



Shaping Energy for a Sustainable Future

Herramientas Digitales para la Regeneración Urbana

Institut de Recerca en Energia de Catalunya (IREC)

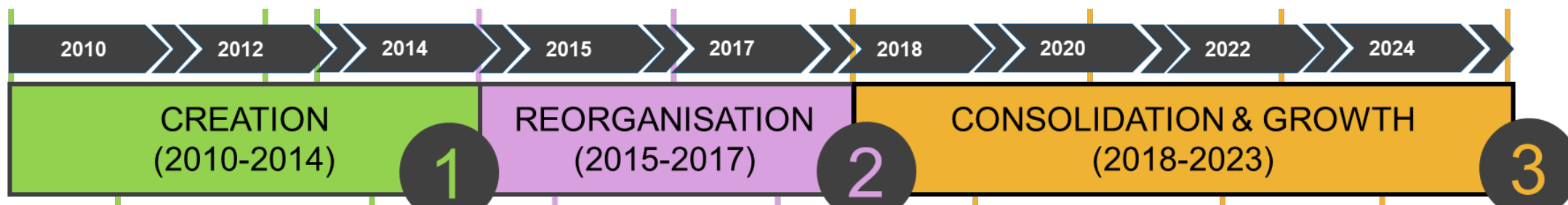
Climate Neutral and Resilient Buildings and Communities Research Group

Iván Luque Segura, Researcher





IREC – Research Groups - Timeline



IREC - Board of Trustees

GOVERNMENT OF CATALONIA

Departament d'Acció Climàtica, Alimentació i Agenda Rural
Direcció General d'Energia
Direcció General de Recerca
Institut Català d'Energia (ICAEN)



GOVERNMENT OF SPAIN

Secretaría de Estado de Energía
Secretaría General de Investigación
CIEMAT (Ministerio de Ciencia e Innovación)
IDAE (Instituto para la Diversificación y Ahorro de la Energía - Ministerio de Transición Ecológica)



UNIVERSITIES

Politécnica de Catalunya (UPC)
Barcelona (UB)
Rovira i Virgili (URV)



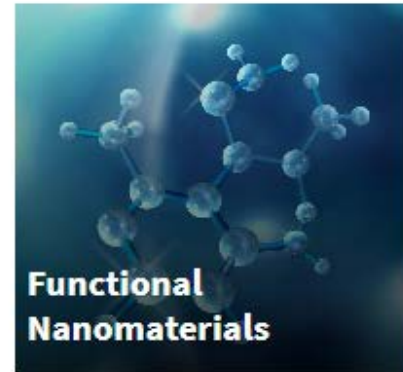
COMPANIES

Enagás
Endesa
Naturgy



IREC - Research Groups

Advanced Materials and Systems for Energy Area



Energy Efficiency in Systems, Buildings and Communities Area



Thermal Energy and Building Performance

The group aims to investigate and develop an **integrated and systemic approach** towards **zero energy communities** with a special focus on the **Mediterranean** and warm weather areas.



BUILDINGS AND DISTRICTS



- Retrofitting of building stock
- NZEB and flexible buildings
- Thermal comfort and health
- Urban modelling
- Green IT/Data centres
- Policy recommendations



THERMAL SYSTEMS



- Optimisation of thermal comfort and efficiency
- HVAC systems
- Heat pumps
- Thermal solar systems



EXPERIMENTAL TESTING



- HVAC systems in real conditions
- Semi-virtual testing approach
- Control and fault detection
- Renewable energy integration



Digital Twins – What is it?

A digital twin is a **virtual representation** of an object or system that uses multiple simulation and/or real data **to help decision making.**

For Urban Areas, visual representation of results using **2D and/or 3D maps** are the best way to communicate results.



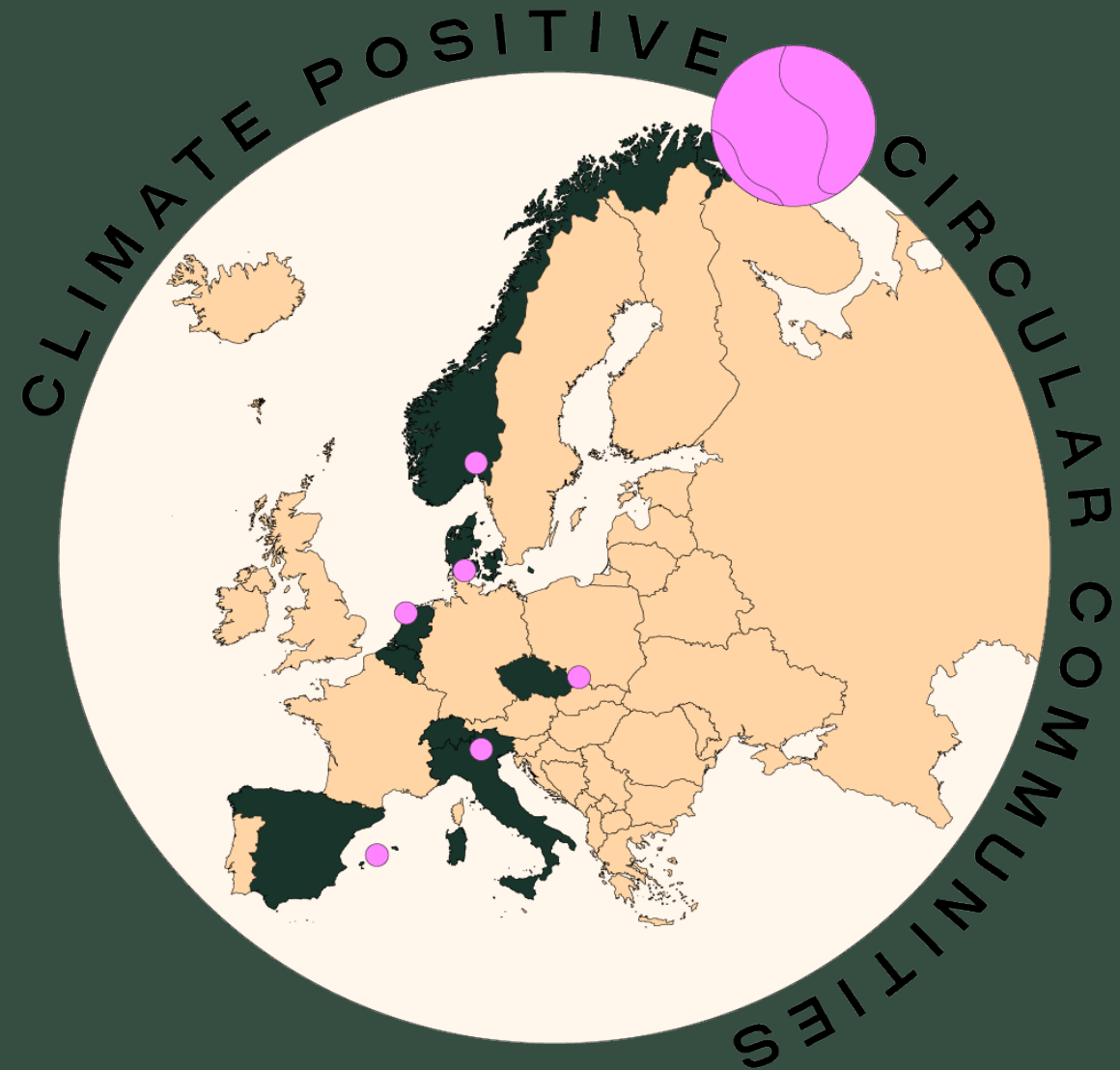
ARV - 6 DEMO PROJECTS

Urban transformation/ regeneration projects

Covering different climates in Europe – north/south, east/west.

Different types of buildings (residential, public, educational, and health care)

<https://greendeal-arv.eu/>



KEY ACTIONS

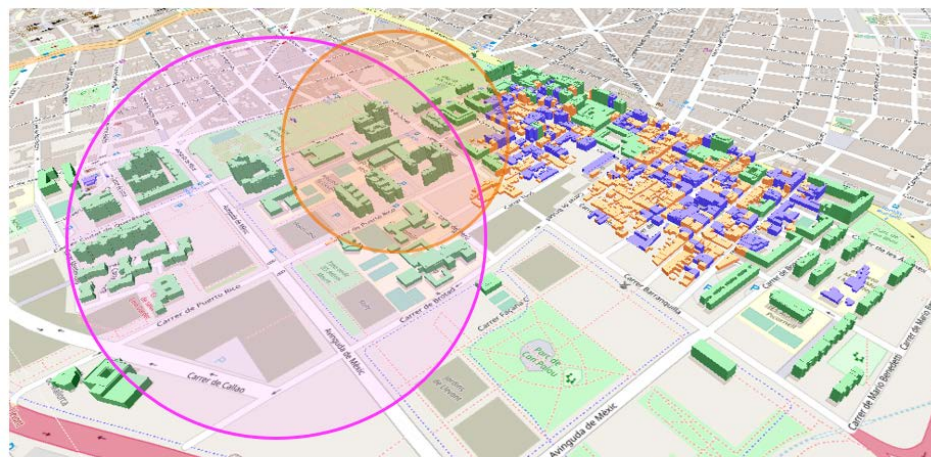
1. Large scale-retrofitting
2. New Positive Energy Social Housing
3. New high efficiency residential multifamily buildings
4. Energy Renovation of flagship heritage protected building
5. Citizen Energy Communities
6. Living Lab



Large Scale Retrofitting

Residential Retrofits at district scale

Business Models under Public Private Partnerships



— Selection area of criteria 1: construction year

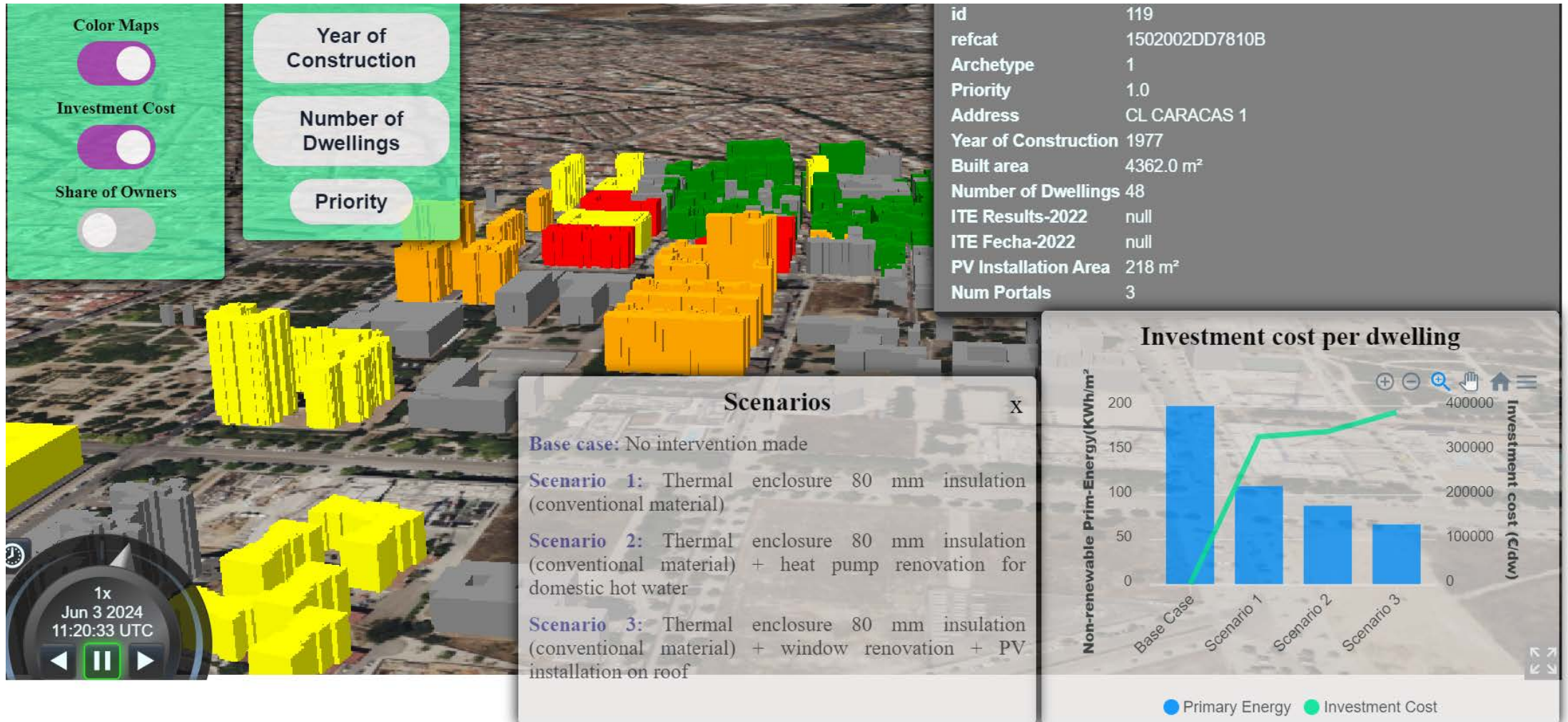
— Selection area of criteria 2: building typology

Orange Single family
Blue Medium multifamily
Green Large multifamily

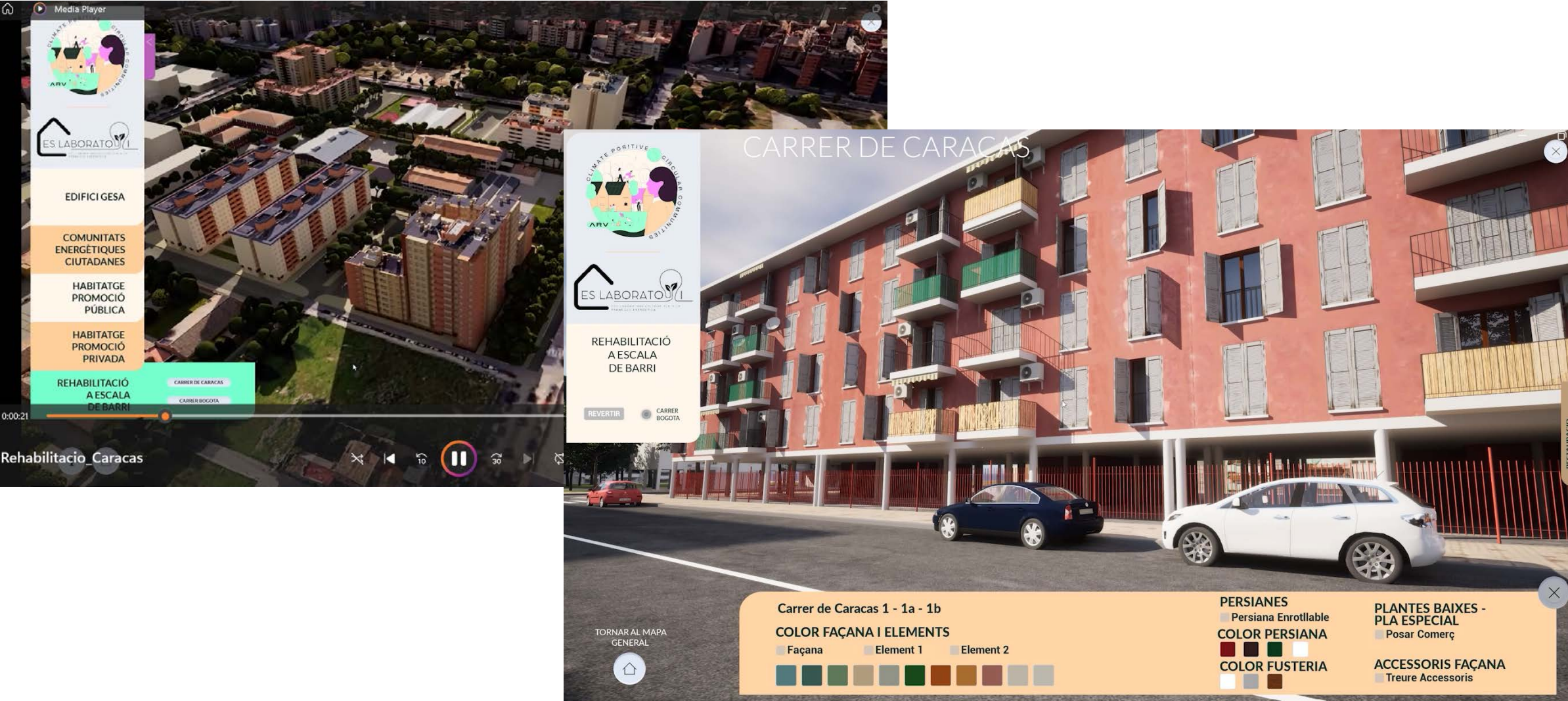


ARV Project – Large Scale Retrofitting

WEB MAP TOOL



ARV: Virtual Reality for User Engagement



The image displays a virtual reality interface for urban rehabilitation. On the left, a media player shows an aerial view of a city with a sidebar menu. The main view on the right shows a street-level view of a red brick building with balconies, with a configuration menu overlaid at the bottom.

Media Player Sidebar:

- ES LABORATOI
- EDIFICI GESA
- COMUNITATS ENERGETIQUES CIUTADANES
- HABITATGE PROMOCIÓ PÚBLICA
- HABITATGE PROMOCIÓ PRIVADA
- REHABILITACIÓ A ESCALA DE BARRI

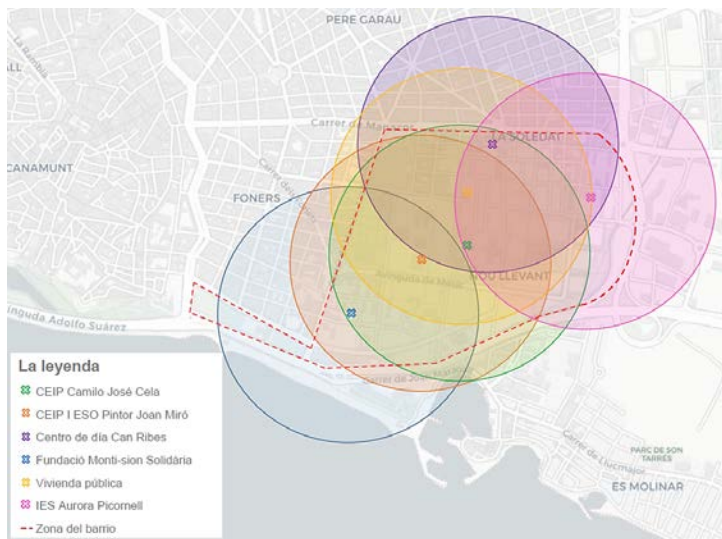
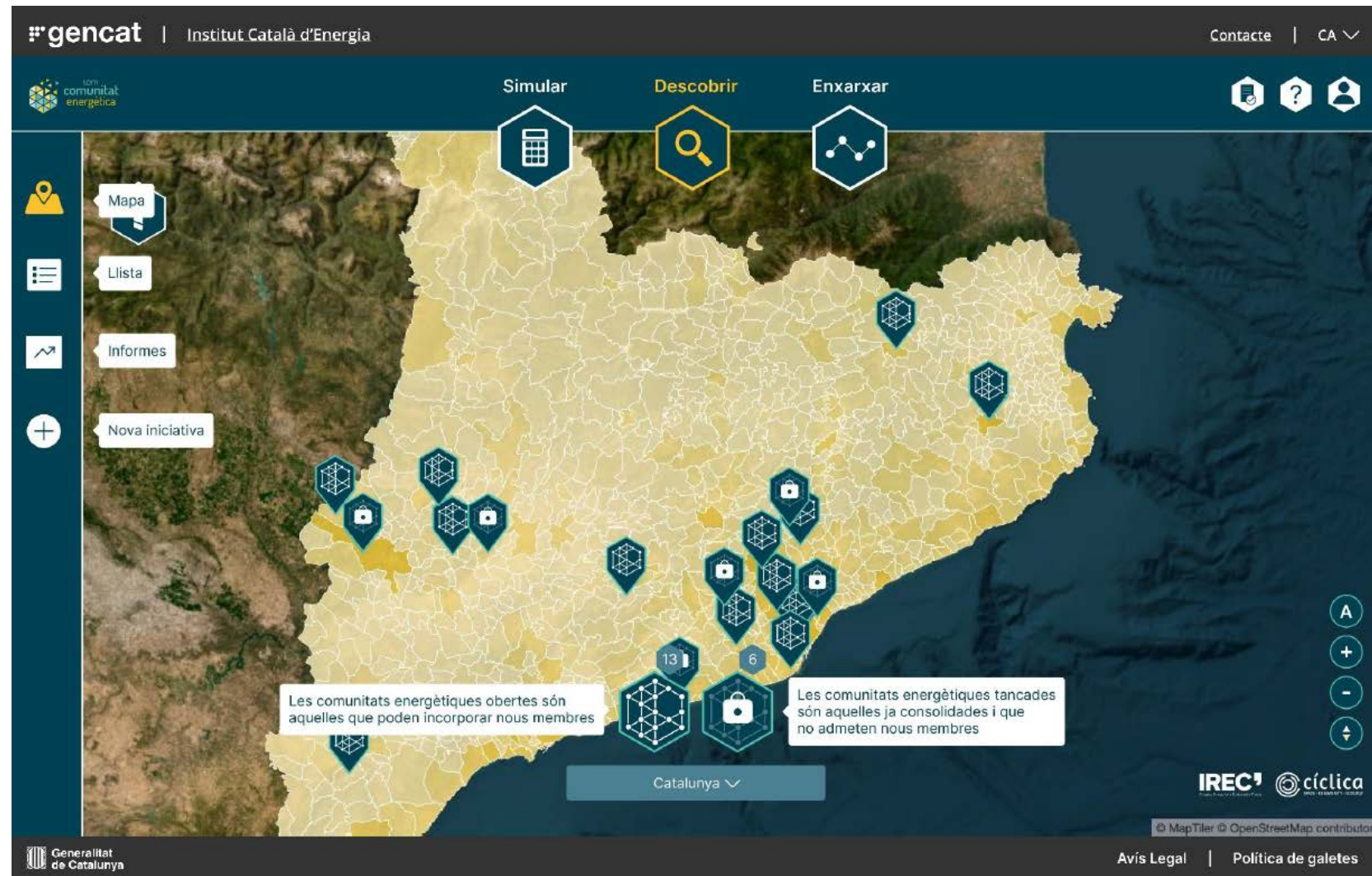
Configuration Menu (Bottom Right):

- Carrer de Caracas 1 - 1a - 1b**
- COLOR FAÇANA I ELEMENTS**
 - Façana: [Color swatches]
 - Element 1: [Color swatches]
 - Element 2: [Color swatches]
- PERSIANES**
 - Persiana Enrotllable: [Color swatches]
- COLOR PERSIANA**: [Color swatches]
- COLOR FUSTERIA**: [Color swatches]
- PLANTES BAIXES - PLA ESPECIAL**
 - Posar Comerç: [Color swatches]
- ACCESSORIS FAÇANA**
 - Treure Accessoris: [Color swatches]

Other UI Elements:

- ES LABORATOI logo and "REHABILITACIÓ A ESCALA DE BARRI" text.
- Buttons: REVERTIR, CARRER BOGOTA, TORNAR AL MAPA GENERAL.
- Video controls: 0:00:21, play/pause, 10s, 30s.
- Street name: CARRER DE CARACAS.

Citizen Energy Communities

gencat | Institut Català d'Energia

Simular | Descobrir | Enxarxar

Mapa | Llista | Informes | Nova iniciativa

Les comunitats energètiques obertes són aquelles que poden incorporar nous membres

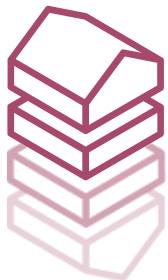
Les comunitats energètiques tancades són aquelles ja consolidades i que no admeten nous membres

Catalunya

IREC^R | cíclica

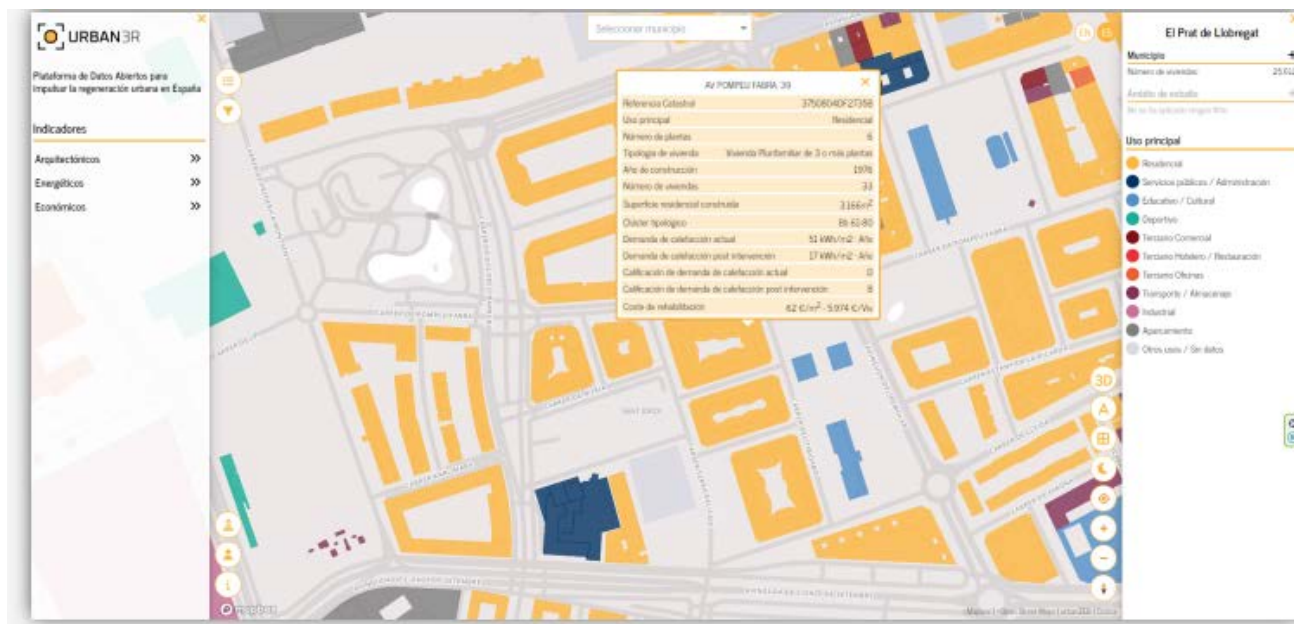
MapTiler | OpenStreetMap contributors

Generalitat de Catalunya | Avis Legal | Política de galetes



MAKING PEDs

DECISION-MAKING
DIGITAL TWINS FOR
CLIMATE NEUTRAL
POSITIVE ENERGY DISTRICTS

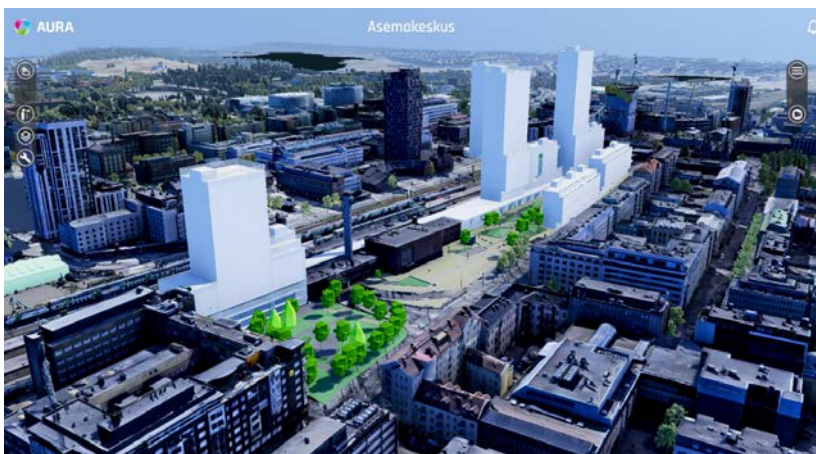
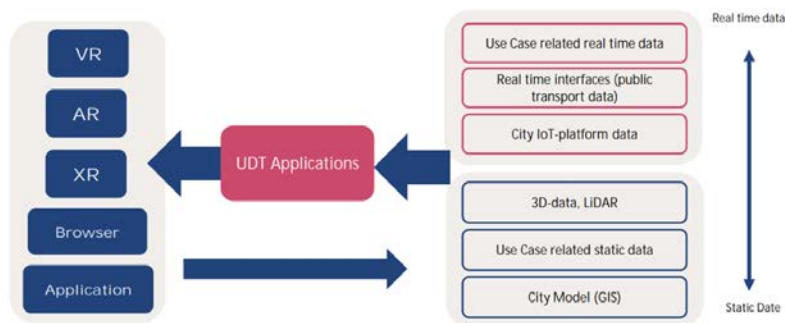


DIGITAL TWINS AS DECISION SUPPORT TOOL FOR CITIES IN THEIR TRANSITION TOWARDS CLIMATE NEUTRALITY





Digital Twin Data Flow



DEMO CITIES & FELLOW CITIES

In this map you will find the location of the **Demo Cities**:

- Bucharest
- Cascais
- Cesena
- Tampere

and the **Fellow Cities**:

- Cartagena
- Kadiköy
- Liepaja
- Szombathely
- Zagreb



Shaping Energy for a Sustainable Future



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