Integrating EPC data with cadastre to foster residential building retrofitting programmes in the implementation of SECAPs

The RETABIT project (2021 – 2024)

Álvaro Sicilia

Anna Noguer

ARC Engineering and Architecture La Salle
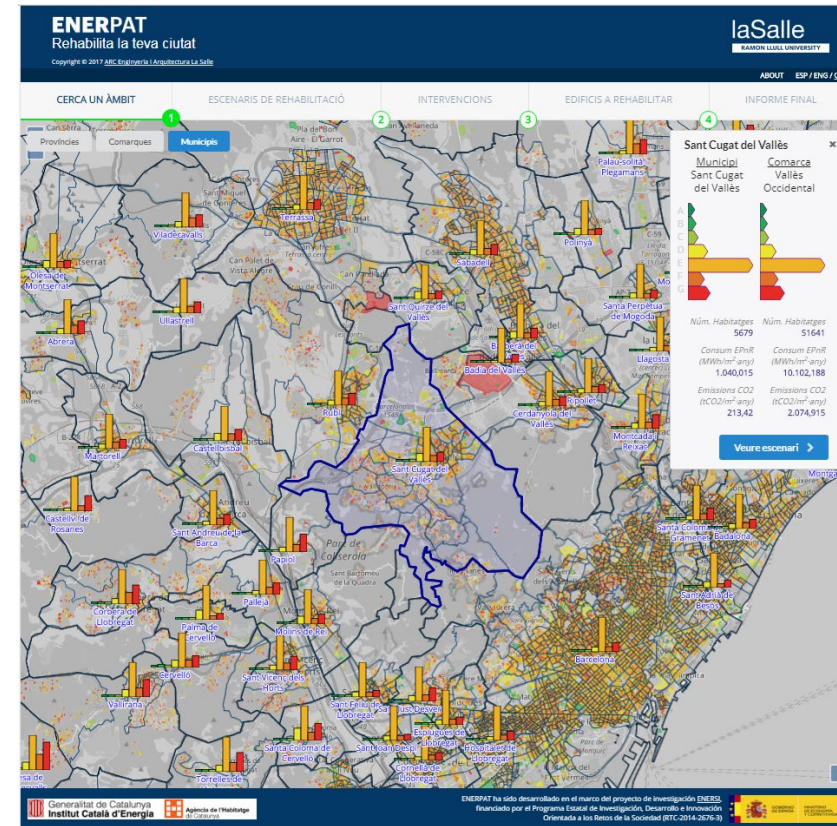Ramon Llull University
Barcelona, Spain

Background

ENERPAT
Renew your city

To guide city planners to arrive to the information which can help them to take decisions concerning the application of large-scale renovation programmes in an urban area.

www.enersi.es/enerpat

Green Deal – Renovation wave

Europe climate-neutral (net zero emissions) by 2050

~75% of EU buildings are not energy efficient

Only 1% are energy-efficient **renovated** every year

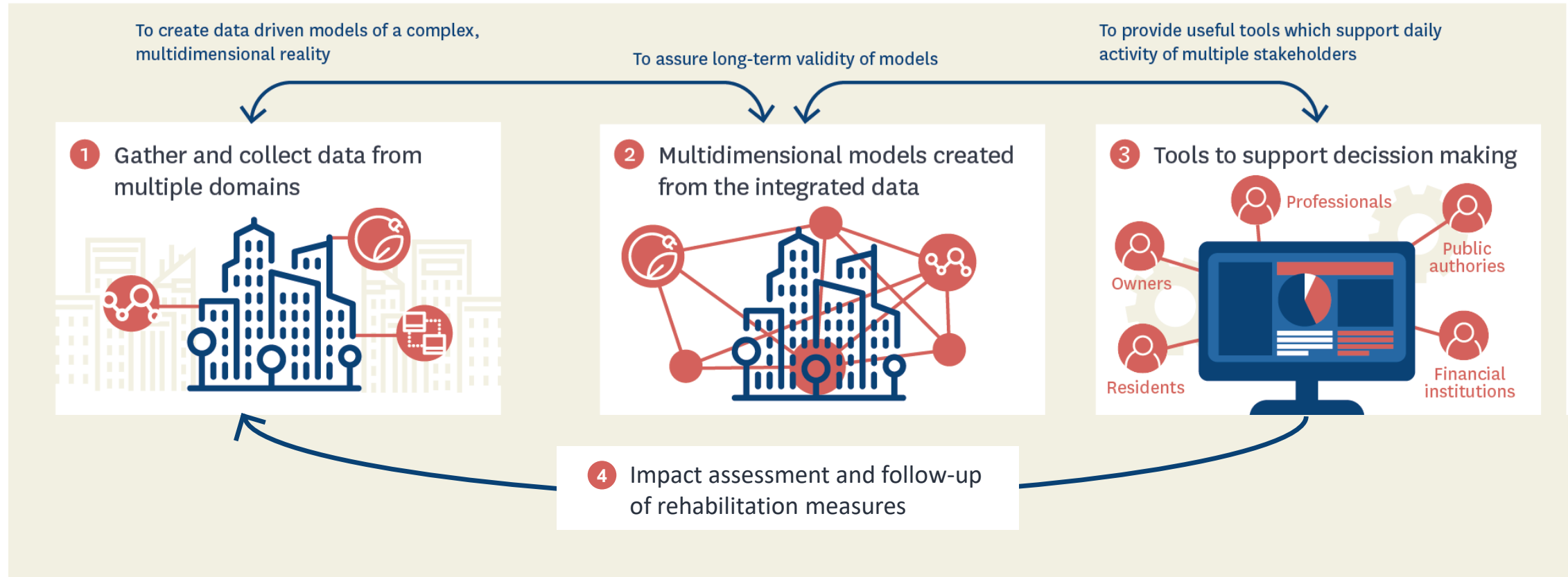## Sustainable Energy and Climate Action Plans (SECAPs)

Currently, a high proportion of municipalities in Catalonia are members of the Covenant of Mayors and have a SEAP in place. However, rather than being a planning and management tool, it is, in most cases, a justification document, with limited guidance and usefulness at a key moment in the energy transition. This is mainly due to:

- the lack of data from the multiple sectors (building, energy, economy, financing) involved in building retrofitting activities.
- the lack of information systems which interrelate these data in order to assess the impact of the adopted actions over long periods of time.
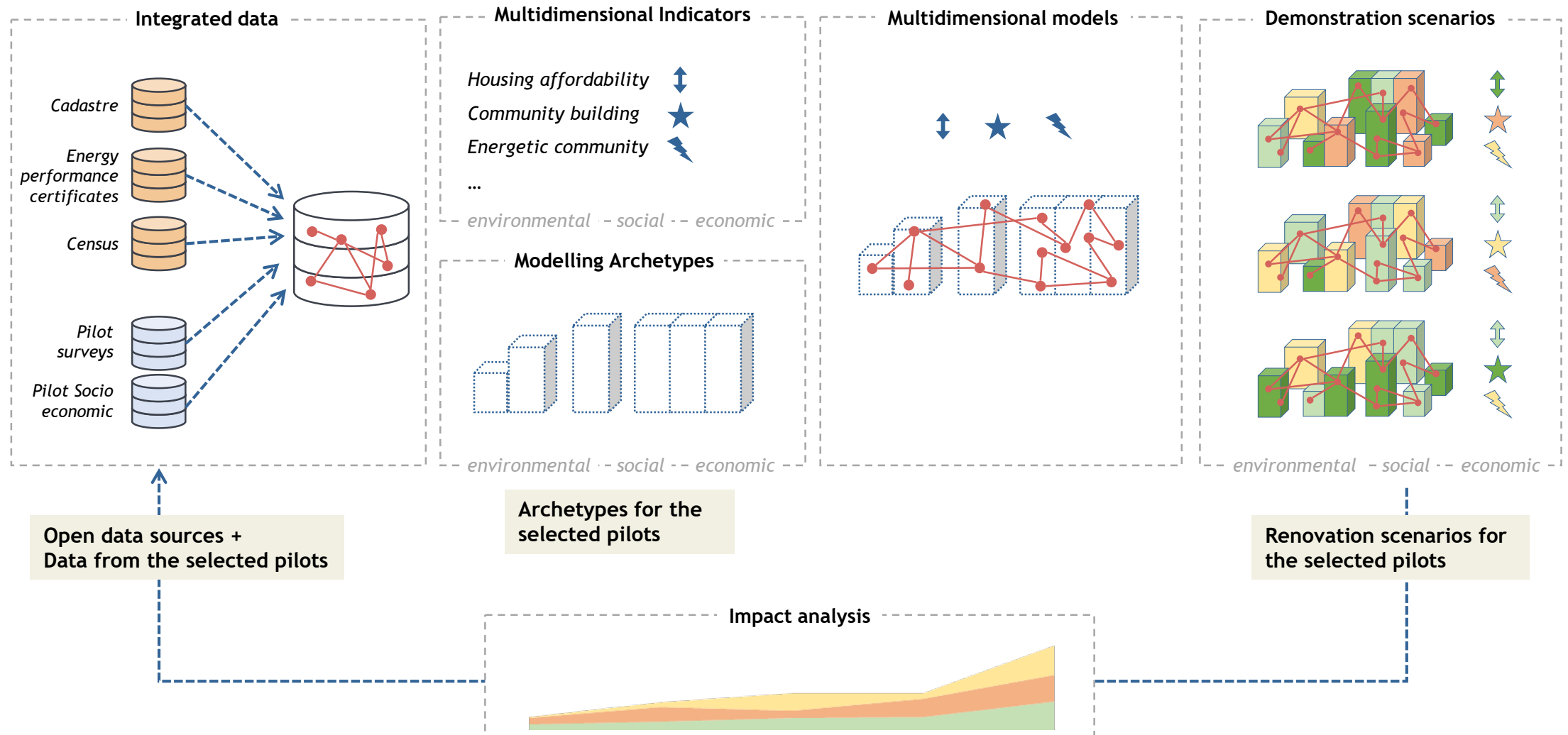
RETABIT will develop a service platform which will facilitate the multiple stakeholders involved in large-scale residential building retrofitting programmes to assess the status of buildings in an urban area and their potential for renovation, to elaborate possible renovation scenarios based on multidimensional indicators, and to monitor the impact of their implementation over time.

1. Explore urban areas and automatically evaluate their renovation potential based on building classification and sustainability indicators
2. Create and assess renovation plans
3. To follow up the impact of the implemented renovation plans

The platform will be demonstrated in two municipalities that represent different realities (building density, age of the building stock, socio-economic characteristics, etc.).

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

laSalle RAMON LLULL UNIVERSITY

IREC Institut de Recerca en Energia de Catalunya Catalonia Institute for Energy Research

GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

To create data driven models of a complex, multidimensional reality

To assure long-term validity of models

To provide useful tools which support daily activity of multiple stakeholders

1 Gather and collect data from multiple domains

2 Multidimensional models created from the integrated data

3 Tools to support decision making

Professionals

Public authories

Owners

Financial institutions

Residents

4 Impact assessment and follow-up of rehabilitation measures

The RETABIT online service platform

Integrated data

- Cadastre
- Energy performance certificates
- Census
- Pilot surveys
- Pilot Socio economic

Multidimensional Indicators

- *Housing affordability* ↕
- *Community building* ★
- *Energetic community* ⚡
- ...

environmental - social - economic

Modelling Archetypes

environmental - social - economic

Multidimensional models

Demonstration scenarios

environmental - social - economic

Open data sources + Data from the selected pilots

Archetypes for the selected pilots

Renovation scenarios for the selected pilots

Impact analysis

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

laSalle RAMON LLULL UNIVERSITY   IREC Institut de Recerca en Energia de Catalunya Catalonia Institute for Energy Research   GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

The RETABIT online service platform

RENOVATION SCENARIOS

RETABIT PLATFORM

MULTICRITERIA EVALUATION OF PLANS

PLAN IMPLEMENTATION

Leading phase
Demand aggregation phase
Project phase
Implementation phase
Financial support phase

PROJECT DEVELOPMENT AND IMPACT MONITORING

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

laSalle RAMON LLULL UNIVERSITY

IREC Institut de Recerca en Energia de Catalunya Catalonia Institute for Energy Research

GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

The RETABIT online service platform

RETABIT PLATFORM

Process: Archetype mapping

ARCHETYPE DESCRIPTORS
Type, EPC label, status,…
Keywords
DOWNLABLE BIM — **Process: BIM model**

BUILDING DESCRIPTION
Location, number of apartments, orientation, envelope, accessibility,….

PLANNING REGULATIONS
Urban plans, parameters, renewal schemes, zoning, usages,…

SOCIOECONOMIC CONTEXT
Number of apartments, apartment type, dimensions, orientation, envelope, accessibility,…

Process: Sustainable indicators

ENVIRONMENTAL CONDITIONS
Access to public facilities, access to public transport, air quality, …

Process: Retrofitting scenarios

RENOVATION POTENTIAL
Renovation measures at the building and community level, renovation costs,…

The RETABIT online service platform

Integrated data
- Cadastre
- Energy performance certificates
- Census
- Pilot surveys
- Pilot Socio economic

Urban data challenges:
- Disparate
- Dispersed
- Available in multiple formats and granularities

Integrating energy-related data using Semantic Web technologies as a plausible solution to manage data heterogeneity (ontologies, RDF, SPARQL…).

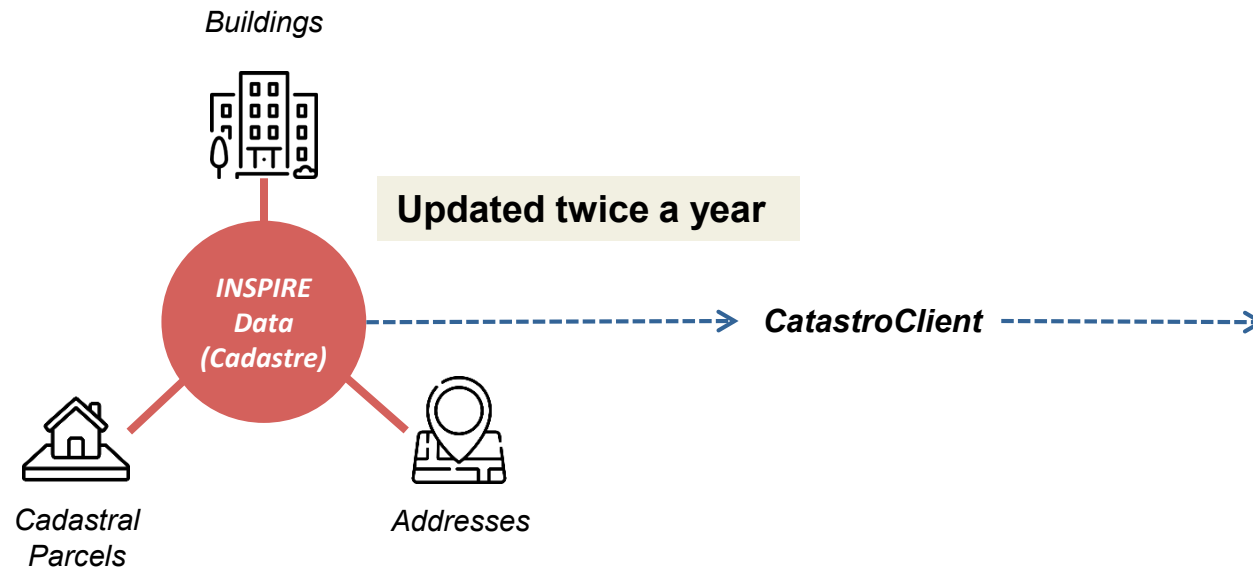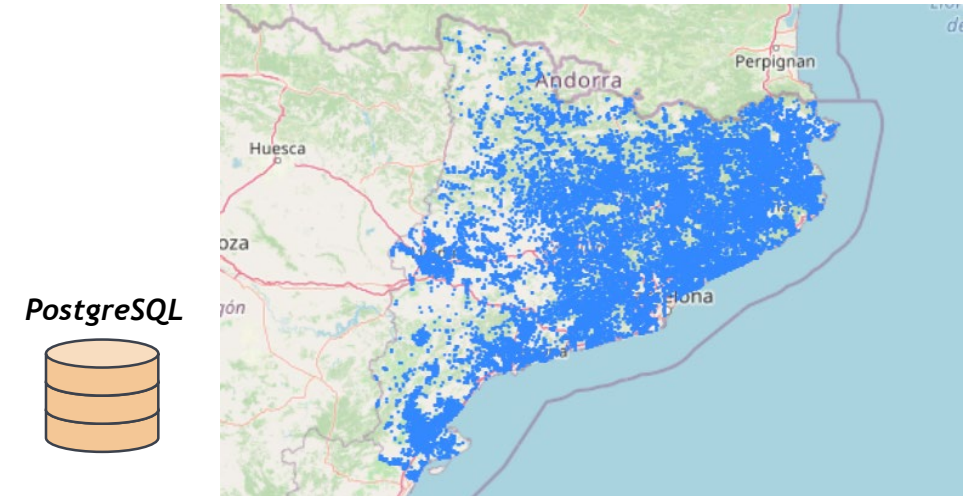Once integrated, we will be able detect inconsistencies in EPC data and correct them

The data integration process

dades obertes
catalunya

Information regarding the year of construction, condition of construction, address, current use and energy efficiency of dwellings

Rows	Columns	Each row is a
1,24M	62	Certificate

EPC Data

Updated weekly

EPCClient

JSON files

JSON

The data integration process

Buildings

INSPIRE Data (Cadastre)

Updated twice a year

CatastroClient

PostgreSQL

Cadastral Parcels

Addresses

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

laSalle RAMON LLULL UNIVERSITY

IREC Institut de Recerca en Energia de Catalunya · Catalonia Institute for Energy Research

GOBIERNO DE ESPAÑA · MINISTERIO DE CIENCIA E INNOVACIÓN

The data integration process

Database with **version control** and **PostGIS** extension for spatial data

Buildings

Updated twice a year

INSPIRE Data (Cadastre)

CatastroClient

PostgreSQL

Cadastral Parcels

Addresses

Every six months, the modifications in the Cadastre are stored in the database → For a particular area, we can know, in a period of time, if there have been changes (new buildings, gross areas updates...)

inspireid character varying (14)	effective timestamp without time z	ini_date date	end_date date	currentuse character varying	grossfloorarea integer
000200400CG55G	2021-03-04 00:00:00	1970-01-01	1970-01-01	3_industrial	3
000600100CG73D	2021-03-04 00:00:00	1900-01-01	1900-01-01	1_residential	292
000600100CG73D	2021-09-11 00:00:00	1800-01-01	1800-01-01	1_residential	586

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

laSalle RAMON LLULL UNIVERSITY

IREC Institut de Recerca en Energia de Catalunya Catalonia Institute for Energy Research

GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

The data integration process: Updates in the cadastre

Updates in building data in the last 6 months	**0.25%** (3528/1385727)

Calaf	12%
Santa Fe del Penedes	9%
Calders	8%
Orrius	6%
Sora	4%
Sant Vicenç de Castellet	4%
Cabrera d'Anoia	3%
La Nou de Bergueda	3%
Castell de l'Areny	2%
Granera	2%
Sant Julia de Cerdanyola	2%

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

laSalle RAMON LLULL UNIVERSITY | IREC Institut de Recerca en Energia de Catalunya / Catalonia Institute for Energy Research | GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

The data integration process: Updates in the cadaster - examples

	inspireid character varying (14)	effective timestamp without time zone	grossfloorarea integer
3	5302206CH5052S	2021-03-04 00:00:00	830
4	5302206CH5052S	2021-09-11 00:00:00	705
5	25215A00500036	2021-03-04 00:00:00	499
6	25215A00500036	2021-09-11 00:00:00	611

Updates in gross floor area

	inspireid character varying (14)	effective timestamp without time zone	currentuse character varying
1	5302206CH5052S	2021-03-04 00:00:00	3_industrial
2	5302206CH5052S	2021-09-11 00:00:00	1_residential

Updates in current use

	inspireid character varying (14)	effective timestamp without time zone	beginningofconstruction date
67	25134A50100009	2021-03-04 00:00:00	2002-01-01
68	25134A50100009	2021-09-11 00:00:00	1996-01-01
69	8686108CG1280S	2021-03-04 00:00:00	1987-01-01

Updates in date of construction

	inspireid character varying (14)	effective timestamp without time zone	conditionofconstru character varying (2
1	4522202CG2642S	2021-03-04 00:00:00	ruin
2	4522202CG2642S	2021-09-11 00:00:00	functional
3	933480700CG34D	2021-03-04 00:00:00	ruin

Updates in condition of construction

The data integration process

Cadastre

SQL data

INSPIRE ontology to represent building, address and cadastral parcel data

SQL to RDF
RMLMapper 1

Virtuoso Server

EPC and Cadastre data are transformed into RDF and linked between them.

EPCs and Cadastre can be queried at the same time.

EPCs

{:}

JSON

JSON data

JSON to RDF
SPARQL-Generate 2

Enersi and Semanco ontologies to represent building energy data
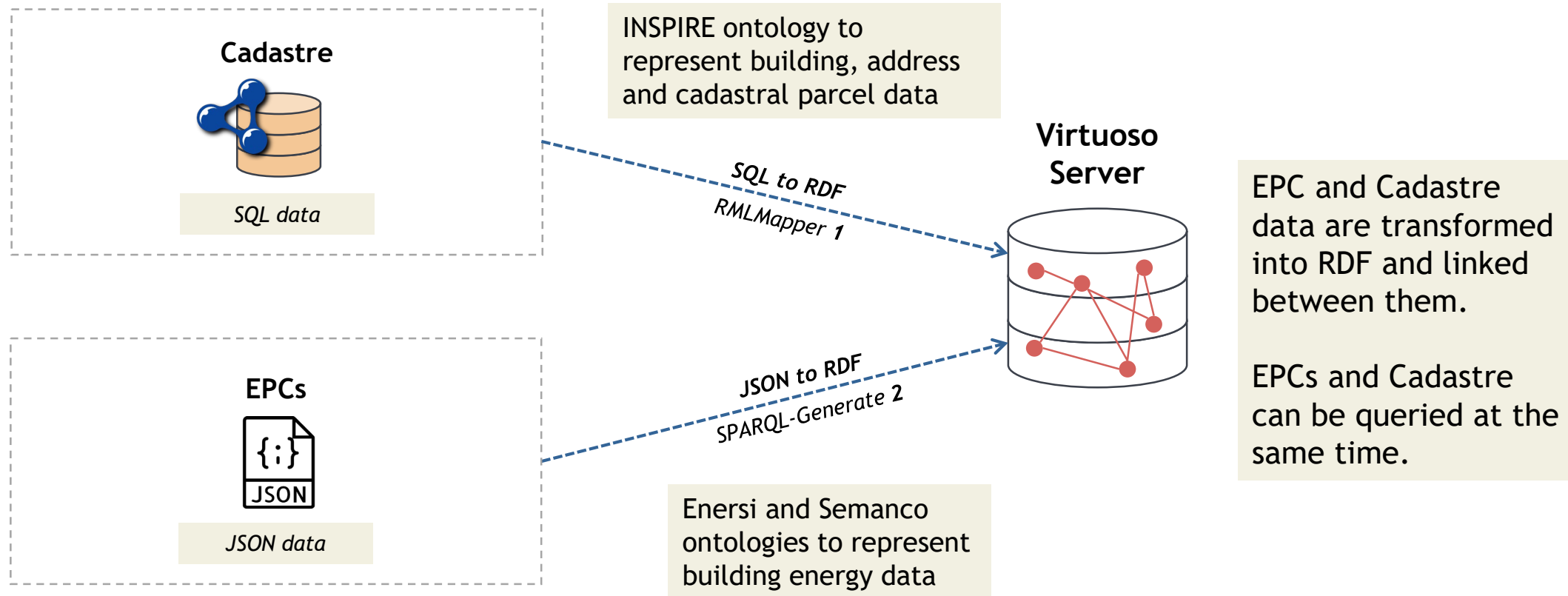
INSPIRE ontoloy - <http://inspire.ec.europa.eu/ont/bu-base#>
ENERSI - <http://enersi.es/resource>
SEMANCO - <http://semanco-tools.eu/ontology-releases/eu/semanco/ontology/SEMANCO/SEMANCO.owl#>

1. RMLMapper - https://rml.io
2. SPARQL-Generate - https://ci.mines-stetienne.fr/sparql-generate

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

laSalle RAMON LLULL UNIVERSITY

IREC Institut de Recerca en Energia de Catalunya Catalonia Institute for Energy Research

GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

The data integration process

After running the data integration process not all data has been successfully integrated

EPCs

Number of EPCs		970.455
	Linked to a dwelling	627.352
	Linked to a building	11.736
	Not linked	331.367

Cadastre

Number of Buildings	903.367
Number of Addresses	1.086.087
Number of Cadastral Parcels	1.870.938

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

laSalle RAMON LLULL UNIVERSITY

IREC Institut de Recerca en Energia de Catalunya — Catalonia Institute for Energy Research

GOBIERNO DE ESPAÑA — MINISTERIO DE CIENCIA E INNOVACIÓN

The data integration process:

Errors detection

Both data sources have been integrated. We can compare the <u>same attribute</u> in both data sources to detect discrepancies.

Virtuoso Server

EPC Data

INSPIRE Data (Cadastre)
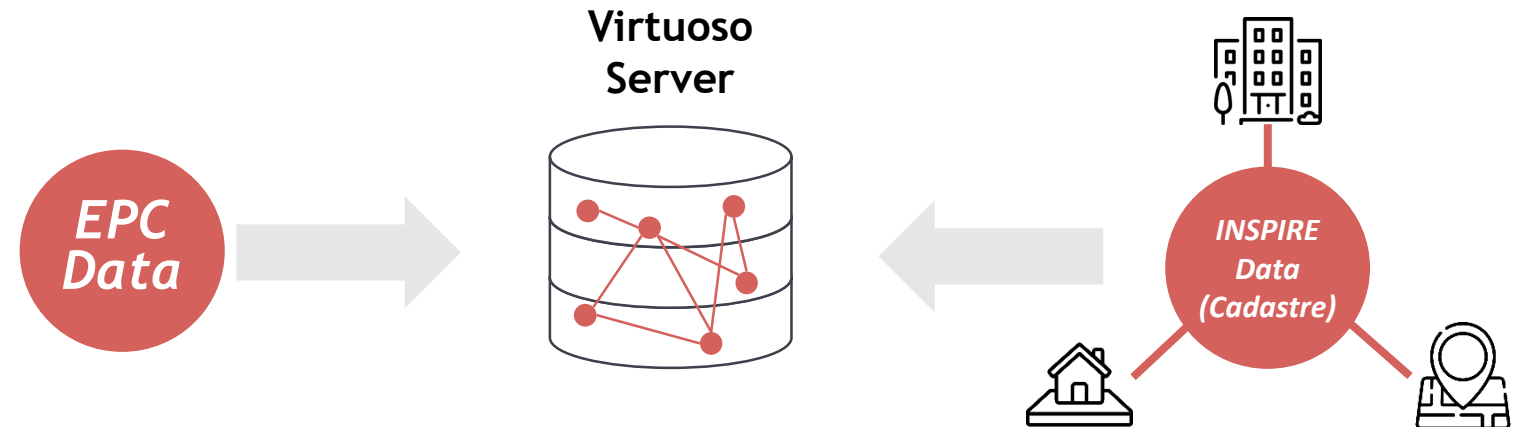
Both data sources might have errors, since some of the EPC data is manually introduced by certifiers cadastre data is more reliable.

The data integration process:

Errors in Climate Zones

CLIMATE ZONES

KO
177.356
20%

OK
731.490
80%
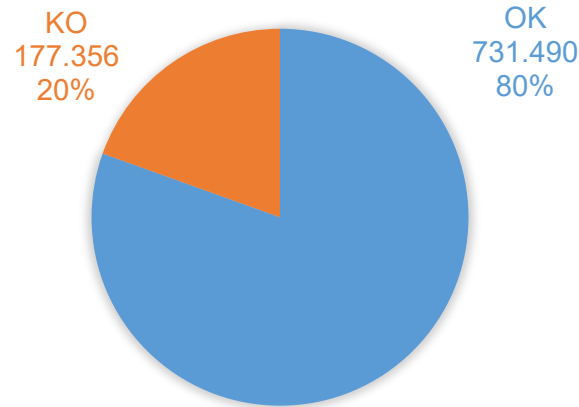
Climate zones have been obtained based on the cadastre data.

Cadastre   EPC

pob	Climate Zone	EPC Climate Zone
http://ex.com/Poblacio/Freginals	B3	C3
http://ex.com/Poblacio/Mar%C3%A7%C3%A0	C2	C3
http://ex.com/Poblacio/Maials	D2	D3
http://ex.com/Poblacio/Salom%C3%B3	B3	C3
http://ex.com/Poblacio/Crespi%C3%A0	C2	D2
http://ex.com/Poblacio/Estar%C3%A0s	E1	D3
http://ex.com/Poblacio/Montagut_i_Oix	C2	D2
http://ex.com/Poblacio/Mar%C3%A7%C3%A0	C2	C3
http://ex.com/Poblacio/Pla_del_Pened%C3%A8s_%28El%29	C1	C2
http://ex.com/Poblacio/Cornudella_de_Montsant	C1	D3
http://ex.com/Poblacio/Bellmunt_d%27Urgell	D2	D3
http://ex.com/Poblacio/Maials	D2	D3
http://ex.com/Poblacio/Freginals	B3	C3

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

laSalle RAMON LLULL UNIVERSITY   IREC Institut de Recerca en Energia de Catalunya Catalonia Institute for Energy Research   GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

The data integration process:

Errors in <u>Surfaces</u>

SURFACE

KO
830
10%

OK
7.617
90%
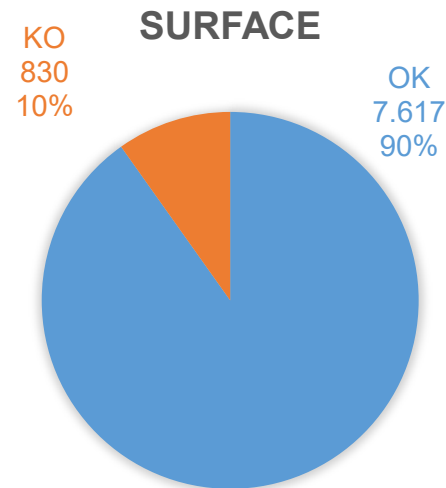
Cadastre   EPC

building	Cadaster Surface	EPC Surface
http://enersi.es/resource/building/8284/6476030DG7167S	209	643.0
http://enersi.es/resource/building/8204/00000000000000	0	39.0
http://enersi.es/resource/building/8204/00000000000000	0	55.9
http://enersi.es/resource/building/8204/00000000000000	0	39.0
http://enersi.es/resource/building/8204/00000000000000	0	55.9
http://enersi.es/resource/building/8900/0011242DF3801A	592	685.76
http://enersi.es/resource/building/43155/7572624CF6577S	117	143.0
http://enersi.es/resource/building/43185/4885205CF4448F	82	302.0
http://enersi.es/resource/building/8900/0813840DF3801D	396	489.18
http://enersi.es/resource/building/8900/8962819DF2886B	393	480.0
http://enersi.es/resource/building/8900/7114601DF2871C	1814	2035.97
http://enersi.es/resource/building/8120/2289211DF5928N	161	215.0
http://enersi.es/resource/building/8120/2289209DF5928N	545	370.0
http://enersi.es/resource/building/8015/5279316DF3857C	1260	852.0
http://enersi.es/resource/building/8105/9904806DG4190S	2293	82.5

RETABIT

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

laSalle — RAMON LLULL UNIVERSITY

IREC — Institut de Recerca en Energia de Catalunya / Catalonia Institute for Energy Research

GOBIERNO DE ESPAÑA — MINISTERIO DE CIENCIA E INNOVACIÓN

The data integration process:

Errors in Years of construction

YEAR OF CONSTRUCTION

KO
51928
12%

OK
372550
88%
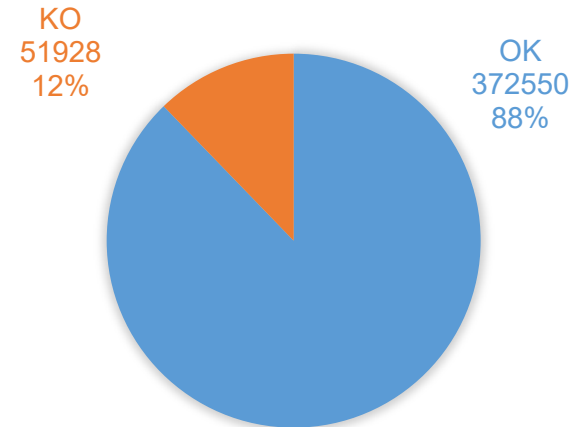
Cadastre   EPC

EPC	Cadastre Year	EPC Year
http://ex.com/Immoble/LSVTV45W	1963	1975
http://ex.com/Immoble/BX9V56LQ	2003	2004
http://ex.com/Immoble/35HSKL9RP	2007	2005
http://ex.com/Immoble/G35SXGW9	2009	2007
http://ex.com/Immoble/MBK0QLCRW	1939	2001
http://ex.com/Immoble/HGN9KS1MV	1999	2005
http://ex.com/Immoble/NFWRK8QRY	2005	2007
http://ex.com/Immoble/RCJJWFD0T	2009	2008
http://ex.com/Immoble/PQ1WZ3RGK	2009	2011
http://ex.com/Immoble/B88FC9M8S	1961	1936
http://ex.com/Immoble/9BH04MC06	1900	2005
http://ex.com/Immoble/PS76STWHT	1900	1966
http://ex.com/Immoble/FXTP1RJW	1940	1950

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

laSalle RAMON LLULL UNIVERSITY | IREC Institut de Recerca en Energia de Catalunya / Catalonia Institute for Energy Research | GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

The data integration process:

Errors in City names

CITY NAMES

KO
60222
6%

OK
910233
94%
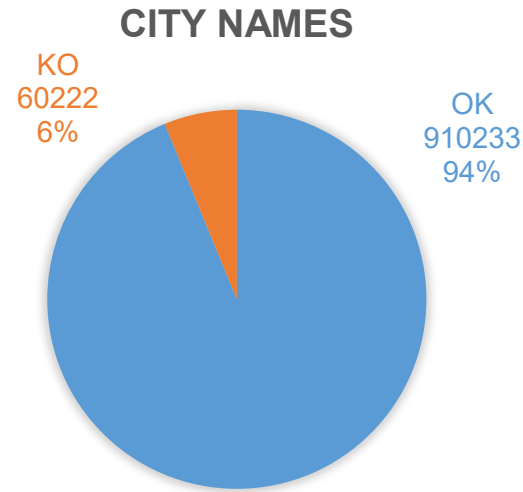
EPC

epc	cityname
http://ex.com/Immoble/CGHN7T47B	"Matar?"
http://ex.com/Immoble/15YK803DF	"Cornell? de Llobregat"
http://ex.com/Immoble/C7MFJPZ92	"Fatarella (La)"
http://ex.com/Immoble/NFJ7S3GJN	"Oluges (Les)"
http://ex.com/Immoble/4MDD4CNZM	"Albi (L')"
http://ex.com/Immoble/GQL476LC7	"Oluges (Les)"
http://ex.com/Immoble/84BVFN5B3	"Febró (La)"
http://ex.com/Immoble/HYZP2MGQX	"Albi (L')"
http://ex.com/Immoble/5R6QKV7T7	"Matar?"
http://ex.com/Immoble/VS6S1RTY3	"Albi (L')"
http://ex.com/Immoble/MW1K2688V	"Cornell? de Llobregat"
http://ex.com/Immoble/6THV2JHDS	"Oluges (Les)"
http://ex.com/Immoble/B17LCX28R	"Oluges (Les)"
http://ex.com/Immoble/95B2C3SMP	"Matar?"

Problems with special characters

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

laSalle RAMON LLULL UNIVERSITY | IREC Institut de Recerca en Energia de Catalunya Catalonia Institute for Energy Research | GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

The data integration process:

Errors in Postal codes

POSTAL CODES

39190
5%

757177
95%
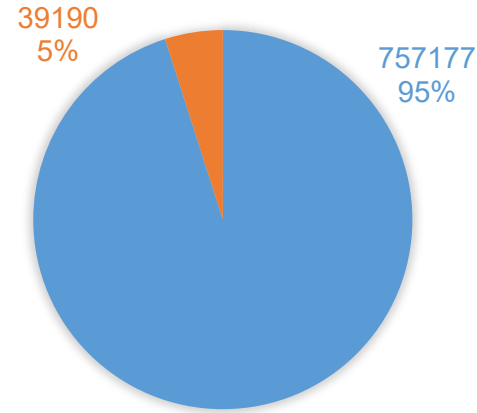
Cadastre   EPC

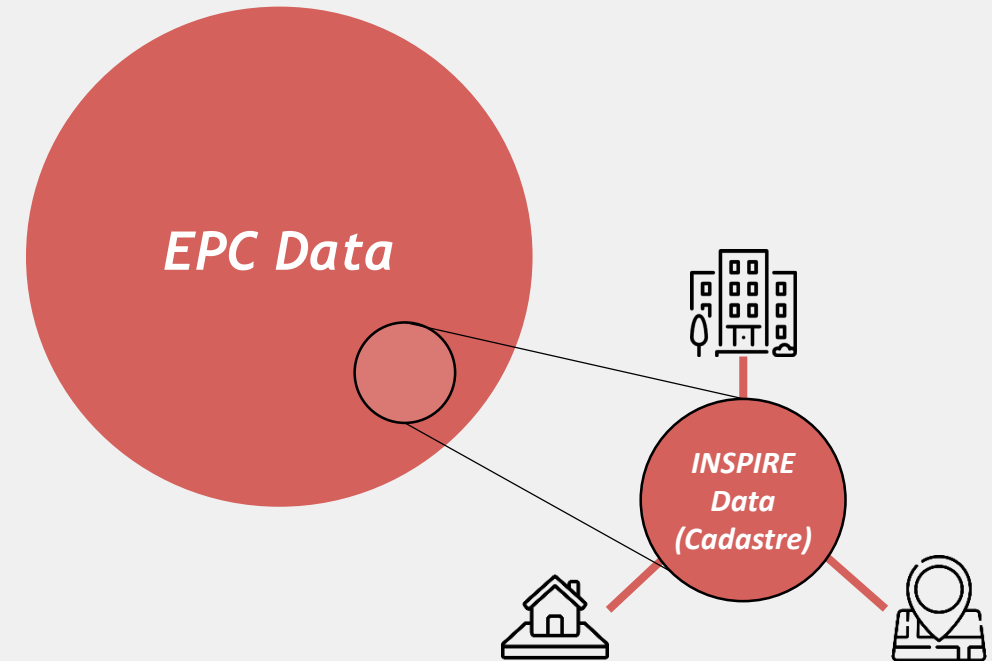| immoble	catastroPostalCode	epcPostalCode
http://ex.com/Immoble/5L8TYYZZM	8402	8401
http://ex.com/Immoble/K4SF93DYL	43700	43719
http://ex.com/Immoble/Y6M8DDXL8	8003	8001
http://ex.com/Immoble/QNRSS8SYM	8860	8660
http://ex.com/Immoble/Q5ZYBLS4L	43005	43004
http://ex.com/Immoble/1QBKFWFR2	8173	8172
http://ex.com/Immoble/1QBKFWFR2	8173	8172
http://ex.com/Immoble/1QBKFWFR2	8173	8172
http://ex.com/Immoble/YK948SD6J	8173	8172
http://ex.com/Immoble/2XZN50V7T	17005	17006
http://ex.com/Immoble/9CGQCYD2K	8208	8206
http://ex.com/Immoble/9CGQCYD2K	8208	8206
http://ex.com/Immoble/9CGQCYD2K	8208	8206
http://ex.com/Immoble/9CGQCYD2K	8208	8206
	0	8410
	0	8410
	0	8410

6177 cadastre postal codes with null value.

Conclusions

Energy performance certificates have been integrated with Cadastre information using Semantic Web technologies.

Changes in the cadastre are monitored and linked to the EPCs.

Errors in EPC data have been identified.

We could validate the EPC attributes (e.g., surface, year of construction, climate zone…) that exist also in the cadastre.

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

laSalle RAMON LLULL UNIVERSITY | IREC Institut de Recerca en Energia de Catalunya Catalonia Institute for Energy Research | GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

Conclusions

Energy performance certificates have been integrated with Cadastre information using Semantic Web technologies.

Changes in the cadastre are monitored and linked to the EPCs.

Errors in EPC data have been identified.

Integrating new data sources such as census, building technical inspections, energy bills... the quality of the EPC data could be increased.
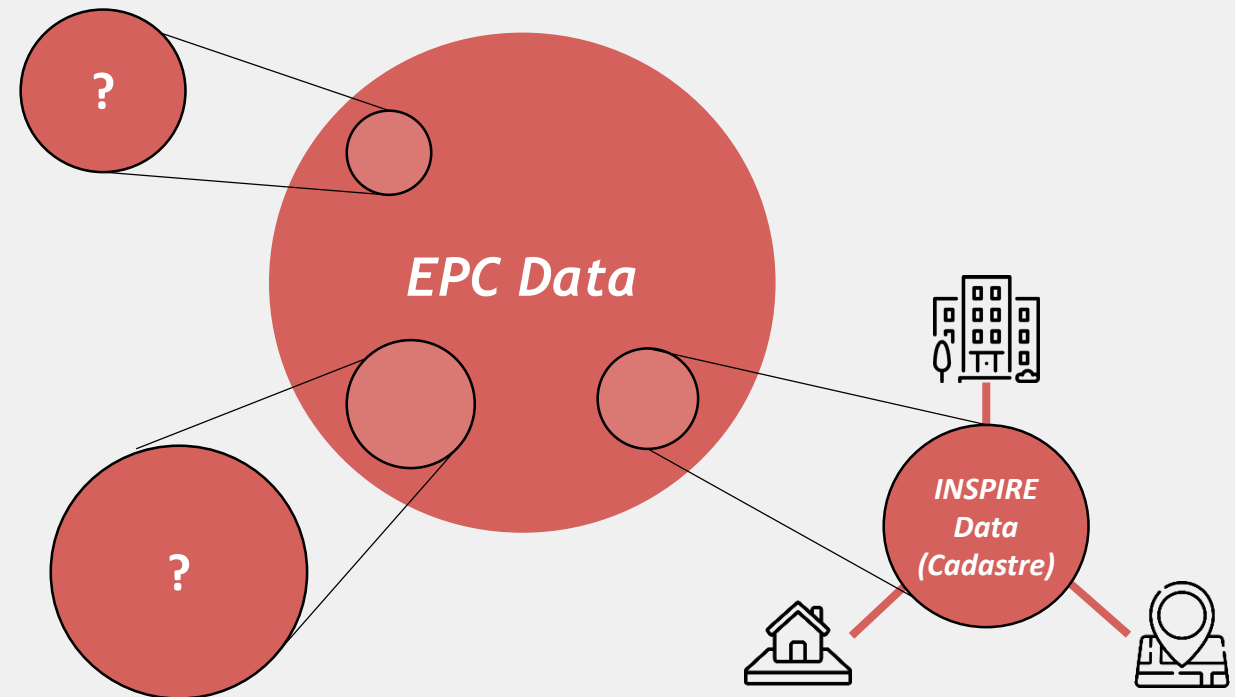
RETABIT: Integrating EPC data with cadastre to foster residential building retrofitting programmes in the implementation of SECAPs

**If you would like more information,
please contact us at**

alvaro.sicilia@salle.url.edu
anna.nogueri@salle.url.edu

Thanks for your attention!