



Supporting the transformation process towards a sustainable built environment at local level

Multi-dimensional data driven services to foster residential building retrofitting programs

The RETABIT Project

29º April 2024

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ARC Engineering and Architecture La Salle
Ramon Llull University, Spain

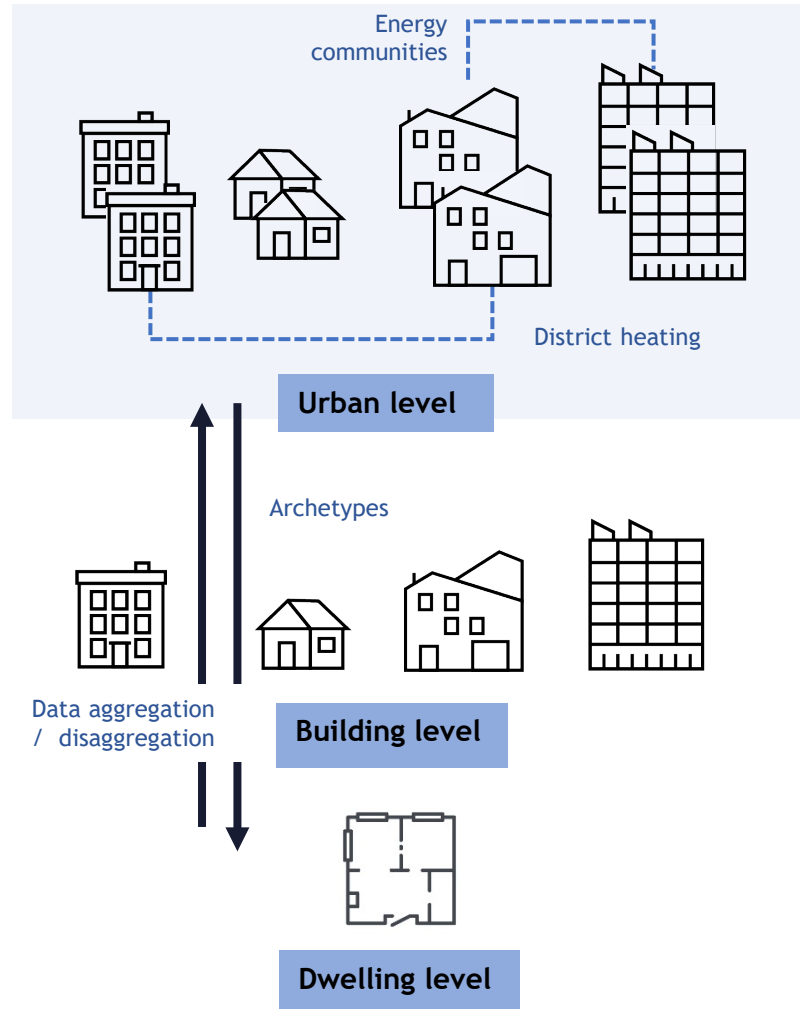


Proyecto PID2020-115936RB-C21
Financiado por el Ministerio de Ciencia e Innovación

Building renovation across scales and domains

DATA

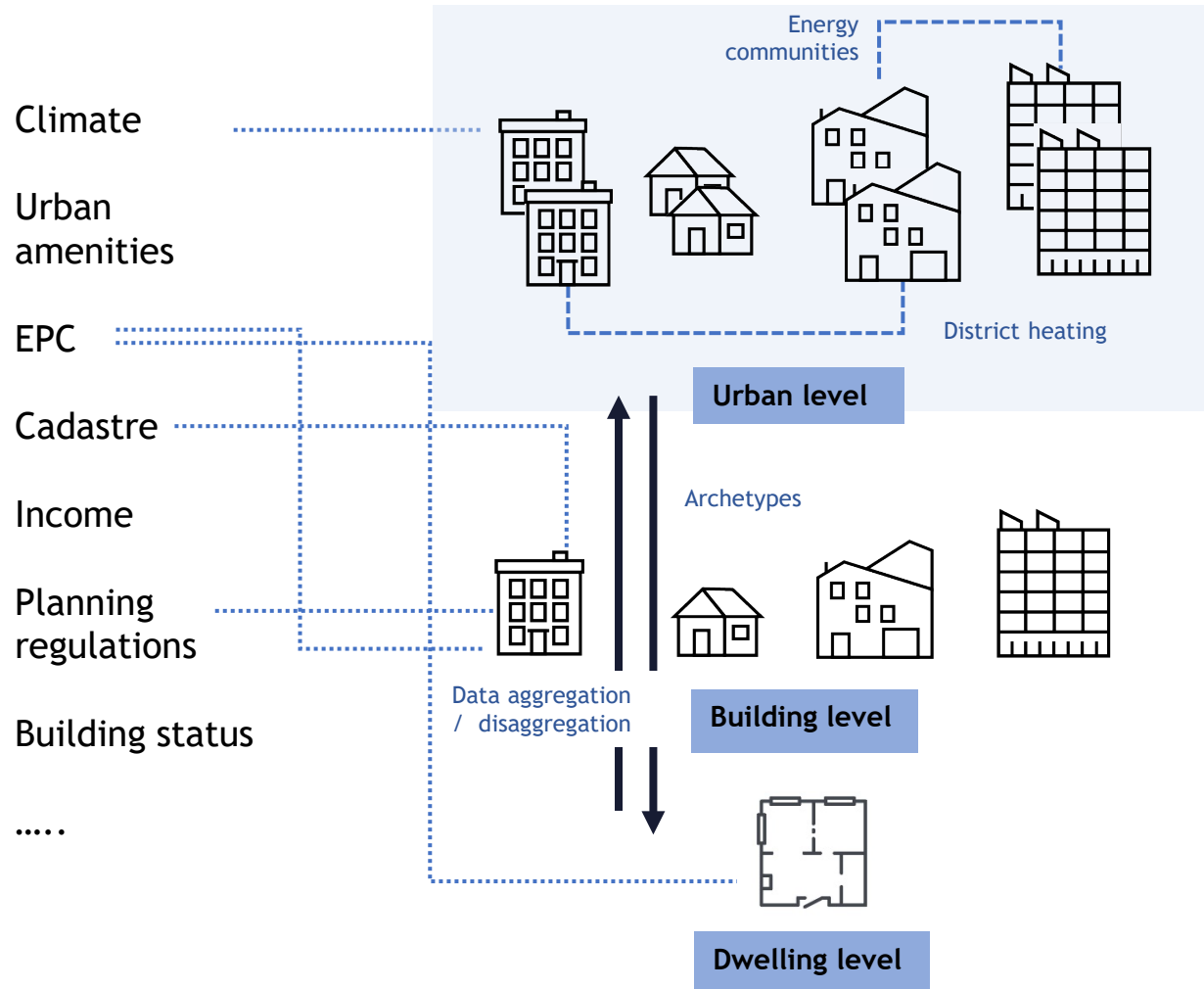
Climate
Urban amenities
EPC
Cadastre
Income
Planning regulations
Building status
.....



Building renovation across scales and domains

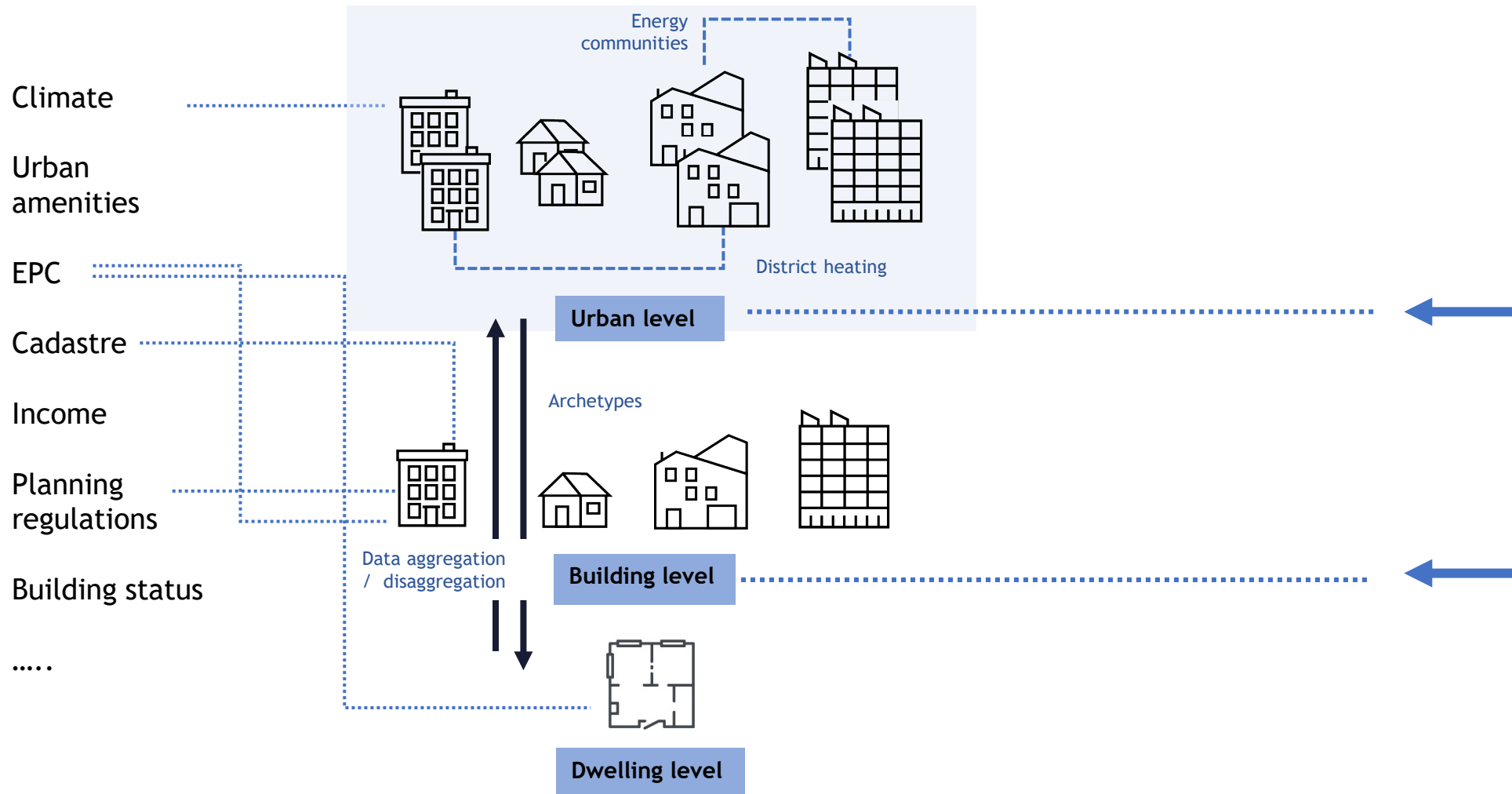
Correspondance between data and scales

DATA



Building renovation across scales and domains

DATA



INTERVENTIONS

Building stock renovation:

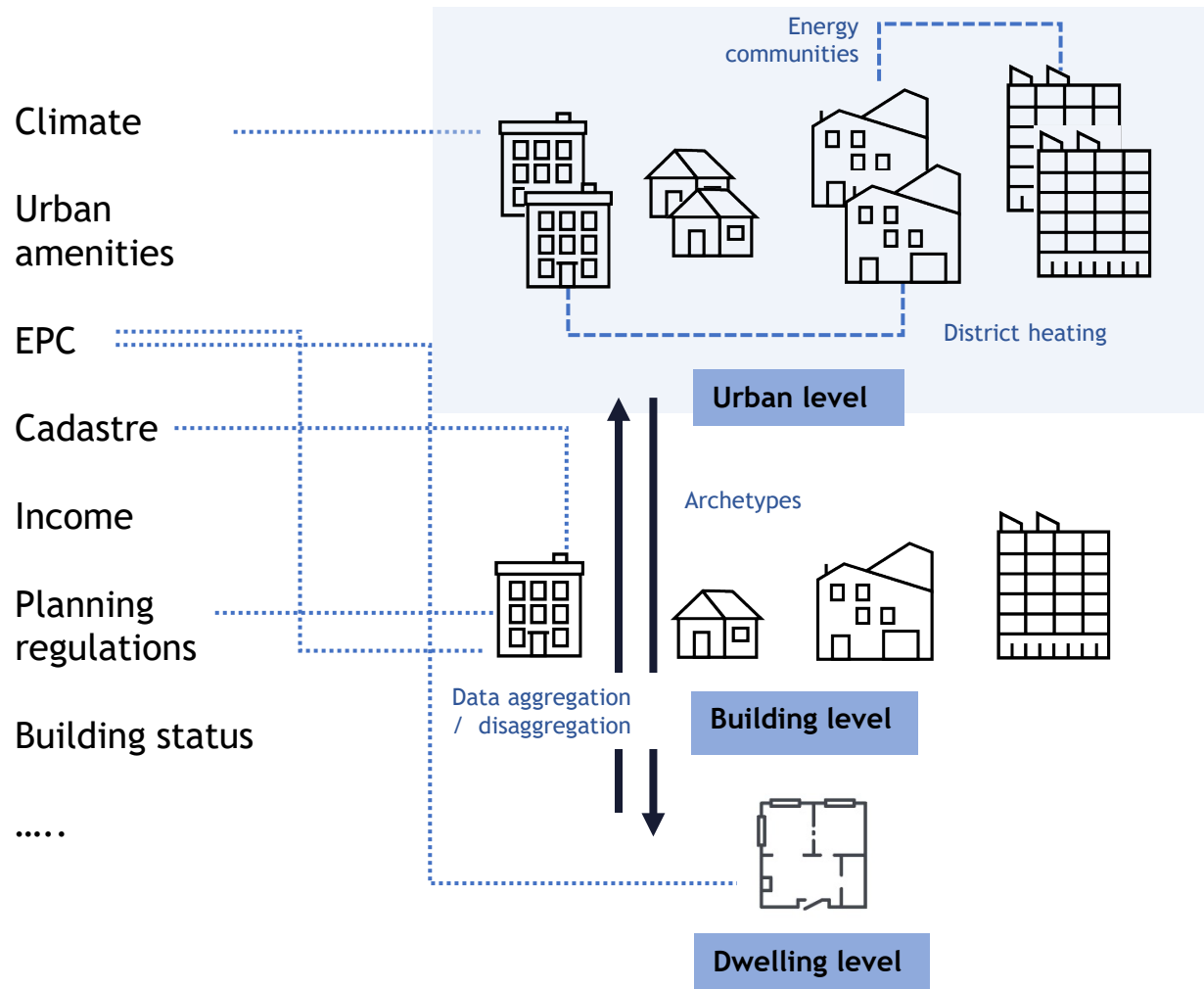
- **Stakeholders:** local administrations, in the context of a SECAP
- **Instruments:** Planning programmes, incentives, UBE,...
- **Objectives:** Reducing carbon emissions in accordance with the EU

Building renovation:

- **Stakeholders:** Building owners, housing associations
- **Instruments:** EPC, RP, energy audits, BIM
- **Objectives:** Minimum EPC label class F by 2030 for residential buildings

Building renovation across scales and domains

DATA



INDICATORS

social, economic, environmental

An indicator is a measurable or observable characteristic or phenomenon that provides evidence or insight into the state, condition, or performance of a system, process, or situation.

Energy efficient and energy recovering homes

Median household income

Population income below 60% average

INTERVENTIONS

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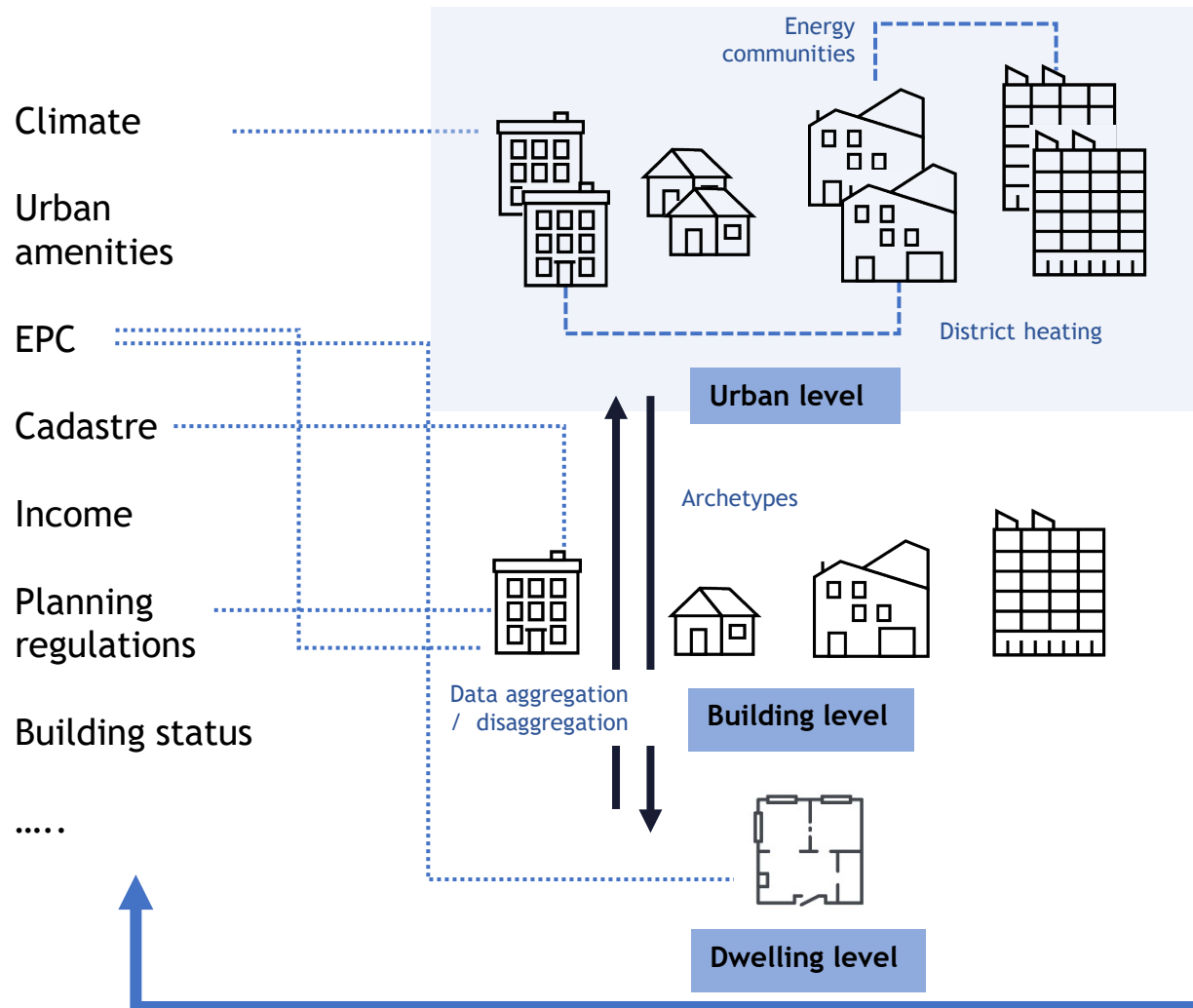
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INTERVENTIONS

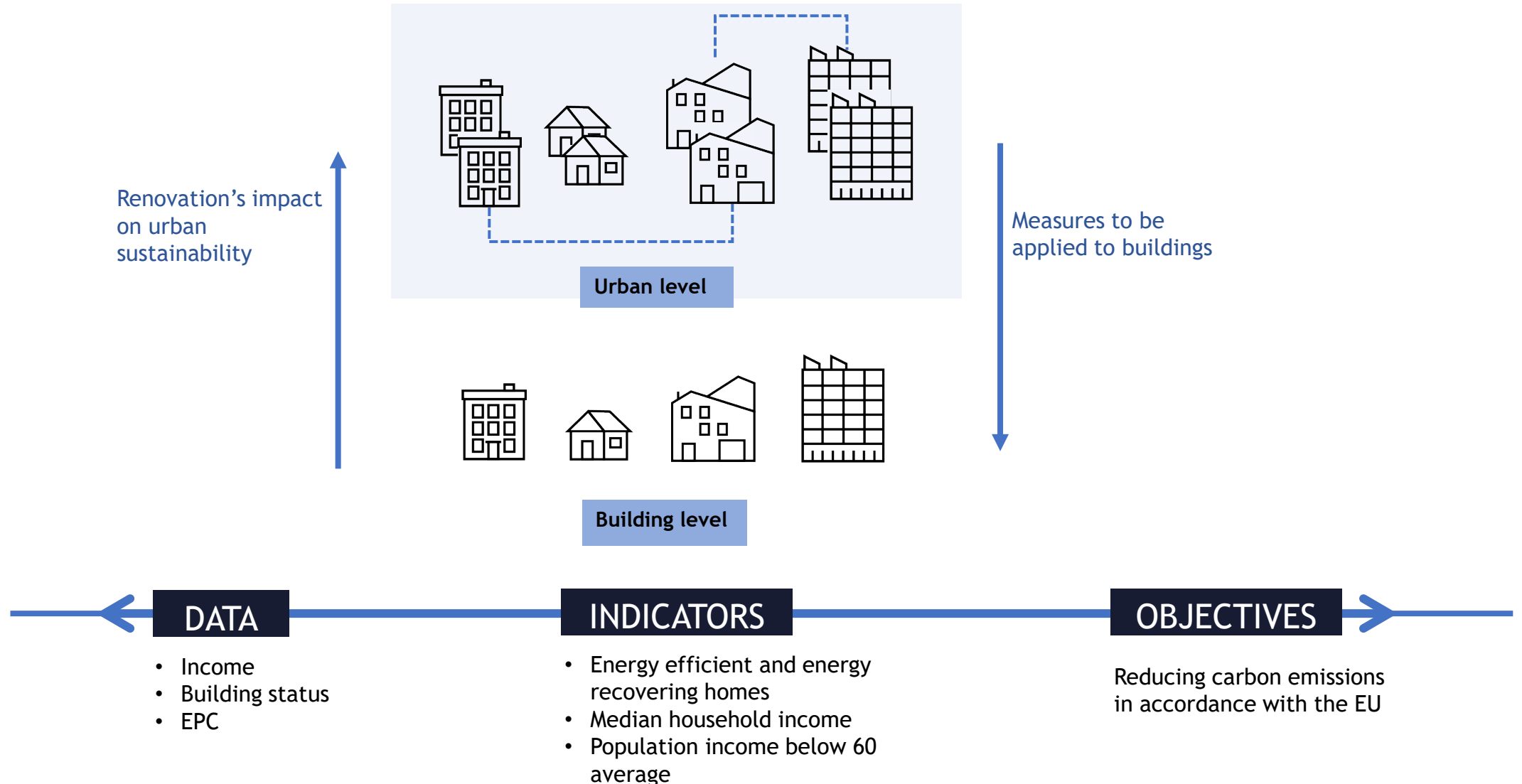
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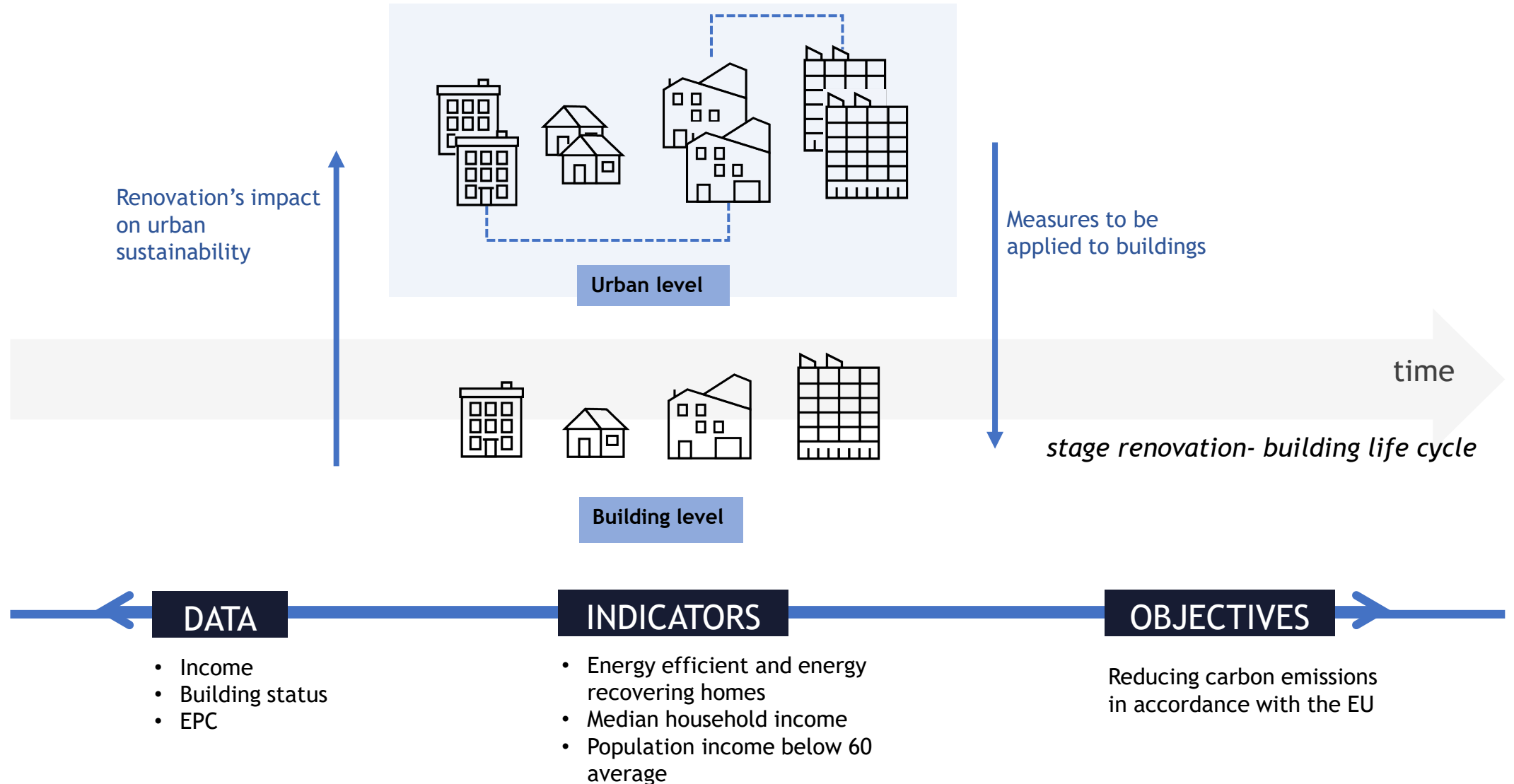
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Building renovation across scales and domains



Building renovation across scales and domains



Retabit research project

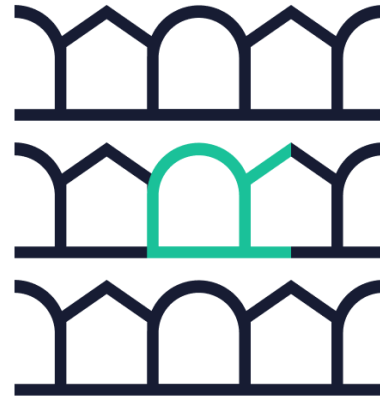


Multi-dimensional data driven services to foster residential building retrofitting programmes in the implementation of SECAPs

[Learn more](#)

Retabit is a project co-financed by the Spanish Ministry of Science and Education, 2021-2024 carried out by the research group ARC La Salle-URL (coordinator) and the Catalonia Institute for Energy Research (IREC)

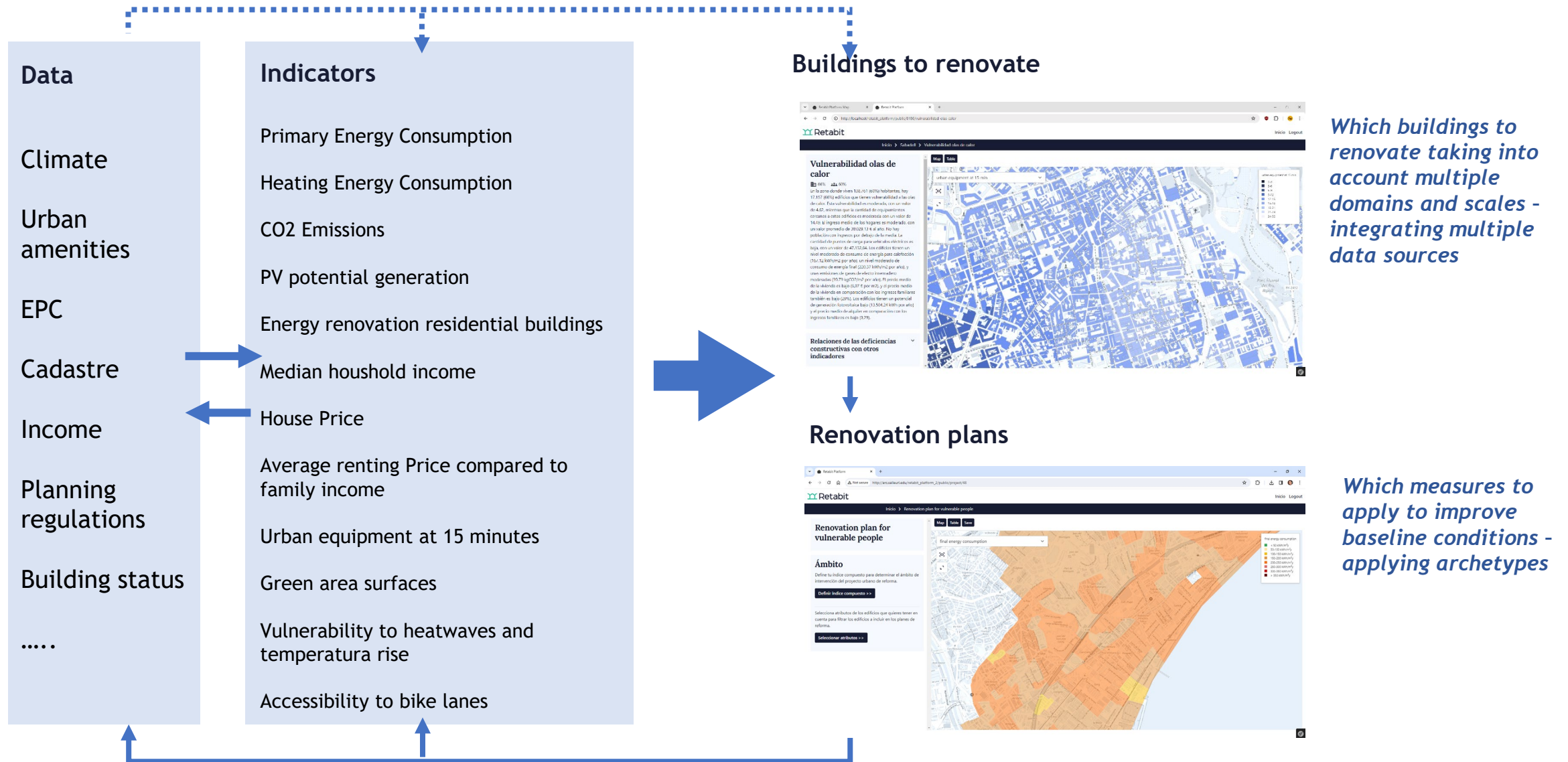
<https://retabit.es>



A data-driven service platform which facilitates multiple stakeholders involved in building retrofitting:

1. to evaluate the current status of an urban area
 - Based on the available data
 - Exploring areas of intervention using a combination of indicators
2. to elaborate and assess the impact of renovation scenarios
 - Using building archetypes to assess impact of energy renovation measures

Retabit platform

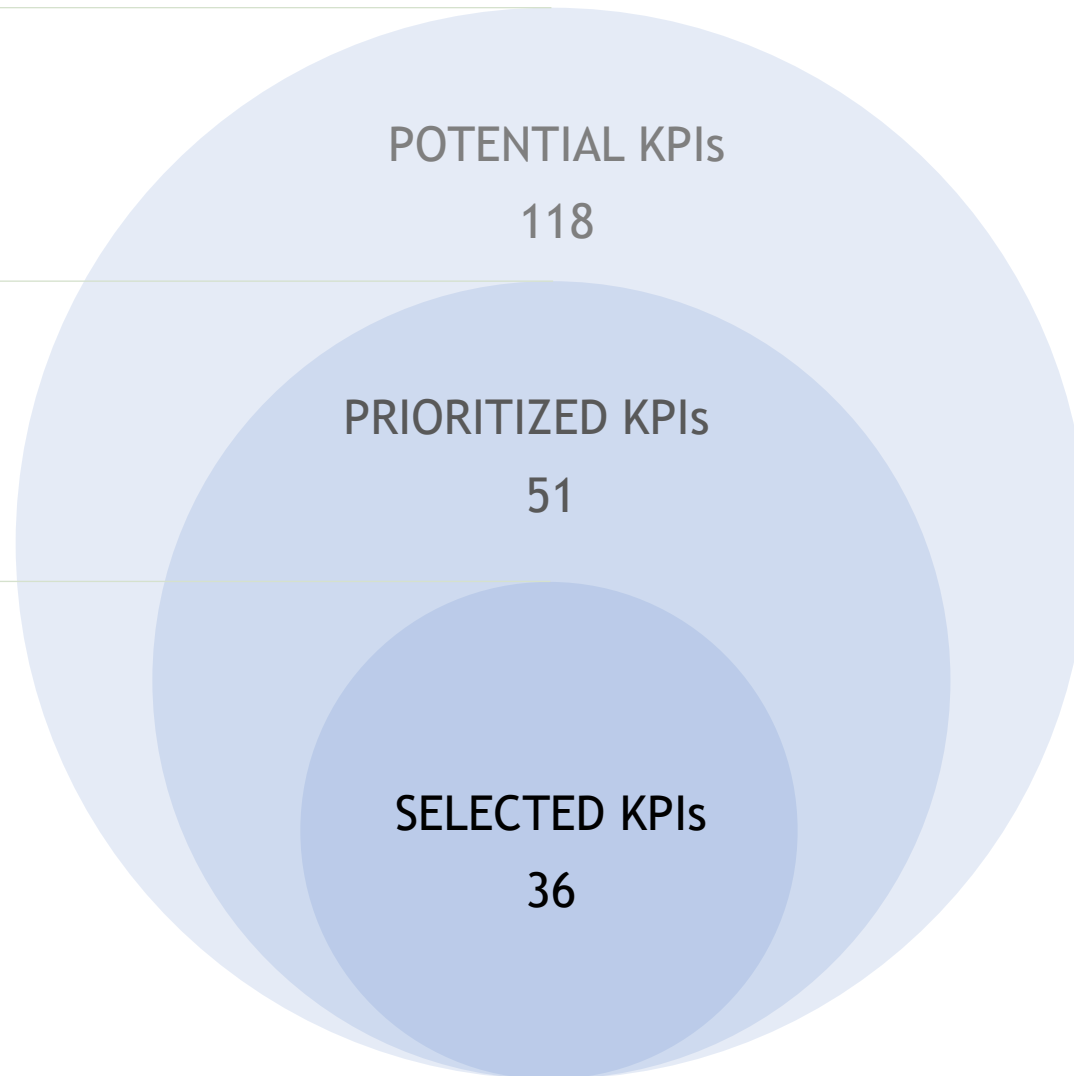


Retabit Generation of KPIs from data: Process

Literature review: (IREC Institute)
Relation to SDGs

Data:
Source/Nature/Availability

Granularity
De-escalation
(La Salle/IREC)

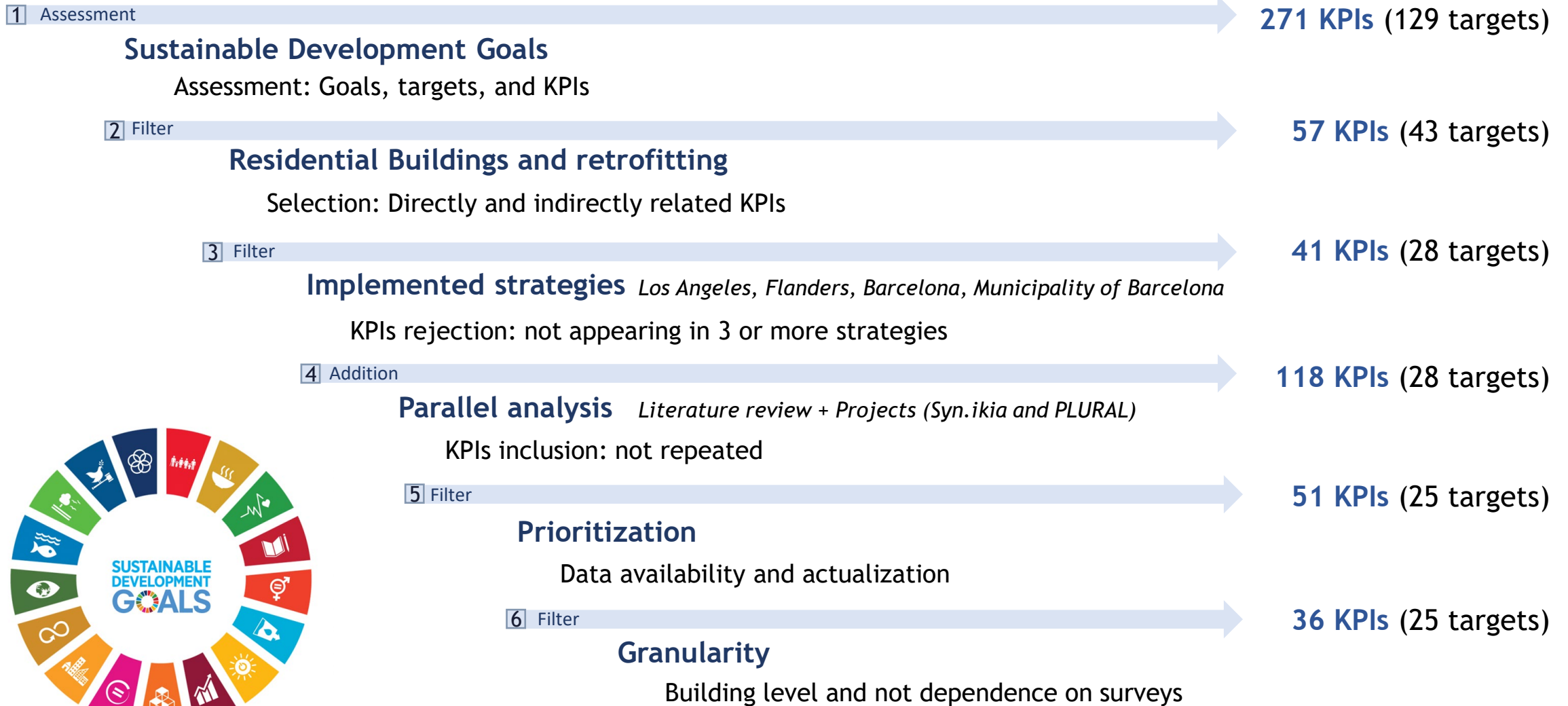


Retabit Generation of KPIs from data: Process

IREC Research Group

SDG CODE	Main energy retrofitting indicators SDG	PRIORITIZATION (1,2,3)	GRANULARITY	LOCAL METHODOLOGY SDG INDICATORS	LOCAL SOURCE SDG INDICATORS	E.U Source	AVAILABILITY OF DATA	DATA NATURE	REPORTED LOCAL INDICATOR	DATA ACTUALIZATION FREQUENCY	LINK	ALTERNATIVE DATA CALCULATION METHOD
7.3.1	Energy renovated residential	3	Building	Registered energy improvement actions in residential buildings. No further information provided.	Local municipal administration.	EU Buildings Observatory, Survey among consumers, architects & construction companies and suppliers of construction materials	Available data at national level.	PROCESSED: Registered energy improvement actions in residential buildings by the city council.	Share of residential buildings over 40 years old that have been rehabilitated for energy improvement. Barcelona city scale.	Irregular. Updated: 2017	https://sdgdata.barcelona.cat/7-3-1/	Data could be predicted based on the analysis of building energy certifications. Also could be gathered from building permits, Visados de los Colegios de Aparejadores, PEM, IEE, ITE.
7.3.1	Final energy consumption in homes including all types of energy	2	Building	Citizen survey + Energy stats + Prediction based on historical data	Institut Català d'Energia, CORES i Idescat	Eurostat	Available data at municipal level.	CALCULATED: Prediction based on historical data + Surveys + energy stats	Consums energètics a escala municipal, per fonts i per sectors. Les fonts originals de dades són ICAEN, ARC, CORES, ACA, ENDESA distribució, Electradistribució Centelles, Estabanell Energia, Electrocaldense, DGT, IDESCAT, el programa Hermes de la Diputació i els ajuntaments adherits al Pacte dels alcaldes pel medi ambient. Les dades de consums de gasoil de calefacció, les de propà butà (GLP) i les de consum de	Annually Updated: 2017	https://dades.obertes.diba.cat/datasets/consuns-energetics-dels-municipis	
7.2.1	Renewable energy consumption in households	2	Building	Citizen survey + Energy stats + Prediction based on historical data	Institut Català d'Energia, CORES i Idescat	Eurostat	Available data at municipal level.	CALCULATED: Prediction based on historical data + Surveys + energy stats	Proporció d'energies renovables sobre el consum d'energia (domèstica i terciari).	Annually Updated: 2019	https://infoanalis-public.diba.cat/pub/extension/visor_2030/visor_2030.html#	
7.2.2, 11.1.2	Energy-efficient and energy-recovering homes	3	Building	Citizen survey on residential	Local municipal adm -	-	-	REGISTERED: Qualita -	-	-	-	Data could be predicted based in Building energy certificates. Annual. 2020
7.3.1, 13.3.2	House heating energy consumption	2	Census Unit	Citizen survey on house heating energy consumption	Local municipal administration, Flanders: (Flanders Environment agency)	Eurostat	Available data at national level.	CALCULATED: Prediction based on historical data + Surveys + energy stats	Disaggregated final energy consumption in households-space heating.	Annually Updated: 2019	https://ec.europa.eu/eurostat/databrowser/view/hrg_d_hhq/default/table?lang=en	

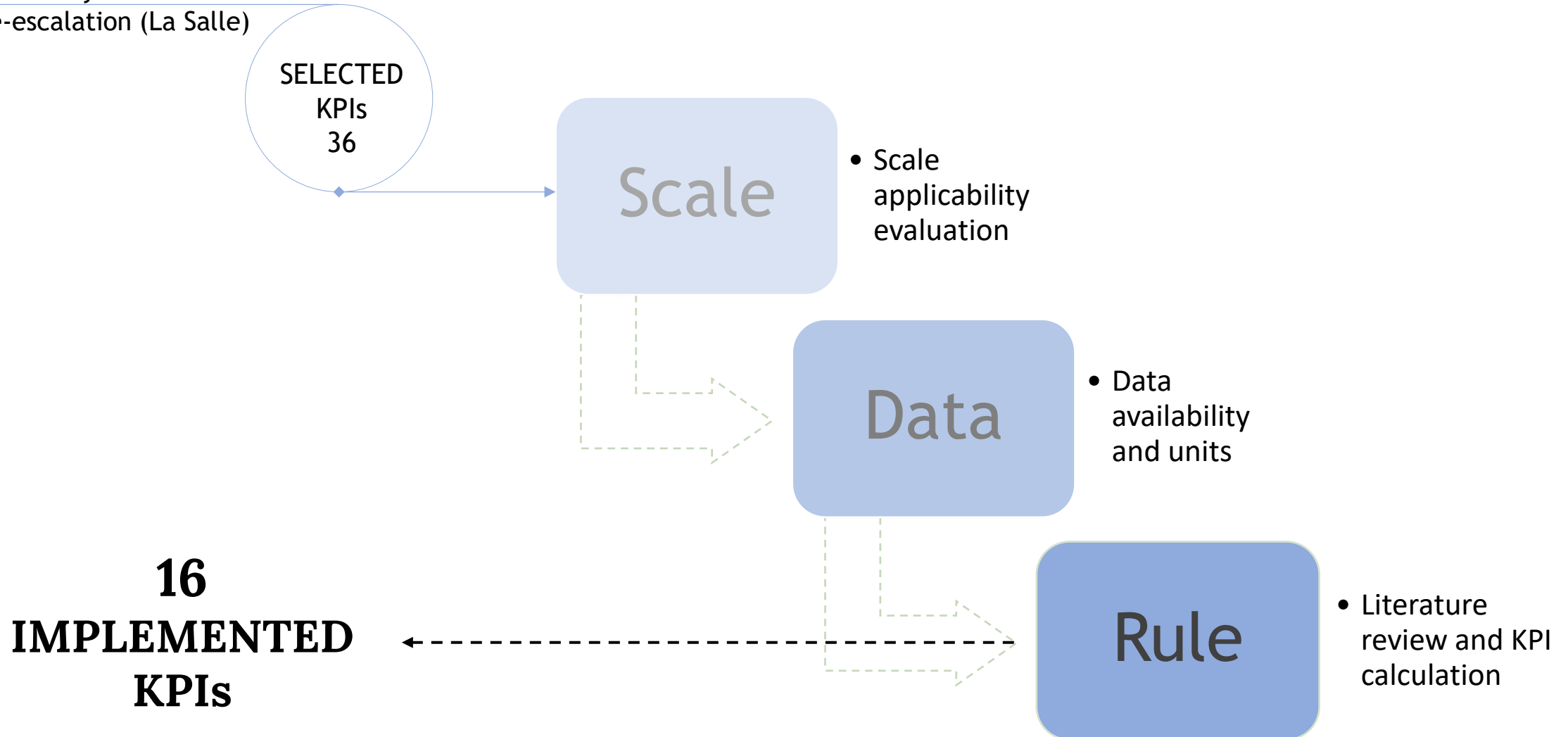
Retabit: Generation of KPIs from data: Process



Retabit Generation of KPIs from data: Process

Granularity:

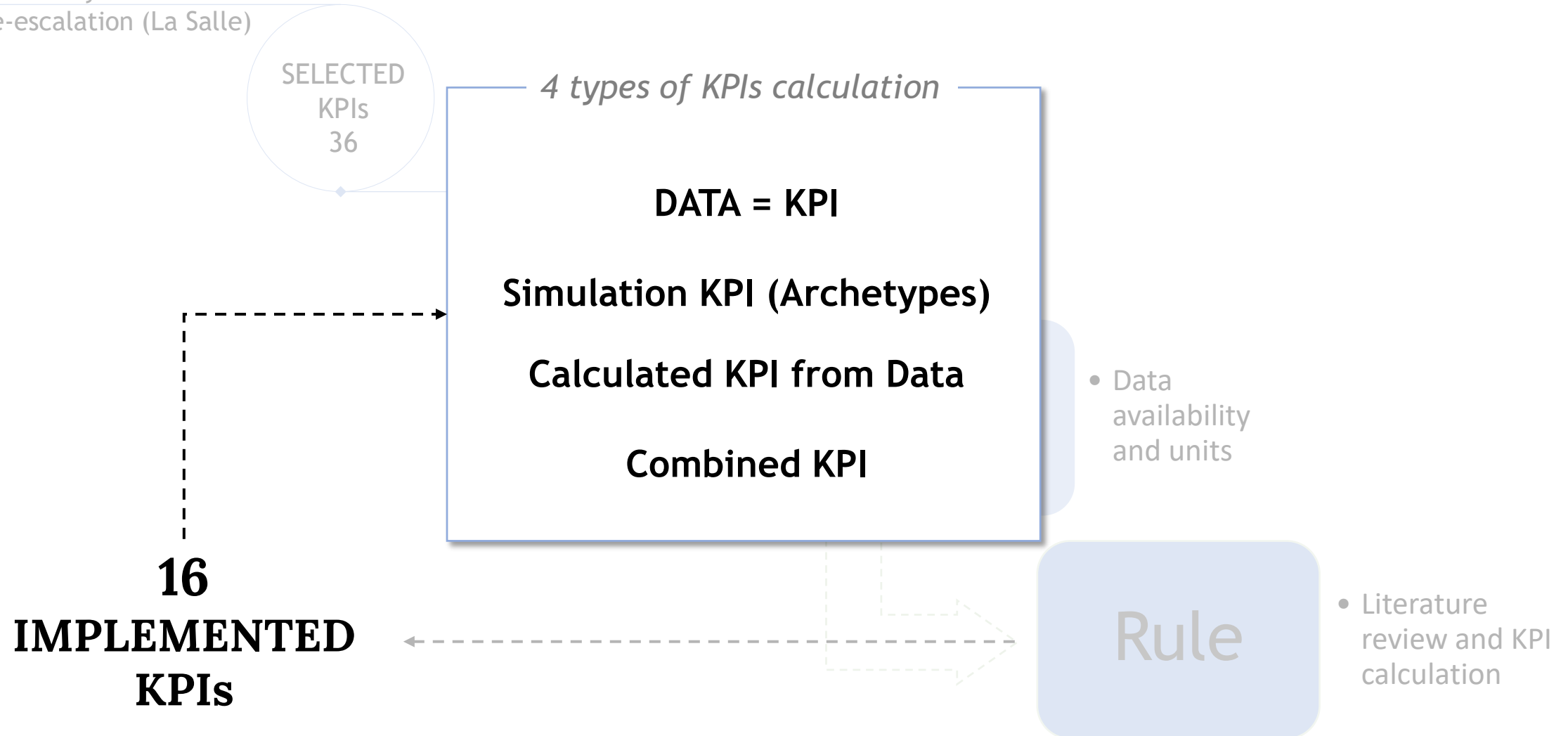
De-escalation (La Salle)



Retabit Generation of KPIs from data: Process

Granularity:

De-escalation (La Salle)



Example: Economic KPI – KPI = DATA

<i>KPI</i>	<i>Median Household income</i>
Scale Possibilities	Building (de-escalation) Urban (Aggregation)
Data source	National Institute of Statistics
SDG - SECAP Asspciation	SDG 1, 10 Mitigation



Definition:

Median household income per building.

Use:

Evaluate economic situation of the population.

Rule for calculation:

- Gathering economic data per census unit.
- Associate the data to each building within the census unit.
- The same data is applied to all buildings within the same census unit (sensitive data protection)

Example: Environmental KPI – Simulation KPI

<i>KPI</i>	<i>Final Energy Consumption</i>
Scale Possibilities	Building Urban (Aggregation)
Data source	IREC (Archetypes Simulation)
SDG - SECAP Association	SDG 7, 11, 12 Mitigation   

Definition:

Final energy consumption of a building considering all types of energy.

Use:

Evaluate the total energy consumed by the buildings, depending on the type of user (aware vs unaware).

Rule for calculation:

- Energy simulation of the archetype
- Associate the archetype to each geo-referenced building
- $\text{Kwh/m}^2\text{y} \times \text{m}^2$



(Location within the urban pattern, types of installation system, common appliances consumption, and different types of users)

Example: Social KPI – Calculated KPI

<i>KPI</i>	<i>15 - Minutes City</i>
Scale Possibilities	Building Urban (Aggregation)
Data source	Open Street Map (geo-located data)
SDG - SECAP Association	SDG 3, 4, 10, 11, 13 Mitigation



Definition:

Equipments within 15 minutes far away from the building.

Use:

Evaluate proximity, accessibility and quality of life.

Rule for calculation:

- Geo-referenciation of all care, education, provisioning, entertainment and transport categories services.
- Limitation of the minutes > Transformation to Meters
- Selection and count of the services > Limit: Meters/service

Example: Social KPI – Calculated KPI

<i>KPI</i>	<i>15 - Minutes City</i>
Scale Possibilities	Building Urban (Aggregation)
Data source	Open Street Map (geo-located data)
SDG - SECAP Asspciation	SDG 3, 4, 10, 11, 13      Mitigation

Function	Category	Minutes	Meters
Care	Health	10	850
Care	Social Services	15	1225
Care	Day centers	10	850
Education	Preschool Education	5	475
Education	Primary education	5	475
Education	Secondary education	10	850
Provisioning	Supermarkets	10	850
Provisioning	Markets	10	850
Provisioning	Fresh food	5	475
Provisioning	Daily non-food	5	475
Provisioning	Catering	5	475
Provisioning	Miscellaneous services	5	475
Entertainment	Shows	10	850
Entertainment	Libraries	15	1225
Entertainment	Civic centers	10	850
Entertainment	Children playgrounds	5	475
Entertainment	Sports facilities	10	850
Entertainment	Squares and parks >1000m2	5	475
Entertainment	Squares and parks > 10000m2	5	475
Transport	Metro stations	10	850
Transport	Bus stations	5	475
Transport	Trams stations (cambio por night bus)	10	850
Transport	Trains stations (cambio por bike lanes)	10	850
Transport	Bike stations	5	475
Transport	Bike lanes	5	475

Example: Social KPI – Combined KPI

Definition:

Value (from 0 to 9) of vulnerability resulting from comfort decrease within the buildings due to heat island effect.

Use:

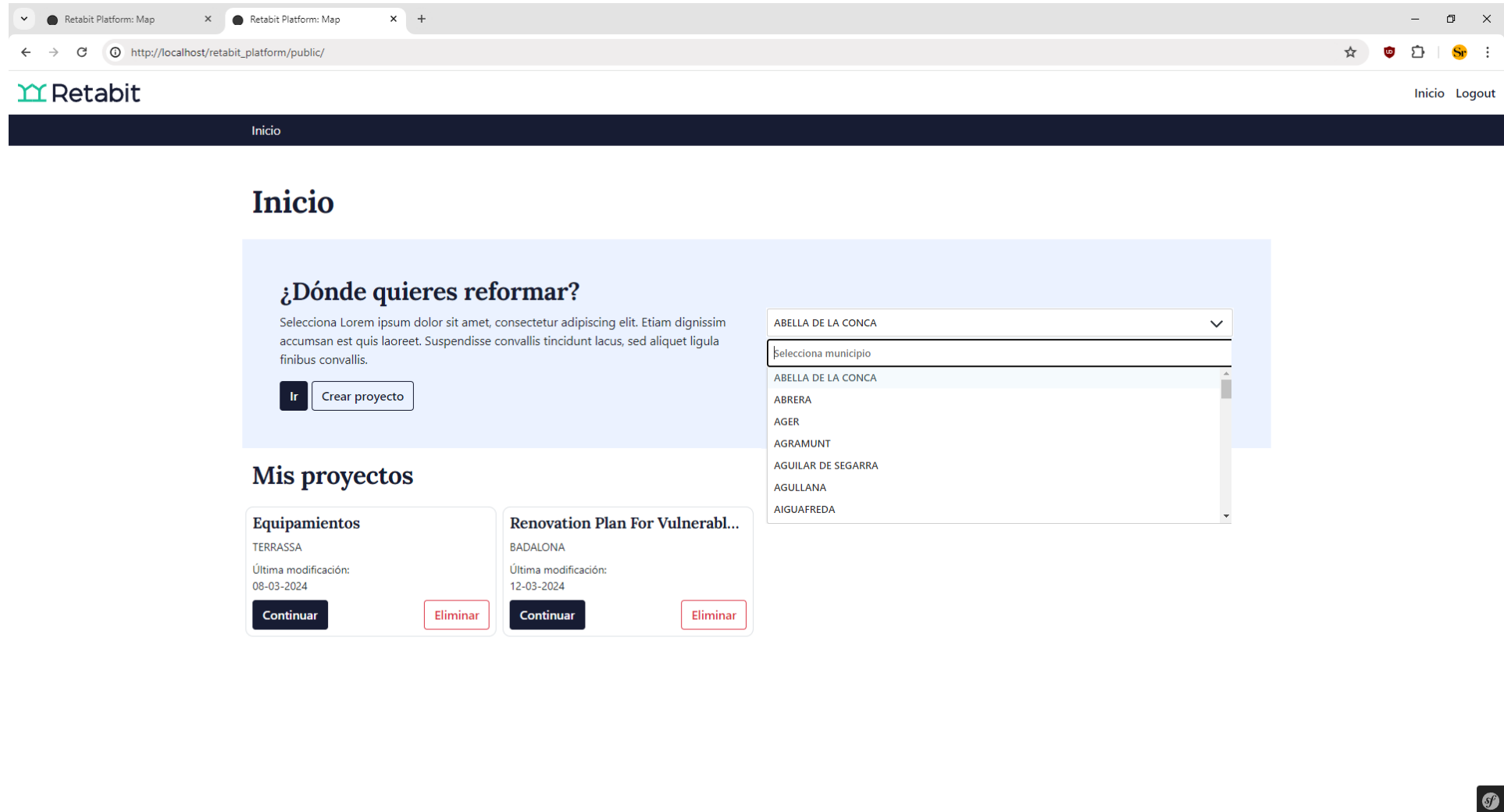
Evaluate resilience and quality of life.

Rule for calculation:

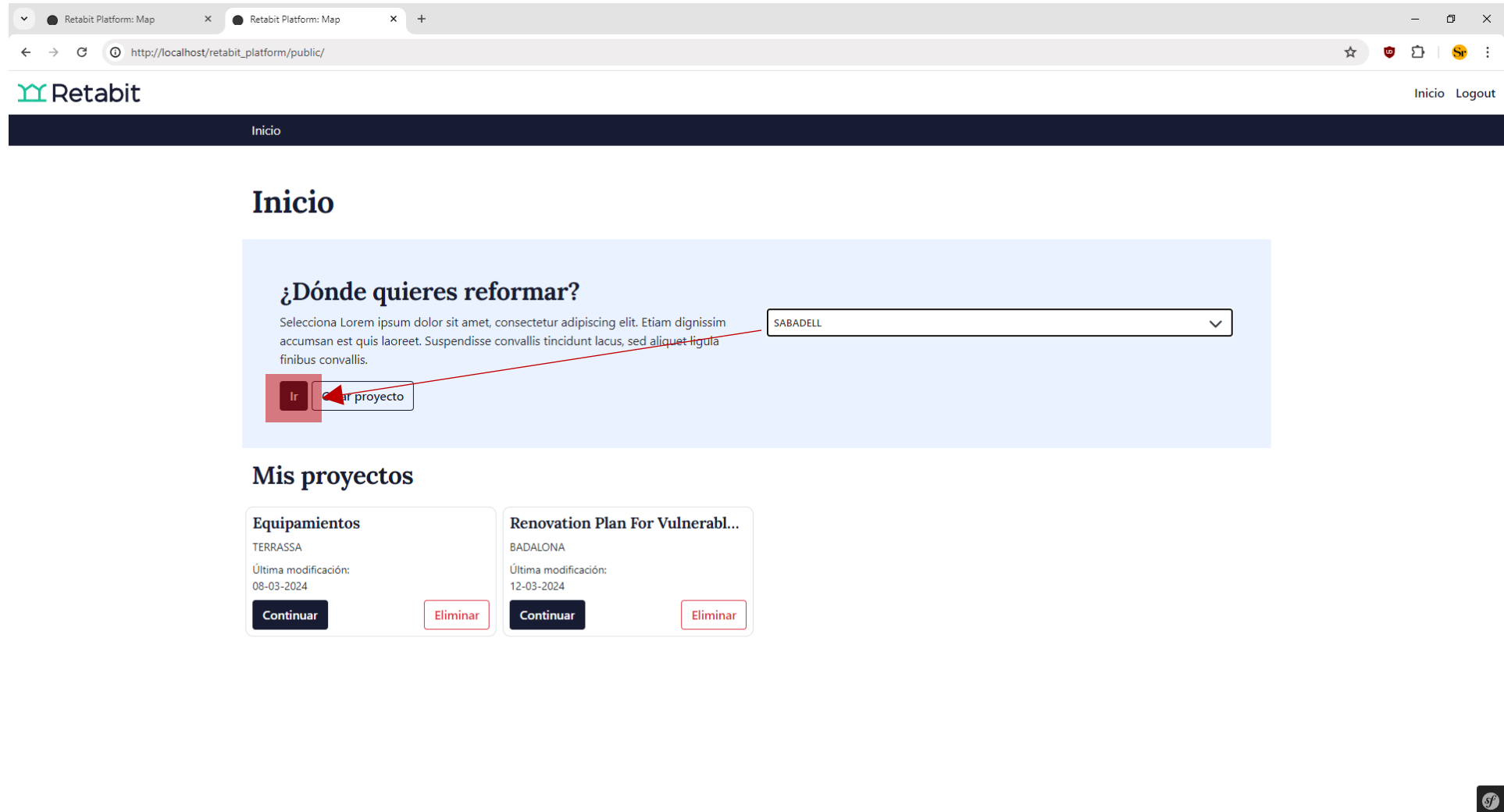
- **Sub-KPI 1:** Calculation of temperature increase projection (1 to 3)
- **Sub-KPI 2:** Evaluation of population density (1 to 3)
- **Sub-KPI 3:** Evaluation of green areas and building conservation status (1 to 3)
 - **Sub-KPI 3.1:** Green areas (1 to 3)
 - **Sub-KPI 3.2:** Building conservation status (1 to 3)
- **KPI:** Combination of the scale of each sub-KPI

KPI	<i>Vulnerability degree against heatwaves and temperature rise</i>
Scale Possibilities	Building Urban (Aggregation)
Data source	Land cover, Weather data, Cadastre, National Statistics
SDG - SECAP Association	SDG 3, 11, 13 Mitigation   

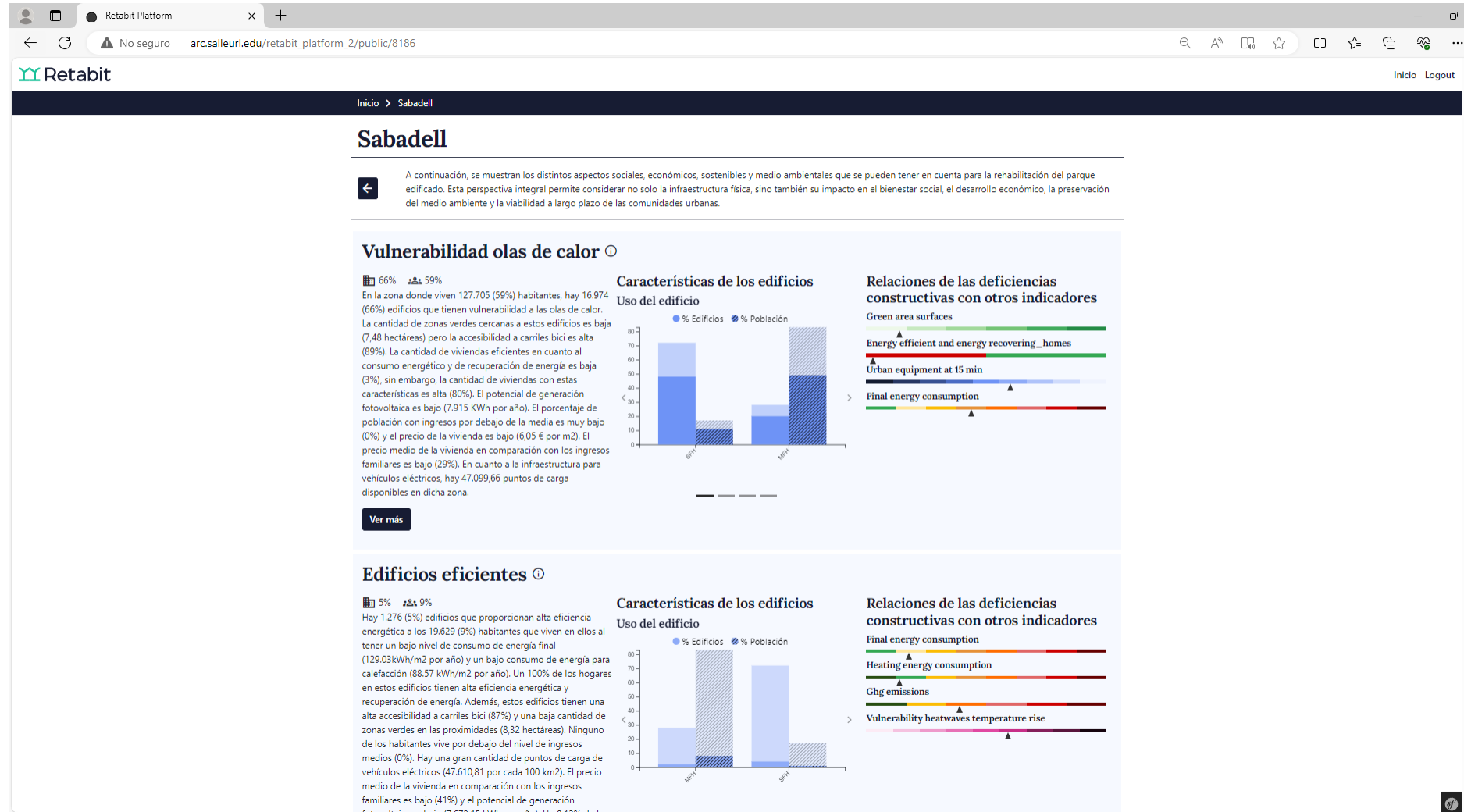
Retabit platform: Analysis



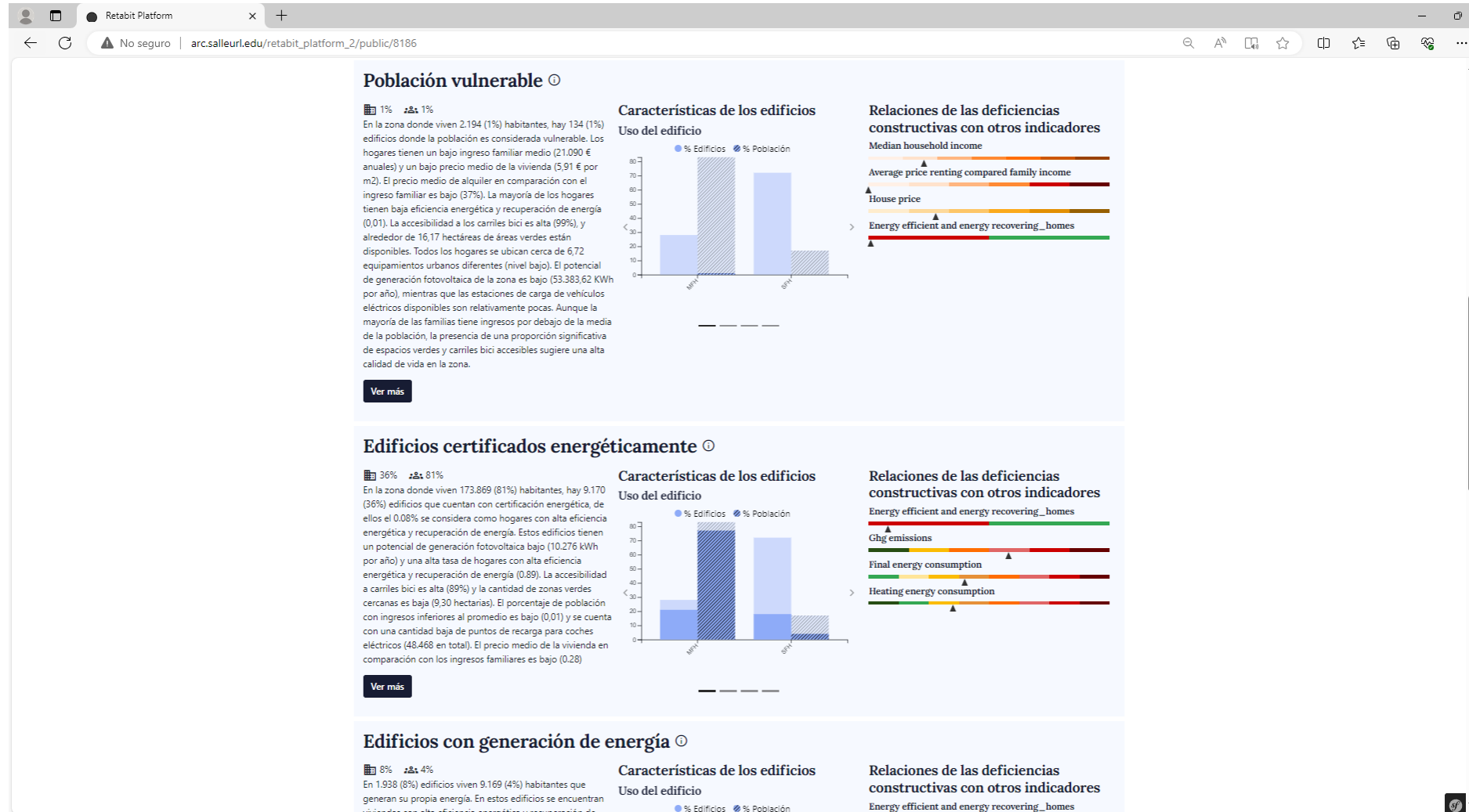
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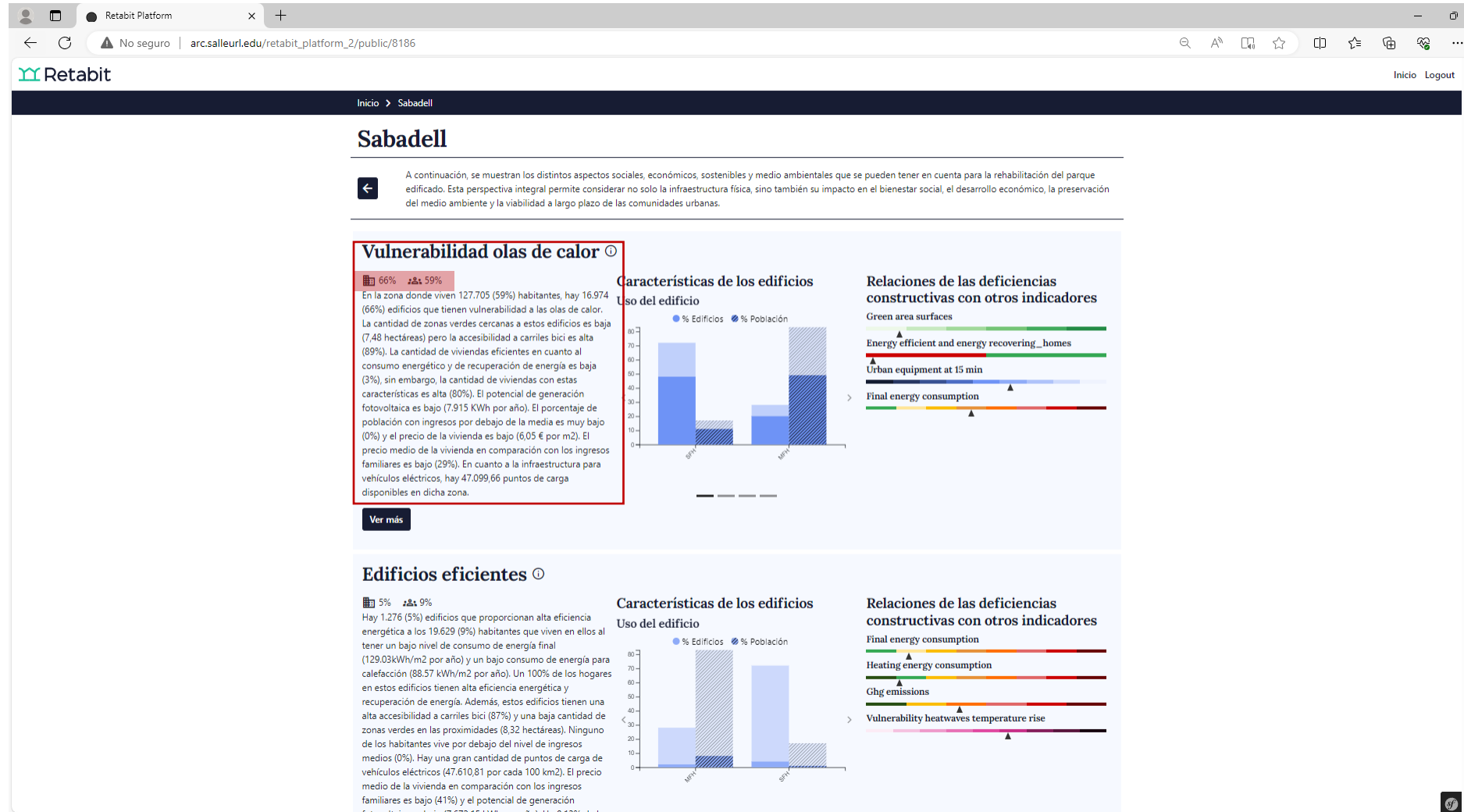
Retabit platform: Analysis



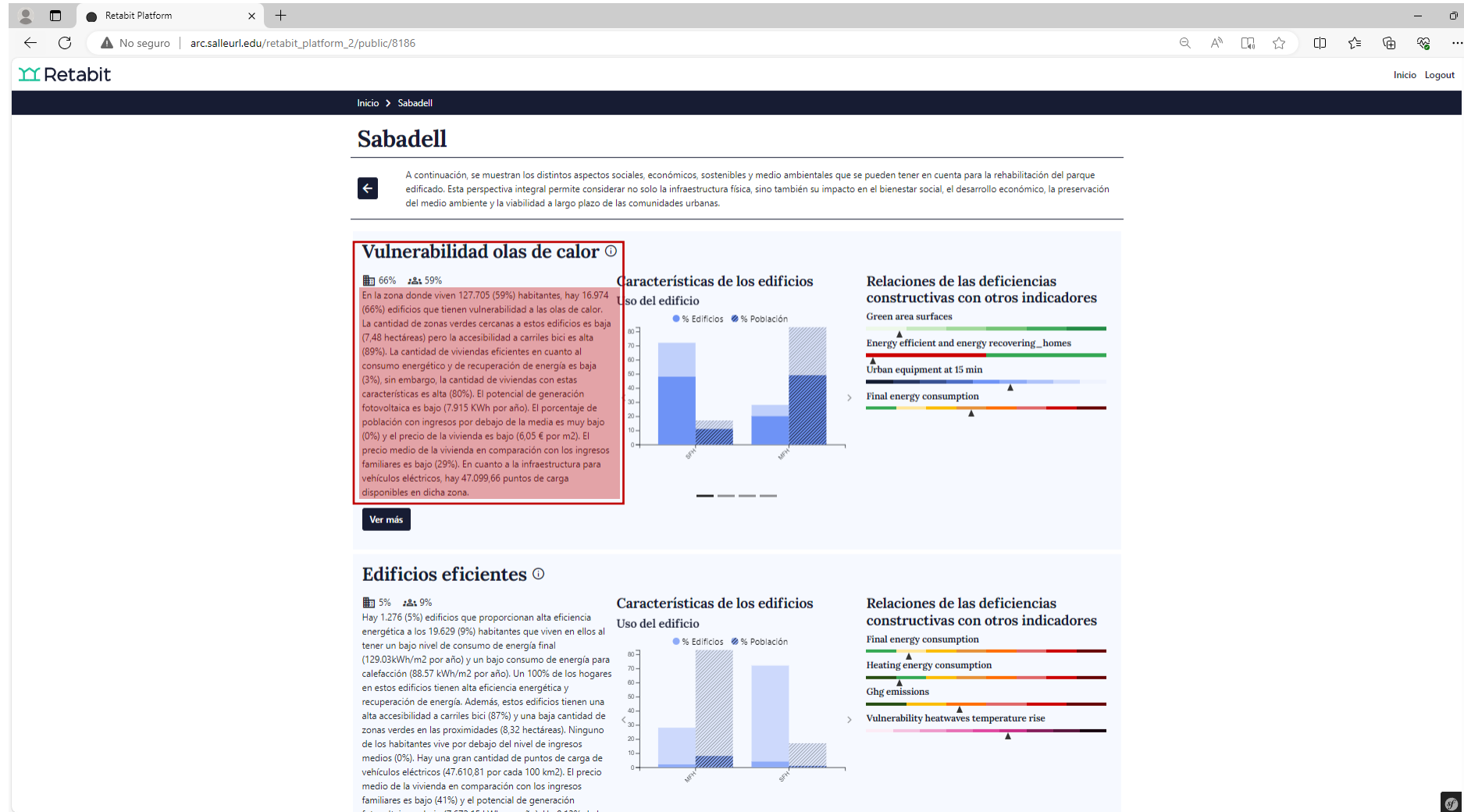
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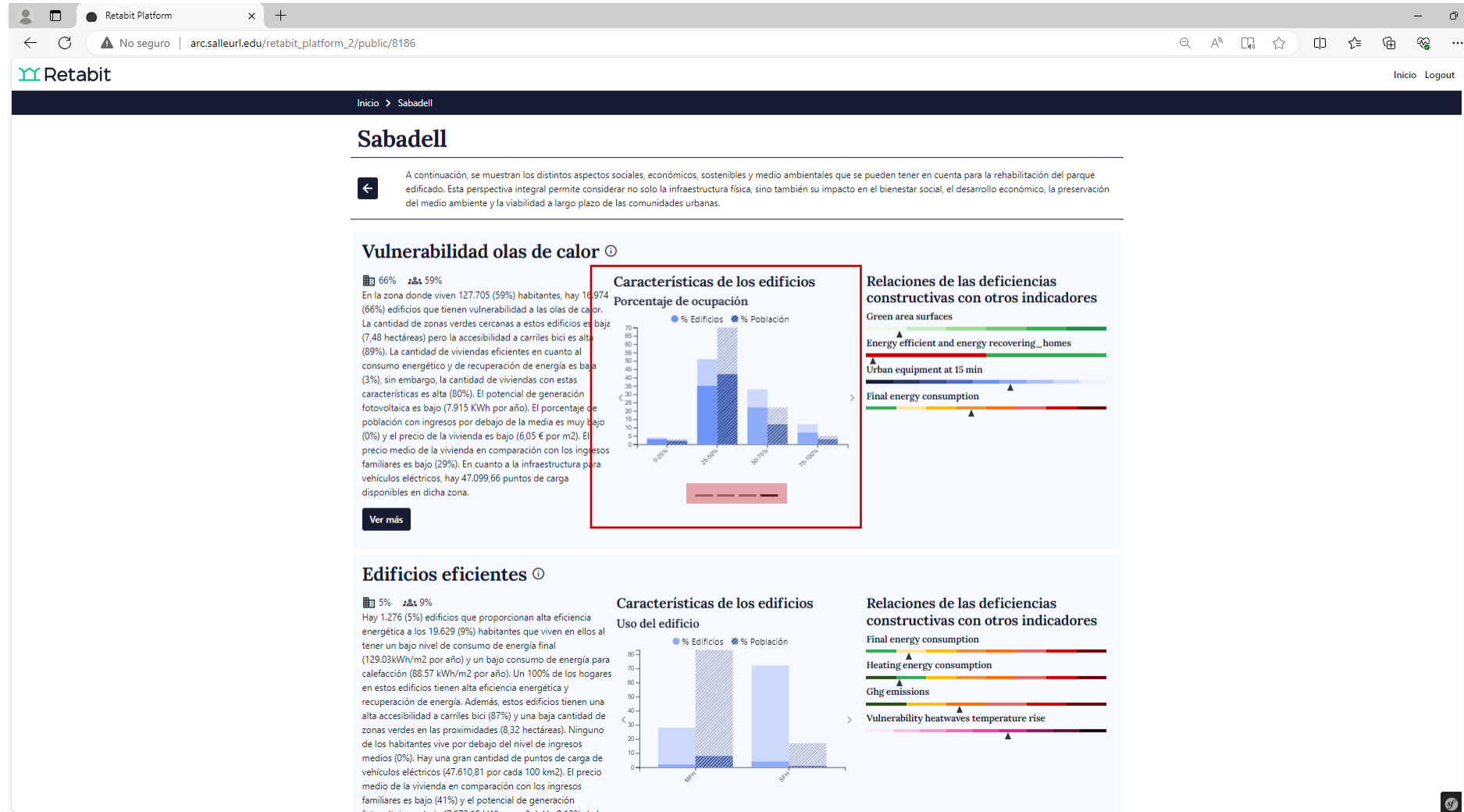
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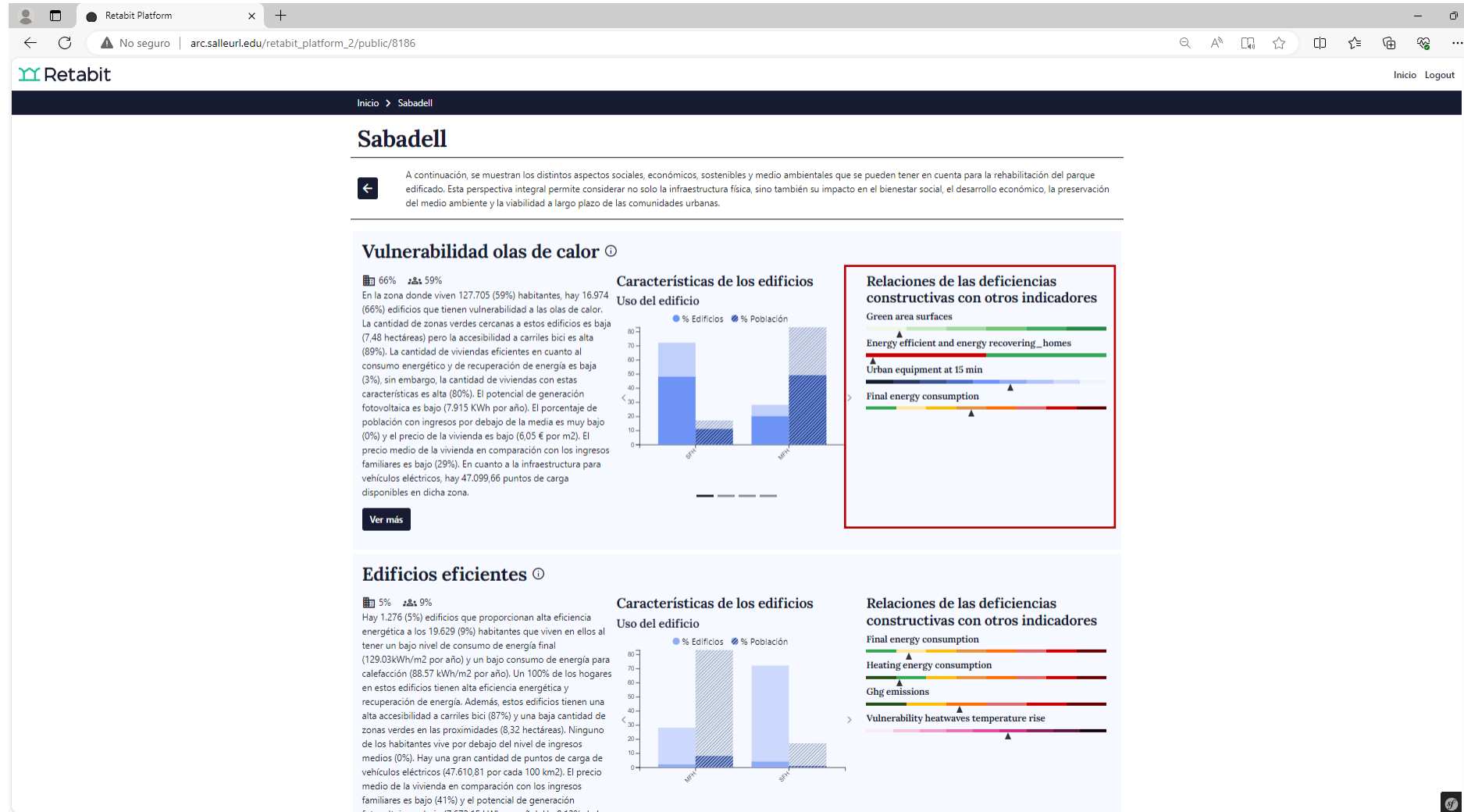
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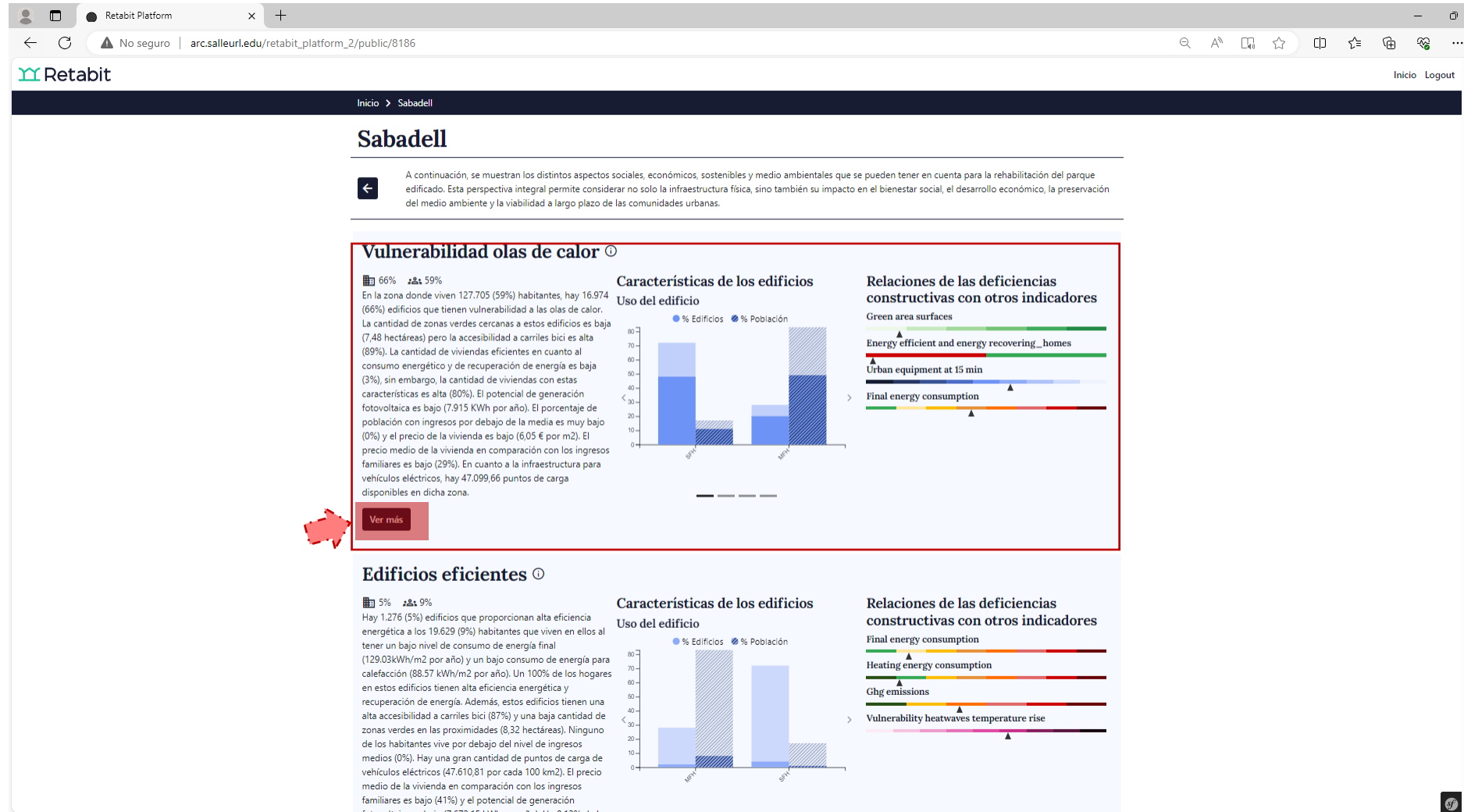
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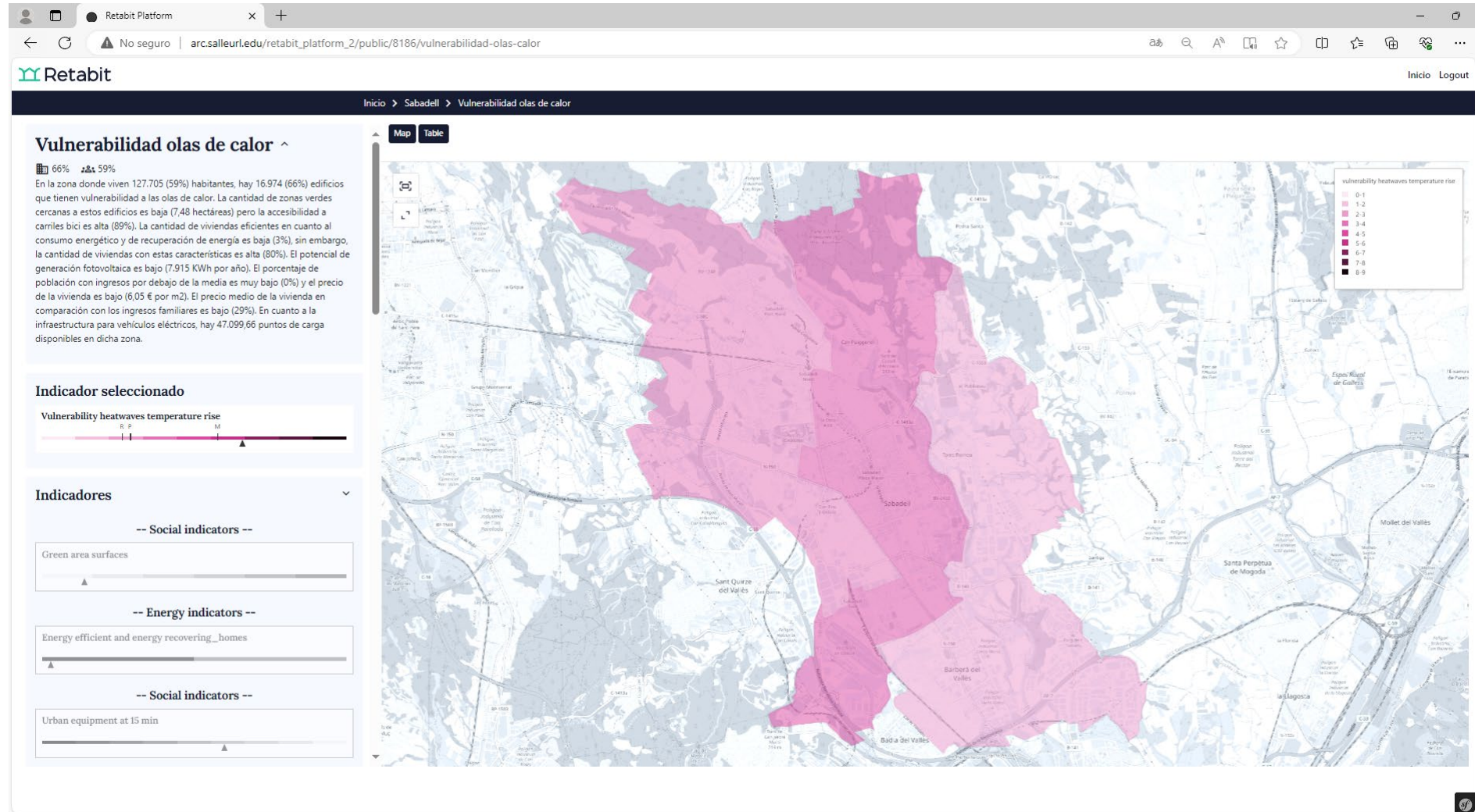
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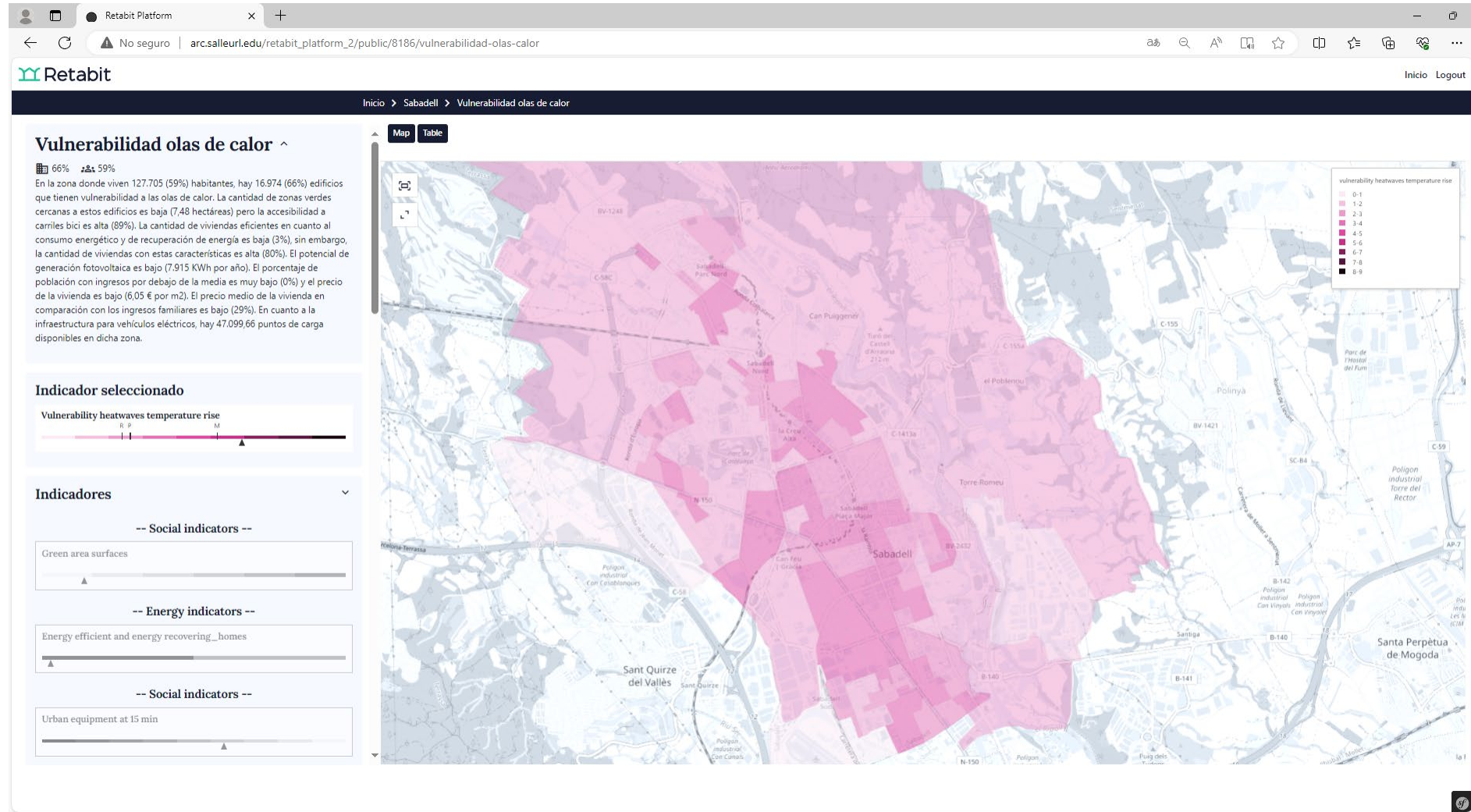
Retabit platform: Analysis



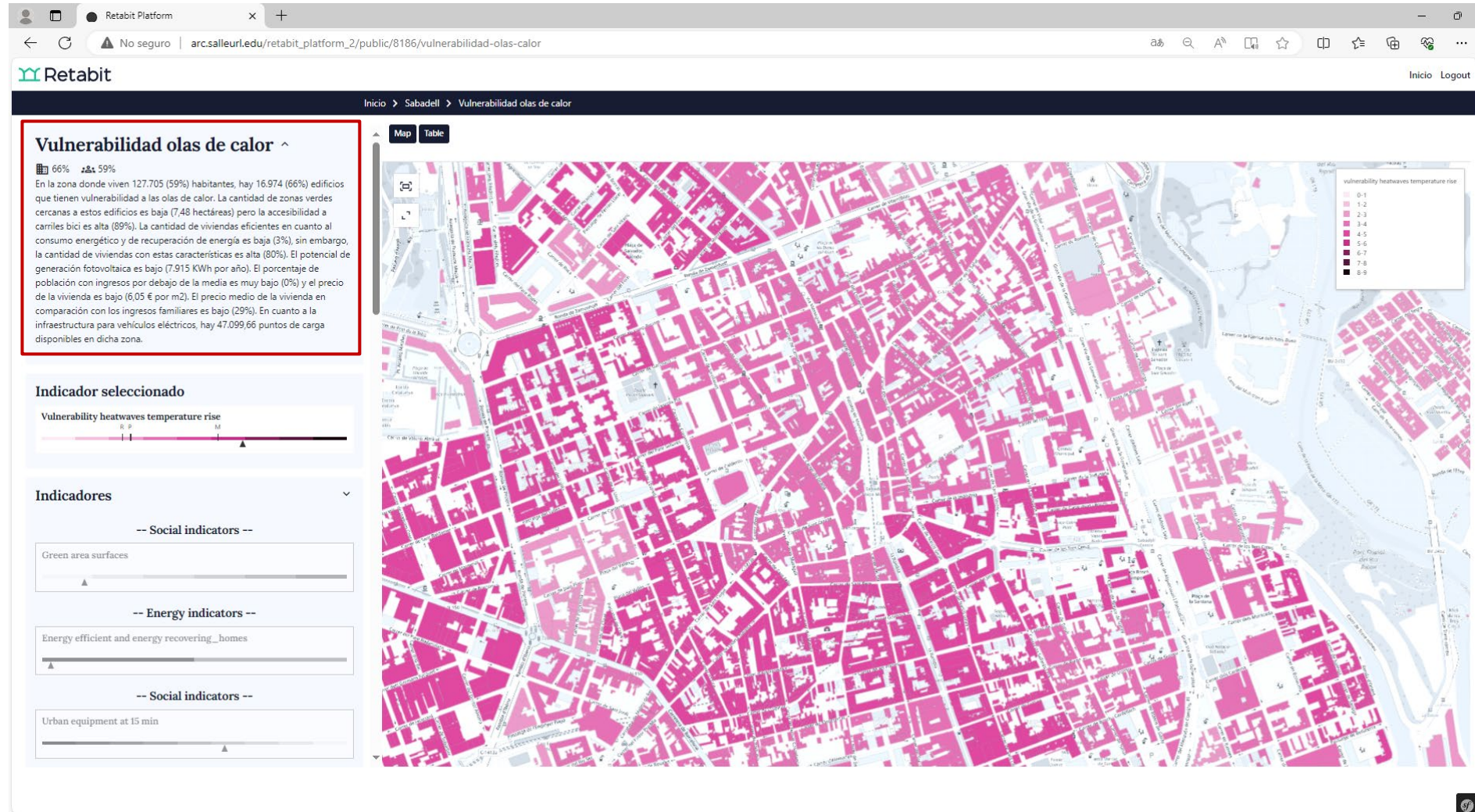
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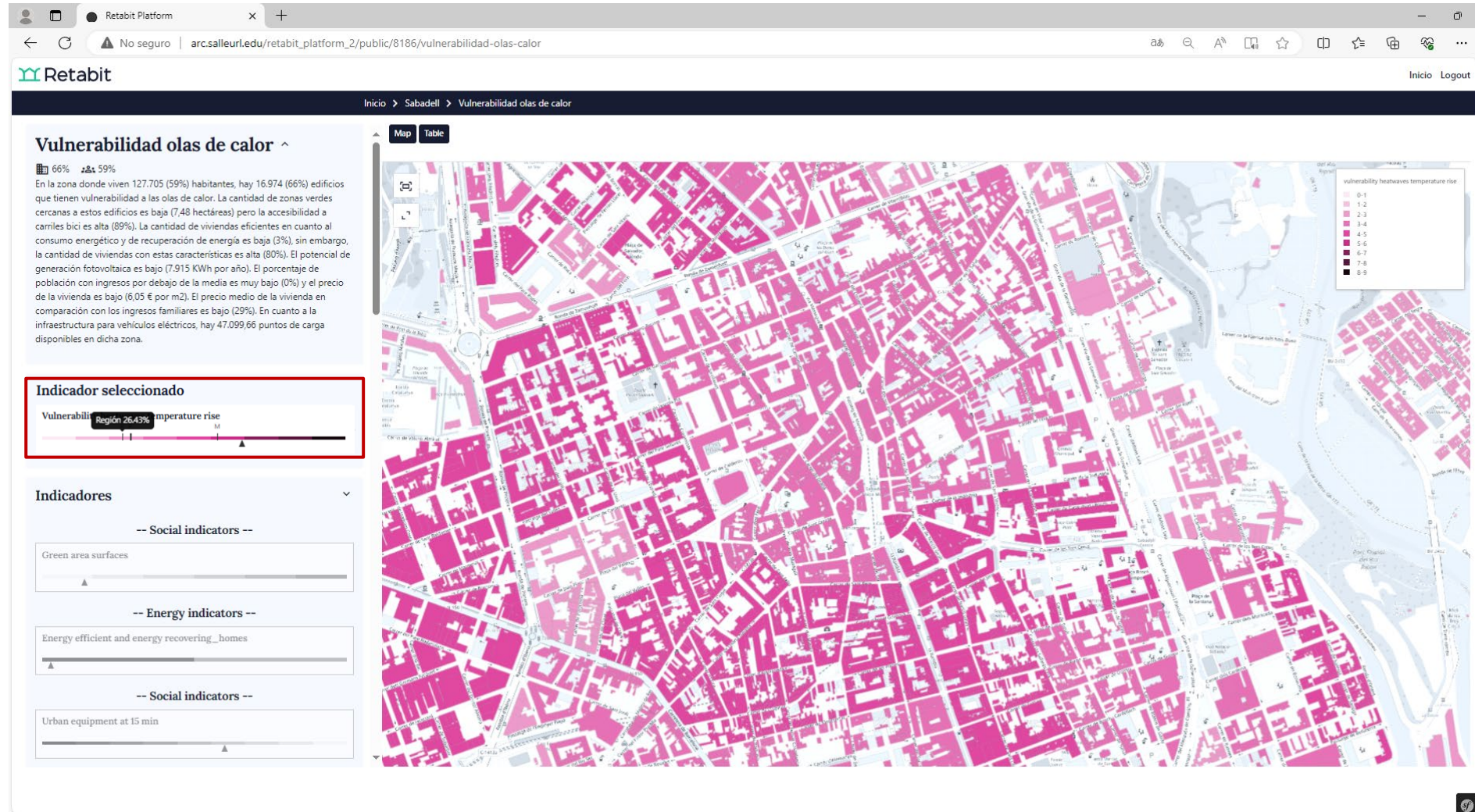
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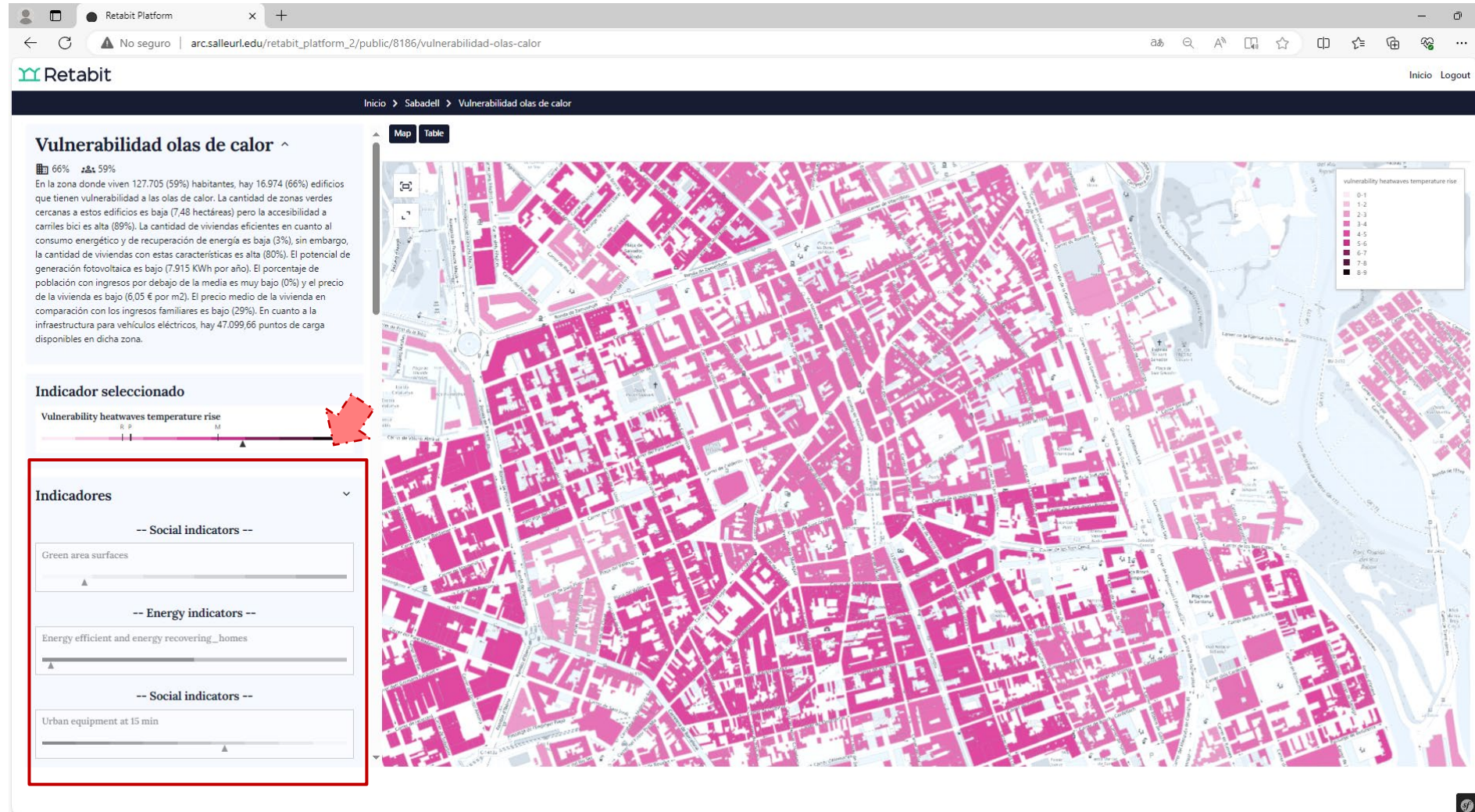
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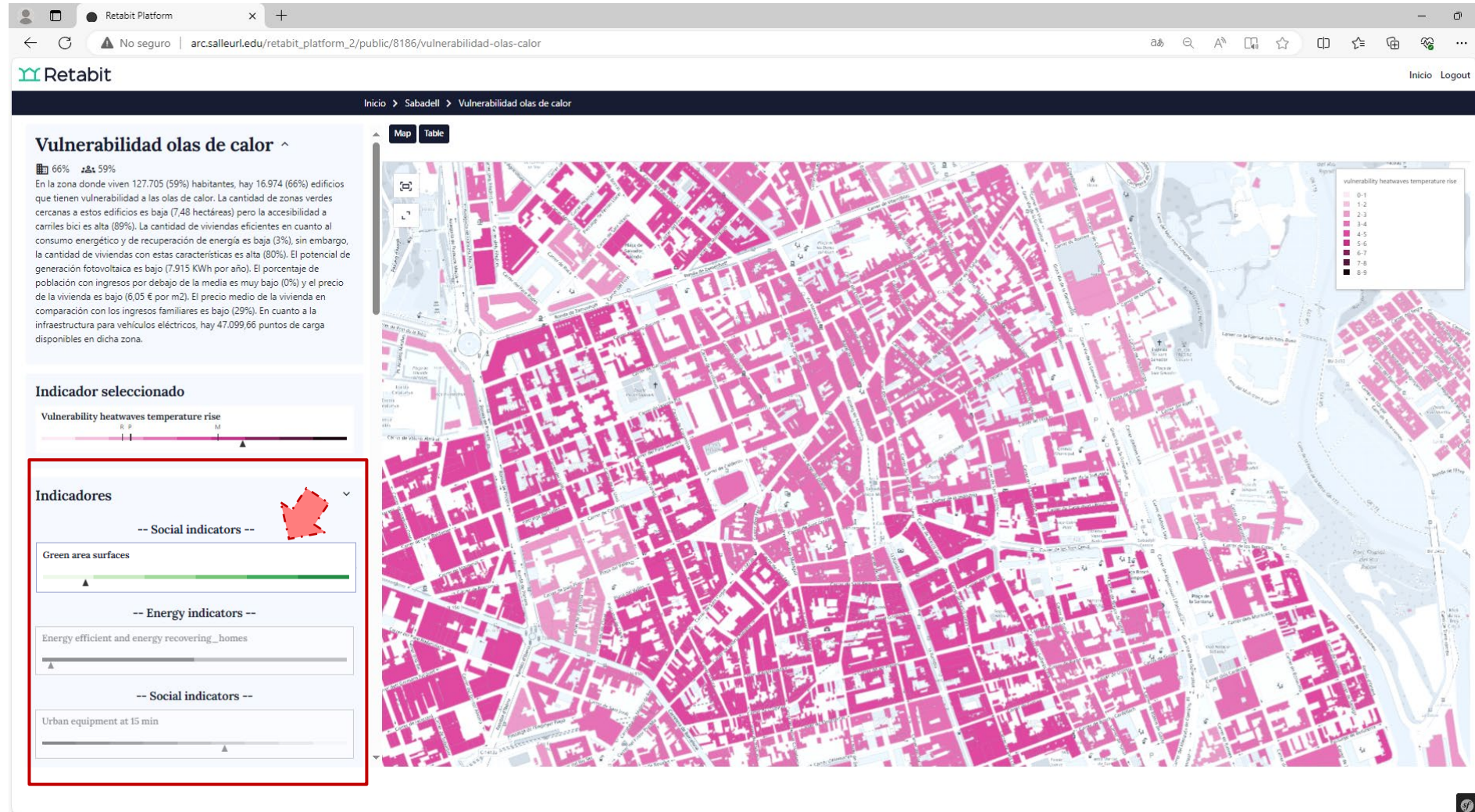
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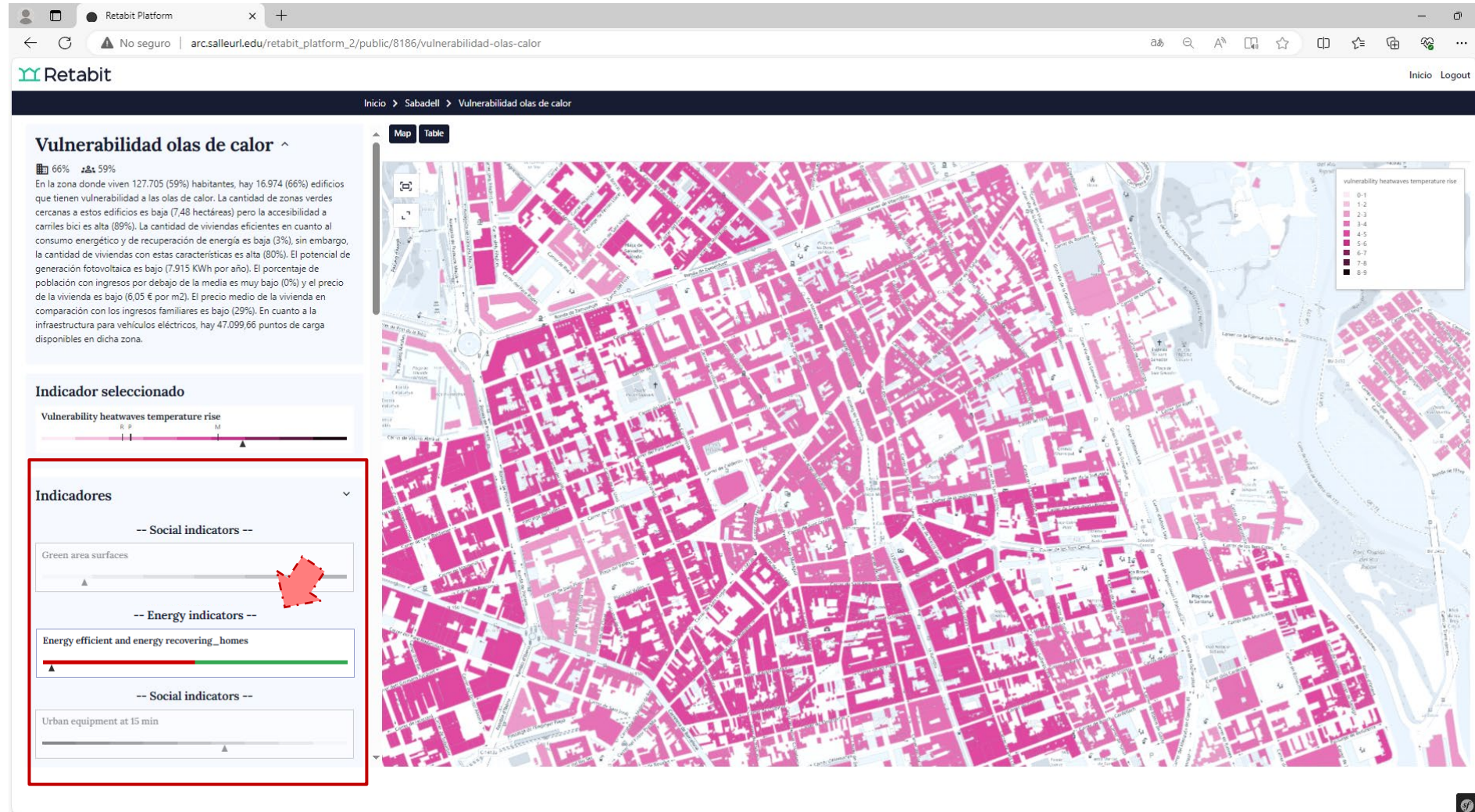
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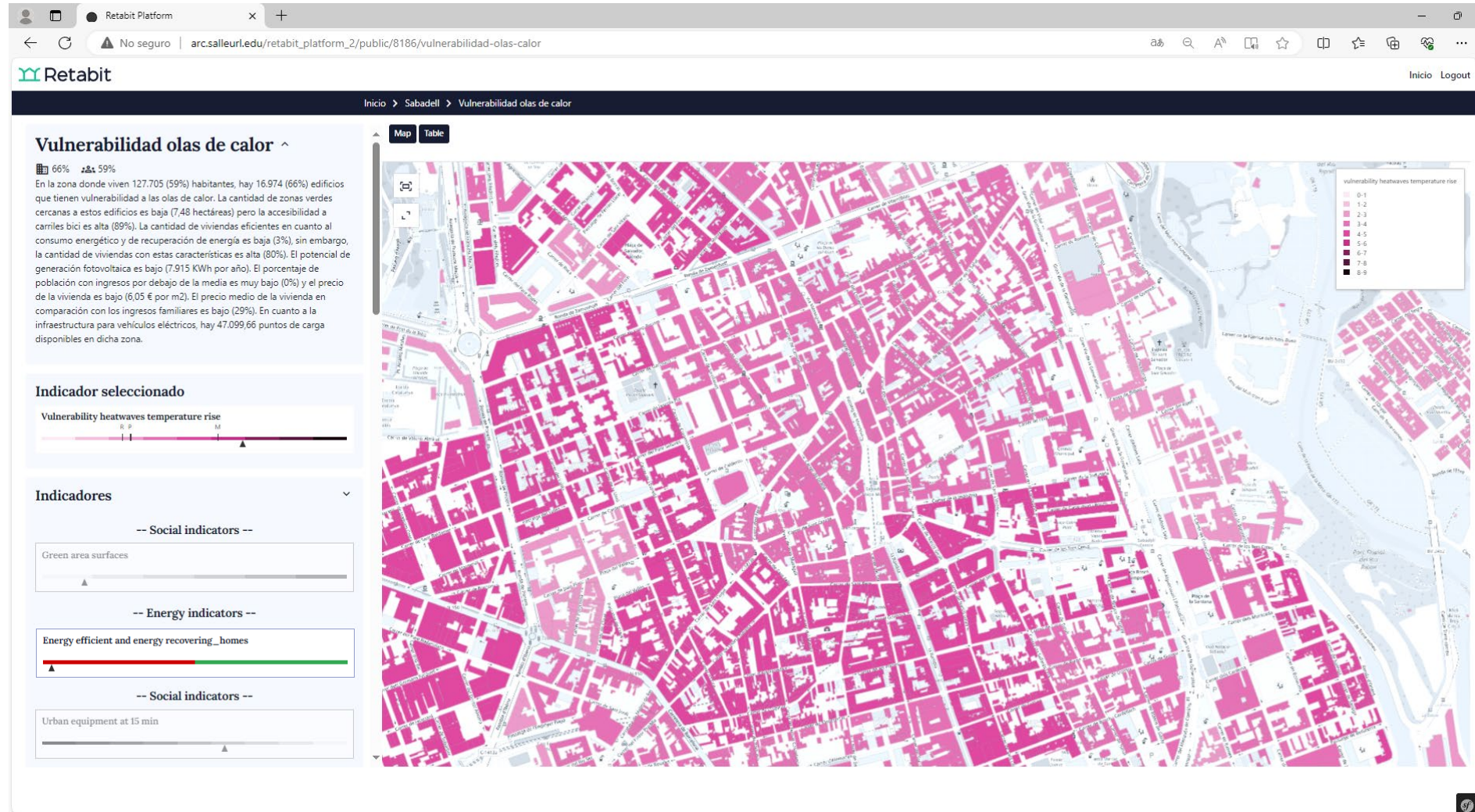
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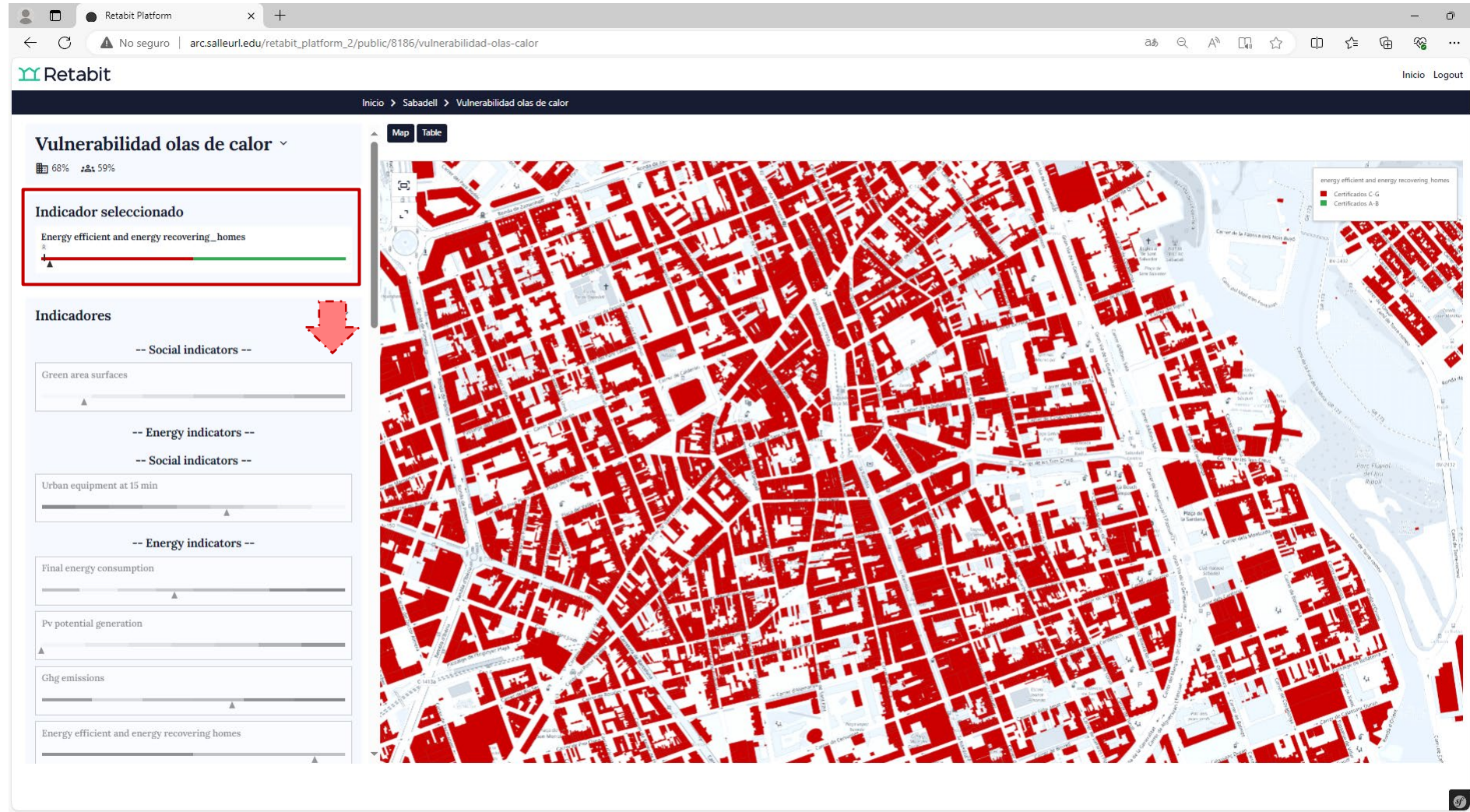
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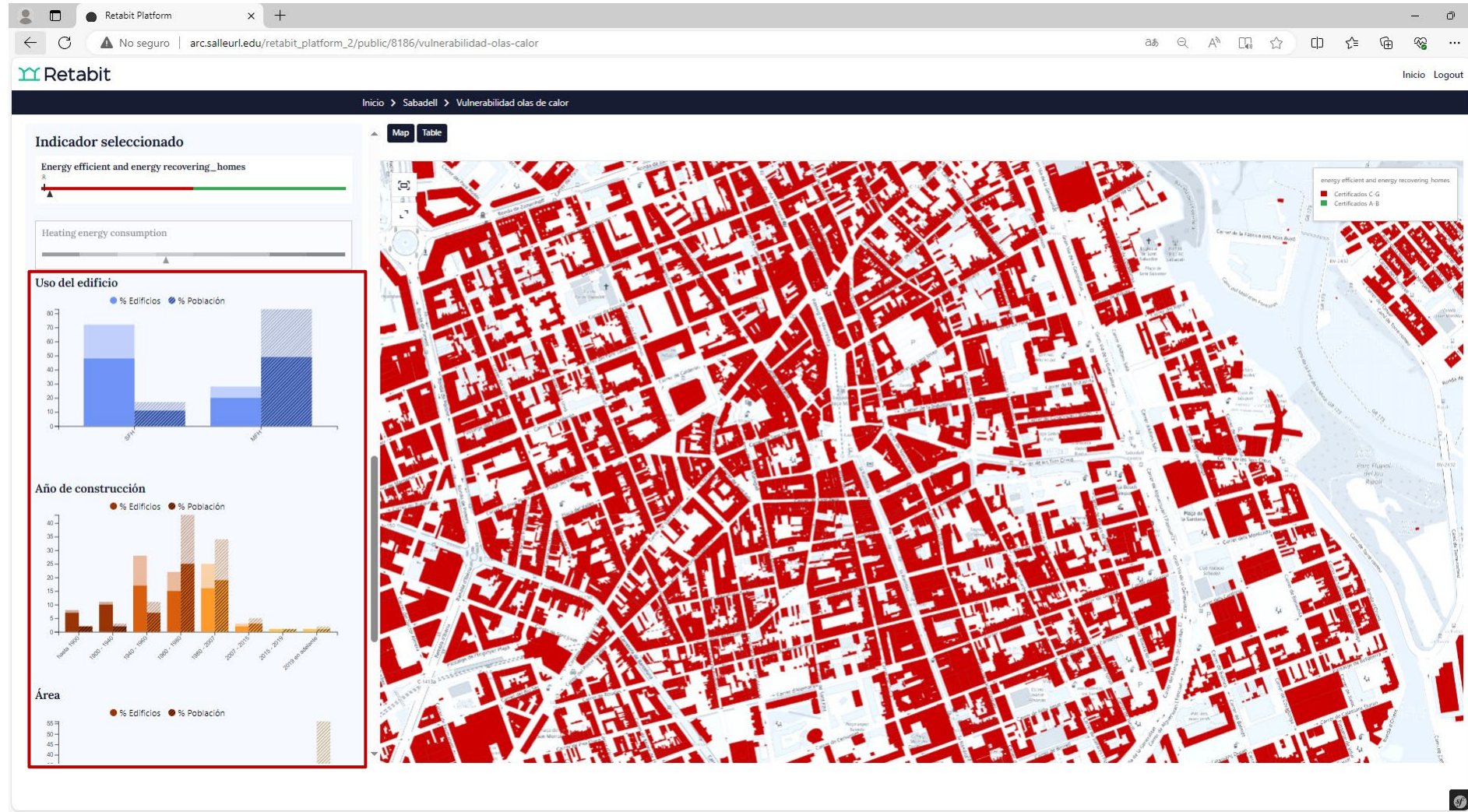
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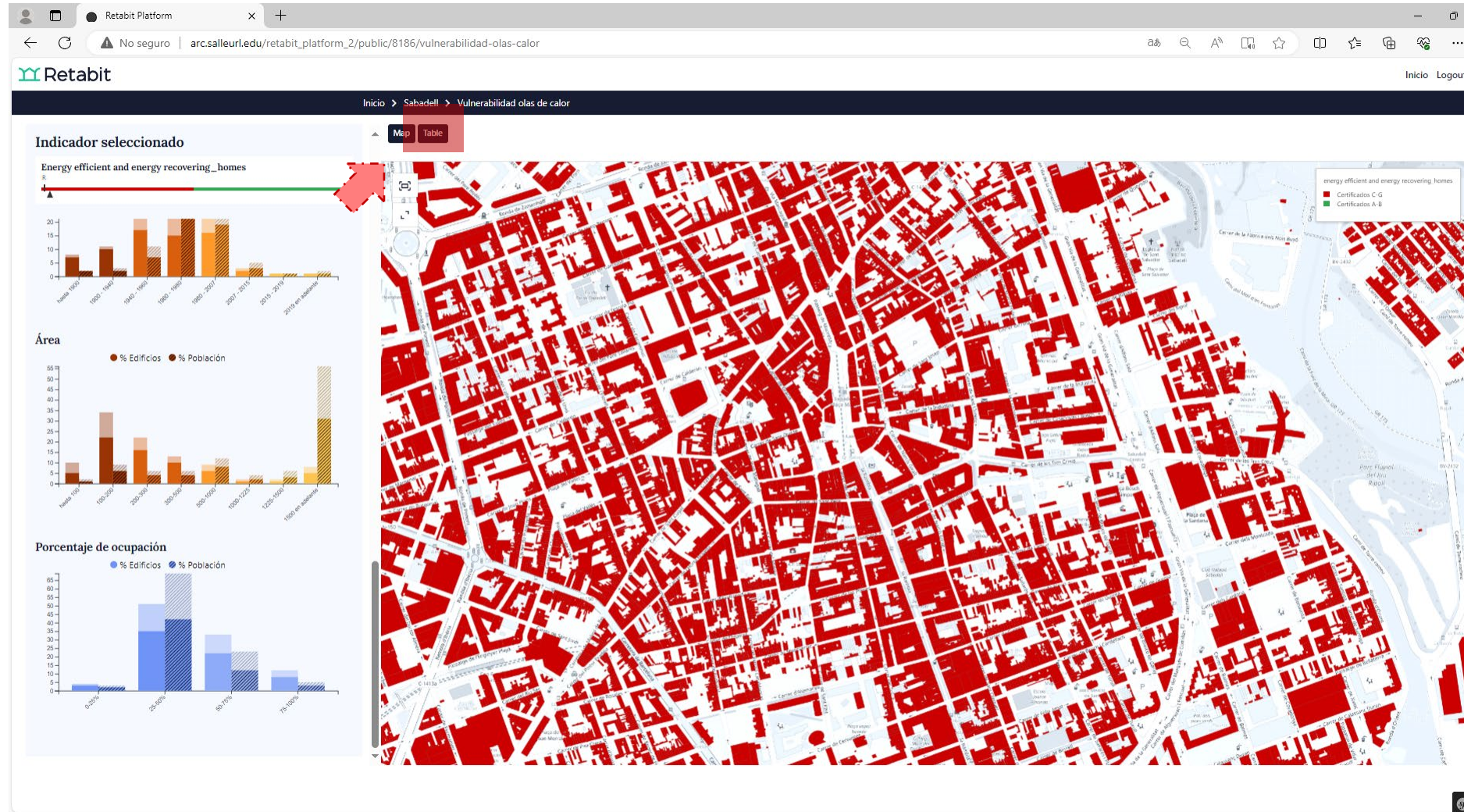
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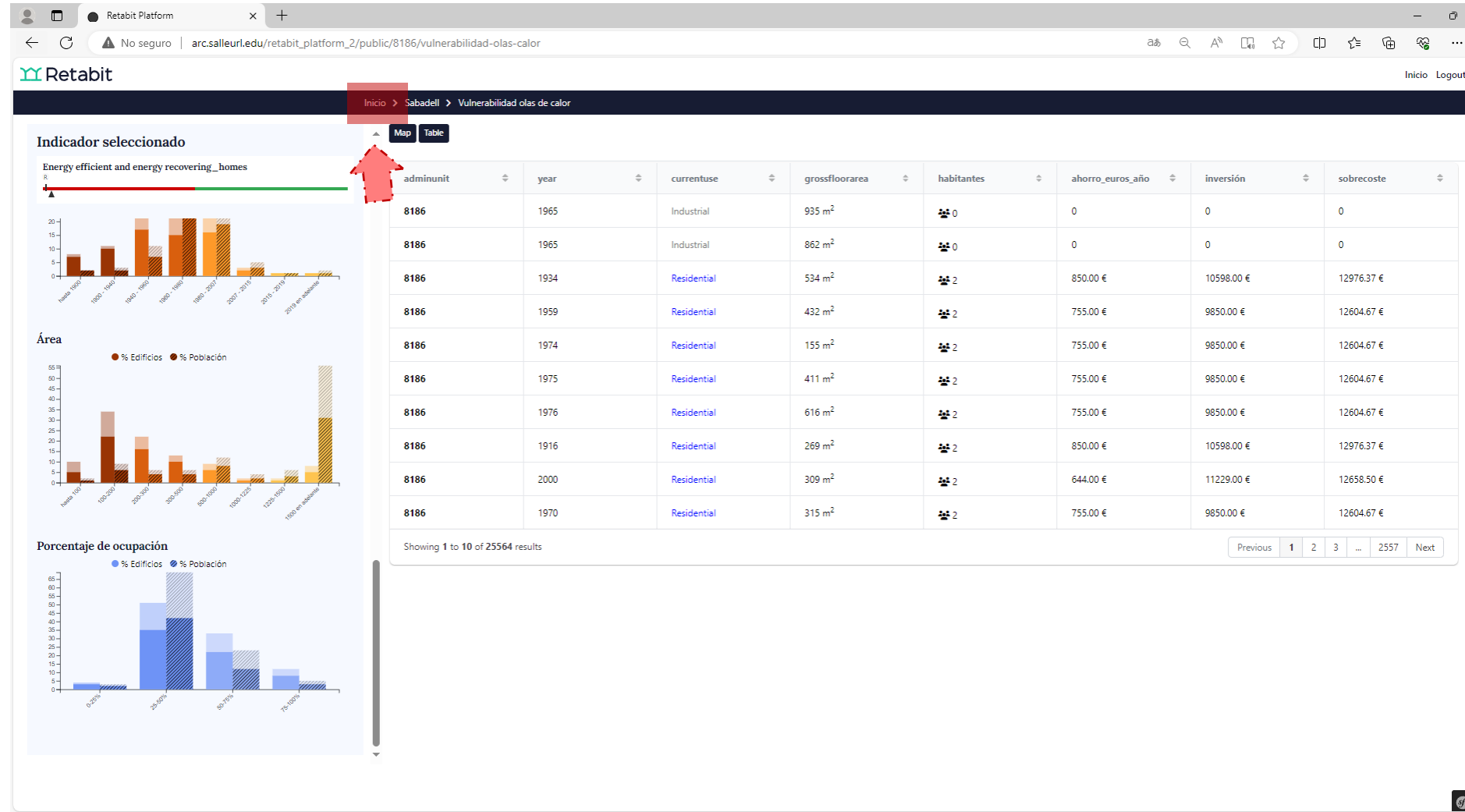
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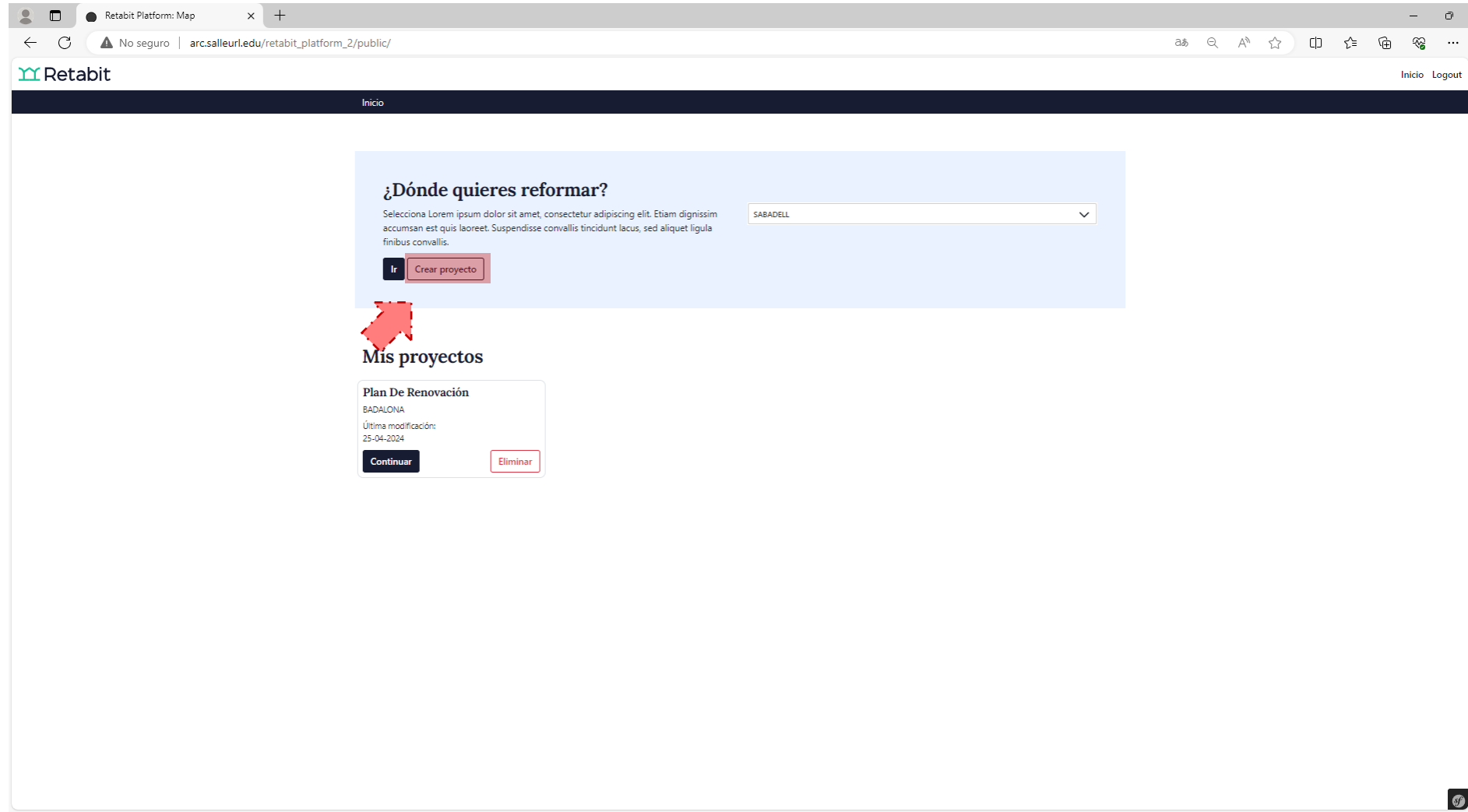
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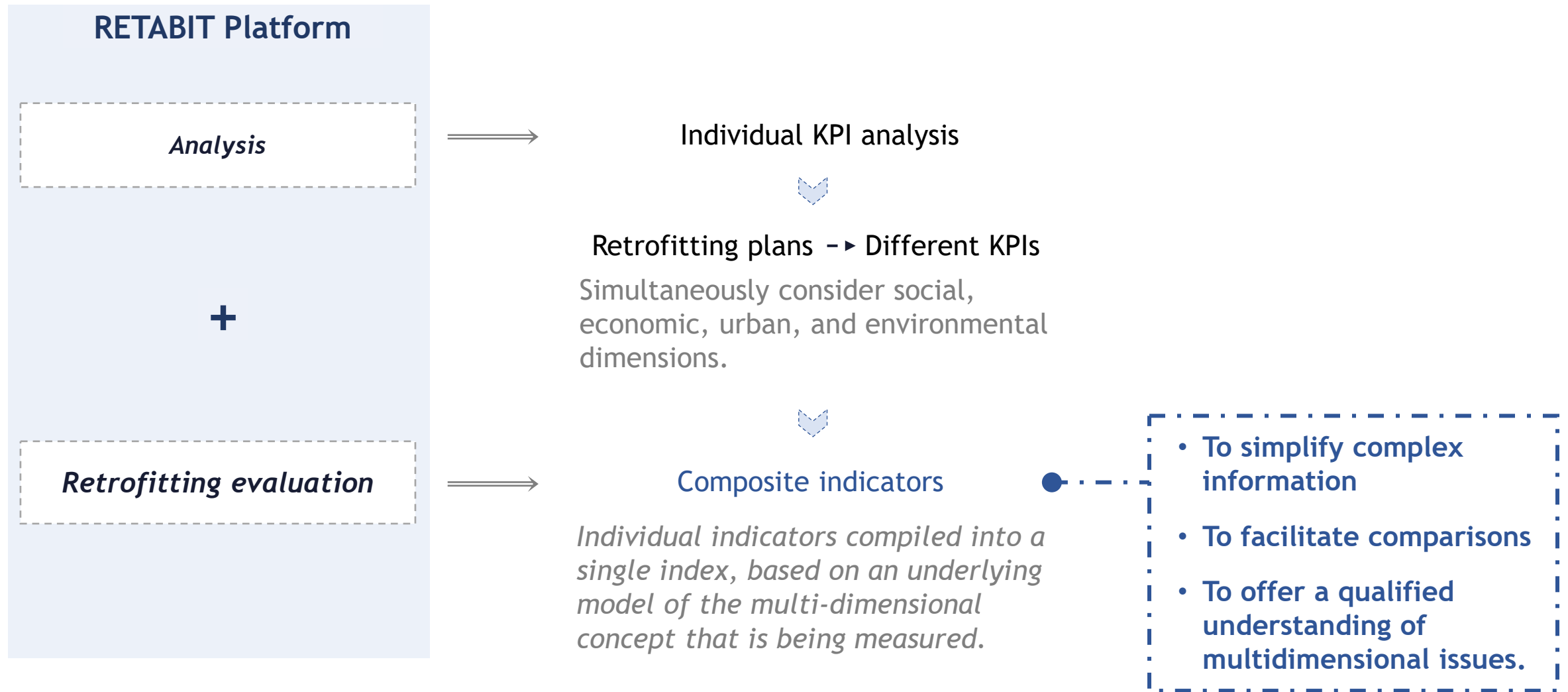
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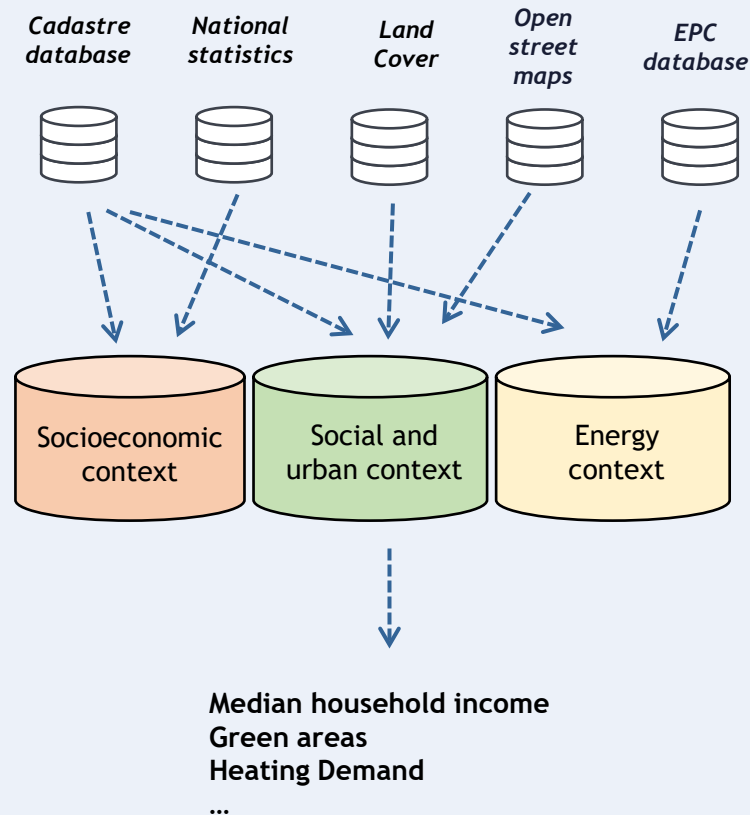
Retabit platform: Analysis



Creating a project: Retabit retrofitting evaluation



Environmental, Social and Urban context

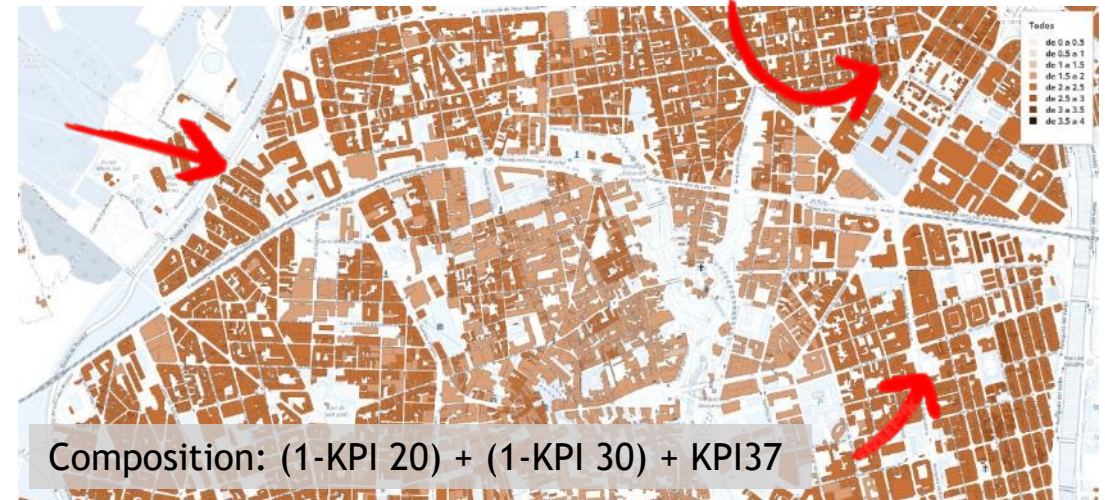


Where can we find neighbourhoods where vulnerable residents reside in buildings lacking energy-efficient features, within urban environments that fail to promote energy efficiency?

Example of energy, socioeconomic and urban KPI application



Example of energy, socioeconomic and urban KPI application



The RETABIT platform

Renovation plan for vulnerable people

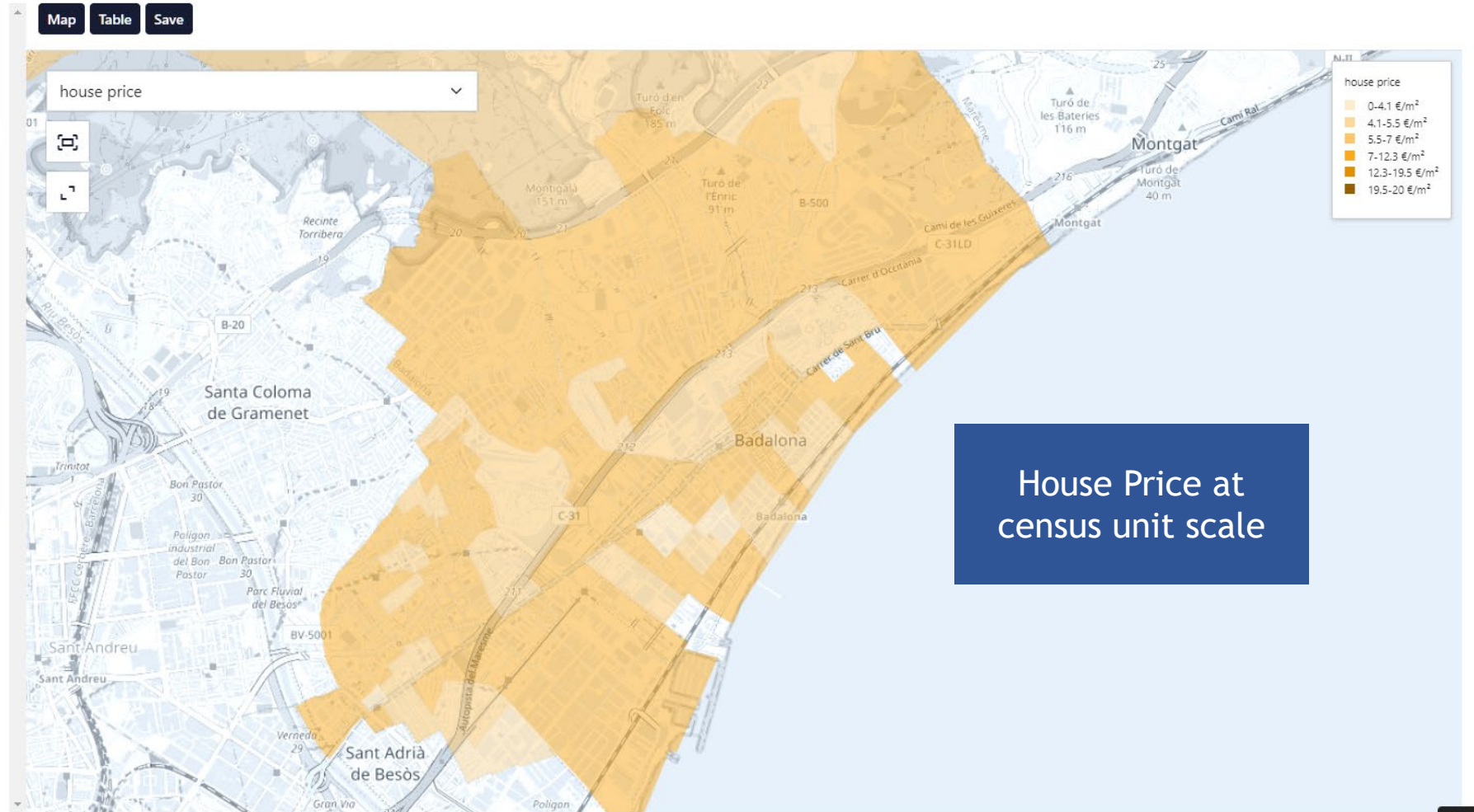
Àmbito

Define tu índice compuesto para determinar el ámbito de intervención del proyecto urbano de reforma.

Definir índice compuesto >>

Selecciona atributos de los edificios que quieres tener en cuenta para filtrar los edificios a incluir en los planes de reforma.

Seleccionar atributos >>



The RETABIT platform

Renovation plan for vulnerable people

Àmbito

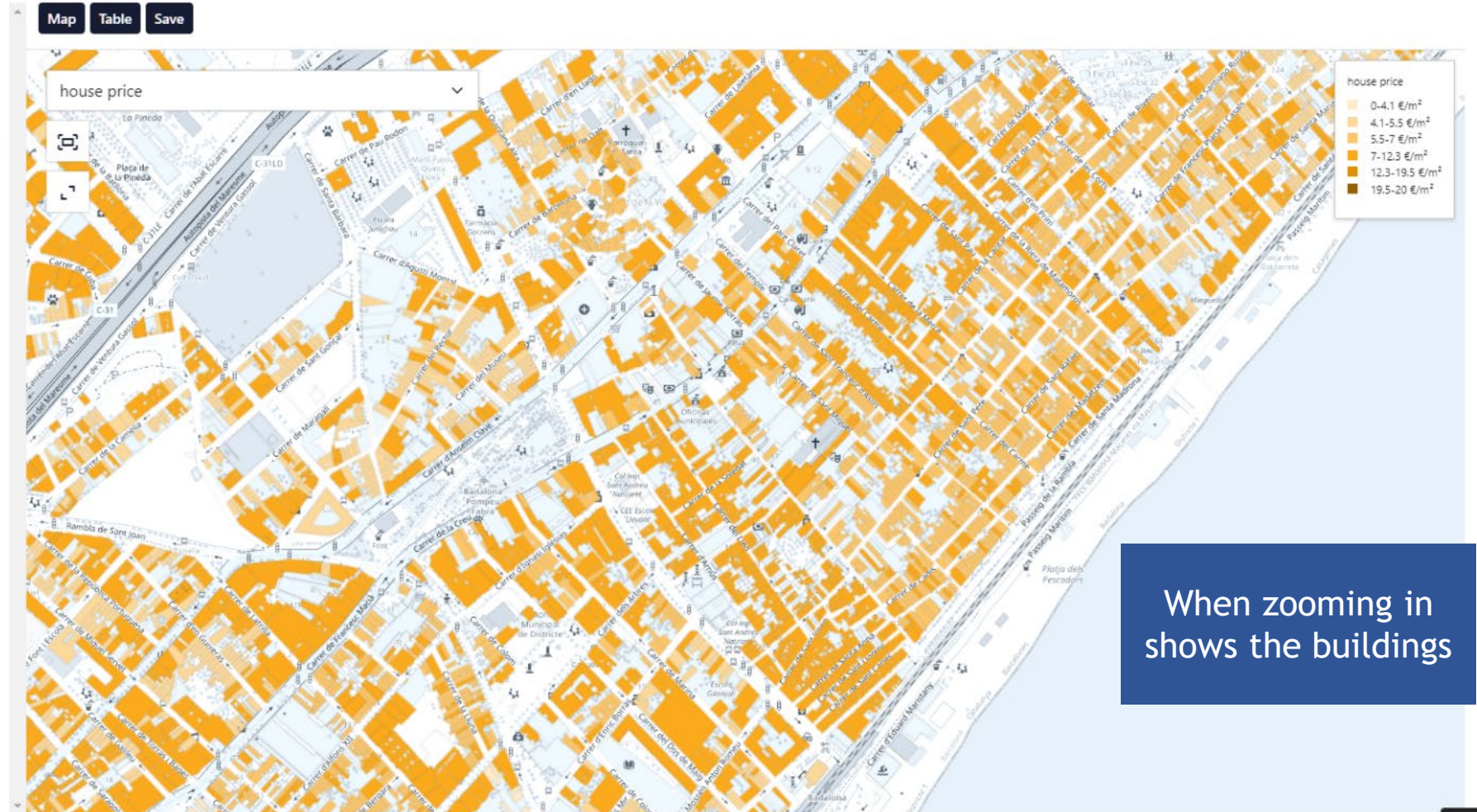
Define tu índice compuesto para determinar el ámbito de intervención del proyecto urbano de reforma.

Definir índice compuesto >>

Selección de cuentas de reforma

Selección

A composite indicator can be created



The RETABIT platform

Índice compuesto

Definir indicador compuesto

Explica con qué criterios quieres definir el indicador compuesto.

Enviar

Indicadores seleccionados

Puedes establecer el peso de cada indicador con la barra de desplazamiento

final energy consumption

Baja

Media

Alta

median household income

Baja

Media

Alta

Indicadores disponibles

renewable energy consumption

pv potential generation

energy efficient and energy recovering_homes

energy efficient and energy recovering homes

population income below 60 average

energy renovated residential buildings

house price

urban equipment at 15 min

green area surfaces

vulnerability heatwaves temperature rise

Todos

Innovation plan for vulnerable people

Map Table Save

Todos



Todos

- de 0 a 0.5
- de 0.5 a 1
- de 1 a 1.5
- de 1.5 a 2
- de 2 a 2.5
- de 2.5 a 3
- de 3 a 3.5
- de 3.5 a 4

The user selects the indicators and weight them with the sliders

Once is done, the platform normalise the indicators and aggregates them based on the weights

The RETABIT platform

Índice compuesto

Definir indicador compuesto

Explica con qué criterios quieres definir el indicador compuesto.

Where are the areas with limited access to green spaces and essential urban amenities near buildings?

Enviar

Indicadores seleccionados

Puedes establecer el peso de cada indicador con la barra de desplazamiento

urban equipment at 15 min

Baja Media Alta

green area surfaces

Baja Media Alta

accessibility to bike lane

Baja Media Alta

Indicadores disponibles

renewable energy consumption

pv potential generation

energy efficient and energy recovering homes

energy efficient and energy recovering homes

Todos median household income house price

innovation plan for vulnerable people

As there are many indicators, the user can provide a description and the platform will precreate the composite indicator using artificial intelligence methods.

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Renovation plan for vulnerable people

Ámbito

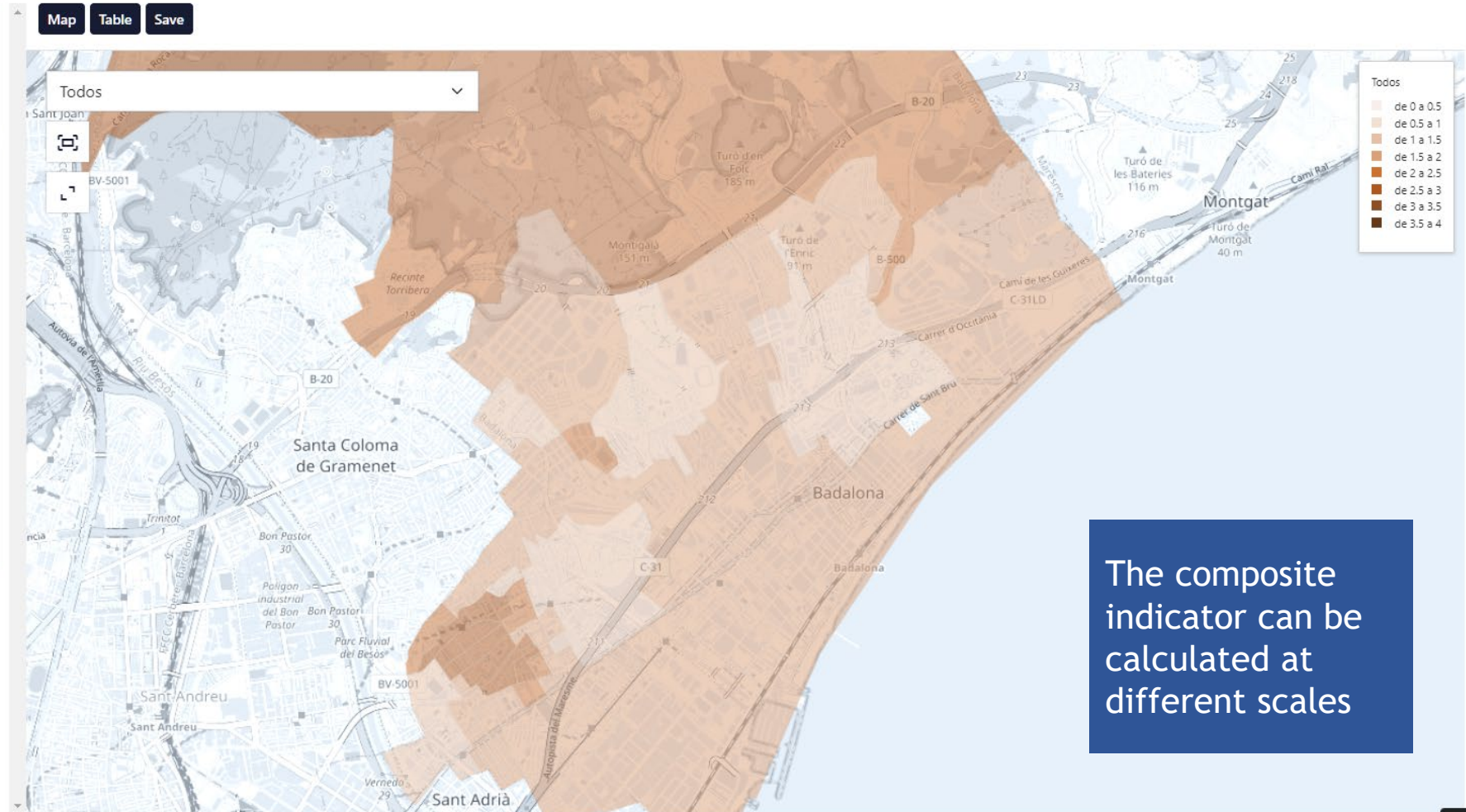
Define tu índice compuesto para determinar el ámbito de intervención del proyecto urbano de reforma.

Definir índice compuesto >>

urban equipment at 15 min green area surfaces
accessibility to bike lane

Selecciona atributos de los edificios que quieres tener en cuenta para filtrar los edificios a incluir en los planes de reforma.

Seleccionar atributos >>



The RETABIT platform

Índice compuesto

Definir indicador compuesto

Explica con qué criterios quieres definir el indicador compuesto.

Where are the areas where vulnerable inhabitants live in non-efficient buildings within an urban context that do not enhance energy efficiency?

Enviar

Indicadores seleccionados

Puedes establecer el peso de cada indicador con la barra de desplazamiento

energy renovated residential buildings

Baja Media Alta

population income below 60 average

Baja Media Alta

vulnerability heatwaves temperature rise

Baja Media Alta

green area surfaces

Baja Media Alta

median household income

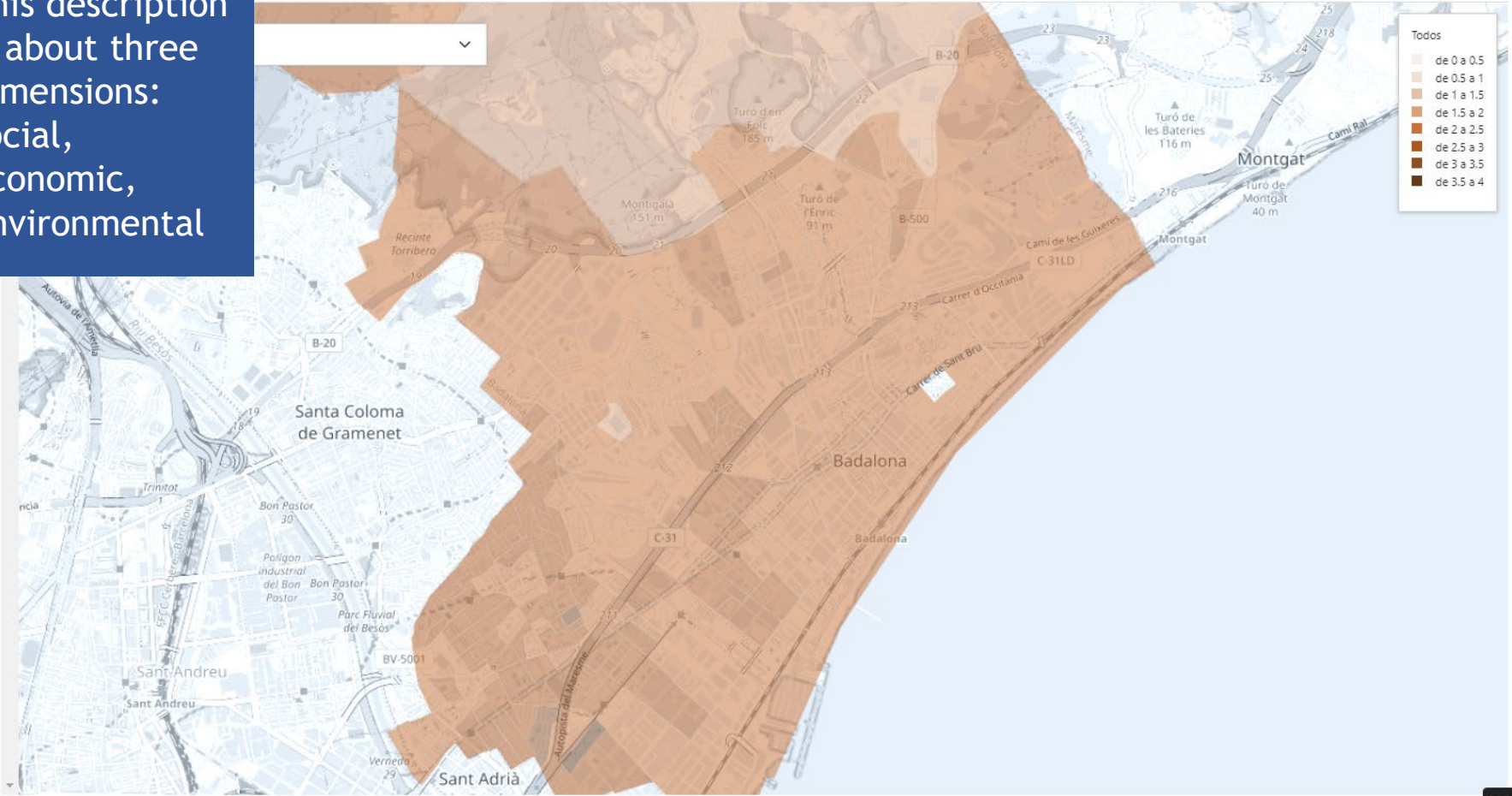
Baja Media Alta

Indicadores disponibles

Inicio Logout

innovation plan for vulnerable people

This description is about three dimensions: social, economic, environmental



The RETABIT platform

Renovation plan for vulnerable people

Àmbito

Define tu índice compuesto para determinar el ámbito de intervención del proyecto urbano de reforma.

Definir índice compuesto >>

energy renovated residential buildings

population income below 60 average

vulnerability heatwaves temperature rise

green area surfaces

median household income

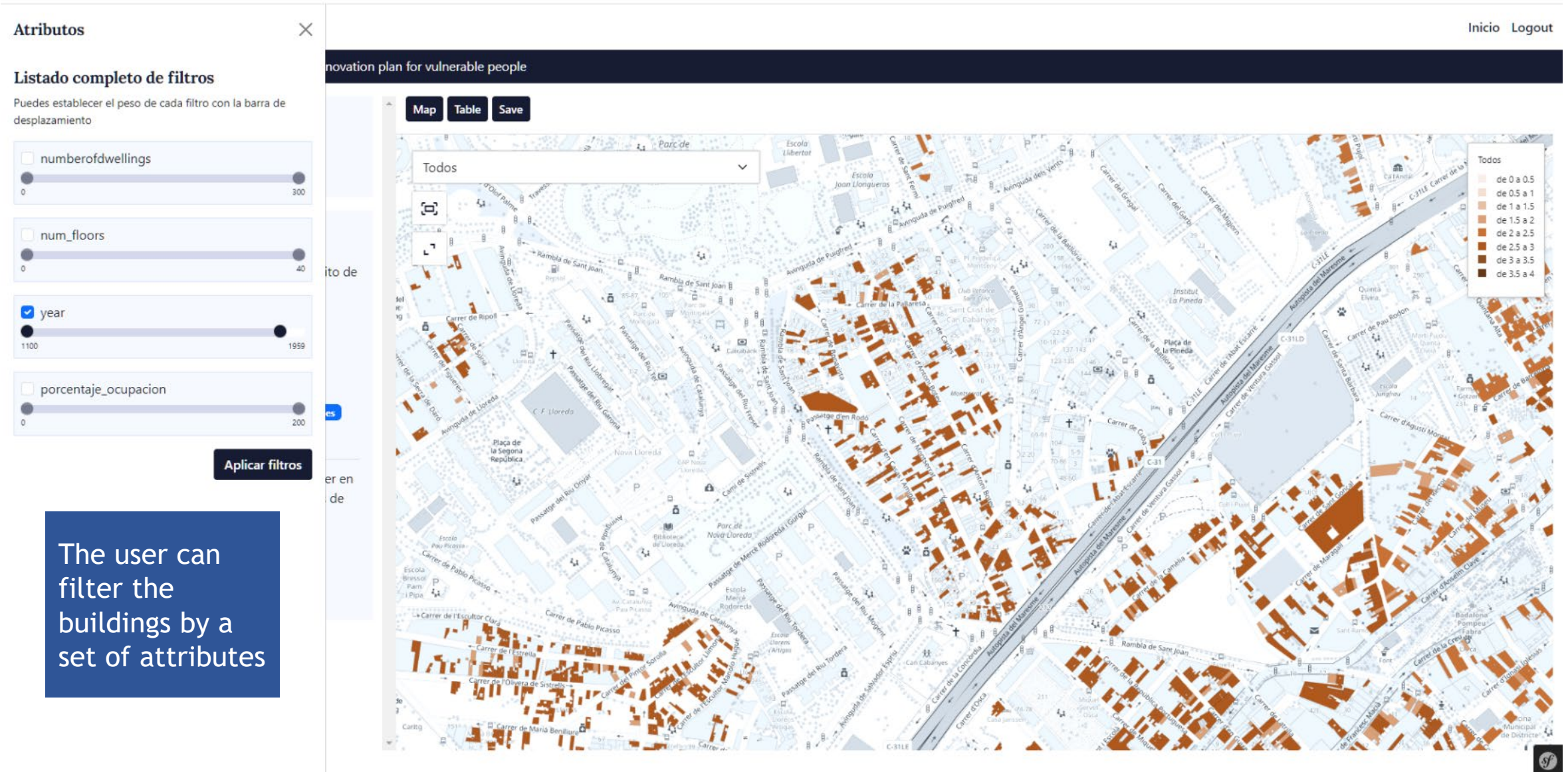
Selecciona el índice compuesto para determinar el ámbito de intervención del proyecto urbano de reforma.

Selección

The attributes are summarized in the left pane



The RETABIT platform



The RETABIT platform

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Explica con qué criterios quieres definir el indicador compuesto.

Where are the areas where vulnerable inhabitants live in non-efficient buildings within an urban context that do not enhance energy efficiency?

Enviar

Indicadores seleccionados

Puedes establecer el peso de cada indicador con la barra de desplazamiento

energy renovated residential buildings

Baja

Media

Alta

vulnerability heatwaves temperature rise

Baja

Media

Alta

population income below 60 average

Baja

Media

Alta

green area surfaces

Baja

Media

Alta

median household income

Baja

Media

Alta

Indicadores disponibles

renewable energy consumption

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median household income

0-28000 €

28000-32000 €

32000-35000 €

35000-38000 €

38000-42000 €

42000-90000 €

90000-900000 €

When the composite indicator is created, the user can display the sub-indicators

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Baja

Media

Alta

vulnerability heatwaves temperature rise

×

Baja

Media

Alta

population income below 60 average

×

Baja

Media

Alta

green area surfaces

×

Baja

Media

Alta

median household income

×

Baja

Media

Alta

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Table

Save

vulnerability heatwaves temperature rise

0-1

1-2

2-3

3-4

4-5

5-6

6-7

7-8

8-9

When the composite indicator is created, the user can display the sub-indicators

Take Aways

- Global and holistic perspective to address sustainability goals through building renovation: going **beyond** urban **energy** modeling.
- To this end, three main needs arise:
 - Adequate data **granularity**: to ensure reliability of analysis avoiding assumptions or inaccuracies.
 - **Standardization** of KPIs: to align global goals with renovation actions and address issues with adequate measures.
 - Use of **Composite Indicators**: To provide a comprehensive approach through a single index, leveraging Artificial Intelligence tools without oversimplifying intricate data.
- Consolidation of the **use** of platforms like RETABIT by the renovation stakeholders (administration, companies, professionals)



If you would like more information,
please visit www.retabit.es, or contact
us at info@retabit.es

Thanks for your attention!



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