Step-WISE training on decarbonisation tools

Sustainable Places, 10/10/2025

Alessandro Piccinini – Technical Manager of Energy Division, R2M Solution
Davide Quaggiotto – EU research project manager, R2M Solution

Step-WISE

A tailored and dynamic ***capacity building programme*** to ***transform local and regional authorities*** into autonomous ***adopters*** of digitised and integrated ***Clean Energy Transition plans***

Alessandro Piccinini – alessandro.piccinini@r2msolution.com
Davide Quaggiotto – davide.quaggiotto@r2msolution.com

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Project Concept

- **Promote energy transition** by building and **increasing the local and regional authorities' skills** to deliver, implement and monitor their **energy plans** for their **local context**.
- To develop a **digital toolkit**, to **train** the disseminators of the toolkit, and to have the toolkit applied by **adopters** in a **use-case-based approach**.

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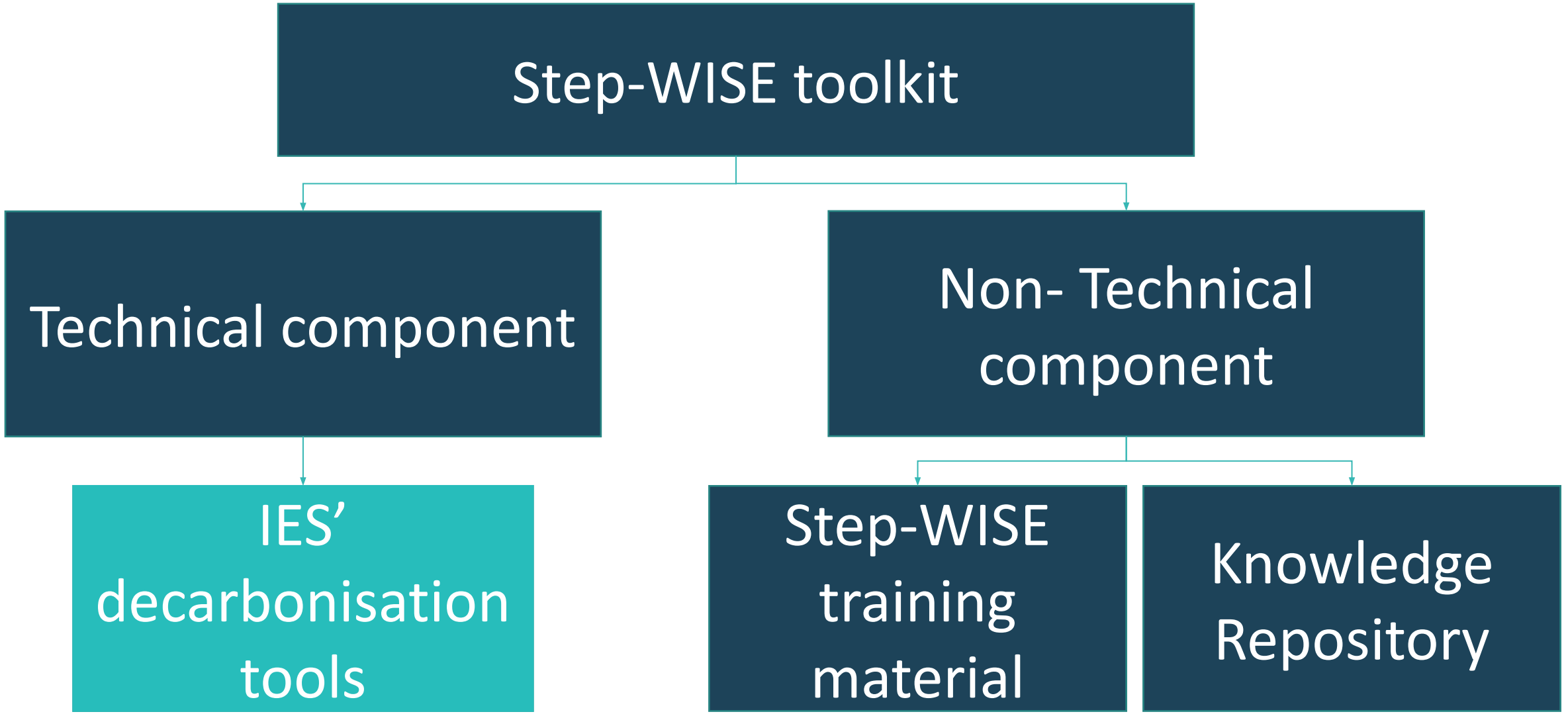

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Why we need the Step-wise Toolkit?

These tools facilitate the development of Clean Energy Transition Plans (CETs).

SECAP
Sustainable Energy and Climate Action Plan

LAEP
Local Area Energy Plan

SEAP
Sustainable Energy Action Plan

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What are the Clean Energy Transition Plans (CETs), and what do we need to demonstrate?

Strategic frameworks that outline how governments, organizations, or regions aim to achieve targets for clean energy usage, enhance energy efficiency, and reduce greenhouse gas emissions.

For instance, the Sustainable Energy and Climate Action Plan (SECAP):

•**Objective:** Achieve a reduction in greenhouse gas emissions by 2030.

Components:

- **Baseline Emission Inventory:** Identifies main emission sources.
- **Risk & Vulnerability Assessment:** Evaluates local climate risks.
- **Energy Actions:** Promotes energy efficiency and renewable energy. (so estimate the energy savings)
- **Climate Adaptation:** Enhances community resilience to climate change.
- **Monitoring:** Tracks progress and allows for plan adjustments.

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How can we demonstrate greenhouse gas emission reductions?

Which strategies we need to plan and implement?

One of the most accurate method is the use of the **Dynamic Energy Simulation of Buildings**

Dynamic building energy simulation refers to the use of computational models to predict and analyze the energy performance of buildings by creating a Digital Twin

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IES ICL
Intelligent Communities Lifecycle

The Stepwise toolkit utilize the **Dynamic Energy Simulation**

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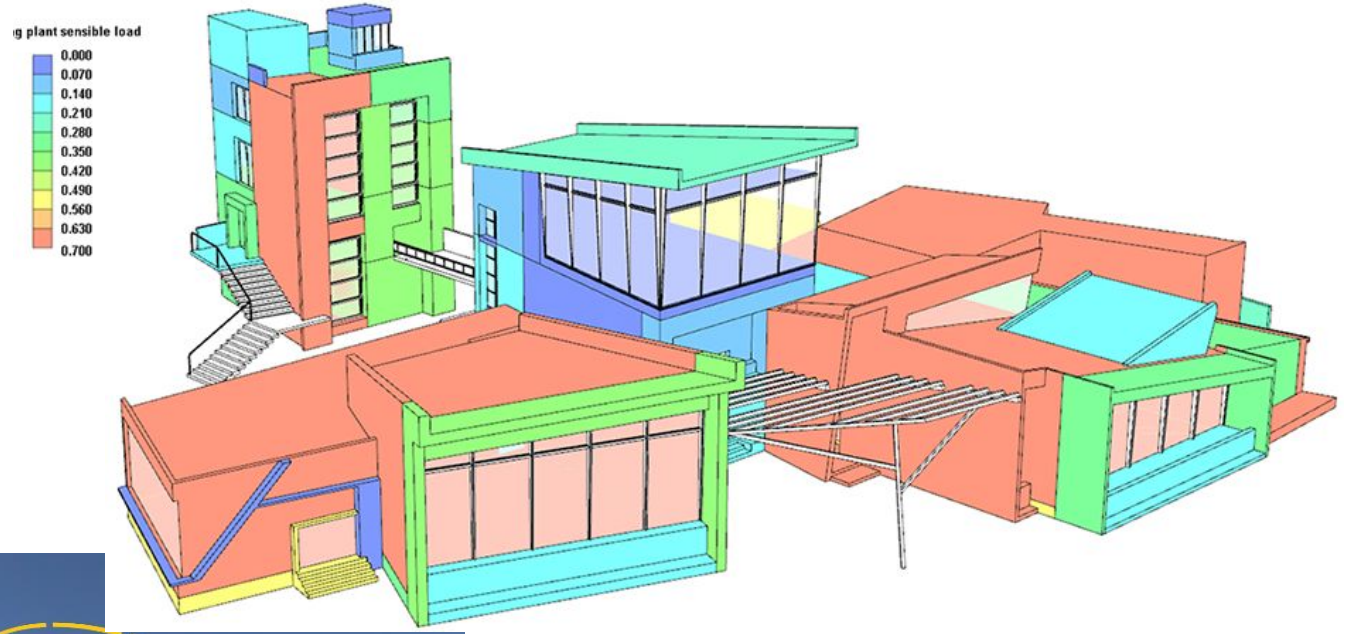
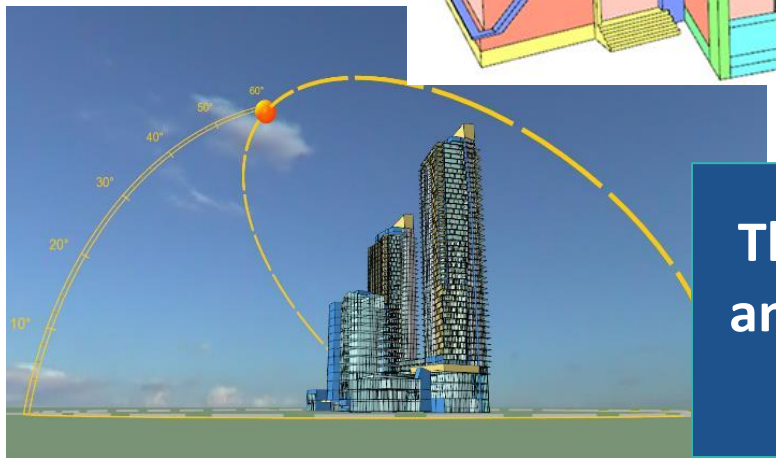


Virtual Environment (VE)



The Virtual Environment software is a suite of integrated building analysis tools that translate complex building physics and detailed dynamic thermal calculations.

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The pros and cons of dynamic energy simulation of buildings:

Pros:

1. **Accurate Predictions**: Models energy consumption realistically by considering dynamic factors.
2. **Comprehensive Analysis**: Identifies energy-saving opportunities.
3. **Climate Adaptation**: Evaluates building resilience to future climate conditions.
4. **Policy Support**: Helps meet regulatory and sustainability standards.
5. **Stakeholder Engagement**: Visualizations enhance communication with stakeholders.

Cons:

1. **Complexity**: Requires detailed data that can be difficult to obtain.
2. **Resource Intensive**: Time-consuming and may incur higher costs for software and training.
3. **Uncertainty in Inputs**: External factors can affect prediction reliability.
4. **Steep Learning Curve**: Requires specialized expertise to operate effectively.

CROSS THESE BARRIERS (CONS)
IES Developed iCD

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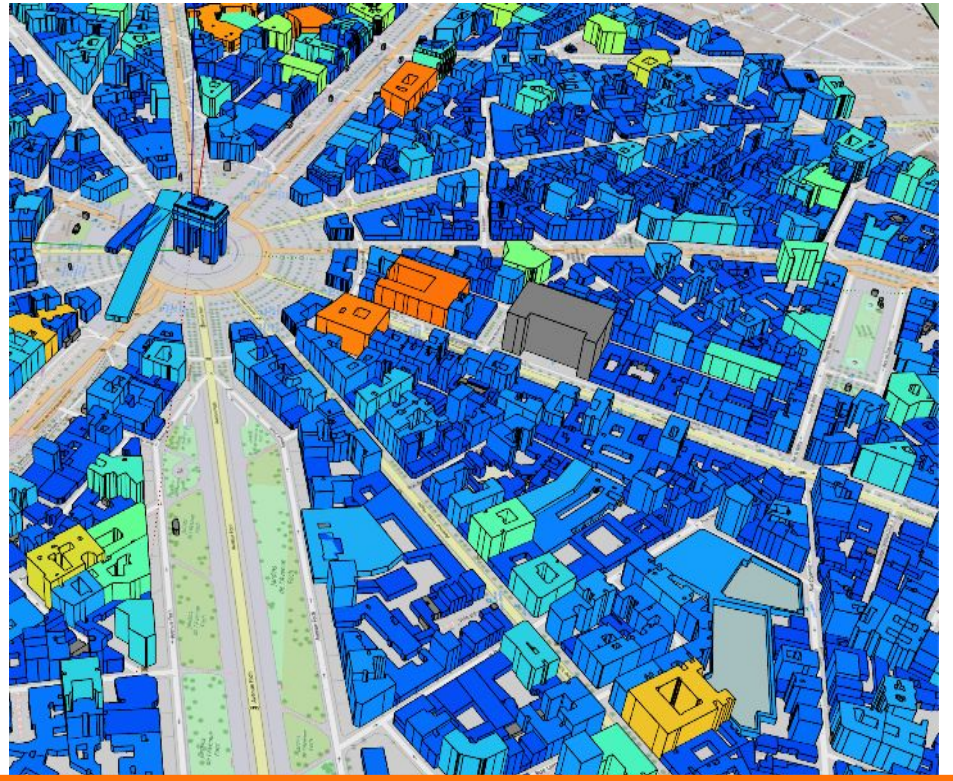
WORKSHOP



iCD

Intelligent Community Design (iCD)

3D urban master planning tool that assist in creating baseline and apply retrofit scenarios at urban level .

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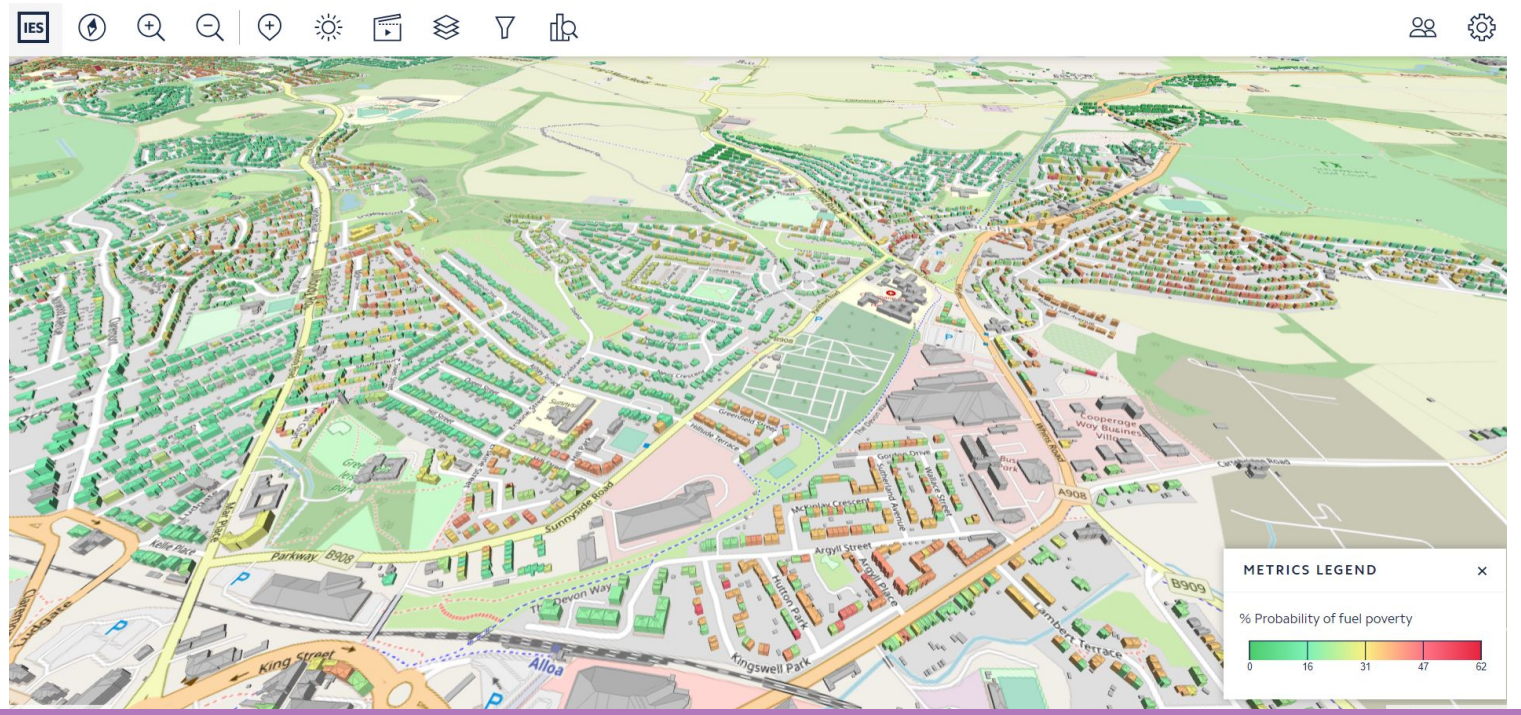
WORKSHOP

Collaboration Monitoring and Visualization Platform

iCM



Provides 3D visualization and stakeholder engagement features

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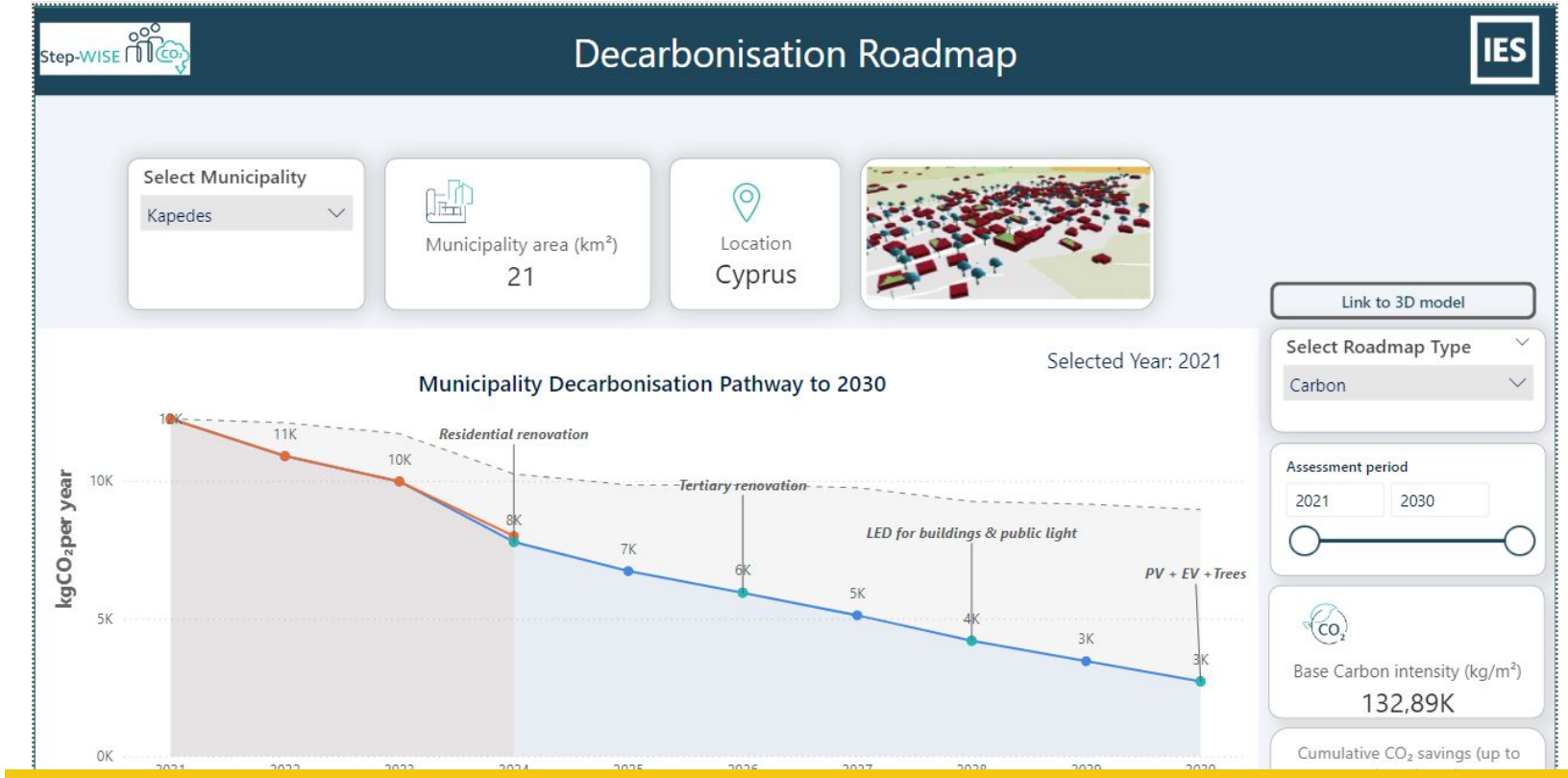
Roadmap visualisation for the implementation of decarbonisation scenarios



Provides the visualisation of the Roadmap with the scenarios for the energy and CO2 emission reduction

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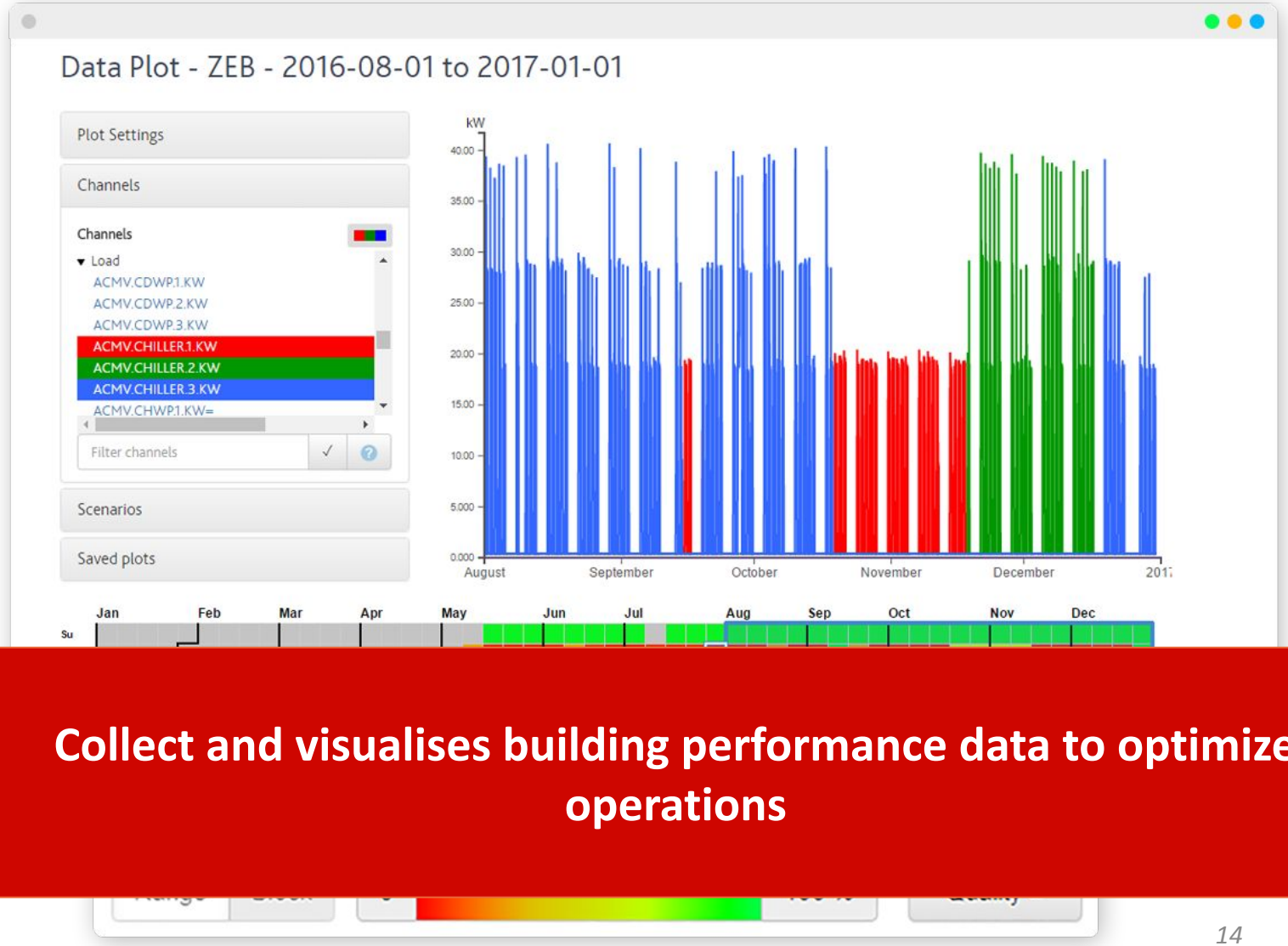
iSC

Intelligent Control and Analysis (iSCAN)



Collect and visualises building performance data to optimize operations

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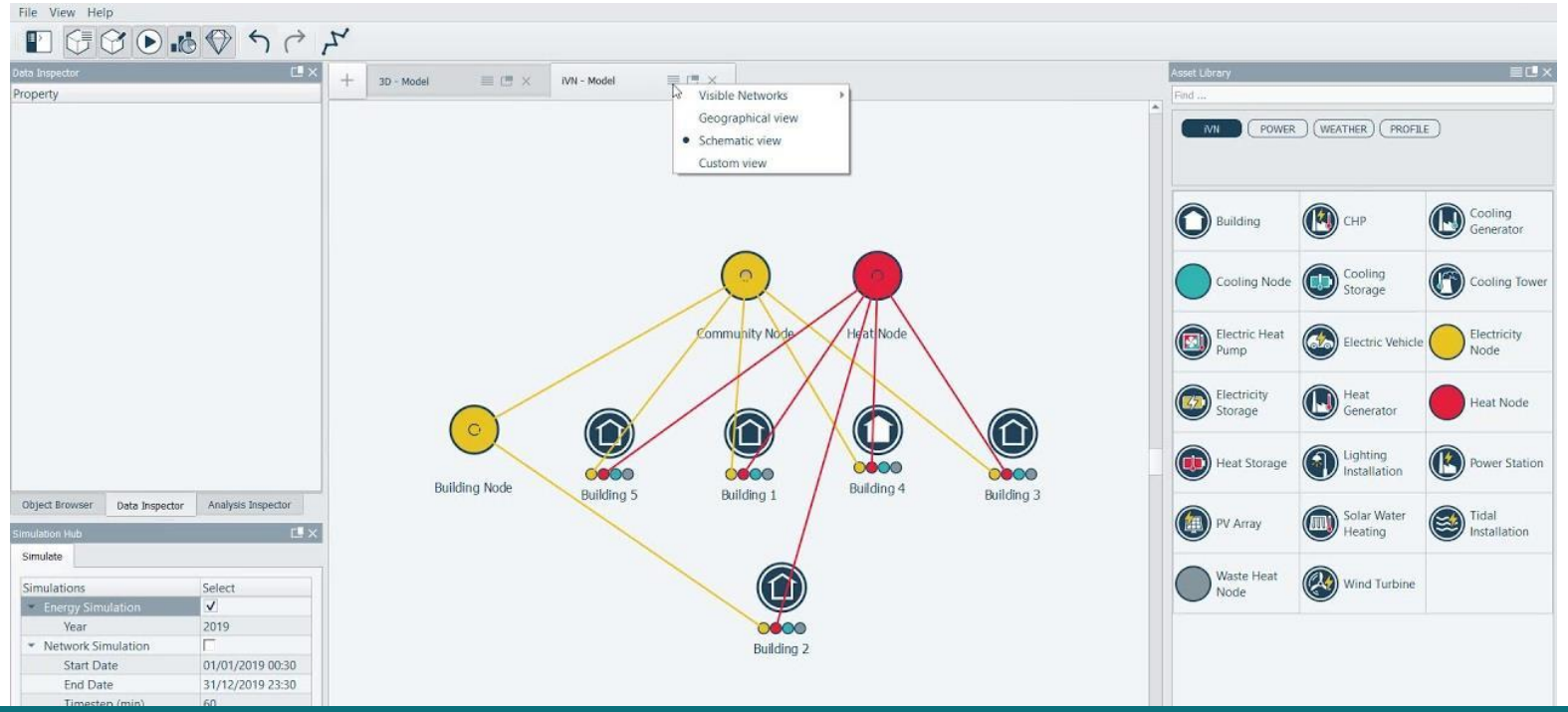
iVN

Intelligent Virtual Network (iVN)



The iVN is a network modelling and management tool that enable advanced analysis of local energy systems including district heating and storage

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WORKSHOP

- WORKSHOP: How to create the Baseline (AS IS)

  iCD

- WORKSHOP: How to create and compare scenarios

  iCD

- WORKSHOP: How to visualise results

  iCM

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CASE STUDIES

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CASE STUDY 1: URBAN MODELING

Bologna	Milano	Udine
Area: 140,86 km² **Inhabitants:** 388 171	**Area:** 181,67 km² **Inhabitants:** 1 361 908	**Area:** 57,17 km² **Inhabitants:** 97 841
Buildings: 1080 **Area:** 7 750 218 m² **Inhabitants:** ~ 23 000 	**Buildings:** 31 **Area:** 50 132 m² **Inhabitants:** 97 841 	**Buildings:** 10 (2 Schools, 1 Shopping mall, 7 Apartment blocks) **Area:** 134 400 m² **Inhabitants:** ~1000 (405 Apartments) 
- Shape (centro) and qgis file containing: - Number of floors - Year of construction - Building Type - Installed PV Capacity	- GeoJSON File containing: - Number of floors - Year of construction - Building Type	- Building's plans and sections - Technical reports of the interventions - Buildings' Energy Performance Certificates

- **From raw data to a reliable energy baseline.**
- **Simulation of retrofit scenarios on an urban scale.**
- **Estimation of intervention costs and return on investment.**
- **Engage local stakeholders with clear visualizations.**

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Bologna

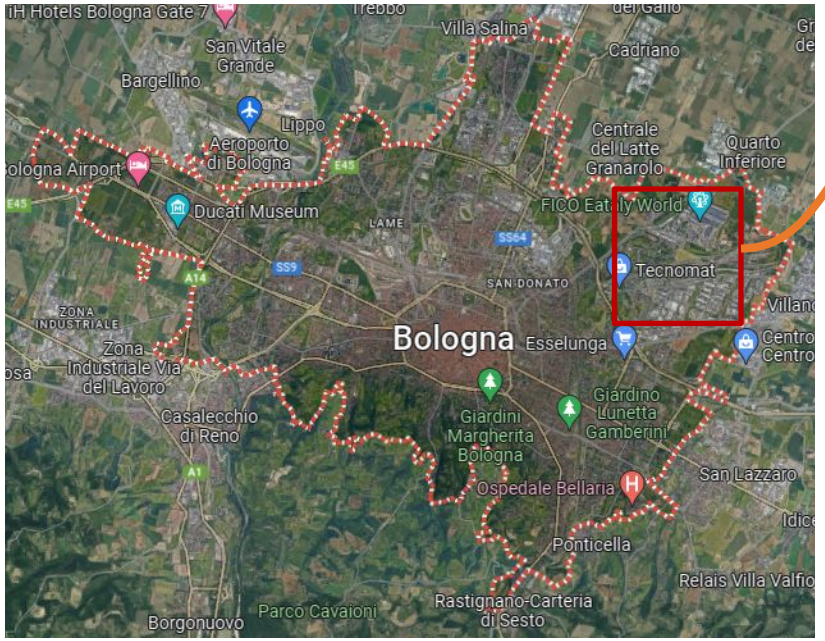
Pilastro-Roveri is the area studied in the Greta EU project, Green Energy Transition Actions. The intent was to make Pilastro - Roveri area an area pioneering the process of climate neutrality that cities and citizens are called to undertake by 2030.

Bologna: 140, 86 km²

Inhabitants: 388 171

Specific area of interest: 1080 Buildings (7 750 218,48 m²)

Inhabitants: around 23 000



Starting from GIS FILE

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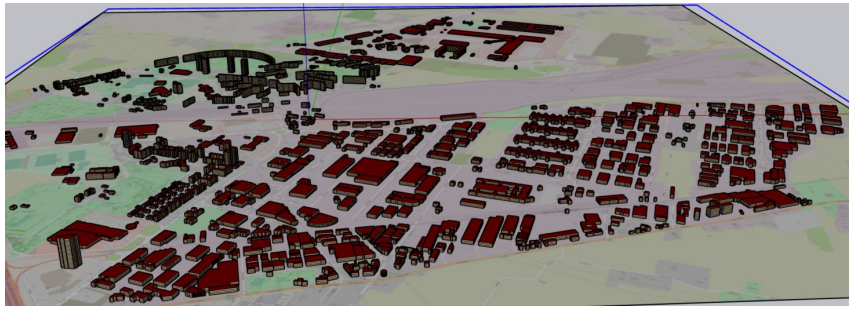
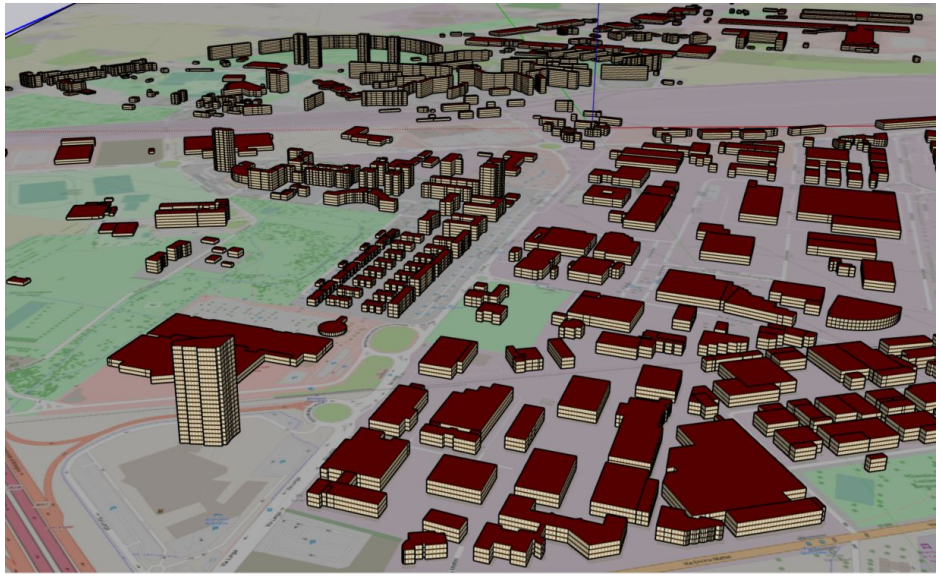
Bologna – Neighborhood Pilastro Roveri

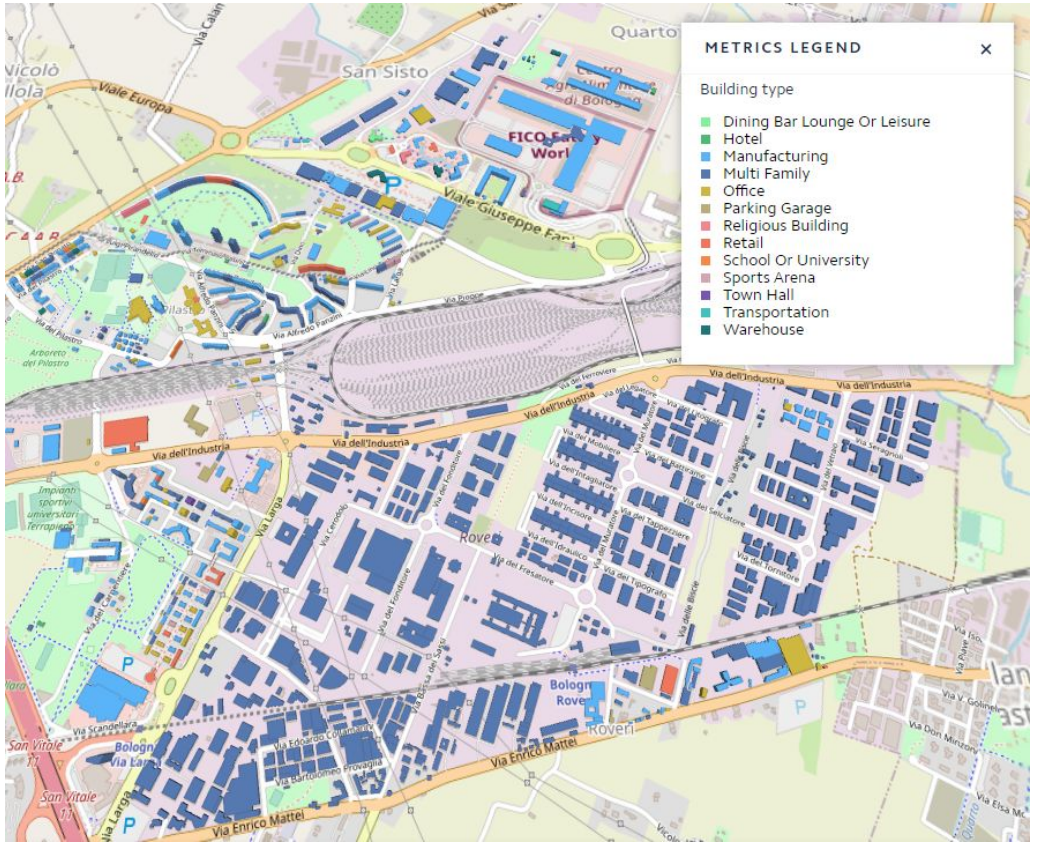
Model set up from iCD plugin in Sketchup:





Visualization from iCIM webpage

https://icim.iesve.com/trial/#/metrics-viewer/68127d7f-1323-4cab-8a9b-a727f97d6721



Building Type *(view from iCIM)*

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Bologna Pilastro – Intervention scenarios

BASELINE – Pre intervention

- External wall U_{value} =2.2 ÷ 1.95 W/m^{2}K
- Windows: U=3.17 ÷ 2.64 W/m^{2}K
- Un-insulated Ground Floors: U=0.71 W/m^{2}K
- Un-insulated Roofs: U=1.56 W/m^{2}K
- Heating/DHW systems: Old/Modern natural gas Boilers

PASSIVE MEASURES

- Scenario 1:
  - Ext Wall: 0.23 W/m^{2}K
  - GroundFloor: 0.29 W/m^{2}K
  - Roof: 0.24 W/m^{2}K
  - Windows U=1.30 W/m^{2}K

ACTIVE MEASURES

- Scenario 2: Substitution of heating system to Air source HP with COP=4 in all buildings
- Scenario 3: Addition of PV panels on building's rooftops

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Bologna Pilastro – PEB Methodology application

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• Workflow example – Economic Analysis

Creation of an excel file with the following characteristics for each building

- Object ID
- Name
- Total floor area (m2)
- Number of storeys
- GlazingRatio
- sup. Disperdente (*) [m2]
- sup finestrata (*) [m2]
- roof area [m2]
- Number of DHW HP
- Type of plant

Highlight the characteristics of each building for each scenario:

- wall insulation [W/m2K]
- roof insulation [W/m2K]
- windows insulation [W/m2K]
- DHW system
- Gen efficiency heating
- heating type of fuel

The excel file created reads if the characteristics are different between the two scenarios and calculates the cost of the intervention

The costs of the interventions have been calculated as follows for each building:

- Wall insulation = MITE cost [€/m2] * dispersing surface
- Roof insulation = MITE cost [€/m2] * footprint area
- Windows substitution = MITE cost [€/m2] * finished surface area (surface Dispersant*glazing ratio)
- DHW substitution (**)= Average price DHW HP [€] * n DHW HP per building (total floor area/average area served by a DHW HP)
- Heating HP (**) = HP price [€/kWt] * Thermal kW (sum of kWh per year/hours

The cashflows for the 2030 and 2050 scenarios have these assumptions:

- O&M costs of 1% of total plant intervention costs
- a percentage of costs saved due to the switch to electric
- an initial investment of 60% of the total cost
- a loan to cover the remaining part of the 10-year cost with an interest rate of 2%
- a tax break of 75% over 10 years

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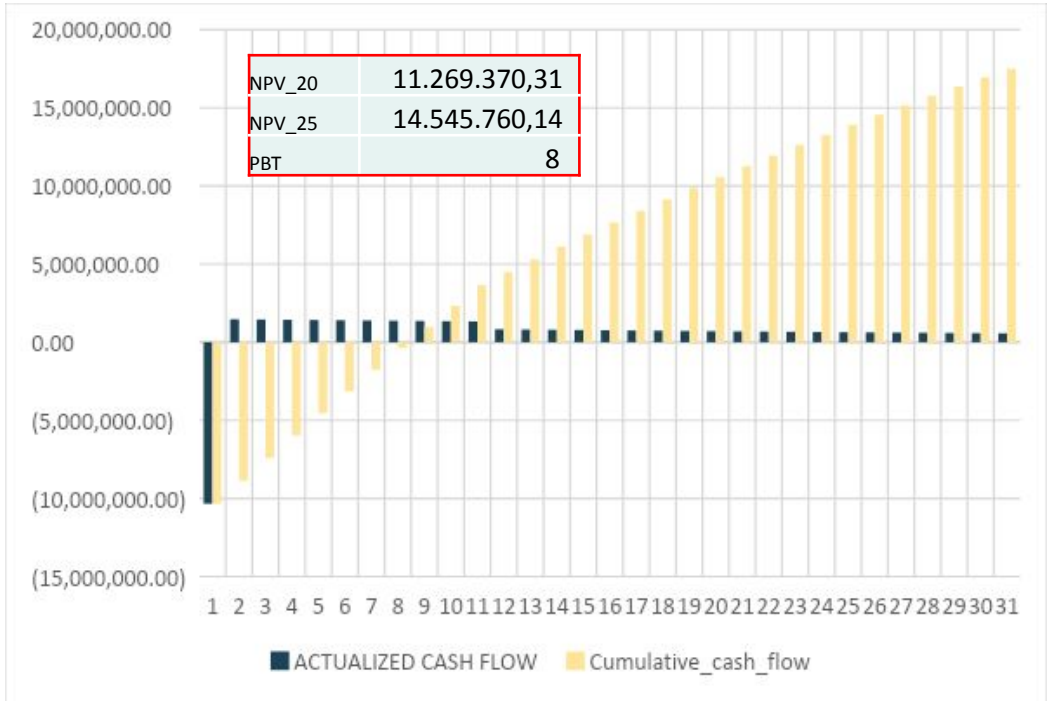
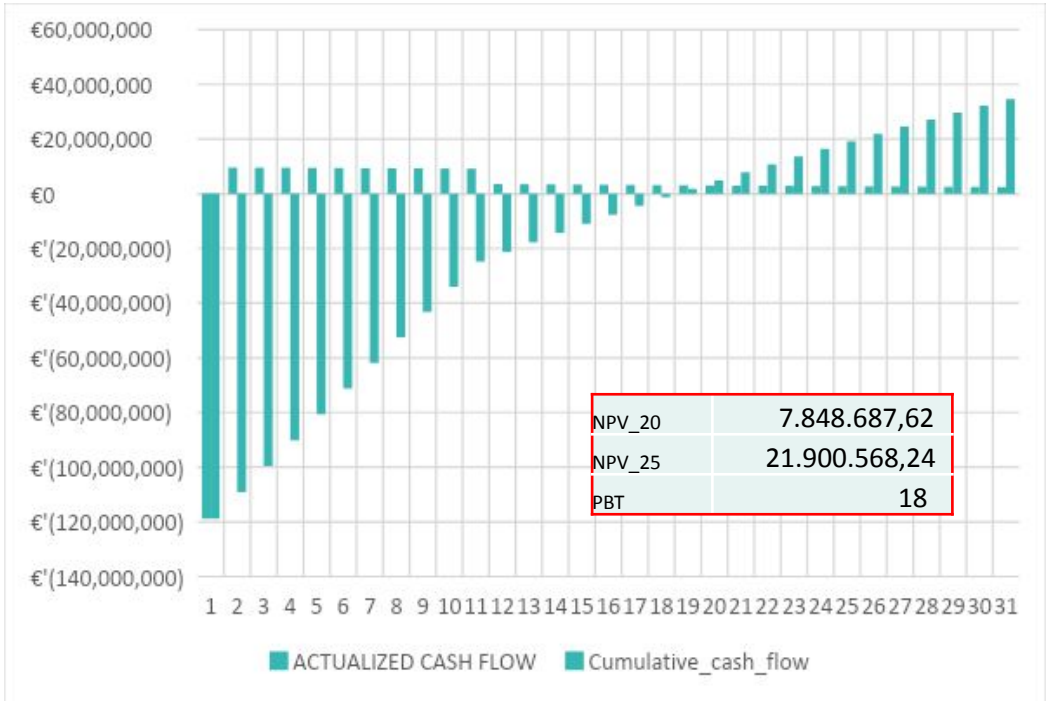
• Workflow example – Economic Analysis

decreto MITE	
isolamento coperture	
copertura ventilata	300€/m2
pareti perimetrali	
esterno/diffusa	180€/m2
sostituzione chiusure trasparenti	
serramento	780€/m2
impianti di riscaldamento con caldaie ad acqaua a condensazione e/o generatori di aria alda a condensazione	
Pnon <= 35 kWt	240€/m2
Pnom > 35 kWt	216€/m2
impianti con pompe di calore	
	€/kW
aria/aria	720t
	€/kW
geotermica	2280t
ACS con pompa di calore	
con accumulo <= 150l	1200€
con accumulo >150l	1500€

2030



2050



Per il calcolo dei cashflow sono stati considerati
- costi di O&M dell 1% rispetto ai costi totali di intervento sugli impianti
- una percentuale di costi risparmiati dovuti al passaggio all'elettrico
- un investimento iniziale pari al 60% del costo totale
- un prestito per coprire la restante parte del costo di 10 anni con tasso di interesse al 2%
- un agevolazione fiscale del 75% in 10 anni

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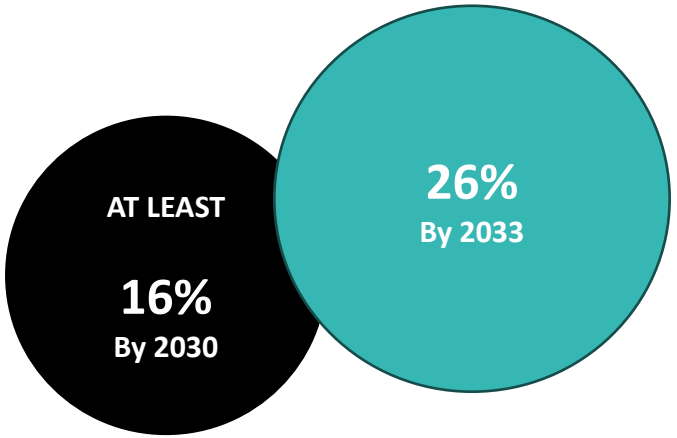
CASE STUDY 2: URBAN MODELING - MUNICIPAL BUILDINGS

- **New EPBD Directive**
  Decarbonisation of the building stock by 2050
  Tackling energy poverty for a just transition to climate neutrality
  Disincentive to the use of fossil fuels and incentive to install renewable sources
  Sustainability throughout the entire life cycle of buildings

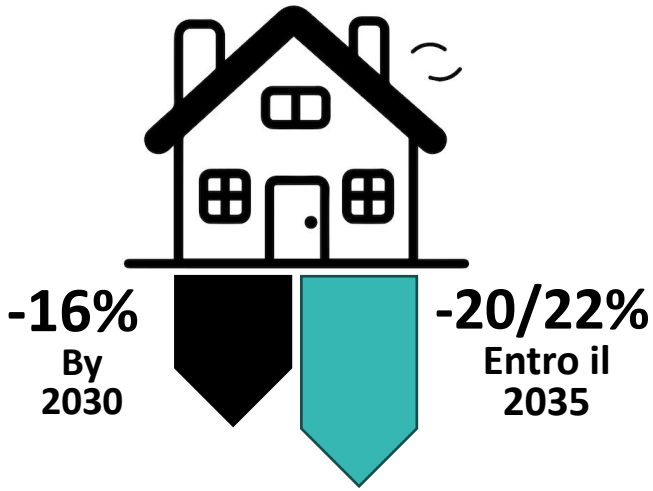
NON-RESIDENTIAL BUILDINGS
MINIMUM ENERGY EFFICIENCY STANDARDS

Building renovation with low performance



RESIDENTIAL BUILDINGS

Energy consumption reduction targets



ZERO EMISSIONS TARGET

- ☑ **From 2030** all new residential buildings
- ☑ **From 2028** all public buildings
- ☑ **From 2050** the entire heritage of existing buildings

OTHER OBLIGATIONS

- ☑ **From 2026** photovoltaic obligation on the roofs of new public and non-residential buildings

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CASE STUDY 2: URBAN MODELING - MUNICIPAL BUILDINGS

OBJECTIVES

🎯Objective

Use IES ICD to carry out Simplified Energy Audits and compare the results with detailed diagnoses.

📌Purpose

🏛️ Generate Energy Audits for municipal buildings

💡 Identify and propose energy efficiency scenarios

🤝 Provide a simulation of the EPC Contract for the implementation of the works

💬Motivation

Traditional analyses of this type require very long times, in-depth inspections and several weeks for modeling.

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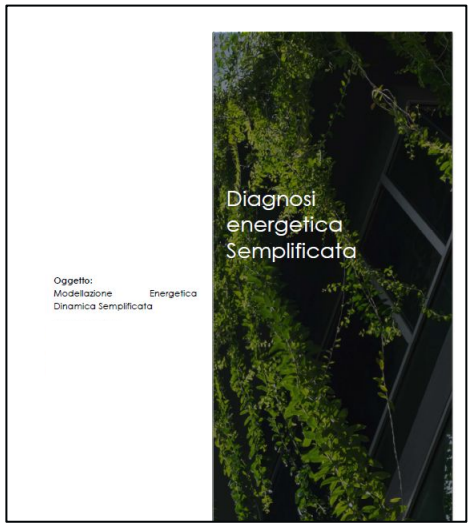
CASO STUDIO 2: MODELLAZIONE URBANA - EDIFICI COMUNALI

RESULTS

GEOMETRIA																								
							DATI IES GEOMETRIA									VERIFICHE GEOMETRIA								
VIA	Deser.	AREA NETTA RISC.	AREA NETTA ILLUMIN.	AREA LORDA RISC.	VOLUME NETTO RISC.	VOLUME LORDO RISC.	AREA LORDA IES	AREA LORDA RISCALDATO IES	SUPERFICIE ORIZZONTALE DI BASE	SUPERFICIE ORIZZONTALE DI COPERTURA	SUPERFICIE FINESTRATA	NUMERO PIANI	AREA LORDA ILLUMINATA	VOLUME LORDO IES	VOLUME LORDO RISCALDATO IES	% Errore rispetto a sup illuminata	% Errore rispetto a sup riscaldata	% Errore volume riscaldato	Consumo gas naturale	Consumo energia termica	Baseline Energia Primaria	
[...]	[...]	m2	m2	m2	m3	m3	m2	m2	m2	m2	m2		m2	m3	m3	%	%	%	Smc	kWh	kWh	
P.zza Vittorio Emanuele II	UFFICI	1355.3	1689.8	1653.1	5035.3	6928	2076.6	1833.7	795.34	805.23	123	3	2061.10	7546.6	7182.2	1%	-9.8%	-3.5%	11231	107704	302494	
Via D. G. Minzoni, 3	SALA CONSILIARE - UFFICIO	123.7	124.1	145	507.2	681.5	159.73	145.53	159.73	0	50.5	1	145.47	702.81	640.33	9%	-0.4%	6.4%	384	3679	5971	1
Via D. G. Minzoni, 44	UFFICIO	49.8	65	60.4	198.7	276.6	78.51	61.091	78.51	0	2.7	1	78.84	329.74	256.62	0%	-1.1%	7.8%	-	-	-	
Via D. G. Minzoni	UFFICIO - SCUOLA	120.1	120.1	150.3	475.2	679.5	151.92	151.92	96.115	97.21	8	2	150.30	653.26	653.26	1%	-1.1%	4.0%	-	-	-	3
Via D. G. Minzoni	UFFICIO	675.8	1101.5	1013.6	3074.6	4071.2	1386.9	1013.4	1136.4	1162	130.8	2	1274.81	6042.6	4449.2	8%	0.0%	-8.5%	34486	330723	502736	7



Scenario 2																				
Descrizione scenario	Consumo totale annuo elettrico IES VE	Consumo totale annuo gas IES VE	Consumo totale annuo IES VE	Energia elettrica e termica prodotta da fonti rinnovabili	Fabbisogno energetico totale	Risparmio energetico IES VE	Risparmio energetico percentuale	TEP totale consumo energetico	Risparmio TEP percentuale	Emissioni CO2 totale	Risparmio CO2 percentuale	Costo Totale Energia considerando PV	Risparmio Costo Totale Energia considerando PV	Risparmio Economico percentuale considerando PV	CAPEX	Totale Conto termico 2.0	Totale Conto termico 3.0	Ritorno dell'Investimento CT 2.0	Ritorno dell'Investimento CT 3.0
	(kWh/anno)	(kWh/anno)	(kWh/anno)	(kWh/anno)	(kWh/m*anno	(kWh)	(%)	(TEP)	(%)	(kgCO2e)	(%)	(i)	(i)	(%)	(i)	(i)	(i)	(anni)	(anni)
Serramenti	94177.20	94842.10	189019.30	0.00	91.02	9571.40	5%	25.78	2%	46562.34	3%	34864.62	538.34	2%	83141.90	41570.95	41570.95	69.48	69.48
Serramenti	1147.00	4628.20	5775.20	0.00	36.16	842.30	13%	0.61	11%	1261.71	12%	836.61	93.92	11%	34135.50	17067.75	17067.75	>75	>75
Serramenti	561.70	2495.60	3057.30	0.00	38.94	38.60	1%	0.32	1%	663.70	1%	436.88	4.58	1%	1825.07	912.53	912.53	>75	>75
Serramenti	2807.20	15164.30	17971.50	0.00	118.30	675.60	4%	1.83	3%	3855.37	3%	2502.72	80.14	3%	5407.60	2703.80	2703.80	33.74	33.74
Serramenti	73372.70	123509.80	196882.50	0.00	141.96	10662.00	5%	24.35	3%	46200.16	4%	33048.72	1214.00	4%	88414.32	44207.16	44207.16	36.41	36.41
Serramenti	32751.40	55479.90	88231.30	0.00	78.51	2617.30	3%	10.90	0%	20692.14	2%	14793.34	58.85	0%	57793.76	28896.88	28896.88	>75	>75
Relamping	3612.50	3286.10	6898.60	0.00	28.43	313.30	4%	0.96	7%	1715.68	6%	1235.61	101.36	7%	3417.78	0.00	1367.11	33.72	20.23
Serramenti	35658.80	128411.90	164070.70	0.00	74.08	28580.20	15%	17.72	12%	36130.41	14%	24173.78	3390.27	12%	344734.72	100000.00	172367.36	72.19	50.84
Solaio Copertura	1189.50	17813.80	19003.30	0.00	88.54	1735.90	8%	1.76	8%	3911.28	8%	2411.39	205.92	8%	22745.35	11372.68	11372.68	55.23	55.23
Serramenti	10586.60	23640.80	34227.40	0.00	62.82	8535.00	20%	4.02	15%	7830.03	18%	5458.85	1012.45	16%	83209.50	41604.75	41604.75	41.09	41.09
Solaio Copertura + Fotovoltaico	2684.40	19059.80	29646.40	23286.86	12.41	16372.36	72%	-2.22	200%	-2230.42	147%	-2309.98	5958.52	195%	86537.22	27940.89	27940.89	9.83	9.83
Fotovoltaico	33592.10	165784.00	199376.10	71417.91	81.44	71417.91	36%	7.20	65%	22073.84	49%	10181.32	17307.45	64%	94016.42	0.00	0.00	5.25	5.25
Solaio Copertura + Fotovoltaico	32195.80	91741.30	123937.10	42635.14 30516.85	48.79	161390.59	62%	0.24	99%	6348.10	86%	613.22	28880.57	98%	296678.21	94282.64	94282.64	7.01	7.01
Fotovoltaico	60566.90	354466.10	415033.00	73328.85 30099.17	75.50	103428.03	18%	22.50	46%	58334.91	34%	31300.83	25933.72	45%	147976.54	0.00	0.00	5.71	5.71
Serramenti	27402.90	24578.70	51981.60	0.00	88.86	7764.50	13%	7.24	8%	12944.79	11%	9786.65	921.05	9%	49236.23	24618.11	24618.11	26.73	26.73
Serramenti	14451.70	0.00	14451.70	0.00	68.38	425.80	3%	2.70	3%	4234.35	3%	3623.64	106.77	3%	11889.37	5944.98	5944.98	55.68	55.68
Fotovoltaico	24047.90	95542.10	119590.00	62109.08	37.31	62109.08	52%	1.11	91%	7956.50	70%	1769.99	15573.33	90%	92189.50	0.00	0.00	5.92	5.92
Fotovoltaico	2939.60	11899.80	14839.40	75572.85	-32.89	75572.85	507%	-12.55	891%	-18884.00	679%	-16785.54	18949.26	678%	110380.86	0.00	0.00	5.83	5.83
Fotovoltaico	171.40	630.60	802.00	2744.97	-29.00	2744.97	342%	-0.43	534%	-627.94	458%	-570.50	688.28	594%	4009.28	0.00	0.00	5.83	5.83
Fotovoltaico	230.80	2707.70	2398.50	2086.36	18.11	2086.36	70%	-0.10	136%	15.44	98%	-129.03	523.14	133%	3013.54	0.00	0.00	5.76	5.76
Fotovoltaico	83.00	944.70	1027.70	4477.40	-32.82	4477.40	436%	-0.74	864%	-1098.62	615%	-989.80	1122.67	945%	6289.18	0.00	0.00	5.60	5.60
Serramenti	9072.00	26950.30	36022.30	0.00	40.03	1754.80	5%	4.02	4%	8048.16	4%	5471.66	208.16	4%	29364.88	14982.44	14982.44	71.98	71.98
Serramenti	13155.40	21850.90	41006.30	0.00	42.59	3636.40	13%	5.46	13%	9982.71	16%	7395.08	1143.10	13%	20278.51	10139.26	10139.26	8.87	8.87

🏢 **Buildings Analyzed**
23 Municipal Buildings
🛠️ **Activity**
🧱 Energy Modeling
⚙️ Simulation of Efficiency scenarios (Economic and Financial

RESULTS: The simplified approach has made it possible to reduce the time to 2 weeks of work, significantly reducing time and resources, while maintaining a maximum error of 10%

BENEFITS FOR THE INSTITUTION Quick estimate of national incentives (e.g. Thermal Account 3.0).

- It improves competitiveness for access to PNRR funds and other calls.
- Optimized planning: priorities, times, resources.

This project has received funding from the European Union's LIFE Programme for Research and Innovation under Grant Agreement no. 101120859

Co-funded by the European Union

WORKSHOP

- Discovering iCD

Creating a model from an OSM import
Creating geometry manually
Object attributes
Export e Import file CSV
Data Painter and filters
Adjacent buildings
Point objects
Solar Assessment and Roof solar Potential
Run Simulation Options
Create a Model from GIS Files and CSV Files to Enrich.

Step-WISE

TOOLKIT MINIGUIDE

Part 1 & 2

Changelog

Version:	Date:	Status:	Author:	Reviewer:	Comments:
0.1	14.10.24	Working	Alessandro Piccinini [R2M]		Miniguide Part 1&2 of 4

Develop a baseline

we can provide templates and examples.

Data Gathering

Gather data on building geometry, type, energy consumption, system performance, and usage patterns from government agencies, utilities, research institutions, and open data platforms.

iCD model creation

ICD models create digital twins of real buildings to simulate their behaviour and provide a valuable baseline for testing and monitoring various options.

Model and simulation

Import all essential data from available data sets into iCD. Develop a virtual model of your area. Assess with a high confidence a baseline for you decarbonisation journey.

Review Results

A reliable baseline model is crucial for a successful zero-carbon journey, providing a stable foundation for future enhancements and ensuring confidence in the process.

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WORKSHOP part 2

- Results visualisation
- Scenarios
- Time Dimension e Multi-year simulation
- Basic Carbon Emissions Analysis
- Basic Cost Analysis
- Creating a custom attribute

PART 1 and 2 - Extra Features

- Boundaries
- Accessibility Assessment
- Walkability Boundaries
- Complex Geometry

Step-WISE

TOOLKIT MINIGUIDE

Part 1 & 2

Changelog

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0.1	14.10.24	Working	Alessandro Piccinini [R2M]		Miniguide Part 1&2 of 4

Identify and analyse potential actions

we can provide templates and examples.

Identify high emitters

Engage with stakeholders that have a potential of a high impact on carbon emission reductions. Start a conversation, understand their view on decarbonisation and actions taken up to date. Include their perspectives and plans in decarbonisation scenarios.

Sort archetypes

Identify groups of similar buildings that can benefit from the same upgrades. This will help to apply the changes to the model. Most importantly, it will streamline a process of future incentives design to help certain parties and community groups to achieve the set goals.

Create scenarios

Create scenarios, and investigate their impact by running multiple simulations using ICL technology. iCD tool allows to investigate larger range of various solutions. This ensures a selection of the best ones, and in the most beneficial sequence.

Step-WISE

Thank you

IES R&D IRELAND

Frederick University

CERES

SINLOC Sistema Iniziative Locali

ENERGY AGENCY OF PLOVDIV

R2M RESEARCH TO MARKET SOLUTION

Cyprus Energy Agency

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