The Green Energy Scenario

Piergiorgio Cipriano

Sinergis is one of one of the major Geo-ICT companies in Italy ...


GISIG

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exploring horizons

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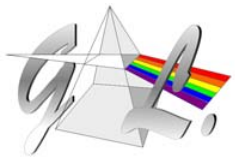

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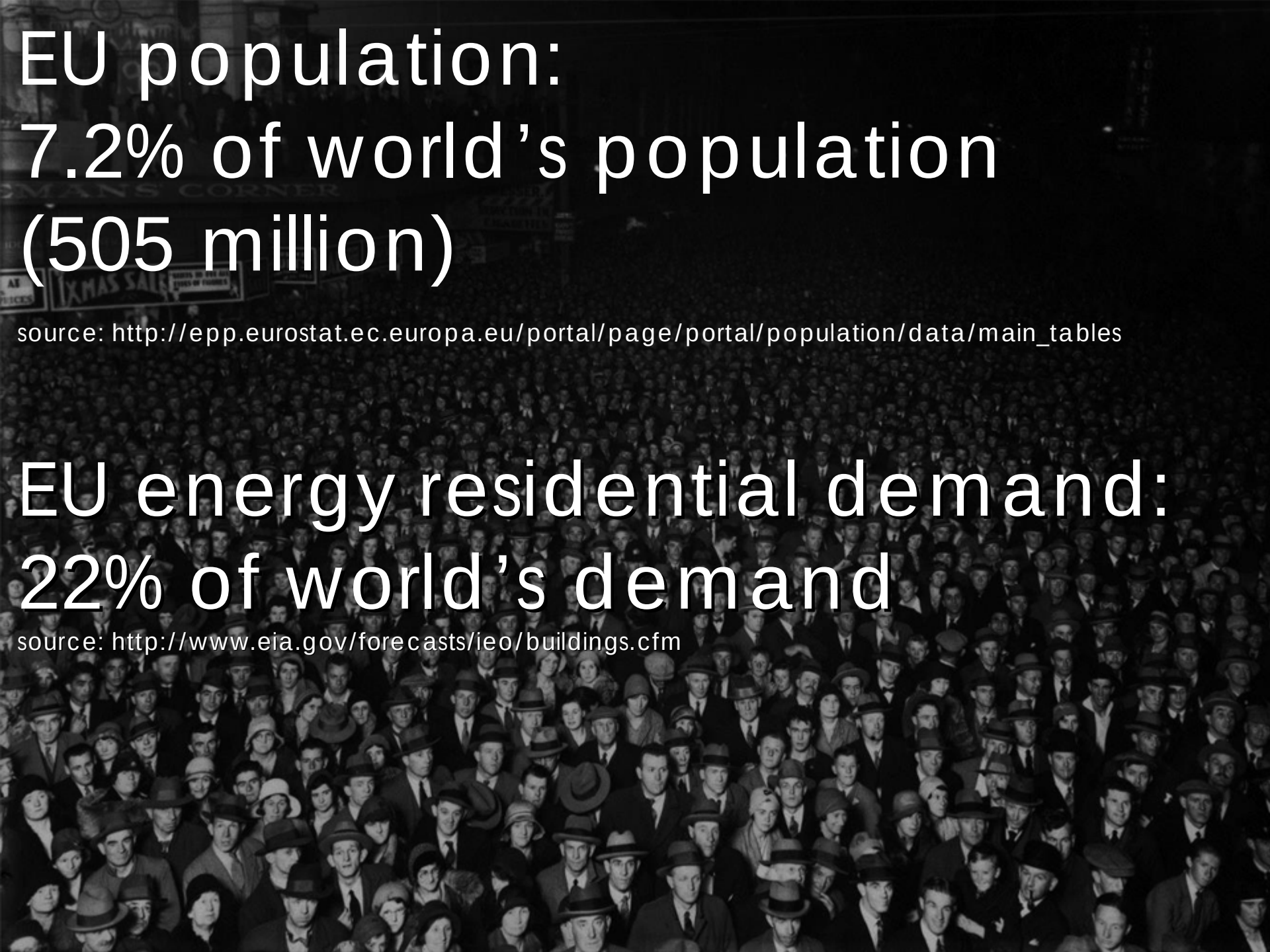
GEOSYS

‘Green Energy’

few (but big) numbers



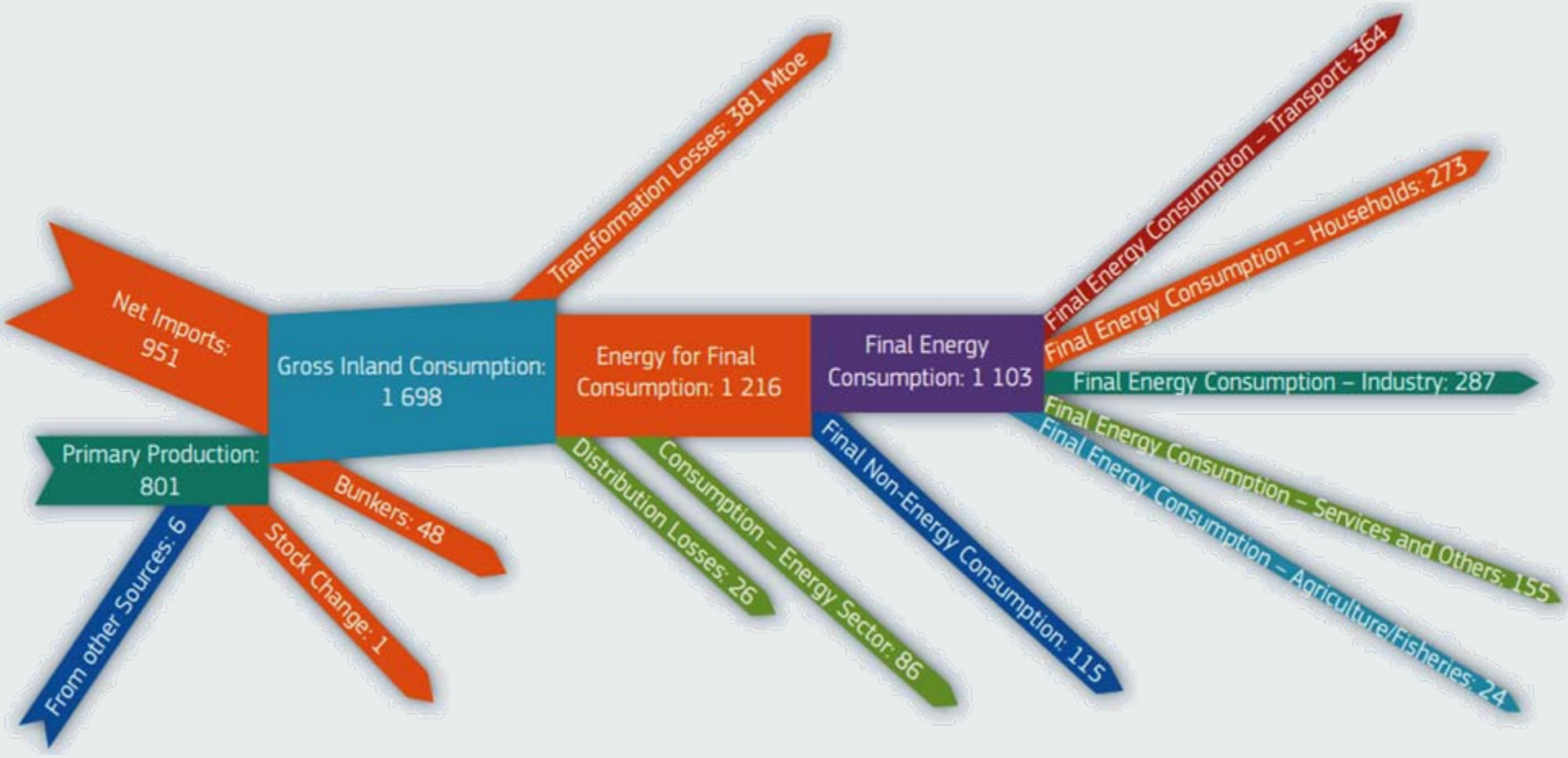
EU population:
7.2% of world's population (505 million)

source: http://epp.eurostat.ec.europa.eu/portal/page/portal/population/data/main_tables

EU energy residential demand:
22% of world's demand

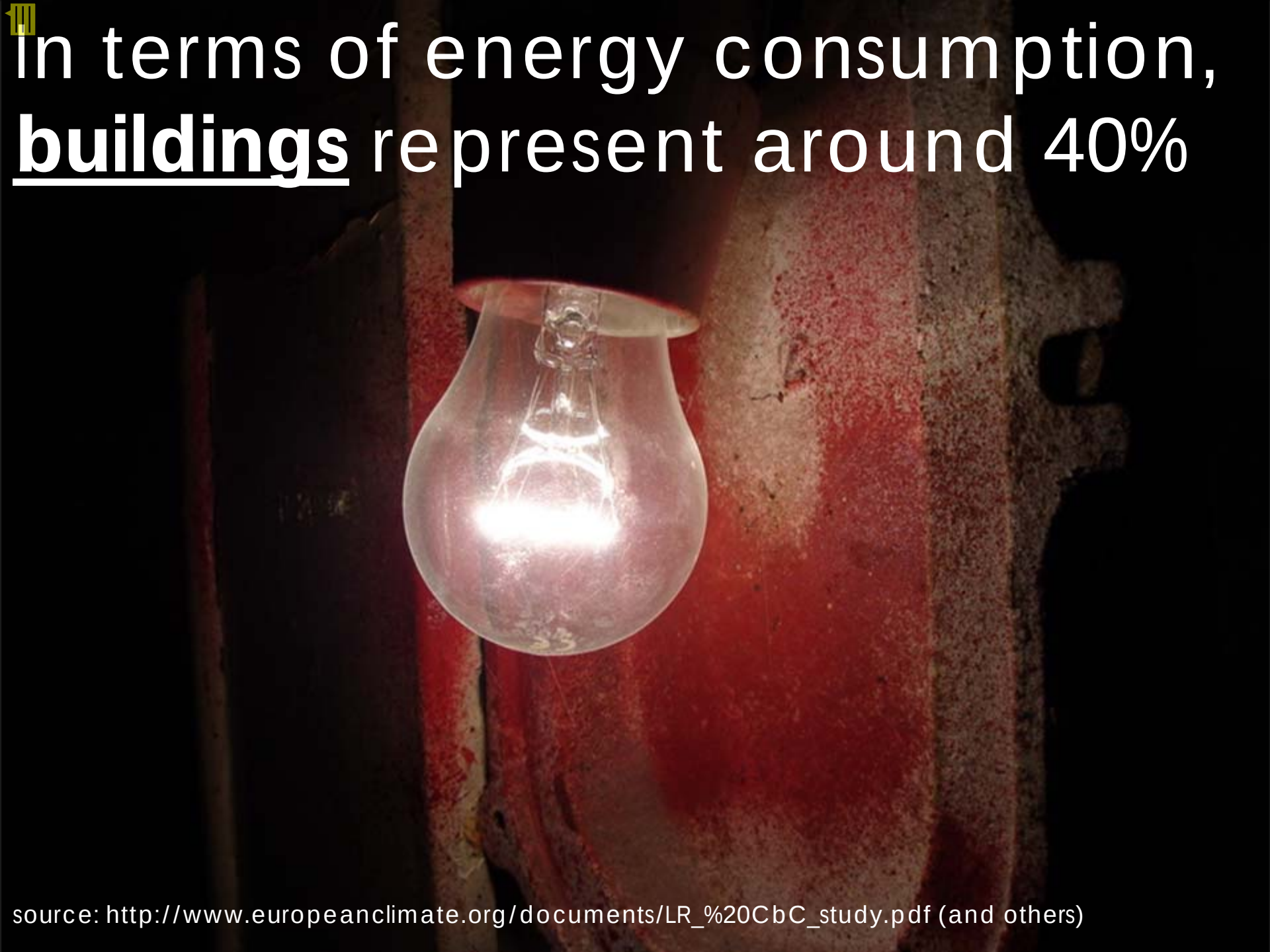
source: http://www.eia.gov/forecasts/ieo/buildings.cfm

Europe 2011 - Energy Flow (MTOE)

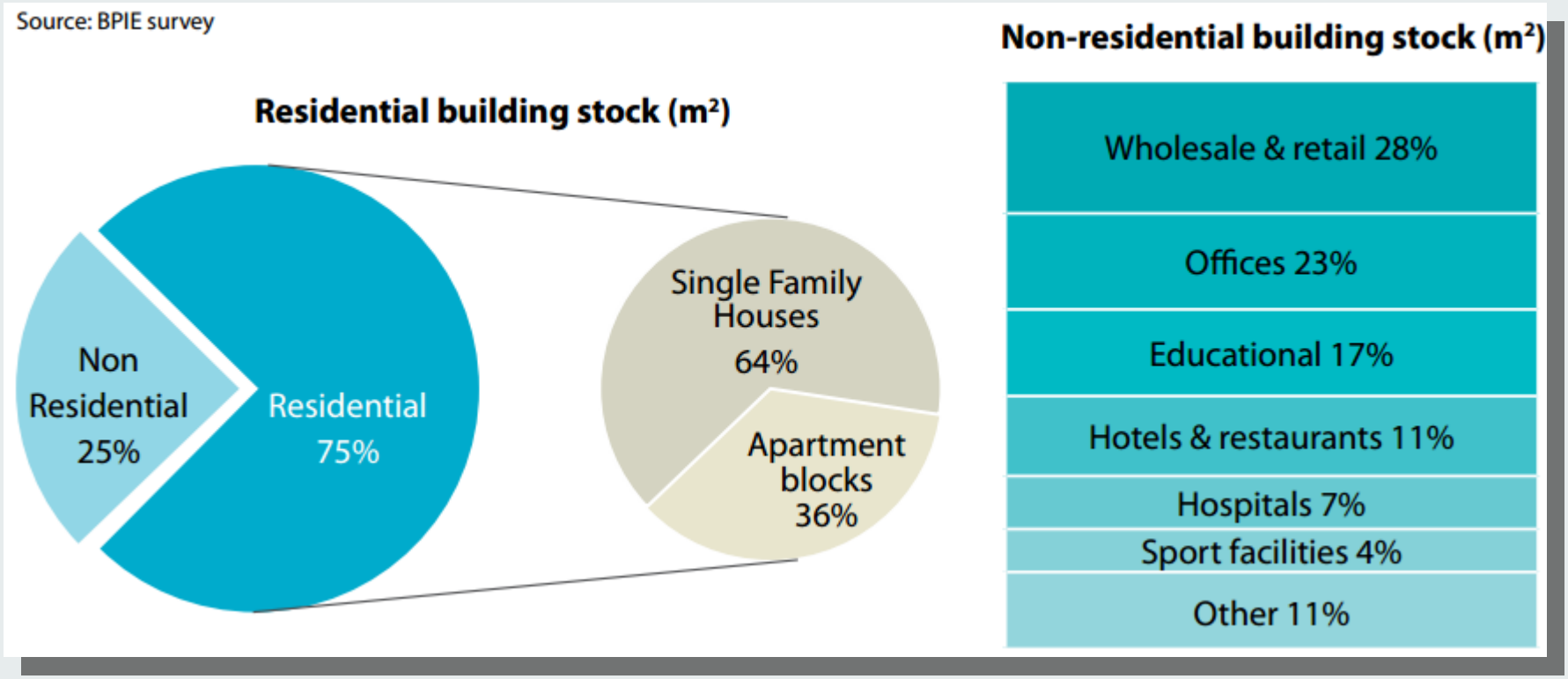


source: http://ec.europa.eu/energy/publications/doc/2013_pocketbook.pdf


In 2020, the European consumption of energy will be 25 trillion kWh (25,000,000,000,000)
In 2040 it will rise to 28 trillion kWh
source: http://www.eia.gov/forecasts/ieo/


In terms of energy consumption,
buildings represent around 40%
source: http://www.europeanclimate.org/documents/LR_%20CbC_study.pdf (and others)

In EU, the gross floor space could be concentrated in a land area equivalent to that of **Belgium** (30,528 km2).



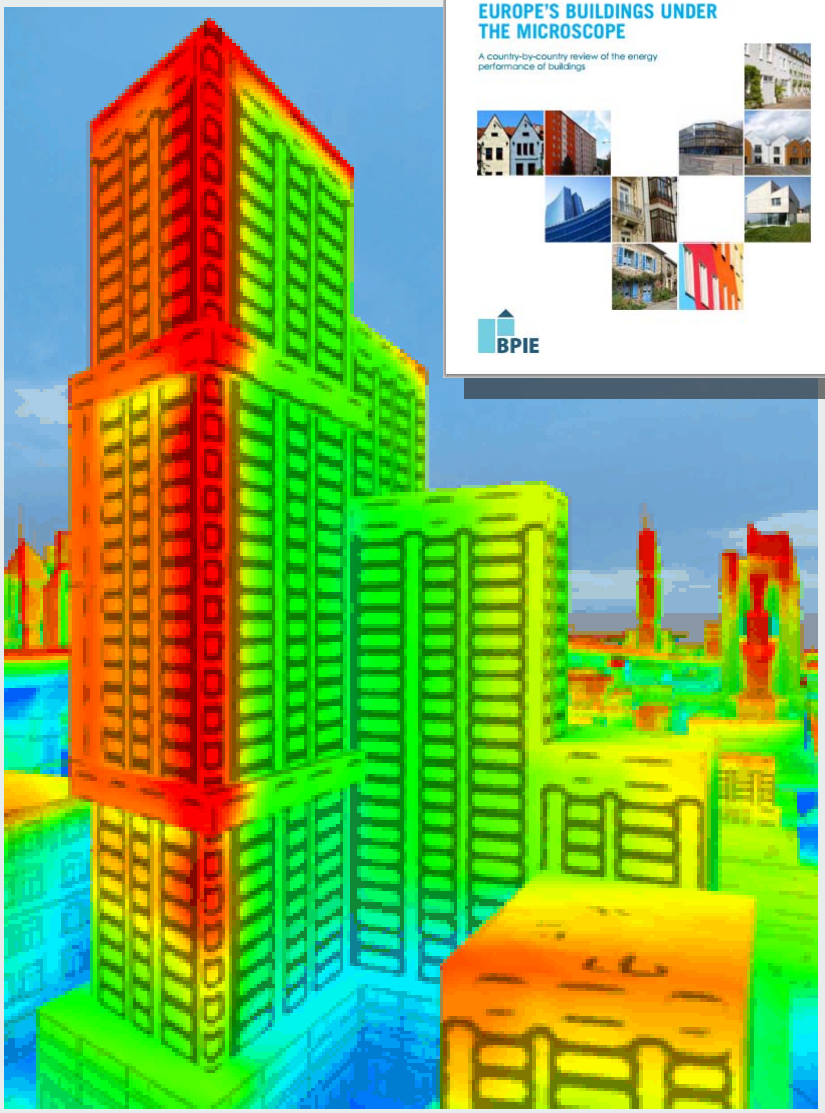
source: http://www.europeanclimate.org/documents/LR_%20CbC_study.pdf

GeoSmartCity

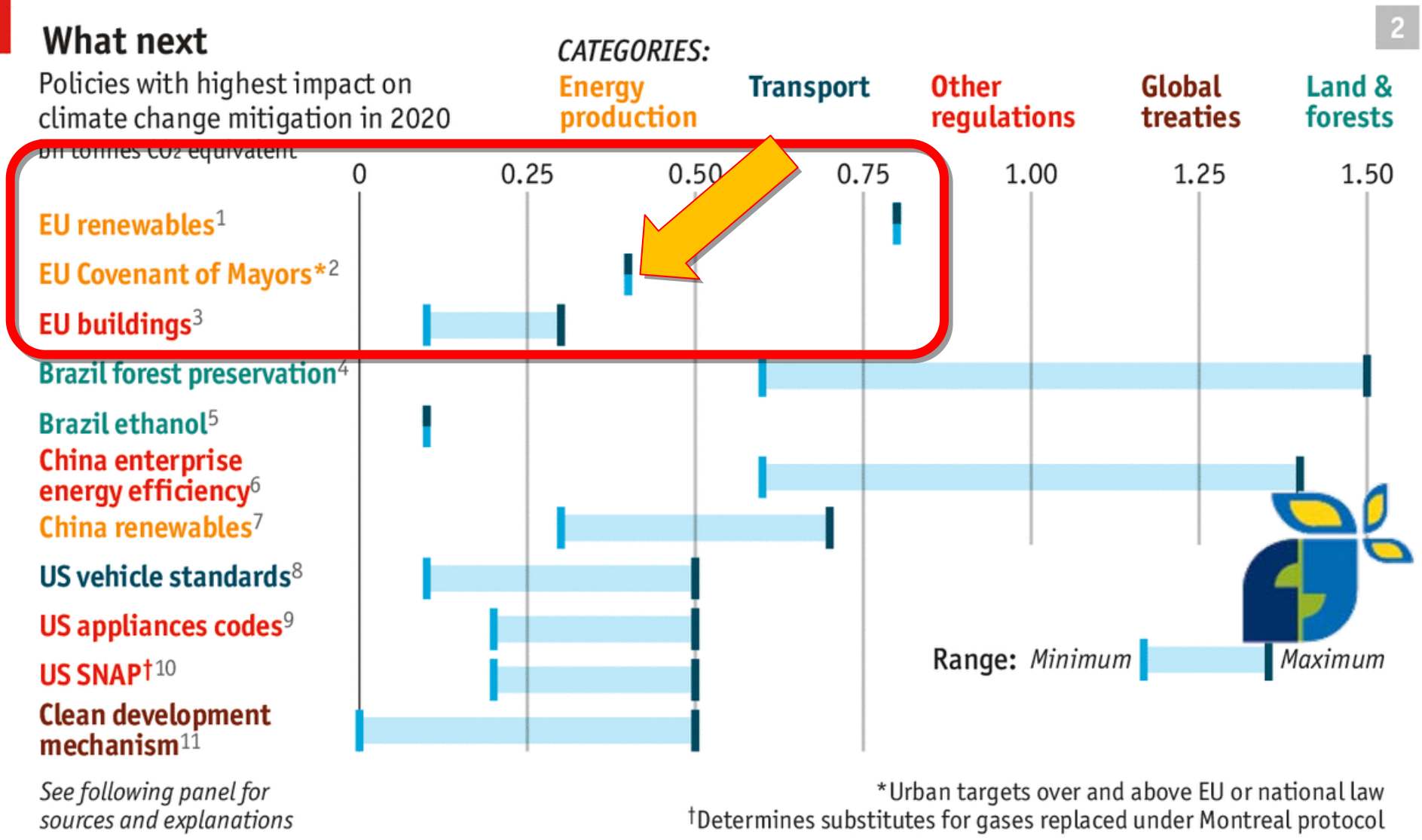
European households are responsible for **68%** of the total final energy use in buildings, for:

-heating (**70%**)
-Cooling
-hot water
-cooking
-appliances

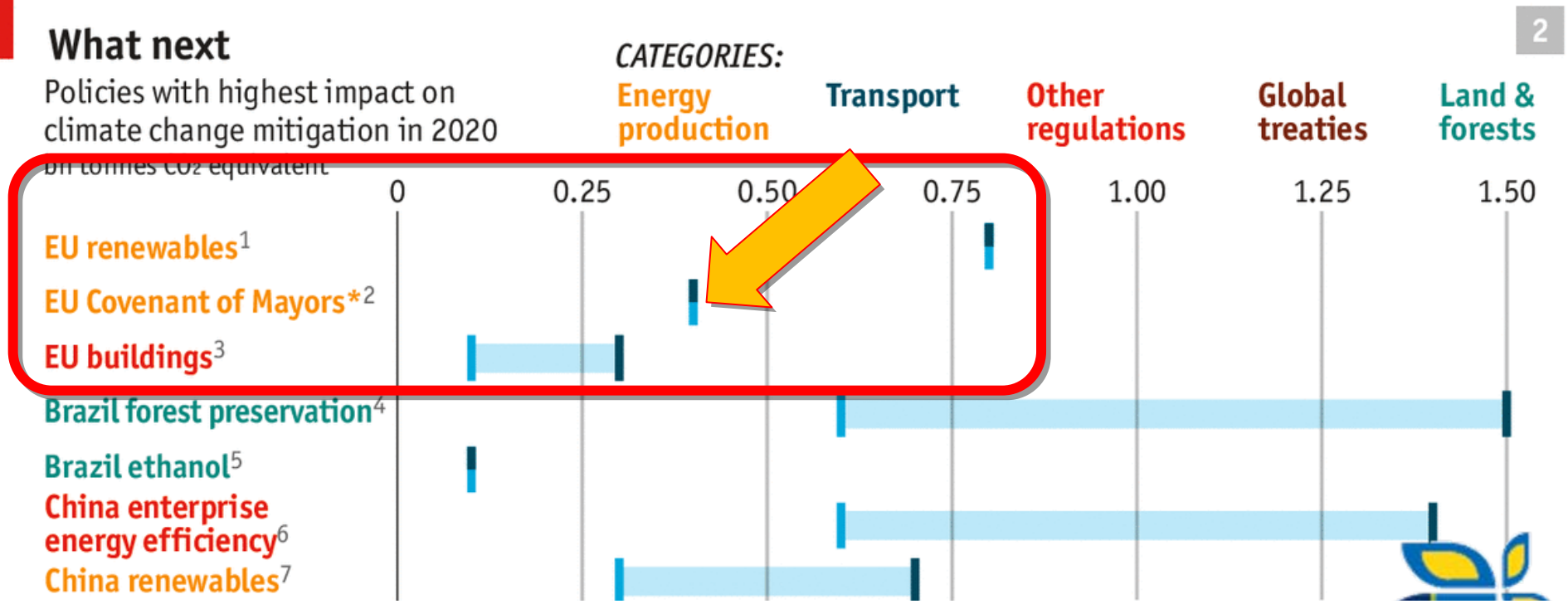
The most used fuel is gas.



source: http://www.europeanclimate.org/documents/LR_%20CbC_study.pdf



http://www.economist.com/news/briefing/21618680-our-guide-actions-have-done-most-slow-global-warming-deepest-cuts



In September 2014 the Economist listed the Covenant of Mayors among '*policies with highest impact on climate change mitigation*'

See following panel for sources and explanations

*Urban targets over and above EU or national law
†Determines substitutes for gases replaced under Montreal protocol

http://www.economist.com/news/briefing/21618680-our-guide-actions-have-done-most-slow-global-warming-deepest-cuts

About the Covenant of Mayors

- More than 6,000 signatories
  - 88% are small municipalities (<50K)
  - but … in terms of population involved, **72% of people** living in municipalities with **> 100K**
- …and the 5 project pilots on Green Energy are between 70K and 180K

Use Cases and Requirements

Data mainly regard:
-Buildings (municipal, residential, …)
-Transport (public, bike)

Buildings and transport represent the main GHG emission sources at urban level.

All five pilot cities are indeed signatories of the **Covenant of Mayors** and need to:
-monitor GHG emission sources
-provide information to stakeholders

5 pilot cities involved in this scenario
-Reggio Emilia (Italy)
-Maroussi (Greece)
-Oeiras (Portugal)
-Turku (Finland)
-Girona (Spain)

13 Use Cases collected

61 requirements (functional, non-functional, generic)

Reggio Emilia (Italy)

Use cases

-Publication of energy performance of municipal buildings
-Publication of energy performance of other buildings

General objectives

-Integrate geodata and energy data for strategic purposes
-Provide integrated open geodata

Main requirements

-Estimate energy performance and CO_2 emissions
-Energy maps and reports, interoperable access to data

Maroussi (Greece)

Use cases

-Data collection via field survey and crowdsourcing
-Energy map creation
-Data publication

General objectives

-Enable citizens and SMEs to make valuable comments and enhance their energy consumption behavior

Main requirements

-Mobile app for editing buildings' properties
-Searching capabilities for buildings
-Provide open geodata through the hub

Oeiras (Portugal)

Use cases

-Urban sustainable planning tool

-Zero-balance calculation

-Calculation of energy performance of buildings

General objectives

-Monitor energy consumption in public buildings

-Achieve a balance between various urban areas

Main requirements

-Calculate solar potential and electric balance

-Reports, statistics

Turku (Finland)

Use cases

-Selecting green route

-Green driving

-Green parking

General objectives

-Shift from private to public transportation in commuter traffic

-Acquire real-life information that can be utilized in city planning and decision making

Main requirements

-Bike routing, bus timetables, paths for commuters

-Estimation of fuel consumption, collect stats

Girona (Spain)

Use cases

-"I want to ride my bicycle, I want to ride it where I like"
-Find healthy bike route

General objectives

-Encourage alternative/light transportation
-Involve city users and stakeholders in data integration

Main requirements

-Provide updates to OpenStreetMap
-Estimate pollution, calculate bike routing

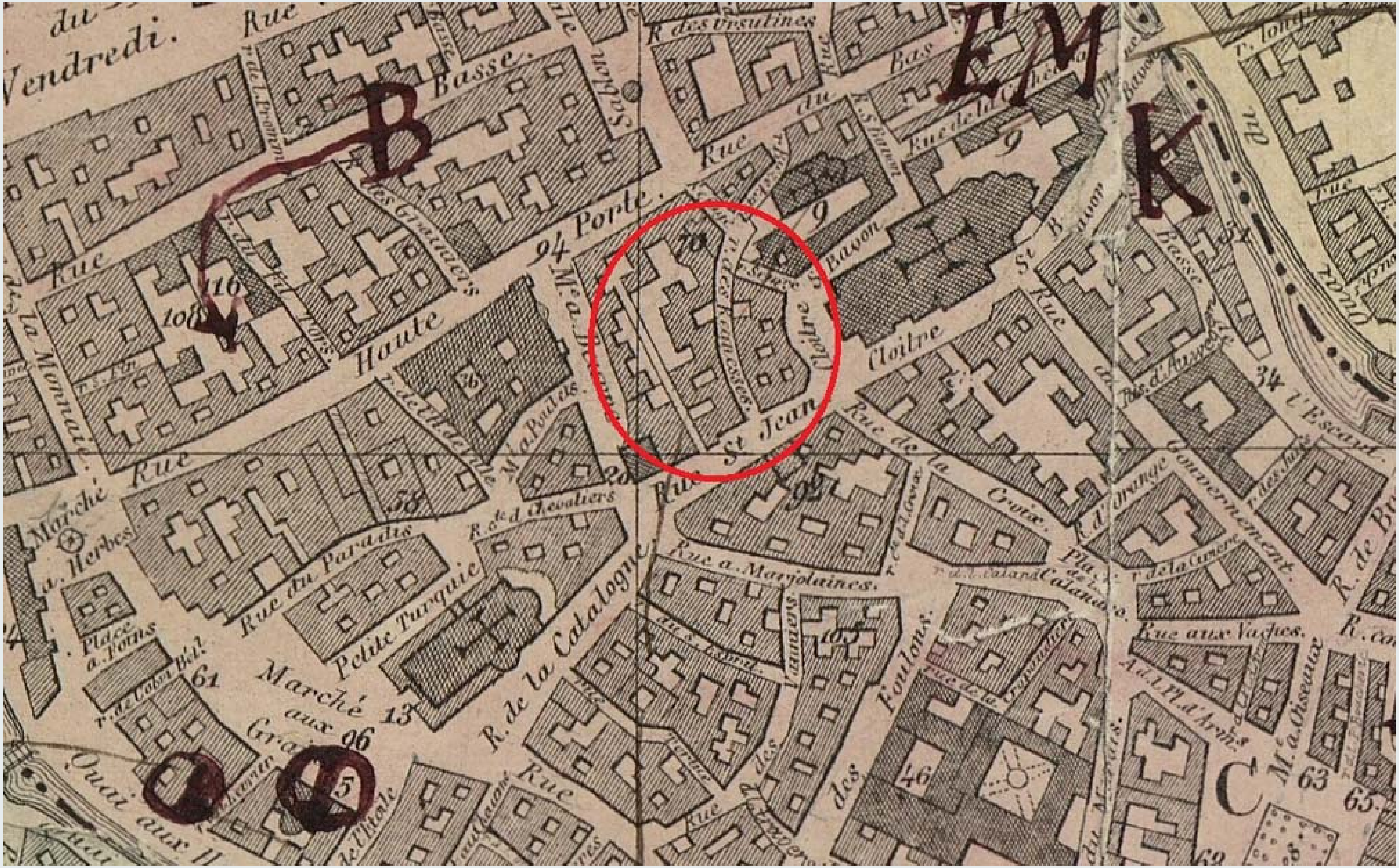
GeoSmartCity

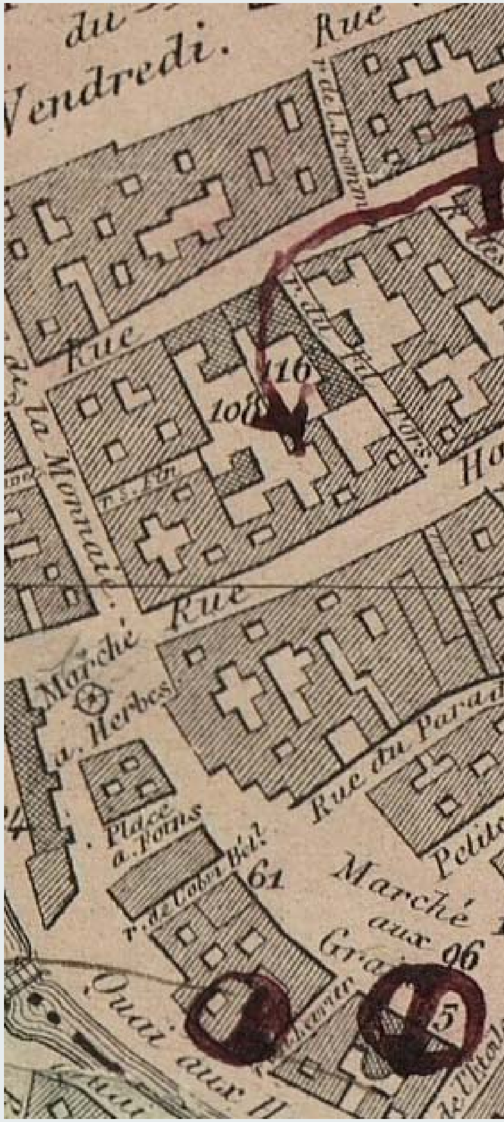
Questions?

The GeoSmartCity Hub

scenarios data services & specialized services

GeoSmartCity

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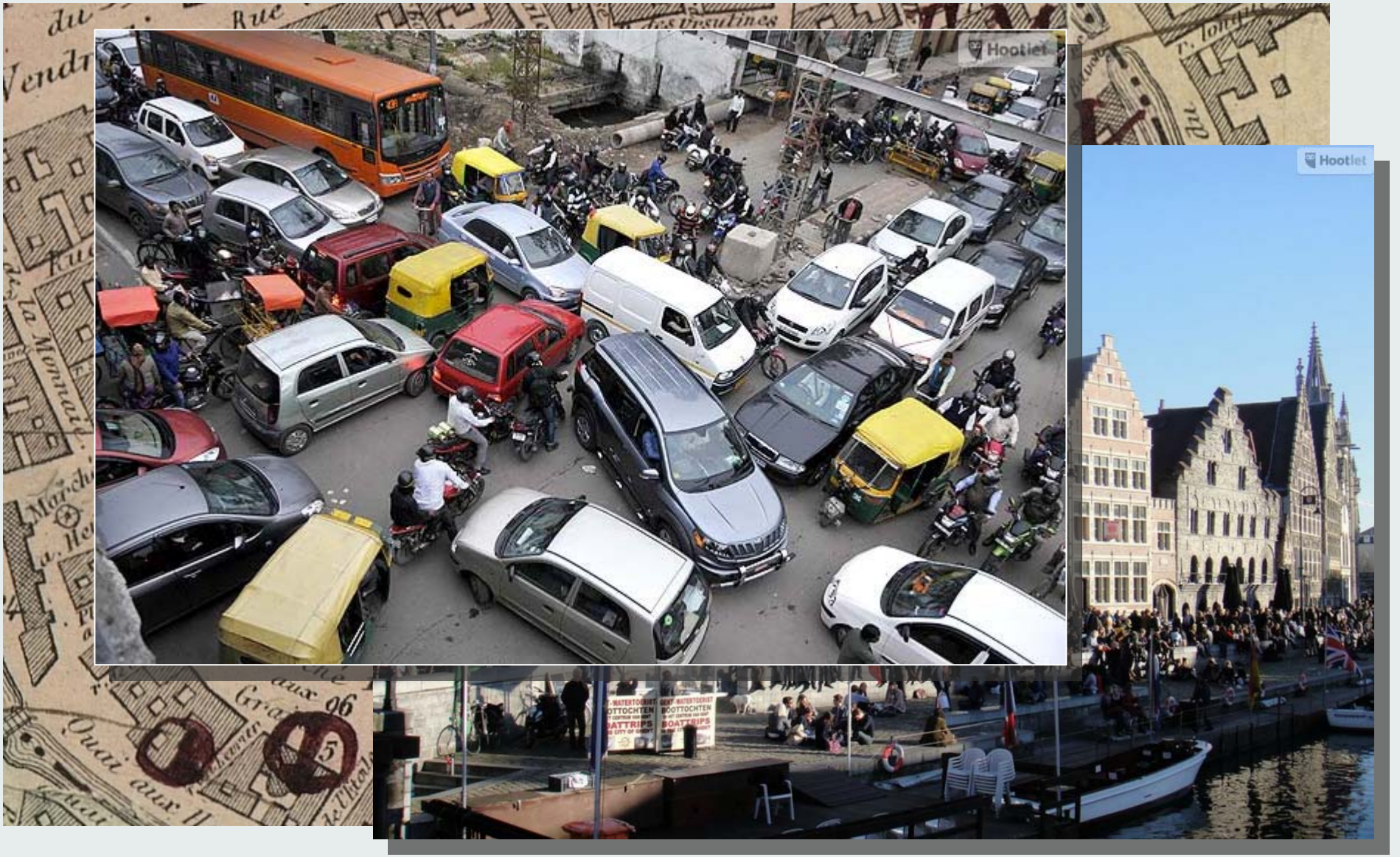
GeoSmartCity




Hootlet

GeoSmartCity

Scenarios data service

Task 3.3 - Design of the scenarios data services (SINERGIS)
According to the architecture and requirements defined in WP2 and output of Task 3.1 and Task 3.2, this task goal is to design the services related to ingestion, management and access for all the types of data (open GI, not-GI and/or not-open data).
Services definition will be carried out in accordance with data models definition (T.3.1) and will be specific to the two scenarios: Underground and Green Energy.
The publishing data services will span from catalogue services (CSW) for browsing and searching data to services for data access and visualization (WMS, WFS, WCS). Sensor data will be available through some of the services of the SWE suite.
Client applications will be able to use these services directly (subject to security policies enforced by the access control components of the system) and implement some business logic locally (see WP5). On the other hand, specific business logic on the server will be implemented by specialised services (see WP4).
Ingestion services, which will take care of populating the data repository with the data harmonised in the Task 3.2, will require some development effort for adapting existing software to the project requirements or developing new ones from scratch. Publishing services will be put in place using existing open source implementation that will need only installation/configuration activities.

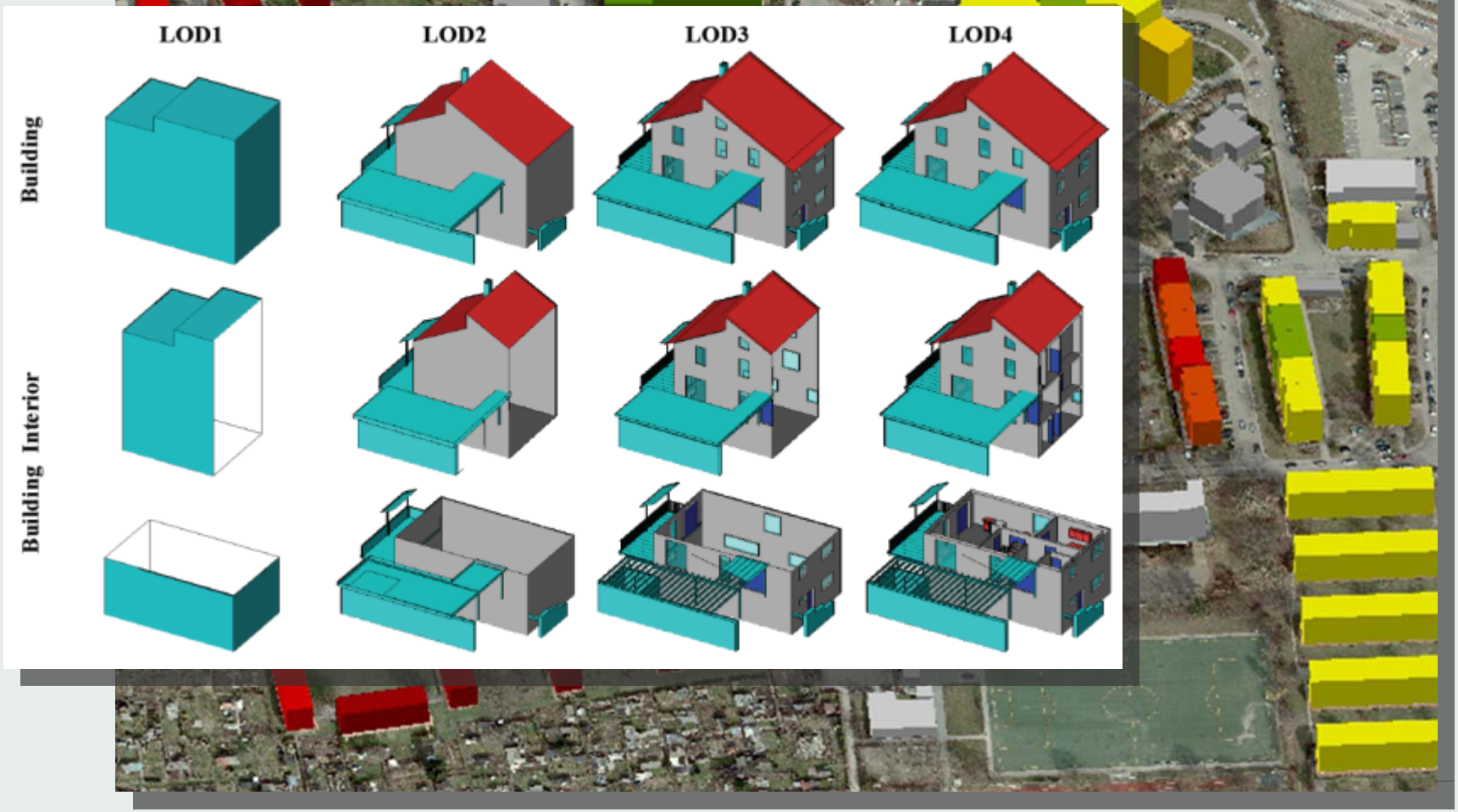
Scenarios data service

- Standard-based open services
  - OGC & INSPIRE (CSW, WMS, WFS, WCS, SOS)
  - INSPIRE Data Specifications (extended)
  - Well-documented APIs for open data and geospatial
  - ISA Core Vocabularies (RDF, SPARQL/GeoSPARQL)
- Reuse of INSPIRE reference platform
  - ARe3NA Registry, EUOSME (Metadata editor)
- Based on outcomes of other projects, e.g.
  - eENVplus - http://www.eenvplus.eu/
  - Sunshine - http://www.sunshineproject.eu/

INSPIRE and “Energy” in Buildings

Figure 37: Main feature types of Buildings Base Extended

source: http://www.simstadt.eu/en/index.html



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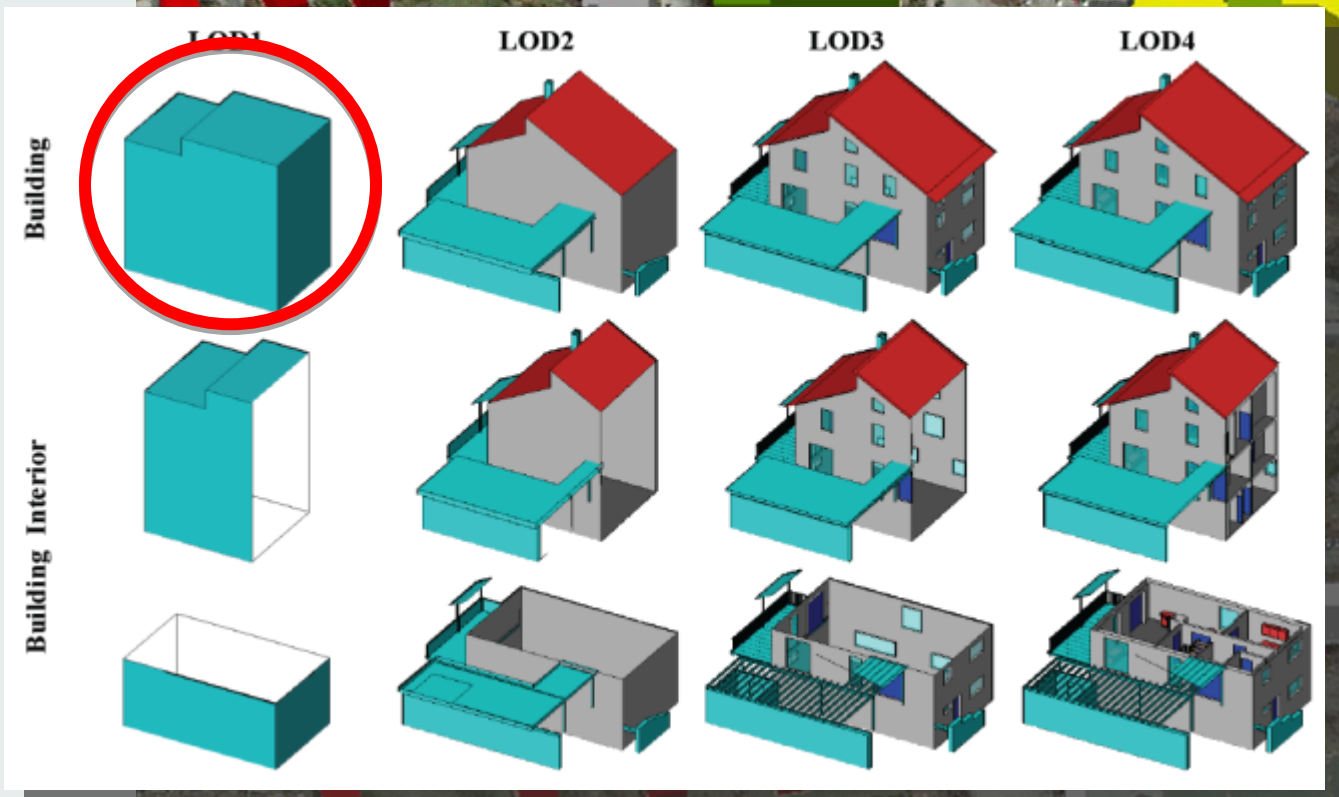
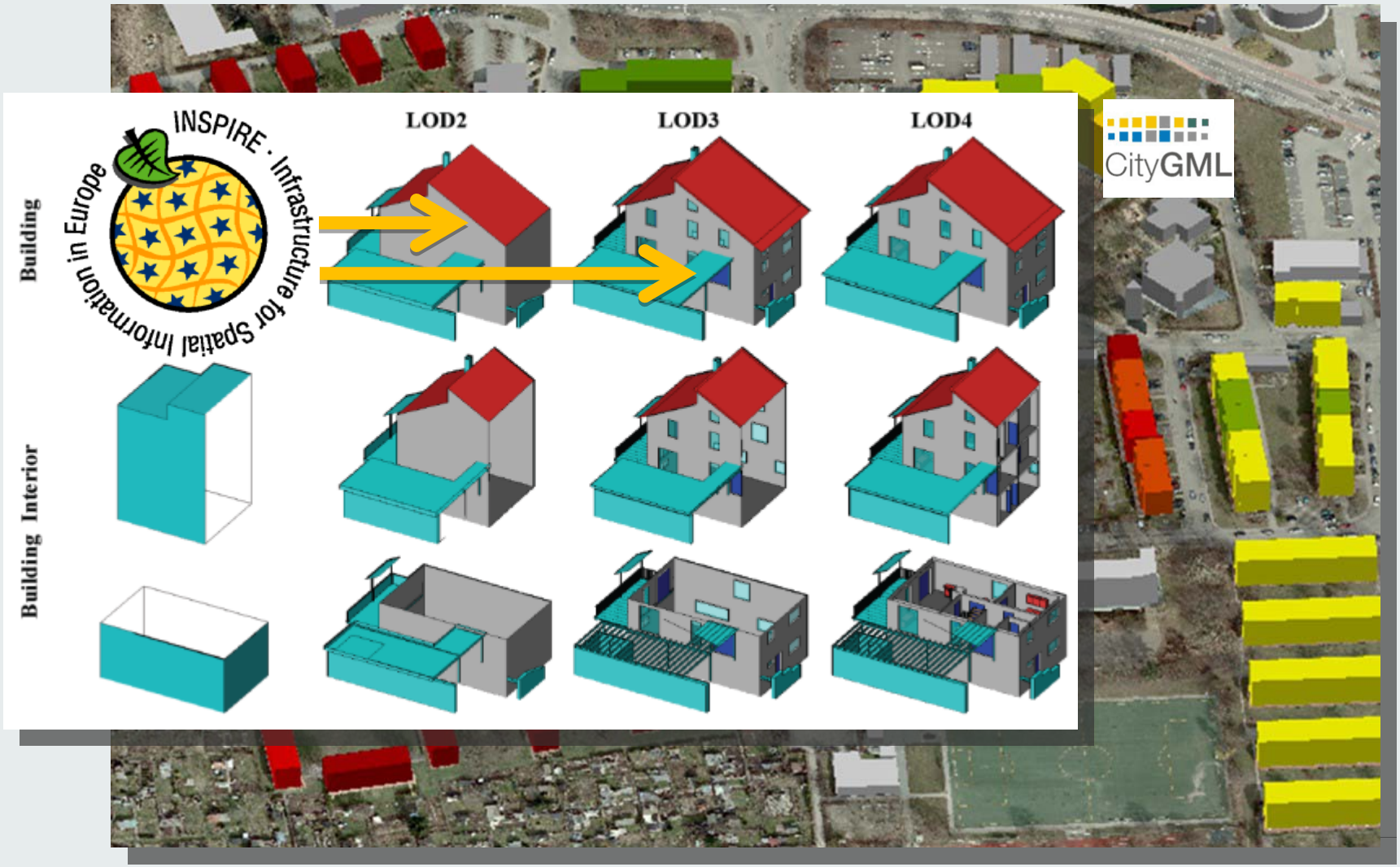


source: http://www.simstadt.eu/en/index.html



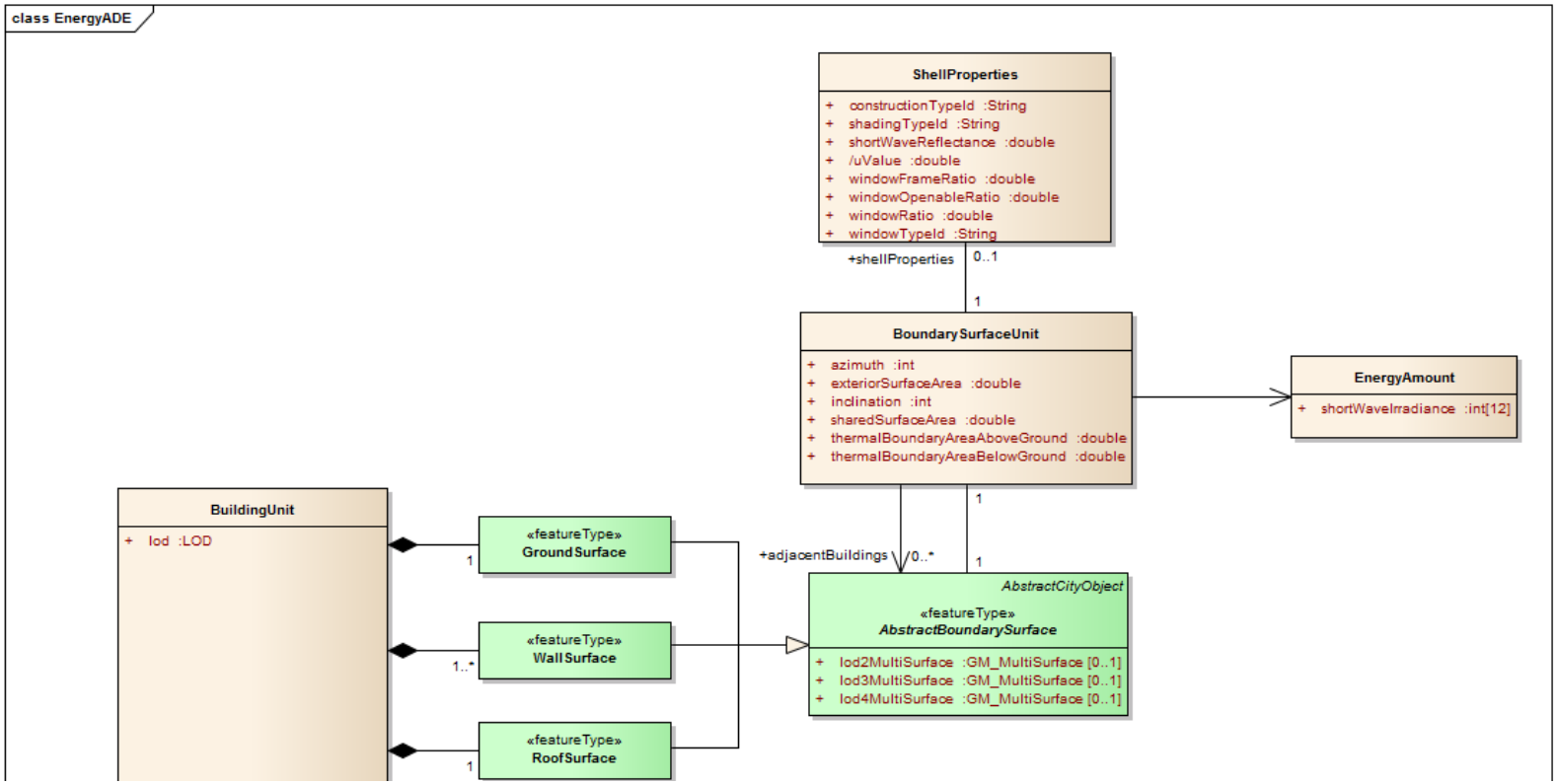
source: http://www.simstadt.eu/en/index.html

2014 S HfT EnergyADE

In CityGML 2.0 a building is described by its geometry in five different level of details, and a set of sttributes such as usage, yearOf Construction, etc. More specific, the spatial entity "building" of the real world is defined by a "BuildingType" in CityGML. A BuildingType is the blueprint of every building in the real world. However, some attributes that are essential for our simulation purposes are missing in the CityGML BuildingType. The BuildingType references it's bounding surfaces. These surfaces are defined by "AbstractBoundarySurfaceType" and by the inferred types "GroundSurface", "WallSurface" and "RoofSurface".

In order to extend the BuildingType and the AbstractBoundarySurfaceType in CityGML, an Application Domain Extension (ADE) has to be developed. This ADE will be called Energy ADE. Goal: Extend the CityGML format with building energy state information data, in order to lead energy diagnostics/simulation and be able to plan energy refurbishment.

As an example take a look at the UML diagram for an EnergyADE of the HFT Stuttgart:



One of the primary challenges to expanding the building energy efficiency retrofit market is the lack of data on the actual energy performance, combined with the physical and operational characteristics, of commercial and residential buildings.

Recent technology, market and policy drivers (smart meters, energy performance disclosure laws, etc.) are resulting in a rapid increase in the generation of building and energy data that has the potential to address these issues. But this data is still hard to access, aggregate, share and utilize because it is being housed in many decentralized databases, and in different formats.

Stakeholders consistently reported that they spend more time on data formatting and cleaning than they do on conducting analysis. The lack of standard data formats, terms and definitions is a significant ongoing barrier to realizing the full utility of empirical information about building energy performance.

*One of the primary challenges to expanding the **building energy efficiency retrofit market** is the **lack of data** on the actual energy performance, combined with the physical and operational characteristics, of commercial and residential buildings.*

*Recent technology, market and policy drivers (**smart meters, energy performance disclosure laws** [illegible] resulting in a rapid increase in the ge[illegible] and energy data that has th[illegible] [illegible]dress these issues. But this **data** [illegible] **[illegible]ess**, aggregate, share and utilize [illegible] housed in many **d[illegible] [illegible]bases, and in different formats**.*

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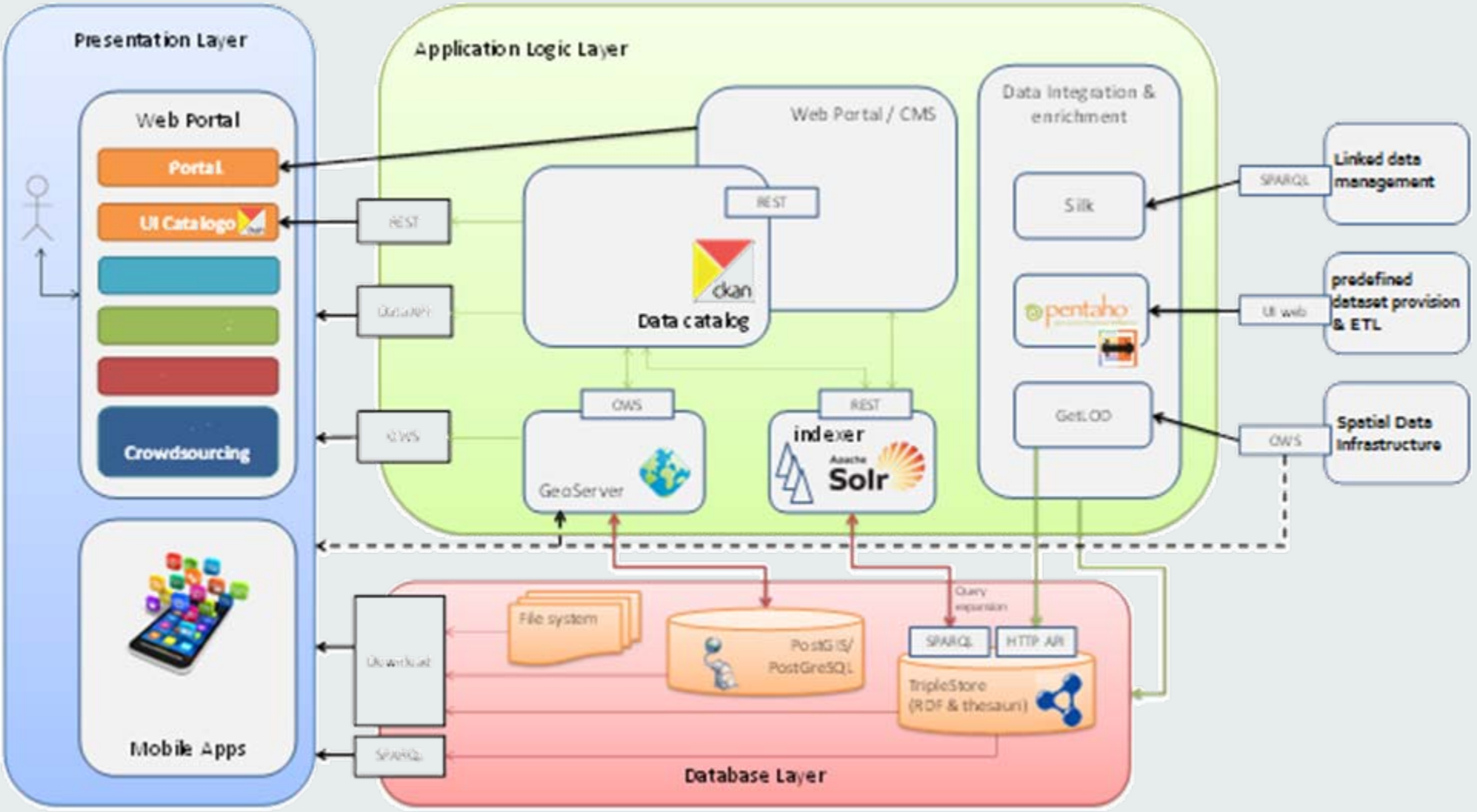
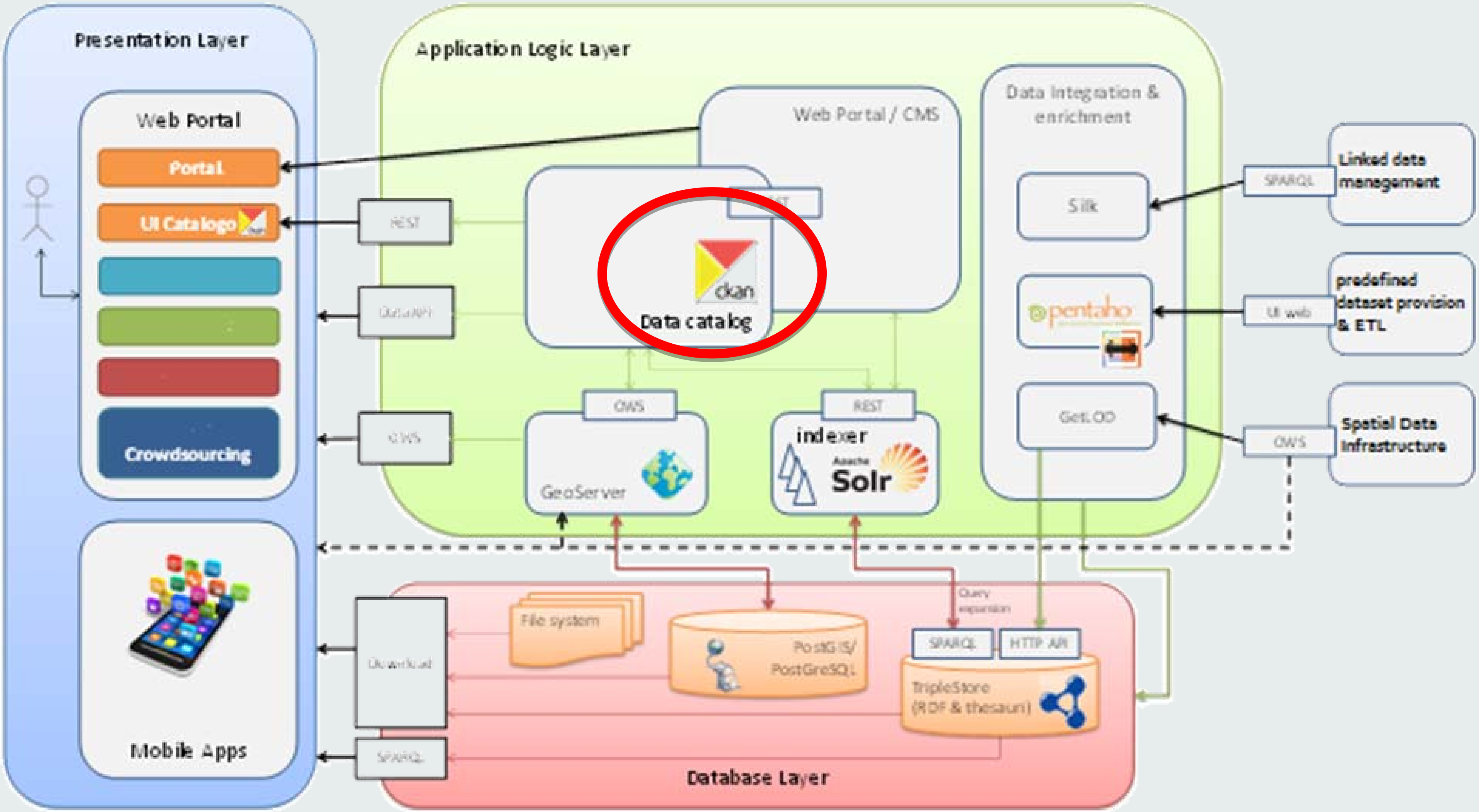
US. Department of Energy
http://energy.gov/sites/prod/files/2013/12/f5/bedes_scoping_080113.pdf

Our goal is

… to implement an **open data hub** based on CKAN and other OSS solutions, connected to **INSPIRE Download Services** provided by pilot cities and enhanced by specialized geo-processing services


Presentation Layer
Web Portal
Portal
UI Catalogo
Crowdsourcing
Mobile Apps
Application Logic Layer
Web Portal / CMS
REST
dkan
Data catalog
OWS
GeoServer
REST
indexer
Apache
Solr
Data Integration & enrichment
Silk
pentaho
GetLOD
SPARQL
Linked data management
UI web
predefined dataset provision & ETL
OWS
Spatial Data Infrastructure
File system
PostGIS/ PostGreSQL
SPARQL
HTTP API
TripleStore (RDF & thesauri)
SPARQL
Database Layer



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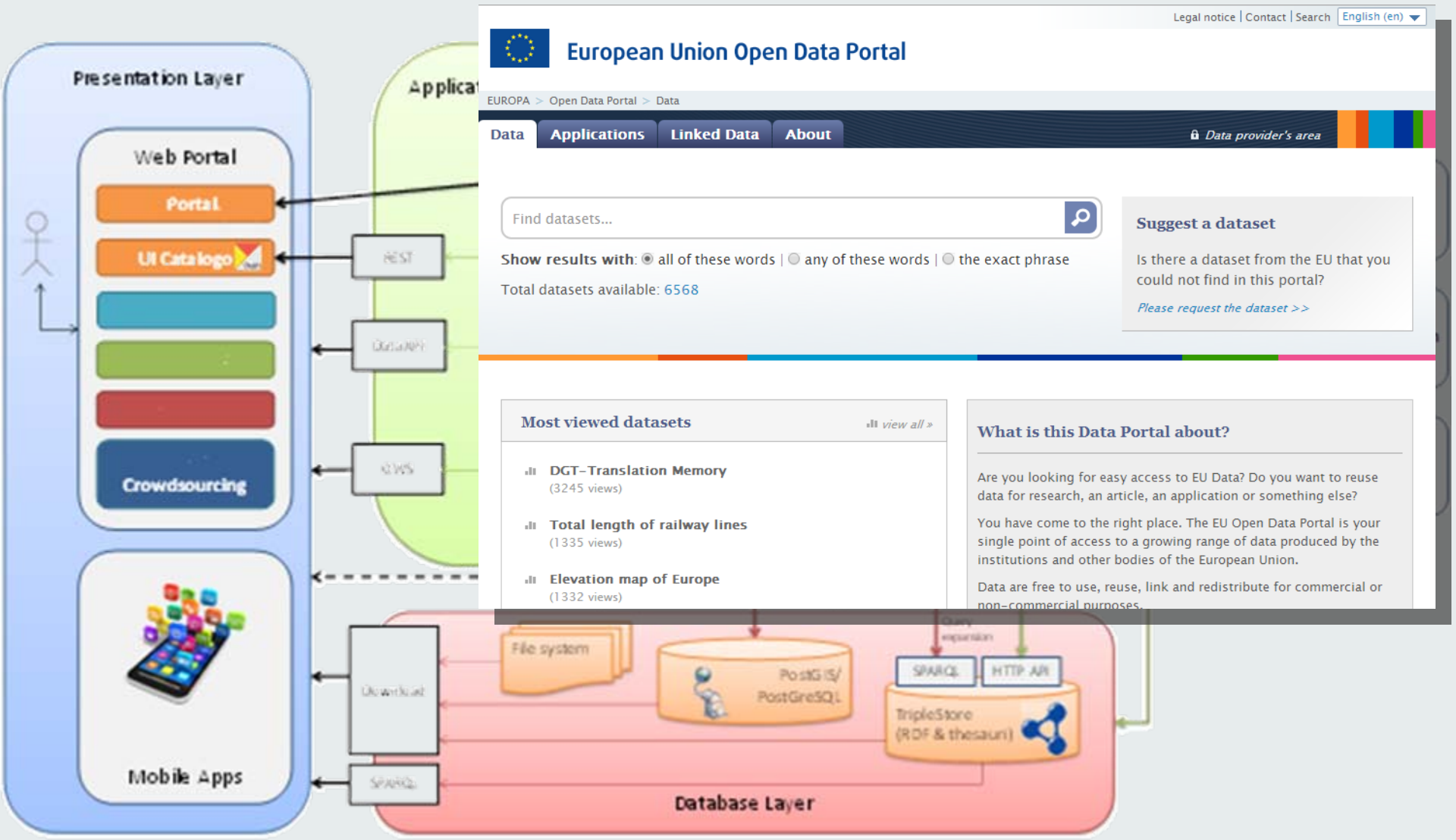
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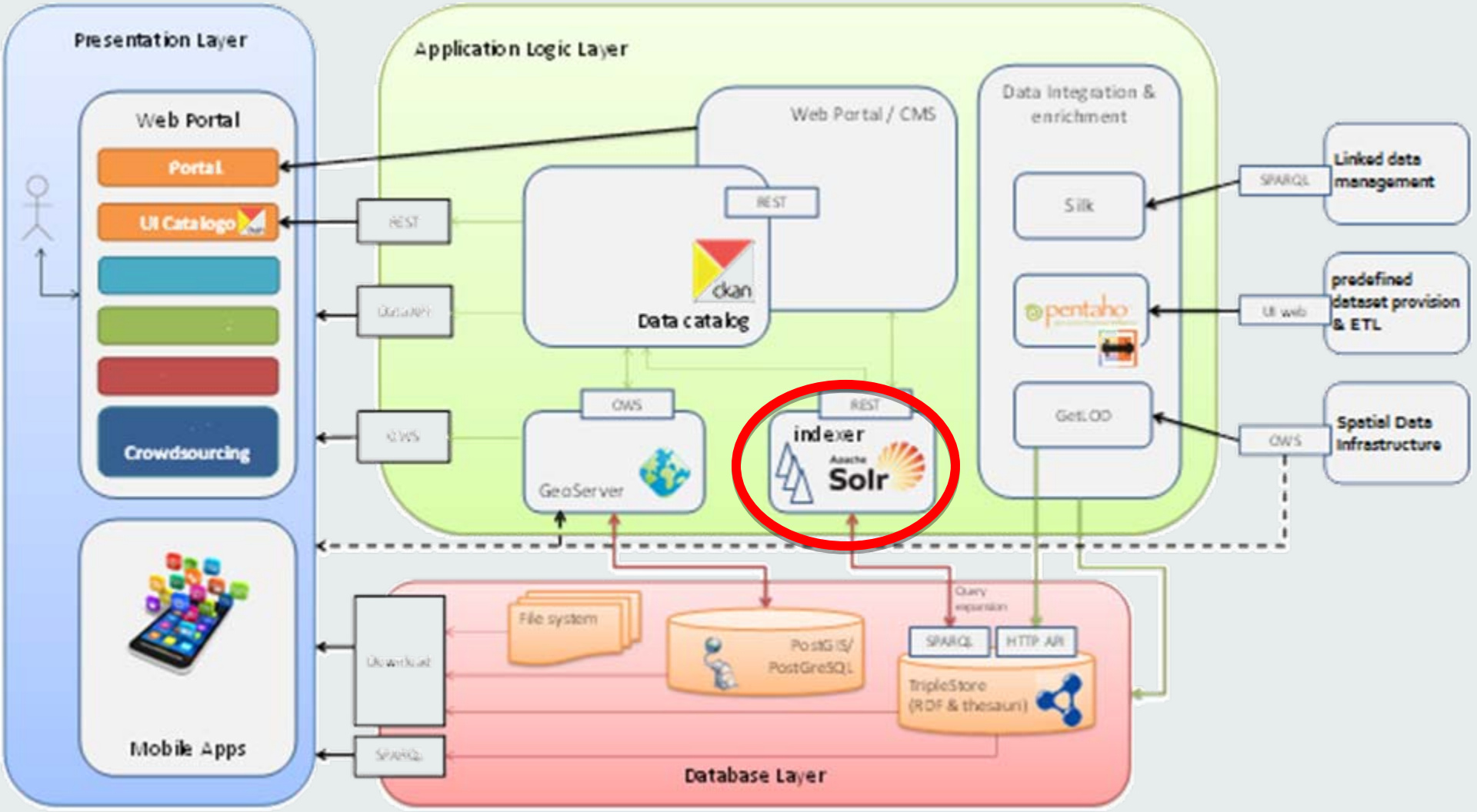
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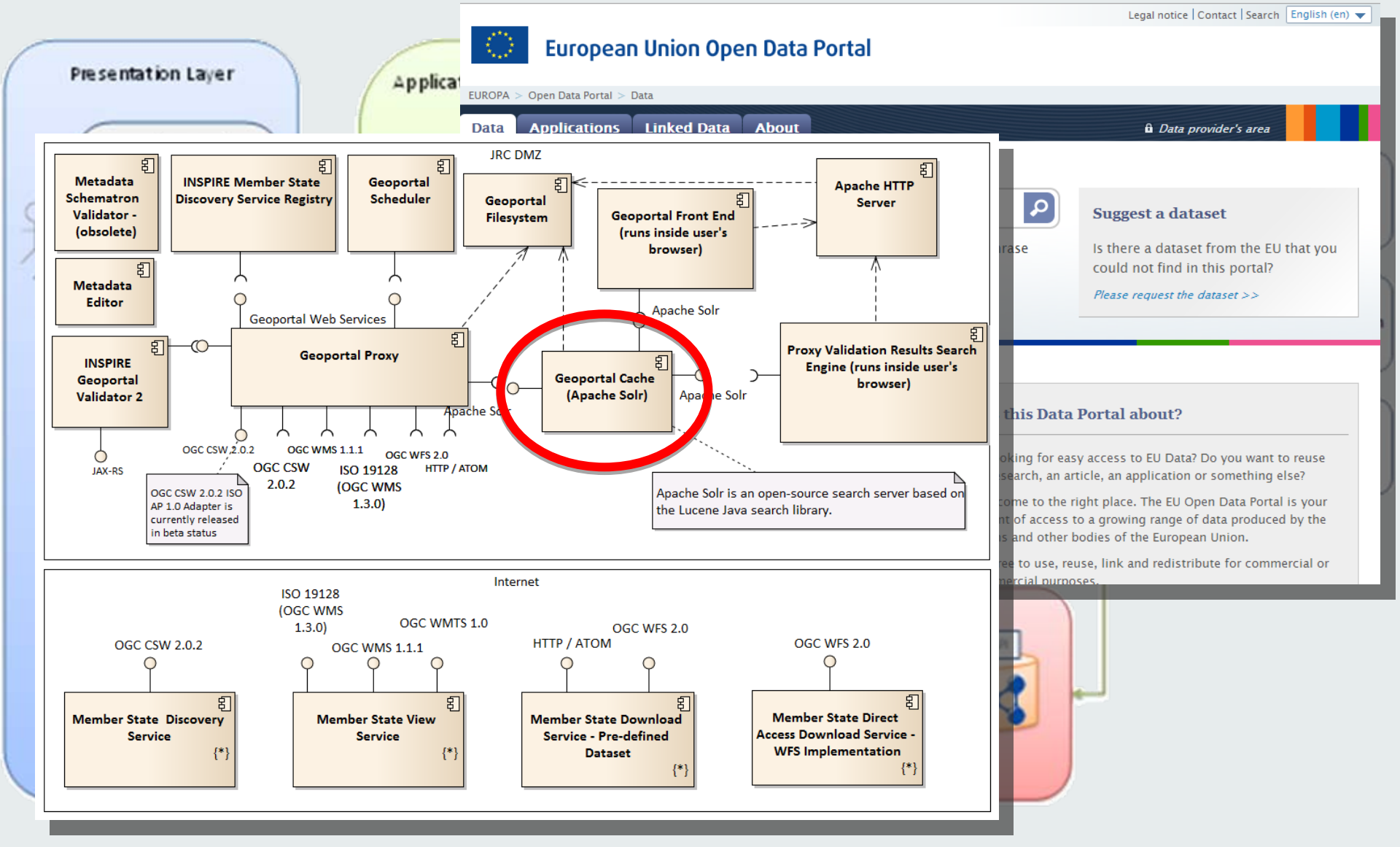
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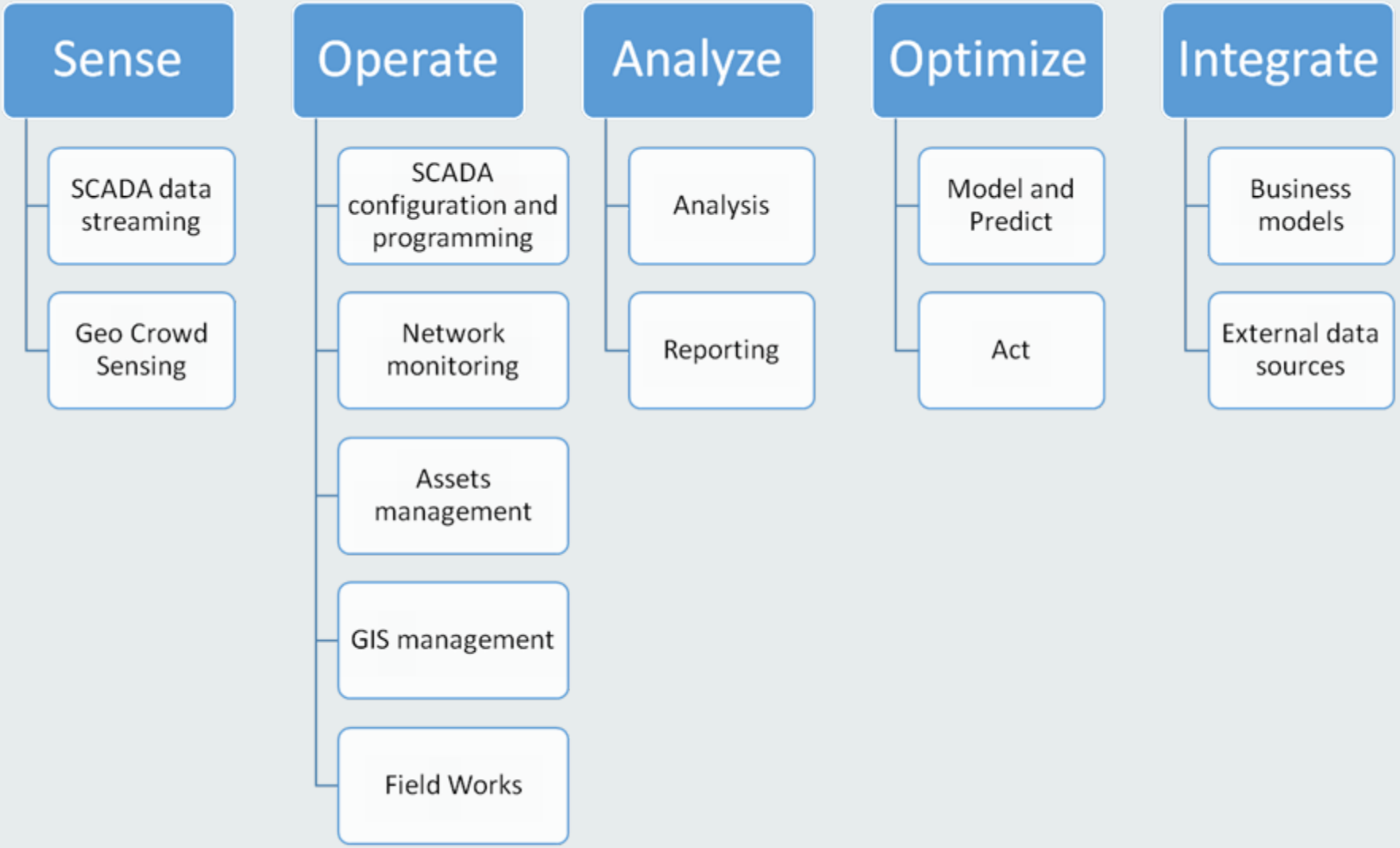
Metadata Schematron Validator - (obsolete)
INSPIRE Member State Discovery Service Registry
Geoportal Scheduler
Geoportal Filesystem
Geoportal Front End (runs inside user's browser)
Apache HTTP Server
Metadata Editor
Geoportal Web Services
Apache Solr
INSPIRE Geoportal Validator 2
Geoportal Proxy
Geoportal Cache (Apache Solr)
Proxy Validation Results Search Engine (runs inside user's browser)
JAX-RS
OGC CSW 2.0.2
OGC WMS 1.1.1
OGC WFS 2.0
HTTP / ATOM
OGC CSW 2.0.2
ISO 19128 (OGC WMS 1.3.0)
OGC CSW 2.0.2 ISO AP 1.0 Adapter is currently released in beta status
Apache Solr is an open-source search server based on the Lucene Java search library.
Internet
ISO 19128 (OGC WMS 1.3.0)
OGC WMTS 1.0
OGC CSW 2.0.2
OGC WMS 1.1.1
OGC WFS 2.0
HTTP / ATOM
OGC WFS 2.0
Member State Discovery Service
Member State View Service
Member State Download Service - Pre-defined Dataset
Member State Direct Access Download Service - WFS Implementation

Underground domain



Underground specialized services / 1

- Geo crowd-sensing client
- Geo crowd-sensing mobile client
- Geo crowd-sensing platform management
- Field work verification and correction
- Creation and sharing of personalized maps
- Field work orientation through augmented-reality

Underground specialized services / 2

- Analysis of interaction between hazards and underground networks
- Tracing of sewage network
- Use of GIS and SCADA information
- GIS access to Sensor data streaming services

Green Energy domain

- **Editing**
  - **Bdgs properties**
  - Bulk uploads (new bdgs)
  - **OSM alignement**
- **Deriving**
  - **EPB**
  - **CO2**
  - Solar potential
  - Drive to park
- **Routing**
  - Multilingual Geocoding
  - **CO2 emitted**
  - **CO2 monitored**
- **Presenting**
  - Dashboard
  - Report

http://www.eumayors.eu/IMG/pdf/seap_guidelines_en-2.pdf

Green Energy specialized services / 1

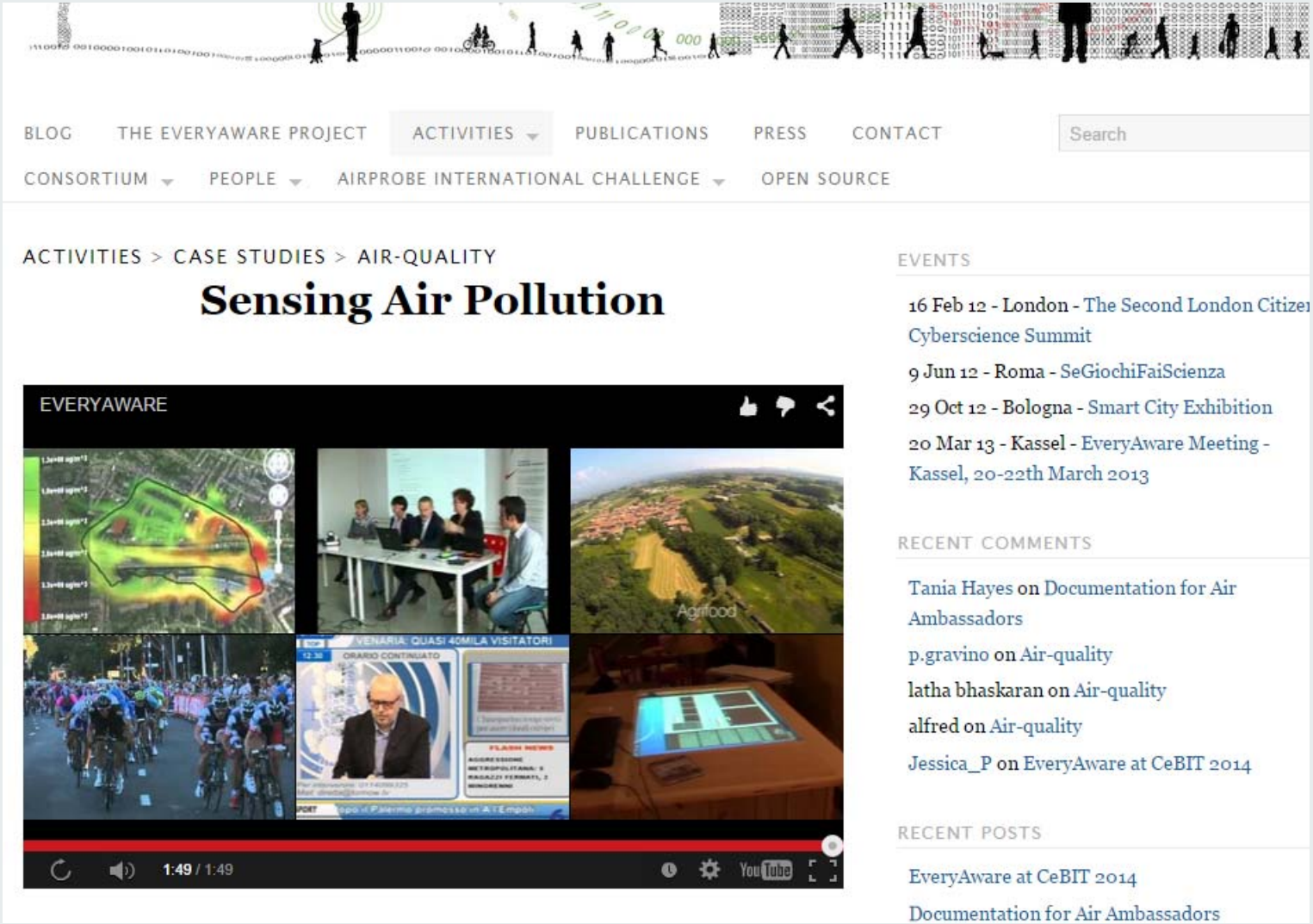
- Buildings "on-site" data quality check
- Estimation of Energy Performance of buildings
- Buildings CO_2 emissions estimation
- Heat consumption dashboard
- Green Energy report
- Upload of "future "buildings datasets
- Solar potential calculation
- Zero-balance layer

Green Energy specialized services / 2

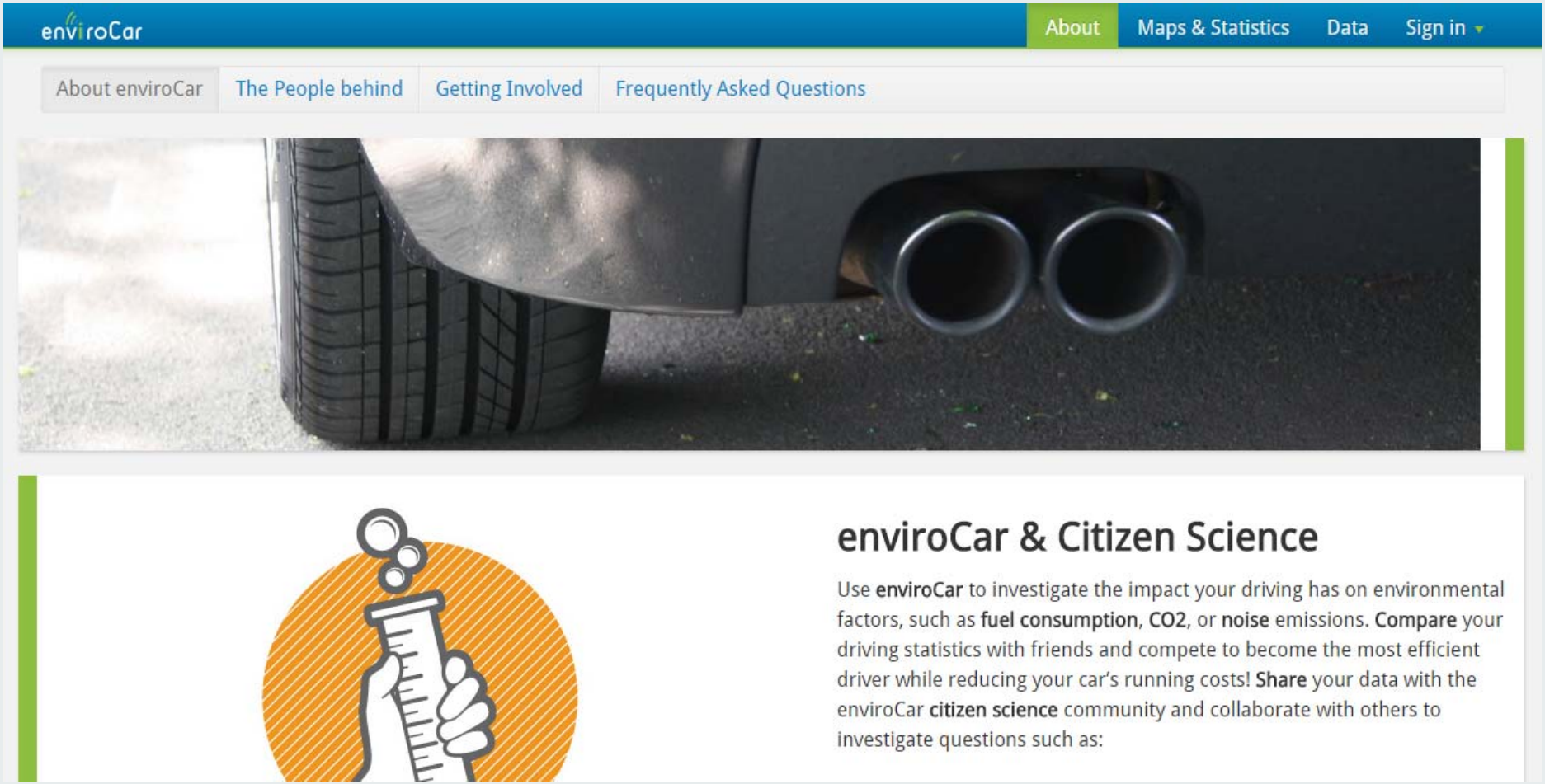
- Multi-lingual Address Geocoding
- Green preferences and routing
- comment and save green route
- Next departure time
- Drive to park
- OpenStreetMap editing
- Geo-fence service

Examples of Green Energy specialized services / 1

- Some pilots (e.g. Girona, Turku) are requesting customized routing services, considering the CO_2 factor as input parameter:
  - the best healthy route (less polluted), or …
  - … the route with less CO_2 by the traveler



http://www.everyaware.eu/activities/case-studies/air-quality/



https://www.envirocar.org/

Examples of Green Energy specialized services / 2

- Some other pilots (e.g. Reggio-Emilia, Maroussi, Oeiras) are requesting processing services, as the estimation at individual building level of:
  - solar potential
  - CO_2 emissions
  - energy performance

A "specialized" service in brief (as WPS):

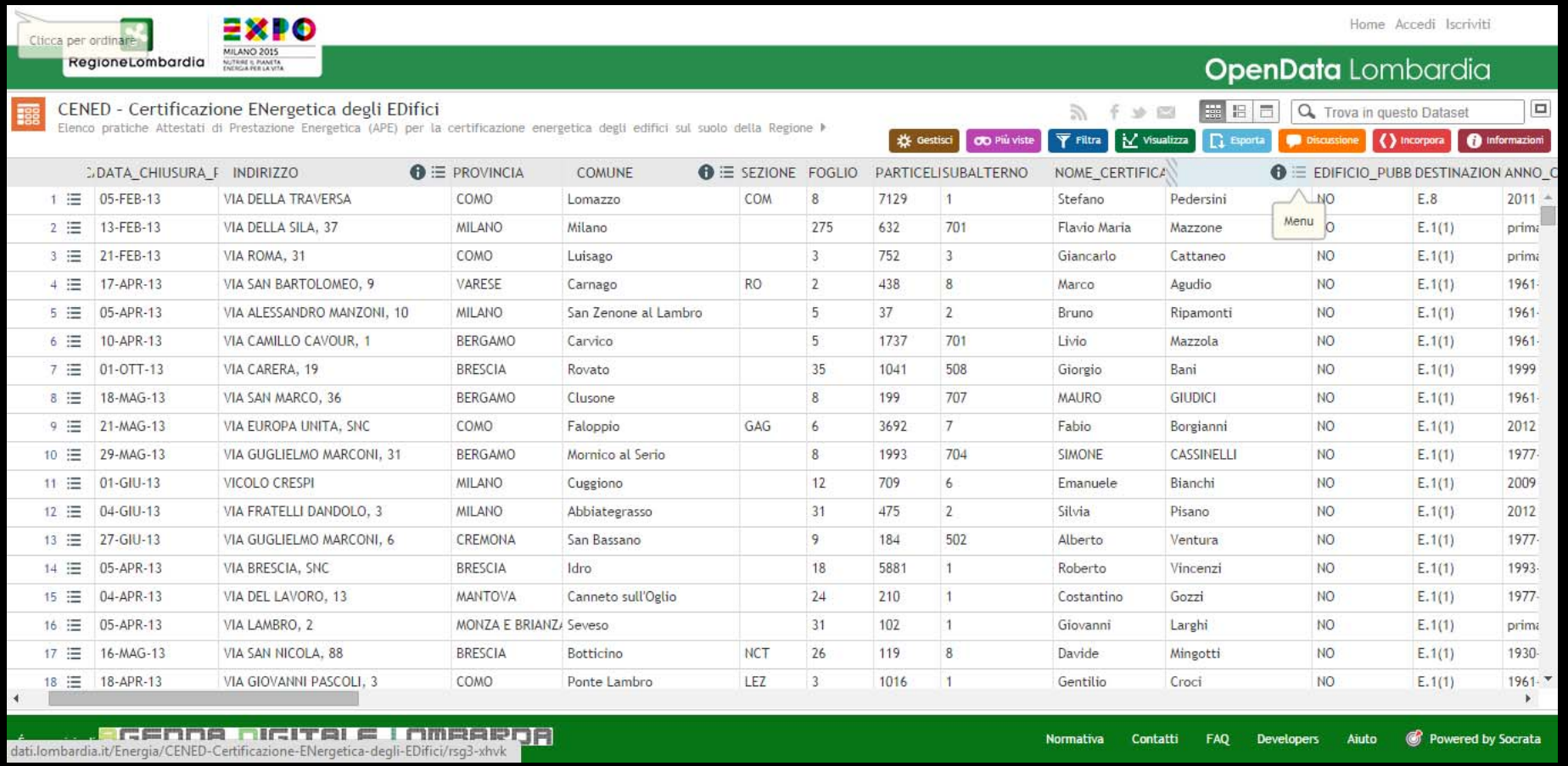
- For the estimation of Energy Performance, this may be a (complex) process that:
  - Considers the physical properties of buildings (e.g. age of construction, size, usage, …)
  - Calculates vertical surfaces (envelope)
  - Apply TABULA typologies for households (U-values for roof, floor, envelope, … degree-days of the location, …) to existing buildings
  - Generates the EP value in annual kWh (per m2 or m3, according to the location and legislation)

http://energielabelatlas.nl/#zuid-holland/delft/17/52.0122/4.3612

For calculating the energy performance, or other processes, we need data (the fuel) with high level of **accuracy** and **detail**.
If not yet available in existing datasets, or if the quality has to be validated, we need to consider the possibility to involve **local communities** to collect or correct data "on site".

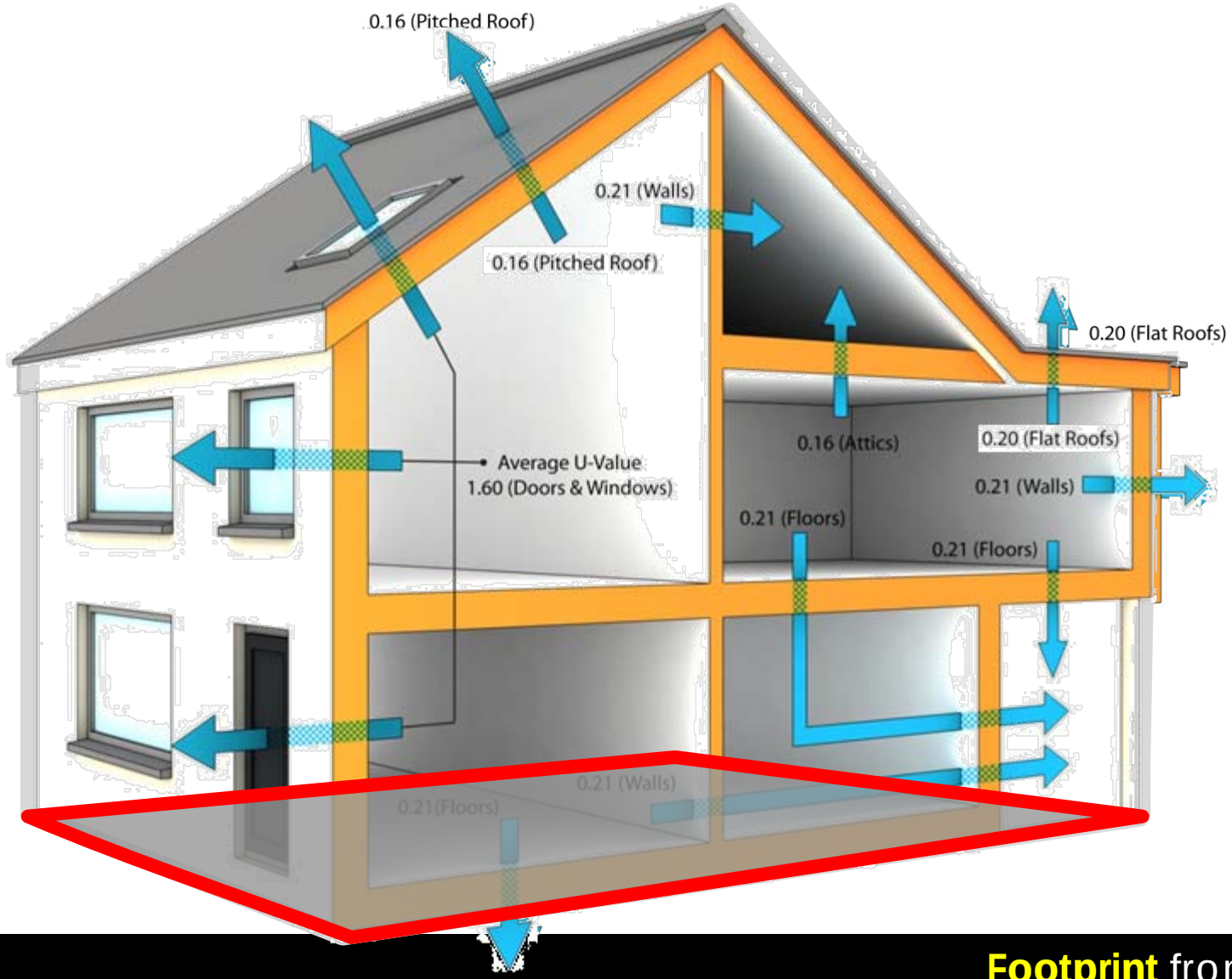
https://youtu.be/W5pNYAUKZl0

We also need to integrate this **"citizen-contributed GI"** (Spyridon S., Lutz M., Pantisano F., 2014) with **authoritative** openly available data:



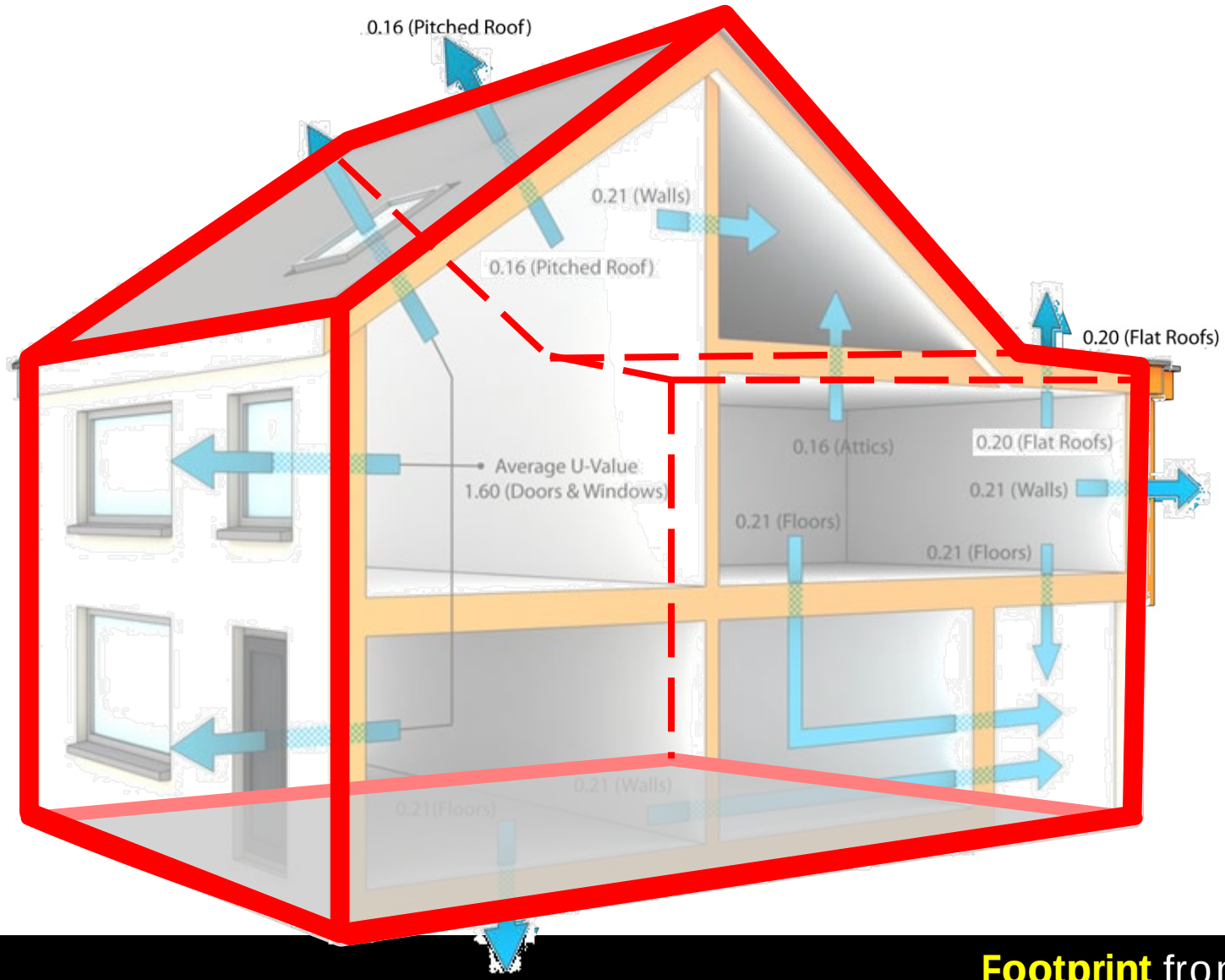
	DATA_CHIUSURA_F	INDIRIZZO	PROVINCIA	COMUNE	SEZIONE	FOGLIO	PARTICELLA	SUBALTERNO	NOME_CERTIFICA		EDIFICIO_PUBB	DESTINAZION	ANNO_C
1	05-FEB-13	VIA DELLA TRAVERSA	COMO	Lomazzo	COM	8	7129	1	Stefano	Pedersini	NO	E.8	2011
2	13-FEB-13	VIA DELLA SILA, 37	MILANO	Milano		275	632	701	Flavio Maria	Mazzone	O	E.1(1)	prima
3	21-FEB-13	VIA ROMA, 31	COMO	Luisago		3	752	3	Giancarlo	Cattaneo	NO	E.1(1)	prima
4	17-APR-13	VIA SAN BARTOLOMEO, 9	VARESE	Carnago	RO	2	438	8	Marco	Agudio	NO	E.1(1)	1961
5	05-APR-13	VIA ALESSANDRO MANZONI, 10	MILANO	San Zenone al Lambro		5	37	2	Bruno	Ripamonti	NO	E.1(1)	1961
6	10-APR-13	VIA CAMILLO CAVOUR, 1	BERGAMO	Carvico		5	1737	701	Livio	Mazzola	NO	E.1(1)	1961
7	01-OTT-13	VIA CARERA, 19	BRESCIA	Rovato		35	1041	508	Giorgio	Bani	NO	E.1(1)	1999
8	18-MAG-13	VIA SAN MARCO, 36	BERGAMO	Clusone		8	199	707	MAURO	GIUDICI	NO	E.1(1)	1961
9	21-MAG-13	VIA EUROPA UNITA, SNC	COMO	Faloppio	GAG	6	3692	7	Fabio	Borgianni	NO	E.1(1)	2012
10	29-MAG-13	VIA GUGLIELMO MARCONI, 31	BERGAMO	Mornico al Serio		8	1993	704	SIMONE	CASSINELLI	NO	E.1(1)	1977
11	01-GIU-13	VICOLO CRESPI	MILANO	Cuggiono		12	709	6	Emanuele	Bianchi	NO	E.1(1)	2009
12	04-GIU-13	VIA FRATELLI DANDOLO, 3	MILANO	Abbiategrasso		31	475	2	Silvia	Pisano	NO	E.1(1)	2012
13	27-GIU-13	VIA GUGLIELMO MARCONI, 6	CREMONA	San Bassano		9	184	502	Alberto	Ventura	NO	E.1(1)	1977
14	05-APR-13	VIA BRESCIA, SNC	BRESCIA	Idro		18	5881	1	Roberto	Vincenzi	NO	E.1(1)	1993
15	04-APR-13	VIA DEL LAVORO, 13	MANTOVA	Canneto sull'Oglio		24	210	1	Costantino	Gozzi	NO	E.1(1)	1977
16	05-APR-13	VIA LAMBRO, 2	MONZA E BRIANZA	Seveso		31	102	1	Giovanni	Larghi	NO	E.1(1)	prima
17	16-MAG-13	VIA SAN NICOLA, 88	BRESCIA	Botticino	NCT	26	119	8	Davide	Mingotti	NO	E.1(1)	1930
18	18-APR-13	VIA GIOVANNI PASCOLI, 3	COMO	Ponte Lambro	LEZ	3	1016	1	Gentilio	Croci	NO	E.1(1)	1961

https://www.dati.lombardia.it/Energia/CENED-Certificazione-ENergetica-degli-EDifici/rsg3-xhvk



Footprint from Cadastre or high quality topo db (open)

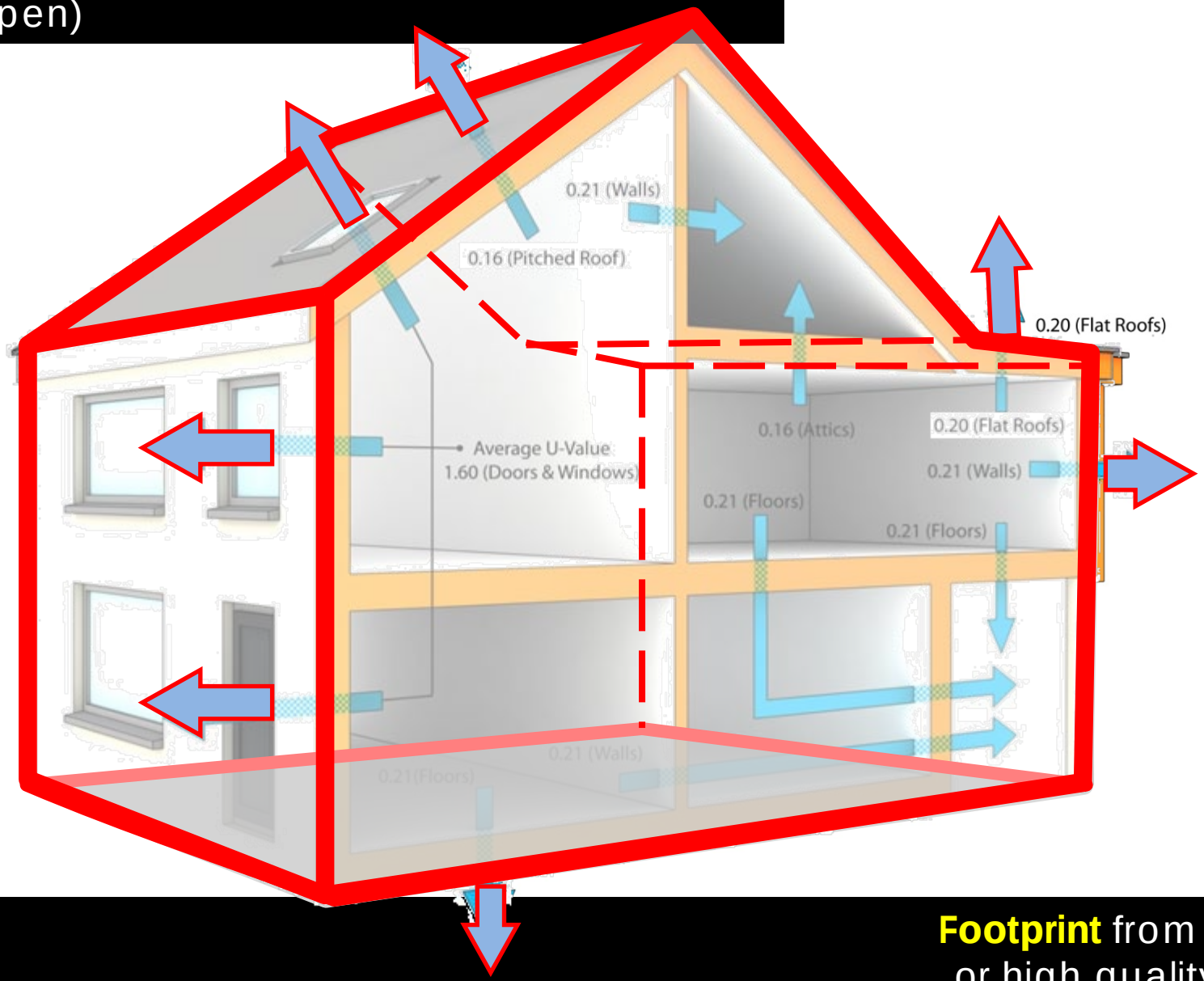
3D from high res. Lidar



Footprint from Cadastre or high quality topo db (open)

UValues and **other properties** (e.g. age of construction) from Energy Certificates registers (free/open)

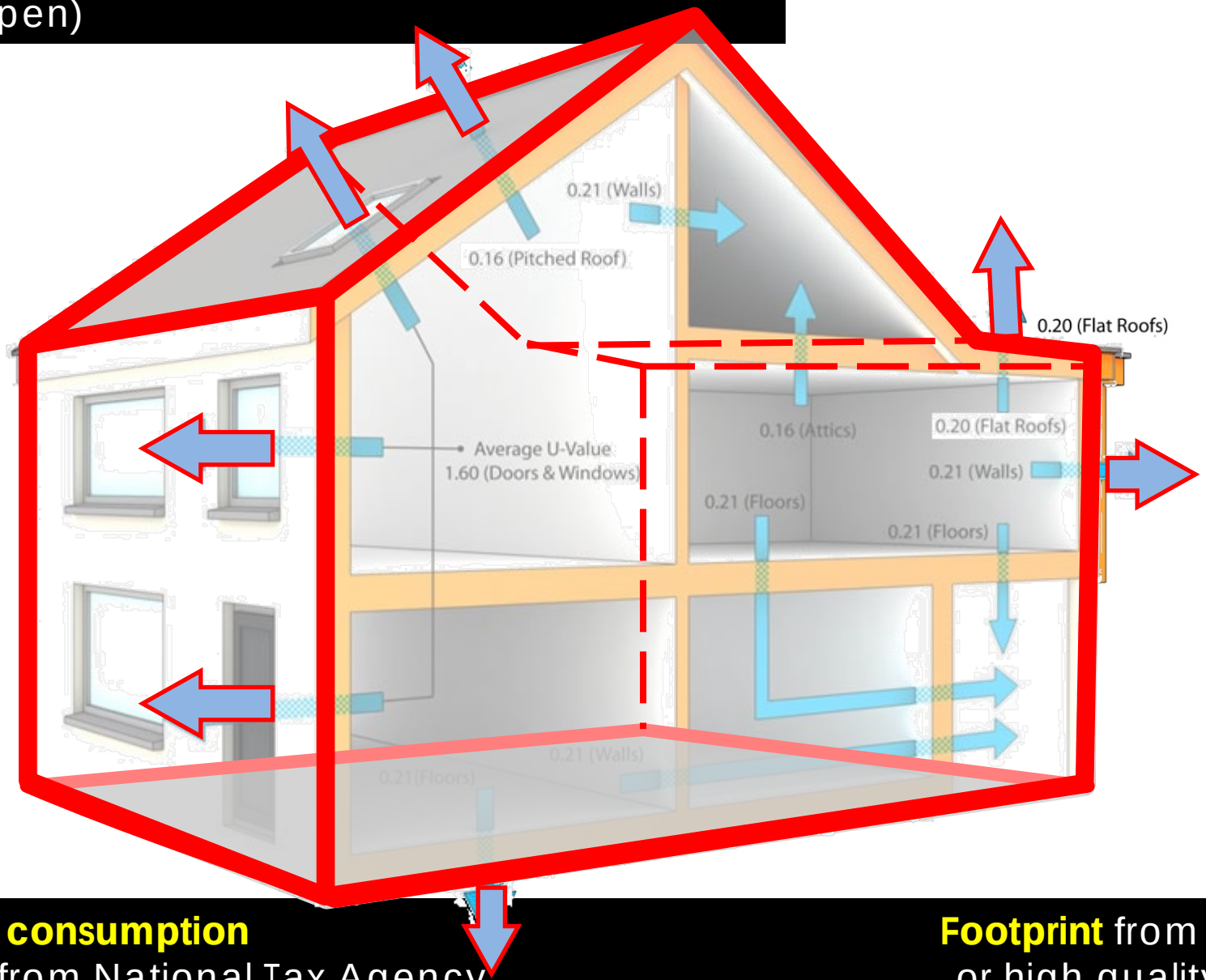
3D from high res. Lidar



Footprint from Cadastre or high quality topo db (open)

UValues and **other properties** (e.g. age of construction) from Energy Certificates registers (free/open)

3D from high res. Lidar



Energy consumption
In Italy from National Tax Agency (free but restricted to public sector)

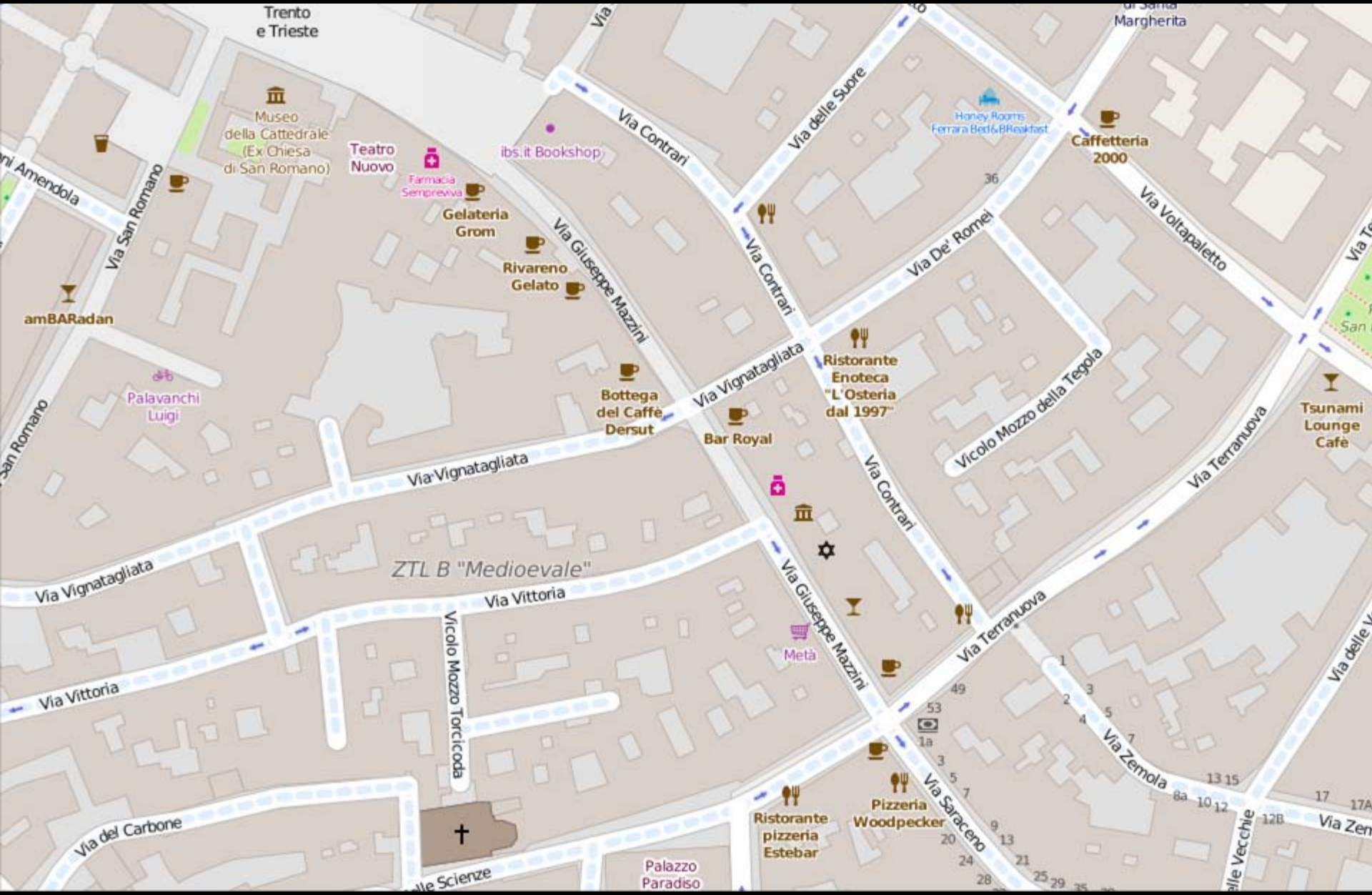
Footprint from Cadastre or high quality topo db (open)

Conclusions – 1

If You Can't Measure It, You Can't Improve It

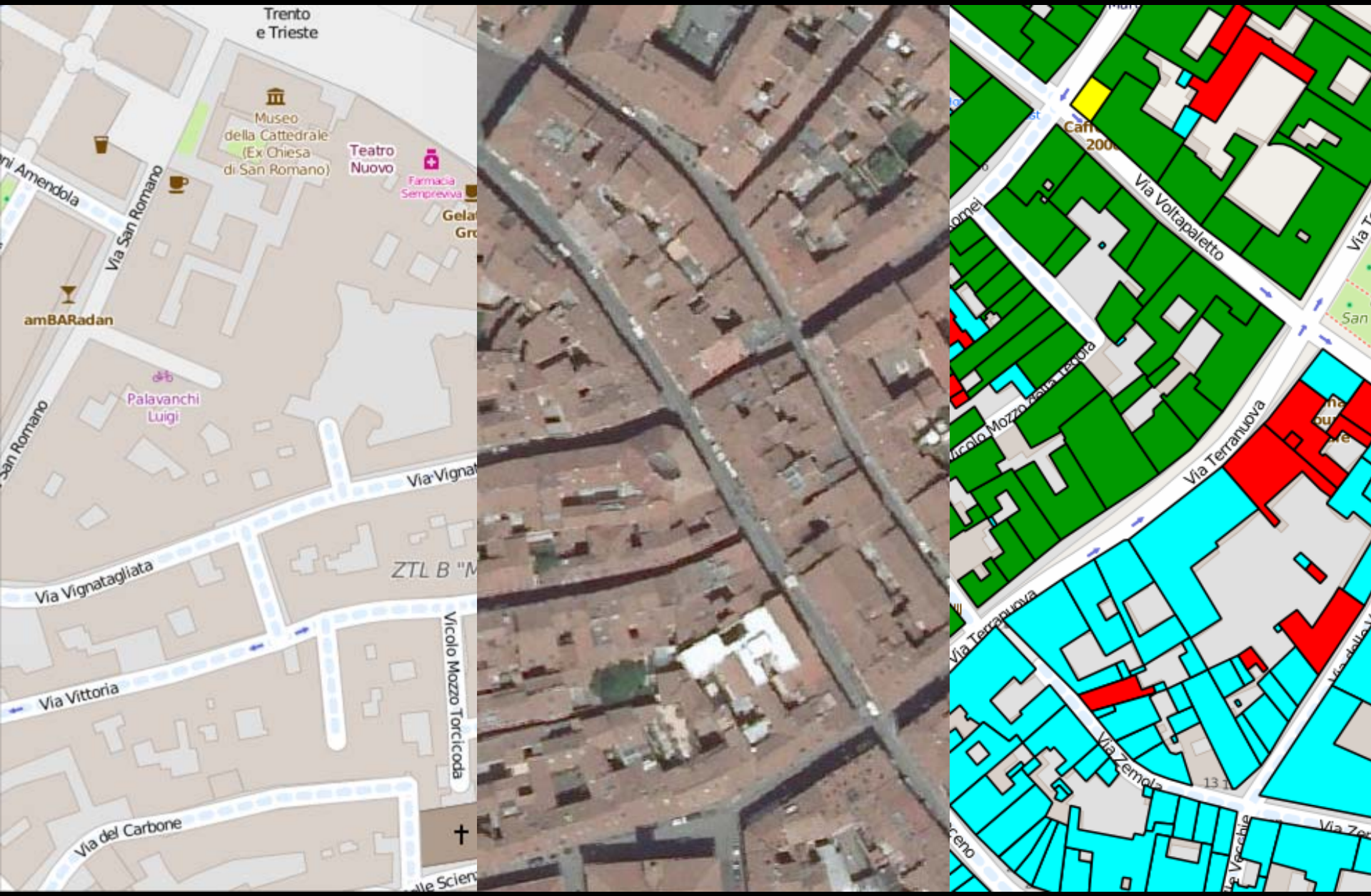
(William Thomson, Lord Kelvin)

Conclusions – 2



http://www.openstreetmap.org/#map=18/44.83449/11.62086

http://www.openstreetmap.org/#map=18/44.83449/11.62086



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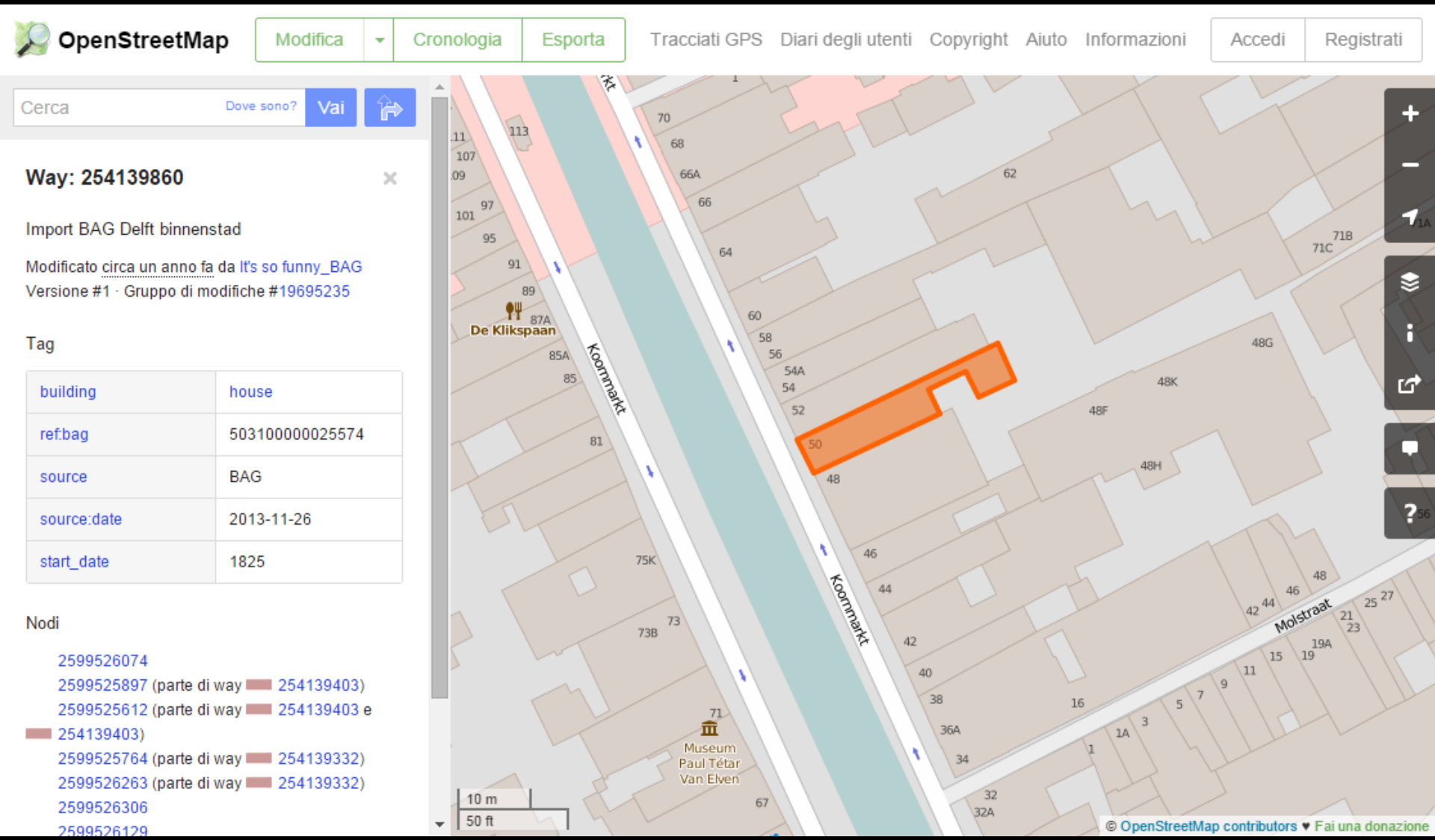

http://www.openstreetmap.org/way/254139860#map=19/52.00997/4.35912

GeoSmartCity

Thanks … any other questions?

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