Multidimensional evaluation framework for plus energy buildings and neighbourhoods

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Digital Event

Our **mission** in syn.ikia is to increase the share of sustainable neighbourhoods with surplus renewable energy, resilient and affordable living places and communities in different contexts, climates and markets in Europe.

Over the next four and half years (2020-2024), syn.ikia will pilot four real-life Sustainable Plus Energy Neighbourhoods to demonstrate their functionality to the rest of Europe.

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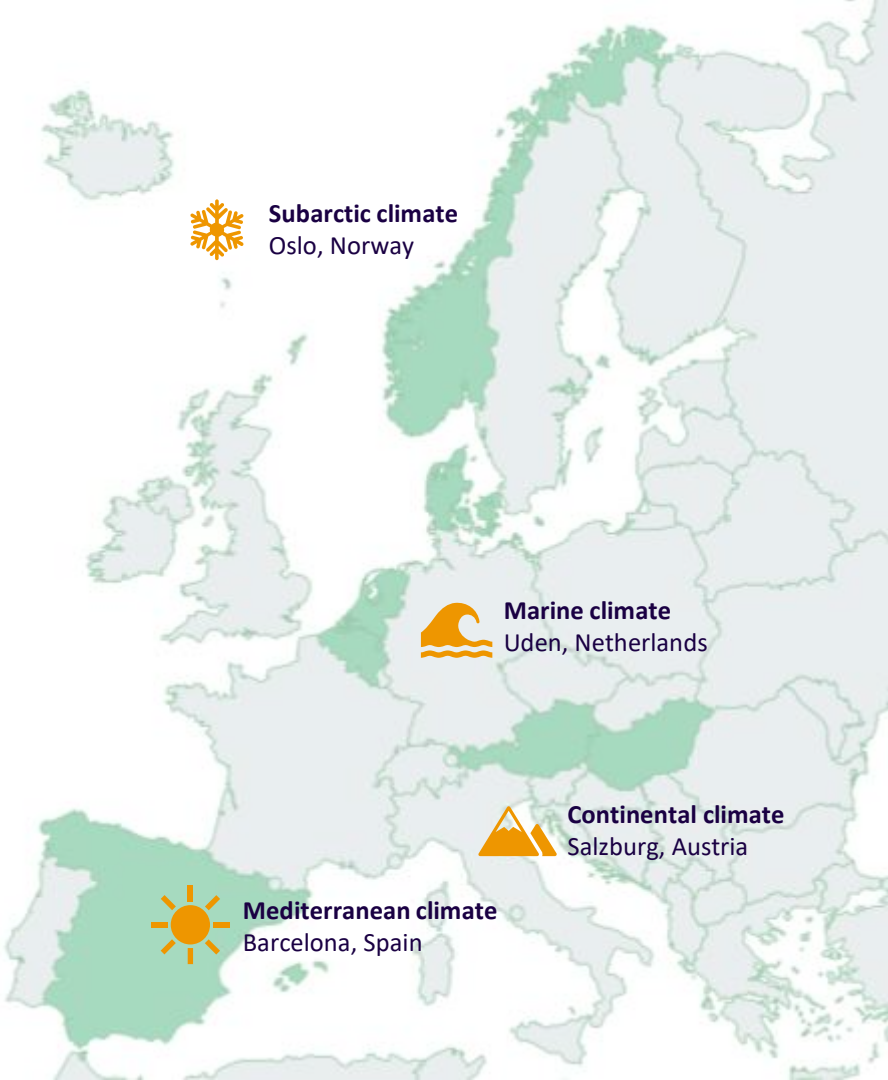
Goals

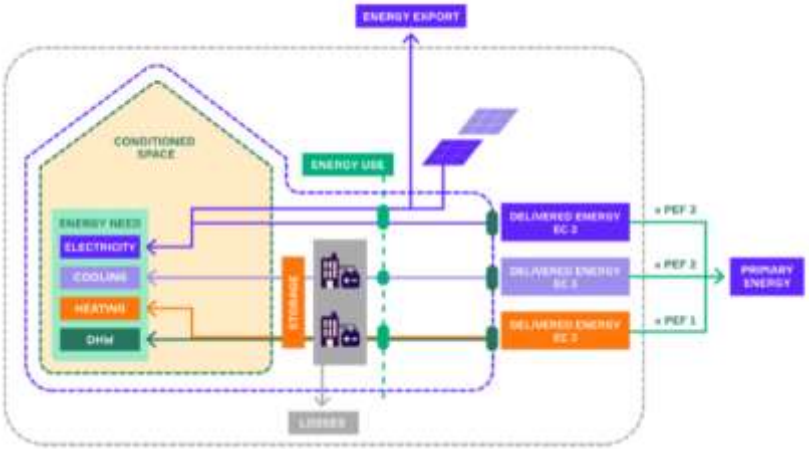
- Over 100% energy savings
- 90% renewable energy generation triggered
- 100% GHG emission reduction
- 10% life cycle costs reduction*

Four real-life Sustainable Plus Energy Neighbourhoods in four climatic zones to demonstrate their functionality

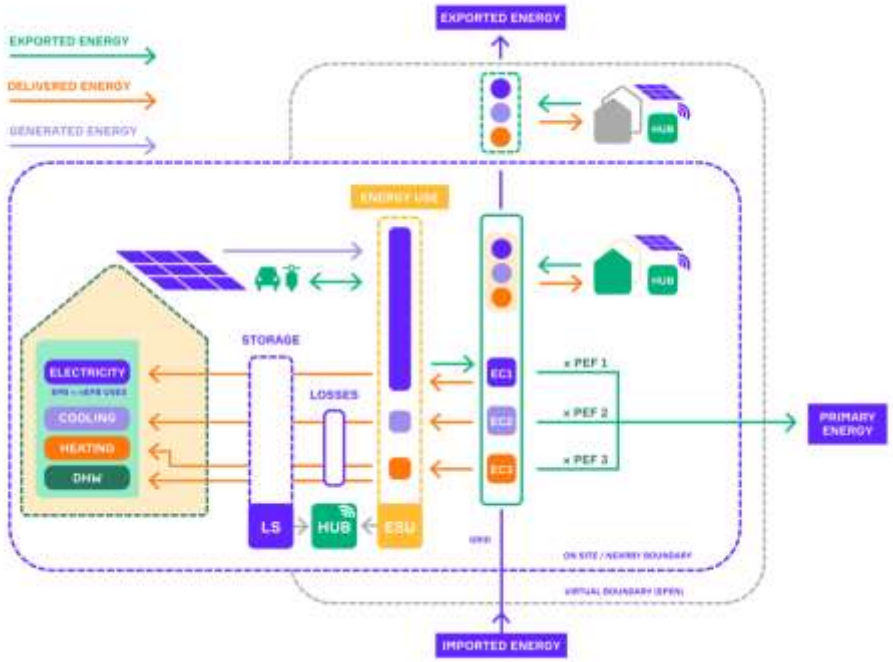
* Compared to NZEB levels



Plus Energy Building



Sustainable Plus Energy Neighbourhood



Positive Energy Balance: | weighted exported energy | - | weighted imported energy | > 0

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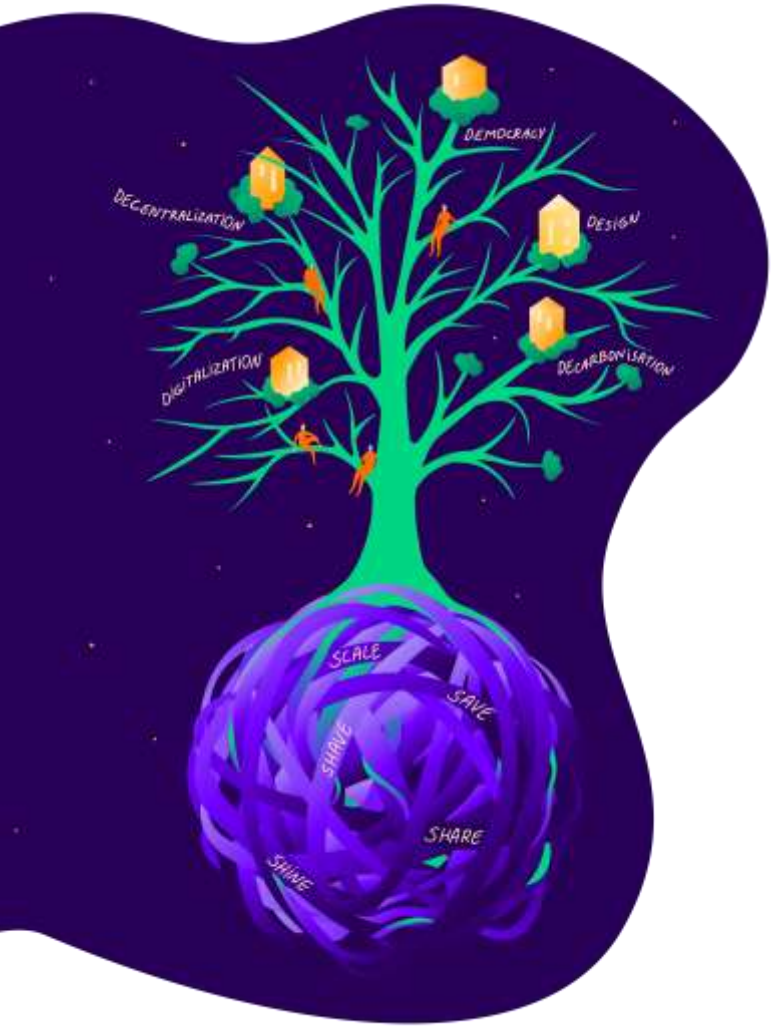

Our 5D impact

- DECENTRALISATION
- DEMOCRACY
- DECARBONISATION
- DESIGN
- DIGITALISATION

Our 5S strategy

- SAVE
- SHAVE
- SHARE
- SHINE
- SCALE

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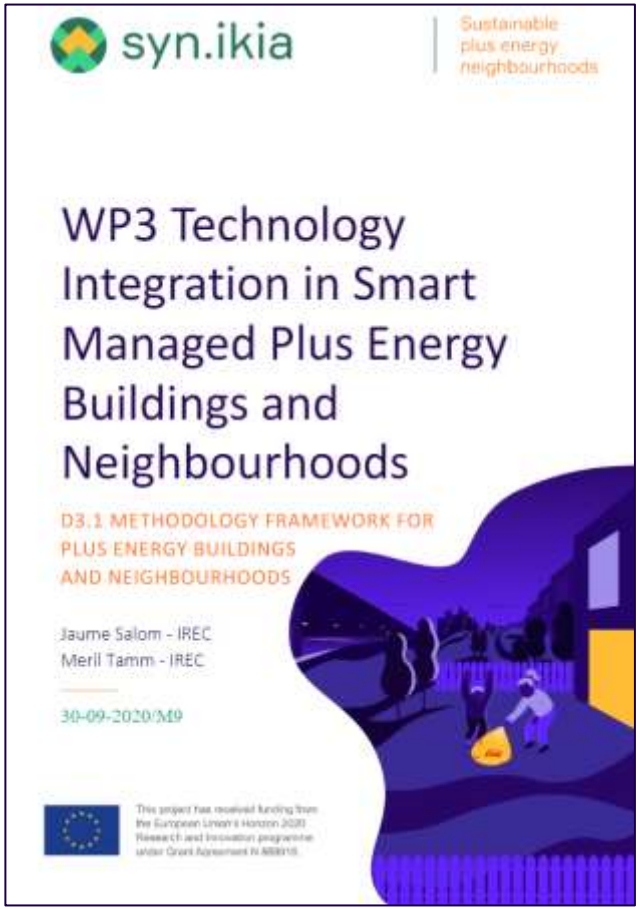

Syn.ikia's methodology for the evaluation of Positive Energy Buildings and Neighbourhoods

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Multi-dimensional Analysis

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Why is mulditimensionality needed?

- Multi-variate problem
- Multi-level problem
- Stakeholder variability

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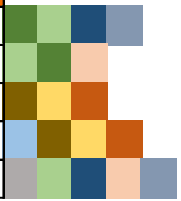
Different KPI dimensions

5D	5S	Syn.ikia master plan aspects	SPEN framework elements
Decarbonisation	Save	Climate neutral	GHG emission
	Share	Surplus RES Energy	Power performance (self consumption)
Decentralization	Save	Energy efficient	Power performance(self consumption)
	Share	Sustainable operation	Social factors
Democracy	Share	Sustainable operation	Social factors
Design	Shine	Improved user comfort & Well-being	Indoor environmental quality
	Shine	Good architectural & spatial qualities	Occupant satisfaction
	Save	Economic sustainability	Cost efficiency
Digitalization	Shave	Management of energy flows	Power performance (peak shaving, flexibility)
	Scale	Economic sustainability	Cost efficiency

KPI dimension
Energy and environmental
Economic
IEQ
Social
Smartness & Flexibility



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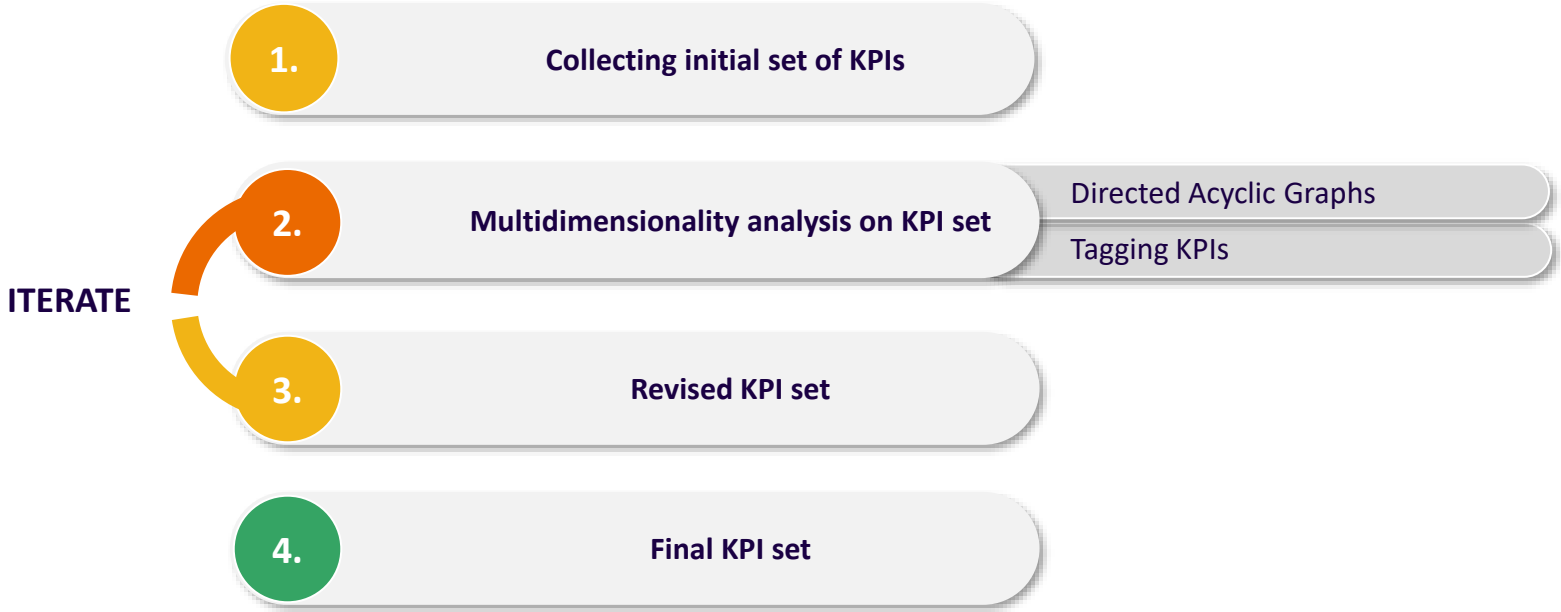

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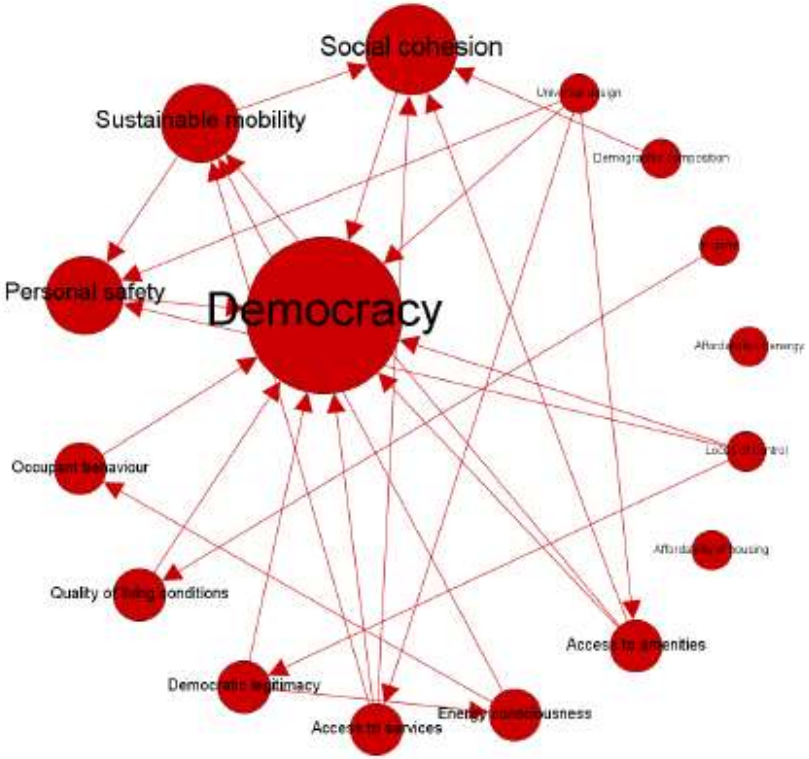
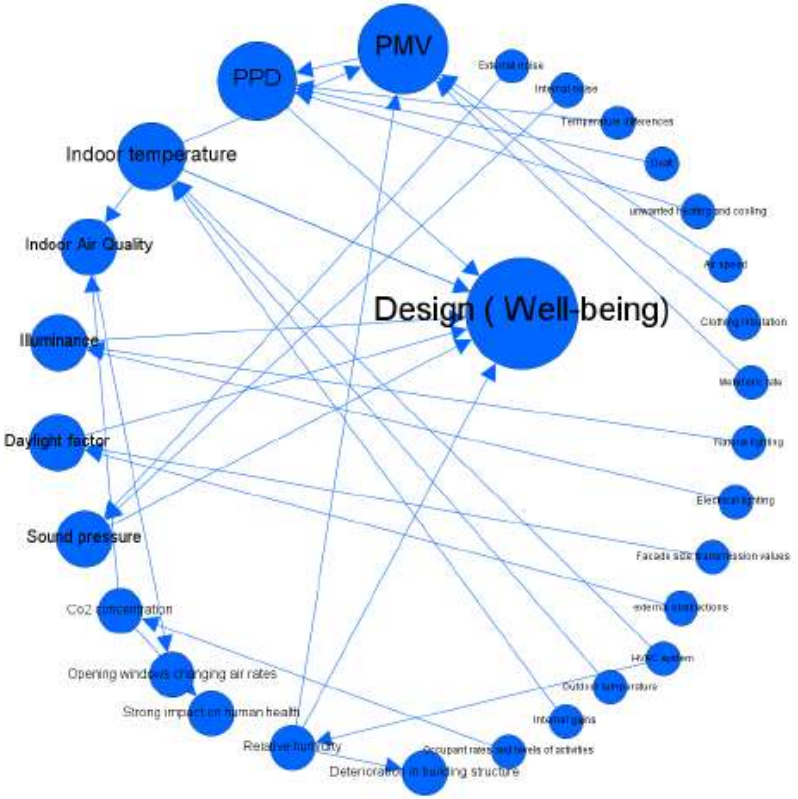
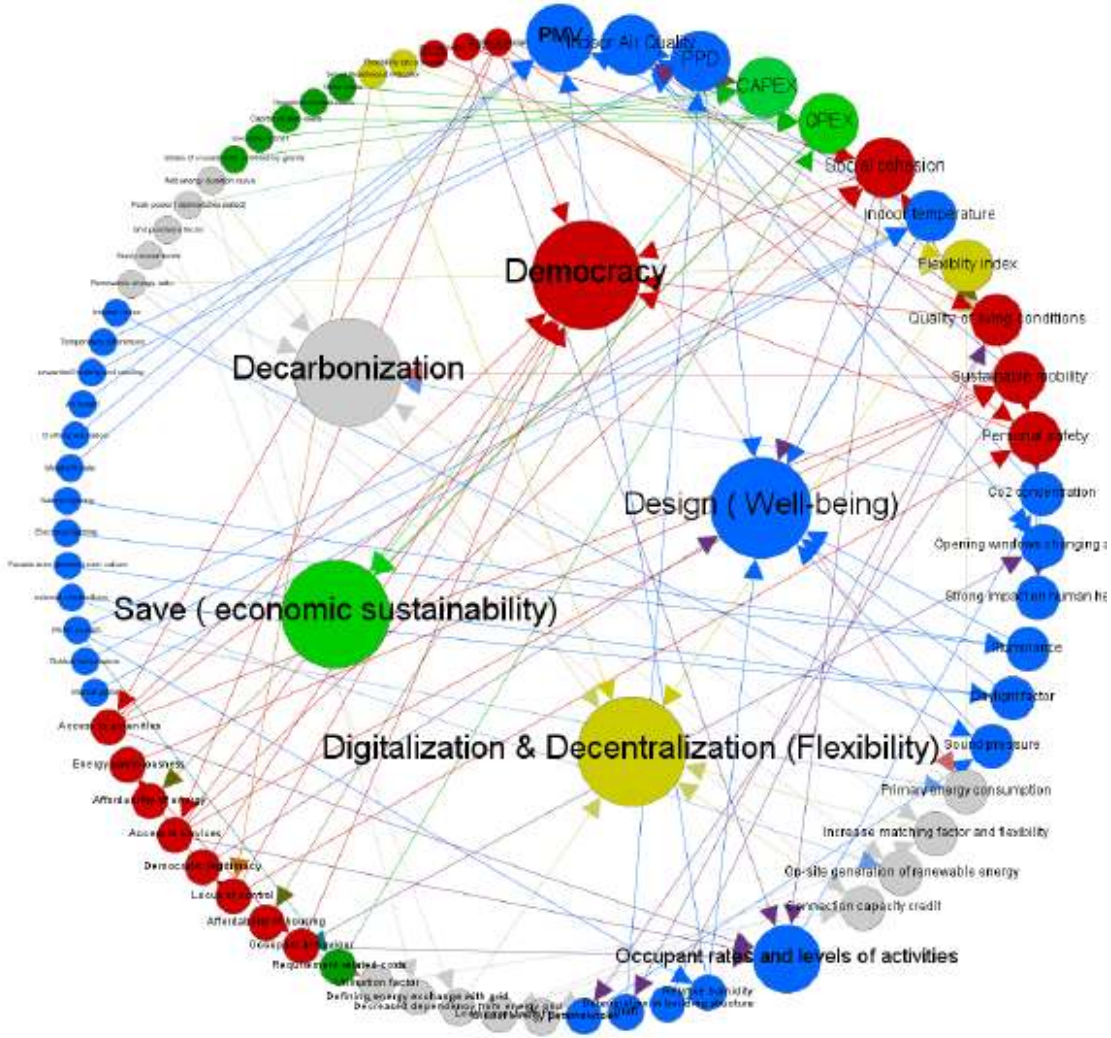
Causal DAGs


Social cohesion
Sustainable mobility
Personal safety
Democracy
Occupant behaviour
Quality of living conditions
Democratic legitimacy
Access to services
Access to amenities


PMV
PPD
Indoor temperature
Indoor Air Quality
Design (Well-being)
Illuminance
Daylight factor
Sound pressure
Co2 concentration
Opening windows changing air rates
Strong impact on human health
Relative humidity
Deterioration in building structure



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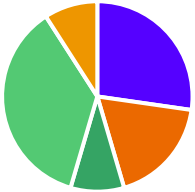
Energy and environment IEQ Smartness & Flexibility Social Economical

Design (Well-being)

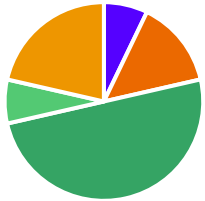
Decarbonisation

Digitalization & Decentralization



Design (Economic)

Democratization



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Tag diversity analysis

Domain of sustainability

Life cycle

Scale

Authority

5D impact

5S strategy

Simpson-index

Shannon-index

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Resulting framework

Category	Sub category	KPI
Energy and Environmental Performance	Overall performance	Non-renewable primary energy balance
		Renewable energy ratio
	Matching factors	Grid purchase factor
		Load cover factor / Self-generation
		Supply cover factor / Self-consumption
	Grid interaction factors	Net energy/ Net power
		Peak delivered/ peak exported power
		Connection capacity credit
	Environmental balance	Total greenhouse gas emissions
	Overall performance	Energy produced on-site
		Electrical vehicle energy consumption

Category	Sub category	KPI
Economic performance	Capital cost	Investment costs
		Share of investment covered by grants
	Operational costs	Maintenance related costs
		Requirement related costs
		Operation related costs
		Other costs
	Overall performance	Net present value
		Internal rate of return
		Economic value added
		Payback period
		nZEB cost comparison

Category	Sub category	KPI
Smartness and Flexibility	Flexibility index	Flexibility index
	Smartness	Smart Readiness Indicator (SRI)

Category	Sub category	KPI
Indoor Environmental Quality	Indoor Air Quality	Carbon Dioxide (CO2)
	Thermal comfort	Predicted Mean Vote (PMV)
		Predicted Percentage Dissatisfied (PPD)
		Temperature (T)
		Relative Humidity (RH)
	Lighting and visual comfort	Illuminance
		Daylight factor
	Acoustics comfort	Sound Pressure Level

Category	Sub category	KPI
Social performance	Equity	Access to amenities
		Access to services
		Affordability of energy
		Affordability of housing
		Democratic legitimacy
		Living conditions
		Sustainable mobility
		Universal design
		Economic value added
	Community	Demographic composition
		Diverse community
		Social cohesion
	People	Personal safety
		Energy consciousness
		Healthy community

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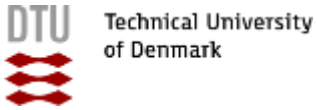
NTNU
Norwegian University of
Science and Technology


DTU
Technical University
of Denmark


BPIE


SINTEF


HOUSING
EUROPE


IREC


OBOS


area


INCASÒL
Institut Català
del Sòl


TNO innovation
for life


ENFOR


ABUD
Advanced Building
& Urban Design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