthetics.

2.) Thermal internal comfort and air quality for inhabitants is strongly improved while reducing drastically the fossil energy consumption

Bonus Cubatura – high quality flats on top of the buildings

In two buildings the possibility given by *Bonus Cubatura* has been used. The existing roof has been dismantled allowing to add an additional floor leading to new high quality flats.

Via Aslago, Comune di Bolzano. Credits: Eurac Research, Ivo Corrà

Removal of existing roof – construction of new floor

Via Brescia, IPES. Credits: Eurac Research

Added value – new balconies and elevators

The moment of energetic refurbishment offers the possibility to enhance the living quality for the tenants in a relevant way by adding additional features such as elevators and new balconies.

Via Aslago, Comune di Bolzano. Credits: Eurac Research

Sustainable development – Is it worth it?

1.) The face of the refurbished buildings and their city quarters is changing drastically leading to a completely different aesthetics.

2.) Thermal internal comfort and air quality for inhabitants is strongly improved while reducing drastically the fossil energy consumption

3.) New living space in the city is created, comfort enhanced (new balconies, larger windows), accessibility enhanced (elevators added), building value increases

LAND
NIEDERÖSTERREICH

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Energy model Niederösterreich 2050

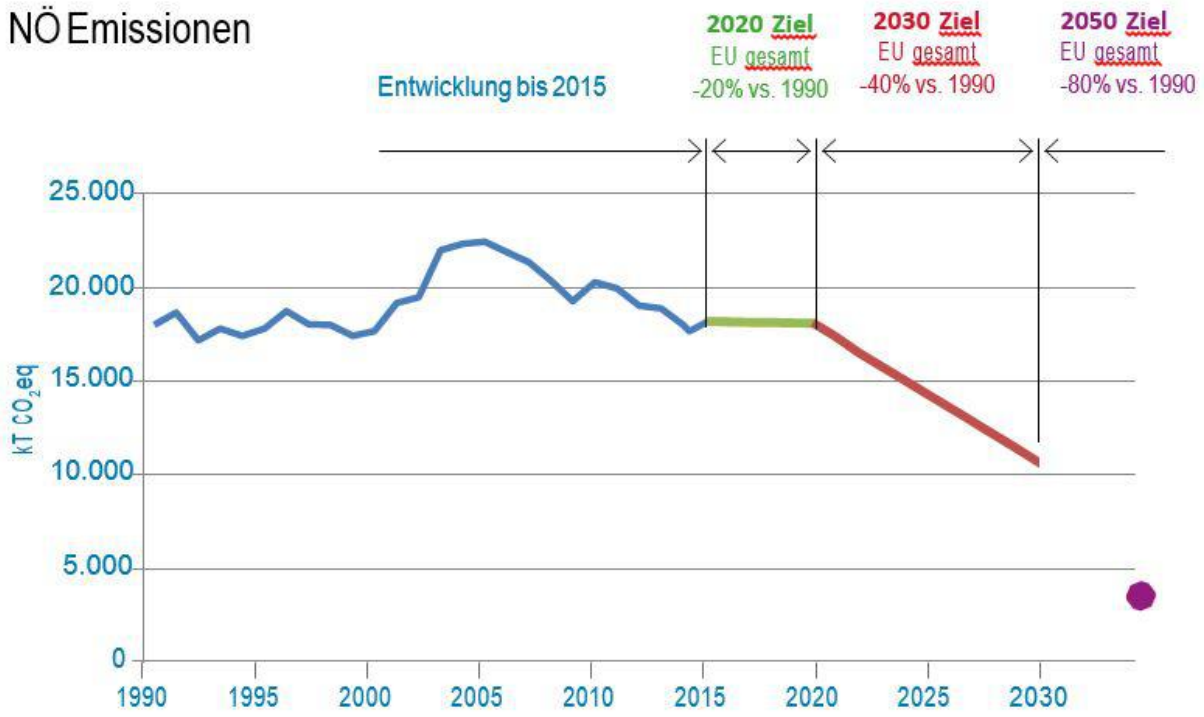
W. Sparber, R. Vaccaro, D. Moser, M. G. Prina

Full presentation available online:
http://www.eurac.edu/en/research/technologies/renewableenergy/references/Pages/Simulazioni-energetiche.aspx

Niederösterreich - Climate plan

Target

-80% emissions
at 2050 in respect
to value of 1990

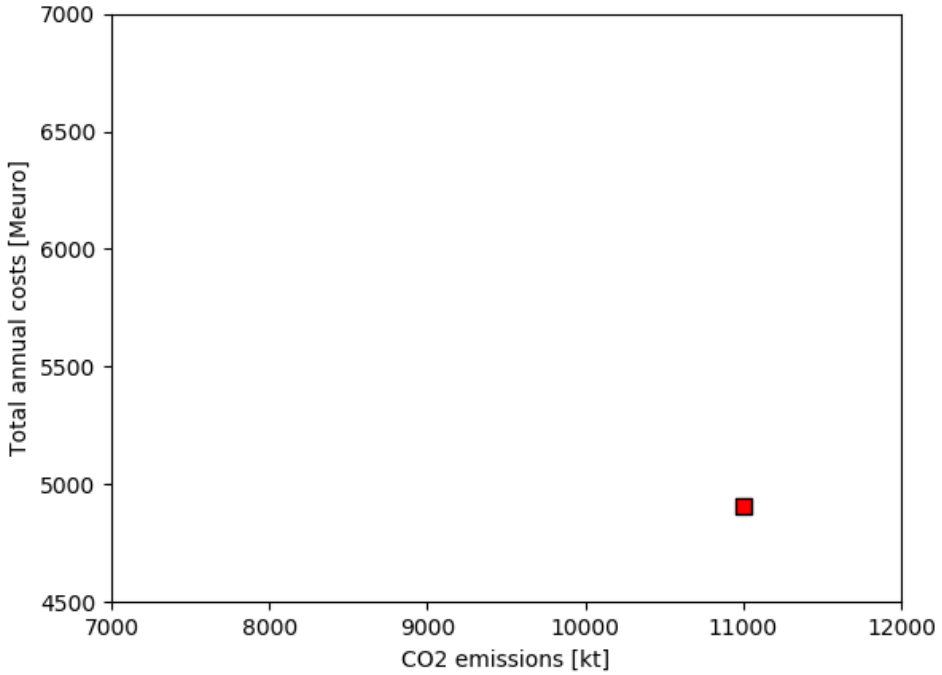


Source: Klima- und Energieprogramm, November 2017

Optimization model of the energy system

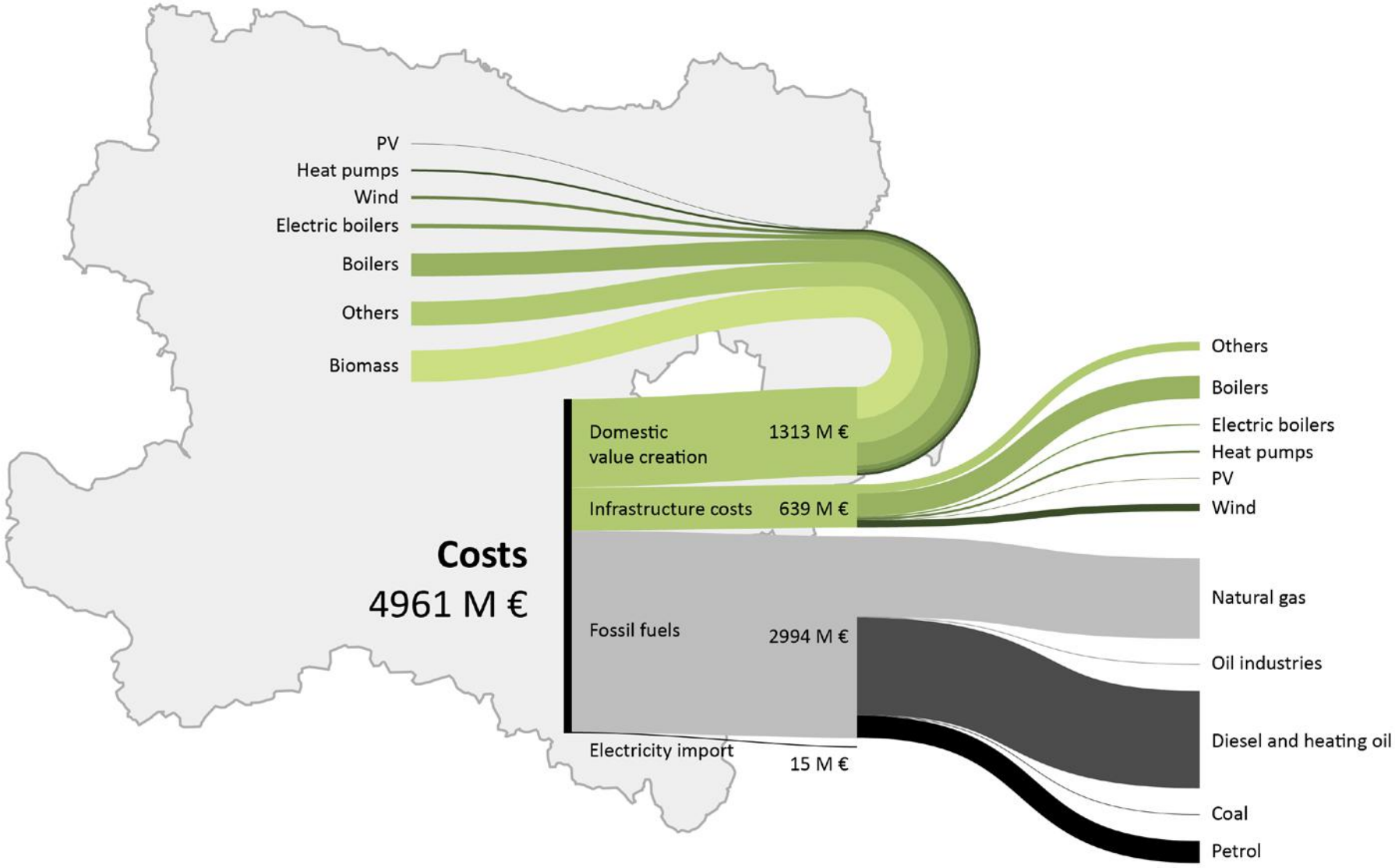
Modelling objectives - Eurac Research

Simulation model		Optimization model
EnergyPLAN (Aalborg University)	+	Multi objective evolutionary algorithm MOEA



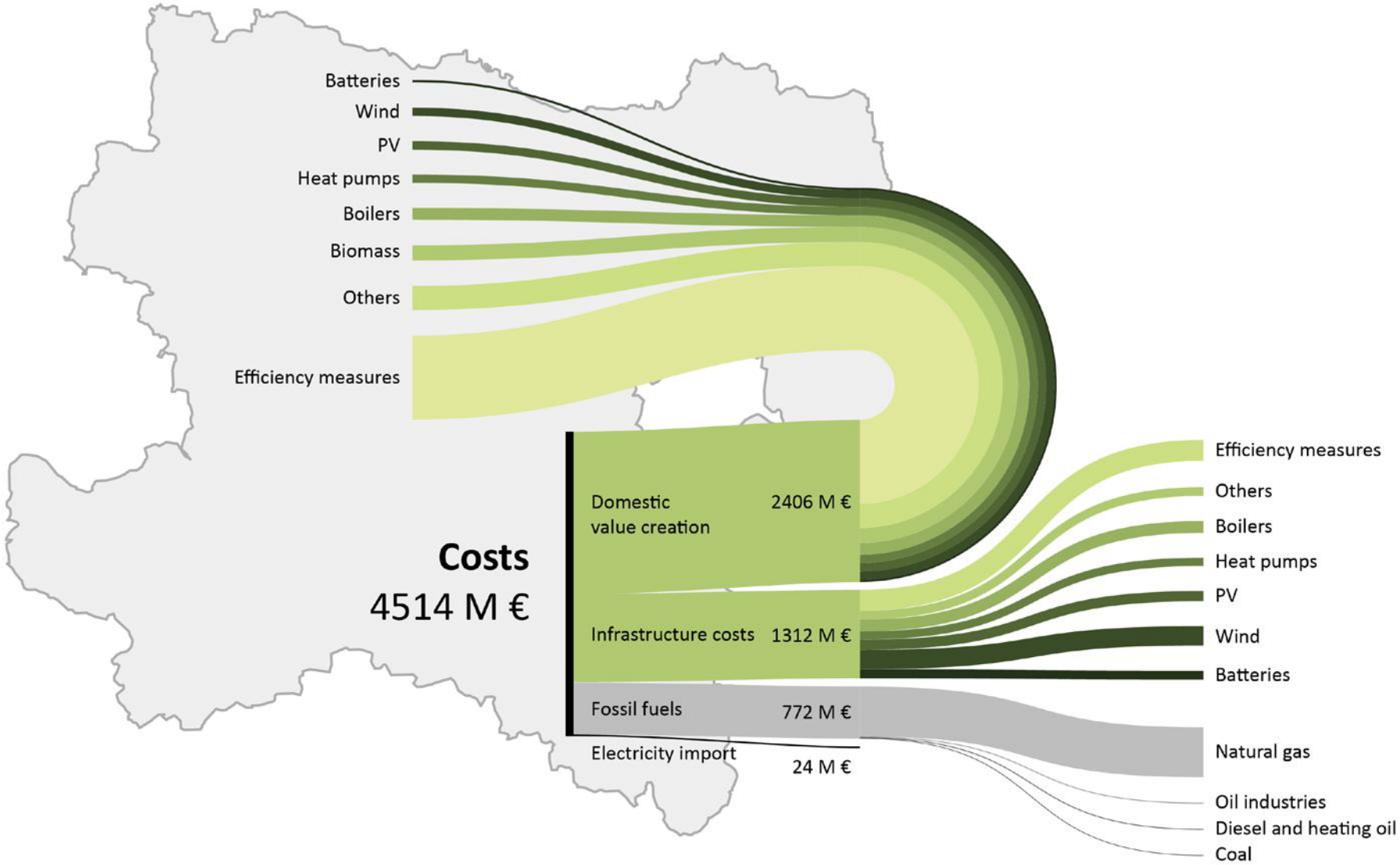
The energy model consists of a coupling of the entire energy system simulation model EnergyPLAN and an optimization algorithm. The algorithm looks for the combination of technologies that reduces CO_2 emissions at lowest possible costs. Each point in the graph represents the total cost and total annual CO2 emissions of a specific combination of technologies of the energy system.

Annual energy system cost structure - reference scenario



Subdivision of investments in the region and import of technology and raw materials

Annual energy system cost structure - target scenario



Subdivision of investments in the region and import of technology and raw materials

Annual energy system cost structure – case study South Tyrol Italy

Reference scenario

Local investment and O&M costs

220 M€

Fuel costs:
Oil
Gasoil
Petrol
Natural gas

1103 M€

Target scenario

Local investment and O&M costs

+

Energy efficiency costs

696 M€

Fuel costs:
Oil
Gasoil
Petrol
Natural gas

294 M€

Sustainable development – Is it worth it?

1.) The face of the refurbished buildings and their city quarters is changing drastically leading to a completely different aesthetics.

2.) Thermal internal comfort and air quality for inhabitants is strongly improved while reducing drastically the fossil energy consumption

3.) New living space in the city is created, comfort enhanced (new balconies, larger windows), accessibility enhanced (elevators added), building value increases

4.) Sustainable development reduces expenditures in imported fossil fuels allowing investments in local energy efficiency and renewables, creating local economic development and jobs!

Target: enhance quality of life in a sustainable way

Via Aslago building, Comune di Bolzano. Credits: Eurac Research

Thank you for your attention

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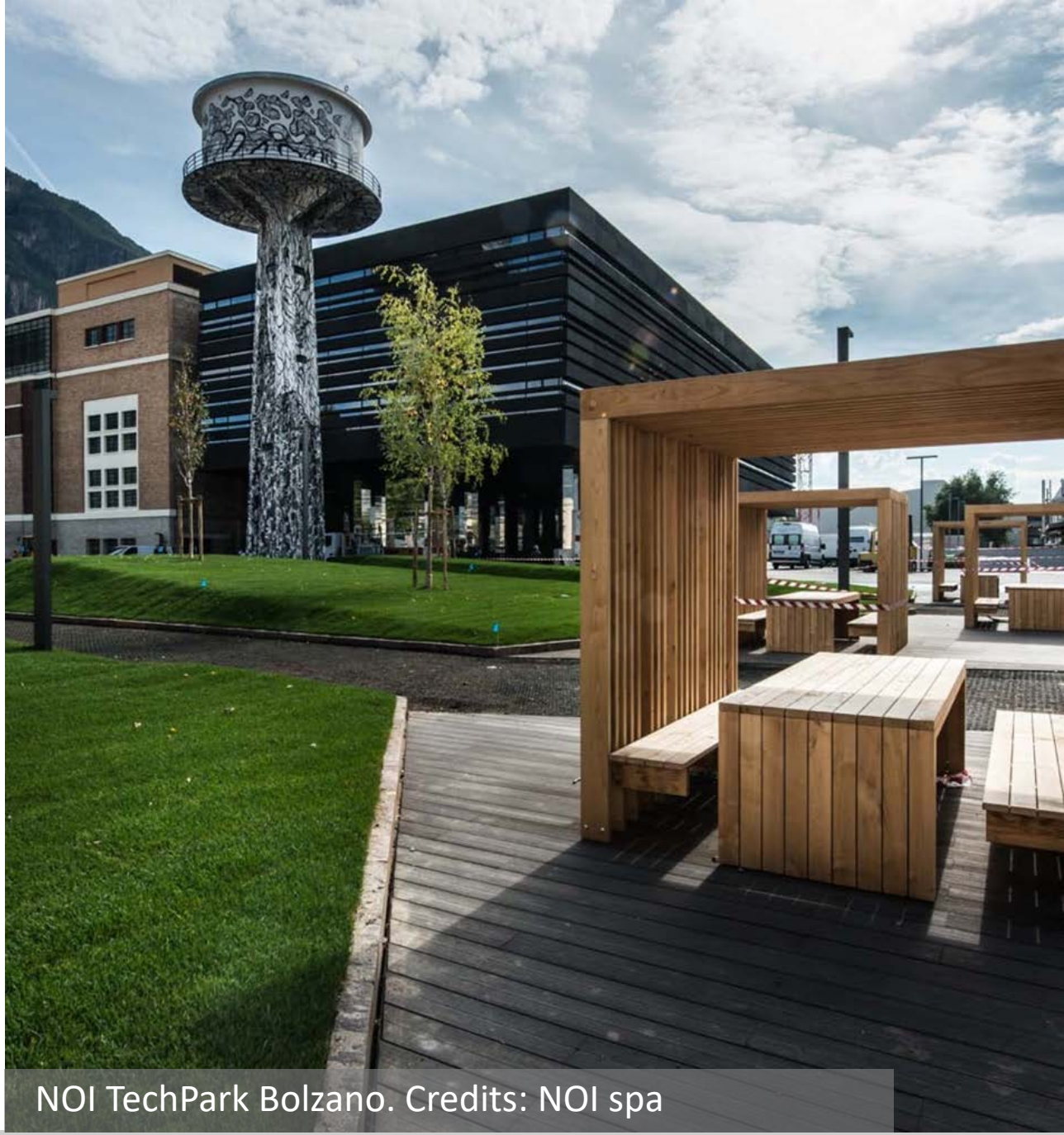


NOI TechPark Bolzano. Credits: NOI spa

Building Via Brescia - IPES

Planning team

Studio Tecnico Vettori
Arch. Elena Comelli
Ing. Mauro Tonellotto
Geom. Stefano Piva

Construction companies

Cavagnis costruzioni srl

Building Via Palermo - IPES

Planning team

Laboratorio di Architettura -
Arch. Roberta Casarini
Ing. Elena Cattani
Ing. Marina Bolzan
p.i. Thomas Meraner
Ing. Ivan Stuflesser

Construction companies

Cavagnis costruzioni srl

Buildings Via Similaun - IPES

Planning team

Area architetti associati –
Arch. Roberto Pauro e
Arch. Andrea Fregoni
Brescia 2 Progetti srl
Ing. Alessandro Gasparini

Constrcution companies

Cavagnis costruzioni srl
Lucato impianti srl
Icras costruzioni per architettura Srl

Building Passeggiata dei Castani - Comune di Bolzano

Planning team

Studio Mellano Associati
Arch. Alberto Sasso
Arch+More - Arch. Gerhard Kopeinig
Studio Benedikter – Arch. Manuel Benedikter
Studio Tecnico Vettori
Ing. Giuseppe Glionna
EQ Ingegneria

Construction companies

Carron Bau Srl
Aster Holzbau Srl
Wolf Fenster Spa

Buildings Via Aslago - Comune di Bolzano

Planning Team

Area Architetti Associati –
Arch. Roberto Pauro e
Arch. Andrea Fregoni
Ing. Paolo Rosa
Energytech Ingegneri s.r.l.

Construction companies

Nerobutto Snc
Ediltione Spa
Metallbau Glurn Srl
AP Elettrica Snc
Termoidraulica Parotto Srl

Sinfonia Smart City – What is it?

The SINFONIA project is a **five-year initiative** to **deploy large-scale**, **integrated** and **scalable energy solutions** in mid-sized European cities.

City of Bolzano. Credits: IDM, Clemens Zahn

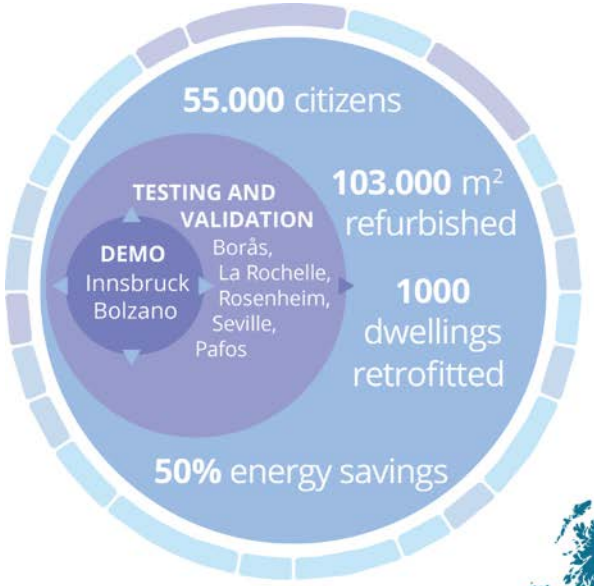
Demo sites

2 pilot cities:

- **Bolzano**
- Innsbruck

5 Early adopter cities:

- Borås
- Pafos
- Sevilla
- La Rochelle
- Rosenheim



Sinfonia

Project numbers

Total budget

- 43 million €

Co-financing by EU

- 27 million €

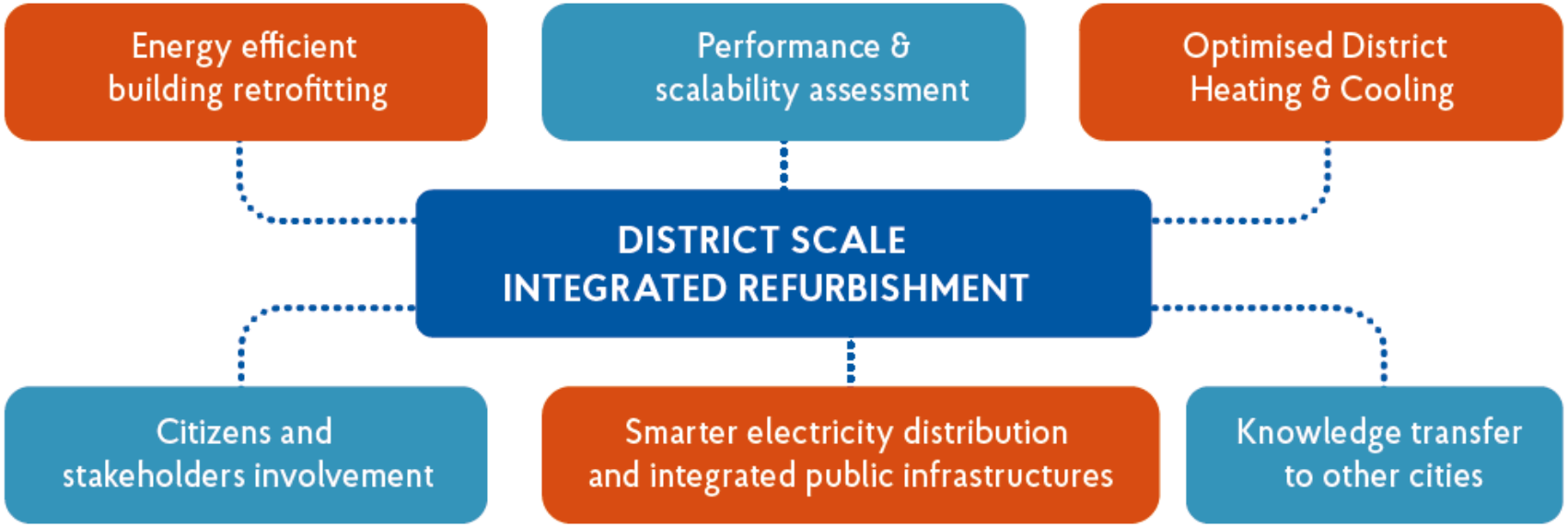
Overall investment in the region is over 30 million € as building efficiency measures are running in parallel with a massive extension of district heating in Bolzano.

Sinfonia

eurac research · Città di Bolzano Stadt Bozen · WOBI IPES · alperia · KlimaHaus CasaClima · IDM Südtirol Alto Adige

Target - Replicable and scalable district solutions

Refurbishment of > 100.000 m² living surface, **reduction of energy** consumption by **40-50%**, application of **renewables by over 20%.**



Sinfonia

Sinfonia in Bolzano

Credits: Alperia

Enhancement of district heating system

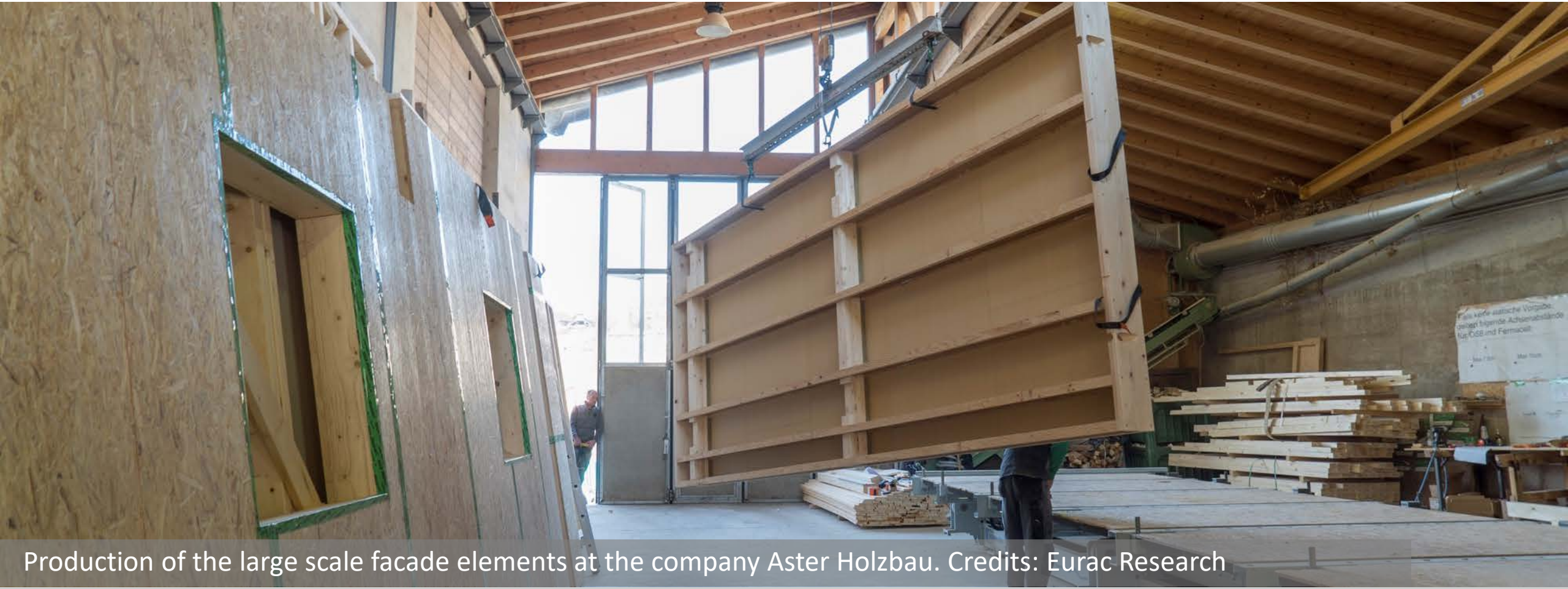
Credits: Comune di Bolzano

Infrastructure for mobility and services

Credits: Eurac Research

Large scale refurbishment of social housing

Technology innovation – prefabricated façade



Production of the large scale facade elements at the company Aster Holzbau. Credits: Eurac Research

Production of wooden façade elements

For the refurbishment of one building, prefabricated wooden facade elements have been used. These large scale elements are produced offsite and mounted on sight in a very short timing.

Production of wooden facade elements, Aster Holzbau. Credits: Eurac Research

Testing of a prototype of the façade in the laboratory

Facade element testing infrastructure at Eurac Research, NOI TechPark Bolzano. Credits: Eurac Research

Prototype realization in the laboratory

In the laboratory several prototypes have been set up emulating the situation on site. Construction of a brick wall, application of the wooden façade element including window and ventilation.

Construction of the prototypes in the laboratory of Eurac Research. Credits: Eurac Research

Prototype measurement set up for testing

Based on the experiences of set up and laboratory tests, the facade construction has optimized for the full scale application.

Prototypes set up with sensors for testing in the double guarded hot box lab at Eurac Research. Credits: Eurac Research

Mounting of the prefabricated facade elements

The large single elements are connected on pre-mounted fixing systems on the building façade.

Passeggiata dei Castani, Comune di Bolzano. Credits: Arch. Manuel Benedikter, Arch. Alberto Sasso

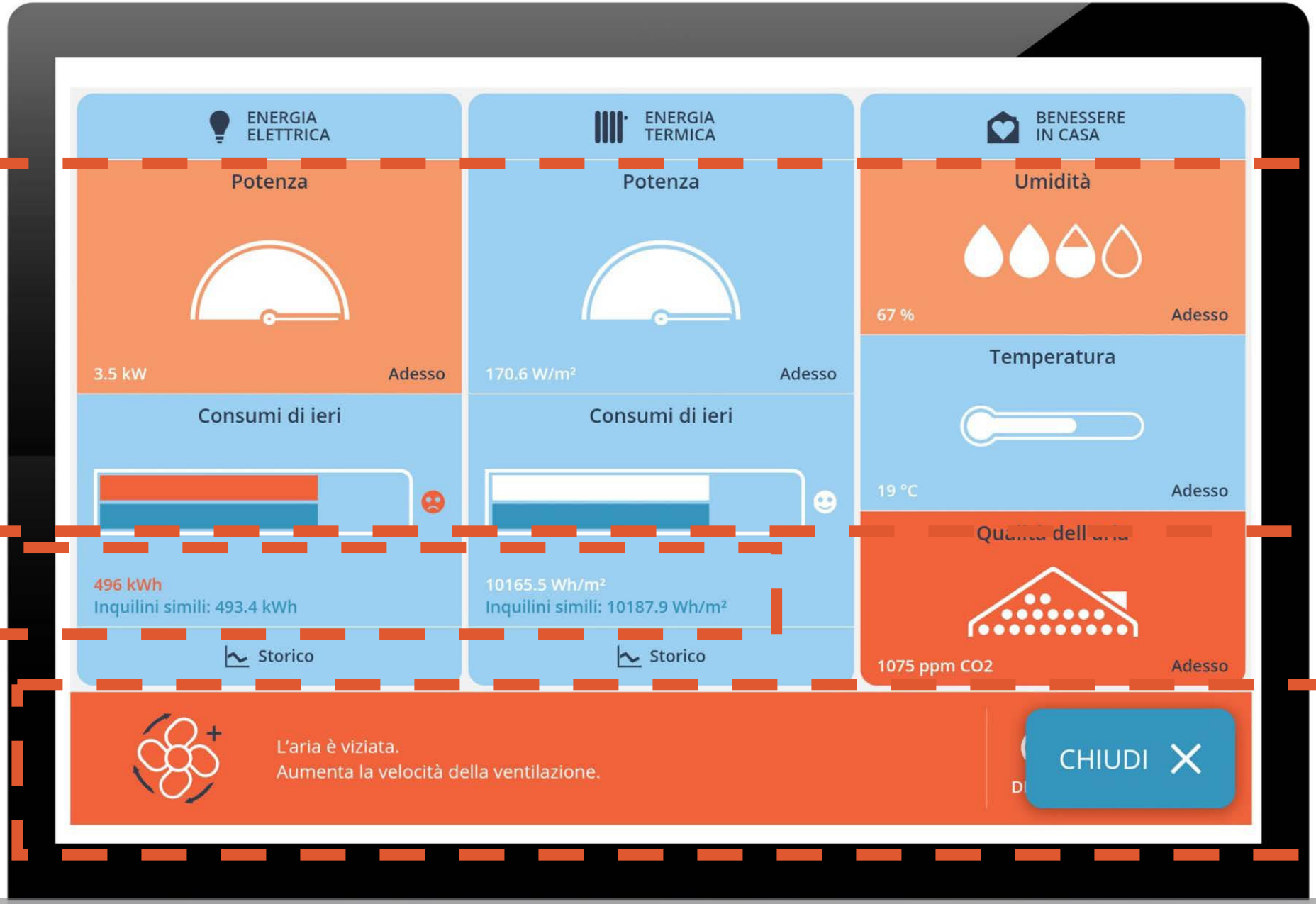
Real time information to tenants over dedicated displays …

Does the energy consumption of tenants change if they have proper **information real time** at disposal?

Can real time information support them for indoor air quality in an energy efficient way?

In over **100 flats dedicated screens will be installed** giving real time information on energy parameters and air quality!

Example of home mounted display. Credits: Eurac Research



Example of screen visualization with real time information. Credits: Eurac Research