



ENCLUDE

Energy Citizens for Inclusive
Decarbonization

Energy citizenship for inclusive and just transition

*Topic #2 – “What have we learned about Energy Citizenship that
can be implemented by others?”*

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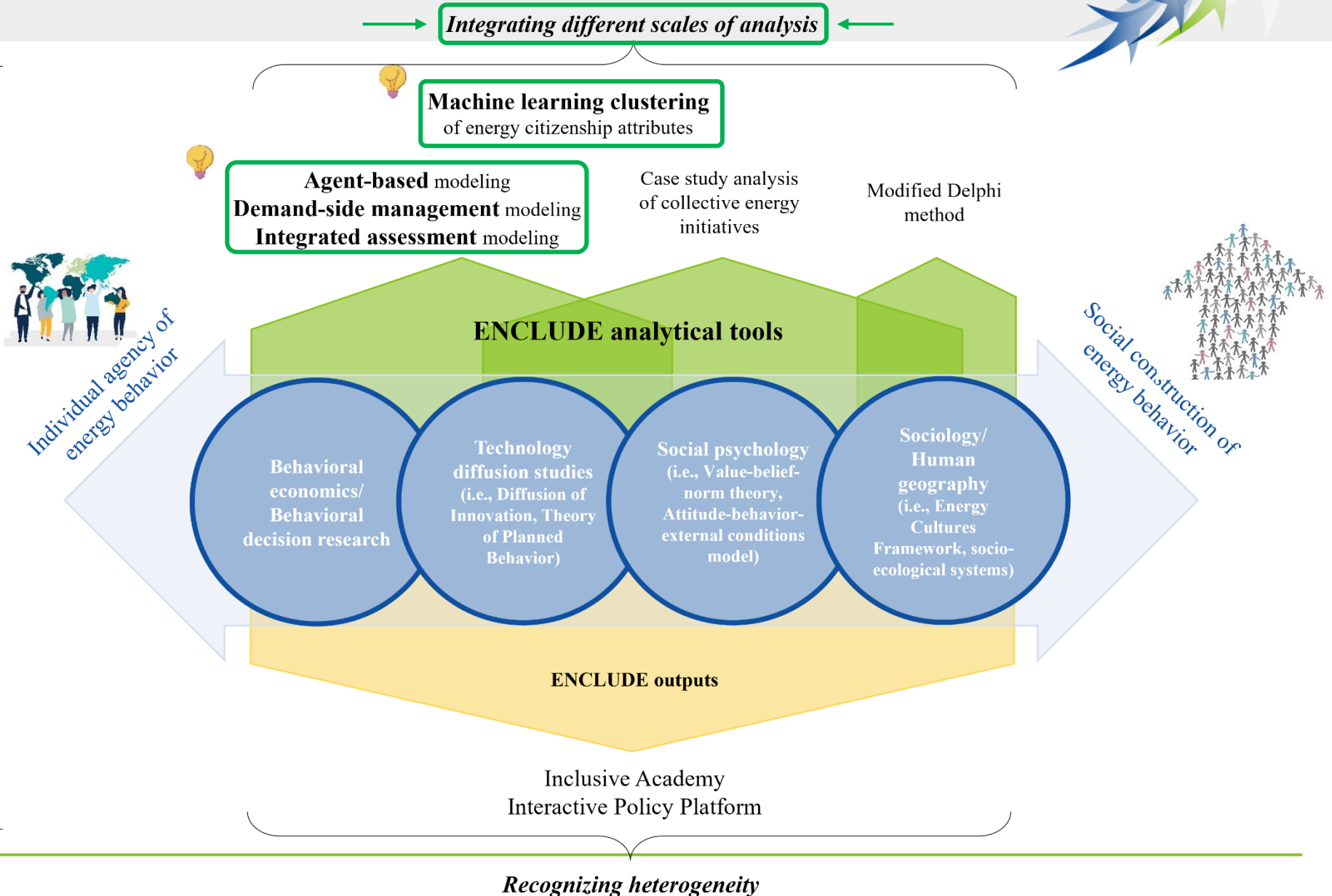


Energy citizenship & Transdisciplinary mixed methods and tools

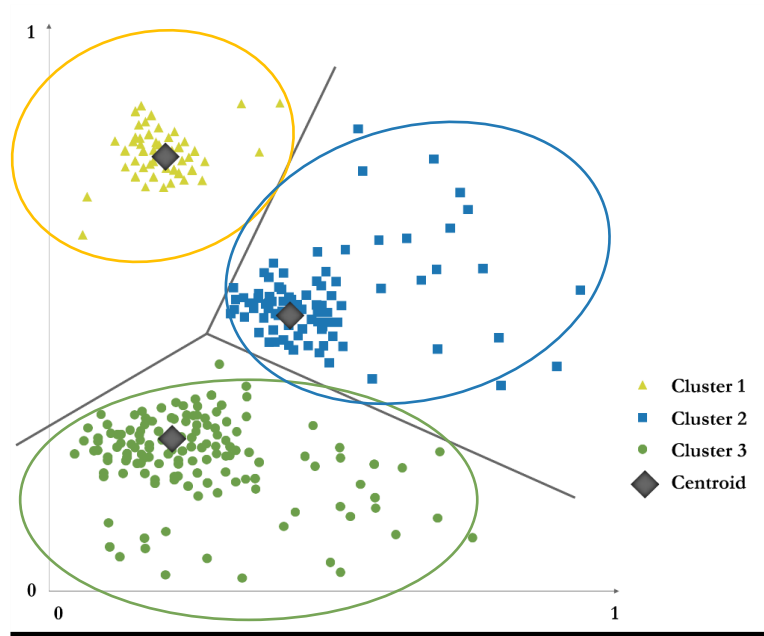


Matching knowledge about energy citizenship to different decision-making contexts

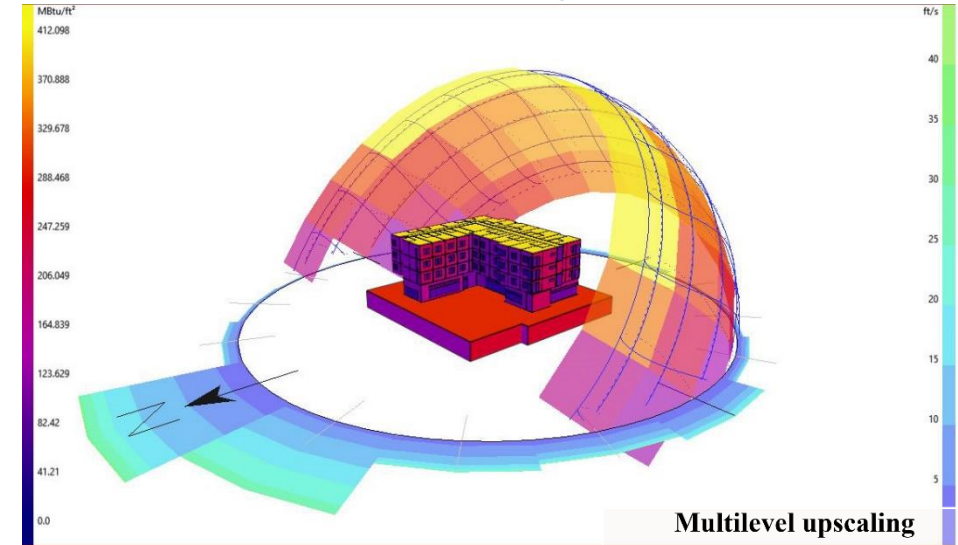
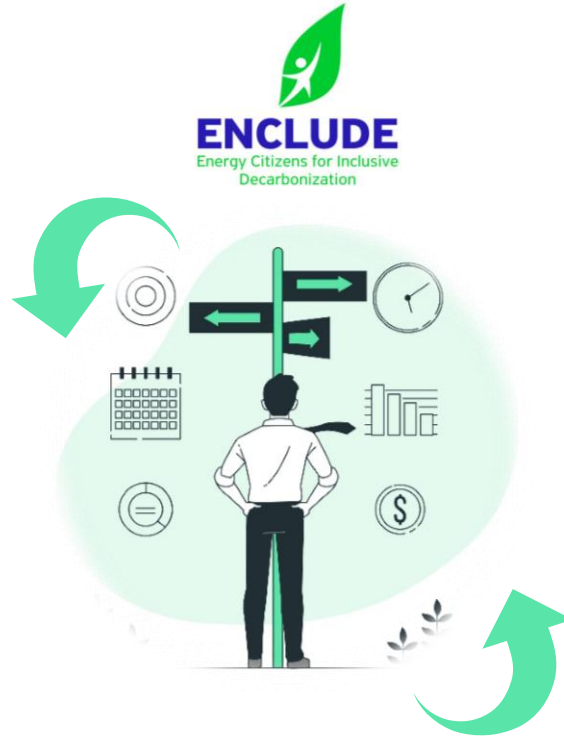
- Citizens
- Practitioners
- Policymakers
- Research/ Scientific community
- Industry & Business world



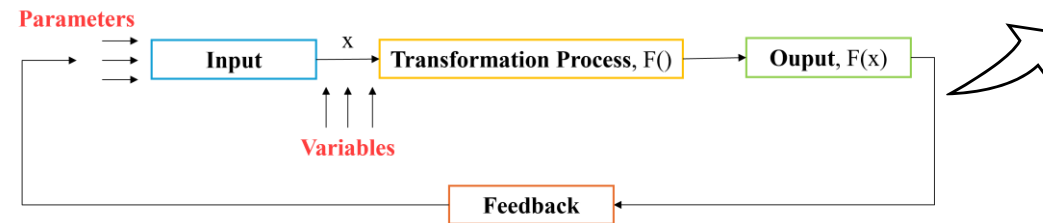
Data-driven clustering algorithms & Simulation models



Different (energy) citizen clusters



Multilevel upscaling

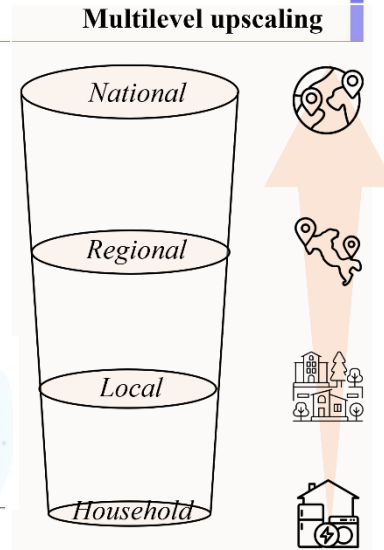


Decarbonization potential

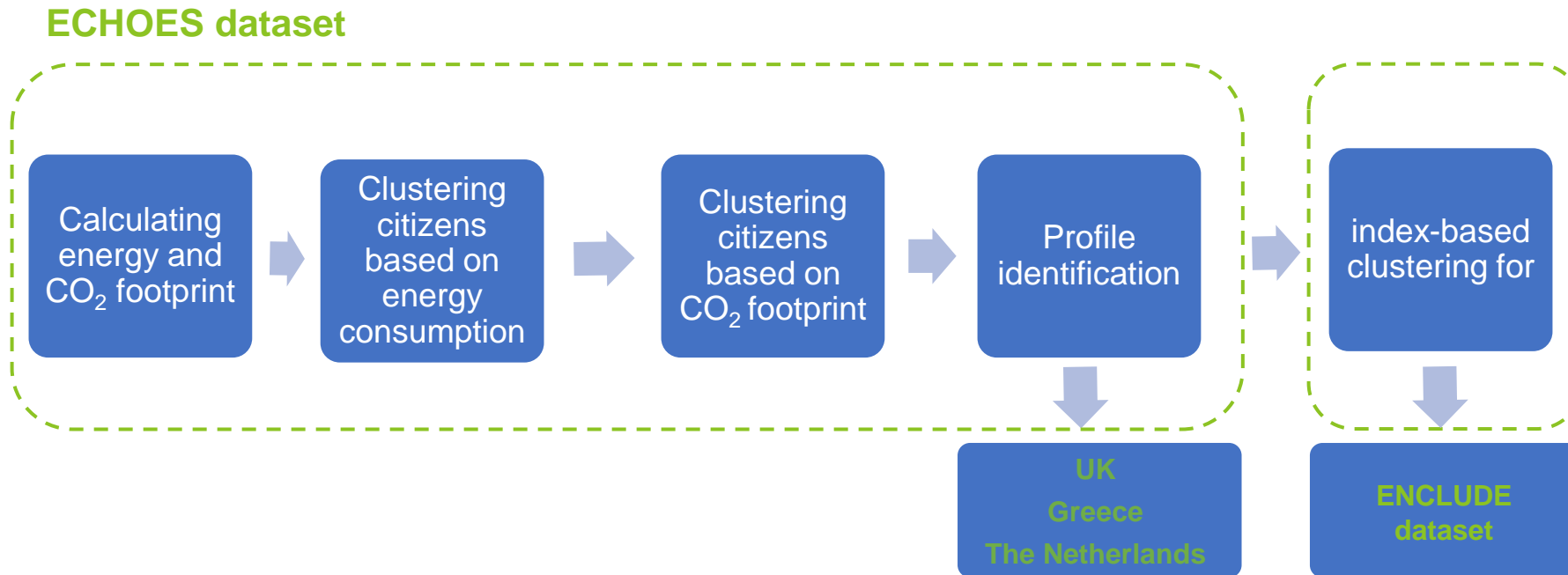
Economic benefits



Social benefits



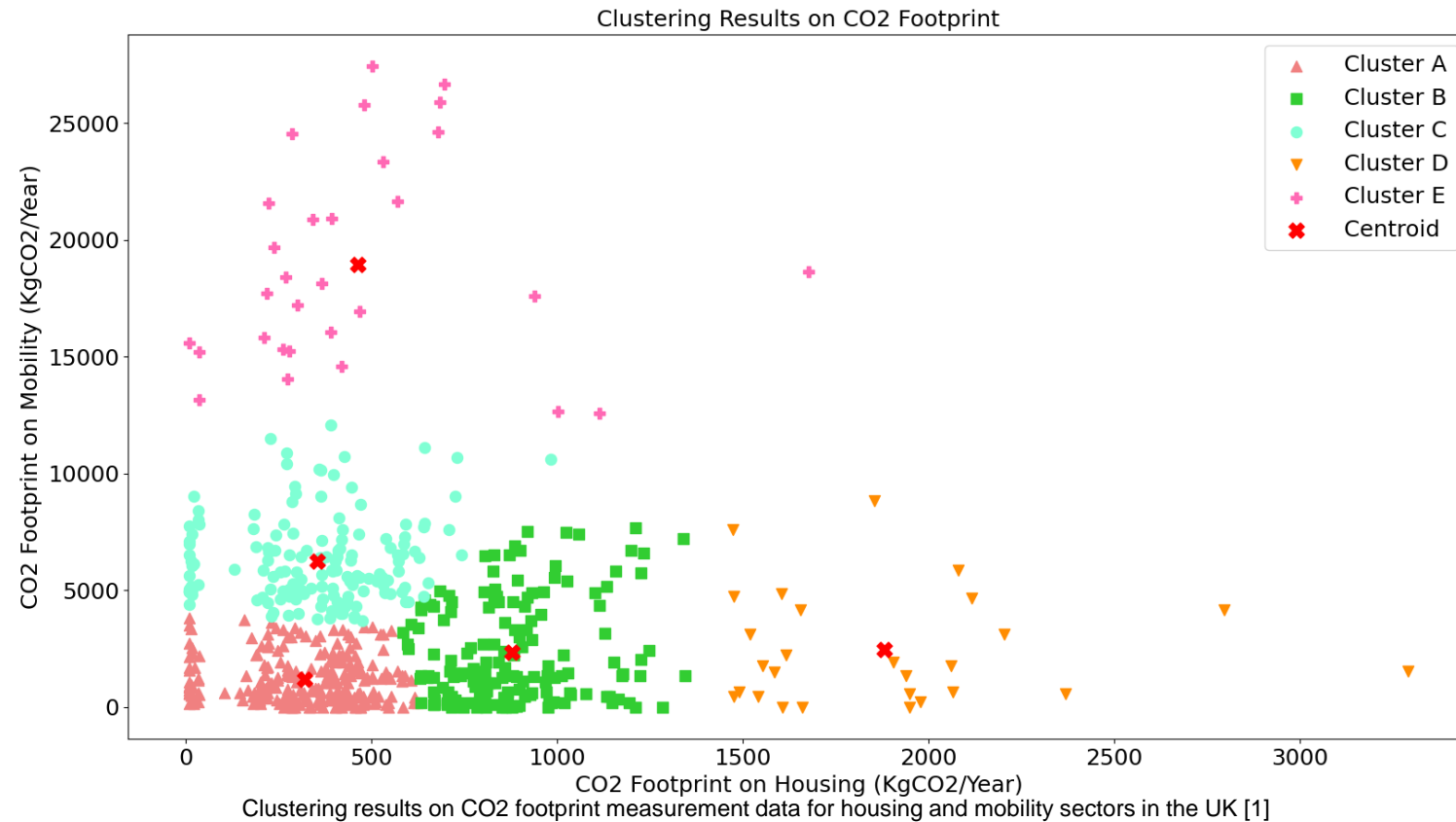
Data framework for clustering citizens – overview



K-means clustering method for clustering citizens based on carbon footprint – Results for ECHOES dataset – UK



Clusters result for CO2 footprint measurement data for the housing and mobility sectors in the UK [1]



Cluster	Population	Centroid location on housing CO ₂ footprint (kgCO ₂ /year)	Centroid location on mobility CO ₂ footprint (kgCO ₂ /year)
A	247	320.63	1180.30
B	161	878.96	2343.67
C	157	352.97	6234.85
D	27	1881.56	2475.36
E	30	463.25	18935.05

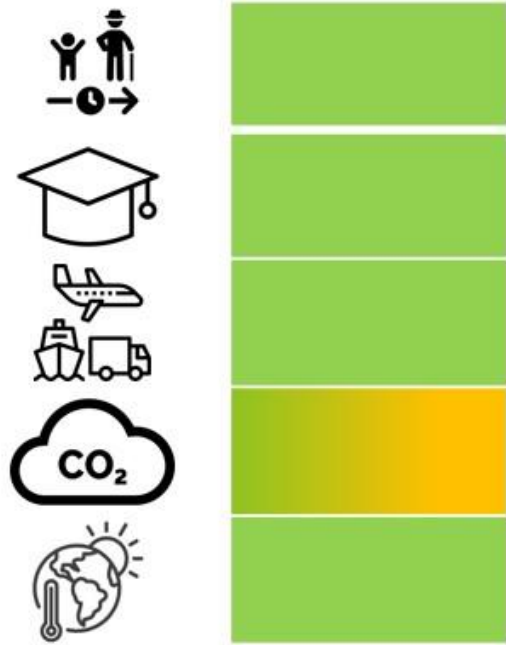
Profile results for CO2 footprint clustering based on within-cluster statistics for the UK [2]

	Profile #1	Profile #2	Profile #3
Age range	19-34	>65	35-49
Education	College	College	College
Population %	64.95%	30.22%	4.82%
Energy on Mobility	Low	Low to medium	High
CO ₂ Emissions (housing and mobility)	Low	Medium to high	High
Climate Change Perception	positive	Neutral to positive	Neutral to positive

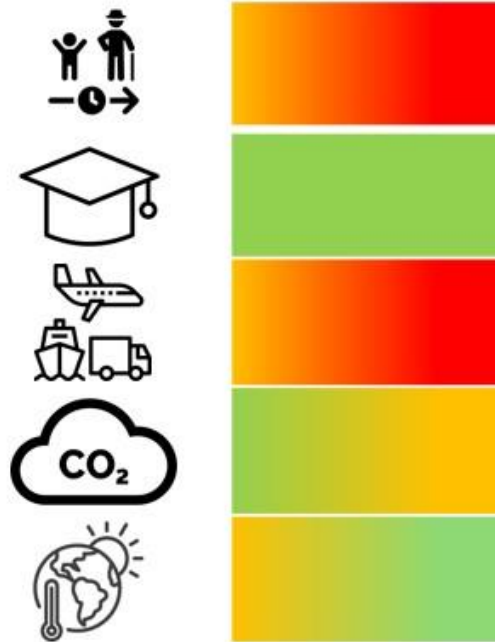
Profile development for citizens based on clustering results of CO2 emission for ECHOES dataset – UK



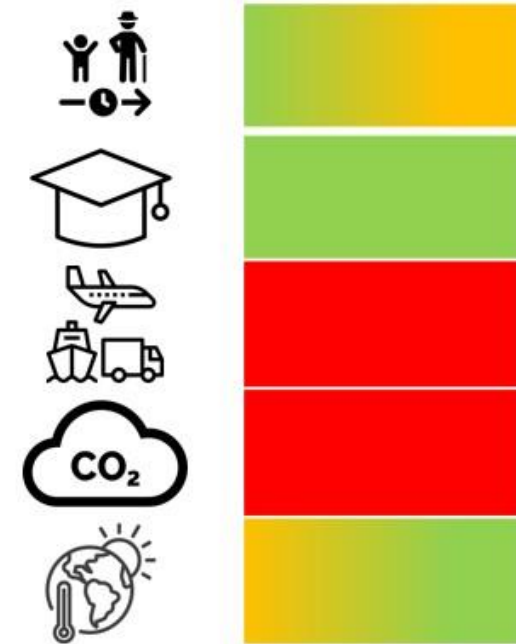
Profile #1



Profile #2

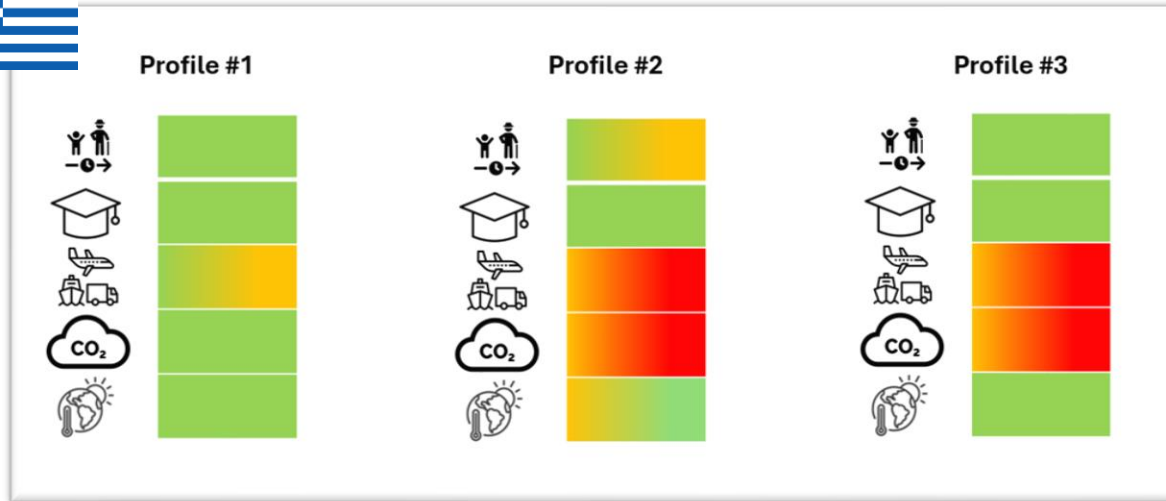


Profile #3

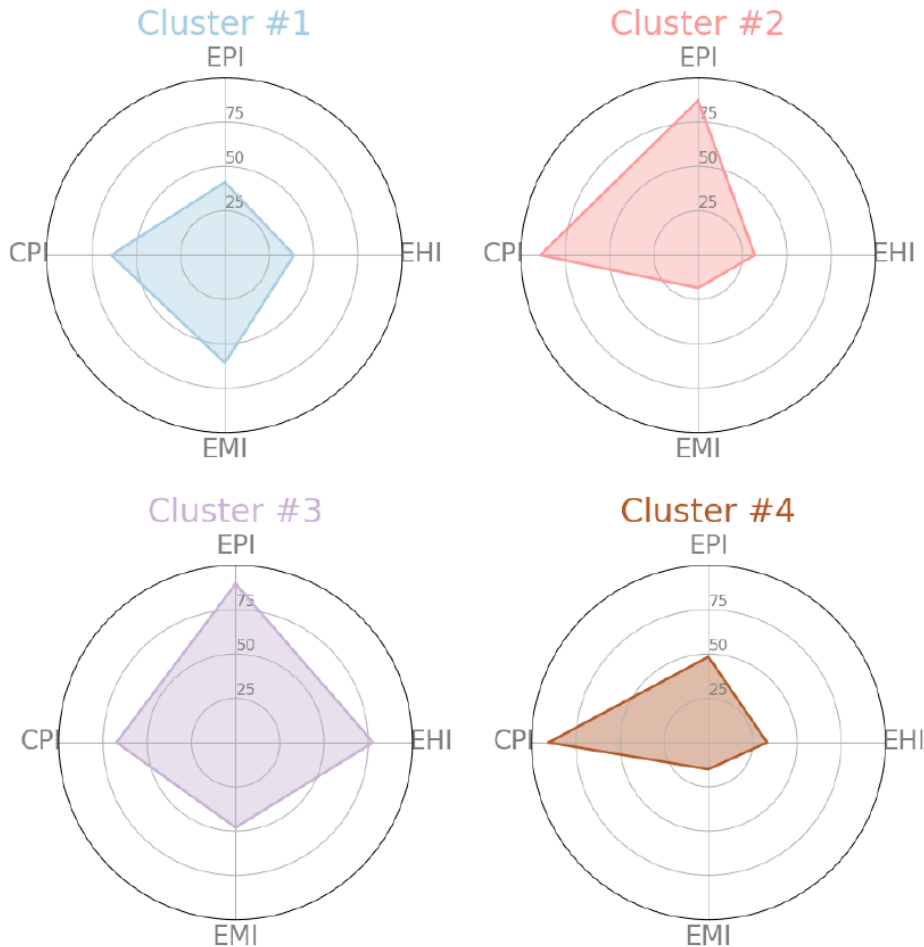


Energy citizens profiles based on clustering results and within-cluster statistics for the UK [1]

Profile development for citizens based on clustering results of CO2 emission for ECHOES dataset – Greece and the Netherlands



In ENCLUDE we did...



Spider plots of index-based clustering results for each of the four clusters [1]

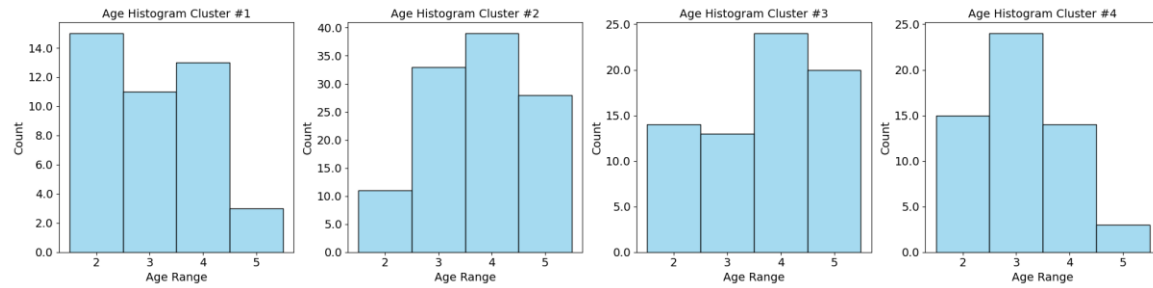
- Clustering ENCLUDE data via defined indices based on answers to questions in 4 categories: **Energy poverty, Mobility, Housing, and Climate Change Perception** [1].
- The aim is to calculate indices for each category using simple addition of answers which are mapped into meaningful numbers.
- 4 indices are defined (rescaled to 0-100) for each respondent based on relevant questions to each index [1].
- k-mean clustering method is applied to the full data set

Cluster	Population	Energy Poverty Index	Energy Housing Index	Energy Mobility Index	Climate Perception Index
1	111	41.12	39.08	60.80	64.28
2	76	87.22	31.98	18.57	89.18
3	54	89.62	77.81	47.99	67.37
4	42	48.37	33.18	15.10	90.47

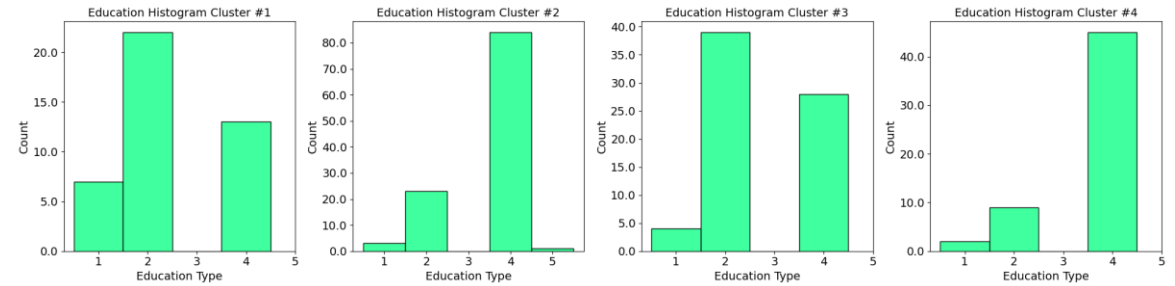
In ENCLUDE we learned...



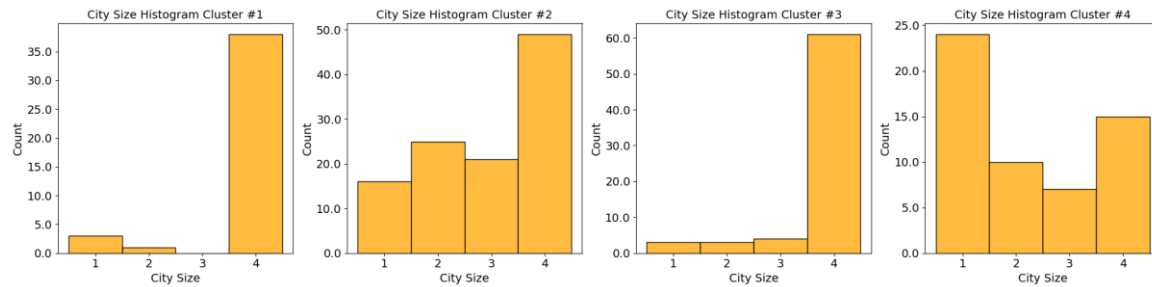
Age



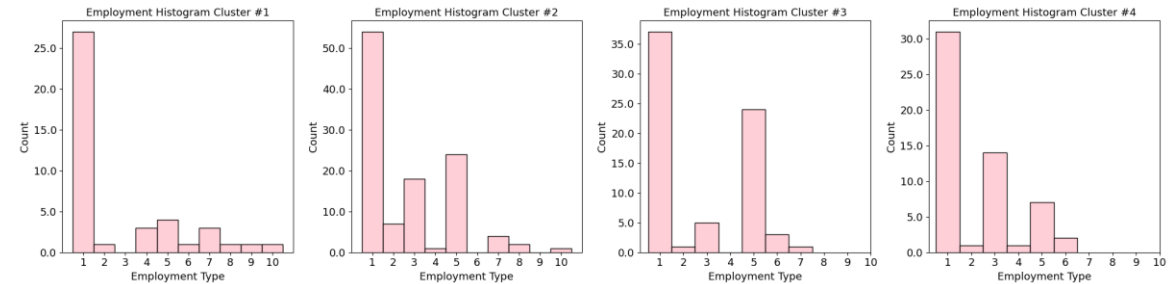
Education



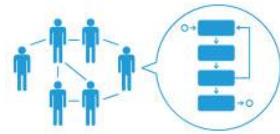
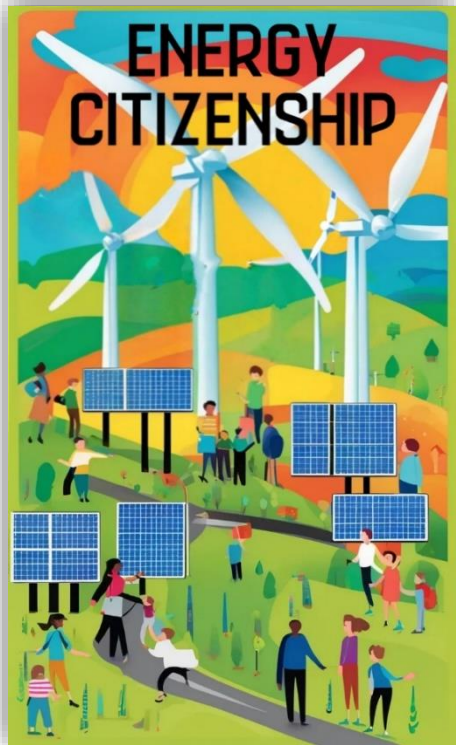
City Size



Employment status



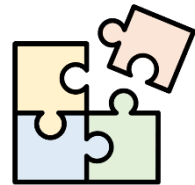
In ENCLUDE we did...



Agent-based Models

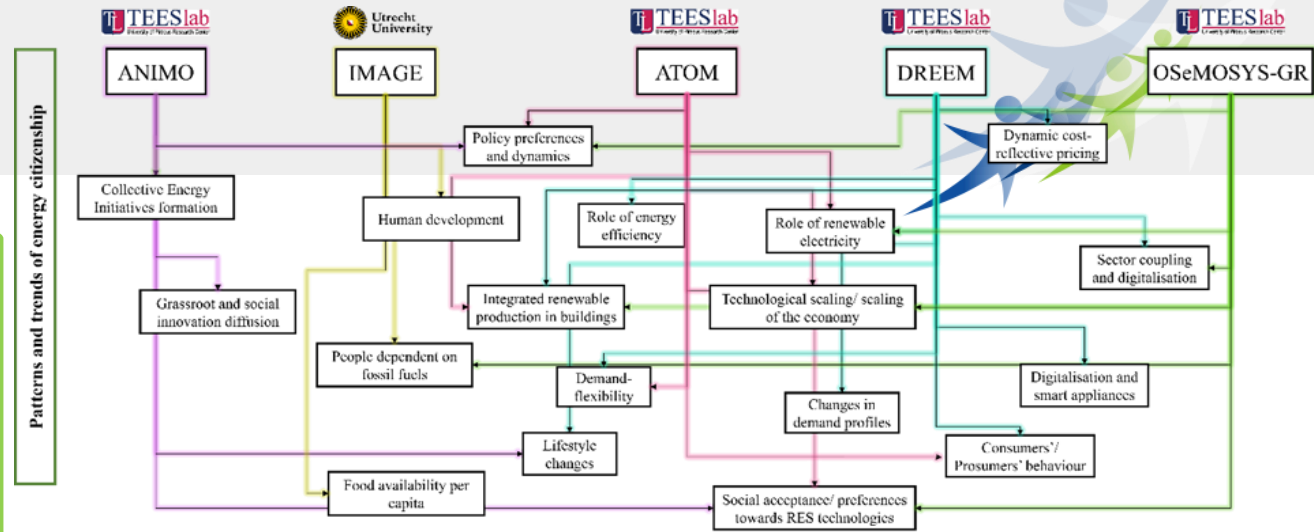


Demand-side Models



Integrated Assessment Models

...for integration of **individual** and **collective** factors of decision-making in the context of **ENERGY CITIZENSHIP** !



- We **matched** patterns and trends of energy citizenship to our models...
- We built “people-centered” **storylines**, and “future-world” **narratives**...
- We **quantified** the impact of energy citizenship at the **local** level...
- We **quantified** the impact of energy citizenship at the **national** and the **supranational** level...

In ENCLUDE we learned...



Transformative



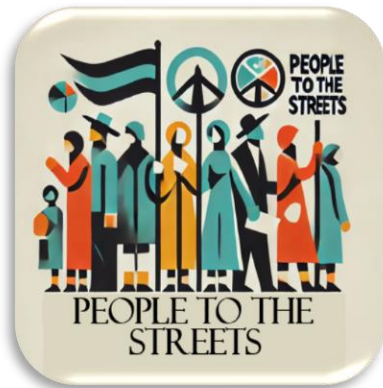
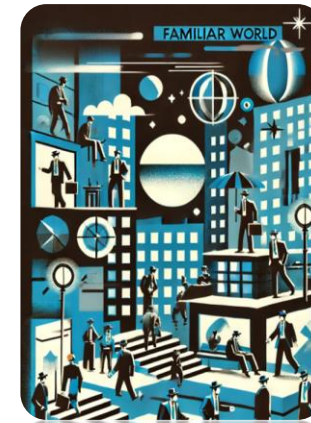
Scenario

Design



Framework

*“Future-world”
narratives*

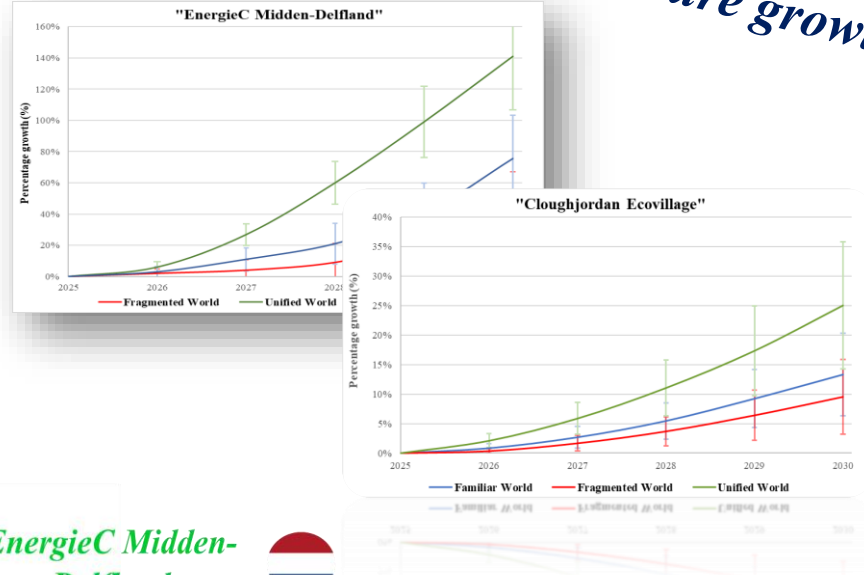
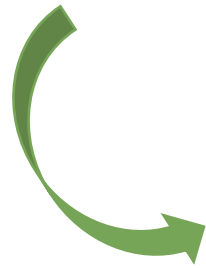


*“People-centered”
storylines*

In ENCLUDE we did...



Agent-based
model

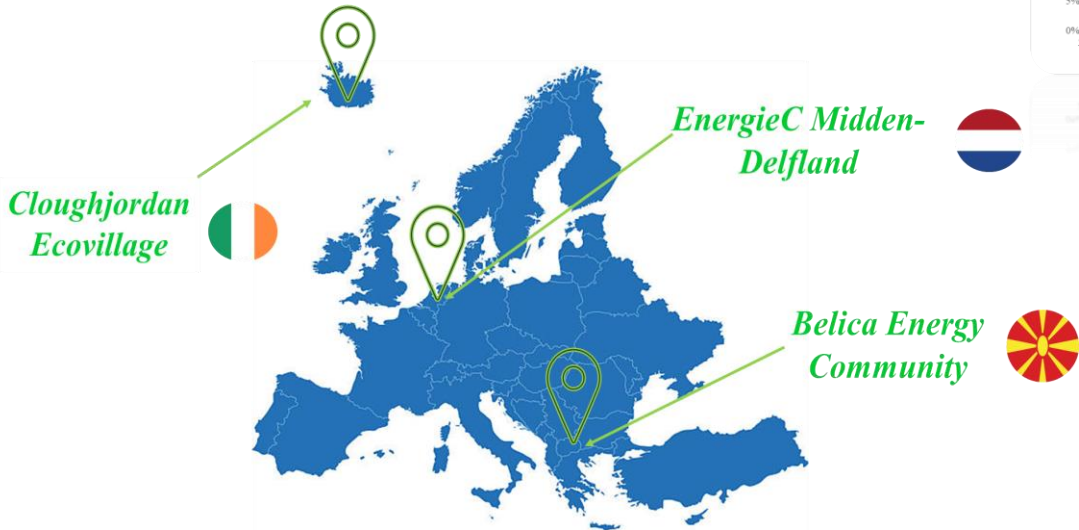


*Population density alone
does not ensure growth!*

**Togetherness
matters!**

*Our work encourages the future growth
of Collective Energy Initiatives (CEIs):*

- Identify and prioritize CEIs with the **highest potential of further growth** and **optimize resource allocation**,
- Increase **likelihood** for citizen **participation**,
- Impact of CEIs on **reducing carbon emissions** at the **local level**,
- Optimize **infrastructure** development.



In ENCLUDE we learned...

Targeted communication
strategies and tailored
policymaking



...about 6 different personas outlining potential characteristics & motivations...



The Green Guardian

- Environmentalist
- Concerned about conventional energy sources
- Carbon footprint reducers
- Grid reliance reducers



The Eco-Collaborators

- Community-oriented
- Motivated by large environmental movements
- Appreciators of RES to reduce their environmental impact



The Self-Reliant Saver

- Self-sufficiency seekers
- Valuing energy independence
- Financial savers
- Motivated by lower energy bills



The Security-Minded Sceptic

- Attracted to financial benefits of CEIs
- Strong communal sense
- Trusting to their neighbors' positive experiences
- Encourage adoption



The Tech Trailblazer

- Technologic innovators
- Value smart home integration
- Interested in experimenting with and adopting latest technology



The Eco-Conscious Saver

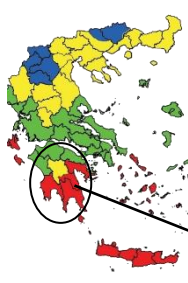
- Environmentally conscious
- Carbon footprint reducers
- Money savers
- Mainly interested in CEIs' financial benefits

...driving citizens' **decision** to **join** a CEI, e.g., energy community, ecovillage!

In ENCLUDE we did...

Towards a “green” rebranding of a Coal and Carbon Intensive Region into a city of the people, by the people, for the people

National scale
Greece



Regional scale
Peloponnese region



Local scale
Municipality of
Megalopolis



THE JUST
TRANSITION
PLATFORM



Familiar World



HELLENIC REPUBLIC
Ministry of the Environment
and Energy

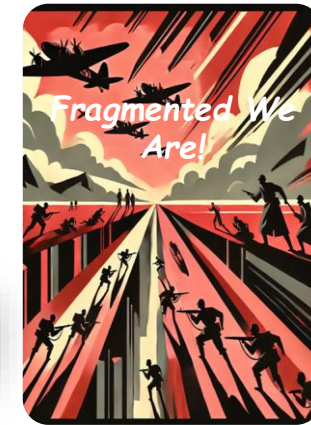


National
Energy and Climate
Plan

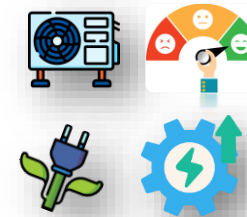
- Current EU and NECP policies
- Mid-late phase out of fossil-fuels



Fragmented World



Unified World



In ENCLUDE we learned...

More PEOPLE around Europe need to know that 

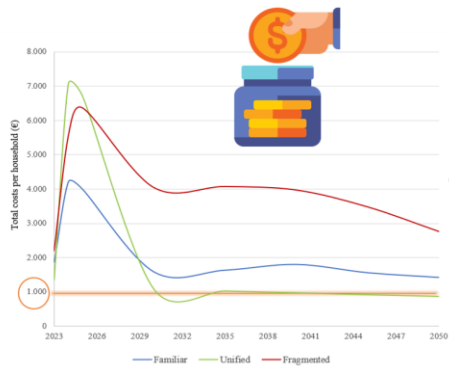


A **green** citizen-led transition in Megalopolis could not only be environmentally friendly, but also the **most financially viable** option in the long term.

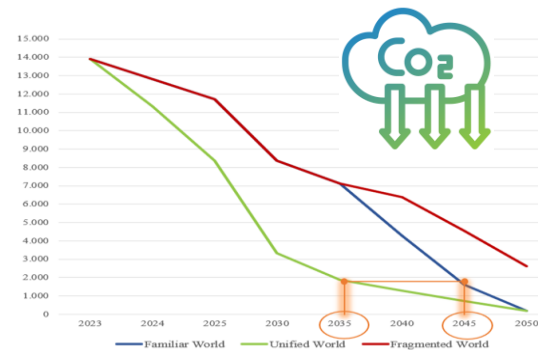
A GREEN TRANSITION *is not necessarily* an EXPENSIVE one

Around **€300 million** could be saved at the municipality level. Downscaling to the household level, this translates to total savings of around **€60,000** by 2050 (i.e., **~3 times the current GDP per capita in Greece!**)

A **green** citizen-led transition could decrease households' energy **costs**, limiting the effect of **wage** reduction, and provide a significant helping hand to the **most vulnerable citizen groups**.



“Unified World” achieves significant emission cuts by 2030- a milestone that **“Familiar World”** doesn't reach until over **10 years later!**



Coal & Carbon Intensive Regions CAN achieve BOTH sustainability and economic prosperity!

In ENCLUDE we did...



Knowledge is power & citizens seize the opportunity to harness the sun !

Unified World



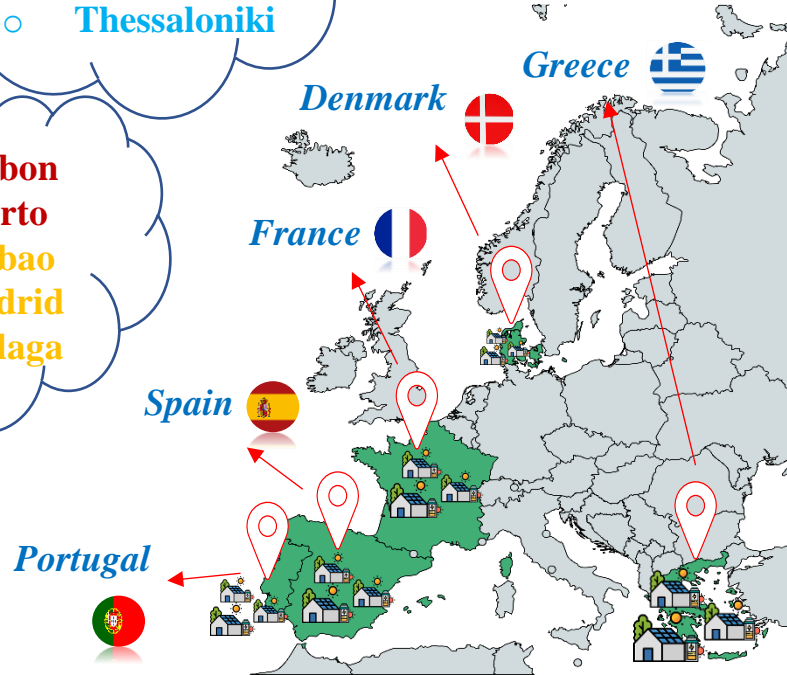
Fragmented World



Uncertainty & lack of trust overshadow the benefits of going green through prosumerism !

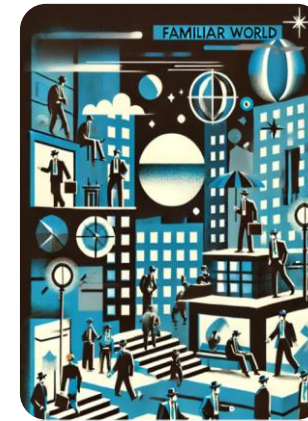
- Aalborg
- Copenhagen
- Marseille
- Paris
- Athens
- Thessaloniki

- Lisbon
- Porto
- Bilbao
- Madrid
- Malaga



- Net metering
- Feed-in-Tariff
- Net metering with BESS
- Net billing

Familiar World



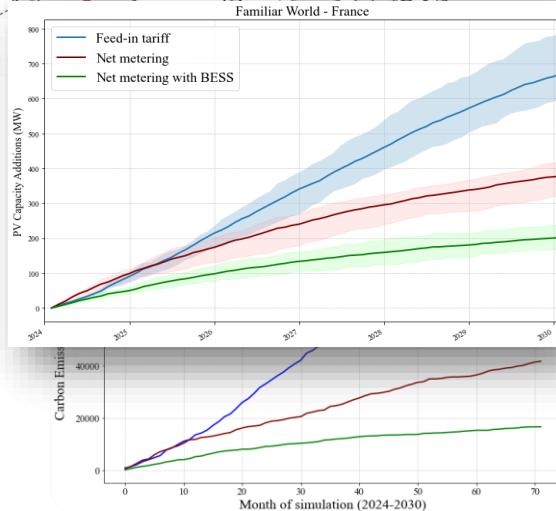
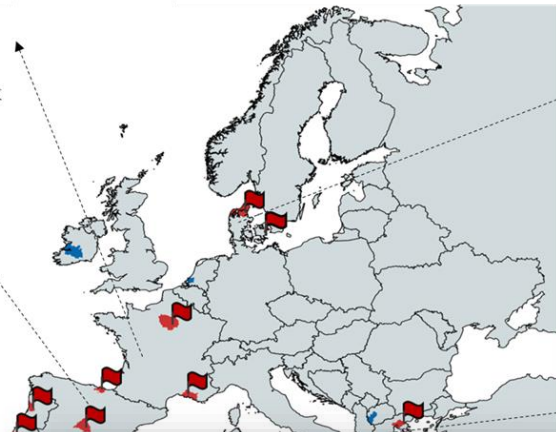
Citizens stick to what they already know about benefits of prosumerism !

Both at the local & the national level!

In ENCLUDE we learned...



- *Middle* solar PV output.
- **Lower decarbonization potential** (electricity production is mainly based on nuclear energy).
- High profitability due to a **relatively high tariff**.
- **Very high capital costs** results to **longer** payback periods.
- **High** solar PV output (especially in Malaga).
- **High decarbonization potential** (energy mix is mostly based on natural gas).
- **Lower profitability** (due to net billing) which results to **longer** payback periods.
- **High** solar PV output.
- **Middle-low decarbonization potential** due to lower electricity consumption
- **Lower profitability** (due to net billing) combined with lower self-consumption results to **longer** payback periods.



- *Middle-low* solar PV output.
- **Lower decarbonization potential** (electricity production is mainly based on wind energy).
- **Low capital costs** and **very high electricity prices** under the net metering scheme result to extremely **high profitability** and **short payback periods**.



- **High** solar PV output.
- **Very high decarbonization potential** (electricity production is mainly based on fossil fuels and especially on natural gas).
- **High profitability** (due to higher self-consumption under the net metering scheme) results in relatively short payback periods.



*Rising with the sun,
opportunities rise too!*

- **Prosumers** have the power to **influence** and **shape** the future of electricity supply, even in a “*dystopian*” world.
- **Tailored country-specific recommendations**, based on the **regulatory environment** and the different potential **evolutions** of the future, as for example:
 - ❑ **Long-term fixed prices** for FiT when short-term may have a **negative effect** on **prosumers’ psychology**,
 - ❑ **More generous battery subsidies** when need to enhance **grid stability** and **flexibility**,
 - ❑ **Tipping points** in prices and costs, and **PV capacity**, in which prosumerism is **economic viable**.

*Prosumerism
could be a real
answer towards
RESILIENCE!*

In ENCLUDE we did...



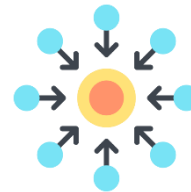
Citizen preference-led planning alternatives towards 100% renewable-based energy systems, or fossil fuel-based economies



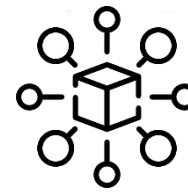
Unified World



100% renewable-based planning

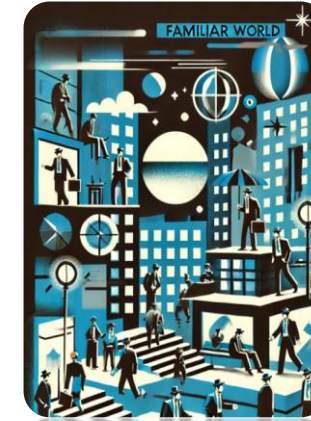


Centralized

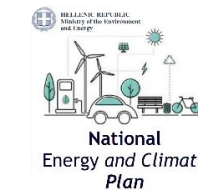


Decentralized

Familiar World



BUSINESS AS USUAL



Fragmented World



Fossil fuel-dependent planning



Gas



Lignite



In ENCLUDE we learned...

Integrate citizens' preferences into decision-making!



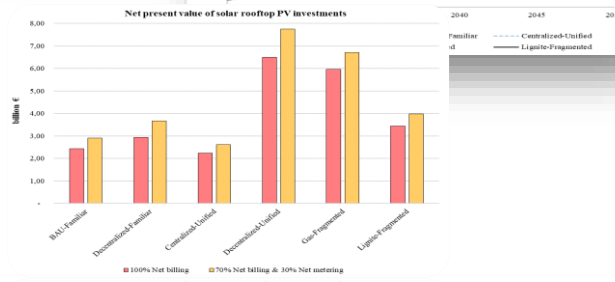
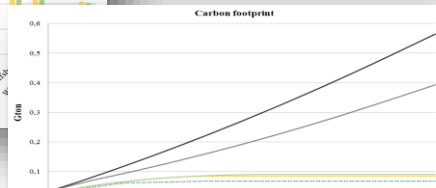
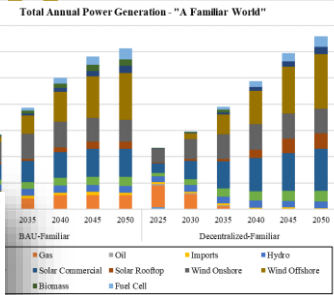
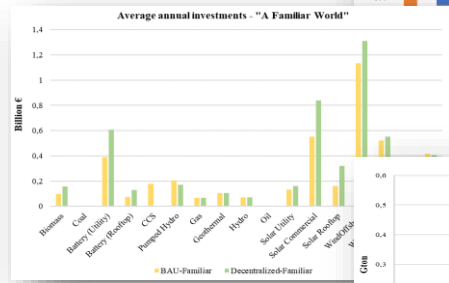
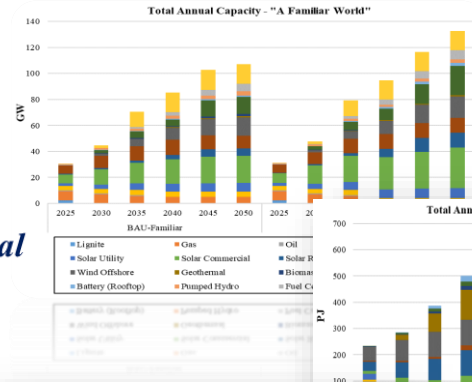
Decentralization

Local renewable solutions

Transition to a 100% renewable-based national system

Prioritize people over corporations

- ✓ Electricity mix
- ✓ Capital costs and investments
- ✓ Power generation
- ✓ Carbon footprint
- ✓ Total costs of electricity supply
- ✓ Socioeconomic benefits for citizens



A green energy system isn't just sustainable. It's also PROFITABLE!

- **Investment timing** is a key factor for the energy transition since *the earlier citizens* start investing in solar rooftop PV the *higher* the potential *socioeconomic benefits* are going to be.
- Acknowledge that a “*Decentralized*” energy system can provide citizens with a more **democratized** and **equitable** future.
- Recognize that a “*Centralized*” energy system presents a more **individualistic** and **unfair** future in which socioeconomic benefits are distributed between a **smaller share** of people.

Find more about our work...!





EnergyCitizenship.eu

About Citizen initiatives Modules Results Provide feedback

Results to explore:

- Driving factors and citizen personas towards the further growth and diffusion of Collective Energy Initiatives in Europe by 2030
- Citizen-led transitions towards justice and inclusivity: A "green" rebranding of Coal and Carbon Intensive Region into a city of the people, by the people, for the people









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Project deliverable [Open](#)

Report on the decarbonisation impact of energy citizenship at the local level: Deliverable 5.3 Energy Citizens for Inclusive Decarbonization (ENCLUDE)



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Project deliverable [Open](#)

Report on the decarbonization potential of energy citizenship at the national and the EU levels: Deliverable 5.4 Energy Citizens for Inclusive Decarbonization (ENCLUDE)

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TEESlab-UPRC

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A multi-scale energy systems modelling framework
Python
- prospect-plus-rdm [Public](#)
Prospect+ Recommendations-Decision Matrix tool
PHP

Thank you!


**Dr. Sobhan Naderian, Prof. Gioia Falcone,
Assoc. Prof. Anastasia Ioannou**




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Thank you!

Dimitris Fotopoulos, Nikos Kleanthis, Nikos Manias, Sophia Theodoropoulou, Dimitris Papantonis, Roula Charitopoulou, Dimitra Aglamisi, Dr. Vassilis Stavrakas, Prof. Dr. Alexandros Flamos


Technoeconomics of Energy Systems laboratory (TEESlab)
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