Renewable Energy Communities as an Enabler for PV

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16th IAEE European Conference
Ljubljana, 28.08.2019

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 764786

Why energy communities?

“Renewable Energy Communities as an Enabler for PV”

Main drivers for renewable energy communities:

- Lower investment costs due to community investments
- More benefitial due to increased self-consumption
- Access to PV in case of building restictions

Overview

"Renewable Energy Communities as an Enabler for PV"

Method:

→ Portfolio (investment) optimization

- Investments into PV and storages
- Regional characteristics (8 countries)
  - Grid tariff design and electricity prices / demand / PV generation
- Different community sizes
  - No community / within one building / multiple buildings

Research question:

→ What is the optimal investment in PV and storages per country to reduce consumers costs?

Target Countries and Reference Cities

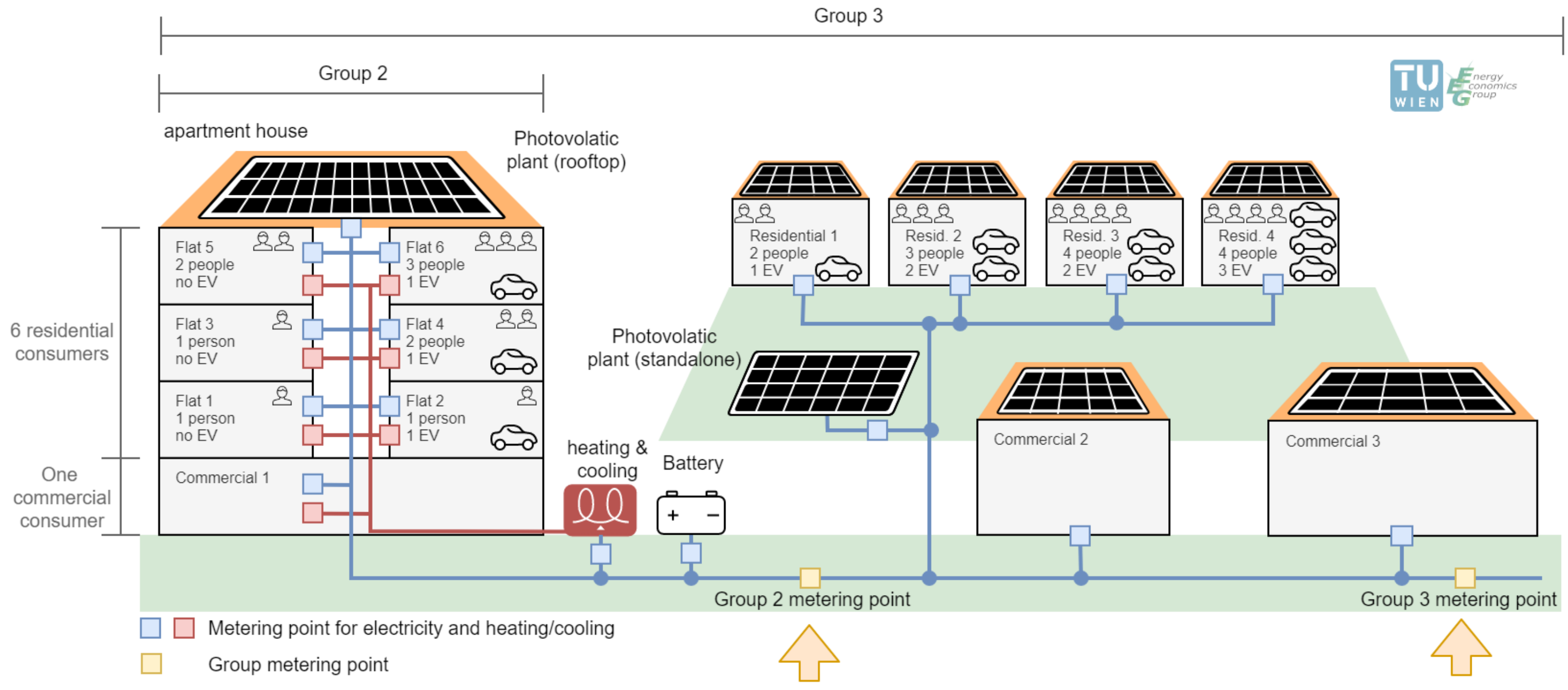
8 countries

Map data ©2019 GeoBasis-DE/BKG (©2009), Google, Inst. Geogr. Nacional, Mapa GISrael, ORION-ME United States

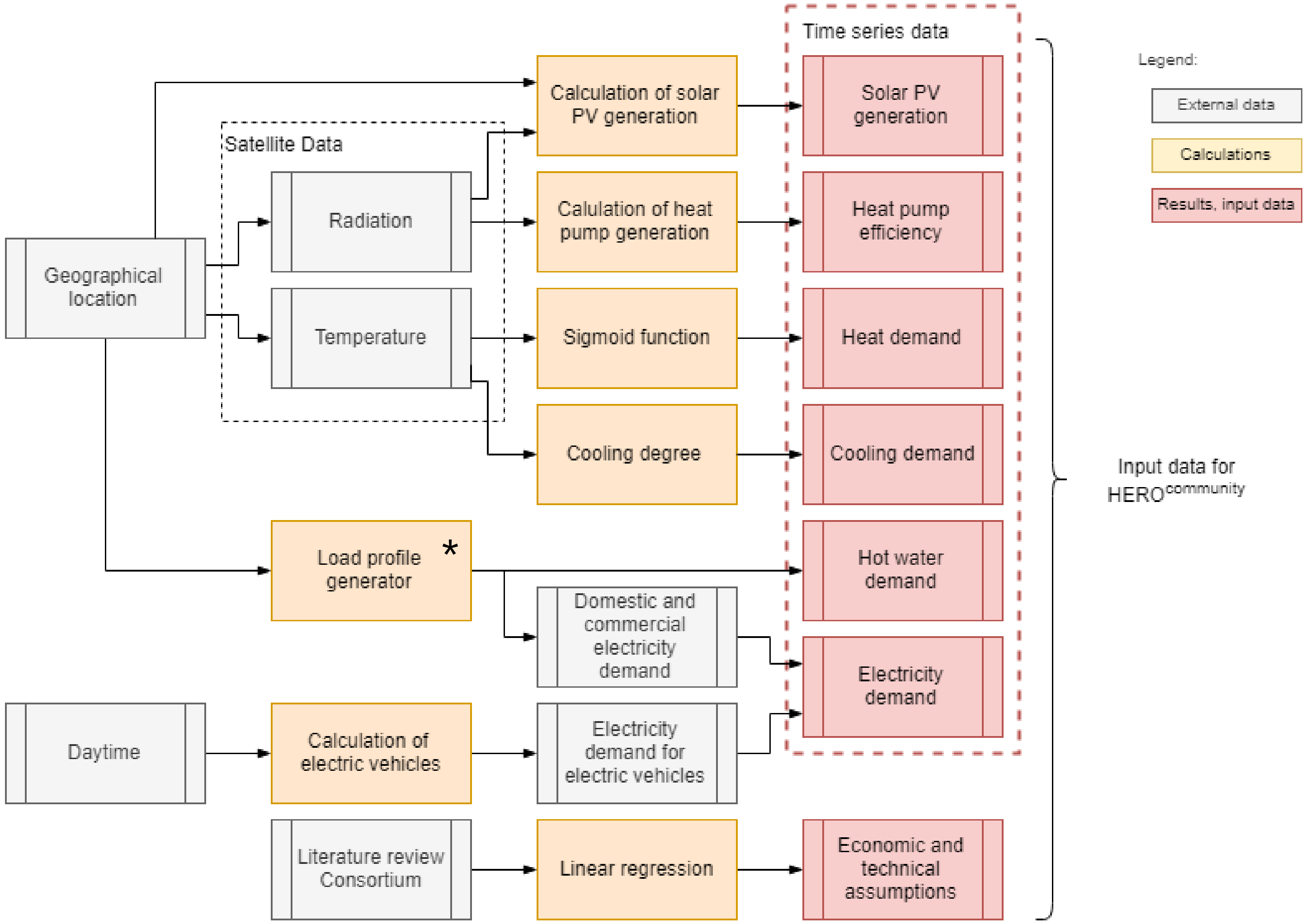
Target Country	Reference City
Austria	Vienna
Belgium	Brussels
France	Paris
Germany	Berlin
Italy	Rome
Portugal	Lisbon
Spain	Madrid
The Netherlands	Amsterdam

Setup for the renewable energy community

- "European Village" represents average housing situation in Europe



Calculation of the Input Data



*Load profile generator source: Pflugradt N., 2019. https://www.loadprofilegenerator.de

Data requirements for simulation of PVP4Grid concepts

Economic data

Billing components of the retail price for electricity:

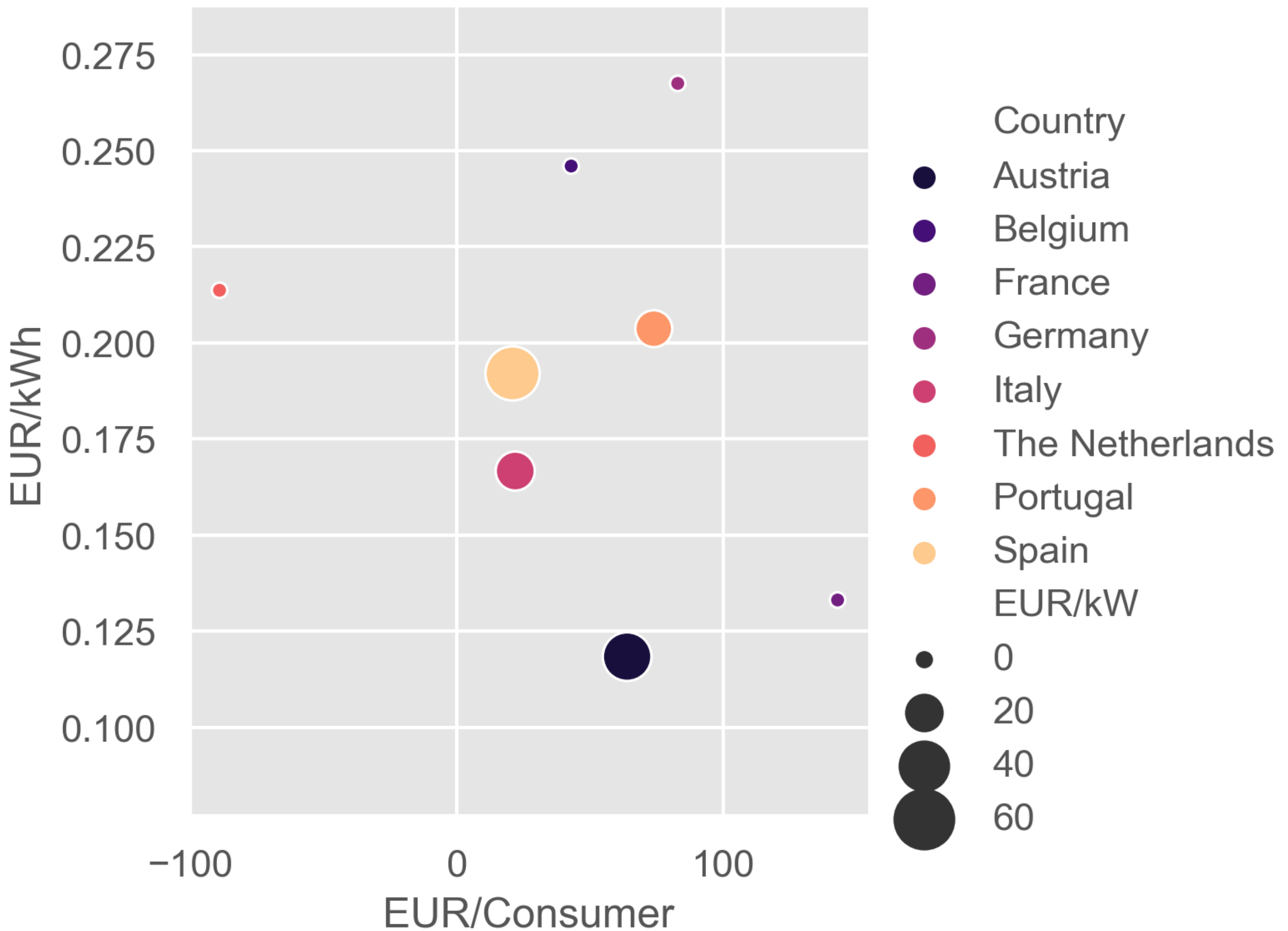
- *Energy tariffs* for private, commercial and industrial consumers (electricity, gas, district heating) in €/kWh, €/kW and €/a
- *Grid or network tariffs* for electricity and gas grid and district heating network in €/kWh, €/kW and €/a
- *Taxes and fees* for private, commercial and industrial consumers in €/kWh, €/kW and €/a

Aggregated to three components:

- EUR/kWh
- EUR/Consumer/Year
- EUR/kW

Current tariff design in the target countries

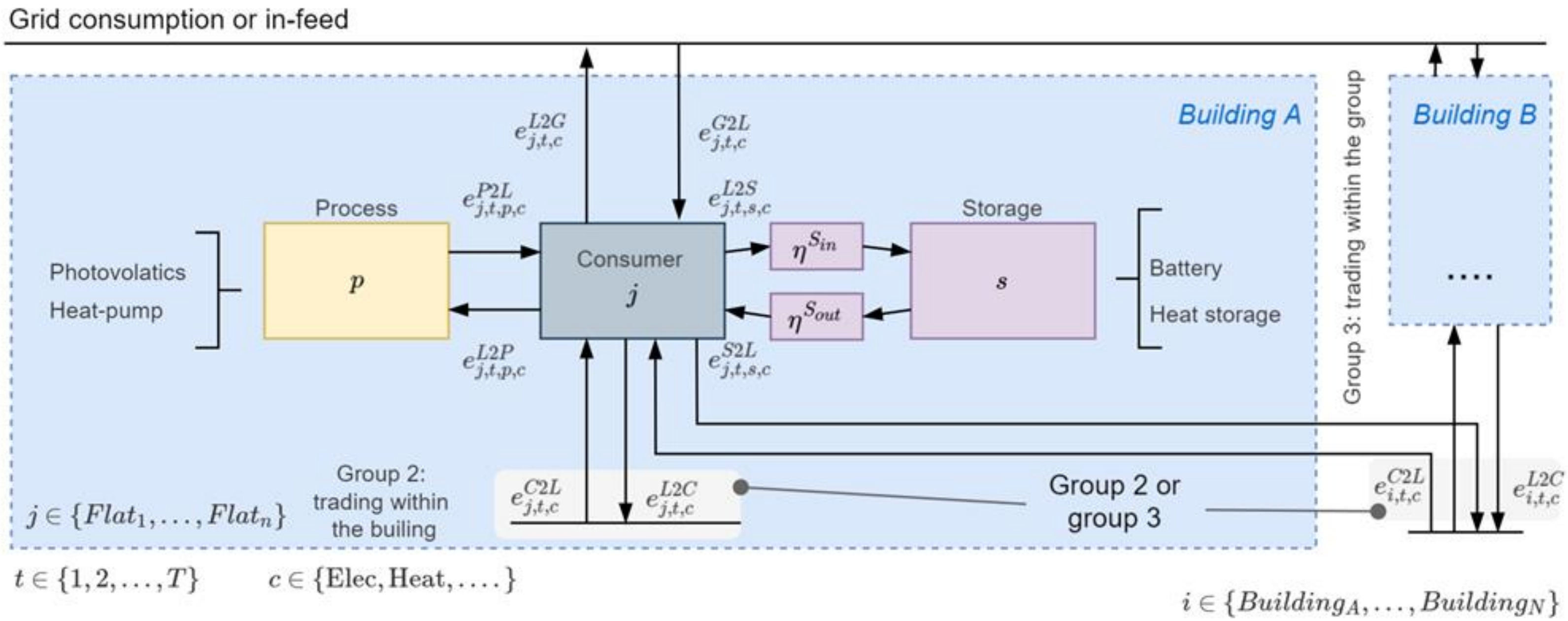
Electricity costs = Energy costs + Grid tariffs + taxes and fees



Overview of energy flows for the optimization

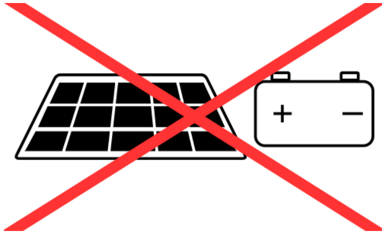
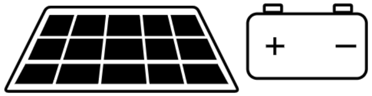
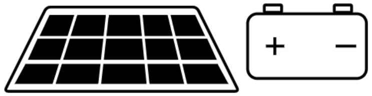
- Optimization tool Hero^{Community}
- Investment into PV and storages if beneficial
- Minimize annual costs (Investment, operational)

$$Total\ Costs(Year) = \alpha * Investment + Grid + Fixed - Revenues$$



Community Scenarios

- ***Grid consumption***:
  - No investments in PV and BESS
  - Demand is satisfied via the grid
- ***No community***:
  - Investments in PV and BESS are possible
  - Energy sharing not allowed
- ***Community***:
  - Investments in PV and BESS are possible
  - Energy sharing allowed

	Metering point	***Technologies***
Grid consumption	separately	
No community	separately	
Community	aggregated	

Electric vehicles (EV)
Photovoltaics (PV)
Battery energy storage systems (BESS)

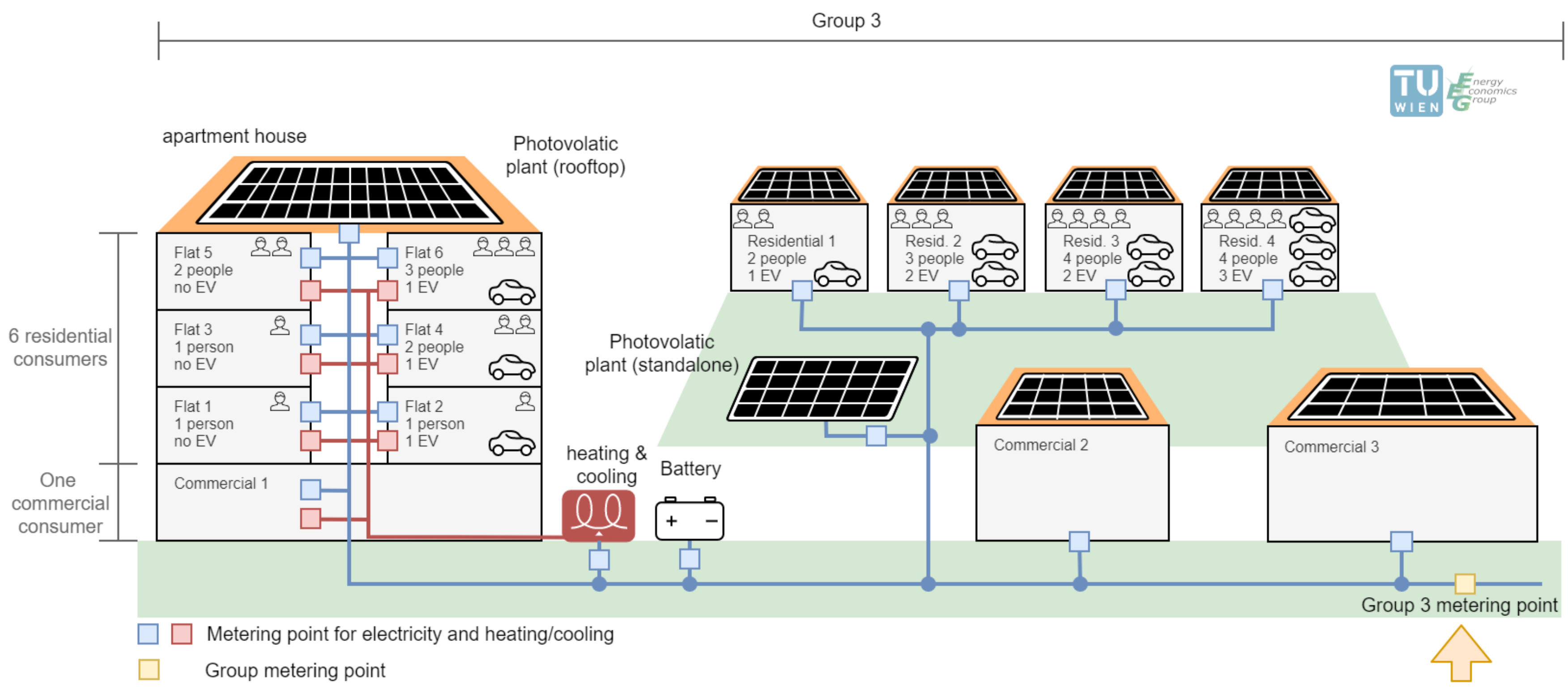
Demand Scenarios

- ***Baseline***
  - Reflects fossil age
  - Heat, hot-water and individual transportation is fossil fuel based
- ***Future***
  - Higher electricity demand due to Sector coupling
  - Heat, hot-water and individual transportation is electricity based

	Floor heat and hot-water generation	***Individual Transportation***
Baseline	Fossil	Fossil
Future	Electric Heat-Pumps	Electric Vehicles

Results for Group 3 "European Village"

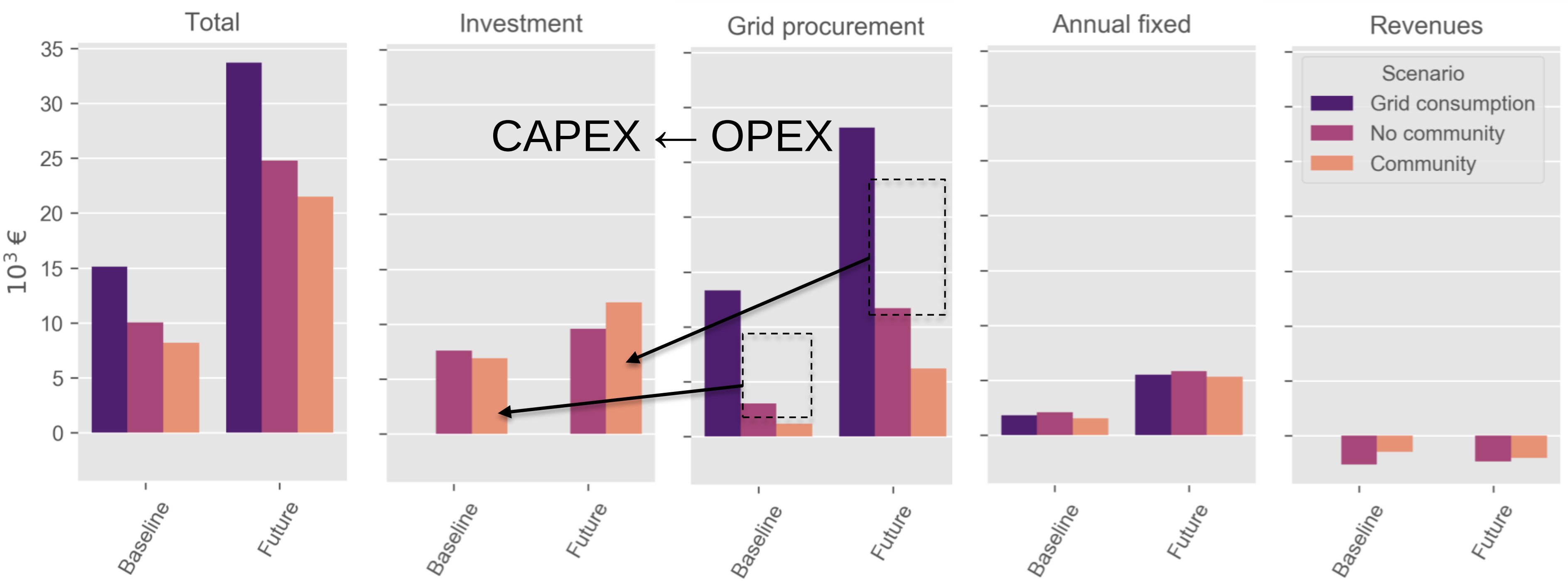
- The whole "European village" (group3) as a renewable energy community
- Minimizing: $Total\ Costs(Year) = \alpha * Investment + Grid + Fixed - Revenues$



Results for Group 3 "European Village"

Electricity costs with investments

$$Total\ Costs(Year) = \alpha * Investment + Grid + Fixed - Revenues$$

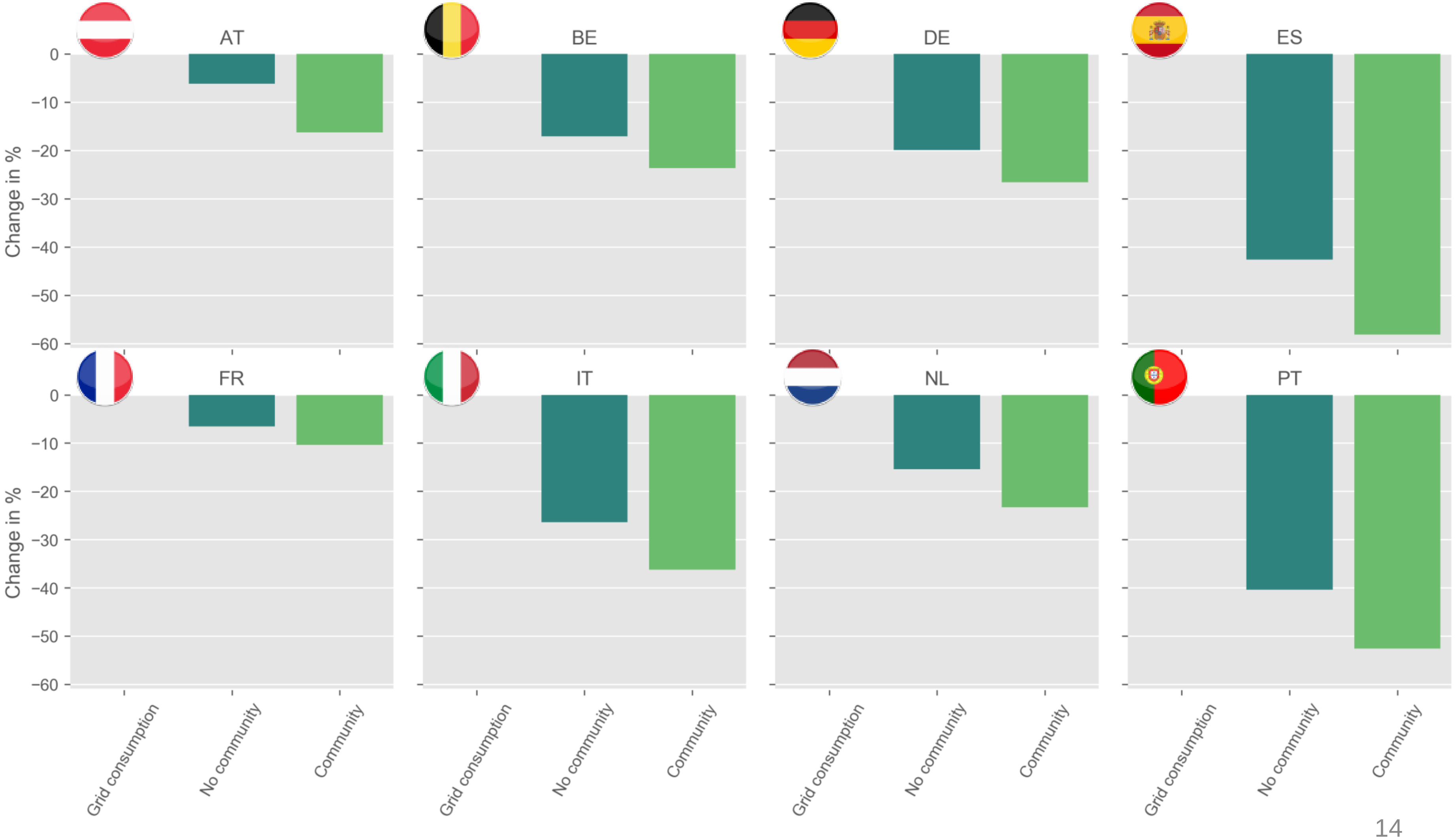


Demand scenario	Heat	Cars
Baseline	Fossil	Fossil
Future	Heat pump	EV's

Community scenario	Investments	Community
Grid consumption	No	No
No Community	Yes	No
Community	Yes	Yes

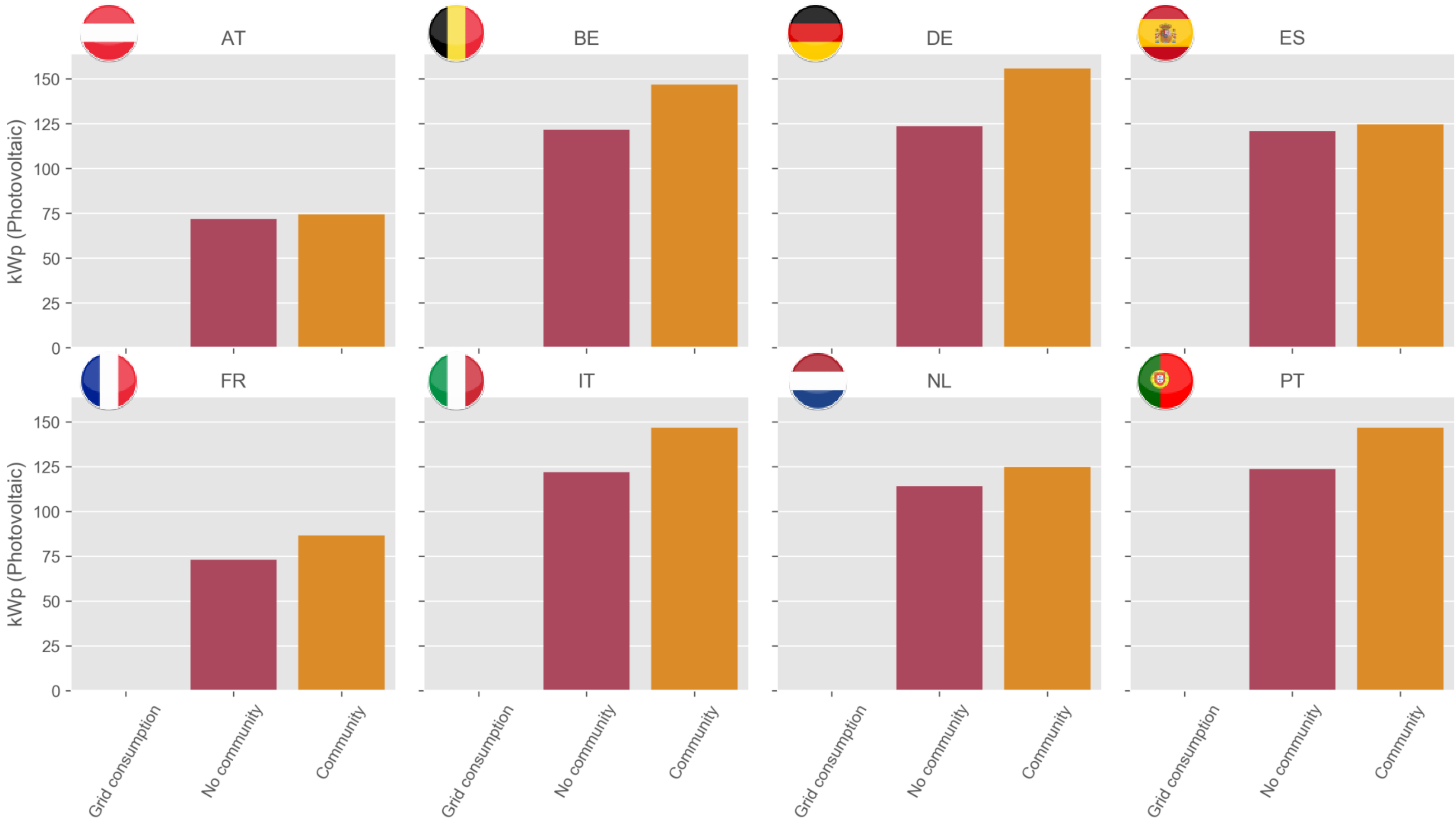
Results for Group 3 “European Village“

Change in Total Costs (compared to Grid Consumption)



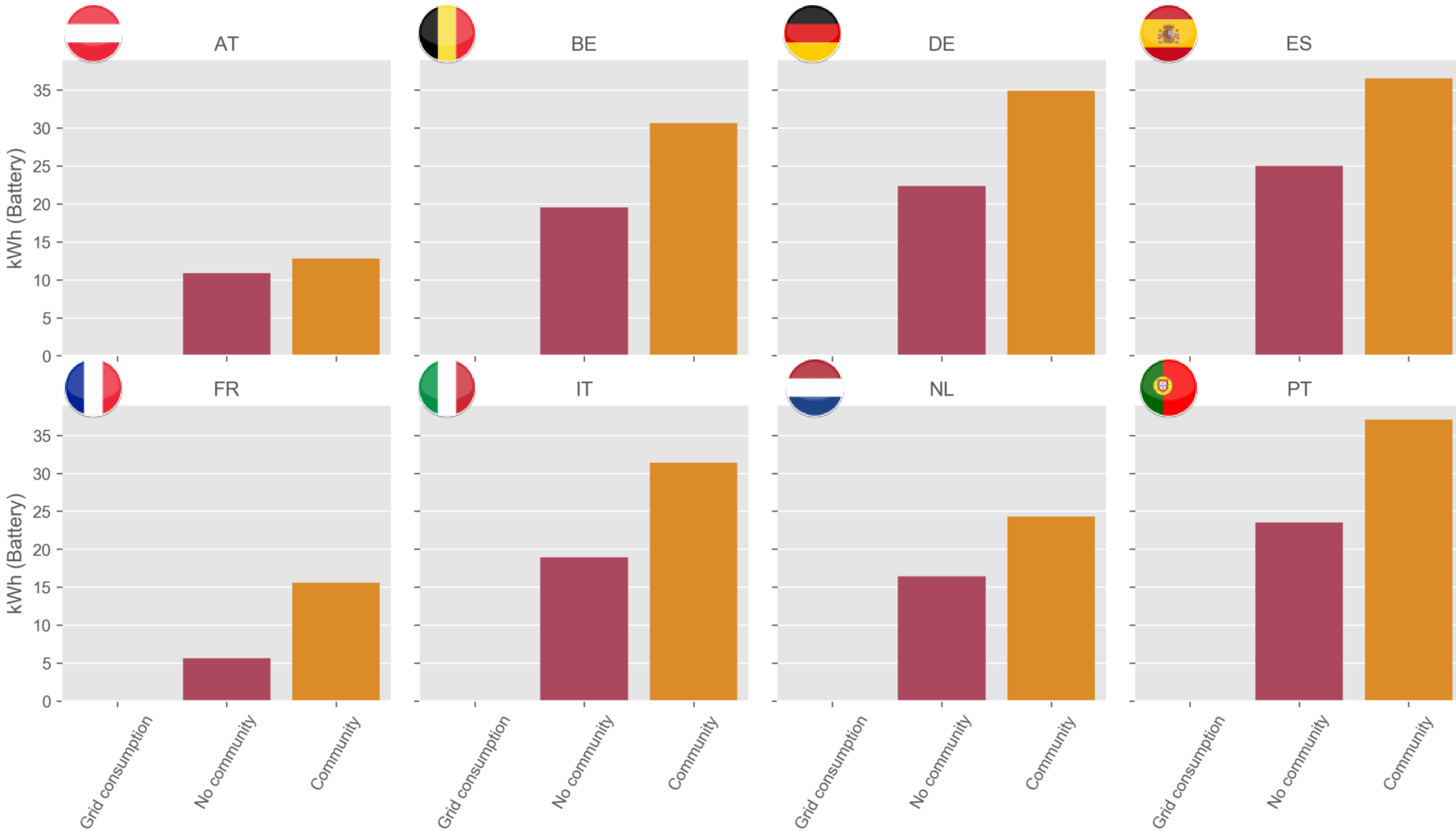
Results for Group 3 “European Village“

Installed PV capacity in kWp



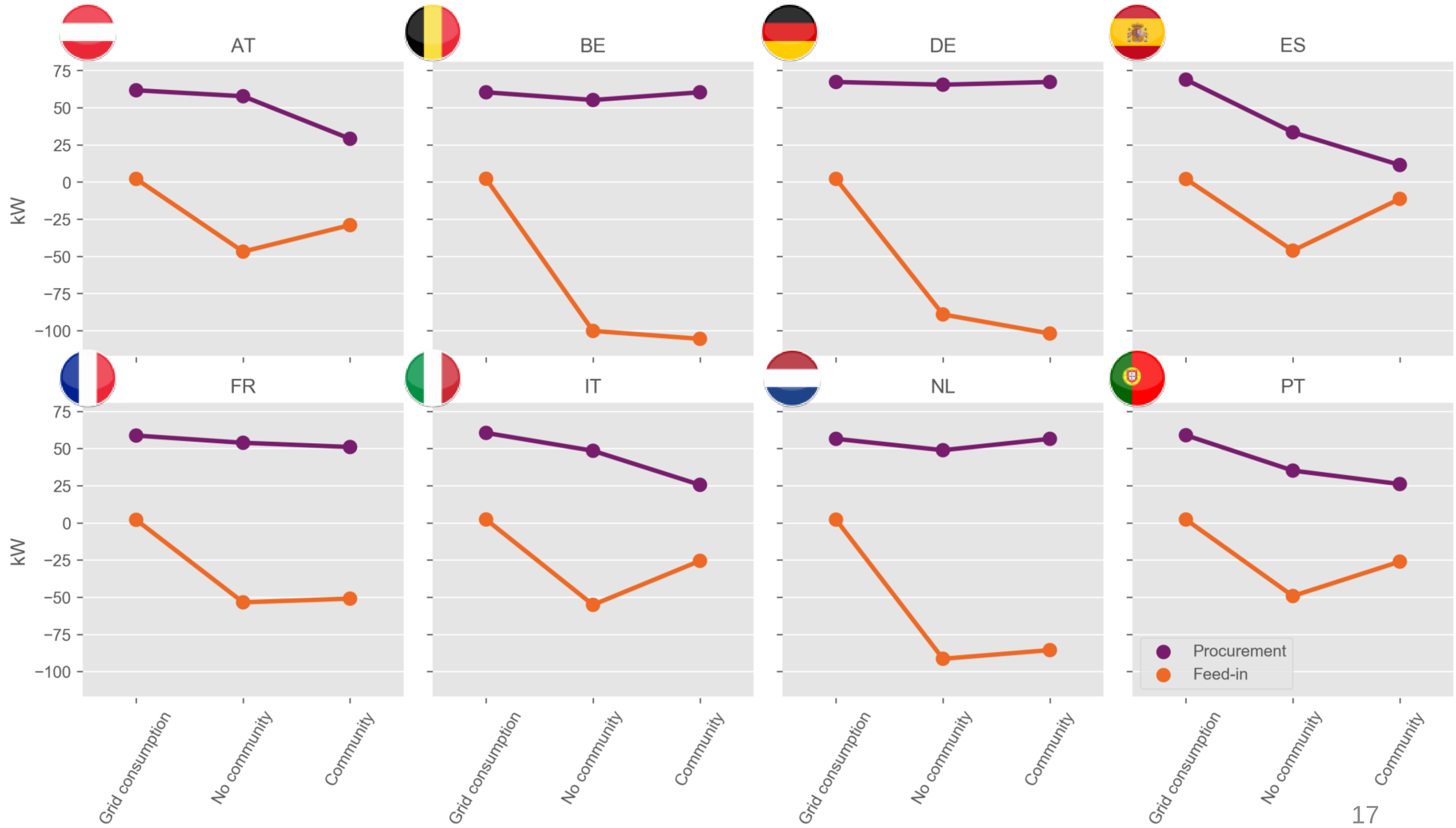
Results for Group 3 “European Village“

Installed battery capacity in kWh



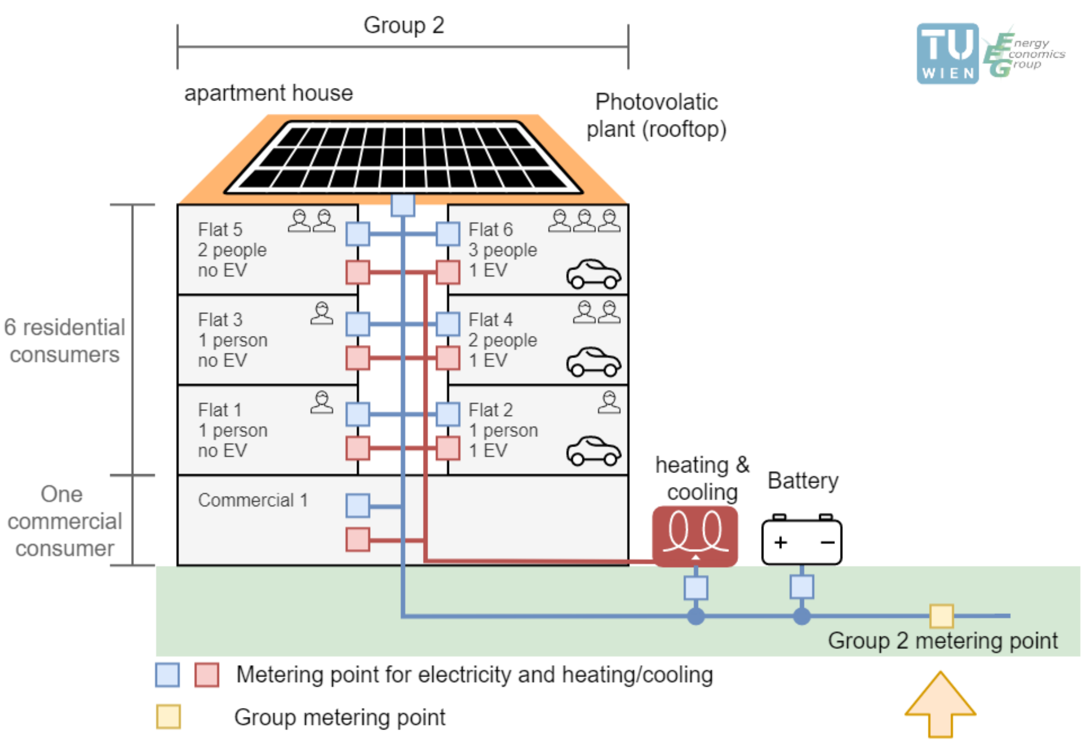
Results for Group 3 “European Village“

Maximum / minimum residual load in kW



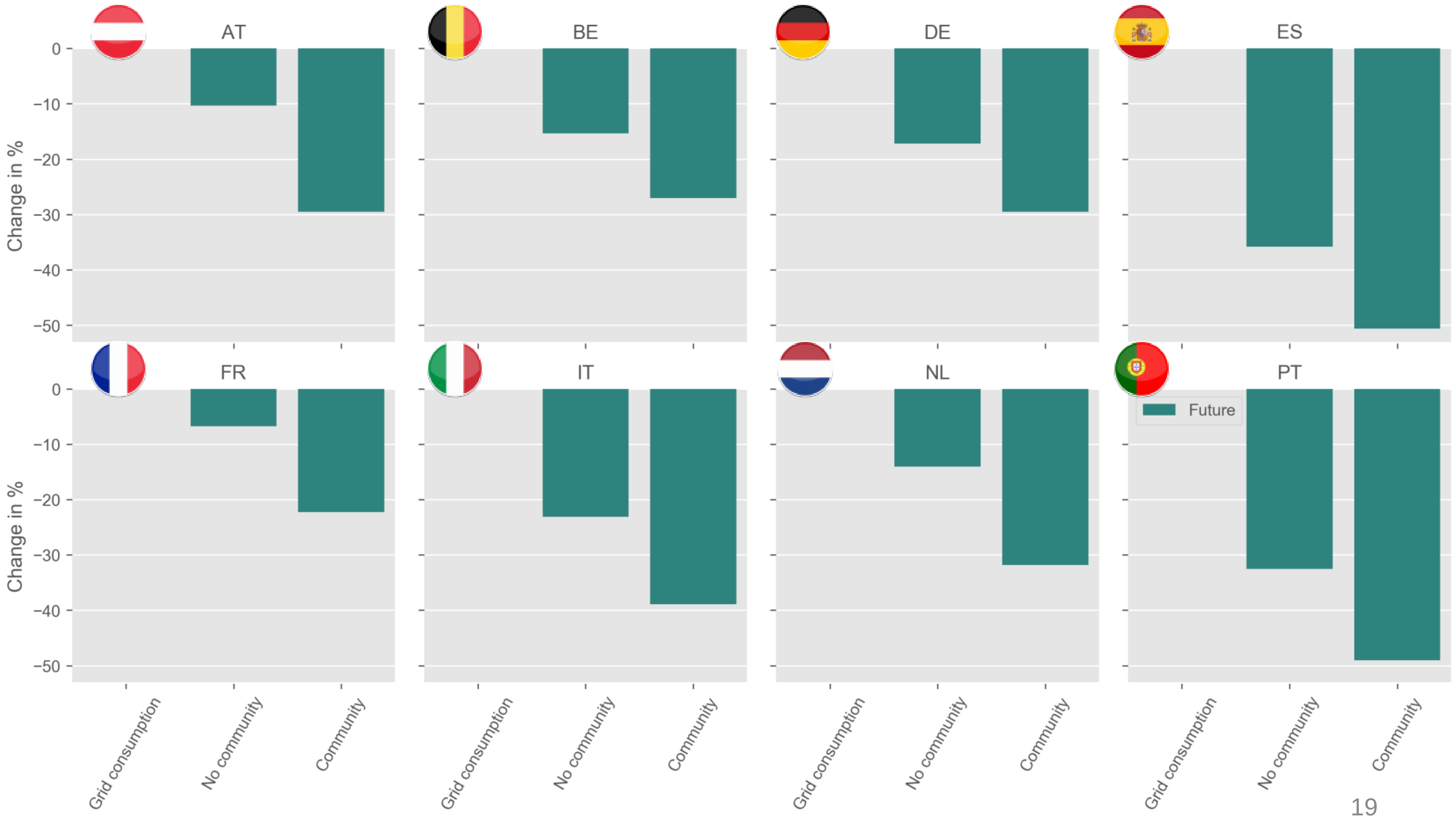
Results for Group 2 "Apartment House"

- "Apartment House" (group 2) as a renewable energy community
- Rooftop limitation: ~ 30 kWp
- Minimizing: $Total\ Costs(Year) = \alpha * Investment + Grid + Fixed - Revenues$



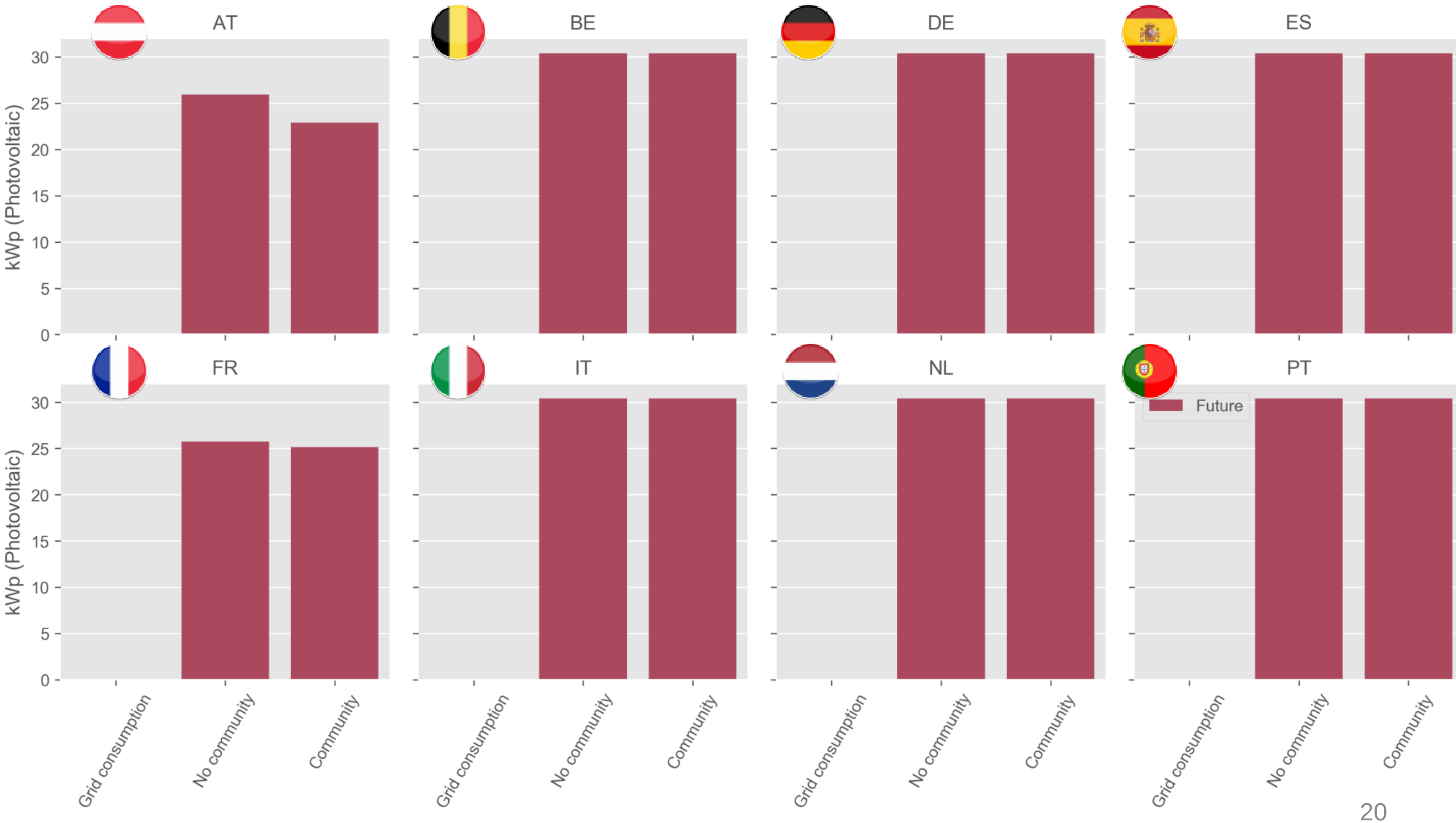
Results for Group 2 “Apartment building“

Change in Total Costs (compared to Grid Consumption)



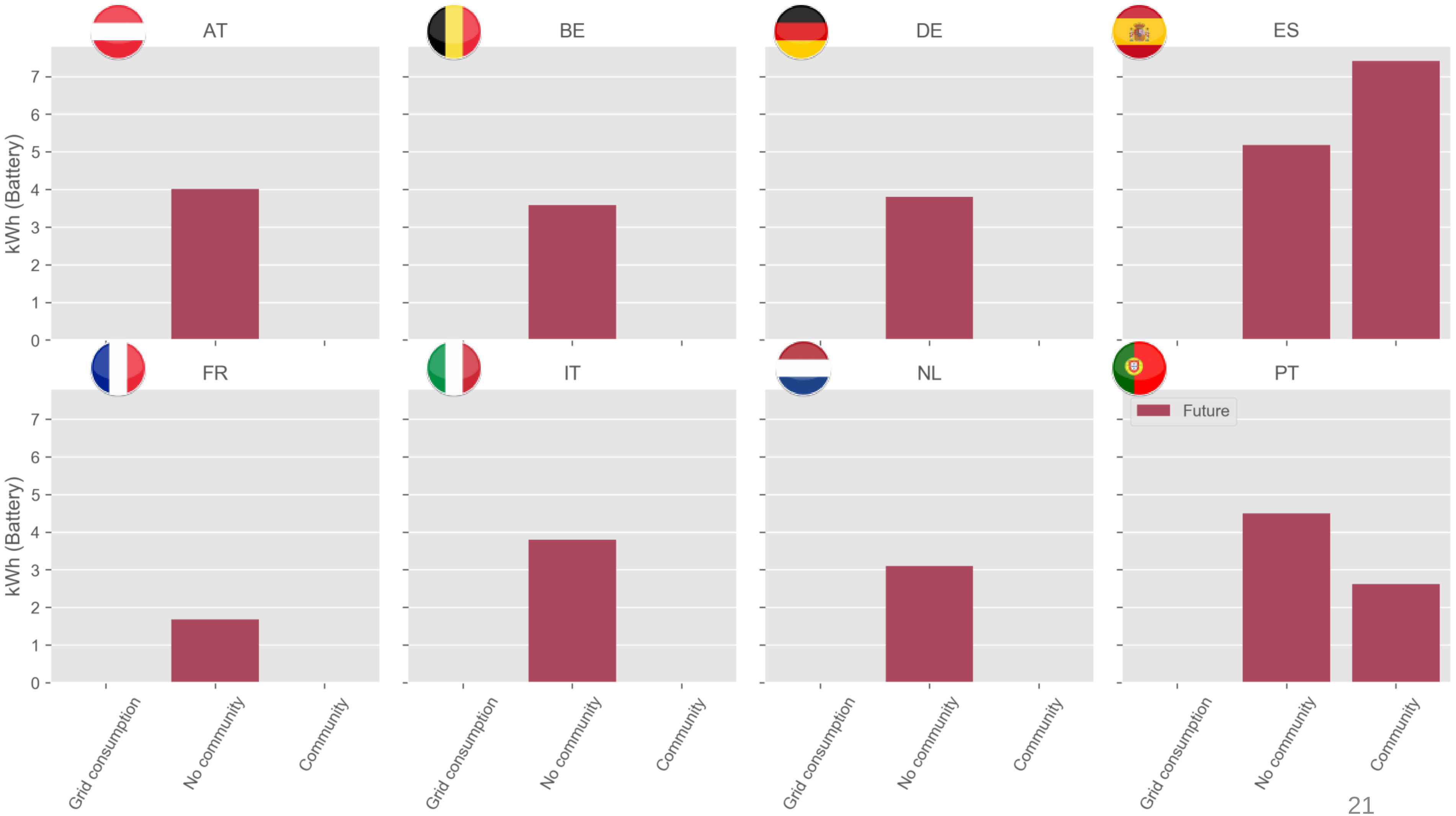
Results for Group 2 “Apartment building“

Installed PV capacity in kWp



Results for Group 2 “Apartment building“

Installed battery capacity in kWh



Conclusions

- The value of PV and energy communities depends not only on PV generation but as well on grid tariff design / electricity prices
- The energy community makes photovoltaics more profitable, reducing the need of subsidies.
- Households with no access to photovoltaics (roof limitation or building restrictions) have the opportunity to be part of a community and benefit from renewable technologies.
- “Grid friendly” behavior must be incentivized by the tariff design. Appropriate tariff design (power component) may reduce peak feed-in of photovoltaics.
- The main benefit of energy communities is the avoidance of grid fees and taxes. The income for distribution system operators (and taxes) decrease as well → discussion of grid tariff design

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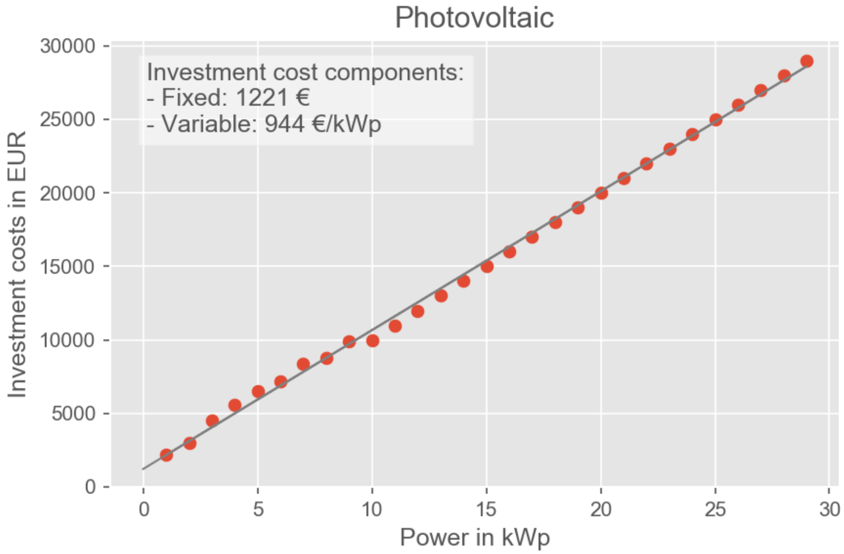
Assumed costs

Sell price electricity: Remuneration as Day-Ahead price per country 2017, upper cap at buy price

PV: interest rate 2% p.a., depreciation period 18 a

El. storage: investment costs 740 EUR / kWh, kW interest rate 2% p.a., depreciation period 13 a



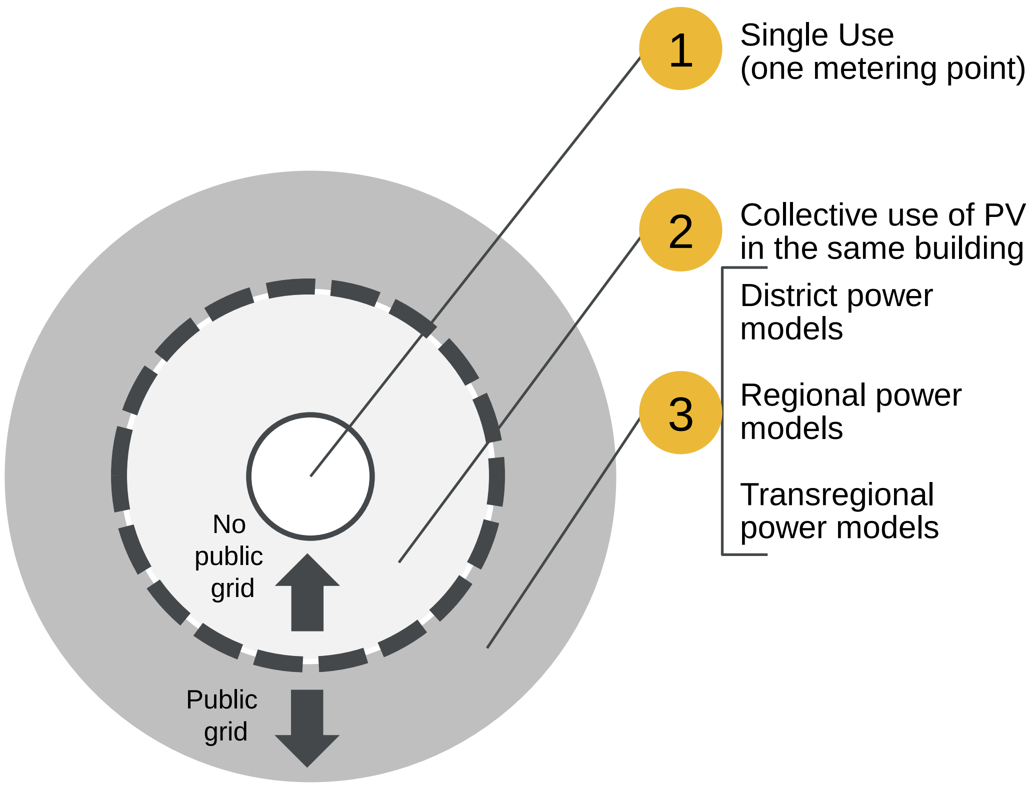
Source: IRENA (2018) and BSW (2019)

Framework in PVP4Grid target countries

Country	Group 1	Group 2	Group 3	Comments
Austria	YES SC+market price or FiT	YES 2a) e.g. Multi-apartment buildings Not yet in commercial / office buildings	NO	Storage is promoted with financial support in CAPEX
Belgium	YES, 2 options: Pure SC Net-metering	NOT allowed yet, except for some exceptions at reginal level	NOT allowed yet, except for some exceptions at reginal level	Example for industrial park near Mery (demonstrative)
France	YES SC+fixed FiT+financial support	YES, designed as VPN embedded in the public network	Limitation to the same low voltage station, but allowed	Example of shared SC: Gironde Habitat/Les Souffleurs in a multidwelling
Germany	YES Very common SC+FIT	YES, Mieterstrommodelle" (neighbour solar supply model) PPA also possible	Allowed, however, hardly found due to condition of "consumer identity"	
Italy	YES SC+PPA or NM (or NB, as it exchanges money, not energy (*Scambio sul posto*)	NOT allowed	NOT allowed	Battery storage costs can be included for tax reduction purposes The last reform of the residential electricity bill, flatten the energy costs, making SC less convenient
Netherlands	YES Net-metering ("saldering")	YES. Well developed for apartments buildings	YES Postal Code Rose Policy	Analysis of optimal PV orientations and tilt for maximized SC (UU). Subsidy support scheme SDE+
Portugal	YES SC+ % of MIBEL)	YES, allowed, although strong barriers for its implementation	YES, allowed, although strong barriers for its implementation	Subsidies to investment for building renovation POSEUR
Spain	YES SC1: no remuneration for excess; SC2 + Market price No NM	NOT permitted yet. Collective self-consumption is not regulated yet	NOT permitted yet. Collective self-consumption is not regulated yet	Sun tax in force: charge for the electricity self-consumed. Storage is allowed

First Classification of current PVP4Grid concepts

- **Group 1:** private local (on-site) self-consumption where only one actor aims at consuming PV electricity at one place.
- **Group 2:** collective self-consumption where a group of actors aims at consuming electricity from a shared PV system.
- **Group 3:** virtual self-consumption where generation and consumption of PV happens at the same time but different locations.



Source: Lettner G., Auer H.,, et al. "D2.1 - Existing and Future PV Prosumer Concepts", Public Report, 2018.

About the project „PV-Prosumers4Grid“

„The aim of the PV-Prosumers4Grid project is to develop and implement innovative self-consumption and aggregation concepts and business models for PV prosumers that will help integrating sustainable and competitive electricity from PV in the electricity system.“

- Target countries: Belgium, Germany, France, Italy, Netherlands, Austria, Portugal & Spain
- Start: 01.10.2017
- Duration: 30 Months (March 2020)
- 12 Partners
- Coordinator: BSW-Solar

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