Artificial Intelligence and Energy Poverty: Innovative Solutions

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How can AI contribute ?

IA delivers tools which help in making decisions:

1. To assess the vulnerability in urban areas at high detail level
2. To support customized energy awareness services

How do we assess energy poverty i urban areas?

- Through implementing a methodology based on AI that integrates:
  - Heterogenous and harmonised datasets in a common database
  - Weather modelling to upscale satellite resolution to microlocal
  - Energy performance modelling of the building stock
  - Key Performance Indicators (KPIs) of energy poverty at building level
  - Visualization of KPIs over a map web interface
  - A extreme events alarm app to address the most vulnerable buildings

Identification and ingestion of multiple data sets

The process identifies and manages more than 100 data sources and thousands of data sets

Ingestion processes

Manually or periodically executed

Reading from webs, files, external databases or APIs

Implemented in Python scripts

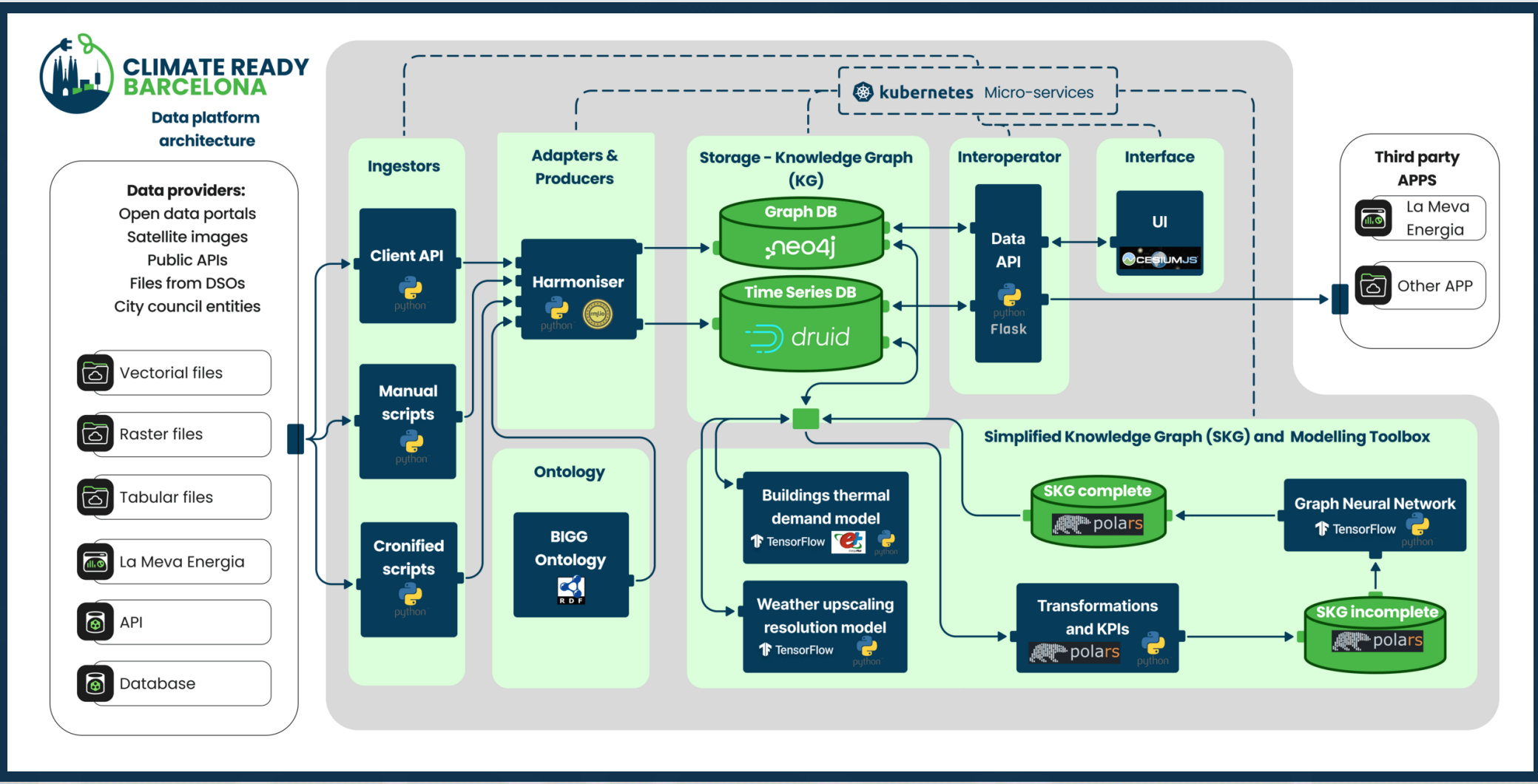
Harmonisation processes

All ingested datasets go through a transformation process to align them to the **data ontology**

Store the data to the databases

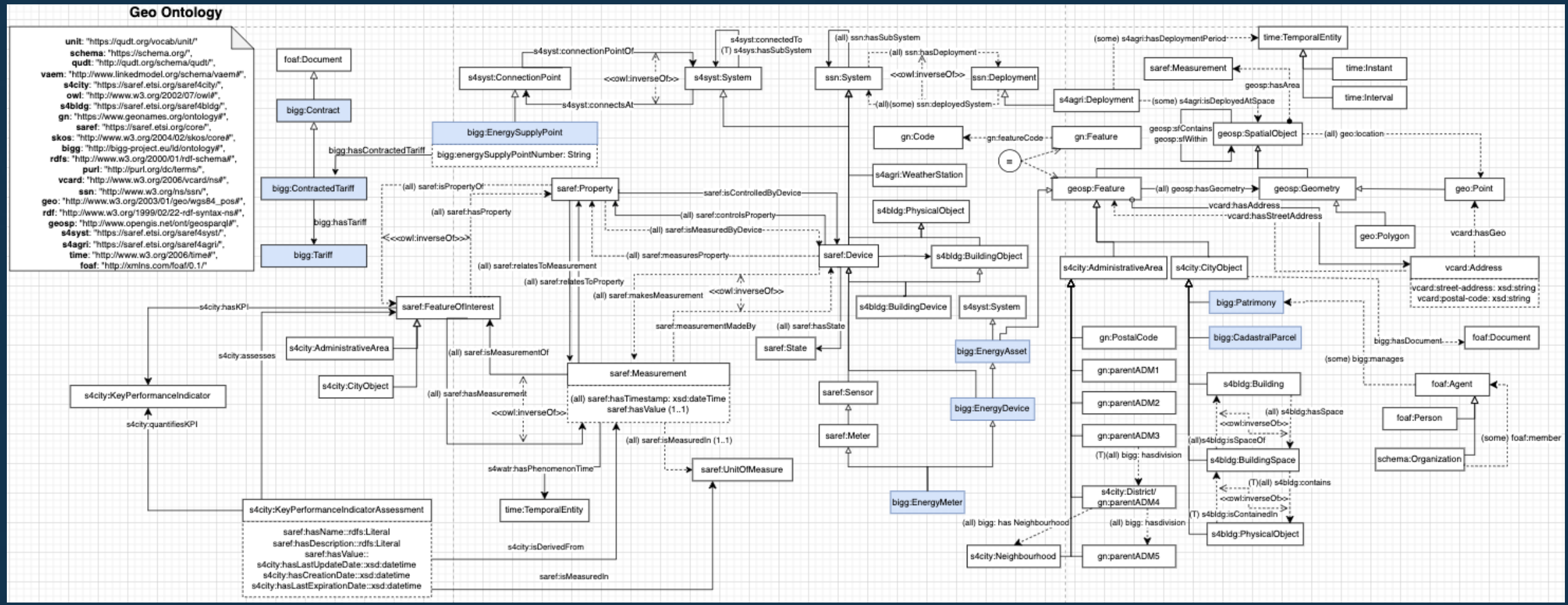
Implemented in Python and using RML.io functionalities.

Data architecture



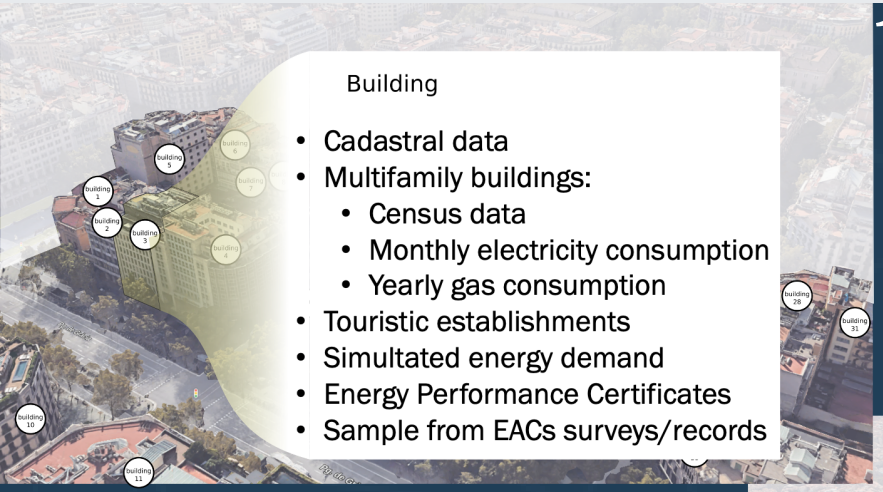
/ Web semantics

An ontology to structure the data



General concept: Knowledge graph

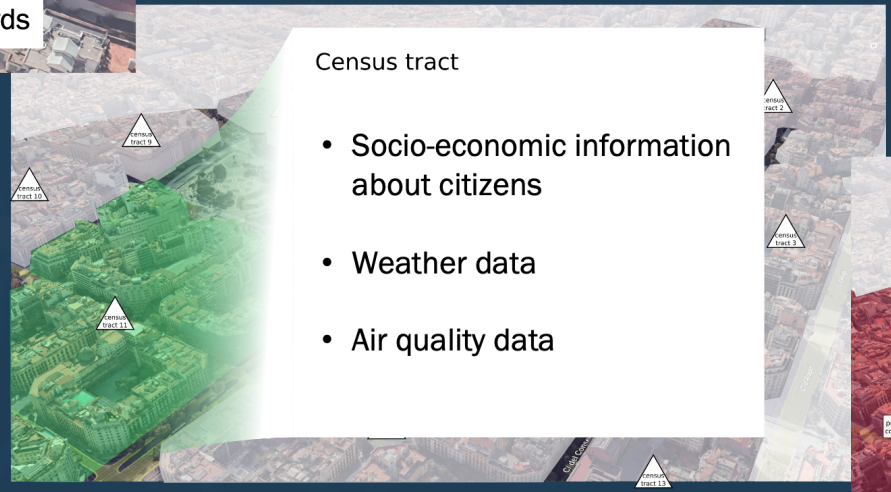
1. Data at building level



Building

- Cadastral data
- Multifamily buildings:
  - Census data
  - Monthly electricity consumption
  - Yearly gas consumption
- Touristic establishments
- Simultated energy demand
- Energy Performance Certificates
- Sample from EACs surveys/records

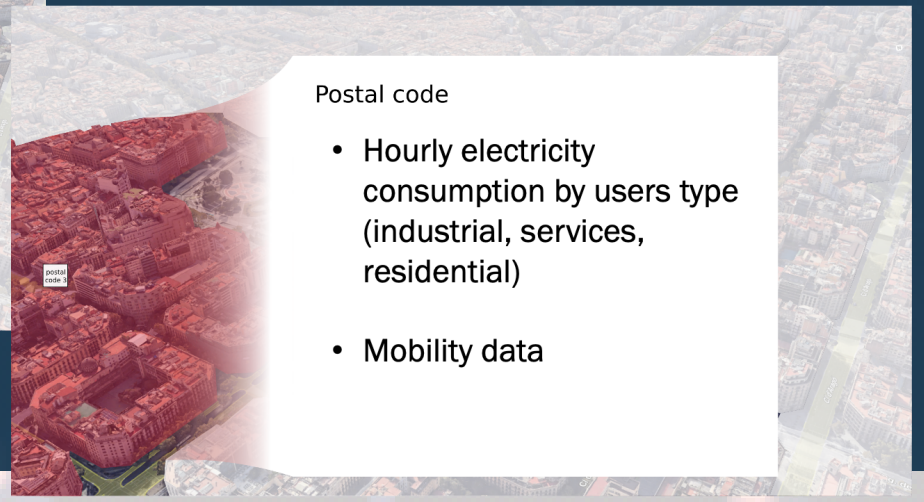
2. Data at census tract level



Census tract

- Socio-economic information about citizens
- Weather data
- Air quality data

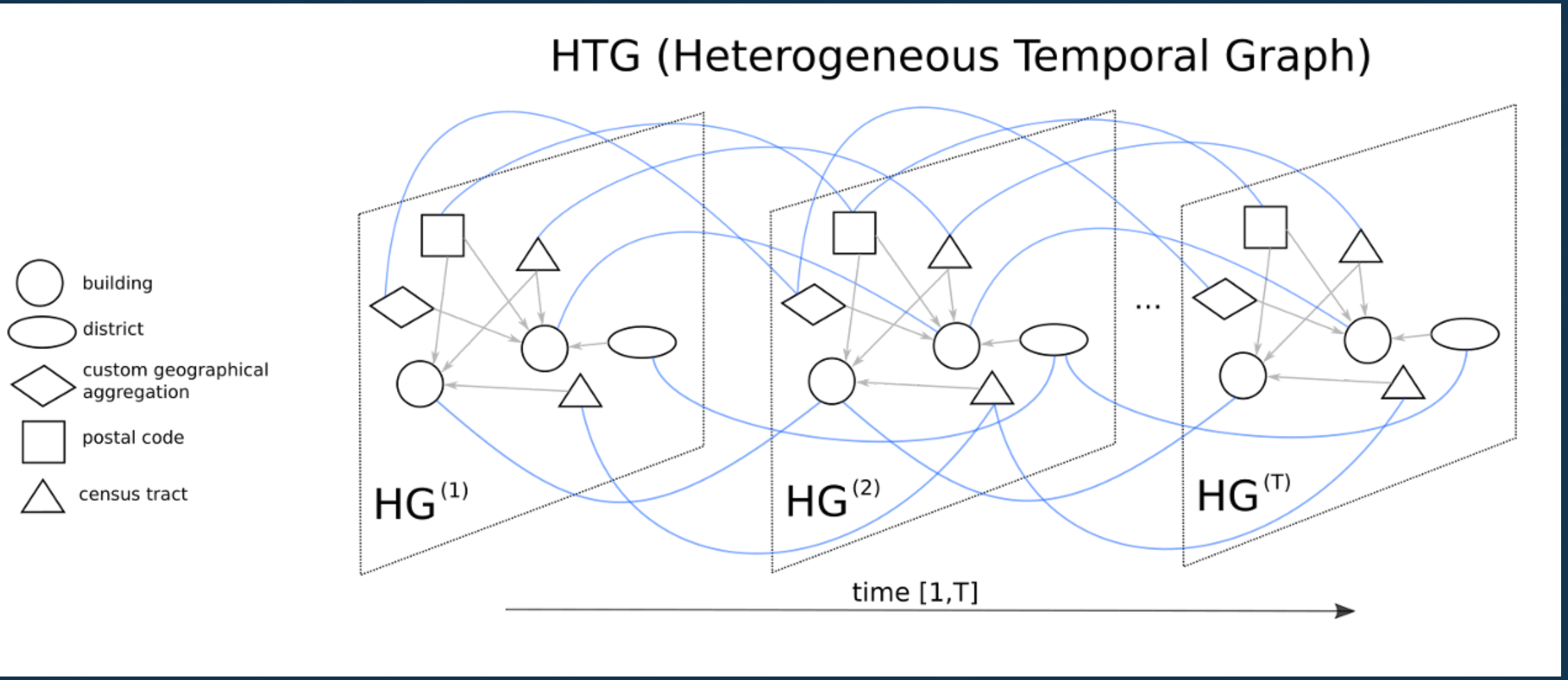
3. Data at postal code level



Postal code

- Hourly electricity consumption by users type (industrial, services, residential)
- Mobility data

General concept: Knowledge graph



/ Modelling

Multifaceted Models: Diverse Objectives

Buildings Energy demand model

Simulation of the energy demand of buildings in the urban area, based on archetypes, construction types, local weather data and user behaviour patterns.

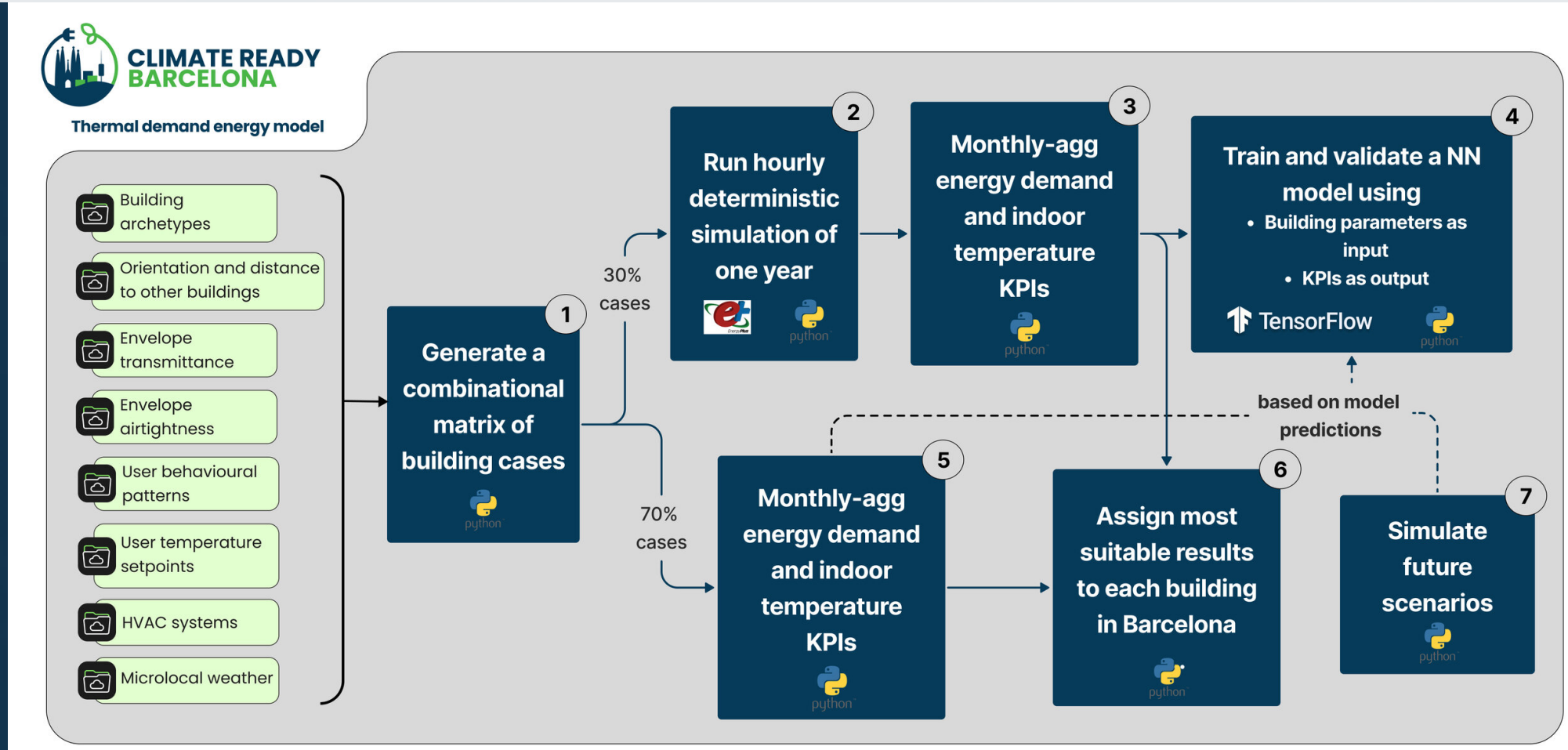
Weather upscaling resolution model

Prediction model to upscale meteorological data from mesoscale to microscale.

Graph Neural Network

General model to predict indicators at building level based on real measurements, location of buildings and their relation among several aggregation layers.

Building's energy demand modelling



Weather upscaling modelling

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Weather upscaling model

Training datasets

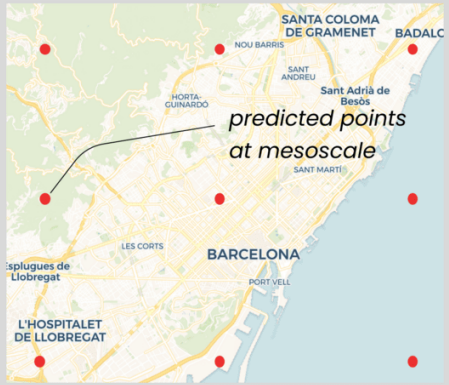
- MeteoGalicia WRF 96h-horizon historical forecasts from 2008 to 2017
- Cadaster
- Vegetation index (NDVI) raster
- Digital Terrain Model
- Land cover map

INPUT

Resolution: ~8km

Daily WRF 96h-horizon forecasts

- Air temperature
- Relative humidity



Static indicators over a 100x100m grid

- Total built volume
- % area dedicated to every land cover typology
- Average height over sea level
- % of each type of vegetation indexes

Weather upscaling resolution model

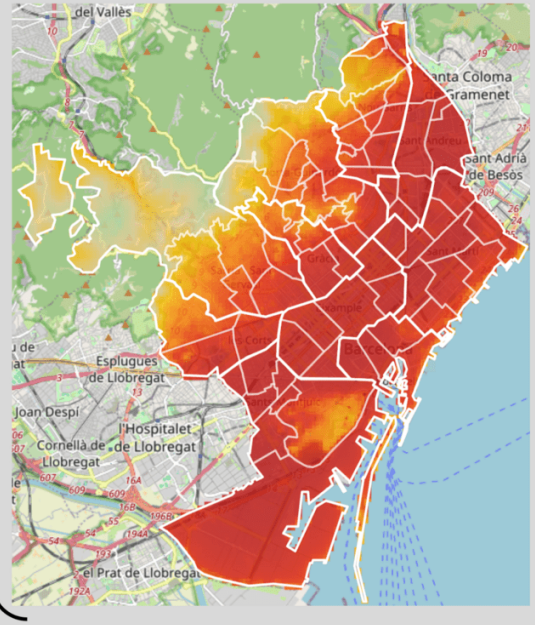
TensorFlow python

OUTPUT

Resolution: 100m

Upscaled daily WRF 96h-horizon forecasts

- Air temperature
- Relative humidity



Training dataset

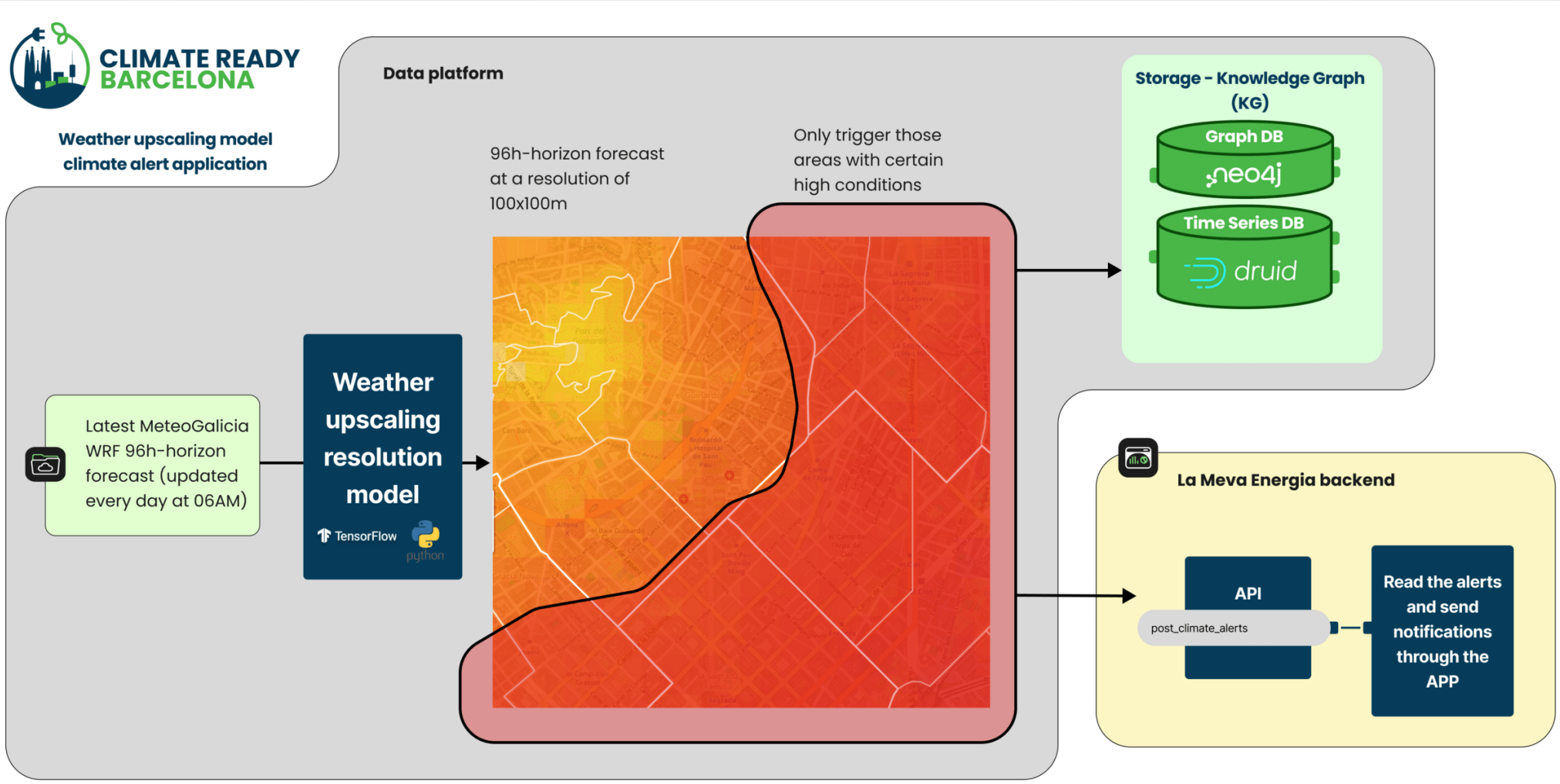
- Climate variables for cities in Europe from 2008 to 2017 based on UrbClim model

How do we support customized user awareness?

- Through a near-real-time interaction with the App "La meva Energia":
  - By providing specific information about the building quality of the user
  - By setting up an alarm system addressing extreme weather events (heat waves)

/ Modelling

Alarms for extreme weather events



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Thanks for your attention

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