efre·fesr Südtirol · Alto Adige
Europäischer Fonds für regionale Entwicklung
Fondo europeo di sviluppo regionale

EUROPEAN UNION

AUTONOME PROVINZ BOZEN SÜDTIROL
PROVINCIA AUTONOMA DI BOLZANO ALTO ADIGE

Energy sector coupling: electric-thermal interaction through heat pumps

Tuesday 23th of October 2018

eurac research – *Institute for Renewable Energy*

NOI Tech Park, via A. Volta 13/A, Bolzano

Integrids

This workshop has received funding from the EFRE- FESR 2014- 2020 programme- project "INTEGRIDS" n. 1042

INTEGRIDS project

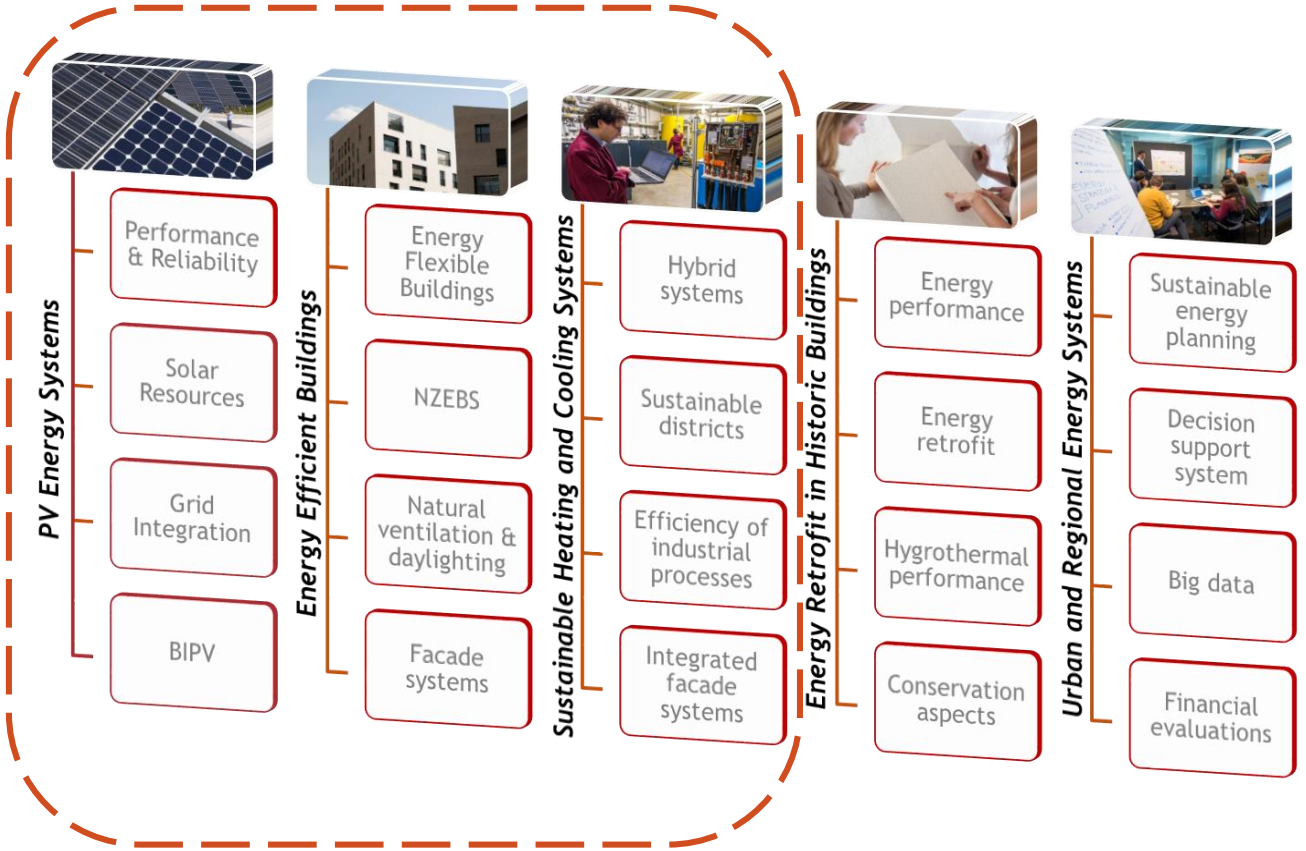
Electric and thermal grids integration with energy flexible buildings

Grazia Barchi, PhD
Eurac Research – Institute for Renewable Energy

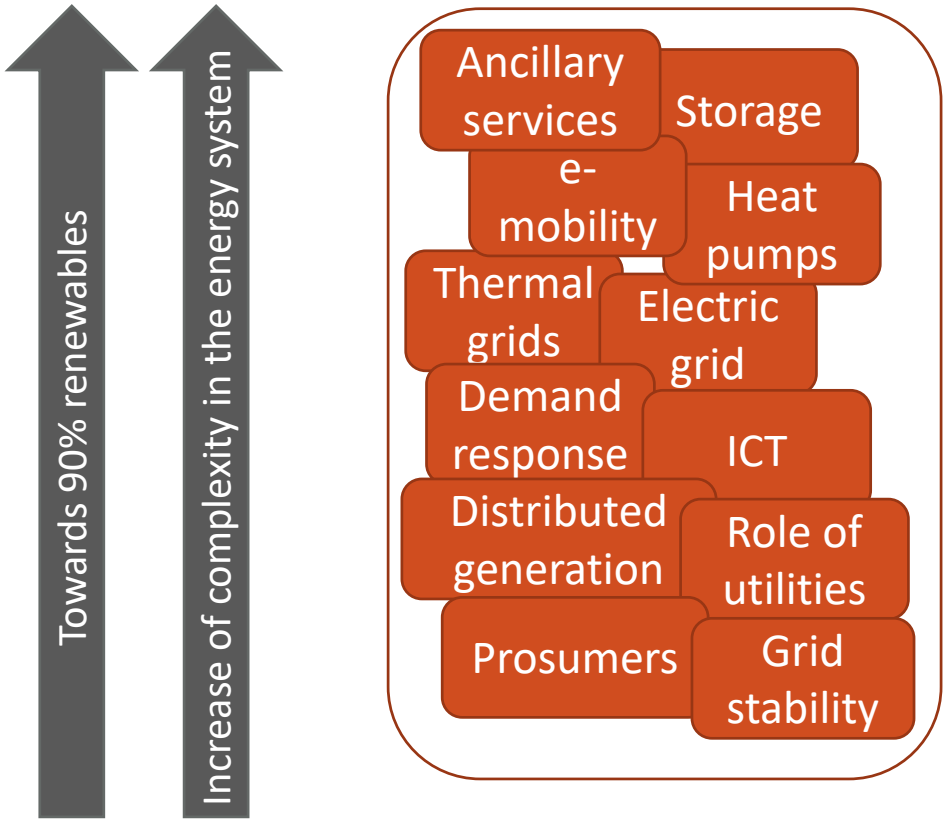
Workshop on "Energy sector coupling: electric-thermal interaction through heat pumps"
Bozen October 23rd, 2018

Project overview

- European fund for regional development of the province of BZ
- Three RENENE groups involved
- Duration of the project 35 months
  (**January 2017 – December 2019)**



Context



Klimaland “Energy strategy of South Tyrol” targets 2050

INTEGRIDS will explore the concept of integrated energy grids defined as the synergy between thermal and electrical networks to enable high renewable energy penetration in efficient buildings and districts.

Objectives

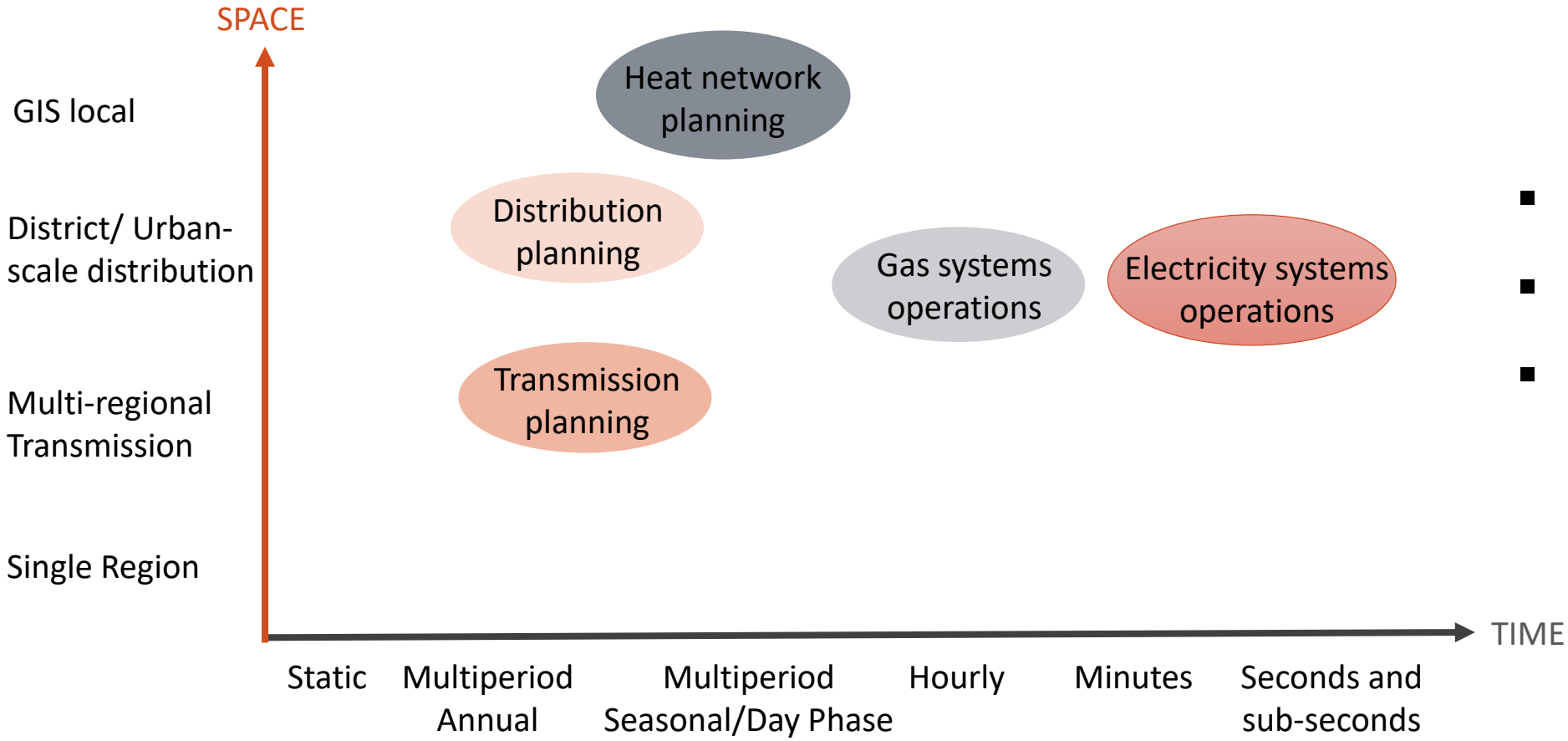
MODELS FOR INTEGRATED GRIDS

FLEXIBILITY IN BUILDINGS AND DISTRICTS

LABORATORY INFRASTRUCTURE

ENGAGE LOCAL STAKEHOLDERS

Models for integrated grids

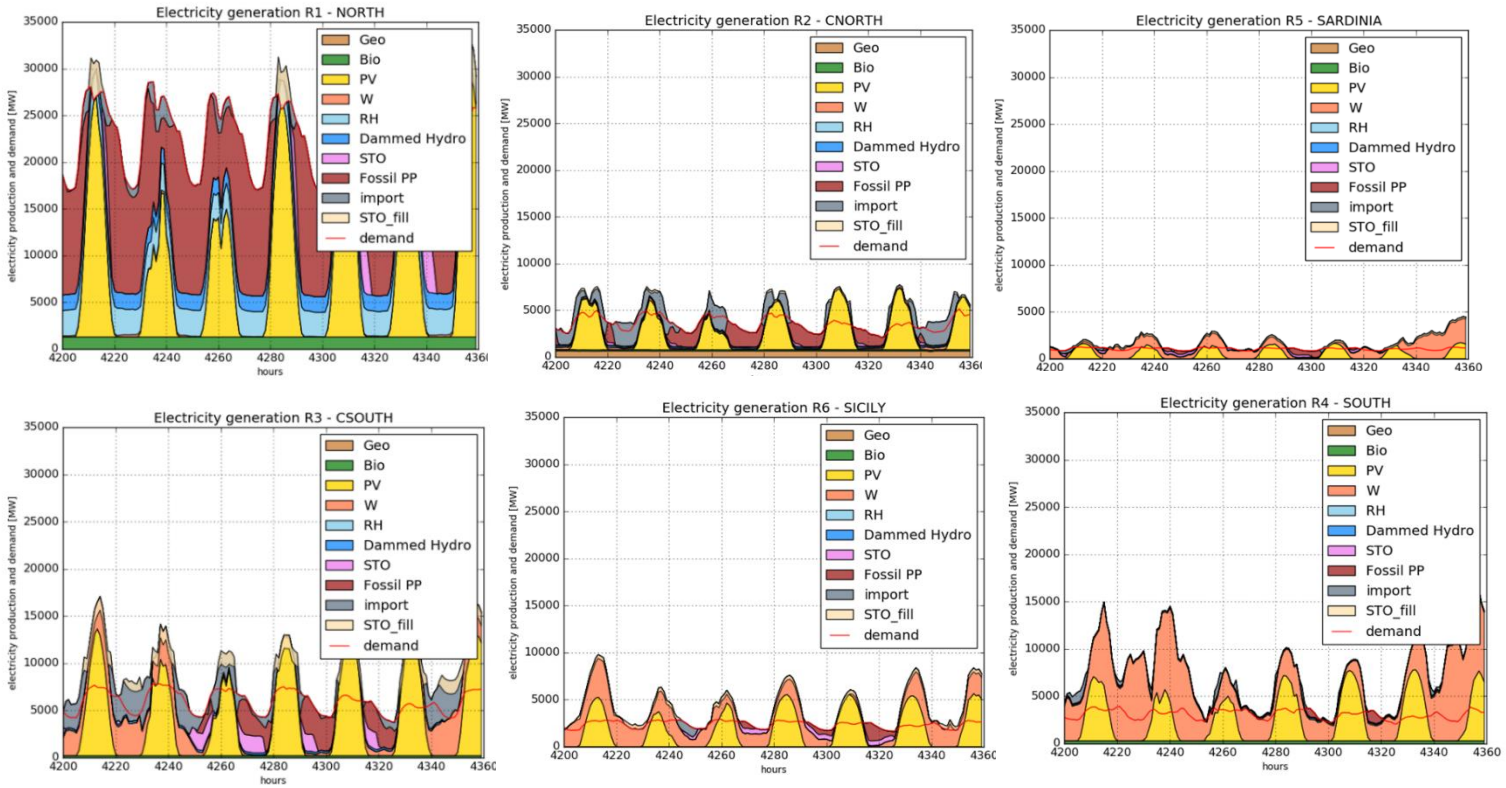


- Different time resolution
- Different spatial resolution
- Different level of accuracy

Source: P. Mancarella, G. Andersson, J. A. Peças-Lopes and K. R. W. Bell, "Modelling of integrated multi-energy systems: Drivers, requirements, and opportunities," *2016 Power Systems Computation Conference (PSCC)*, Genoa, 2016, pp. 1-22.

Models for integrated grids – RES impact

- **Multi-regional level – Hourly resolution**

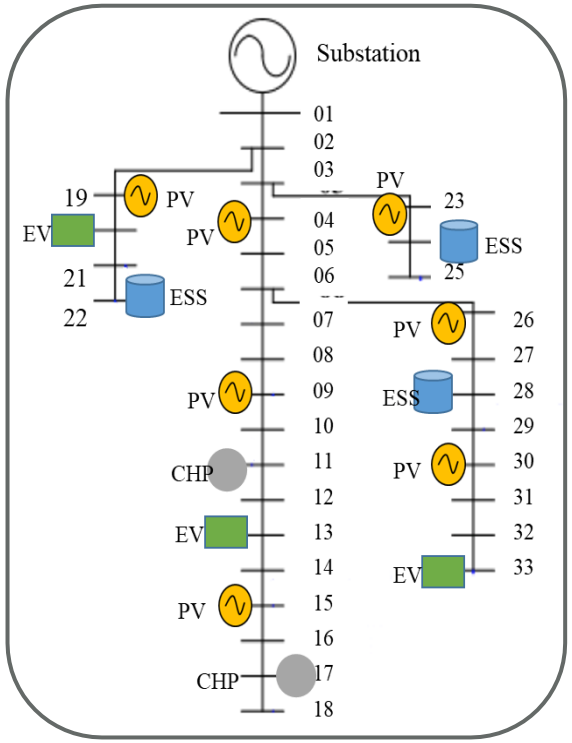


oemof ['ø:məf]
open energy modeling framework

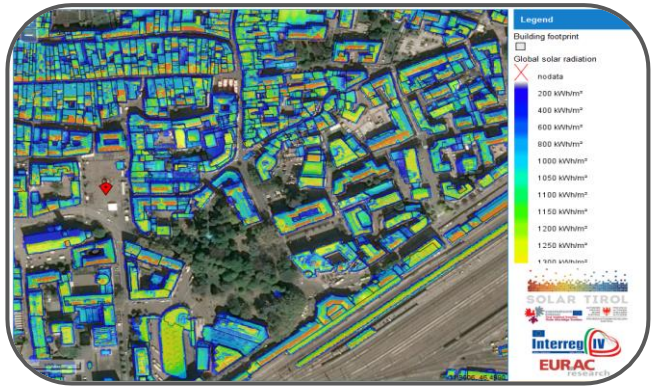
Models for integrated grids – MV/LV distribution grid

- **Urban scale – Minute and second time resolution**

MV-LV Distribution grid



Solar Tyrol cadaster

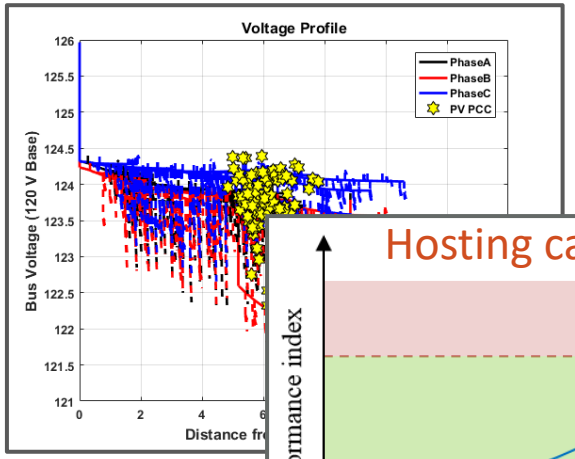


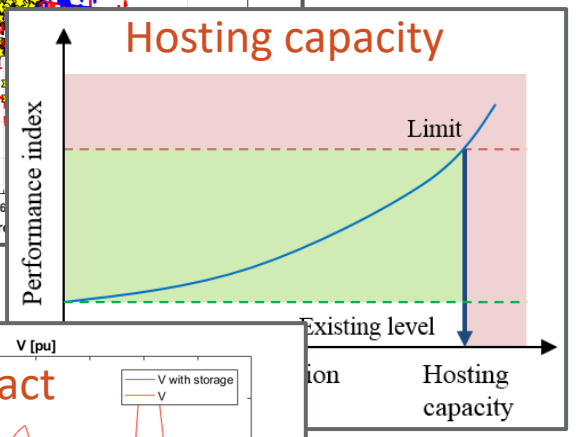
LoadProfileGenerator

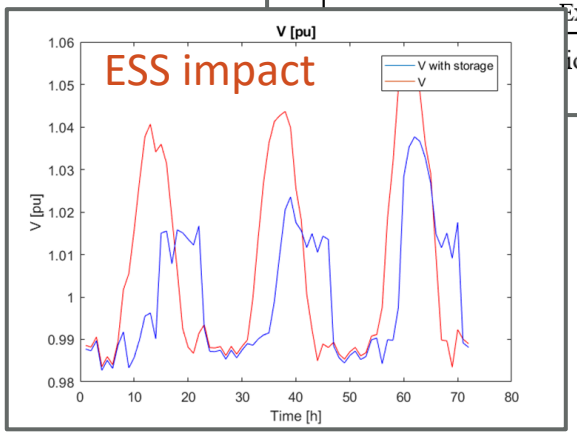
HP profiles

TRNSYS 18

Peak-time analysis







DSS

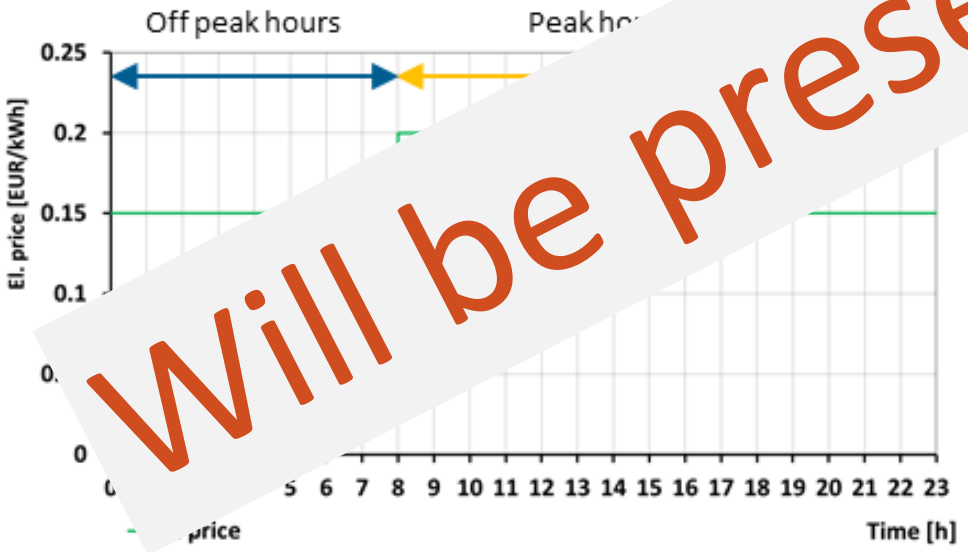
Impact of DERs requires Time-series POWER FLOW ANALYSIS!!

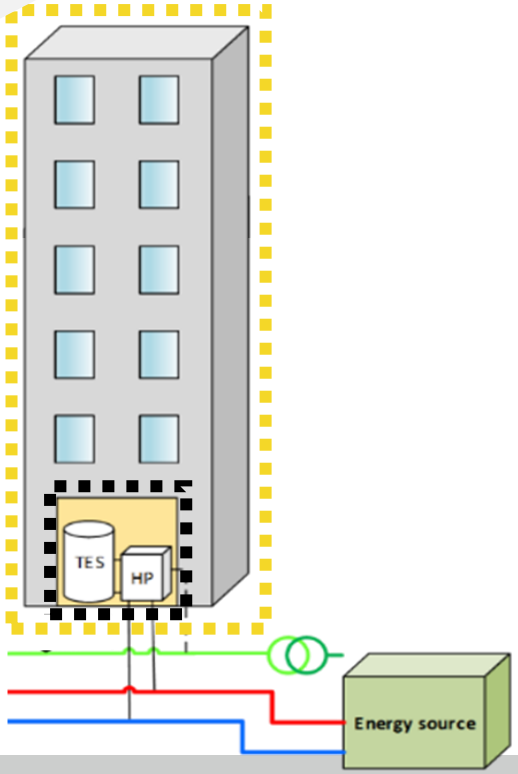
Models for integrated grids – DSM in DHC

Potential study on DSM in DHC networks wi… HPs

Buffa S., Cozzini M., Henze G. P., Dipasquale… ISEC 2018, Graz

Will be presented later!!





Flexibility in buildings and districts

Energy Flexibility represents the capacity of a building to react to one or more forcing factors, minimizing their effects in a given time interval.

LOW FREQUENCY FORCING FACTORS

- Climate change
- Macro-economic factors
- Technological improvement
- Building intended use
- Energy production cost

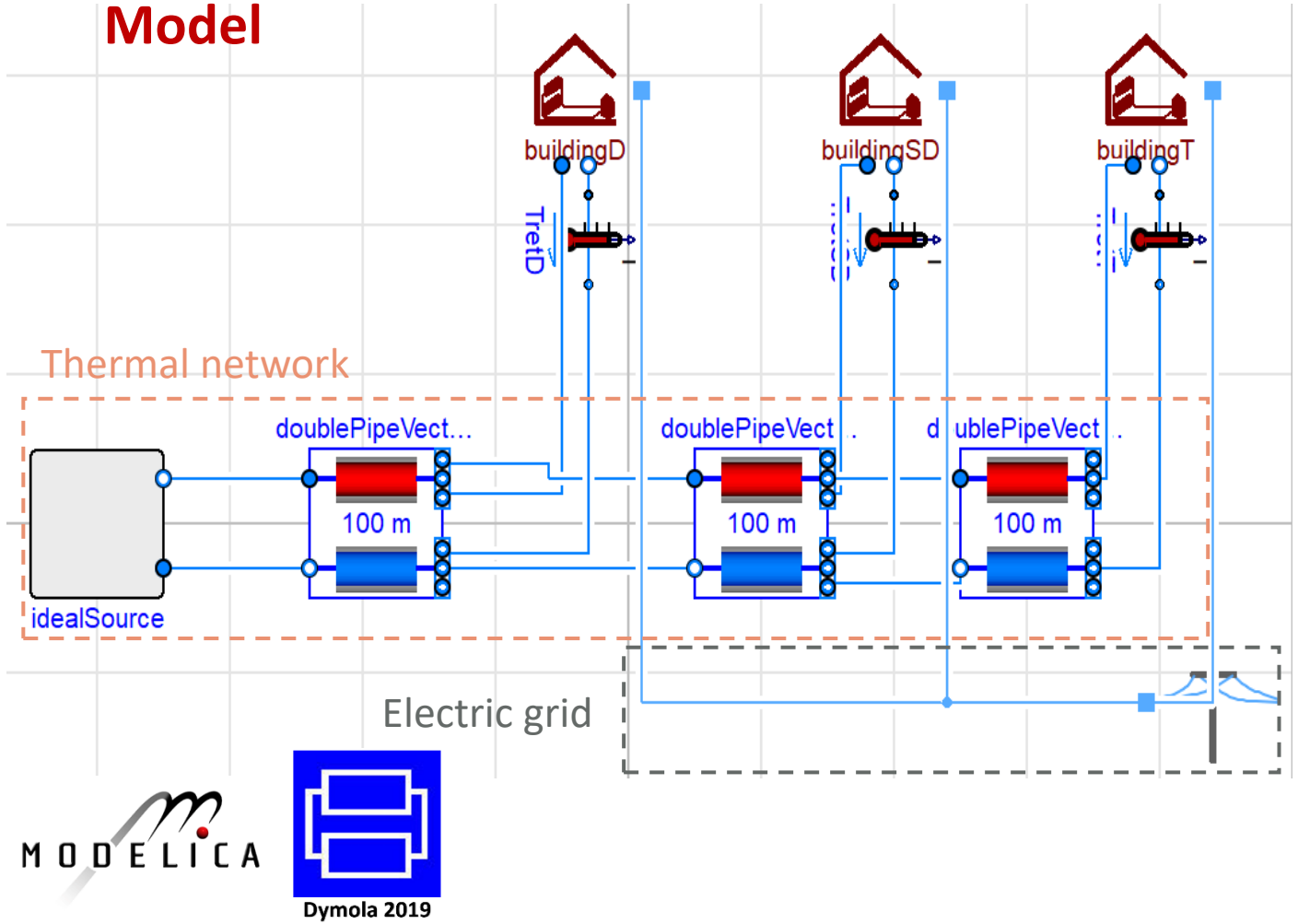
HIGH FREQUENCY FORCING FACTORS

- Internal loads
- Solar loads
- User behavior
- Energy prices

Vigna I., Pernetti R., Pasut W., Lollini R., "New domain for promoting energy efficiency: Energy Flexible Building Cluster". *Sustainable Cities and Society*, 38 (2018), 526–533.

Flexibility in buildings and districts

Model



Define the building energy demand profile at district level and quantify the energy flexibility potential of buildings

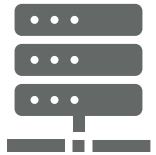
FORCING FACTORS

- Matching with RES production
- Electricity price
- CO_2 emissions due to the electrical grid

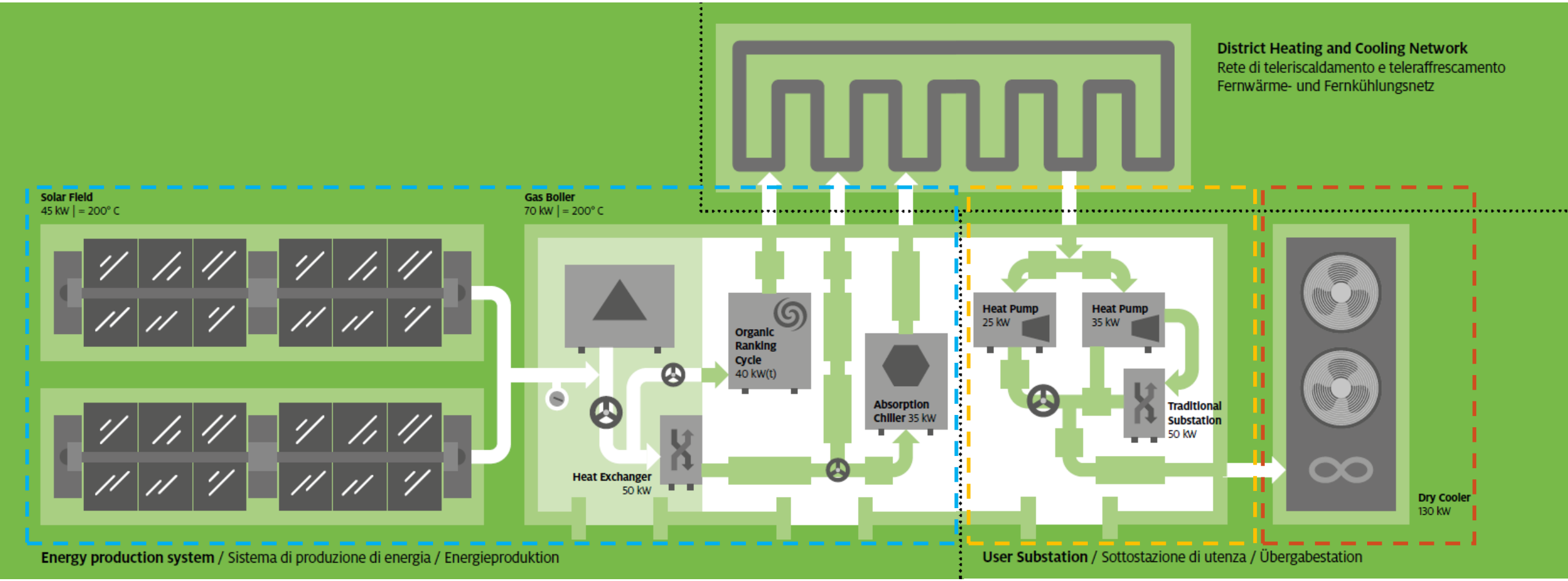
Laboratory – Energy Exchange lab

ExCHangE

- Traditional DH networks
- Heat-pump based DHC (H2020 flexynet project)



Laboratory – Energy Exchange lab



Laboratory – Energy Exchange lab

Generation units and network

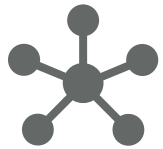
Solar field

Network

Substations

Laboratory – PV Integration lab

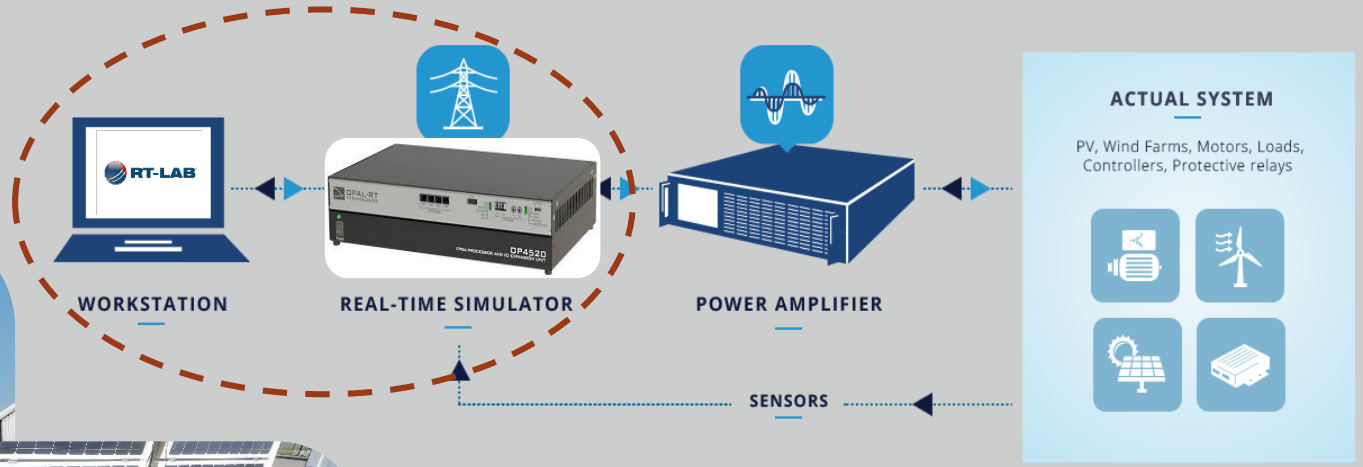
PV Integration



- Building Integrated PV
- Electronic load
- Electric storage
- Electric grid real-time simulator

Laboratory – PV Integration Lab

- Different PV installations



- Real-time electric grid simulator
  - Control prototyping
  - HIL
  - PIL (today no power amplifier)

Laboratory – MultiLAB

MultiLAB

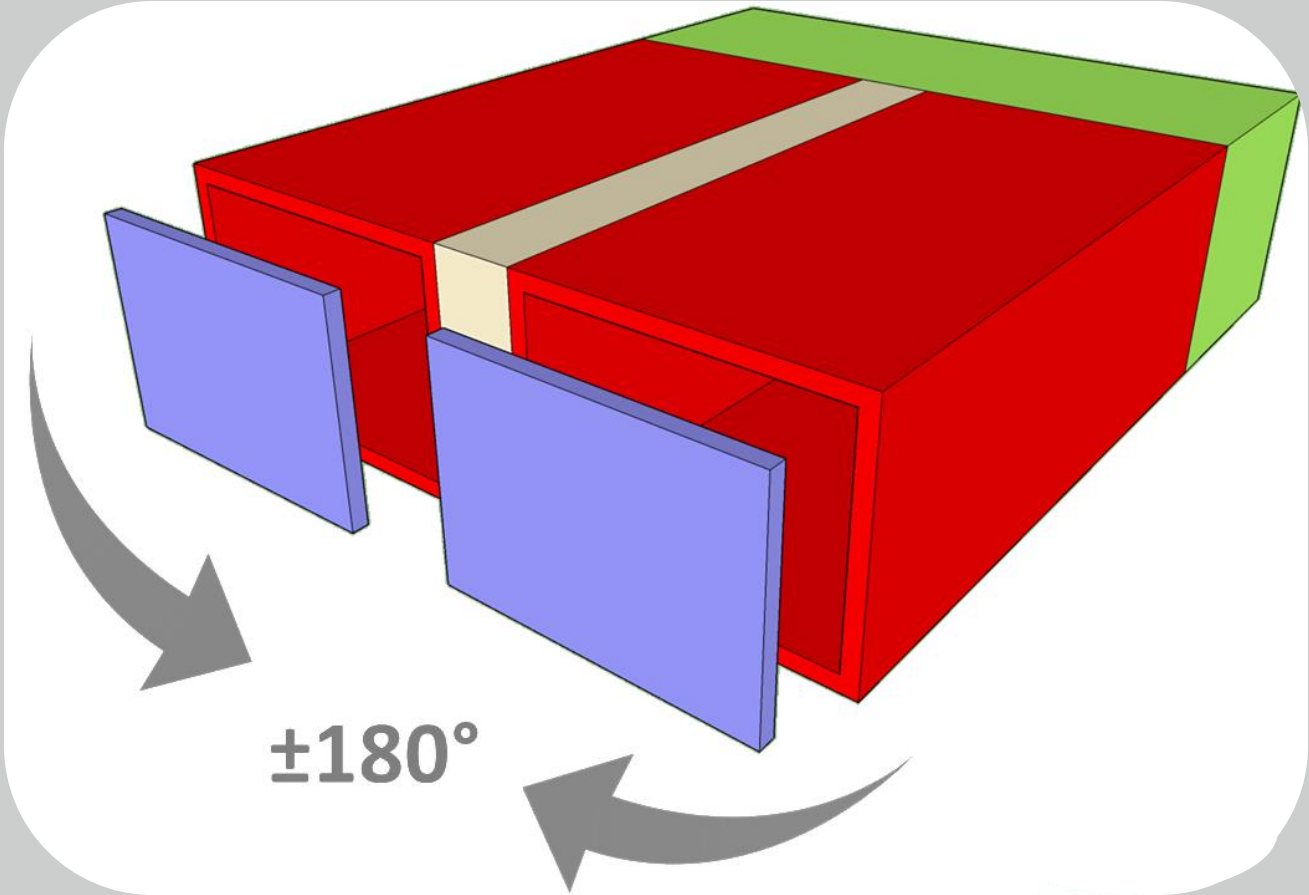
- Test facades
- Building energy demand profiles

Laboratory – MultiLAB

Two identical environmental chambers which can rotate to obtain the desired orientation for

- Testing building envelop components such multifactional facades systems
- Analysis of human thermal comfort and indoor environmental quality

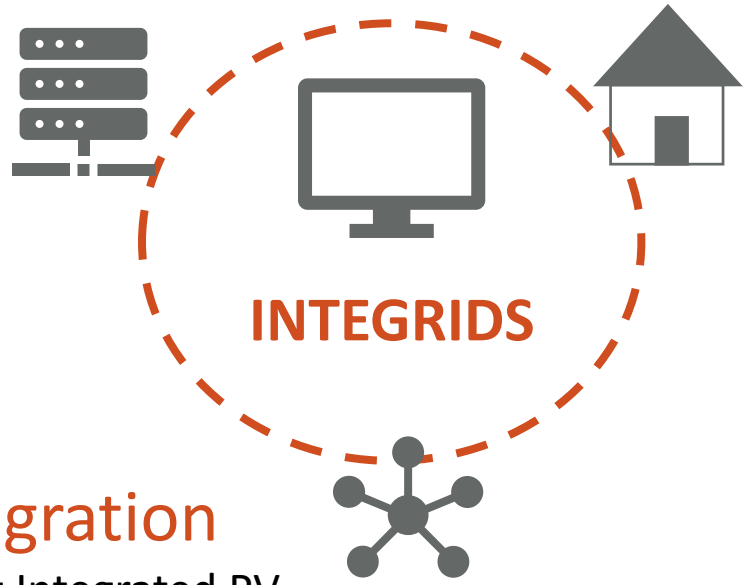
Ready by June 2019!



Laboratory – Integrids infrastructure

ExCHangE

- Traditional DH networks
- Heat-pump based DHC (H2020 flexynet project)



MultiLAB

- Test facades
- Building energy demand profiles

PV Integration

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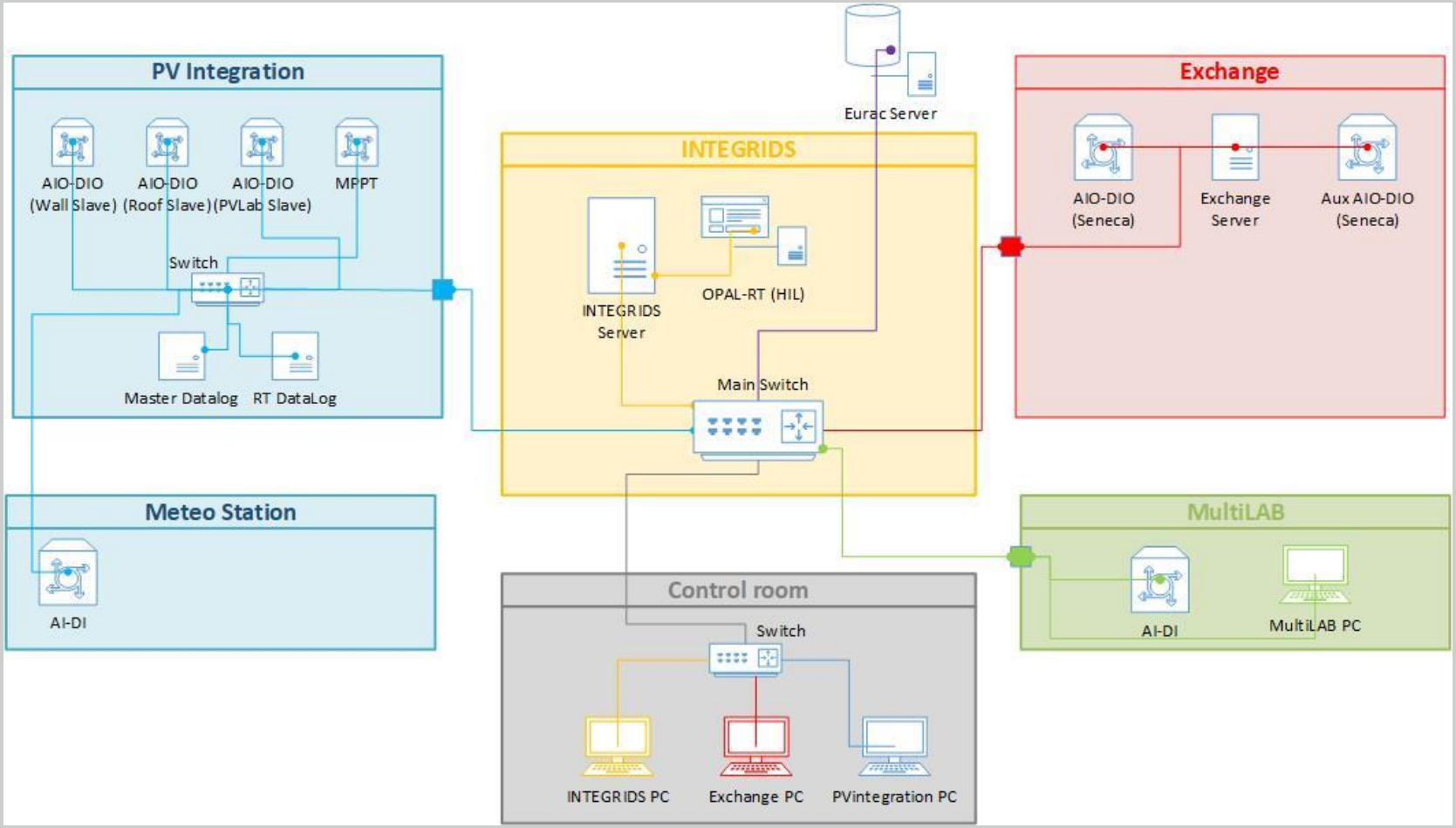
Laboratory – Integrids infrastructure



Online Mode:

- At least two labs run at the same time for the same experiment

(e.g. meet the Exchange HP demand with PV production)

Offline Mode:

- Data stored in the Database can be used from a single lab to run an experiment

(e.g. using building profiles previously generated by MulitiLAB for Exchange lab tests)

Laboratory – Energy management system

OBJECTIVES

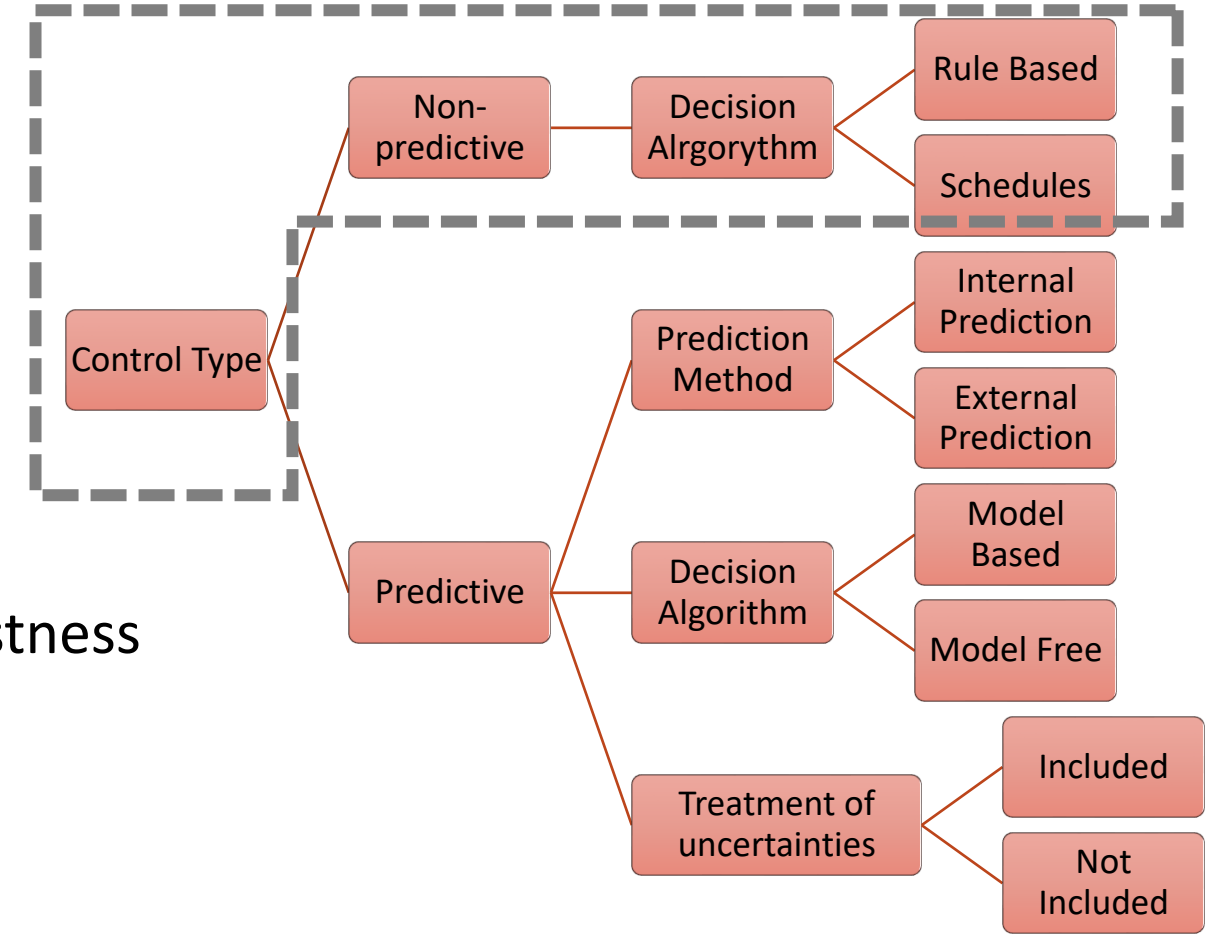
- Maximize RES exploitation
- Price changing
- Grid support

BENEFITS

- fast and simple rules
- good performance
- low computational power and robustness

CHALLENGES

- Direct lab control
- Priority management



Engage local stakeholders

- **Local Project Advisory Board (PAB) Members:**

KlimaHaus CasaClima®	Energy certification of buildings
CONFCOOPERATIVE	New districts and buildings
alperia	Utility / electrical grid/ district heating
H2 SOUTH TYROL	Expert in the field of H2 and e-mobility
edyna	Electrical grid and e-mobility
SYNECO energy | environment | innovation	Consultant in the energy sector
IPES	Owner of social housing
SEV	Cooperative small energy producers
energytech	Engineering company
IDM SÜDTIROL ALTO ADIGE	Expert in the energy sector

- **National Project Advisory Board (PAB) Members:**

RSE Ricerca Sistema Energetico	Research on energy system
GRID PARITY 2	Virtual power plant concept and ESCO
POLITECNICO MILANO	Polytechnic of Milan

Thank you for the attention!

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