Finance related policy recommendations from ZEN

Ann Kristin Kvellheim, Centre manager FME ZEN,
SINTEF Community and NTNU

Photo: Powerhouse Trondheim

Foto: Powerhouse nettside

2016 – 2024:
THE RESEARCH CENTRE ON

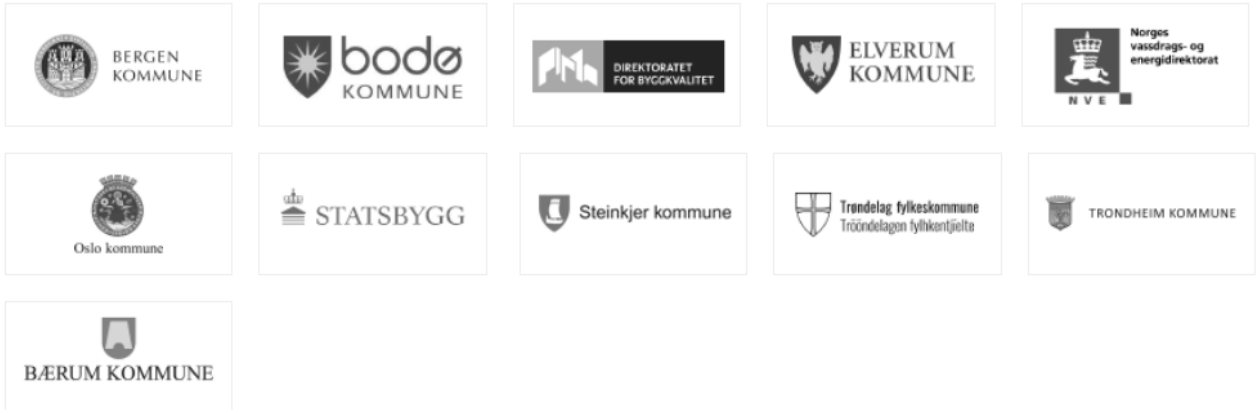
Zero Emission Neighbourhoods in Smart Cities

BUILDINGS – USERS – ENERGY SYSTEMS – PILOT PROJECTS

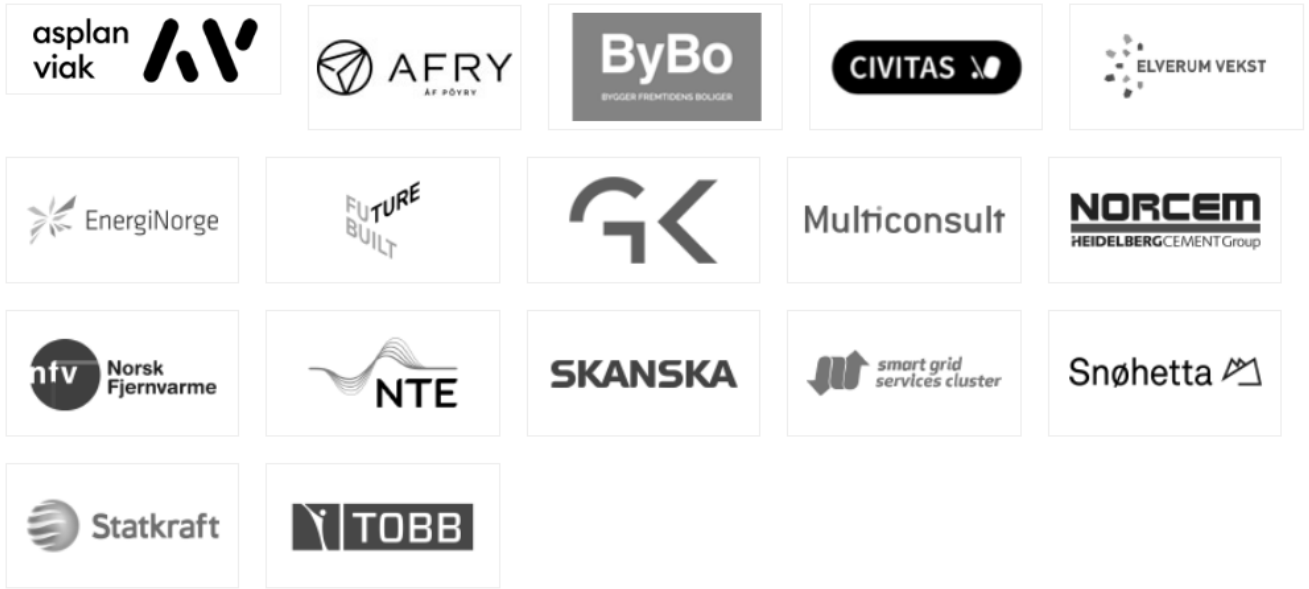
ZERO EMISSION NEIGHBOURHOODS IN SMART CITIES

Partners in ZEN

Public sector



Private sector



Research and education

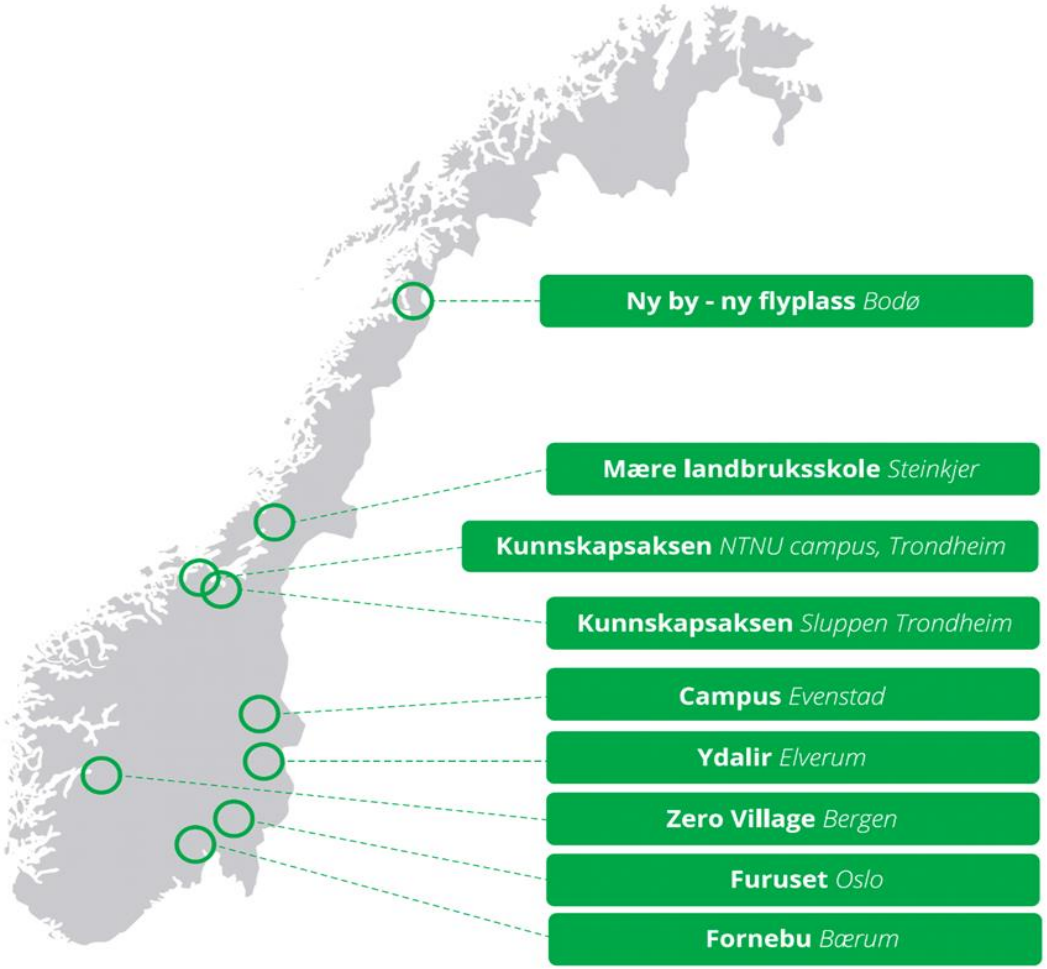
ZERO EMISSION NEIGHBOURHOODS IN SMART CITIES

The ZEN Centre's vision:

Sustainable neighbourhoods with zero greenhouse gas emissions

SINTEF NTNU

ZEN test arenas – pilot projects




Ydalir, Elverum


Furuset, Oslo


Ny By-ny flyplass, Bodø


Sluppen, Trondheim


NTNU Campus, Trondheim


Mære landbruksskole, Steinkjer


Zero Village Bergen

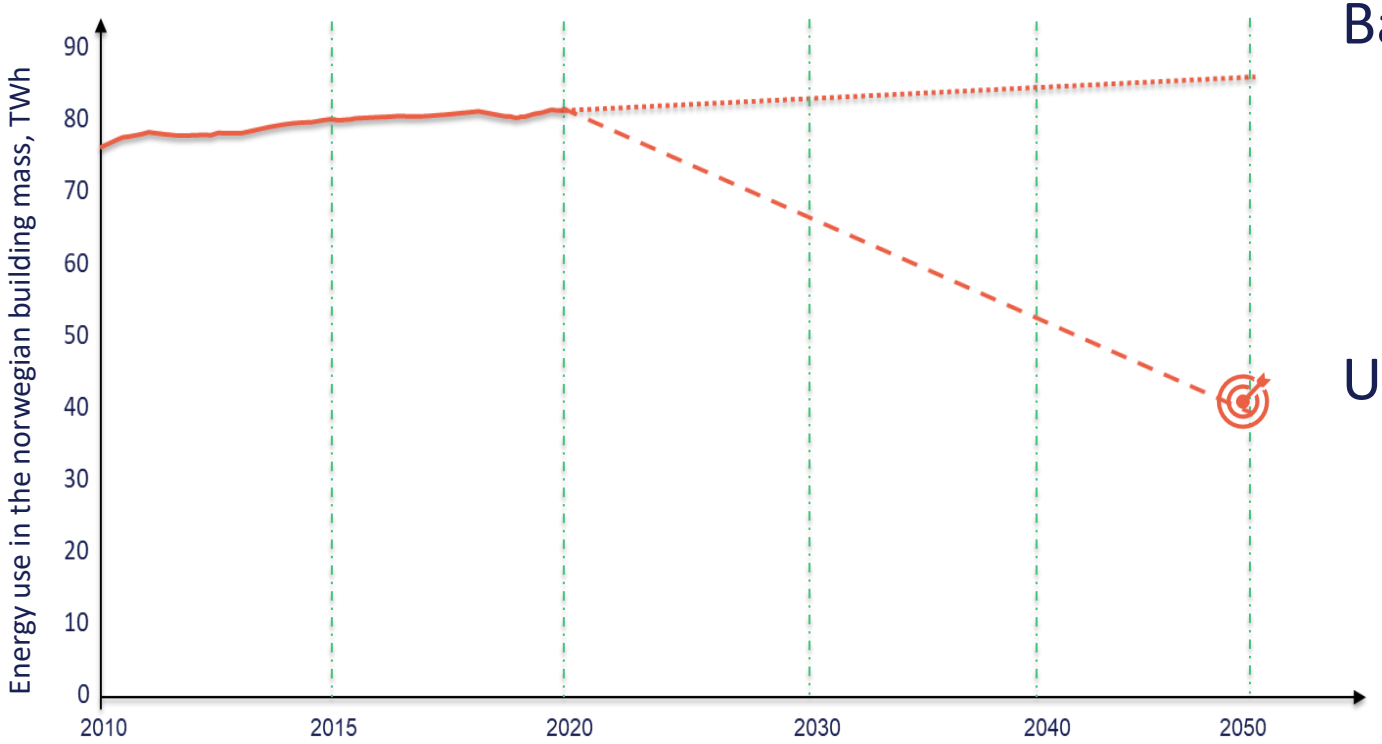

Campus Evenstad


Fornebu, Bærum

Key challenge is not how to build zero emission neighbourhoods but to implement them on a large scale

ZERO EMISSION NEIGHBOURHOODS IN SMART CITIES

Energy saving potential in Norwegian building stock



Source: Sandberg et al. ZEN, 2023

Baseline scenario

+ 2 TWh in 2030

+ 4 TWh in 2050

Ultra green scenario

- 13 TWh delivered energy in 2030

- 40 TWh - halving of delivered energy in 2050

Releases 60 % of bought electricity

4 TWh solar power in 2030 and 12,5 TWh in 2050 (80 % for own use)

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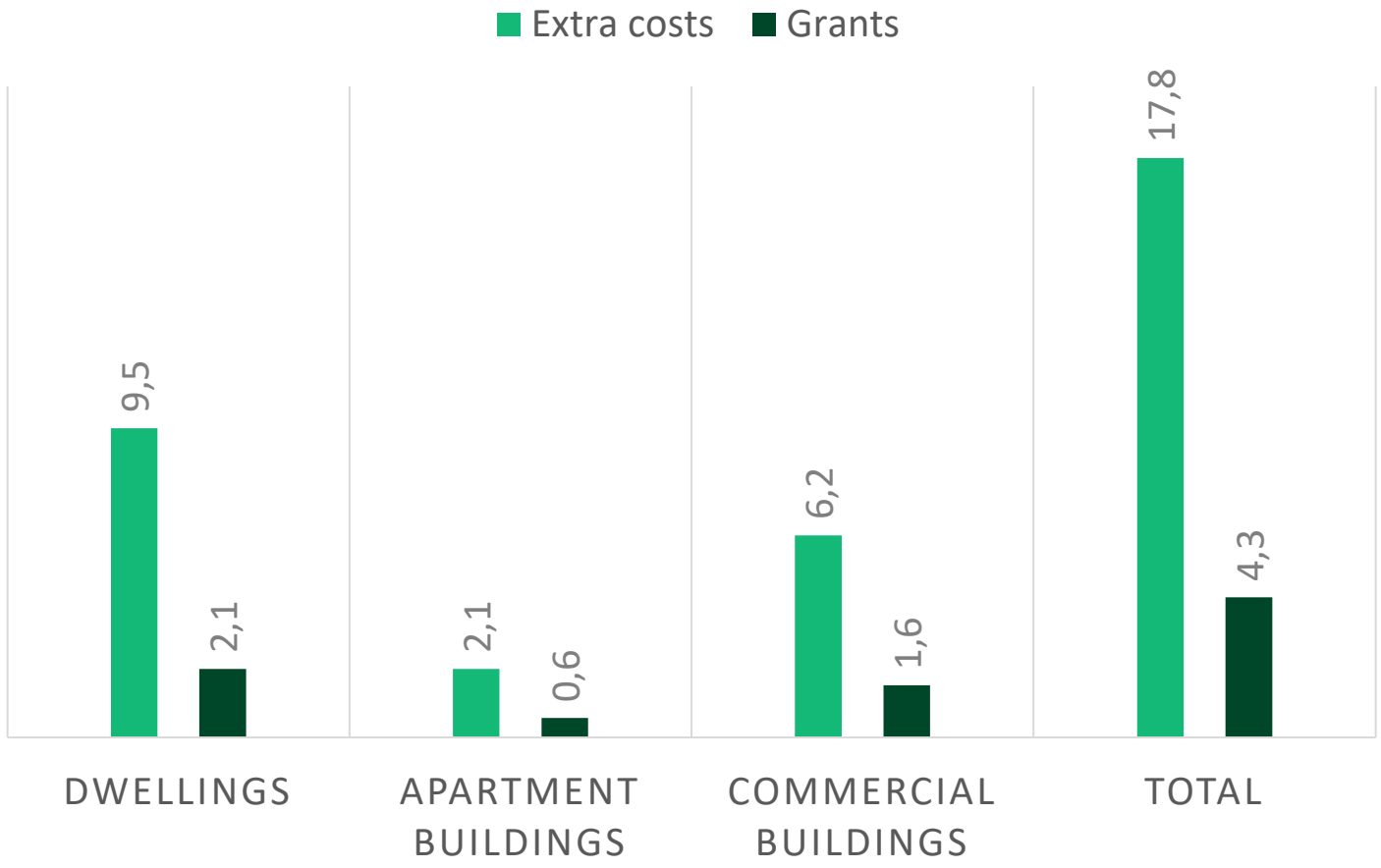
EXTRA COSTS AND SUBSIDY LEVEL PER BUILDING CATEGORY IN BILLION NOK PER YEAR

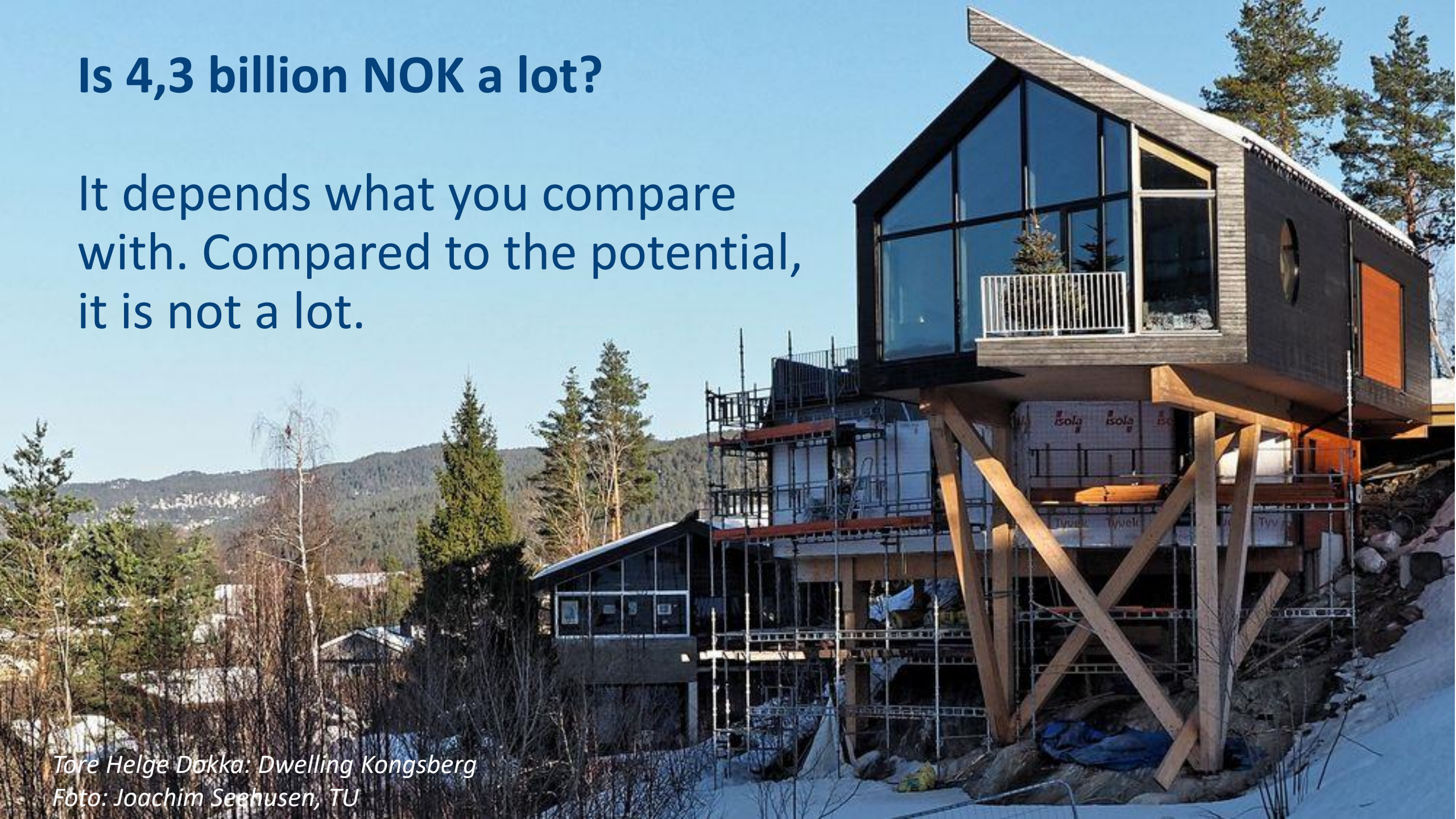


EXTRA COSTS AND GRANTS PER M2			
	In NOK (1NOK=0,09Euros)	**Extra costs/m2**	**Grants/m2**
New	Dwellings	2 500	900
	Apartment buildings	2 000	900
	Commercial buildings	2 000	900
Existing	Dwellings	2 500	1 000
	Apartement buildings	2 500	1 000
	Commercial buildings	2 400	1 000

Source: Sandberg et.al. ZEN, 2023

Is 4,3 billion NOK a lot?

It depends what you compare with. Compared to the potential, it is not a lot.



Tore Helge Dokka: Dwelling Kongsberg
Foto: Joachim Seehusen, TU

What other measures (than grants) are needed?

- Green loans to cover the rest of the extra costs (65%)
- Clear targets, and a system to follow up that these have been met
- More profitable to produce energy, and easier to share in energy communities
- Coordinated metods and concepts across different regulations
- Tightening the building code in a predictible manner

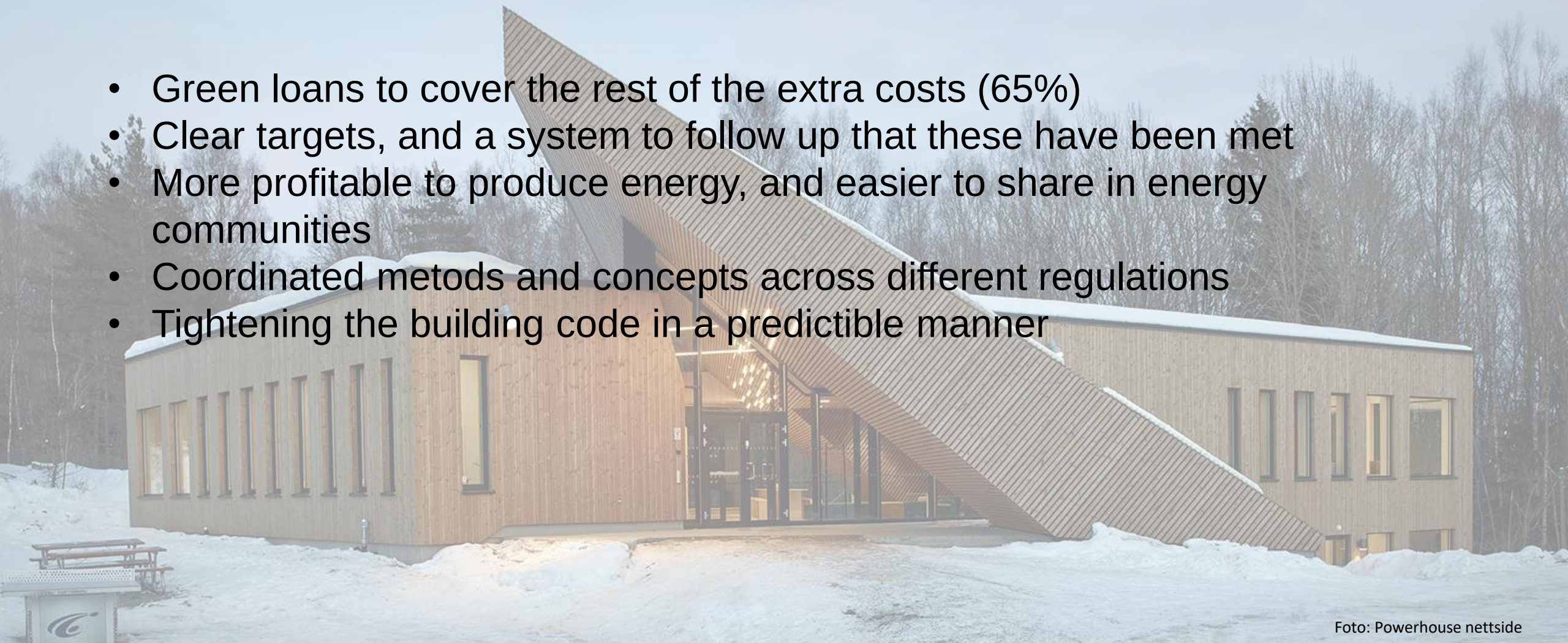


Foto: Powerhouse nettside

ZERO EMISSION NEIGHBOURHOODS IN SMART CITIES

Contact information and useful links

- www.fmezen.no
- www.zeb.no
- www.klima2050.no
- www.zeblab.no
- Ann Kristin Kvellheim, Centre director FME ZEN
  Ann.Kristin.Kvellheim@sintef.no

SINTEF NTNU

CLIMATE POSITIVE

ARV

June 13th, 2024

CIRCULAR COMMUNITIES

THE PROJECT

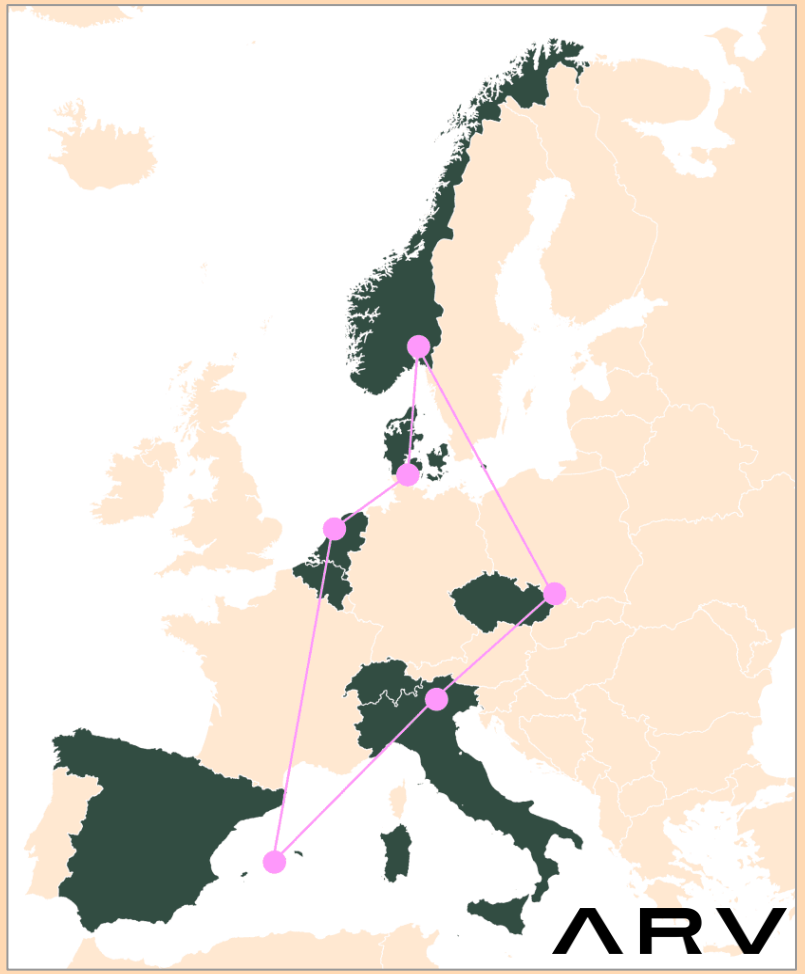
ARV is a Horizon 2020 EU-funded project to create **climate positive circular communities** in Europe.

6 demonstration sites in 6 cities

- Oslo, Norway
- Sønderborg, Denmark
- Utrecht, the Netherlands
- Karviná, Czech Republic
- Trento, Italy
- Palma de Mallorca, Spain

Wide range of innovations: new build and renovation, energy communities, NbS, circular and timber-based construction and renovation methods, RE, smart building controls, citizen engagement strategies etc...

Key challenge: leverage the benefits and incentivise and enable investment and develop bankable climate positive and circular business models



KEY PROJECT IMPACTS

Key KPIs that go beyond energy and environmental benefits

Energy

Non-renewable Primary Life Cycle Energy in the Built Environment
Renewable Energy Ratio
Grid Delivered Factor
Net Energy/Net Power
Flexibility Index

Architecture

Aesthetics and Visual Qualities
Flexibility and Adaptability
Sufficiency and Adequacy of Space
Solar and Daylight Access
Accessibility
Indoor Air Quality
Thermal Comfort
Overheating Risk
Acoustic Comfort
Outdoor Comfort

Circularity

Materials from Cycled Sources
Reusability

Social

Democratic Process
Social Inclusion
Social Engagement
Demographic Composition
Social Interaction and Cohesion
Safety and Security
Energy & Environmental Consciousness
Affordability of Energy
Affordability of Housing
Access to Sustainable Mobility
Access to Services and Amenities

Environment

Life-cycle GHG Emissions in CPCC
Air Pollution from the Energy Consumption
Dust during Retrofitting
Noise during Retrofitting

Economics

Global Cost
Energy Renovation Rate
Number of Jobs Created
Construction Time Reduction

DATA AND DIGITAL CAN DRIVE INNOVATION

Data and digitalisation can both create and visualise new value streams and multiple benefits of climate positive and circular communities.

This drives innovation through:

- Efficiency and optimization
- Scalability and replication
- Data-driven metrics and decision making
- Reducing climate risk
- Regulatory compliance
- Methodologies to turn new value streams into financeable metrics
- Impact driven businesses & impact investing

Some business and financing models applied in ARV

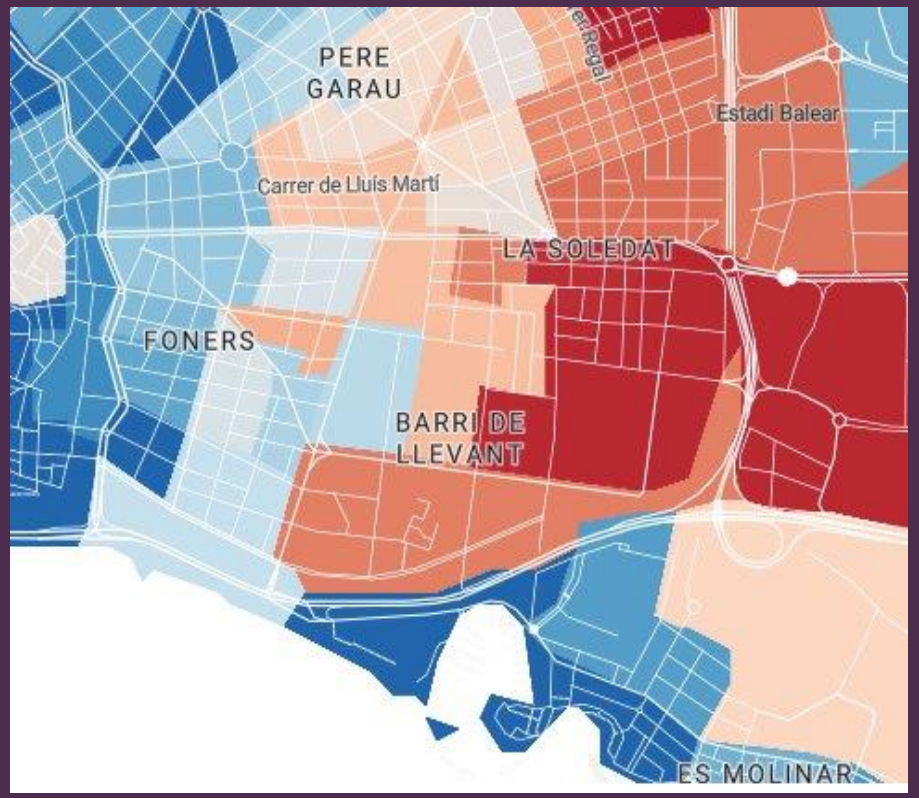
FINANCING RETROFITTING TO TACKLE ENERGY POVERTY

Spain, Palma de Mallorca
Low-income neighbourhood where energy poverty is a real concern. In some cases, this means under heating or undercooling and compromising wellbeing and health

PPP: retrofitting management entity to facilitate retrofitting contracting on a building level (multiple apartments) and the application for EU's NextGen funding, as well digital tools to renovate at scale.

EU NextGen funding (up to 80% subsidy for deep renovations)

Serves demand creation, but remaining upfront costs and cash flow remain an issue



Average annual salary per household: € 20,456.
16% poorest nationally and 1% poorest in the Autonomous Community
Graph: INE.

FINANCING RETROFITTING TO TACKLE ENERGY POVERTY

Beyond households, who has the incentive to fund the gap?

- Municipality through understanding health and social benefits (reducing budget burden elsewhere)?
- Banks to decarbonise their mortgage portfolios?
- Private investors with moderate ROI expectations?
- Local impact (or image) driven businesses – carbon credits from renovation?

Need for financial innovation and quantification of benefits beyond investment costs vs bill savings

Need to overcome the "must fit in an Excel" challenge…

ESCO/Energy-as-a-Service

Utrecht, The Netherlands
Densely populated districts with high share of social housing, majority low-income households.

Inside-Out: Modular, industrialised renovation for comfort and high energy performance. Leverages standard building design and data-driven workflows to speed up renovation and lower cost. ESCO is responsible for maintenance costs, residents only pay for the energy used.

Rising material costs and ambitious renovation hurt the business case, esp. while multiple benefits cannot be accounted for. Tendering for circularity

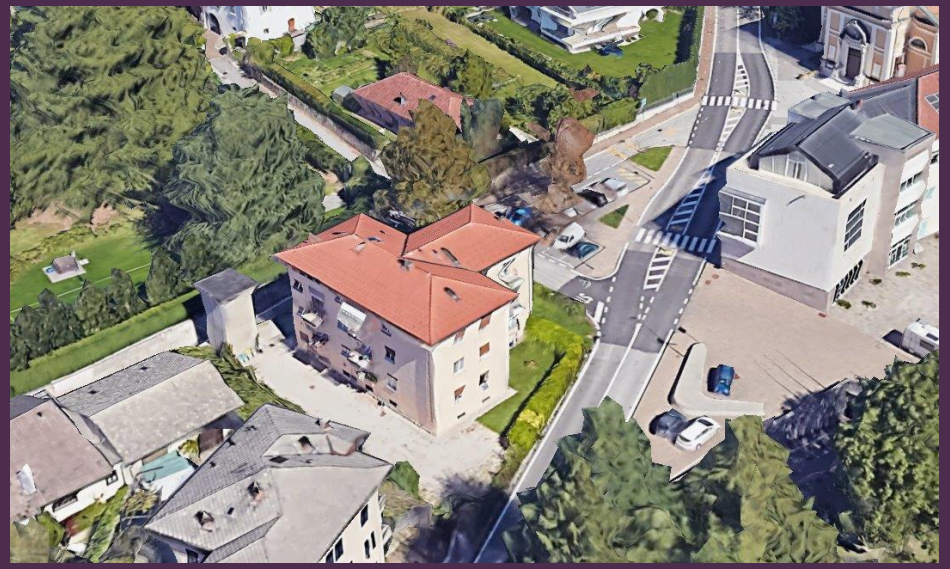
ONE-STOP-SHOP FOR CIRCULAR RENOVATION

Trento, Italy
Privately owned multi-family, residential buildings in need of a renovation.

Industry driven one-stop-shop: aggregate and match demand and supply of sustainable renovation works, showcase and demonstrate circular, timber based and sustainable renovation technologies (i.e., prefab-kits).

Benefitted from the Italian “superbonus” tax credit, which paid homeowners 110% of energy renovation costs. Appealing for consumers, but industry already experiencing labour shortages and this created a renovation bubble, leading to dodgy or unfinished renovations.

Need to design financial subsidies in a way that supports ramping up the industry



https://greendeal-arv.eu/

https://twitter.com/GreenDealARV

https://www.linkedin.com/company/arv-h2020/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036723

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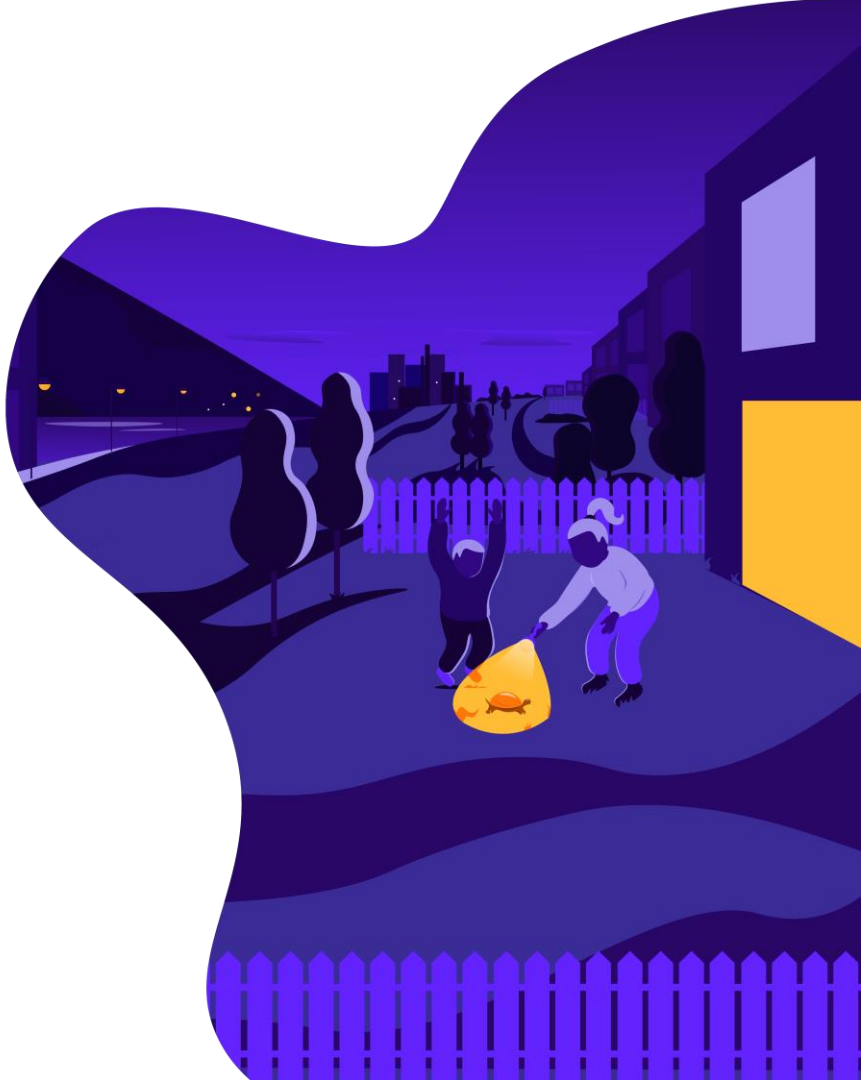
An overview of financing opportunities and strategies from Syn.ikia



Dr.ir. Angela Greco
Senior Scientists TNO
Assistant Professor TU Delft

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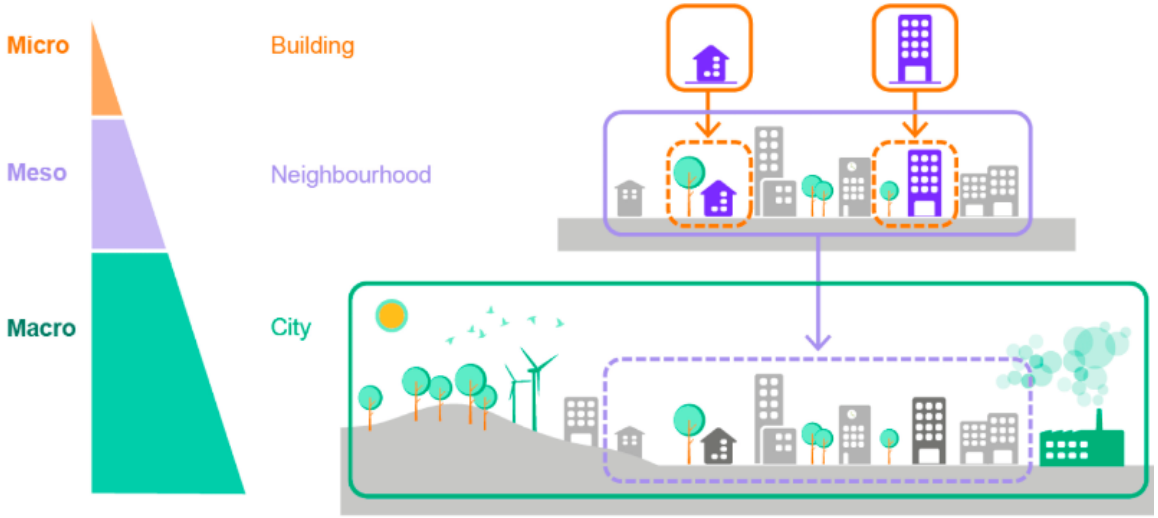
Financial Schemes: why and what?

- The upscale to the neighborhood, district, and city scale is of the utmost importance for mitigating the impact of climate change.
- But multi-stakeholder complexity (e.g., economic disparity, ownership issues) call for financial incentives to kick-start the value-case shift from building to district levels.



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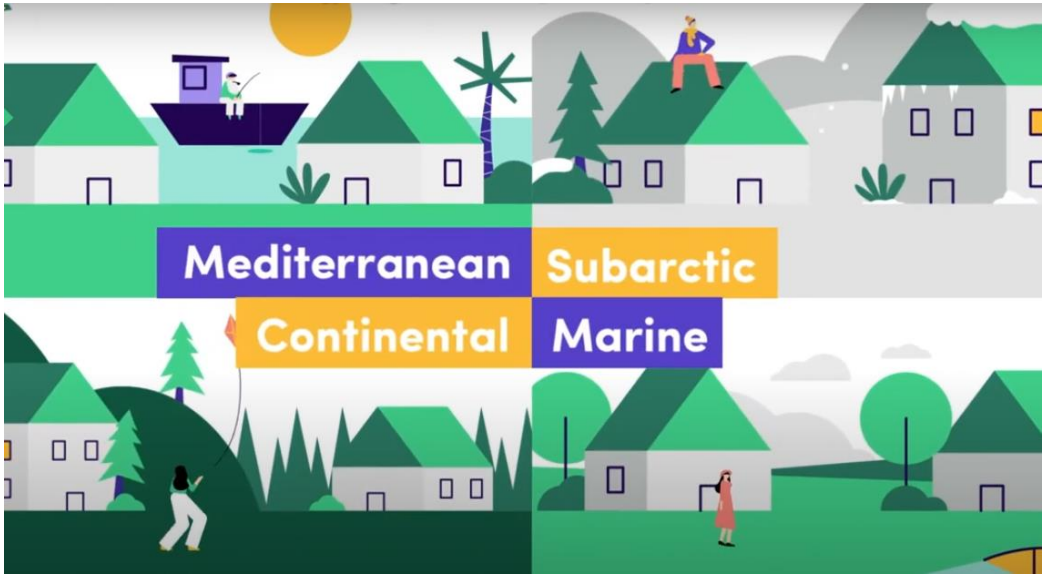
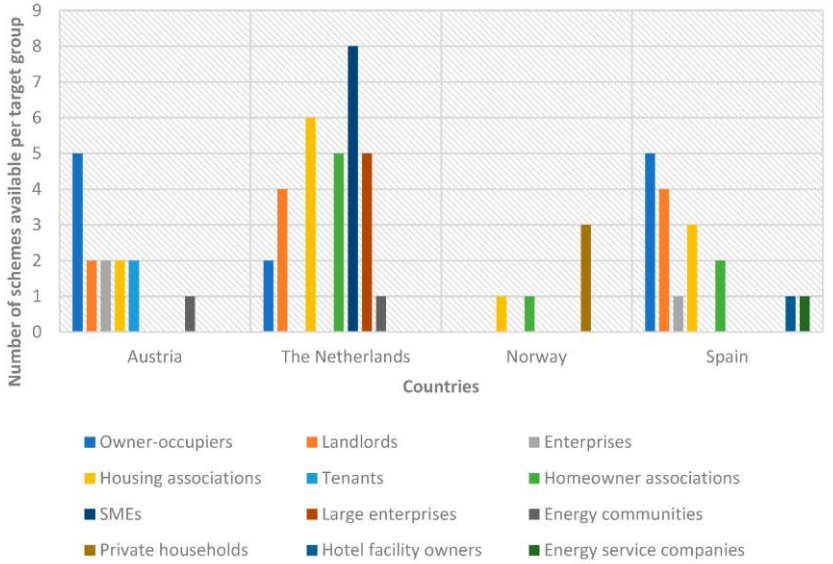
Current outlook across the four Demo-Countries



Kerstens, A., & Greco, A. (2023). ***From Buildings to Communities: Exploring the Role of Financial Schemes for Sustainable Plus Energy Neighborhoods***. Energies, 16(14), 5453.

Current outlook across the four Demo-Countries

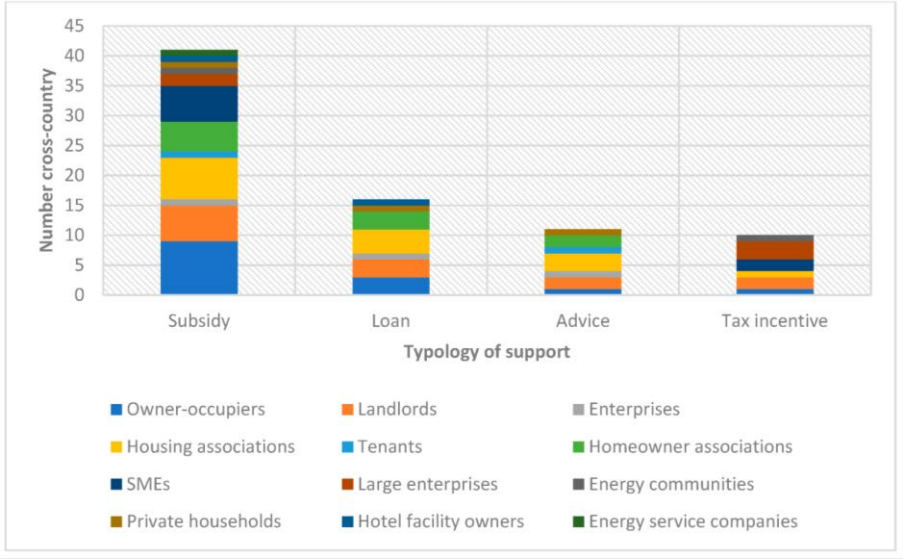
- Common financial schemes focus on improving insulation and heating to enhance energy efficiency in buildings.
- All four countries support sustainable energy production, but fewer incentives for shared production among buildings and units.
- In Austria and The Netherlands, energy communities are supported through reduced taxes and subsidies. These communities are crucial for organizing collective sustainable energy actions.



Current outlook across the four Demo-Countries

- Subsidies are most frequently used to provide support to owners, followed by loans.
- Tax incentives were found in all countries, expect Norway.

1. Which schemes and policies can incentivize collective action?
2. Are these schemes inclusive and accessible to a variety of target groups?



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Critical evaluation

- **Prosumerism is not incentivized**: Issues such as legal establishment, spatial limits, and technical requirements create challenges for smaller-scale prosumers.
- **Accessibility:** Most schemes require target groups to pay high upfront costs for interventions, posing problems for low-income groups who may struggle to access subsidies.
- **Country-specific approaches**: Norway's subsidies are often focused on high-income households, while Spain appears to support lower-income groups more effectively. Austria uniquely targets tenants directly.

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Critical evaluation

- **Split-Incentive issue:** Building owners, who invest in energy measures, and tenants, who benefit, face a split-incentive issue. This is particularly problematic for social housing, where rent increases are regulated.
- **Role of Energy Service Companies (ESCOs):** Spain has schemes targeting ESCOs, which play a crucial role in bringing energy efficiency solutions to the market, contributing to a holistic approach to sustainability transitions.

Many financial schemes inadvertently disincentivize a holistic approach to energy positive measure.

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Which mechanisms are working?

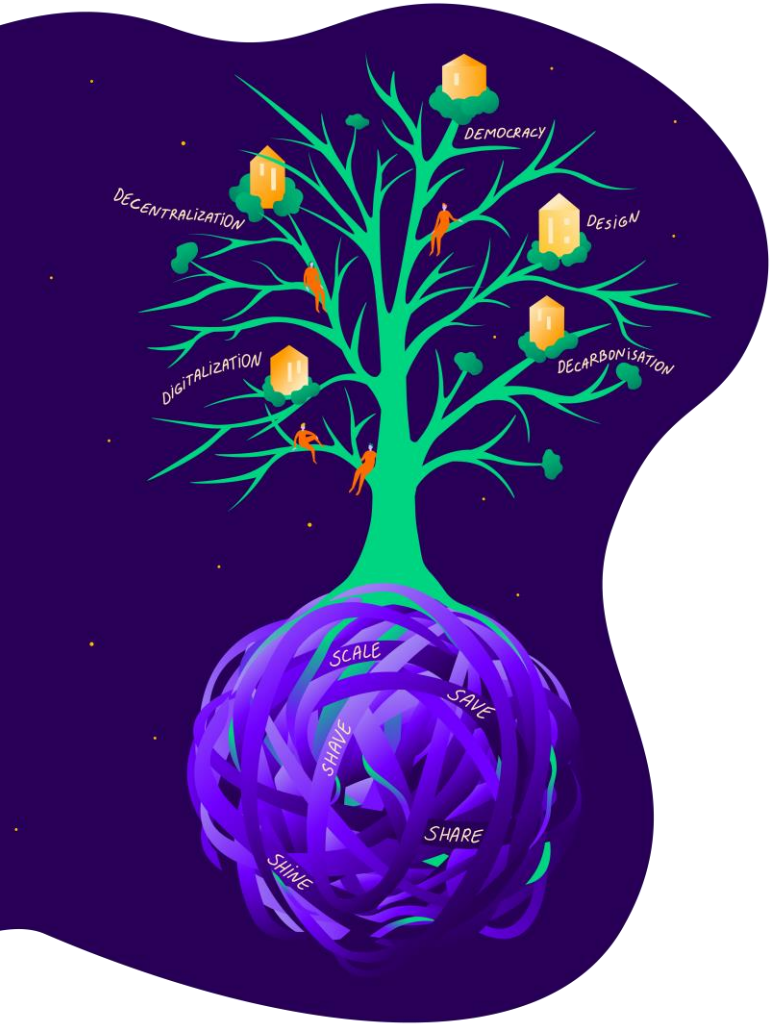
Mechanisms:

1. Bottom-up initiatives (e.g. online and offline platforms to facilitate collective action).
2. Municipality driven interventions (through e.g. energy coaches).
3. Intermediary organizations initiating collectives.

The absence of a responsible entity for neighborhood-level energy management and fragmented financial schemes hinder the prioritization of collective energy solutions.

- Syn.ikia innovation, Energy Manager Spain could be a promising solution.

Questions?



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European Commission (2015). Financing Energy Efficiency (2015)

Hall, S., Brown, D., Davis, M., Ehrtmann, M., & Holstenkamp, L. (2020). Business Models for Prosumers in Europe.

Panteli, C., Klumbytė, E., Apanavičienė, R., & Fokaides, P. A. (2020). An overview of the existing schemes and research trends in financing the energy upgrade of buildings in Europe. Journal of Sustainable Architecture and Civil Engineering, 27(2), 53-62.

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Update on initial results

Crowdfunding

- Multiple private funders. Small investments by many individuals instead of large investment by few individuals.
- Grown exponentially since 2012, through platformization.
- Communities become shareholders rather than (simply) stakeholders (Crowdfunding for Energy Efficiency, 2020).
- Fertile for the “Prosumer” business model (see e.g. Hall et al., 2020).
- Example of EU-funded projects include Citizenergy (https://citizenergy.eu/) and CrowdFundRes (http://www.crowdfundres.eu/).

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Update on initial results

PPP—EU public funds

- The number of public funds needed for the period 2021-2030 to reach the EU's energy and climate objectives for 2030 will be €177 billion per year (European Commission, 2015)
- There are more than 60 EU funds available (Euro funding data-base) concerning the Energy Sector.
- The most well-known are the European Energy Efficiency Fund (EEEF), the European Regional Development Fund (ERDF), the Joint European Support for Sustainable Investment in City Areas (JESSICA) and the European Local Energy Assistance (ELENA).

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Sustainable
plus energy
neighbourhoods

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PEB economics

Economic aspects, funding, and business models: lessons learned from the Cultural-E project

Roberto Lollini, Francesco Isaia, Isabelle Büttner

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870072

What is a Plus Energy Building (PEB)?

https://www.cultural-e.eu/peb-definition/

A Plus Energy Building is an energy efficient building that produces more final energy than it uses via locally available renewable sources over a time span of one year.

Positive balance reached by ensuring:

a good dynamic matching between load and generation providing building flexibility

+ generation

− load

the lowest greenhouse gas emissions

Building uses include both building operation and **user related energy consumption**

Heating | Cooling | Domestic Hot Water

Auxiliaries | Ventilation | Plug Loads

Energy generation shall be performed by renewable energy systems located within building footprint.

It can be extended to adjacent lots as long as there is a physical connection and direct control of renewable energy generation system.

Ownership of the buildings or lots, neighborhood grid infrastructure and building management is a must.

PEB Shall ensure an **added value** providing accessible and comfortable and **healthy indoor environment.**

PEB shall ensure an added value providing easy access to e-mobility.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 870072.

Plus-Energy Building concepts

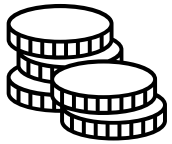
Plus Energy Buildings (PEBs) represent a step forward from nearly or Net Zero Energy/Carbon Buildings, contributing to:

- **decarbonizing** the built environment by exchanging energy with other buildings and infrastructures
- **reducing** the energy grid **congestion**
- **providing** a **flexible energy asset** able to actively participate to a larger energy system
- **ensuring healthy** and **comfortable indoor environment**, embracing occupants' diversities and needs
- **supporting users**' energy-related practices and their flexibility
- **minimizing** their own **carbon footprint**

A consolidated definition is needed in order to enable the design, assessment, and documentation of PEBs in different contexts, climates, cultures, and markets.

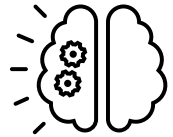
https://www.cultural-e.eu/peb-definition/

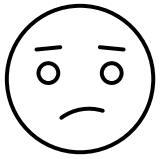
Plus-Energy Building barriers and drivers



Depending on the context, **higher upfront costs can be a barrier** to the broader roll-out of PEBs and public incentives can play a role in helping projects to get off the ground

Complexity of PEB concept, and the related need for an **integrator to handle the project** from design to operation and maintenance, with immaturity of the regulatory environment





Lack of awareness of the PEB concept is a common barrier, and relevant for wide variety of actors, from general public to professionals, investors and regulators

Plus-Energy Building concepts: a user-centric approach

Different users embrace a great variety of backgrounds, perceptions, behaviors, and expectations, driven by the need of achieving comfort and convenience, interested in having access to services and not in energy consumptions per se. Users' perception and attitudes are highly influenced by contextual boundaries and other socio-cultural influences.

State of the art

Indoor Environmental Quality (IEQ) requirements are defined based on ideal conditions that generally match with a subjective sensation of neutrality. Consequently, **design is usually aimed at very tight and static environments**, where transition and stimuli are not permitted, with very narrow ranges to be equally maintained for all the subjects

Front runners

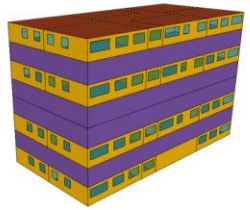
Indoor Environmental Quality (IEQ) aspects and occupants' needs put at the heart of a new design and operation paradigm, where **IEQ is not only a side-effect deriving from other processes, but it is a key point** in the checklist of achievements. In the lifespan of PEBs the 1) thermal, 2) visual, 3) acoustic, and 4) air quality environments

Next steps

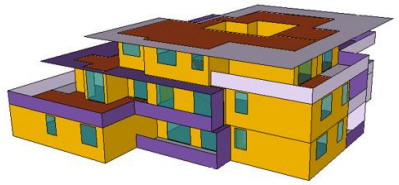
The **IEQ KPIs are verified during all the phases of the building life cycle** by means of design and calculation (design phase), and post-occupancy evaluation (operational early and late phases)

Potential PEB implementation in EU

HIGH-RISE BUILDING

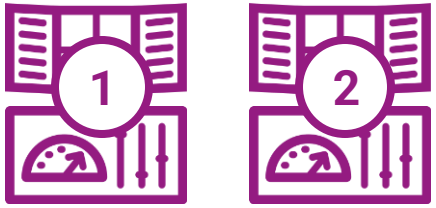


LOW-RISE BUILDING



2x Building archetypes

SOLUTION SETS



2x Solution Sets

MEDITERRANEAN GEO-CLUSTER

OCEANIC GEO-CLUSTER

CONTINENTAL GEO-CLUSTER

SUB ARCTIC GEO-CLUSTER

4x Geoclusters

Boundary conditions:

- **Envelope performance** depending on the geocluster
- **H/C setpoints** according to cultural aspects
- **Internal gains** according to stochastic profiles based on geocluster-based statistics

Slide prepared by Francesco Isaia - Eurac research

**Repository of reference building models of multi-residential Plus Energy Buildings online*

Cultural-E key technologies for PEB

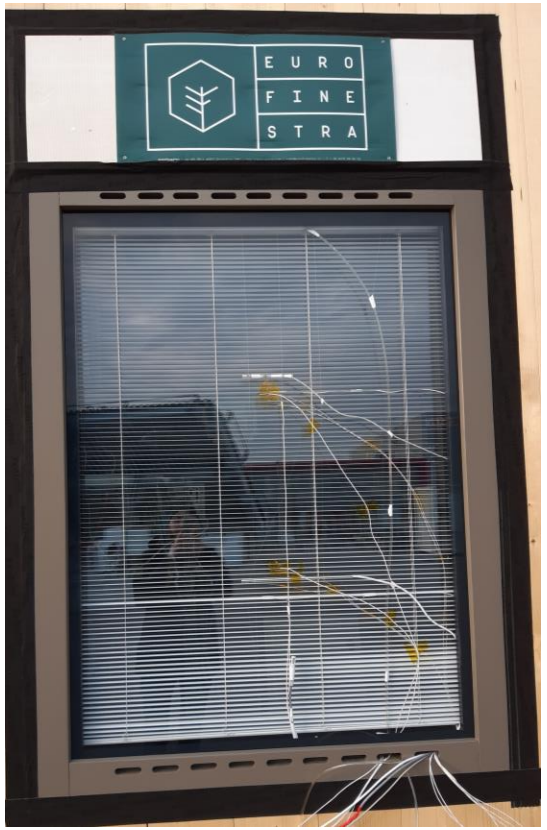
Smart air Movement

Active Window System

Packed Heat Pump

Cloud-based House Management System

Strategies for building flexibility



Solar irradiance

Occupancy

Indoor RH

Outdoor RH

CO2 concentration

BESS SOC

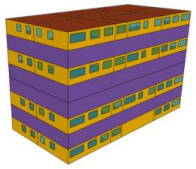
PV production

Windows opening

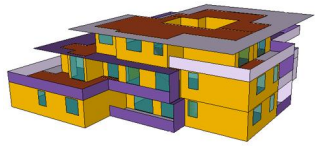
Slide prepared by Francesco Isaia - Eurac research

PEB configurations: Cultural-E factsheets

HIGH-RISE BUILDING

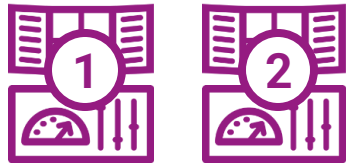


LOW-RISE BUILDING



2x Building archetypes

SOLUTION SETS



2x Solution Sets

MEDITERRANEAN GEO-CLUSTER

OCEANIC GEO-CLUSTER

CONTINENTAL GEO-CLUSTER

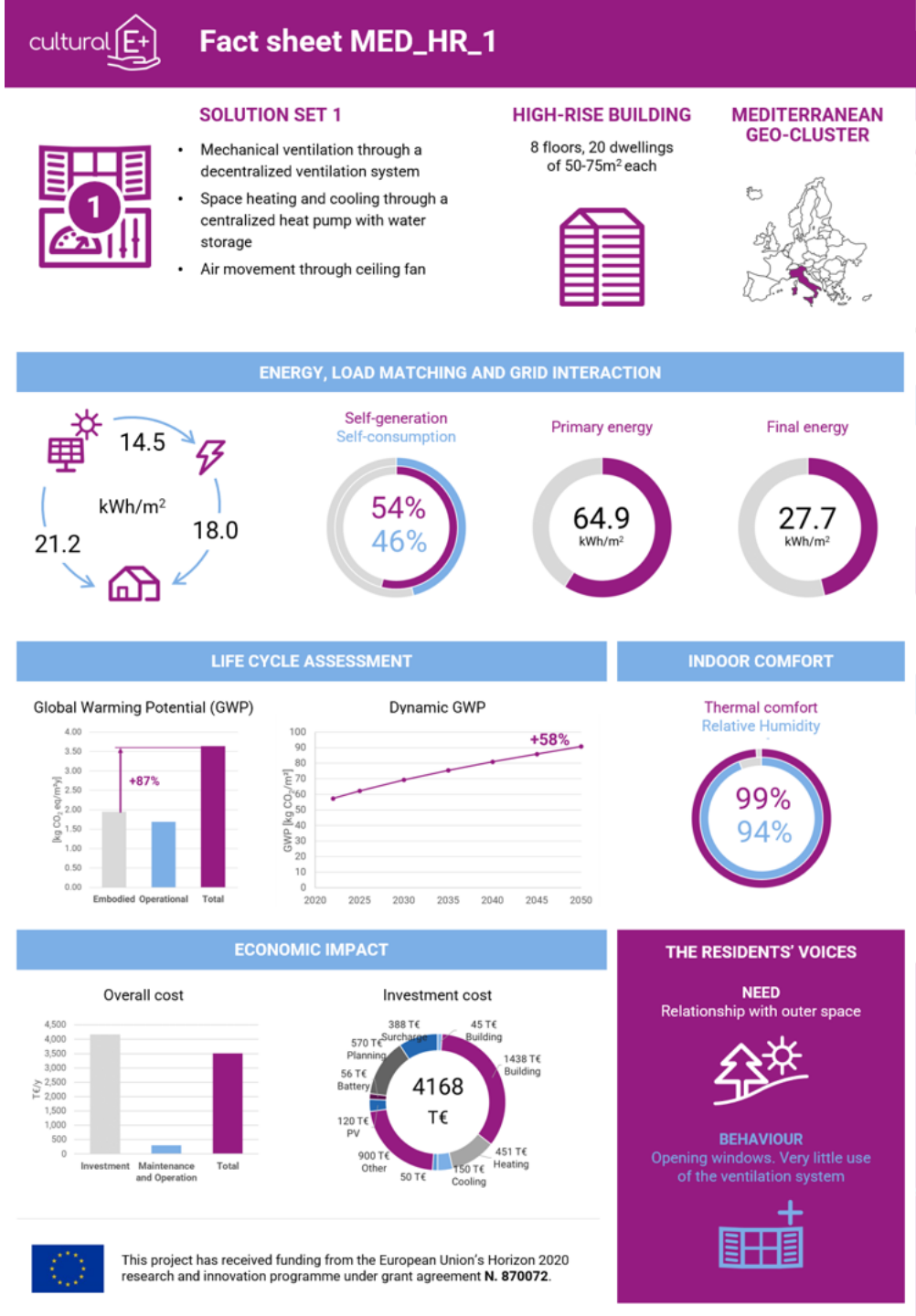
SUB ARCTIC GEO-CLUSTER

4x Geoclusters

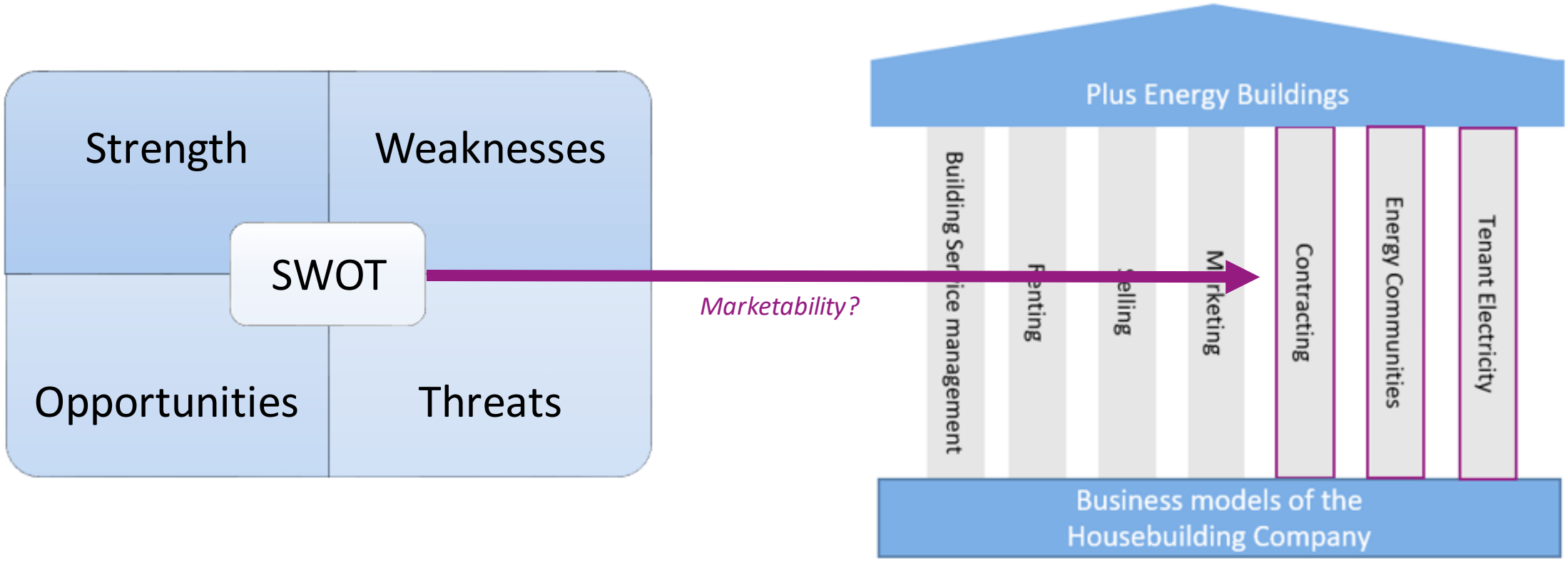
16 factsheets

https://zenodo.org/records/8273531

Slide prepared by Francesco Isaia - Eurac research



Different business approaches for promoting PEB



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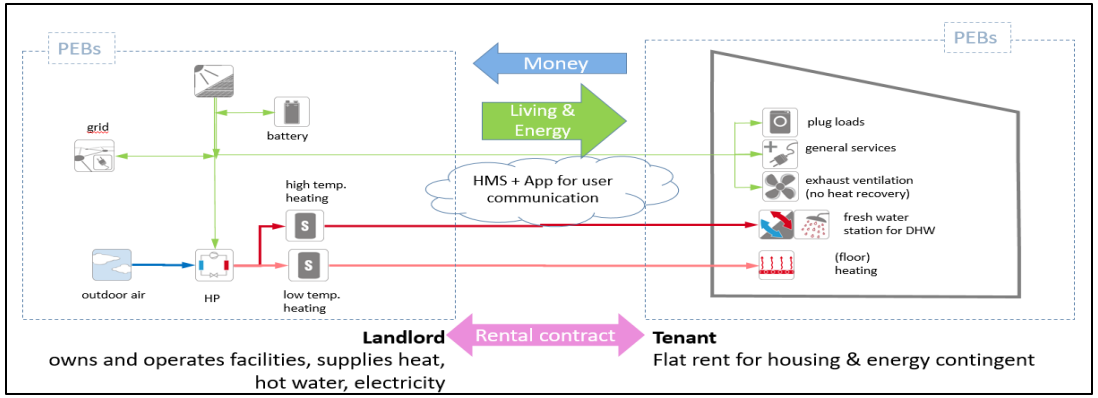
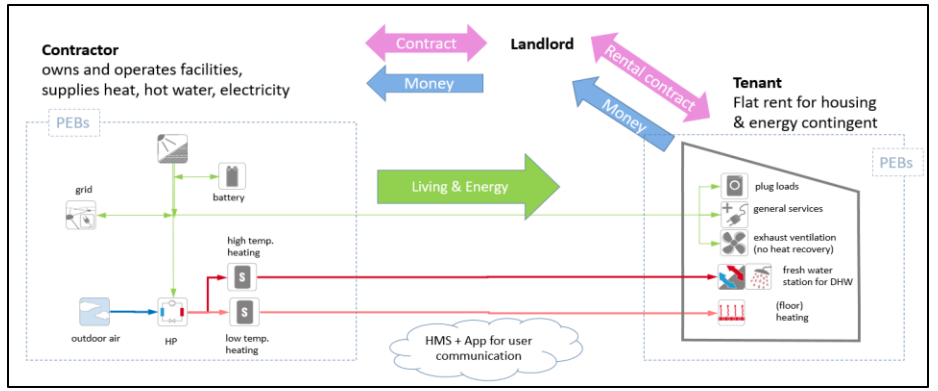
Different business approaches for promoting PEB

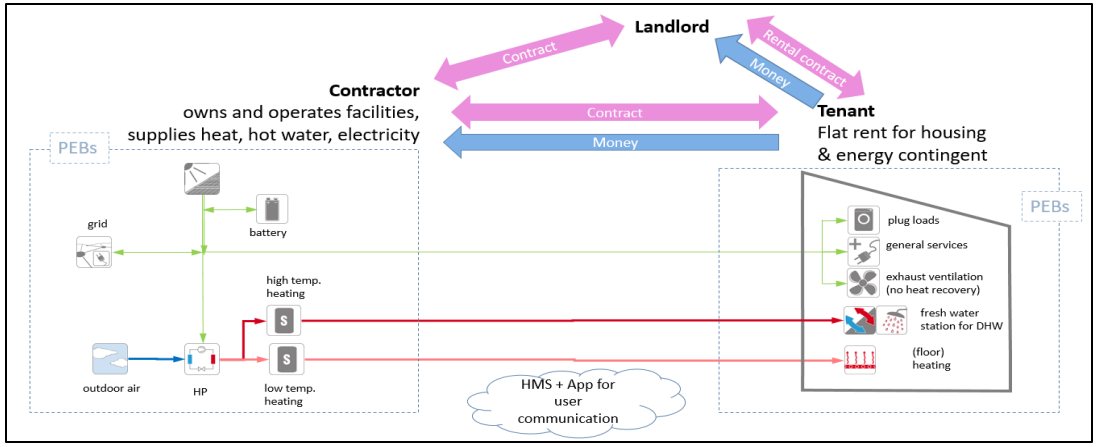
All incl. Rent



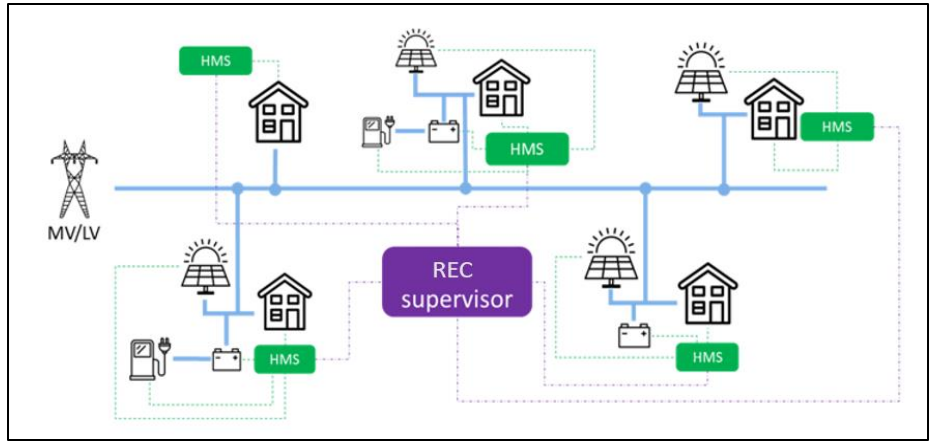
All incl. Rent - Type Contracting



Energy Budget



PEBs for Renewable Energy Communities



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SWOT results on PEB business models from interviews

Business Model	S (Strength)	W (Weaknesses)	O (Opportunities)	T (Threats)
All incl. Rent	S1: One contract	W1: More technology, more costs	O7: Standardization O10: General public is interested in ecological energy	T1: EU Law of freedom to choose energy provider
All incl. Rent – Type Contracting	S1: If no staff/expertise the contractor is a solution	W3: Landlord as middleman means extra effort	O1: With many dwellings company could debate for a low price O2: Contractor has expertise leading to efficiency	T3: EU Law of freedom to choose energy provider
Energy Budget	S2: Less work for landlord as tasks are outsourced	W2: Dependence on contractor	O1: Energy efficiency (is) ensured by contractor O2: Applied on big buildings more economically	T1: Contractor could impact tenants' satisfaction with housing situation
PEBs for Renewable Energy Communities	S2: Internal energy prosumption S4: Members have the possibility to participate in low-cost electricity generation S5: Community idea is attractive S8: the EU law supports EC	W1: Costly RE system W2: Connection of buildings is costly W3: Proof of concept W4: Administrative effort	O1: Mixture of infrastructure (shops and housing) to reduce grid peaks O2: the possibility of Raising awareness for energy related topics O3: the implementation of a Portfolio community O4: Integration of older buildings O5: the integration of Technical opportunities (e.g. waste water energy)	T1: The state law that hinders the implementation of energy communities T4: Members leaving the energy community

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SWOT results on PEB business models from interviews

"So one weakness is, yeah, more work for the for the landlord and that we are not used to more contracts"

"building those super-efficient dwellings is costing too much"

Business Model	S (Strength)	W (Weaknesses)	O (Opportunities)	T (Threats)
All incl. Rent	S1: One contract	W1: More technology, more costs	O7: Standardization O10: General public is interested in ecological energy	T1: EU Law of freedom to choose energy provider
All incl. Rent – Type Contracting	S1: If no staff/expertise the contractor is a solution	W3: Landlord as middleman means extra effort	O1: With many dwellings company could debate for a low price O2: Contractor has expertise leading to efficiency	T3: EU Law of freedom to choose energy provider
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"one less administrative task, I store it all out, so that's the minimum, so to speak, the most minimal involvement from the landlord's side"

"you know humans are social animals. *Laughing* So it's it's it's good. People are proud to live in a building that is part of the community, producing locally etcetera, etcetera."

"the whole thing is associated with large costs in production and then also in maintenance"

"the opportunity […] that the contractor, of course, by being professional and focussing only on that, perhaps in the future somehow either through technology or by doing a lot of objects in the area or whatever, that it will increase efficiency"

Additional achievements from PEB business models interviews

"In Italy people prefer a contract with personal relationships and people they know, as they trust them more."

"in France during winter it is not possible to cancel a rental agreement, if tenants are not paying their rent.
If tenants are not paying their energy bill, the delivery of energy can be cancelled by the energy provider. "

"tenants trust their landlord more than the energy provider"

Trust Question

Albanese & de Blasio (2014): Self-declared trust (0= no trust, 10= trust in all)	
France	4.50
Germany	4.68
Italy	4.41

Student Housing

Policy recommendations: political implications

i. RED II states that RECs must not act for profit → hinders investment and innovative BMs → Amendment of the current EU directive

ii. Create a better legal framework for landlord-to-tenant-electricity & RECs
→ Promote the purchase of local renewable energy
→ as an effective tool to face energy poverty
(The Italian National Integrated Energy and Climate Plan recognises self-consumption systems and RECs as an effective tool to combat energy poverty)

iii. Implement support measures for contracting in the private sector
→ Support private households on their path to greater energy efficiency

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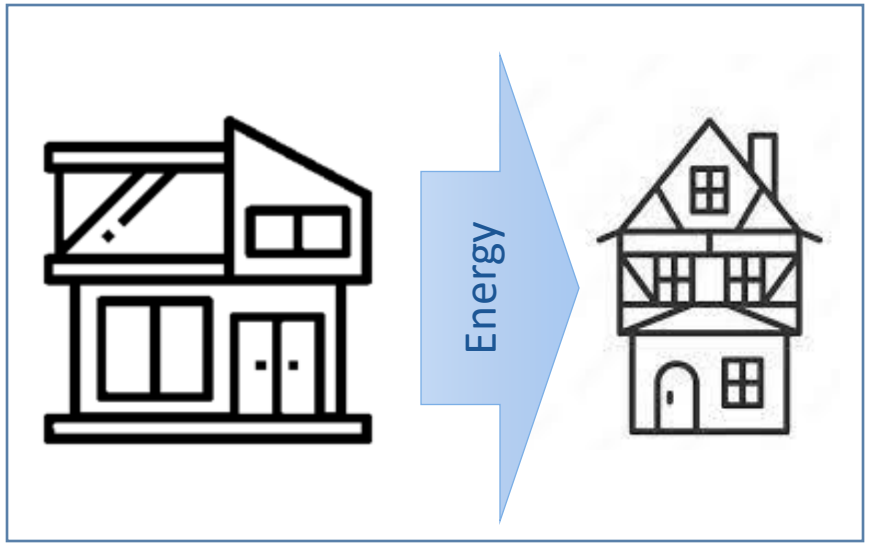
Policy recommendations: guidelines for PEB investors

Grouped price with a contractor for several buildings



PEBs aiding older houses

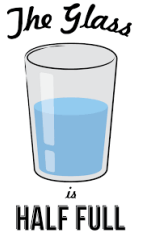
Policy recommendations: marketing for PEBs

one-contract as a unique selling point

a PEB certificate for branding

the BM PEBs for REC could be promoted in the sense of "PEBs for all", which could increase the sales of PEBs

trend towards more sustainability



the marketing must emphasise the advantages.

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Thank you for your attention!

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870072.

Financial barriers and mixed incentives to accelerate the decarbonization of the EU's housing stock: **Lessons learned from the EXCESS project**

EU Sustainable Energy Day Event: *Speeding up the implementation of Net Zero Emission Buildings and Neighbourhoods through targeted financial policies*

12.06.2024

Andreas Tuerk

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 870157. This document reflects only the author's view and the Commission is not responsible for any use that may be made of the information it contains.

The EXCESS project

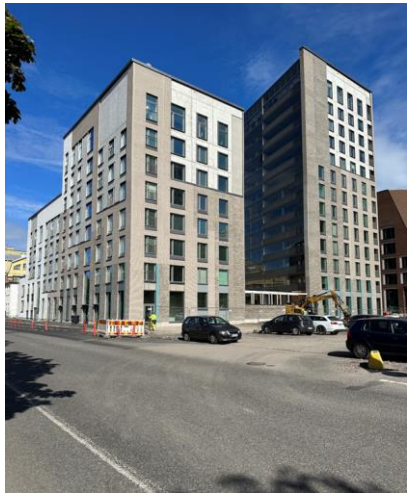
- H2020 Project: 2019-2024

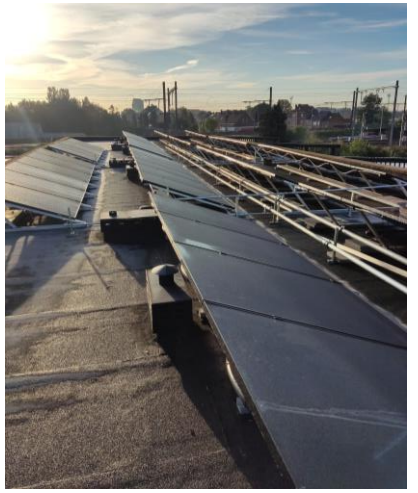
4 demos in 4 climate zones

Cost-optimal analysis of EXCESS demos Cost-optimal analysis of EXCESS demos

Technology Packages

- Hybrid geothermal system (Demo Finland)
  - Multisource heatpump, PVT, 600m deep boreholes (seasonal storage)
- Multifunctional façade (Demo Austria)
    - Element for heating/cooling, insulation and BiPV
- Photovoltaic-Thermal collectors –PVT and heatpumps (Demo Belgium and Finland)
- Conventional technologies in historical building (Demo Spain), PV, airsource Heatpump





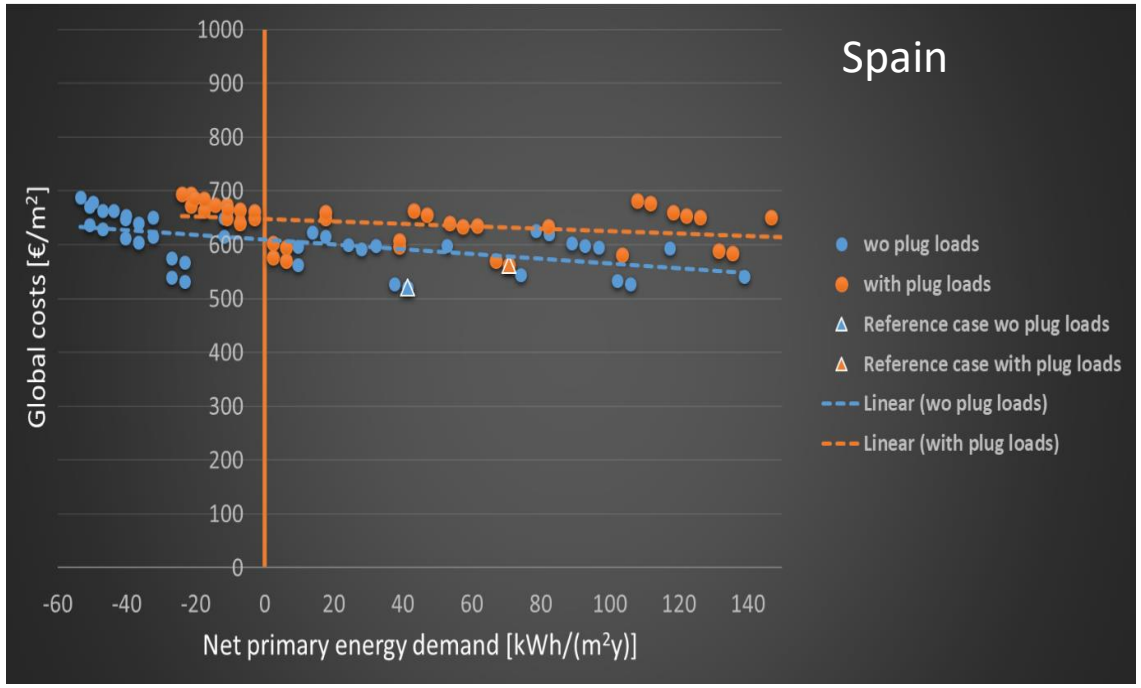
EXCESS demo Valladolid – scenarios and technology packages

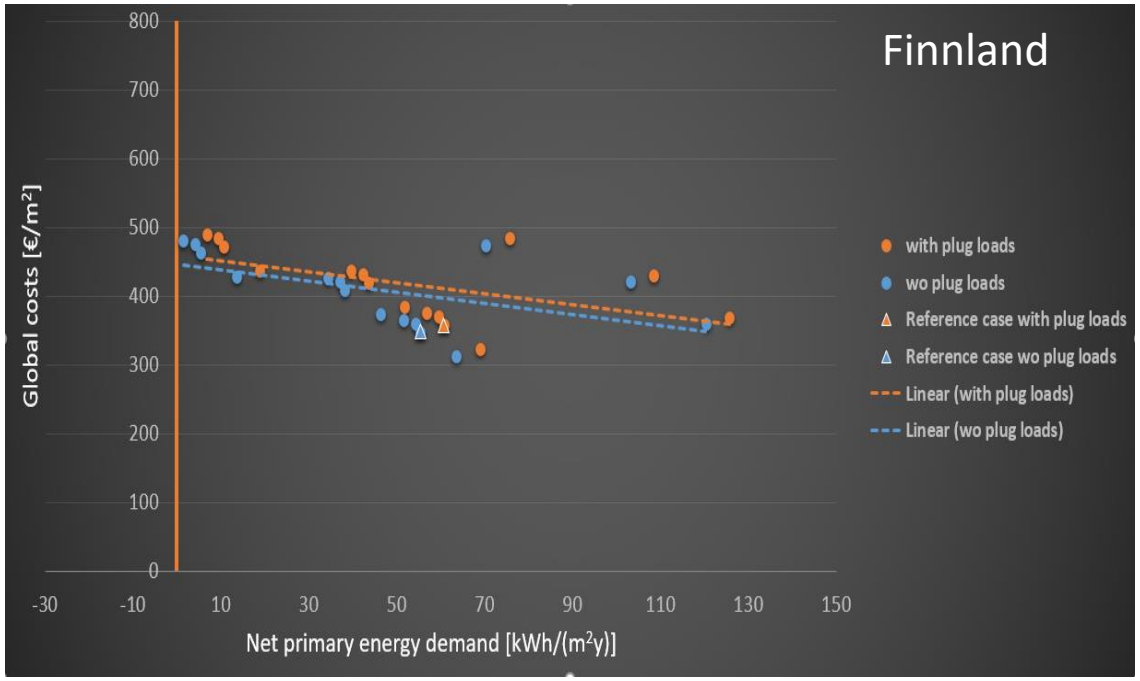
- Scenarios for building elements (envelope, thermal system, PV, BEMS) defined
- Scenarios are combined to 42 technology packages and cost-optimal framework applied

	Scenario	Description	Investment costs [€]	Investment costs per unit [€/(m² or kW or kWh)]	Expected technology lifetime [y]
Building envelope	D0	Baseline Spanish regulation envelope; U-value of envelope [W/(m² K)]: walls 0.41, roof 0.35, floor 0.65, windows 1.8	143 700	131 €/m²	50
	D1	High efficiency envelope; U-value of envelope [W/(m² K)]: walls 0.13, roof 0.1, floor 0.27, windows 0.87	269 100	247 €/m²	50
	D2	High efficiency envelope D1 plus heat recovery unit **(EXCESS scenario)**	318 600	292 €/m²	50
Thermal system	TS0	Gas heating with boiler and solar thermal for DHW	78, 300	348 €/kW	15
	TS1	Aerothermal heat pump (40 kW) with floor heating	156 200	3905 €/kW	20
	TS2	Aerothermal heat pump (40kW) with PVT (2.8kW) for DHW **(EXCESS scenario)**	164 600	3905 €/kW HP 3000 €/kWp PVT	20
PV facility	PV0	no PV	0	0 €/kWp	n.a.
	PV1a	22.75 kWp (70 panels each 375Wp), no storage	48 000	2110 €/kWp	25
	PV2a	51.38 kWp (70 panels each 375Wp), no storage	95 900	1866 €/kWp	25
	PV2b	51.38 kWp (70 panels a 375Wp), 30kWh battery energy storage **(EXCESS scenario)**	149 900	1866 €/kWp PV 1800 €/kWh bat.	25
Building management system	CS0	Baseline monitoring - control for heaters	4 100	n.a.	30
	CS1	Standard monitoring - control for space heating/cooling floor	15 000	n.a.	30
	CS2	Advanced Building Energy Management System **(EXCESS scenario)**	58 500	n.a.	30

Envelope	Thermal system	PV facility	Building management system	Gas demand [kWh/(m²y)]	Electricity demand [incl. plug loads] [kWh/(m²y)]	Electricity demand w/o plug loads] [kWh/(m²y)]	Electricity production [kWh/(m²y)]	Net Primary Energy demand wo plug loads [kWh/(m²y)]	Global costs wo plug loads [€/m²]
D0	TS0	PV0	CS0	77	36	22	0	139	637
D1	TS0	PV0	CS0	60	36	22	0	117	671
D2	TS0	PV0	CS0	42	36	22	0	97	669
D0	TS1	PV0	CS1	0	64	50	0	106	587
D1	TS1	PV0	CS1	0	58	44	0	93	649
D2	TS1	PV0	CS1	0	53	39	0	82	679
D0	TS2	PV0	CS1	0	63	49	0	102	582
D1	TS2	PV0	CS1	0	56	42	0	89	644
D2	TS2	PV0	CS1	0	51	37	0	78	674
D0	TS0	PV1a	CS0	77	36	22	31	74	650
D1	TS0	PV1a	CS0	60	36	22	31	53	684
D2	TS0	PV1a	CS0	42	36	22	31	32	682
D0	TS1	PV1a	CS1	0	64	50	31	41	587
D1	TS1	PV1a	CS1	0	58	44	31	28	651
D2	TS1	PV1a	CS1	0	53	39	31	18	682
D0	TS2	PV1a	CS1	0	63	49	31	38	584
D1	TS2	PV1a	CS1	0	56	42	31	24	648
D2	TS2	PV1a	CS1	0	51	37	31	14	679
D0	TS0	PV2a	CS0	77	36	22	62	10	680
D1	TS0	PV2a	CS0	60	36	22	62	-12	713
D2	TS0	PV2a	CS0	42	36	22	62	-32	711
D0	TS1	PV2a	CS1	0	64	50	62	-23	609
D1	TS1	PV2a	CS1	0	58	44	62	-37	673
D2	TS1	PV2a	CS1	0	53	39	62	-47	706
D0	TS2	PV2a	CS1	0	63	49	62	-27	606
D1	TS2	PV2a	CS1	0	56	42	62	-40	672
D2	TS2	PV2a	CS1	0	51	37	62	-51	704
D0	TS0	PV2b	CS0	77	36	22	62	10	711
D1	TS0	PV2b	CS0	60	36	22	62	-12	745
D2	TS0	PV2b	CS0	42	36	22	62	-32	742
D0	TS1	PV2b	CS1	0	64	50	62	-23	641
D1	TS1	PV2b	CS1	0	58	44	62	-37	706
D2	TS1	PV2b	CS1	0	53	39	62	-47	737
D0	TS2	PV2b	CS1	0	63	49	62	-27	639
D1	TS2	PV2b	CS1	0	56	42	62	-40	704
D2	TS2	PV2b	CS1	0	51	37	62	-51	736
D1	TS1	PV2b	CS2	0	56	42	62	-40	717
D2	TS1	PV2b	CS2	0	52	38	62	-50	749
D1	TS1	PV2b	CS2	0	55	41	62	-44	715

Cost-optimal analysis of EXCESS demos





Installation costs a strong cost driver

Cost-optimal analysis of EXCESS demos

- Even if technologies may not be cost effective, they can be enabling technologies or provide additional benefits that were not considered in the analysis
  - **PVT can be used in combination with geothermal heat pump to**
    - Increases COP of heat pump
    - Regenerate the bedrock => amount and depth of boreholes can be smaller
    - Long-term reliability of thermal system (ground source) increased
  - **Multifunctional façade element**
    - Flexibility of building thermal mass increases self-sufficiency rate of the district
    - Revenues from demand response
    - Non-intrusiveness
    - Higher comfort

Key findings (1)

- Not all PEB technologies reduce global costs with current energy prices and a 30 years calculation period => subsidies, grants, other support needed to upscale PEBs
- PV and change of heating system (from gas to heatpump) are mostly cost-efficient (reduction of net primary energy and global costs)
- Results very sensitive to calculation parameters such as electricity prices, discount rate, calculation period, PEF
- Shape of building is a crucial parameter as PEB can be only achieved cost-efficient if there is enough area for PV
- PEB and PEDs are a vision, many building cannot achive this, high self sufficiency still highly beneficial

Key findings (2)

- Innovative Technologies need to be considered from a **systemic perspective**
  - PVT can reduce drilling cost of groundsource heatpump
  - BPIV solutions can substitute conventional construction materials such as concrete or glass and, therefore, can have additional functions than only electricity production

➢Funding schemes are often not made for systemic solutions

- Modular, intelligent building technology systems must be constructed as robust and flexibly scalable as possible - and must additionally integrate low-tech backup solutions to work stable under all conditions.
- Intelligent building technology control systems may help to save up to +7 to +10% of energy when additionally combined to smart, effective incentivizing / rewarding tools for end-users;

Key findings (3)

- Technological breakthroughs are especially lacking in the area **of seasonal energy storage** technologies;
- Huge potential can be seen in the area of **heat energy** in general; eg local heat networks
- Open (product) **liability issues** during the introduction of new (building) technologies - maybe in this field we can draw on lessons learned from past eras;
- **Investor and operator objectives** (CAPEX vs OPEX) must be better aligned in new business models; Some actor resistant to change eg housing associations
- **EU Taxonomy Regulation** can be seen as an effective incentivizing tool to facilitate sustainable investments in Europe. But this can only be a starting point!

SUPER·i

Extended Public-Private Partnerships for Investment in Smart Energy Efficiency Projects in Social Housing

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101028220.

Housing Europe – who we are

43,000 local housing organisations

25 countries

24,936,000 dwellings

roughly 200,000 new dwellings per year

over 200,000 dwellings refurbished per year

roughly €40bn in new investment per year

7,500+ staff employed by the federations

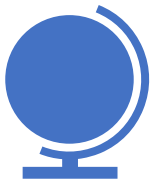
300,000+ staff employed by local providers

One goal
To provide decent & affordable housing for all

Super-i

Aims at generating substantial investments in energy efficiency within the social housing sector by establishing a direct dialogue among the different stakeholders, collecting relevant data on EE investments, helping to develop efficient and innovative financial schemes

13 PARTNERS



6 COUNTRIES: Denmark Italy Slovenia + UK Spain Belgium

SEPTEMBER 2021
FEBRUARY 2025

Pilots

Italy

The buildings are located on the outskirts, in densely populated areas and where there are numerous other social housing buildings.

Learn more

Denmark

Both at the pilot-site in Herning and Aalborg the buildings are mixed building types, from cluster houses to multi-storey buildings.

Learn more

Development of a model to:

- Identify the optimal set of renovations for the social housing stock
- Implement the renovations through a review of the available business models

Slovenia

The proposed building is located in the suburbs of a small town called Trbovlje. Trbovlje is the 9th largest city in Slovenia in terms of population.

Learn more

Public Private Partnership (PPP) contracts analysed

Direct credit lines

Guaranteed savings

Shared savings

Energy supply contracts

- Different actors involved (social housing company, ESCO, Financing institution, funding body
- Different allocation/sharing of risk

Pilots: technical evaluation

Simplified ‘traffic light’ evaluation of the impact of different renovation components

Planned interventions	LCA	SLCA	Description
	5	8	High performance triple glazing materials and design should be evaluated when choosing the windows (LCA). Positive impact from the point of view of the residents as they will improve the comfort and ventilation and temperature control with minimal disruption (SLCA)
	6	3	Doubling insulation will improve the performance of the building, natural materials should be considered (LCA), it is likely to be disruptive, and may require significant works to the building envelope given the existing insulation but on the other hand comfort will be increased, natural based paints without additives should be considered as they will increase the comfort and health conditions (LCA and SLCA)

Pilots: cost benefit analysis of financial solutions

Ranking of financing solutions

PPP		Social housing company (Owned by tenants)	ESCO	Financial Institution	Civil Society
Direct Credit Line	Cost	Is responsible for covering 90% of the investment costs using funds from financial institutions(debt financing) or government (grants), and the tenants covers 2% of the investment cost The social housing company is responsible for covering the maintenance and operating costs of the energy efficiency technologies.	Not involved	Offers a loan for funding the energy efficiency project	10% of the refurbishment cost is covered by Government grants
	Benefit	Gets 100% of energy savings. The energy savings are then directly transferred to the tenants but the social housing company benefits from the increased value of the building after the energy efficiency intervention	Not involved	The financial institution gets the interest rates on loan plus, at maturity, the repayment of the loan itself	Environmental benefits measured in terms of lower CO2 emissions.
	Risk adjust extra return	Good		Good, a higher risk adjusted extra return than that of S&P500	Excellent
	Rank	7		7	9

Challenges

Overcoming the issue of split incentives

Translating extra costs into the financial model

Declining returns of energy renovations

Need to mix with grants and public guarantees

Importance of data

Moving towards neighbourhood/district approach

SUPER·i

Thank you!

Alice.pittini@housingeurope.eu

https://super-i-supershine.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101028220.

Innovation Readiness Levels for PENs

Supporting viable business models for Positive Energy Neighbourhoods

In partnership with:

bax

Make ideas happen

We work across Europe to turn **breakthrough ideas** for society and the environment into initiatives with **real-world impact.**

1987 37 years piloting Europe's future

75 Innovation specialists based in 5 countries across Europe

250 Ongoing initiatives

3,000 Active clients and partners

€500M Investments mobilised in 3 years

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The oPEN Lab project

Scaling Positive Energy Neighbourhoods across Europe

Tartu Living Lab, Estonia
(Soviet-era apartments)

Genk Living, Belgium
(Single-family neighbourhood)

Pamplona Living Lab, Spain
(Social housing & commercial)

bax

Innovation Readiness Levels – an Introduction

Innovation Readiness Levels (IRL) - an innovation methodology and management tool.

Going beyond TRL alone, innovation depends on simultaneous developments in:

- **Policy** (e.g. NZEBs, collective consumption)
- **Markets** (e.g. flex services, multiple benefits)
- **Financing** (long-term, de-risking, collective)
- **Organisational** capacity (knowledge, coordination)

(both for cities as facilitators, and innovators as service providers)

		Objective
Ideate	1	Challenge observed
	2	Idea described
	3	Concept articulated
Test	4	Solution validated
	5	Prototype tested
	6	Controlled demonstration
Deliver	7	Open demonstration
	8	Solution scaled
	9	Solution standardised

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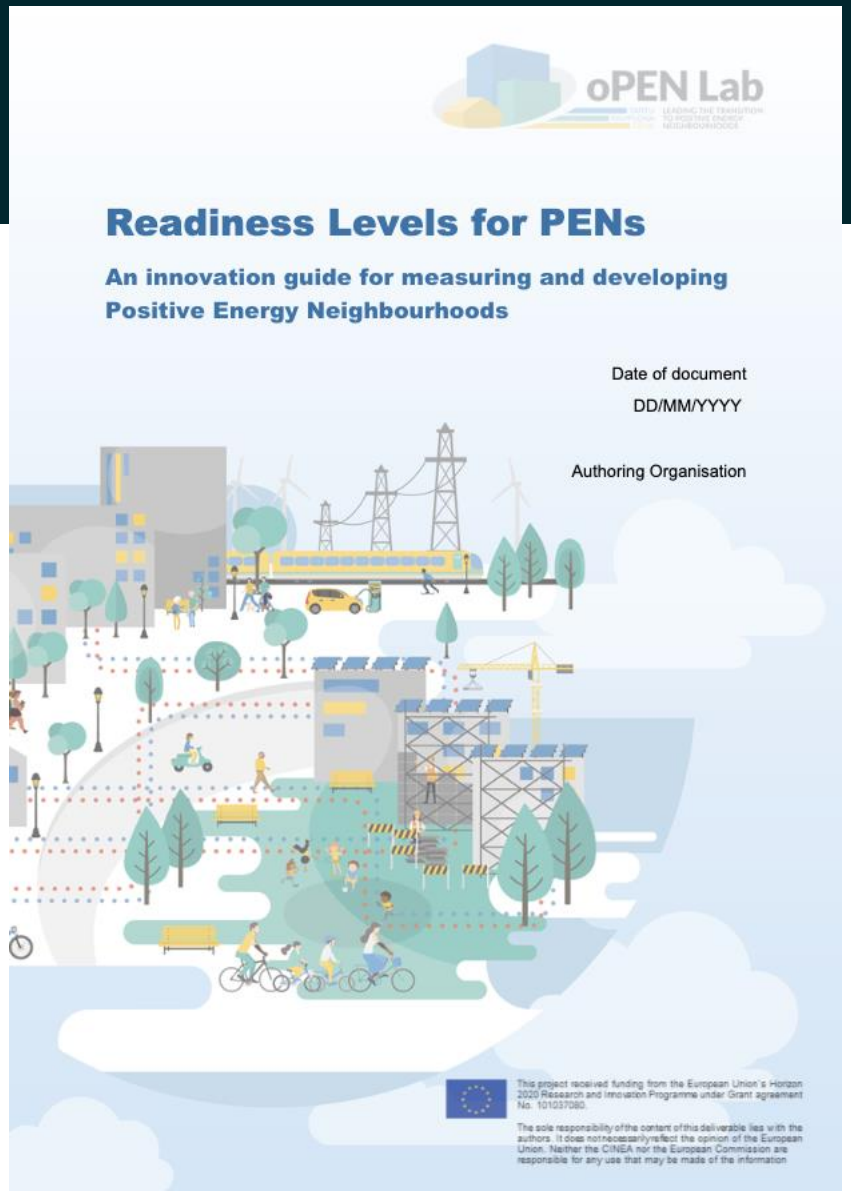
Innovation Readiness Levels for PENs

The opportunity

- Measure and compare PEN progress (and their solutions)
- Identify and overcome business model bottlenecks
- Define criteria for future uptake - cities and stakeholders

The challenge

- Ensuring locally useful vs widely replicable
- How many components to measure?
- Few successful PENs to benchmark against
- Assumes that “PEN” is the end-goal



PEN Readiness Workshop – May 2024

Bax hosted a workshop to **present** and **validate** the IRL methodology with *oPEN Lab* project partners.

1) IRL self-assessment
2) "Filling the gaps"

- **Technical solution providers** found the exercise accessible, interesting, and useful.
- **Living Lab leaders**, policy, and social researchers found it too broad to capture the full complexity.

bax

Brief summary of IRL responses

		Objective
Ideate	1	Challenge observed
	2	Idea described
	3	Concept articulated
Test	4	Solution validated
	5	Prototype tested
	6	Controlled demonstration
Deliver	7	Open demonstration
	8	Solution scaled
	9	Solution standardised

Technology:

- NZEB buildings (8)
- Prefab renovations (7)
- High TRL of individual PEN components (7-9)
- Improved monitoring, EMS, and interoperability needed.

Business:

- Markets for energy trading, export, and collective consumption exist for some (7-9)
- Non-monetary value streams not yet well developed (3-5)
- PENs not yet viable beyond heavy subsidisation (3-4)

Policy:

- Policy needed to support energy communities and energy sharing (4-5)
- Stronger incentives needed for positive energy standards (2)

Organisational:

- Neighbourhood-level renovation dependent on community alignment (5) (e.g. Tartu)
- Many innovators not yet able or interested to work at multi-building level (3)

Financial:

- Projects need stable financing beyond one-off projects (3-4)
- Collective financing solutions are developing (5-7)
- Few finance instruments able to support vulnerable households (3-6)

Next steps for improving the methodology

1) **Consider the scale of IRL application**:

- PEN as a sector/system (from perspective of city and community)
- vs. PEN as multiple separate components (from perspective of innovation providers)
    - And the definition of "Readiness" for each

2) **Structured application of IRL methodology to Living Labs**

- Measure progress (current IRL)
- Consolidate best practice (advancing between IRLs – implications for business models)
- Support development (overcoming IRL barriers)

3) **Improve methodology and process**

- Digital RL data collection tools
- Need for successful case studies

bax

Questions

How do you best see IRLs being used in your PEN projects?

Would you include any other IRL categories (e.g. societal)?

What examples of best practice show "PEN Readiness"?

Which key stakeholder groups need to be "PEN Ready"?

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Interested to learn more?
readinesslevels@baxcompany.com

Mobilising mortgage markets in support of the climate transition

13 June 2024

The EeMAP, EeDaPP, EeMMIP projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 746205, no. 784979 and no. 894117 respectively.

About EEMI

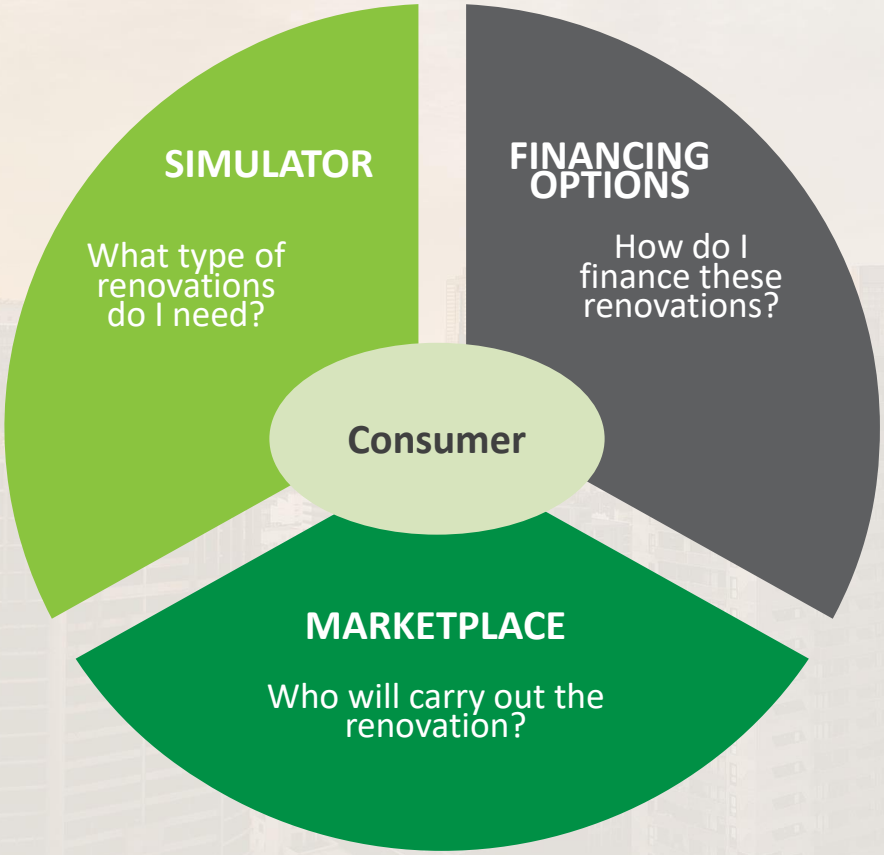
- **What:**
  - pan-European private bank financing mechanism
  - aims to stimulate and support investment in energy efficient buildings & energy saving renovations via energy efficient mortgages & consumer loans

- **Who:**
  - **70** lending institutions representing **55%** of EU mortgages outstanding
  - Supported by **fifty-two** Supporting Organisations & an Advisory Council

- **How:**
  - EEMI is developing the market through research, analysis, partnerships & establishment of **national market hubs** across Europe
  - National market hubs are active in Belgium, Germany, Hungary, Italy, the Netherlands, the Nordics, Spain and the UK (Scotland).

Energy Efficient Mortgage Label

Energy Efficient Mortgage 'Ecosystem'



Energy Efficient Mortgage Label

CORE ELEMENTS OF THE EEM LABEL: THE LABEL CONVENTION

Excerpt of the EEM Definition as stated in the Convention:

> EEMs are intended to finance the purchase/construction and/or renovation of both residential (single family & multi-family) and commercial buildings where there is evidence of: (1) energy performance which meets or exceeds relevant market best practice standards in line with current EU legislative requirements and/or (2) an improvement in energy performance of at least 30%.
>
> This evidence should be provided by way of a recent EPC rating or score, complemented by an estimation of the value of the property according to the standards required under existing EU legislation. It should specifically detail the existing energy efficiency measures in line with the EEM Valuation & Energy Efficiency Checklist.
>
> Lending institutions are committed to providing regular information enabling investors to analyse the Energy Efficient Mortgage products, following the Harmonised Disclosure Template.

Footnote: In the context of the EEM Label the term “mortgage” refers to residential and commercial property loans which fall within the scope of the Capital Requirements Regulation (Regulation 2013/575/EU) and/or Mortgage Credit Directive (Directive 2014/17/EU) or under equivalent legislation outside of the EEA.

Energy Efficient Mortgage Label

CORE ELEMENTS OF THE EEM LABEL: THE HARMONISED TRANSPARENCY TEMPLATES

Mortgage Products

For **mortgage** products information divided for residential and commercial RE. Information on the mortgage asked, among others: location, size, interest rate type, LTV, NPL, EPC, CO2, building age structure, type of building

Retrofitting Loan

For retrofitting loan products information divided for non-targeted loans, targeted loans and rent/leasing. Information asked, among others: size, interest rate and amortisation type, intended use

A1. EEM Harmonised Disclosure Template - General Mortgage Assets

EEM HDT 2024

Reporting in Domestic Currency	[Please insert currency]

CONTENT OF TAB A1

Field Number	1. Mortgage Assets			
	1. Property Type Information	Nominal (mn)		% Total Mortgages
M.1.1.1	Residential	[For completion]		
M.1.1.2	Commercial	[For completion]		
M.1.1.3	Other	[For completion]		
M.1.1.4	Total	0.0		0.0%
OM.1.1.1	*o/w Housing Cooperatives / Multi-family assets*			
OM.1.1.2	*o/w Forest & Agriculture*			
OM.1.1.3	*o/w [If relevant, please specify]*			
OM.1.1.4	*o/w [If relevant, please specify]*			
OM.1.1.5	*o/w [If relevant, please specify]*			
OM.1.1.6	*o/w [If relevant, please specify]*			
OM.1.1.7	*o/w [If relevant, please specify]*			
OM.1.1.8	*o/w [If relevant, please specify]*			
OM.1.1.9	*o/w [If relevant, please specify]*			
OM.1.1.10	*o/w [If relevant, please specify]*			
OM.1.1.11	*o/w [If relevant, please specify]*			
	2. General Information	Residential Loans	Commercial Loans	Total Mortgages
M.1.2.1	Number of mortgage loans	[For completion]	[For completion]	
OM.1.2.1	*Optional information eg, Number of borrowers*			
OM.1.2.2	*Optional information eg, Number of guarantors*			
OM.1.2.3				
OM.1.2.4				
OM.1.2.5				
OM.1.2.6				
	3. Concentration Risks	% Residential Loans	% Commercial Loans	% Total Mortgages
M.1.3.1	10 largest exposures	[For completion]	[For completion]	[For completion]
OM.1.3.1				
OM.1.3.2				
OM.1.3.3				
OM.1.3.4				
OM.1.3.5				
OM.1.3.6				
	4. Breakdown by Geography	% Residential Loans	% Commercial Loans	% Total Mortgages

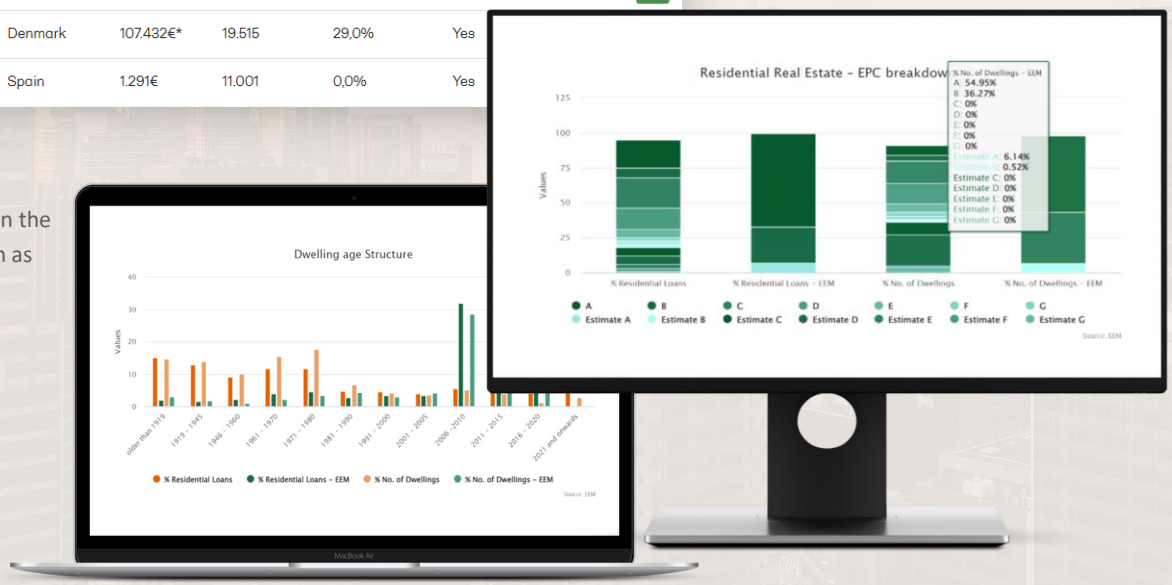
Energy Efficient Mortgage Label

EEM Label website features

Name	Lending institution name	Country	EUR)[1]	loans	portfolio	RRE[2]	CRE[3]	information
Mutuo Crédit Agricole	Crédit Agricole Italia S.p.A.	Italy	8.501€	84.511	33,0%	Yes	No	
Sustainable Loans	BNP Paribas Fortis	Belgium	4.446€	40.504	8,0%	Yes	No	
Offerta Green Mutui	Intesa Sanpaolo S.p.A.	Italy	5.345€	34.311	5,0%	Yes	No	
Mutuo Green with Green Factor	Banco BPM S.p.A.	Italy	3.754€	26.881	0,0%	Yes	No	
Green Residential Mortgage	PKO Bank Hipoteczny Spółka Akcyjna	Poland	5.901€*	25.860	32,0%	Yes	No	
Loan for Green Buildings	Jyske Realkredit A/S	Denmark	107.432€*	19.515	29,0%	Yes		
Hipotecas verdes CRN	Caja Rural de Navarra, S.C.C.	Spain	1.291€	11.001	0,0%	Yes		

List of 30 Products (+ 1 complementary product) highlighting numbers of loans, aggregate value amount and share of green products in the institution's loan portfolio

- Graphic presentation of key data presented in the HDT of each labelled lending institution, such as EPC distribution or dwelling age structure



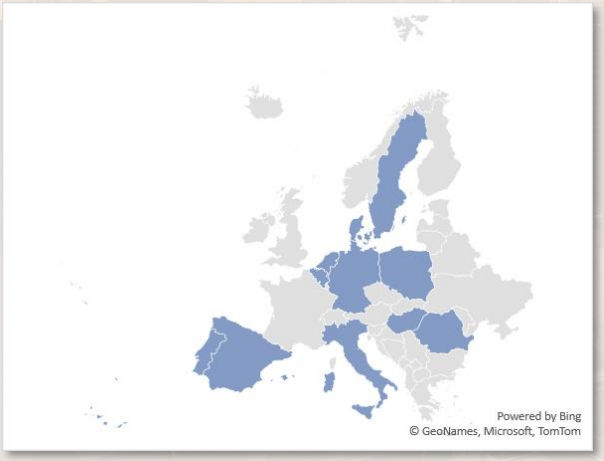
Energy Efficient Mortgage Label

The EEML Family

29 LENDING INSTITUTIONS (BANKS, RESIDENTIAL MORTGAGE SERVICE PROVIDERS, ALTERNATIVE INVESTMENT FUNDS, ETC)

AgOs · ALPHA BANK · Allianz · BANCO BPM · Berlin Hyp · CRÉDIT AGRICOLE · BNP PARIBAS FORTIS · CAJA RURAL DE NAVARRA · Sella · CiviBank · ingage · obvion · onesto · CASSA RURALE ALTA VALSUGANA · GRUPPO CASSA CENTRALE · MBH MORTGAGE BANK · NN · JYSKE REALKREDIT · SPARKASSE CASSA DI RISPARMIO · INTESA SANPAOLO · UCI · Bank Hipotecny · Swedbank · venn HYPOTHEKEN · Volksbank · Triodos Bank

11 COUNTRIES



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