Prosumers for the Energy Union

PROSEU

PEARL PV

Potential for collective self-consumption in local energy communities

Guilherme Luz (gpluz@fc.ul.pt)
Rodrigo Amaro e Silva (rasilva@fc.ul.pt)

PEARL-PV WG5 Workshop
12/01/2021

FC

cE3c
centre for ecology, evolution and environmental changes

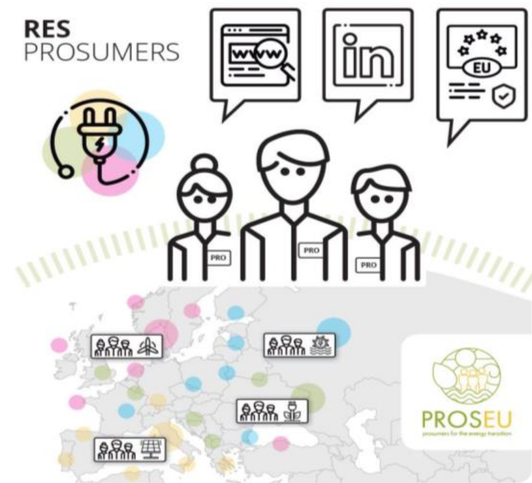
Agenda

- PROSEU project
- Self-consumption (@Portugal)
- Energy systems modelling
- Two case studies

PROSEU

PROSEU H2020 project

- PROSumers for the Energy Union (www.proseu.eu)
- The role of *prosumers* in the EU energy transition
- 10 participants, 6 countries, 3 M€
- Living Labs as co-creation spaces

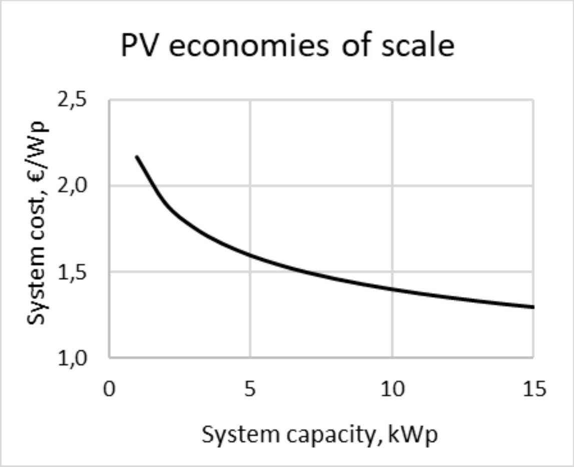


Horizon 2020
European Union Funding
for Research & Innovation

PROSEU

Self-consumption in 

- Started in 2015, most of it PV
- 170+ MWp by 2019 (82% of distributed PV)
- However, residential sector is strangled
  - Very small-sized systems (66% ≤ 1 kWp)
  - High unitary costs



* Statistics, source: *Direção Geral da Energia e Geologia*
Figure adapted from doi: 10.1016/j.apenergy.2017.03.112

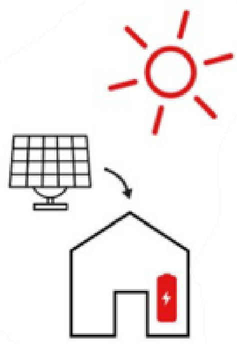
PROSEU

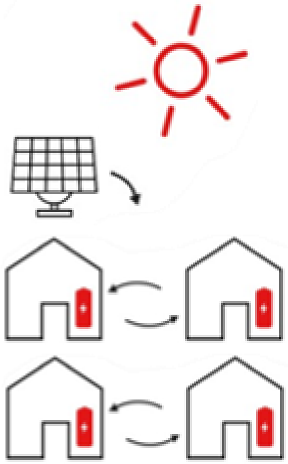
Communities and collectives

Clean Energy Package

Legal decree 162/2019

<u>From an individual to a Community/collective paradigm</u>





Energy Systems modelling

- A tool to better understand the potential of Energy Communities and collective self-consumption

- Optimization-driven PV sizing, considering:
  - Electricity sharing
  - Potential constraints (e.g., rooftop area)
  - Network tariffs

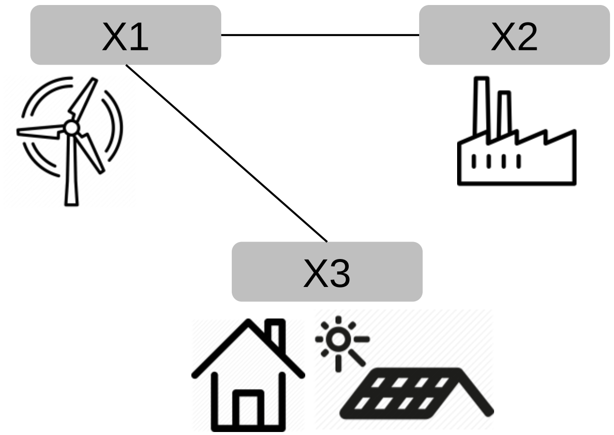
* *Suggested reading,* doi: arXiv:2008.03044

PROSEU

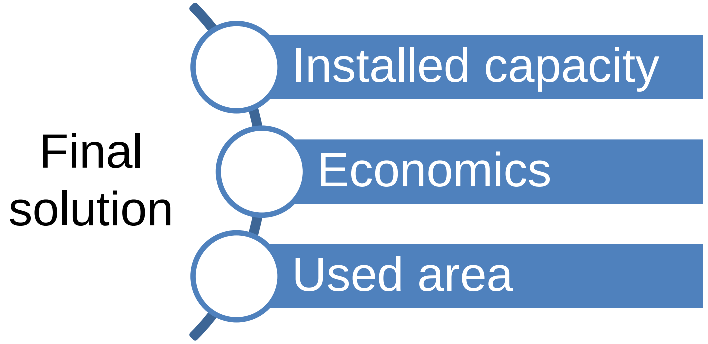
Considered approach

Calliope: a multi-scale energy systems modelling framework*
(ETH Zürich, www.callio.pe)

Formulation



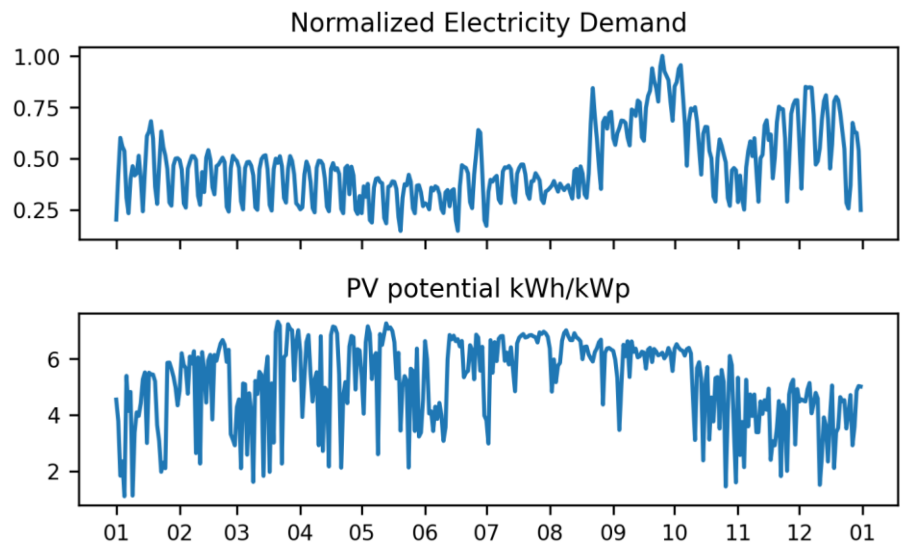
Treated as a (MI)LP problem



* *The Journal of Open Source Software*, doi: 10.21105/joss.00825

PROSEU

Data, data, and some more data



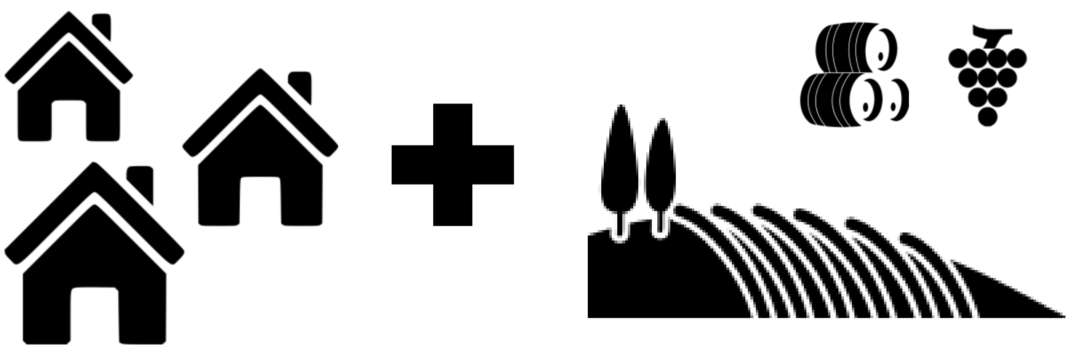
	Lifetime	Efficiency	Unitary cost	Area occupation
Residential-scale PV	25 years	18%	3 €/Wp	15 m^2/kWp
Industrial-scale PV			2 €/Wp	20 m^2/kWp
Grid supply			15 c€/kWh	
LV grid tariff			5.88 c€/kWh	

PROSEU

Case study #1

Energy Community w/ collective PV:

synergies between a semi-rural city and a winery



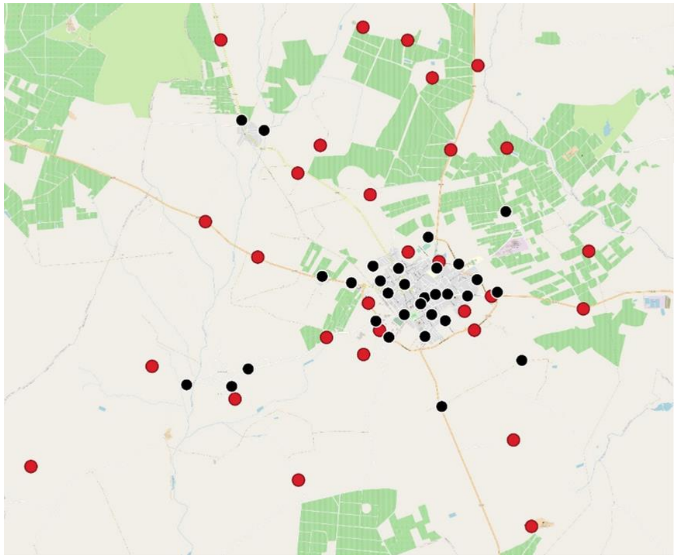
distribuição

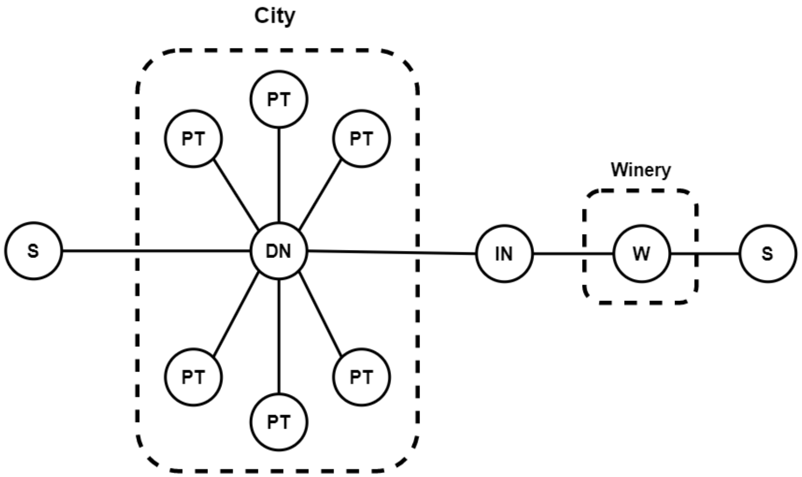
SoDa Solar radiation Data

VINHOS DO ALENTEJO Únicos por Natureza.

* *Energies*, doi: 10.3390/en14020323 (recently published)

Network modelling





S - substation; DN - derivation node; PT - power transfomer; IN - interface node; W - winery

Testing different Energy Community configurations

Overall results

When compared with two independent actors (city & winery)

- $\Delta PV_{capacity}$ by up to +29%
- ΔLCOE between -0.6 and +0.9 c€/kWh
- ΔSelf-sufficiency rate by up to 5 pp
- Exceeding PV generation increases by up to 10 pp

Trade-off between economies of scale and grid costs

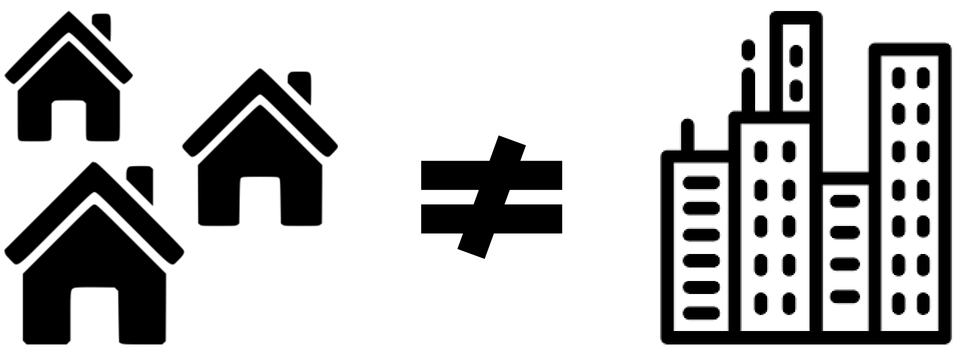
Need for storage and/or demand side management

PROSEU

Case study #2

<u>Energy Community w/ collective PV:</u>

impact of neighborhood layout



edp distribuição

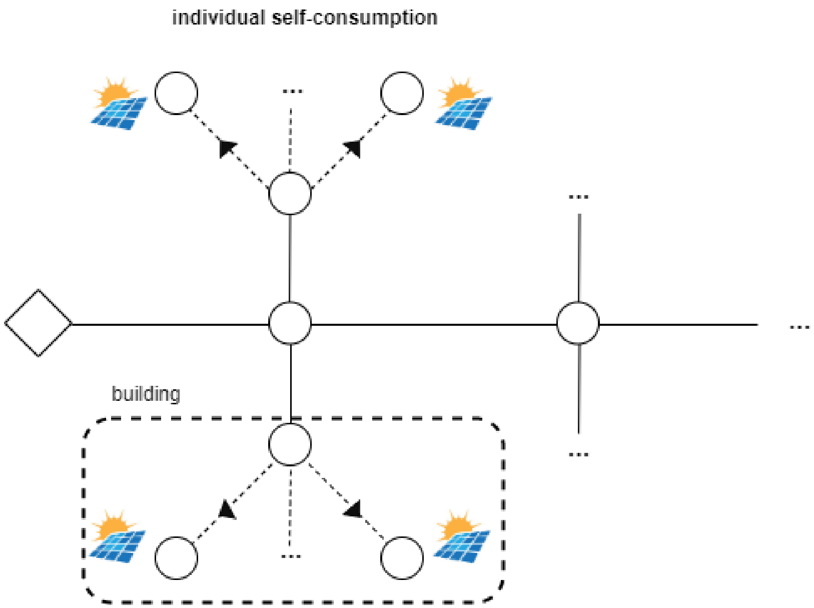
SoDa Solar radiation Data

* *Work in progress*

PROSEU

Network modelling

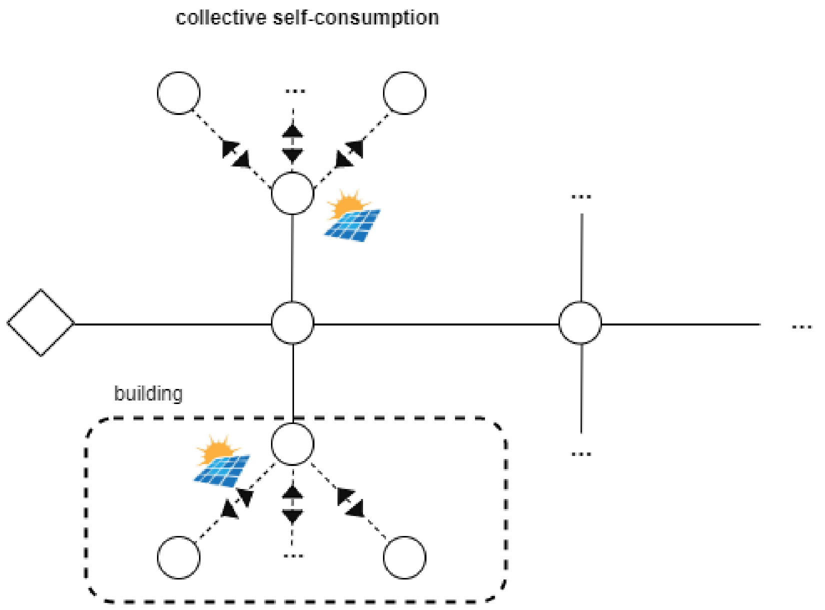
- 10 residential loads from Lisbon, Portugal
- Simulated neighborhoods
  - 1 multiapartment building
  - 10 single-family houses
- Economies of scale considered



PROSEU

Network modelling

- 10 residential loads from Lisbon, Portugal
- Simulated neighborhoods
  - 1 multiapartment building
  - 10 single-family houses
- Economies of scale considered



PROSEU

Individual self-consumption

PV deployment

- Small & expensive PV systems
- MAB is limited by rooftop area

PV-load matching

- 15-min balance
- Moderate self-consumption rate

	SFH	MAB
kWp	0.33	
€/Wp	3.2	
Roof usage	48%	100%
SCR	65%	

**Median values*

* SFH: single-family house, MAB: multiapartment building,
SCR: self-consumption rate

PROSEU

Collective self-consumption

PV deployment

- SFH: +11% total capacity, +13% LCOE*
- MAB: one larger system, -33% LCOE

PV-load matching

- Sharing between dwellings
- SCR improves by 10-20 pp

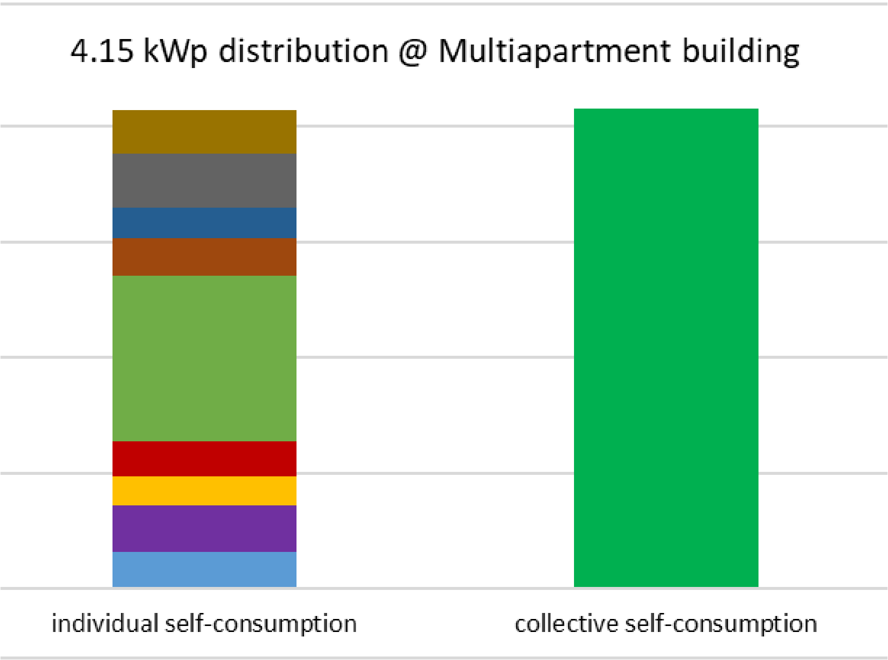
	SFH	Δ	MAB	Δ
kWp	1	0.7	4.15	3.85
€/Wp	2.8	-0.4	2,2	-1
Roof usage	53%	5%	100%	0%
SCR	71%	6%	85%	20%

Median/aggregated values for individual/ collective self-consumption

* Due to grid tariffs for LV grid usage

PROSEU

An illustration



PROSEU

Summary

- Individual self-consumption strangles residential PV
- Energy communities / collective self-consumption
  - Lower costs
  - Higher self-consumption rate
  - More democratic paradigm

PROSEU

For more information: www.proseu.eu

gpluz@fc.ul.pt, rasilva@fc.ul.pt

FCiências[ID] · ICLEI Local Governments for Sustainability · ClientEarth · drift for transition · iöw Institute for Ecological Economy Research · University of Leeds · University of Zagreb Faculty of Mechanical Engineering and Naval Architecture · Leuphana University of Lüneburg · CE Delft Committed to the Environment · U.Porto FEUP Faculdade de Engenharia Universidade do Porto · eco-union

This project received funding from the EU's Horizon 2020 research and innovation programme under grant agreement N°764056.