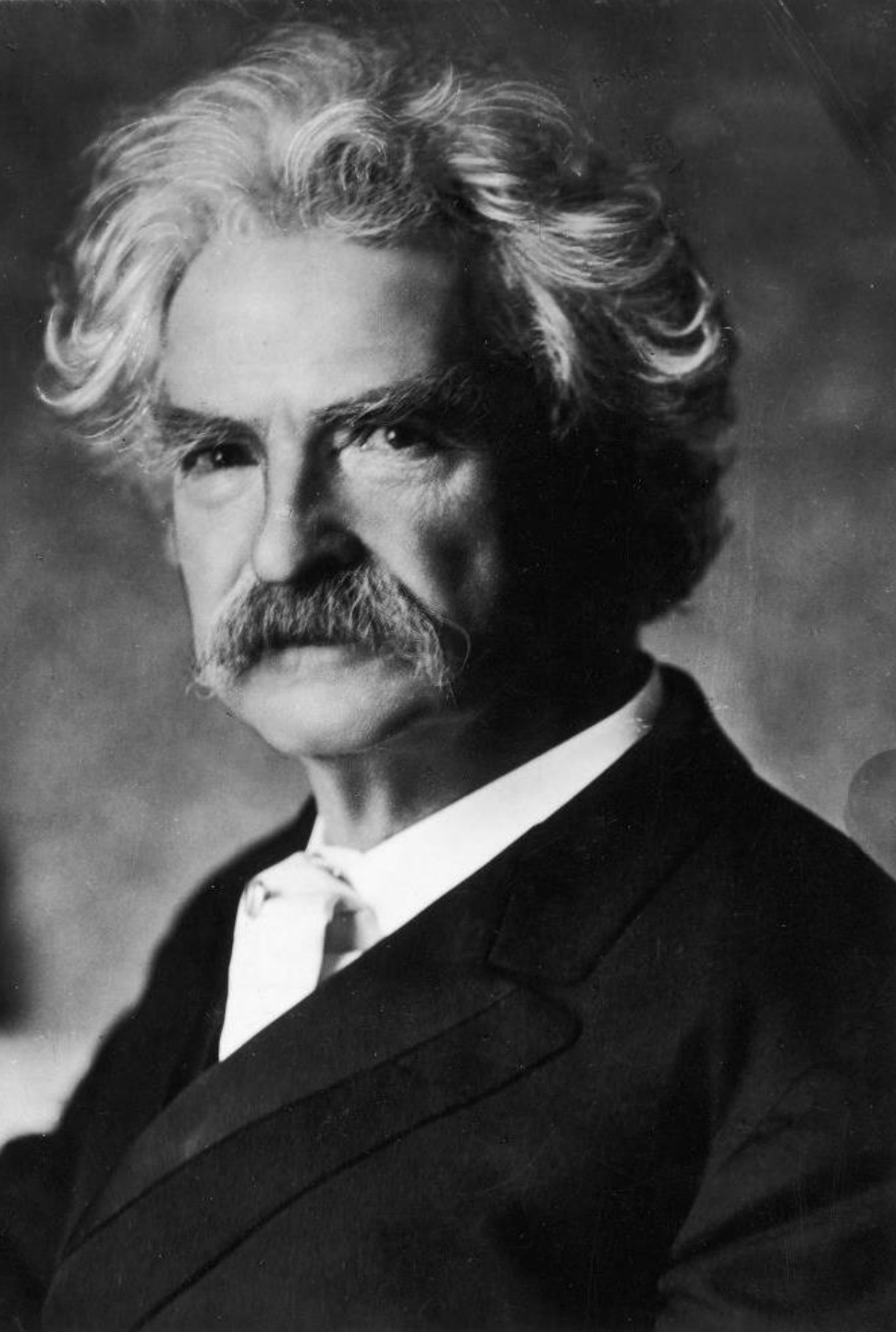


# The Green Energy Scenario

from EU-wide (big) numbers ...  
... to local actions with local real data

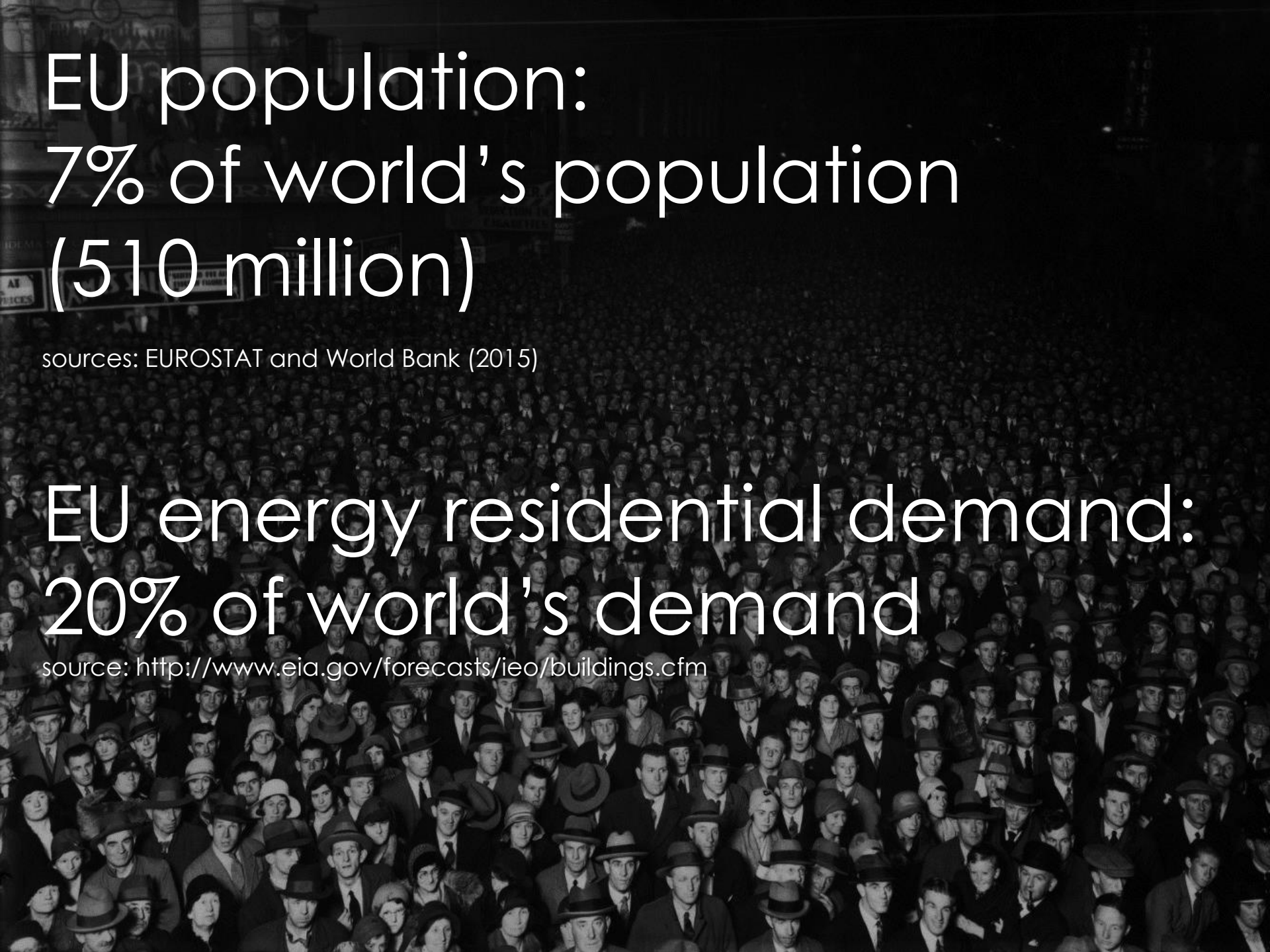
Piergiorgio Cipriano  
Business Analyst – Public Sector & Utilities





There are three  
kinds of lies:  
lies, damned  
lies, and  
statistics

Mark Twain



EU population:  
7% of world's population  
(510 million)

sources: EUROSTAT and World Bank (2015)

EU energy residential demand:  
20% of world's demand

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



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**



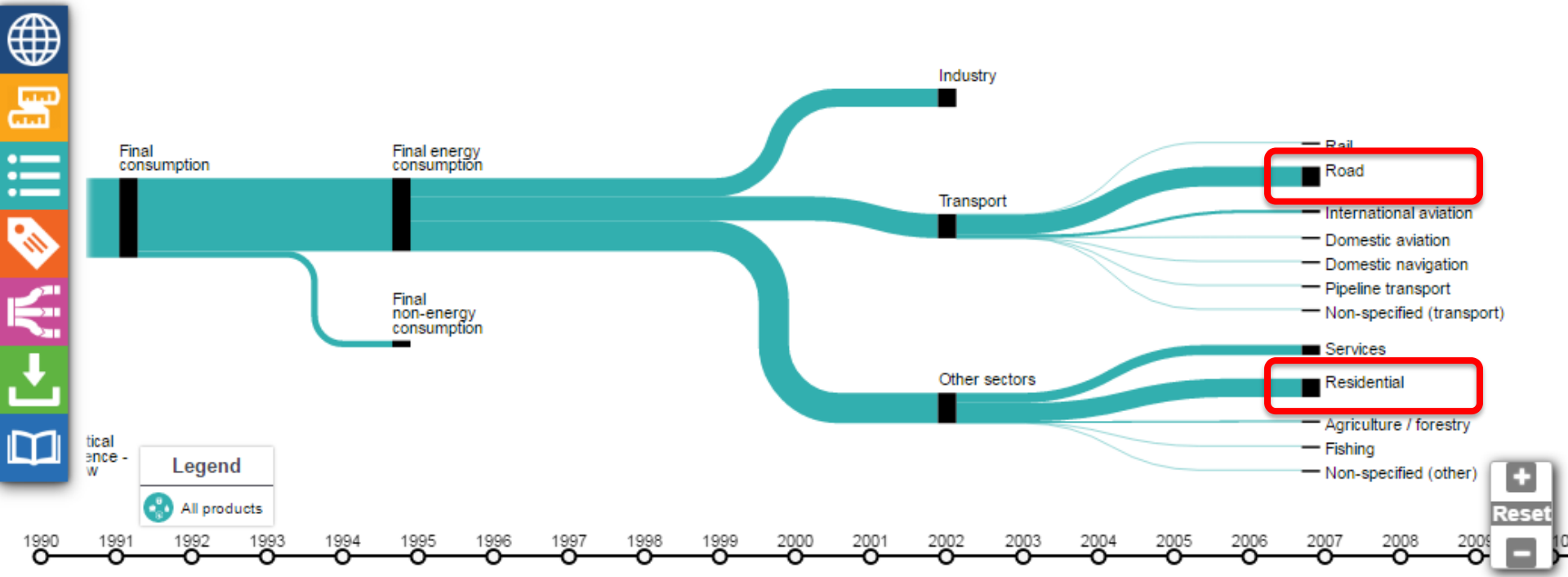
In terms of energy consumption,  
buildings represent around **40%**



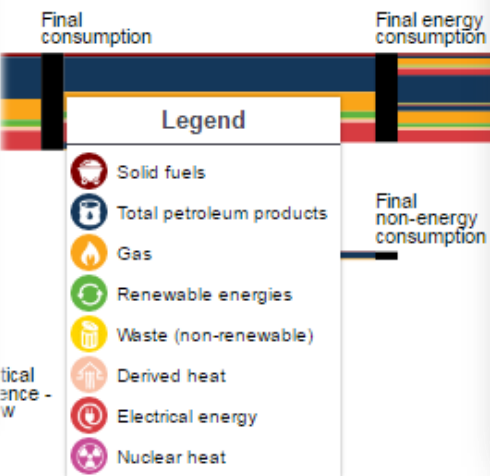




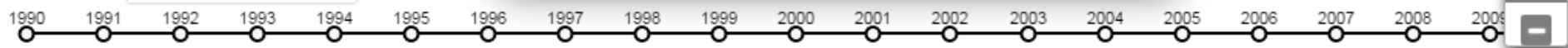
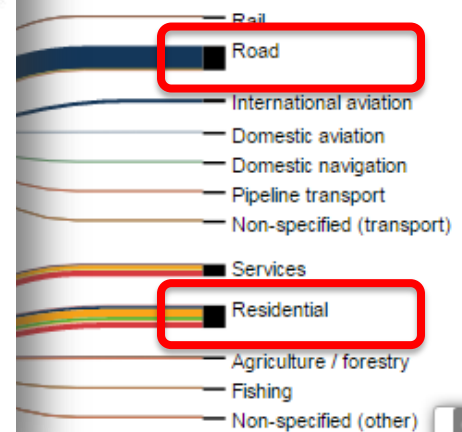
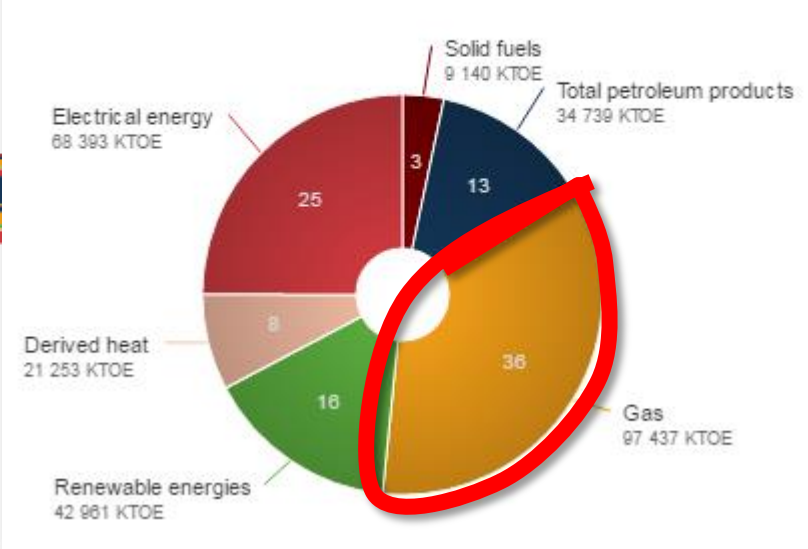
... and transport is another 33%







Fuels going into Residential European Union (28 countries) in year 2015

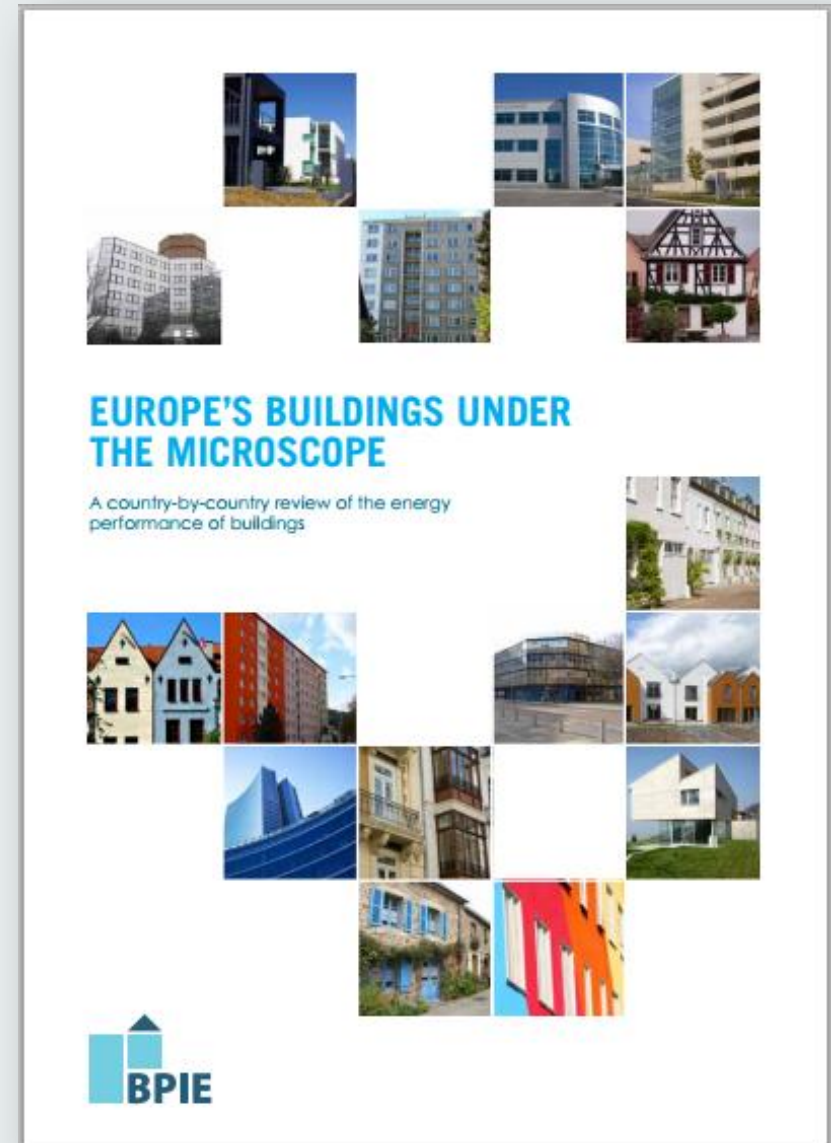




European **households** are responsible for **68%** of the total final energy use in **building sector**:

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

The most used fuel is gas.



Well ... we have a lot of statistics,  
but we need actual data

preferably open and harmonized



local and detailed data



## Covenant of Mayors for Climate & Energy

Covenantofmayors.eu My Covenant

[Home](#)
[About](#)
[Actions](#)
[Participation](#)
[Support](#)
[Media](#)

Search...

OK

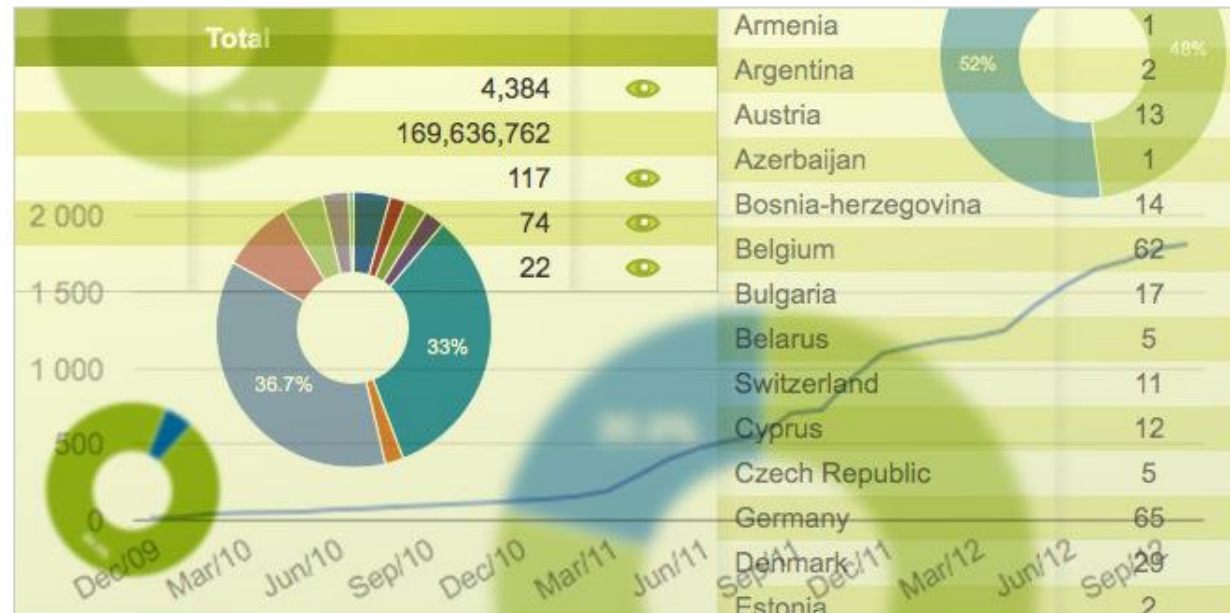
English (en)

226,666,341  
Inhabitants

Heralded as the “world’s biggest urban climate and energy initiative” by Commissioner Miguel Arias Cañete, the Covenant of Mayors for Climate & Energy brings together thousands of local and regional authorities voluntarily committed to implementing EU climate and energy objectives on their territory.

New signatories now pledge to reduce CO<sub>2</sub> emissions by at least 40% by 2030 and to adopt an integrated approach to tackling mitigation and adaptation to climate change.

[Read more](#)



Covenant of Mayors is the policy '*with highest impact on climate change mitigation*'

(Source: Economist, 2014)



## Energy strategy:



- 20% reduction in EU greenhouse gas from 1990
- 20% of energy from **renewable sources**
- 20% improvement of **energy efficiency**



- 40% reduction in EU GHG
- 27% of energy from renewable sources
- 27% improvement of energy efficiency



- 85-90% reduction in EU GHG
- About **2/3** of energy from renewable sources

Source: <http://ec.europa.eu/energy/en/topics/energy-strategy>

# Green Energy pilots

## Use Cases and Requirements

... local actions with local real data

5 pilot cities involved in this scenario

- Reggio Emilia (Italy)
- Maroussi (Greece)
- Oeiras (Portugal)
- Turku (Finland)
- Girona (Spain)

13 Use Cases collected

59 requirements (functional, non-functional, generic)



## 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 CO2 emissions
- Energy maps and reports, interoperable access to data

## 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

## 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



## Use cases

- Selecting green route
- Green driving
- Green parking

## General objectives

- Shift from private to public transport in commuter traffic
- Acquire real-life information to be used for planning

## Main requirements

- Bike routing, bus timetables, paths for commuters
- Estimation of fuel consumption, collect stats

## 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

# Green Energy Specialized Services (standard Geo-ICT services)

## ... Geo-ICT services for Buildings

- Buildings "on-site" data quality check
- Estimation of Energy Performance of buildings
- Buildings CO<sub>2</sub> emissions estimation
- Heat consumption dashboard
- Upload of "future "buildings
- Solar potential calculation
- Zero-balance layer
- Linked open data

## ... Geo-ICT services for Transport

- Multi-lingual Address Geocoding
- Green preferences and routing
- Next departure time
- Drive to park



## Examples – Buildings

- Some pilots (e.g. Reggio-Emilia, Maroussi, Oeiras) are requesting processing services, as the estimation at individual building level of:
  - energy performance
  - CO<sub>2</sub> emissions
  - solar potential

## A (WPS) “specialized” service in brief

- E.g. for the “**Estimation of Energy Performance**” this is a (complex) process that:
  - Considers the characteristics of buildings (e.g. age of construction, size, usage, ...) as well as climatic zones
  - Calculates vertical surfaces (envelope)
  - Apply TABULA project 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 m<sup>2</sup> or m<sup>3</sup>, according to location and legislation)

# A (WPS) “specialized” service in brief

Building Type

Construction Year

Country

Climatic Zone

Typical climatic parameters	
Heating season length	183 days
Average outdoor temperature during the heating season	12° C
Indoor design temperature	20° C

Facade element	Typical U-value [W/m <sup>2</sup> ·K]	Typical % of facade
Walls	full/semi-full bricks 1,08	60%
Roof	bricks and concrete 0,95	10%
Floor	bricks and concrete 0,92	10%
Windows	thermal break frames + low-emission glass 2,63	20%

Typical building shape parameters	
Heated volume (V)	1234 m <sub>s</sub> <sup>3</sup>
Shape factor (S/V)	0.66 m <sub>s</sub> <sup>-1</sup>
Useful floor area (A)	353 m <sub>s</sub> <sup>2</sup>

Typical Degree Days  
**DD<sub>t</sub>** [days/K·year]

Typical heat transmission coefficient for  
building envelope  
**HT** [W/m<sub>s</sub><sup>2</sup>·K]

$$Q_t = 10^{-3} \cdot HT \cdot 24 \cdot DD \cdot V \cdot S/V \cdot A$$

$$[\text{kWh/m}_A^2 \cdot \text{year}] = [\text{kW/m}_S^2 \cdot \text{K}] \cdot [\text{h/K} \cdot \text{year}] \cdot [\text{m}_S^2/\text{m}_A^2]$$

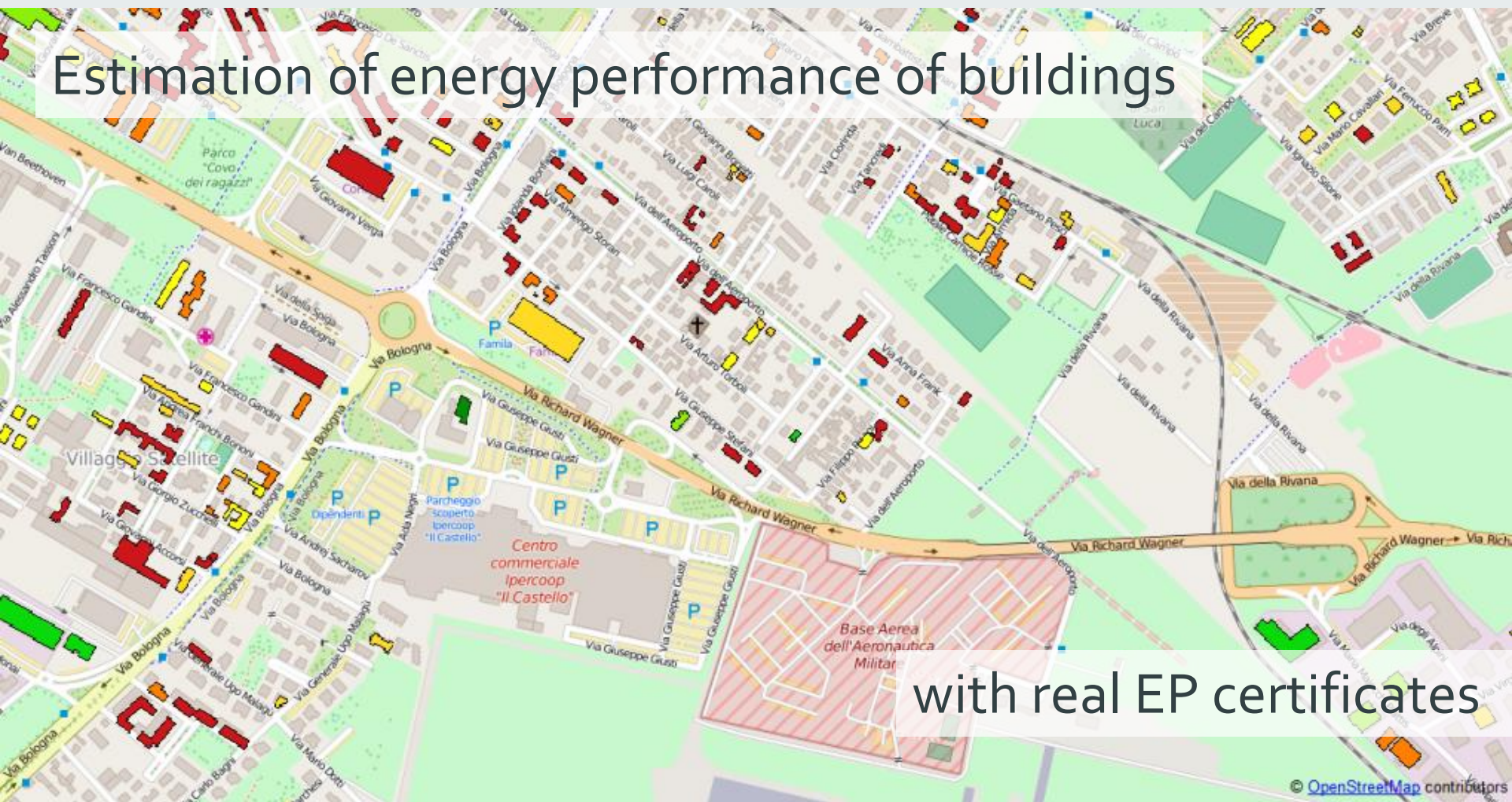
Typical Consumption  
**Q<sub>t</sub>** [kWh/m<sub>A</sub><sup>2</sup>·year]





# ... without any "specialized" service

Estimation of energy performance of buildings





## A (WFS-T) “specialized” service in brief

- In order to calculate the energy performance we need data with **good 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”**.

# A (WFS-T) "specialized" service in brief

Buildings "on-site" data quality check



<https://play.google.com/store/apps/details?id=it.sinergis.geosmartcity.map4data>

In **Marousi(GR)** buildings' data have been collected, but some **attributes are still missing** or need to be checked (e.g. "age of construction, age of renovation, uses, ...").

An **on-site campaign** has been organized by the **EPSILON International**, involving the local School of Architecture.

People involved used smartphones and tablets to edit attributes via **WFS-T** service, and updates data on PostGIS database.



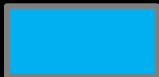




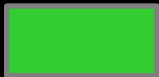
Buildings properties missing, on-site to be performed



Some buildings properties still missing, on-site already done



Buildings properties available, on-site check suggested



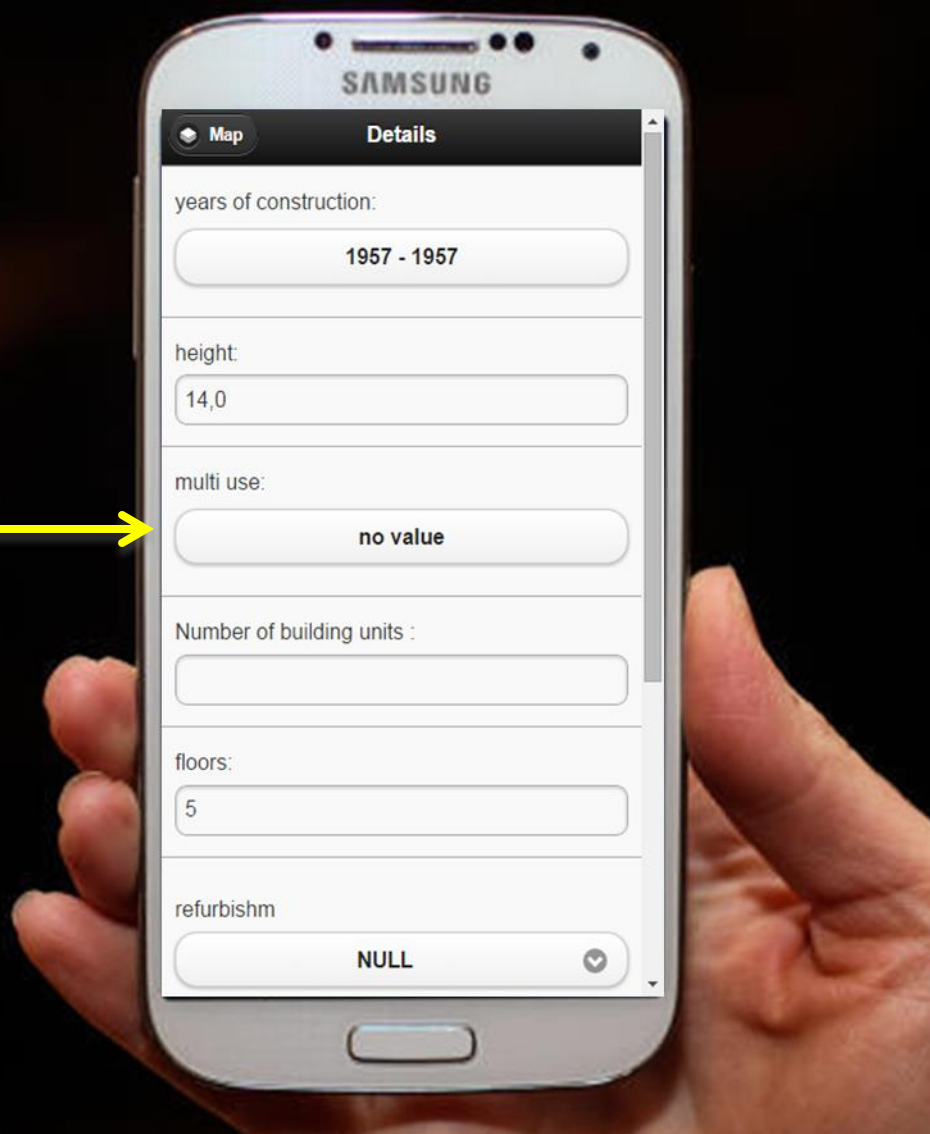
Buildings properties available and on-site check performed



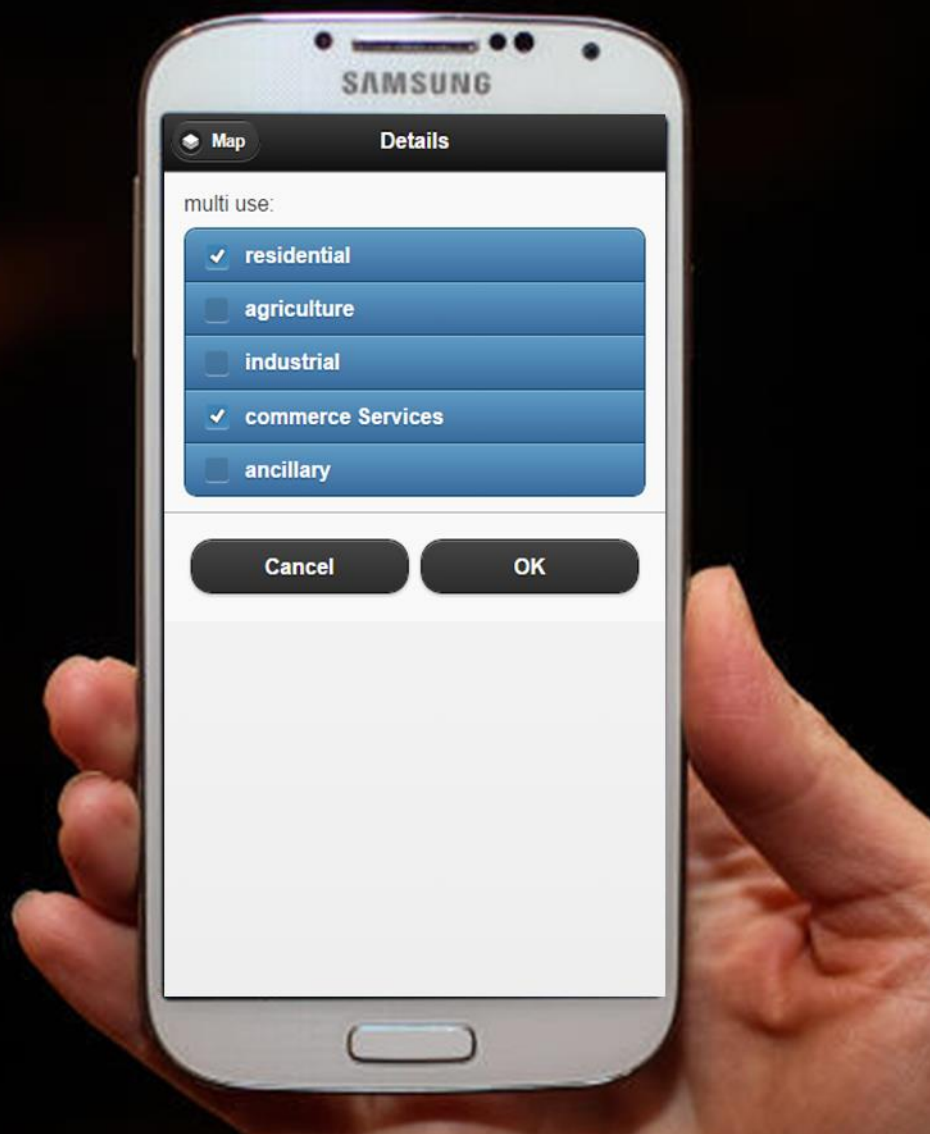
Building selection  
(on 1<sup>st</sup> click)

Building properties  
(on 2<sup>nd</sup> click)

Editing of multi-value  
attribute





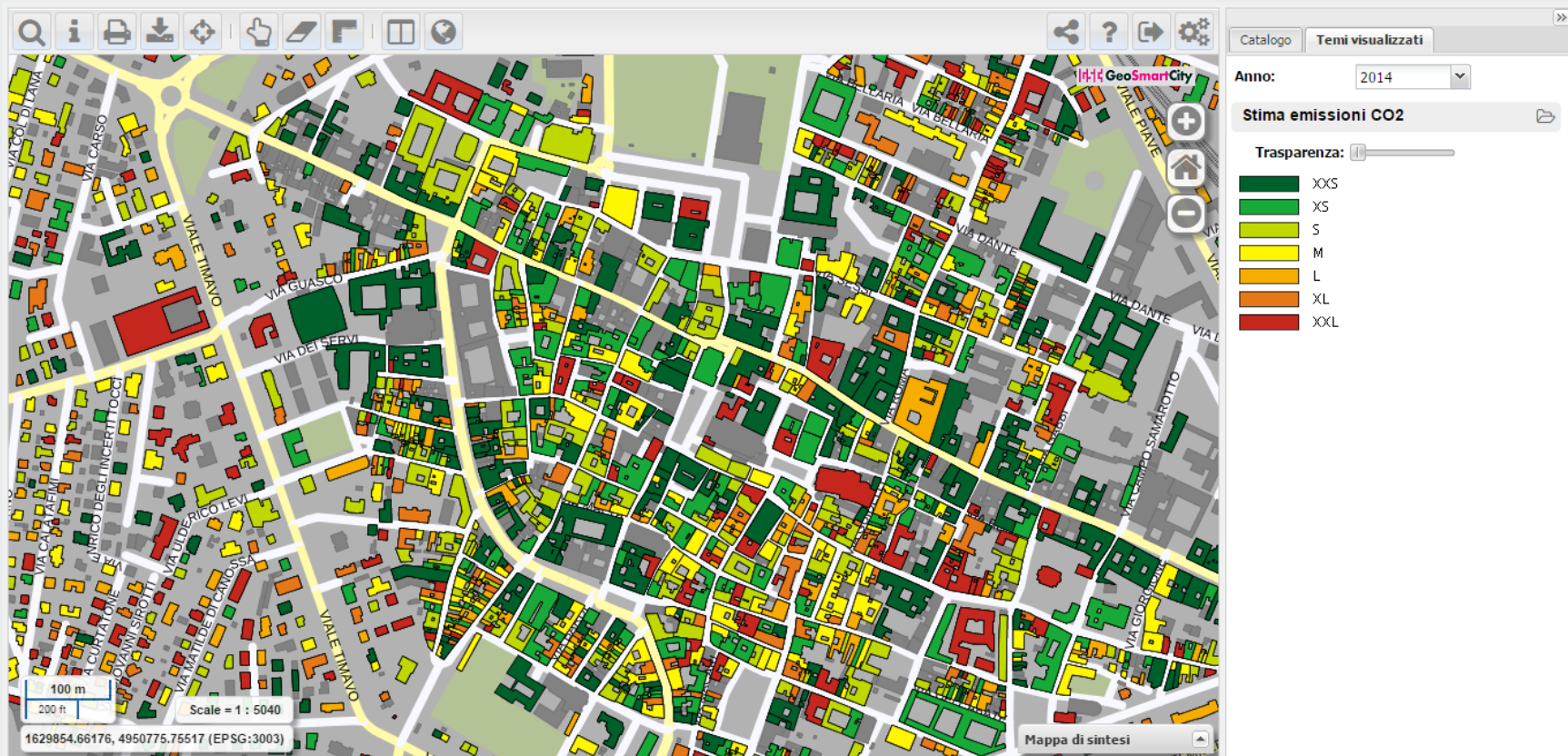


## Another (WPS) “specialized” service in brief

- E.g. similarly to the estimation of the energy performance, the **estimation of the CO<sub>2</sub> emissions** is based on an algorithm that uses in input spatial feature (buildings) with attributes containing data about real energy consumption, by type of fuel (gas, electricity, LPG, DH, ...)

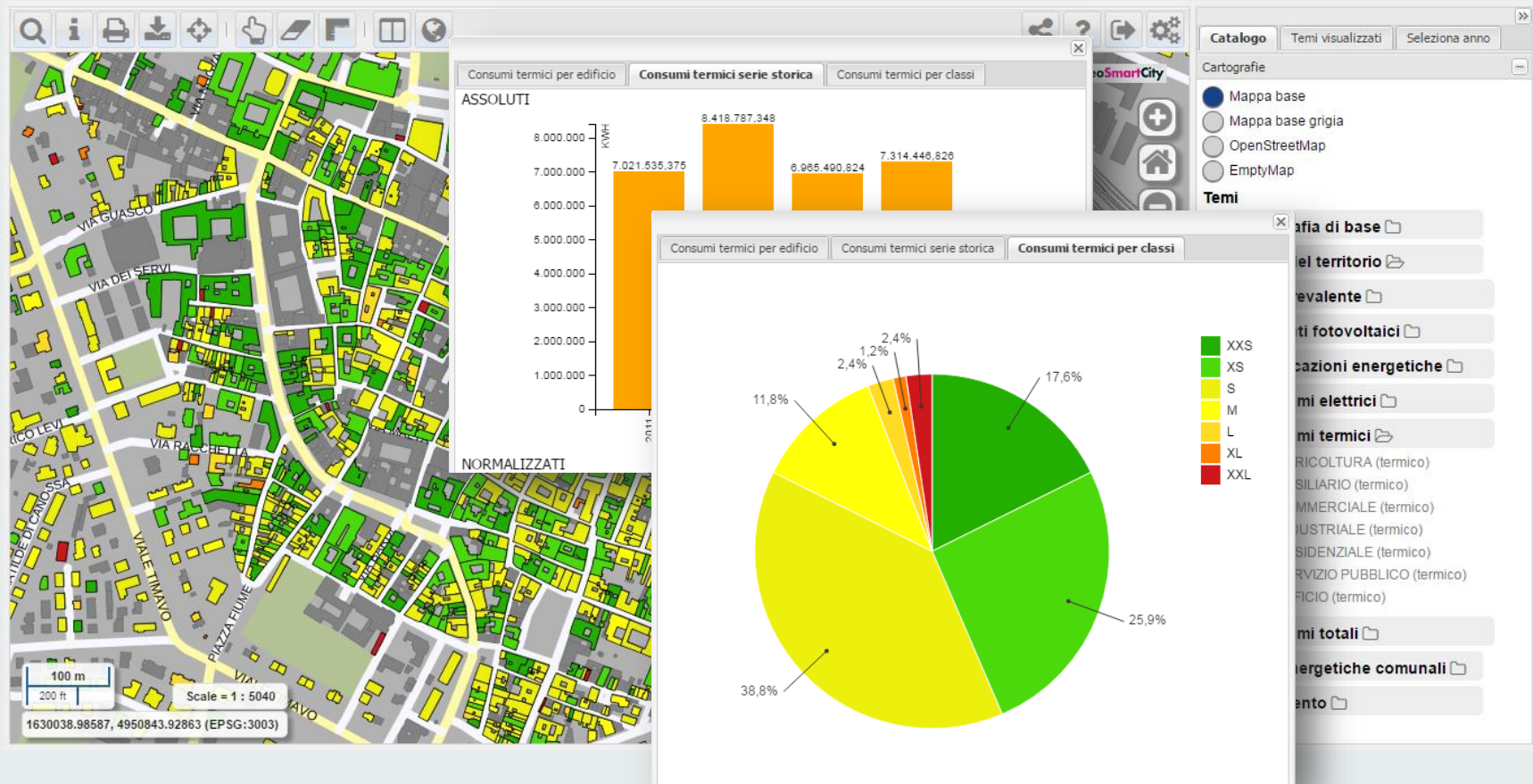
# Another (WPS) “specialized” service in brief

## CO<sub>2</sub> emissions estimation



# A (RESTful) "specialized" service in brief

## Heat Consumption dashboard

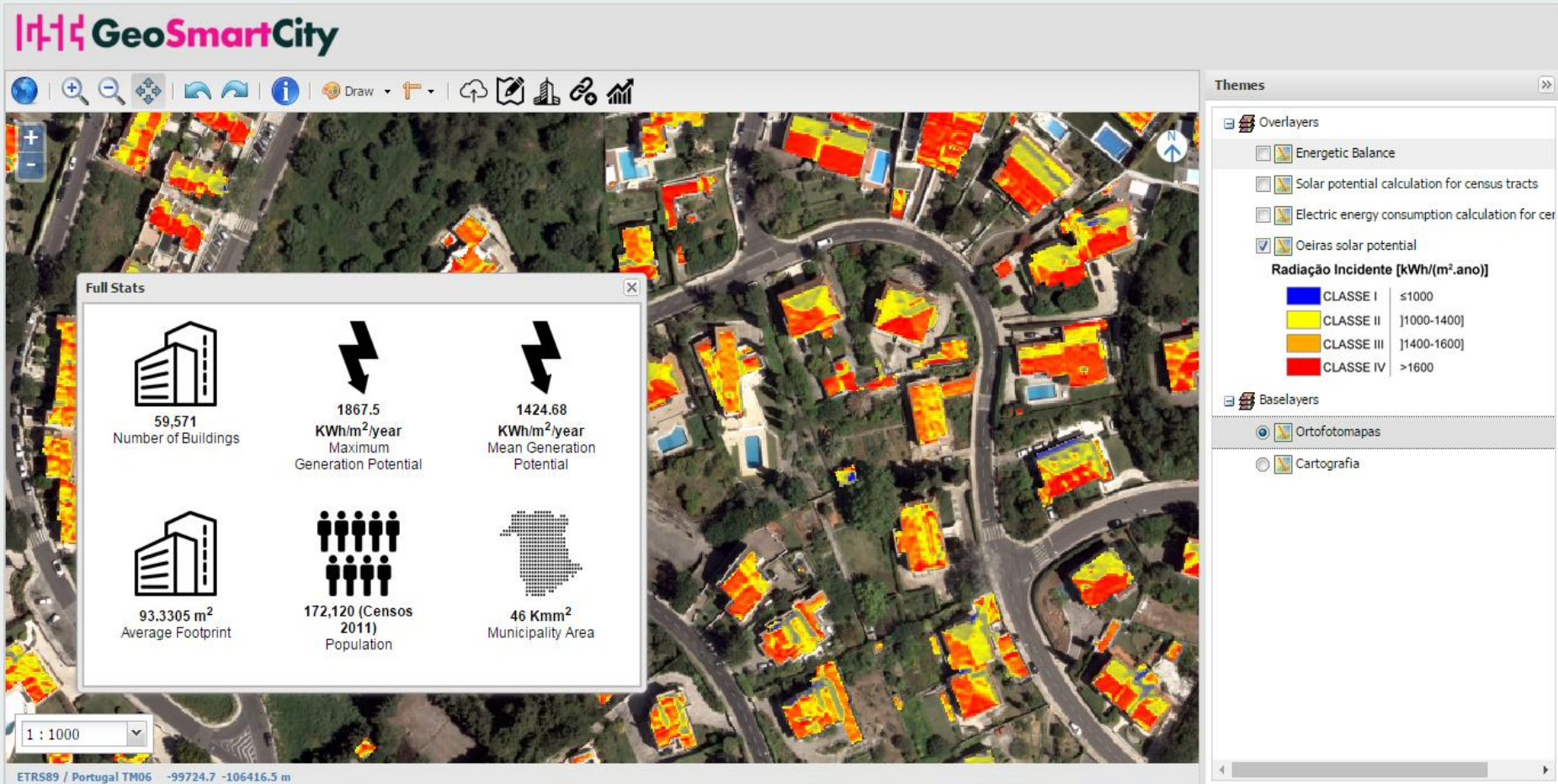


## Another (WPS) “specialized” service ...

- The “Solar potential” in brief:
  - Routing calculation based on green preferences (avoid most crowded routes, use public transportation, minimize fuel consumption).
  - This service provides routes calculated for different types of vehicles (depending on user preference for maximum distances) so to let users to select “zero emission” instead of bus or private car. CO<sub>2</sub> equivalent emissions will be based on available data and statistics provided by the European Environmental Agency (EEA, 2015).









# Another (WPS) “specialized” service ...



**GeoSmartCity**

**Full Stats**

 <b>59,571</b> Number of Buildings	 <b>1867.5</b> KWh/m <sup>2</sup> /year Maximum Generation Potential	 <b>1424.68</b> KWh/m <sup>2</sup> /year Mean Generation Potential
 <b>93,3305 m<sup>2</sup></b> Average Footprint	 <b>172,120 (Censos 2011)</b> Population	 <b>46 Kmm<sup>2</sup></b> Municipality Area

**Themes**

- Overlayers
  - Energetic Balance
  - Solar potential calculation for census tracts
  - Electric energy consumption calculation for cer
  - Oeiras solar potential
- Radiação Incidente [kWh/(m<sup>2</sup>.ano)]**
  - CLASSE I ≤1000
  - CLASSE II ]1000-1400]
  - CLASSE III ]1400-1600]
  - CLASSE IV >1600
- Baselayers
  - Ortofotomapas
  - Cartografia

1 : 1000

ETRS89 / Portugal TM06 -99724.7 -106416.5 m

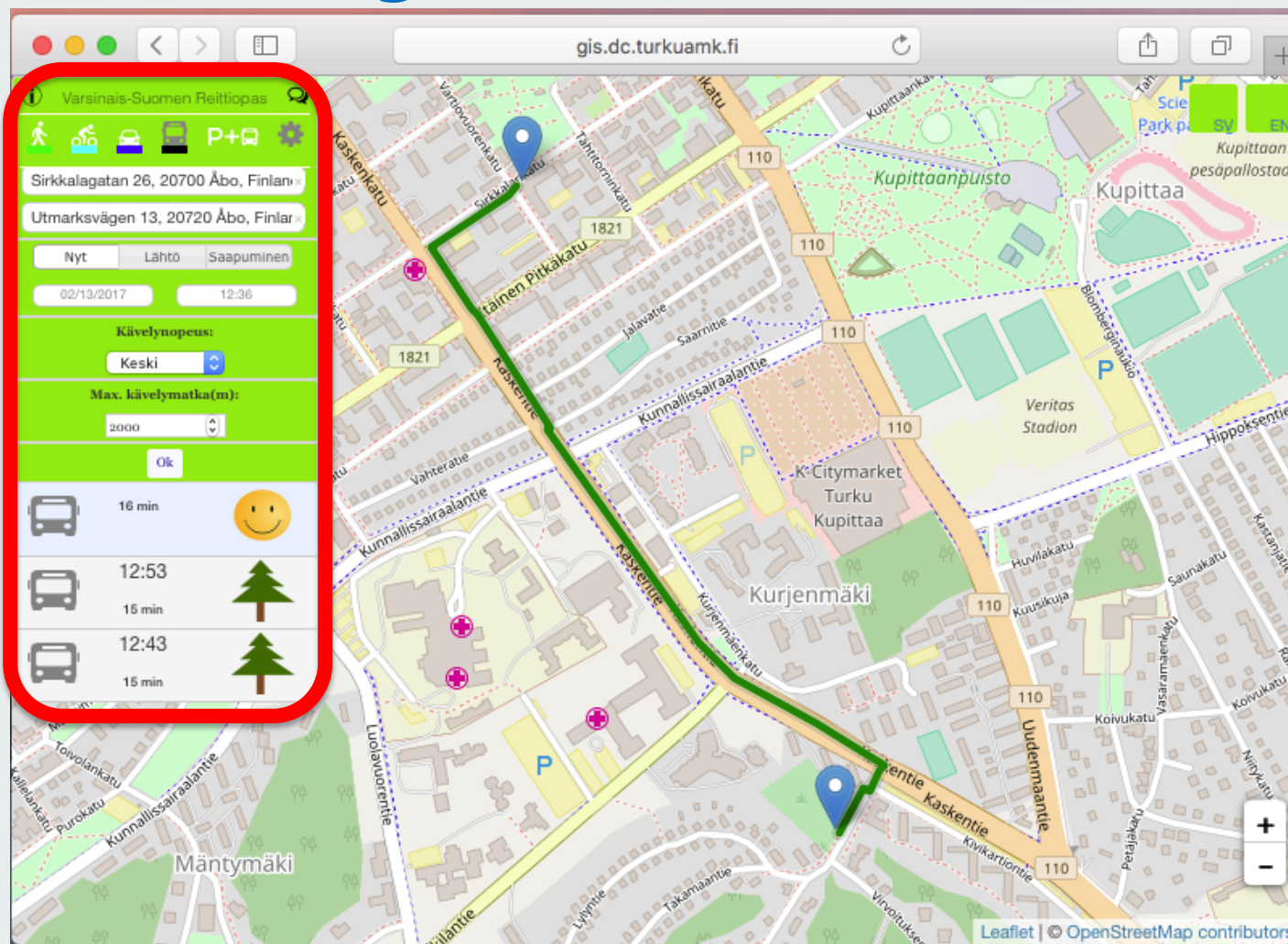
## Example – Transport

- Some other pilots (e.g. Turku) require processing services as “green” route calculation based on green preferences (avoid most crowded routes, use public transportation, minimize fuel consumption).

## A (RESTful) “green routing” service in brief

- The “Green preferences” service provides routes calculation for different types of vehicles (depending on user preference for maximum distances) so to let users to choose “zero emission” instead of bus or private car.
- CO<sub>2</sub> equivalent emissions are based on data provided by the European Environmental Agency (EEA, 2015).

# Green routing service in brief ...





# Components (Specialized Services)

## Hub Support resources

### Validation Service



On-line validation of datasets harmonized according to the GeoSmartCity target data models.

[Validation Service](#)

### Geospatial Catalogue



A cataloging application for spatially referenced resources. It provides metadata editing and search functions.

[Geospatial Catalogue](#)

### Codelists Manager



The JRC's **Re3gistry** is reused and extended in order to manage new codelists and codelist values.

[Codelists Manager](#)

### Specialised Services



Standardized and re-usable data processing services based on requirements coming from the **GeoSmartCity Pilots**.

[Specialised Services](#)

Specialized services are “**pilot-driven**” services tightly coupled to the detailed requirements coming from pilot partners in terms of **data processing** and user engagement.

The overarching objective of the specialized services is to provide **common re-usable functionalities** among the “Green Energy” and “Underground” scenarios.



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

William Thomson, Lord Kelvin



# The GeoSmartCity Hub

**Piergiorgio Cipriano**  
Business Analyst – Public Sector & Utilities



# The idea

Imagine that, in few years, all European cities will share geographic information being really interoperable, with the same semantic, encoding and licenses.

We started with the idea of a “hub” where to provide data related to “energy” and “underground” being interoperable as open&harmonized data.

# The Hub concept

GeoSmartCity “Hub” is a software and hardware platform to **catalogue, store,** and make **data available** through standard APIs and protocols.

The software **components** (open source) expose interfaces for **integrating, visualizing, analyzing** and **processing** spatial and non-spatial data sources, allowing users to upload or connect their data sources, configure maps and publish data through a web based user interface.

The list of installed basic applications is:

- Apache 2.4.7 (Web server)
- Tomcat 7.0.62 (applications server that contains applications packed as war)
- PostgreSQL 9.5.2 (Database server) PostGIS 2.2.1 (Spatial and Geographic objects for PostgreSQL extension)
- pgRouting 2.1 (Routing library for Postgis)
- OpenTripPlanner (Multimodal trip planning & analysis application)
- Virtuoso 07.20.3212 (database engine for RDF)
- SOLR 5.2.1 (indexer and search engine)
- CKAN 2.4 (Open-source data portal platform)
- GeoServer 2.7.1.1 (Map Server)
- Geonetwork 3.0.3.0 (Geospatial catalog)
- Geowebcache (Geoserver extension that create cache for layers)
- Re3gistry 1.0 (INSPIRE registry of codelists, codelist values and feature concepts)
- Python 2.7.6 (Programming language)

The GeoSmartCity HUB is distributed as a SaaS service or as virtual machines based on Ubuntu Linux available for download, in order to allow the reuse of all the software components developed for the project.

The benefit of the Hub lies simultaneously in:

- its innovative approach to bridging and bringing together public sector data infrastructures
- its extensive use of well-known open standards;
- its simplicity of implementation

# Design of scenario data service

- Standard-based open services
  - OGC & INSPIRE (CSW, WMS, WFS, WCS, WPS, SOS)
  - INSPIRE Data Specifications (extended)
  - Well-documented APIs for open data and geospatial
- Reuse of INSPIRE reference platform
  - INSPIRE Registry
- Based on outcomes of other projects, e.g.
  - eENVplus - <http://www.eenvplus.eu/>
  - Sunshine - <http://www.sunshineproject.eu/>



# Components

[What is the Hub?](#)

[Project website](#)

[Contact Us](#)

[Log in](#)

## Hub Core resources

### GeoSmartCity Data Catalogue



An application to catalog different data sources, publish all or some of this information and produce a configuration JSON for its map display.

[Data Catalogue](#)

### GeoSmartCity Data Portal



Data discovery in GeoSmartCity is managed by an instance of the **CKAN** software augmented by three extensions for custom metadata management.

[Data Portal](#)

### GeoSmartCity Client Side API



A library for rapid spatial web application development. The library builds on **jQuery**, **OpenLayers3** and invokes methods from the GeoSmartCity Hub.

[Client API](#)

## Hub Support resources

# Components (Data Catalogue)

Home

Logged in as admin@geosmartcity.eu | [Logout](#)

## Menu

### Data management ▾

+ Manage data sources

+ Manage data sets

+ Manage layers

### Administration ▾

+ Manage users

+ Manage organizations

## Manage data sources

[Data source list](#)

[Create/edit data source](#)

### Data source name\*

PostGIS database

### Data source description\*

A PostGIS database running at SINERGIS' servers in Italy.

### Organization\*

AVINET - Asplan Viak Internet AS ▾

### Type of data source\*

PostgreSQL/PostGIS database ▾

### Database host

gsm-db.nco.inet

### Port number

5432

### Database name

hub\_reggio

### Username

postgres

### Password

.....

[Update](#)

# Components (Data Portal)

## Hub Core resources

### GeoSmartCity Data Catalogue



An applicatiton to catalog different data sources, publish all or some of this information and produce a configuration JSON for its map display.

Data Catalogue ↻

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Data Portal ↻

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Client API ↻

## Hub Support resources

# The importance of being ... 'well described'

Datasets

Organizations

About

Search



Home / Organizations / Comune di Reggio-Emilia

Emilia Romagna region, in the North-Centre of Italy. It is located in... [read more](#)

Additional Info

Field

Value

Buildings  
Emilia - Sc

Home / Organizations / Comune di Reggio-Emilia / Buildings in Reggio Emilia - ... / preview WMS

## preview WMS

Manage

Go to resource

Followers

0

Follow

URL: [http://labcatania.dedagroup.it/geoserver/Edifici/P\\_EDIFICI\\_ETICHETTA\\_ENERGETICA/ows?service=wms&version=1.3.0&request=Get...](http://labcatania.dedagroup.it/geoserver/Edifici/P_EDIFICI_ETICHETTA_ENERGETICA/ows?service=wms&version=1.3.0&request=Get...)

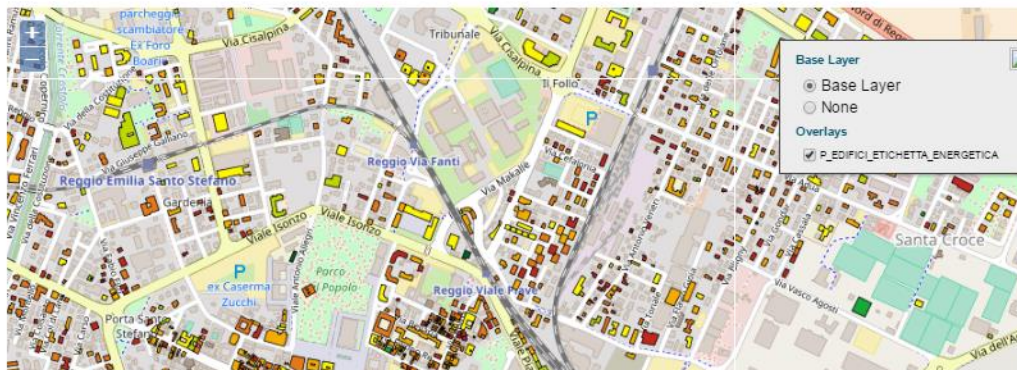
### From the dataset abstract

This dataset has been generated in the context of GeoSmartCity project by the Municipality of Reggio nell'Emilia, based on different background data sources already available in the...

Source: [Buildings in Reggio Emilia - Energy label](#)

Map viewer

Embed



active

February 12, 2017, 20:46

February 12, 2017, 20:00

Dataset

Reggio:Buildings-in-Reggio-Emilia---Solar-panels

eng

Planning, Cadastre

Free

- GeoSmartCity, Reggio, foreground, cadastre, energy, solar, panel

GEMET - INSPIRE themes, version 1.0

- Buildings

10.49 44.62 10.77 44.78

creation: 2014-12-31

The background data provided by GSE have been geocoded by address, normalized using as reference dataset the official Municipal gazetteer. Data are anonymized and contain reference to the estimated installed power.

1: 5000

Commission Regulation (EU) No 1089/2010 of 23 November 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services

Pass: no

<https://creativecommons.org/licenses/by/4.0/>

# Components (Validation Service)

## Hub Support resources

### Validation Service



On-line validation of datasets harmonized according to the GeoSmartCity target data models.

[Validation Service](#)

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Standardized and re-usable data processing services based on requirements coming from the **GeoSmartCity Pilots**.

[Specialised Services](#)

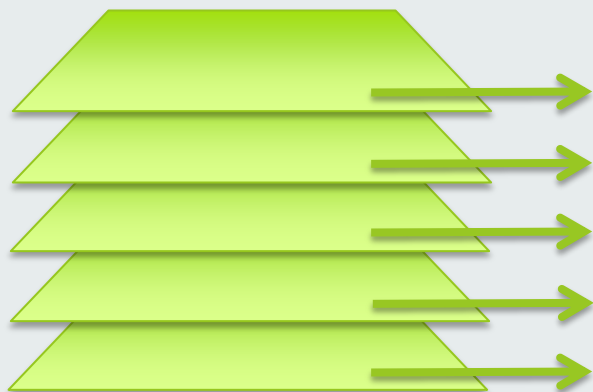
## User resources

[GeoSmartCity Repository](#)[Applications Showcase](#)[User Guides and Training](#)[Contact and Enquiries](#)



# The importance of being ... 'harmonized'

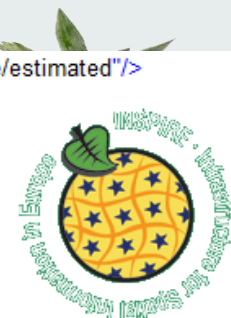
SHP, XLS, CSV,  
ORACLE, POSTGIS, ...



```

<bu-base:status xlink:href="http://inspire.ec.europa.eu/codelist/HeightStatusValue/estimated"/>
<bu-base:value uom="meter">8.0</bu-base:value>
</bu-base:HeightAboveGround>
</bu-base:heightAboveGround>
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</base:Identifier>
</bu-base:inspireId>
<bu-base:currentUse>
<bu-base:CurrentUse>
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<bu-base:percentage>100</bu-base:percentage>
</bu-base:CurrentUse>
</bu-base:currentUse>
<bu-base:numberOfDwellings>1</bu-base:numberOfDwellings>
<bu-base:numberOfFloorsAboveGround>2</bu-base:numberOfFloorsAboveGround>
<bu-core2d:geometry2D>
<bu-base:BuildingGeometry2D>
<bu-base:geometry>
<gml:Polygon gml:id="_2cb12b17-5bkd-7b57-720e-8fe04av0c931" srsName="EPSG:3044">
<gml:exterior>
<gml:LinearRing>

```



# The importance of being ... **'harmonized'**

- To facilitate pilots to harmonize their own data, a double-step approach has been proposed:
  - 1<sup>st</sup> transformation into a **pseudo-INSPIRE SQL database** (“Buildings” only), structured for creating target databases on pilots’ premises (Reggio, Oeiras, Marousi)
  - 2<sup>nd</sup> transformation from pseudo-INSPIRE SQL db into GSC (INSPIRE extended) **GML compliant datasets**
- SQL structures are based on extended INSPIRE data model

# The importance of being ... 'harmonized'

```

CREATE TABLE conversion (
    classid varchar(70) NOT NULL,
    input varchar(80) NOT NULL,
    location varchar(80),
    output varchar(80) NOT NULL,
    value double precision NOT NULL,
    year date
);

--
-- CREATE TABLE: buildings
-- Rappresenta la classe: Buildings - BUILDINGS
--

CREATE TABLE buildings (
    classid varchar(70) NOT NULL,
    buildingtype varchar(80),
    condition varchar(80) NOT NULL,
    connection_electricity char(1) ,
    connection_gas char(1) ,
    connection_sewage char(1) ,
    connection_thermal char(1) ,
    connection_water char(1) ,
    date_c_beginning numeric(15,0) ,
    date_c_end numeric(15,0) ,
    date_r_beginning numeric(15,0) ,
    date_r_end numeric(15,0) ,
    dist_floor varchar(40) NOT NULL,
    elev_ref varchar(80),
    --

```

# Components (Codelist Registry)

## Hub Support resources

### Validation Service



On-line validation of datasets harmonized according to the GeoSmartCity target data models.

[Validation Service](#) 

### Geospatial Catalogue



A cataloging application for spatially referenced resources. It provides metadata editing and search functions.

[Geospatial Catalogue](#) 

### Codelists Manager




The JRC's **Re3gistry** is reused and extended in order to manage new codelists and codelist values.

[Codelists Manager](#) 

### Specialised Services



Standardized and re-usable data processing services based on requirements coming from the **GeoSmartCity Pilots**.

[Specialised Services](#) 

## User resources

[GeoSmartCity Repository](#)

[Applications Showcase](#)

[User Guides and Training](#)

[Contact and Enquiries](#)

# The importance of being ... 'INSPIRed'

A proposito di questo sito

italiano (it) ▼

```
<?xml version="1.0" encoding="UTF-8"?>
<RE_RegisterItem xmlns:gmd="http://www.isotc211.org/2005/gmd"
  xmlns:gco="http://www.isotc211.org/2005/gco"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.isotc211.org/2005/grg"
  xsi:schemaLocation="http://www.isotc211.org/2005/grg http://standards.iso.org/iso/19135/-2/register.xsd">
  <itemIdentifier gco:nilReason="inapplicable"/>
  <name>
    <gco:CharacterString>publicServices</gco:CharacterString>
  </name>
  <status>
    <RE_ItemStatus>valid</RE_ItemStatus>
  </status>
  <definition>
    <gco:CharacterString>The building (or building component) hosts public services. Public services are tertiary services
  </definition>
  <description>
    <gco:CharacterString>Public services are often ruled by public governments or on behalf of them. EXAMPLES: Schools, hos
  transport station.NOTE: in case of a building being both office and public service (e.g. a city hall), the building should be
  </description>
  <additionInformation xlink:href="http://hub.geosmartcity.eu/registry/codelist/CurrentValue/publicServices"/>
  <itemClass>
    <RE_ItemClass>
      <name>
        <gco:CharacterString>CodeListValue</gco:CharacterString>
      </name>
      <technicalStandard gco:nilReason="inapplicable"/>
      <alternativeNames gco:nilReason="inapplicable"/>
      <describedItem gco:nilReason="inapplicable"/>
    </RE_ItemClass>
  </itemClass>
</RE_RegisterItem>
```

<http://hub.geosmartcity.eu/registry/codelist/CurrentValue/publicServices/>



# Components (Specialized Services)

## Hub Support resources

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[Validation Service](#)

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[Codelists Manager](#)

### Specialised Services



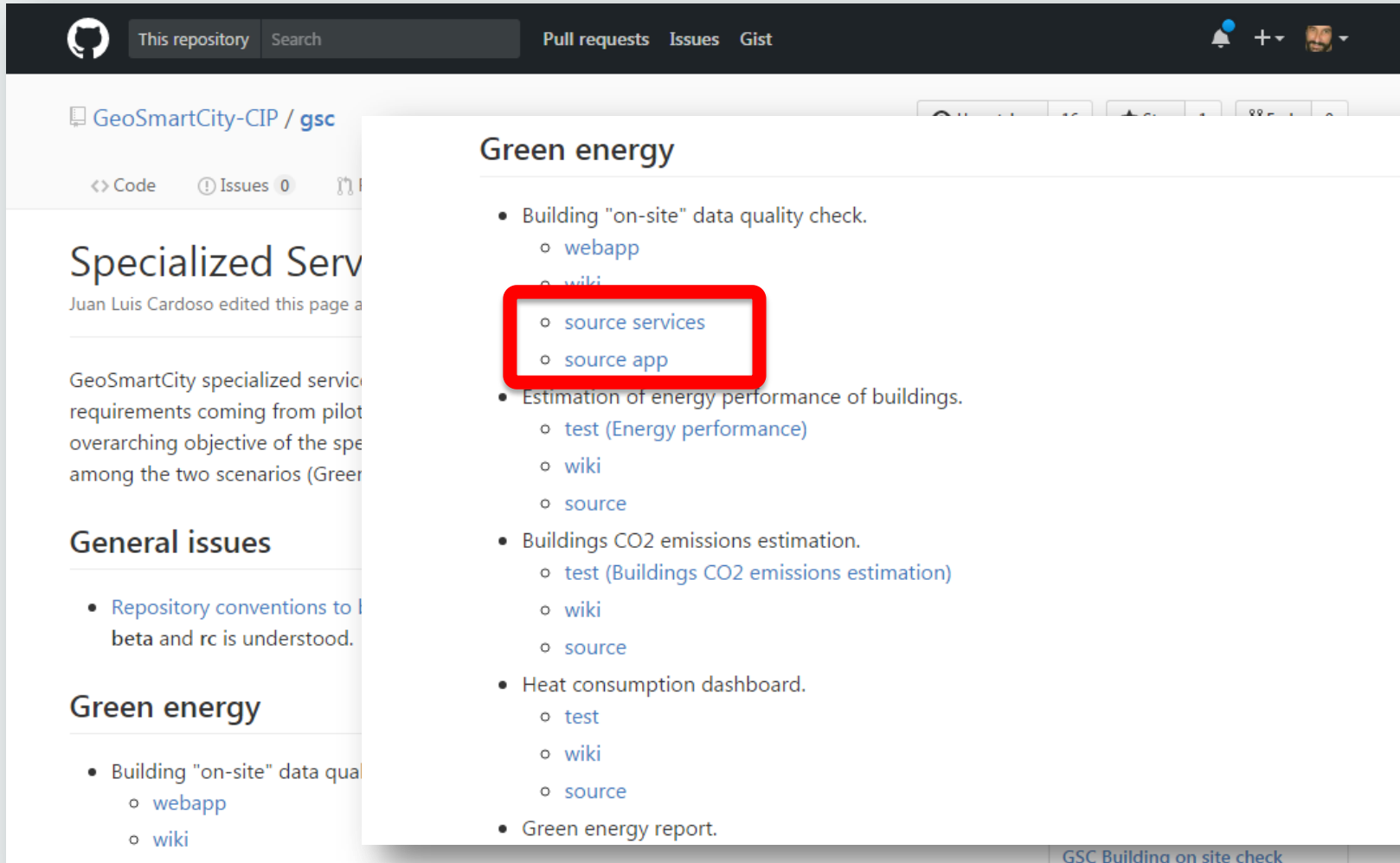
Standardized and re-usable data processing services based on requirements coming from the **GeoSmartCity Pilots**.

[Specialised Services](#)

## User resources

[GeoSmartCity Repository](#)[Applications Showcase](#)[User Guides and Training](#)[Contact and Enquiries](#)

# Specialized services are public on Github



The screenshot shows a GitHub repository page for 'Green energy' under the 'GeoSmartCity-CIP / gsc' organization. The page is titled 'Green energy' and contains a list of services. A red box highlights the 'source services' link under the 'Building "on-site" data quality check' section.

GeoSmartCity-CIP / gsc

Specialized Serv

Juan Luis Cardoso edited this page a

GeoSmartCity specialized service requirements coming from pilot requirements coming from pilot overarching objective of the spe among the two scenarios (Green

### General issues

- Repository conventions to beta and rc is understood.

### Green energy

- Building "on-site" data quality check.
  - webapp
  - wiki
  - source services**
  - source app
- Estimation of energy performance of buildings.
  - test (Energy performance)
  - wiki
  - source
- Buildings CO2 emissions estimation.
  - test (Buildings CO2 emissions estimation)
  - wiki
  - source
- Heat consumption dashboard.
  - test
  - wiki
  - source
- Green energy report.

GSC Building on site check

# Thanks for your attention

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**DEDAGROUP**  
PUBLIC SERVICES

