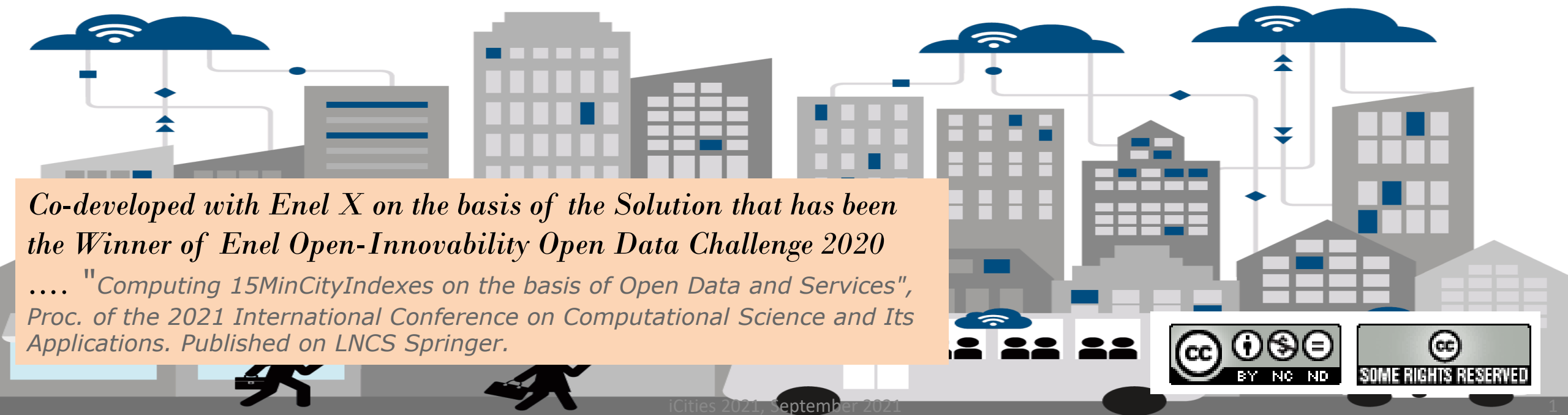


Exploiting OpenData for 15MinCityIndex

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Co-developed with Enel X on the basis of the Solution that has been the Winner of Enel Open-Innovability Open Data Challenge 2020

.... "Computing 15MinCityIndexes on the basis of Open Data and Services", Proc. of the 2021 International Conference on Computational Science and Its Applications. Published on LNCS Springer.

Concept 15MinIndex

Assessing in each point of the area (city or rural) the capability of providing services ad 15 Min walking distance for the city users

- Several different approaches from early Carlos Moreno concept
- Several different subindexes

Carlos Moreno Functions	Li et al., 2019	15MinCityIndex subindexes
living		Housing viability
	Gov	Govern Services
		Safety Services
		Culture and Cults Services
		Environment Quality
	Roads	Slow Mobility Services
		Fast Mobility Services
	[Medical]	Sport Services
working		Economy/
	pension	sustainability
commerce	commerce	
	dining	Food Services
healthcare	medical	Health Services
education	edu	Education Services
entertainment	entertainment	Entertainment Services

Technical Challenges

- **The main constraints:**
 - use Open Data
 - maintain the concept of 15 Min distance
- **Problems: conceptual, computational and technical such as**
 - For Who: young, elders, impaired, etc.
 - If not walking: how moving...
 - Effective routing for walking ? walkability
 - For Where, strong differences on: city, rural, industrial area
 - How:
 - Data collection processes and costs
 - Independency of the subindexes
 - Combining measures for computing subindexes
 - Combining subindexes for computing the 15MinCityIndex
 - Computational complexity of **combining data from different sources** and data density, availability, semantics, etc.
 - Definition of the acceptance level according to **objective KPIs**



The SubIndexes categories

A) **environment** quality:

- **quality** of the environment in which one is going to live.

B) **economy/sustainability**:

- assessing **sustainability** by matching the offer vs the demand of work, in first approximation.

C) **housing viability**:

- assessing **affordability** of having a house of reasonable quality.

D) other: health services, food services, education services, govern services, safety services, culture and cults services, slow mobility services, fast mobility services, entertainment services, sport services.

- assessing the **availability** of services, POI, etc.

Environment SubIndex

- AIM: assess the environmental **quality** of the area for living.
- Good indicators can be:
 - EAQI (European Air Quality Index), or others,
 - specific pollutants (NO₂, CO₂, O₃, PM₁₀, PM_{2.5}, etc.).For most of them, recommended values are provided at the EC level. Please note that, most of the pollutants are also taken into account by the EAQI which is based on PM_{2.5}, PM₁₀, NO₂, O₂ and SO₂, so that, the EAQI supersedes them.
- quality of water,
- presence of green areas/gardens (which can be recovered from municipality or from Copernicus Satellite data with some limitations and complexity),
- noise level in most data set related to traffic,

$$SubIndex(env) = (EAQI + K GreenAreasSM / \#Inhabitants) / 2$$

Economy SubIndex

- AIM: assess the economic **sustainability** of the area,
 - demand-vs-offer index,
 - self-sustainability: working places (commercial and industrial) wrt workforce in the area is satisfactory to ensure the economic well-being of the people.
- Good Indicator can be:
 - census data: people living in the area: ages, skill, etc.
 - commercial / economic data
 - POI as shops, services, industries, etc. as POI
 - capability in terms of personnel per POI
 - level of salary of the area (including retired people) for the sustainability of the whole population of the area.

European Air Quality Index **EAQI**

<http://airindex.eea.europa.eu/>

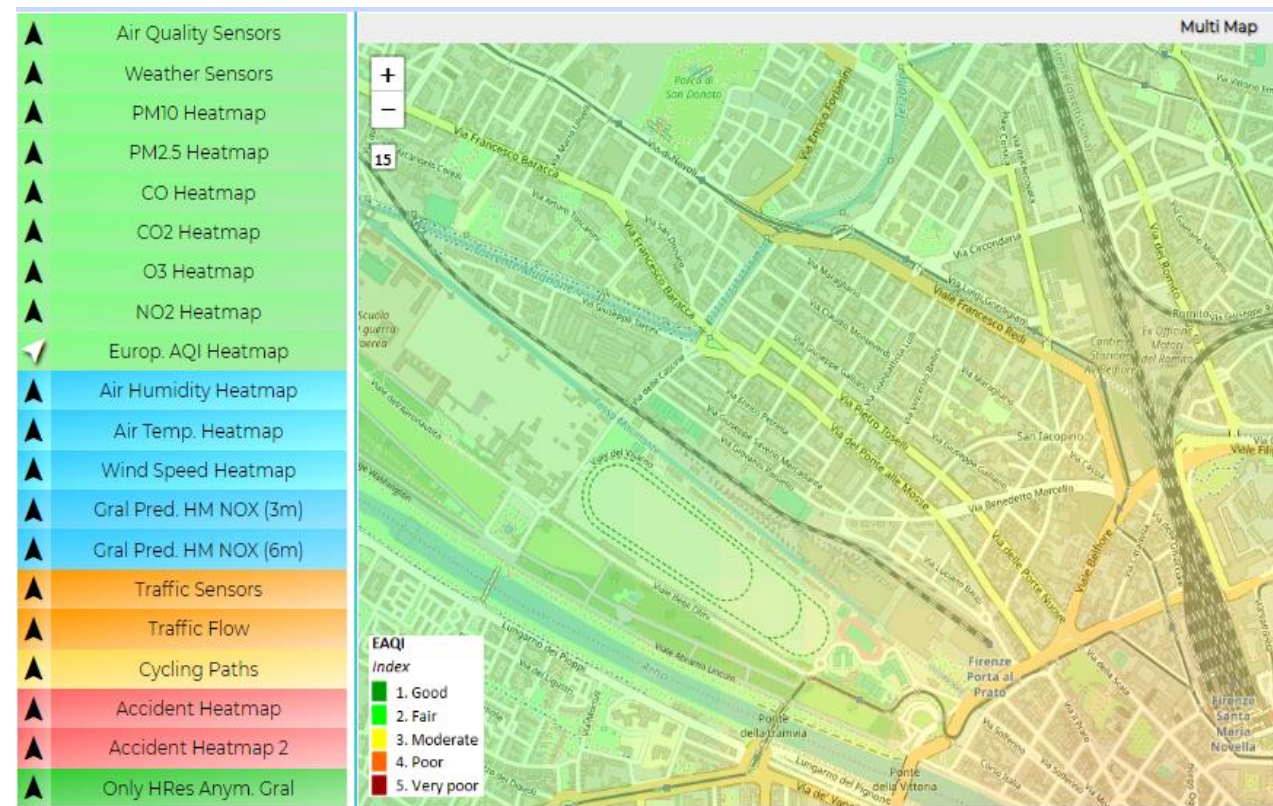
Pollutant	Index level (based on pollutant concentrations in µg/m3)				
	Good	Fair	Moderate	Poor	Very poor
Particles less than 2.5 µm (PM _{2.5})	0-10	10-20	20-25	25-50	50-800
Particles less than 10 µm (PM ₁₀)	0-20	20-35	35-50	50-100	100-1200
Nitrogen dioxide (NO ₂)	0-40	40-100	100-200	200-400	400-1000
Ozone (O ₃)	0-80	80-120	120-180	180-240	240-600
Sulphur dioxide (SO ₂)	0-100	100-200	200-350	350-500	500-1250

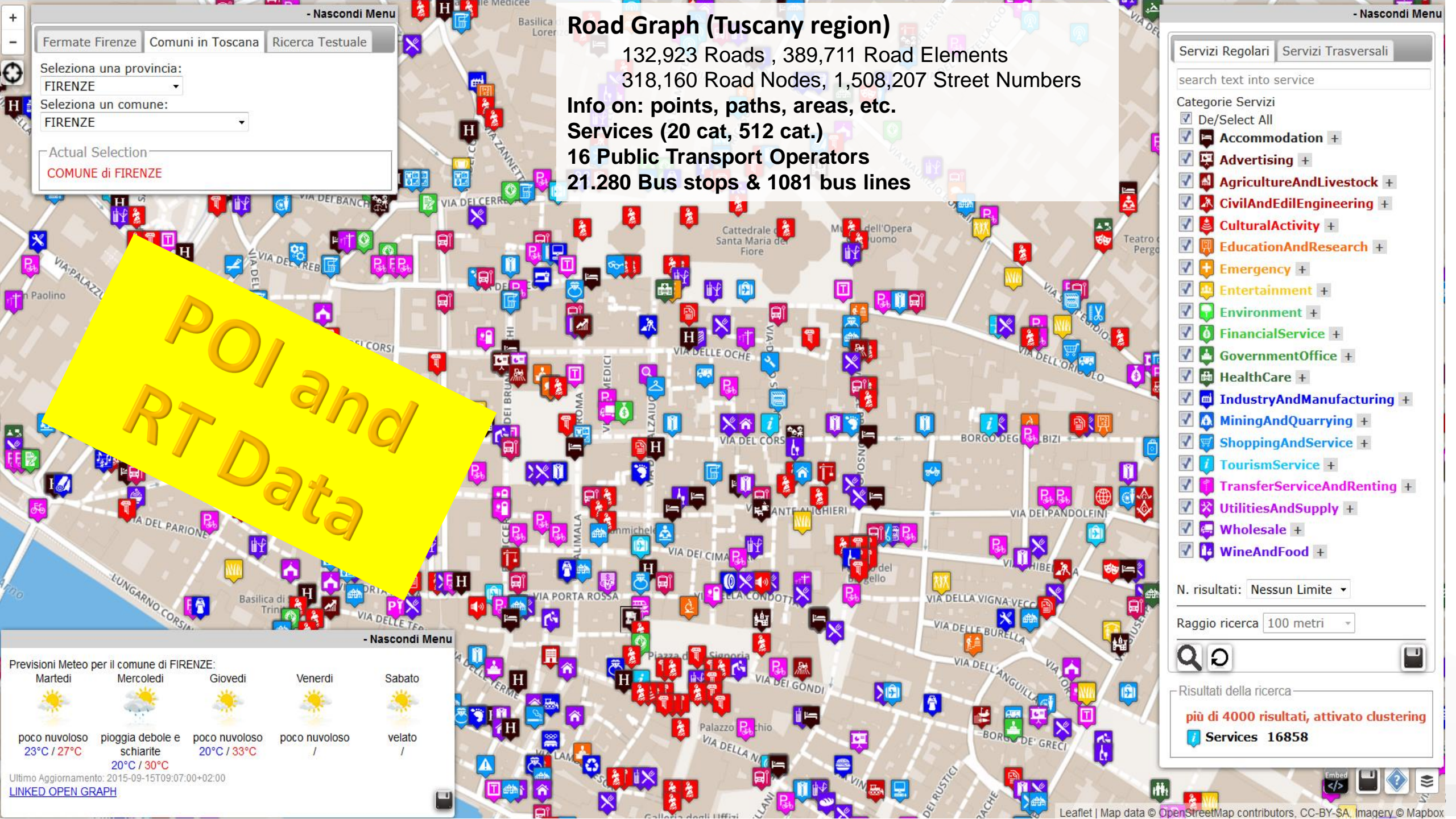
Measurements of up to five key pollutants supported by modelled data determine the index level that describes *the current air quality situation at each monitoring station*.

The index corresponds to the poorest level for any of five pollutants according to the following scheme.

Legend of Environmental data:

<https://www.snap4city.org/435>





- Nascondi Menu

Fermate Firenze Comuni in Toscana Ricerca Testuale

Seleziona una provincia:

FIRENZE

Seleziona un comune:

FIRENZE

Actual Selection

COMUNE di FIRENZE

Road Graph (Tuscany region)

132,923 Roads , 389,711 Road Elements

318,160 Road Nodes, 1,508,207 Street Numbers

Info on: points, paths, areas, etc.

Services (20 cat, 512 cat.)

16 Public Transport Operators

21.280 Bus stops & 1081 bus lines

POI and
RT Data

- Nascondi Menu

Previsioni Meteo per il comune di FIRENZE:

Martedì



poco nuvoloso
23°C / 27°C

Mercoledì



pioggia debole e
schiarite
20°C / 30°C

Giovedì



poco nuvoloso
20°C / 33°C

Venerdì



poco nuvoloso
/

Sabato



velato
/

Ultimo Aggiornamento: 2015-09-15T09:07:00+02:00

[LINKED OPEN GRAPH](#)

- Nascondi Menu

Servizi Regolari

Servizi Trasversali

search text into service

Categorie Servizi

- ☒ De/Select All
- ☒ Accommodation +
- ☒ Advertising +
- ☒ AgricultureAndLivestock +
- ☒ CivilAndEdilEngineering +
- ☒ CulturalActivity +
- ☒ EducationAndResearch +
- ☒ Emergency +
- ☒ Entertainment +
- ☒ Environment +
- ☒ FinancialService +
- ☒ GovernmentOffice +
- ☒ HealthCare +
- ☒ IndustryAndManufacturing +
- ☒ MiningAndQuarrying +
- ☒ ShoppingAndService +
- ☒ TourismService +
- ☒ TransferServiceAndRenting +
- ☒ UtilitiesAndSupply +
- ☒ Wholesale +
- ☒ WineAndFood +

N. risultati: Nessun Limite

Raggio ricerca 100 metri



Risultati della ricerca

più di 4000 risultati, attivato clustering

Services 16858

Embed

Map data

CC-BY-SA

Imagery © Mapbox

Housing SubIndex

- AIM: assess the **affordability** of houses in the area.
- Indicators can be:
 - services of the buildings, hard to get
 - age of the buildings, possible
 - prices for square meters of the real estate market, which is also related to the affordability of living.
- Consideration:
 - An affordable price with respect to the population living there could simplify the live-ability.

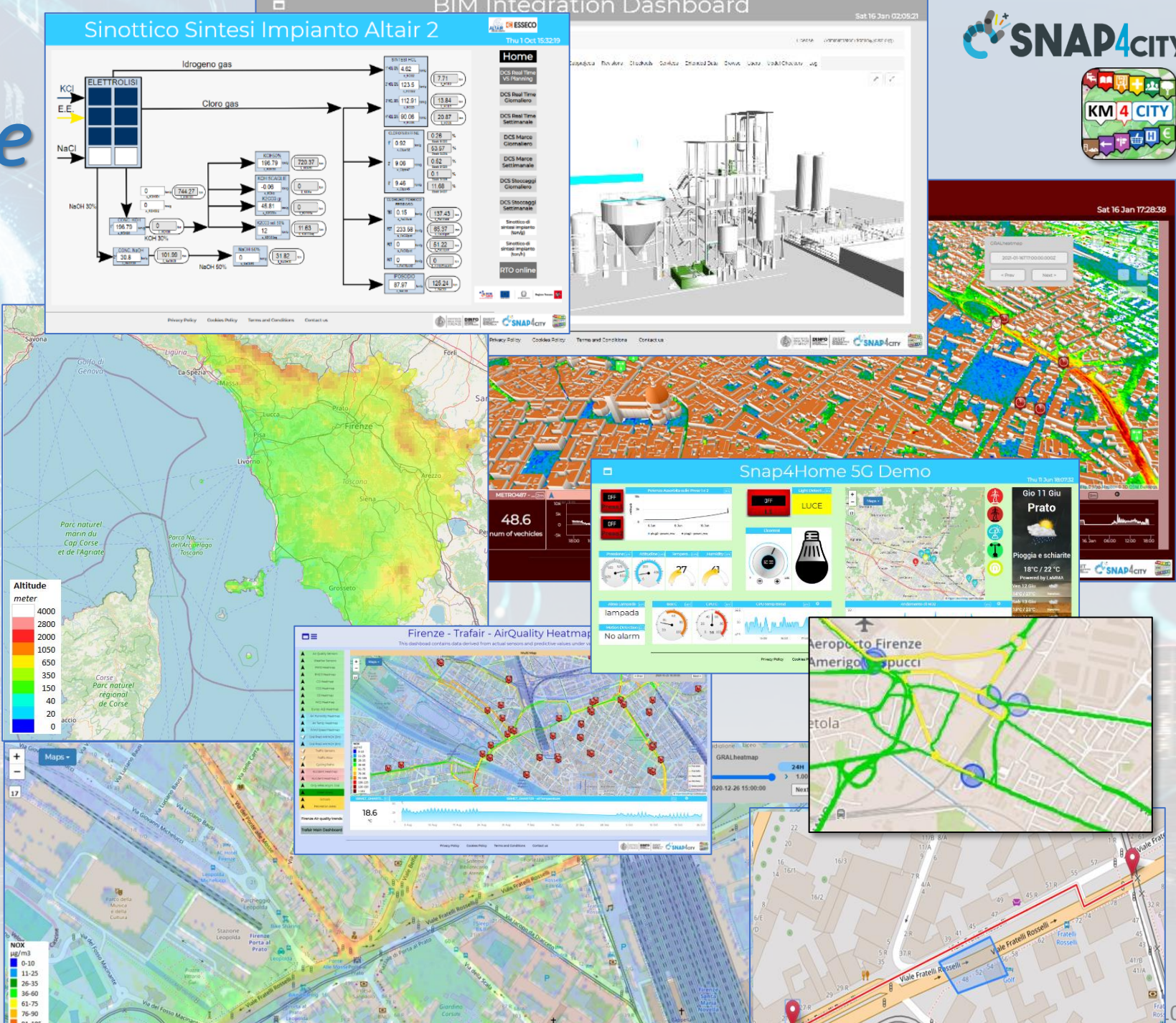
Health SubIndex

- AIM: assessing the **availability** of health services
- Indicators:
 - Presence of: pharmacies, private and public hospitals, labs, studio of doctors, presence of defibrillators, etc. with respect to the number of users.
- Consideration
 - There are some *KPI* provided by the EC.
 - coverage of the pharmacies in terms of potential clients of the area.
 - a pharmacy every 3000 people for Italian govern,
 - 500 hospitals' beds every 100.000 inhabitants,
 - 80 dentists per 100.000 inhabitants,
 - 1.6 hospitals per 100.000 inhabitants, etc.

For example

Data Type Coverage

- POI, IOT, shapes,...
- maps, orthomaps, GTFS, GIS WFS/WMS, GeoTiff, ..
- calibrated heatmaps, ..
- traffic flow, typical trends, ..
- trajectories, events, ..
- 3D, BIM, Workflow, ..
- Dynamic icons/pins, ..
- OD Matrices, scenarios, ..
- prediction models,
- decision support,
- Synoptics, animations, ..
- social media, Routing, ..
- Satellite data, ..
- KPI, personal KPI,..
- etc.



Slow Mobility SubIdx

- AIM: assess **presence** of services to facilitate the local mobility.
- Indicators:
 - walkability, presence of sidewalks, number of Km of roads (that can be used for walking and biking), presence and number of cycling paths, availability of bike/cart sharing, number of sharing station for short range travel,
 - critical presence of barriers such as bridges, highways, etc., which can limit the walkability. Eventual usage of routing but computationally too complex.
- Consideration:
 - good services can facilitate the movements in the area and reduce the needs of taking less sustainable travel means.
 - having a good rank on most of the subindexes (taking into account of services in the area) it would reduce the needs of exiting from the local area by using a private or public travel means to access at the not accessible services.

Fast Mobility SubIdx

- AIM: assess the **presence** of services for moving out of the area.
- Indicators:
 - Presence of city busses, area busses and long distances (railways, airports, highway joint), with respect to the number of users of the authorized age to use them.
 - presence of fuel stations,
 - size of bus stops and railways stations,
 - long range recharging stations, etc.,
- Consideration:
 - Open Data, and POI.
 - Public transportation data (bus stops, bus lines, train stops, etc.) can be recovered from GTFS and/or Transmodel files which are accessible from the operators.

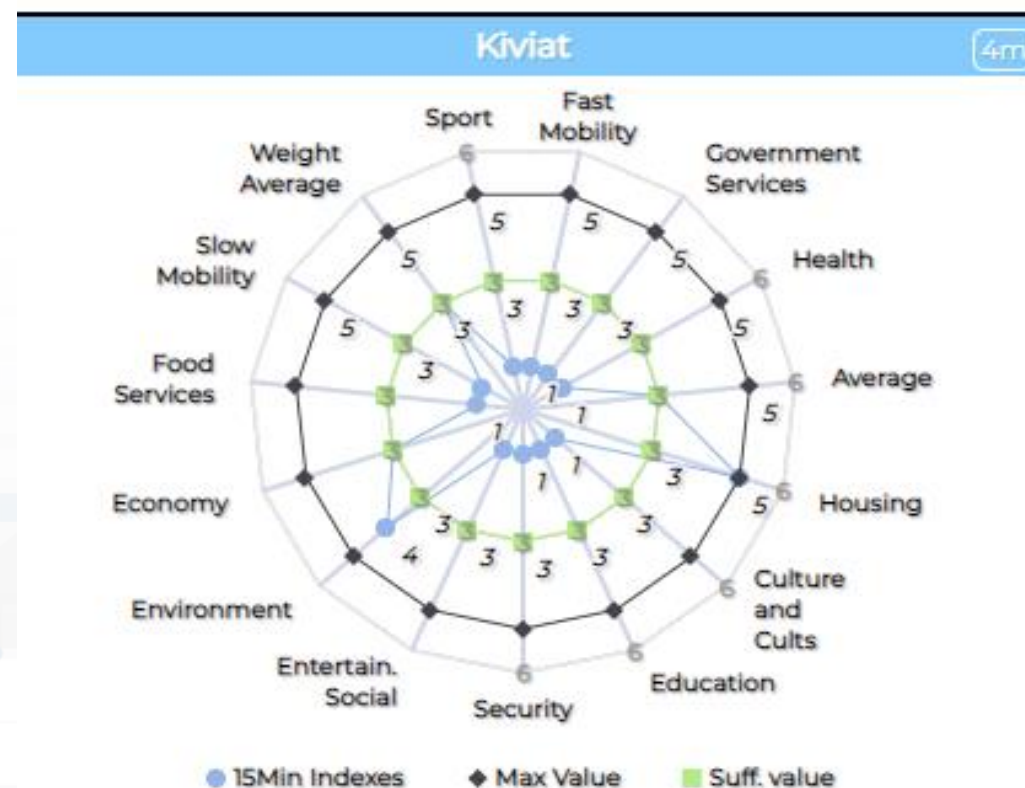
For example

Prototype development: the process

- **Creating a grid 700x700 mt**
 - Computing number of inhabitants for grid area
- **For each Subindex**
 - Collecting: each sub-subindex data by using IoT App and saving them on Snap4City
 - Mapping data on the grid Analysing distribution,
 - scaling and centering the distribution according to KPI
 - Saving the Subindex
- **Computing the 15MinCityIndex**
 - Saving the 15MinCityIndex



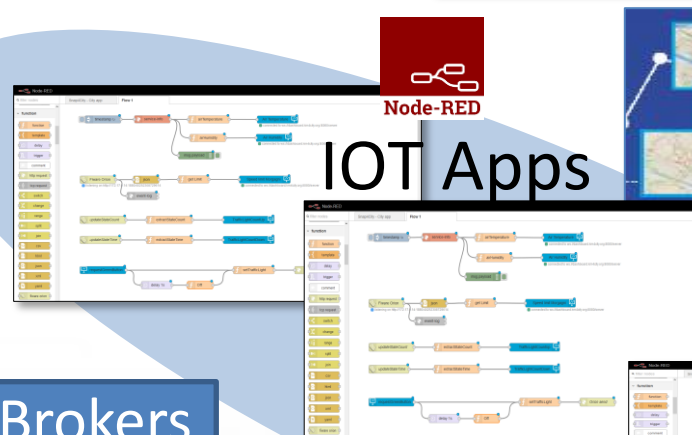
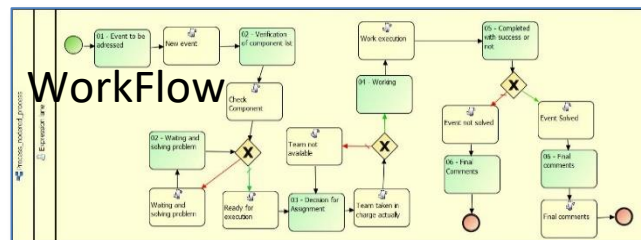
PRATO : VIA DEL LEONE N. 120/C



Prototype development: On Snap4City platform



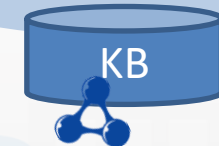
KPI, POI, MyKPI, ...
API, External Services
Web Scraping



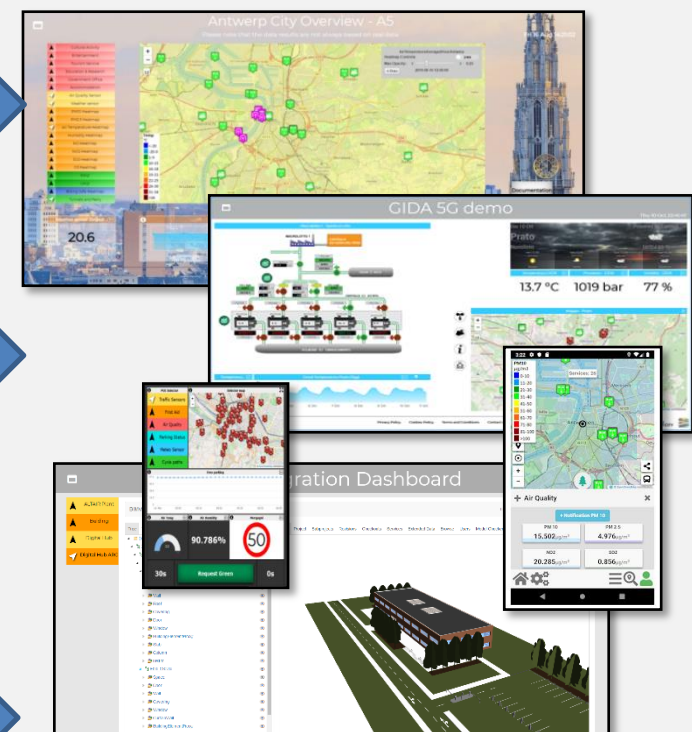
Data Analytics,
Artificial Intelligence

IOT Brokers

IOT Broker
IOT Broker

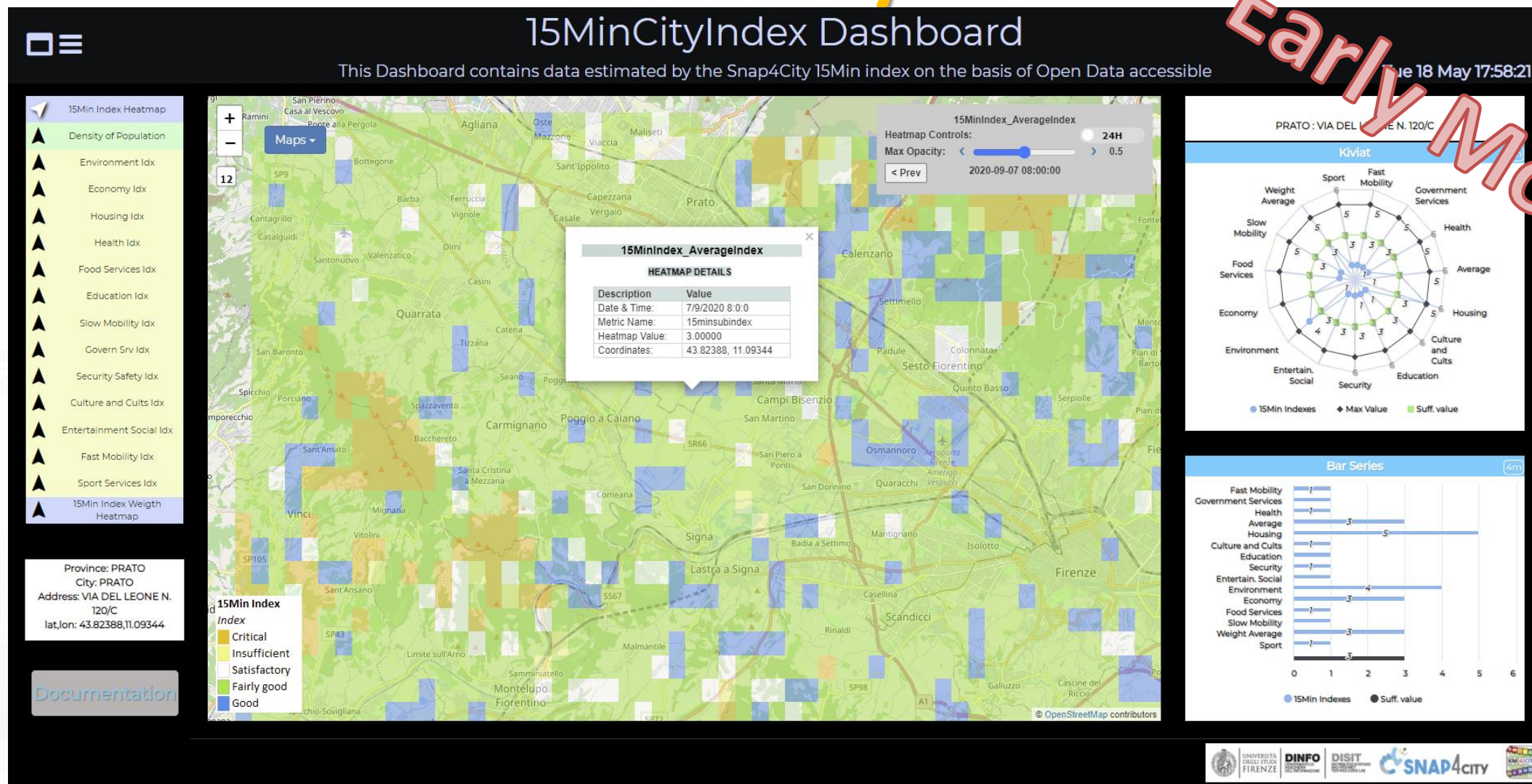


LD, LOD



Dashboards and Apps

15MinCityIndex



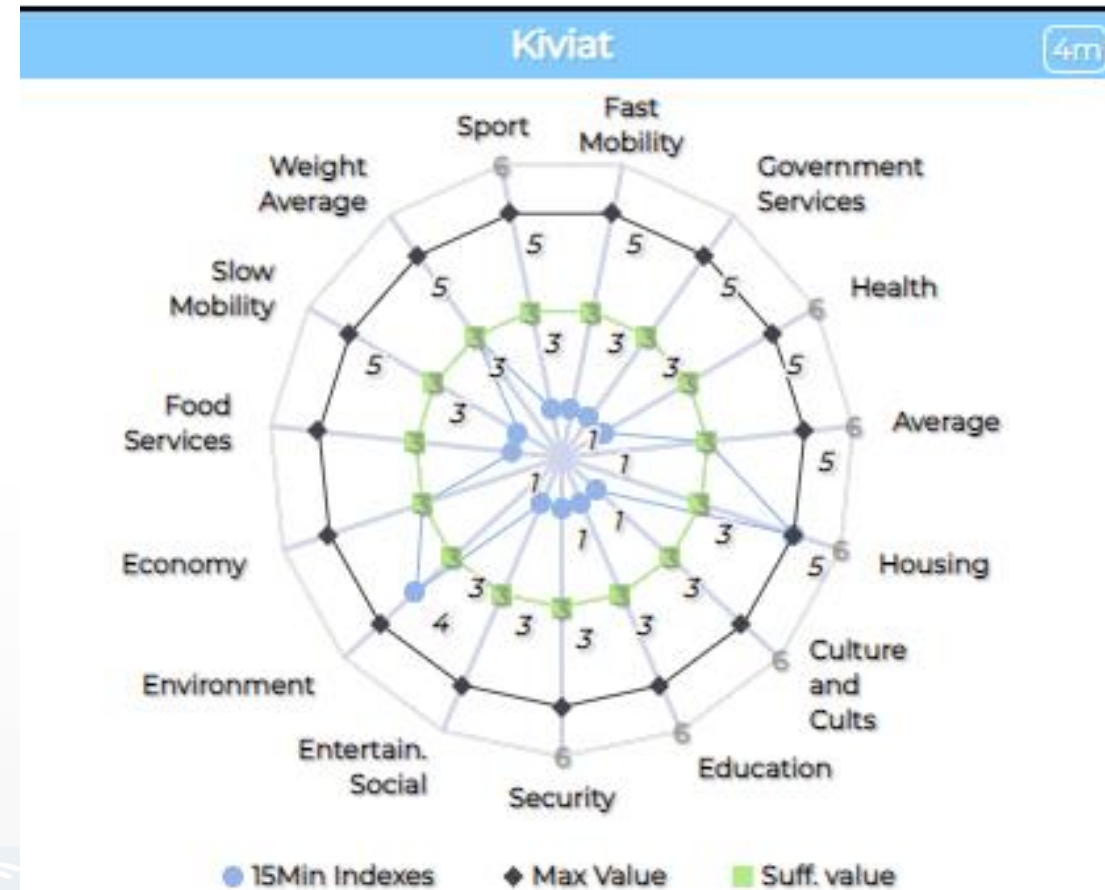
Early Model

- <https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjkzOA==>

15MinCityIndex

- Derived and extended from Carlos Moreno 15 Minute concept
 - But with 13 different subindexes
- Computable on the basis of Open Data
- Validated on major city area
- Extendable to whole national level or large regions
- Accessible as Dashboard to play with
- **Winner of the ENEL-X Open Data Challenge 2020.**

PRATO : VIA DEL LEONE N. 120/C

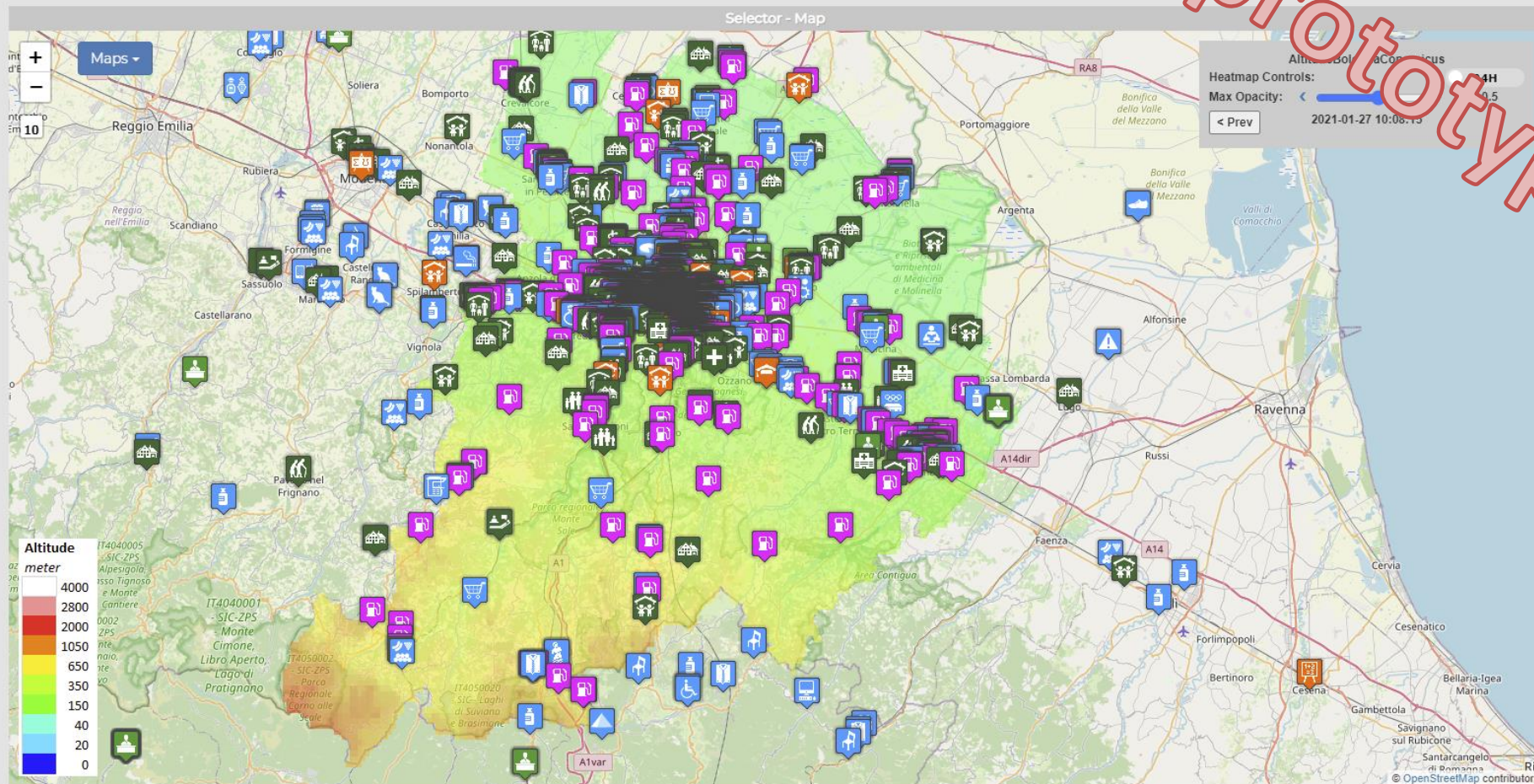


Bologna Metropolitan Area Dashboard

enel x

Sun 19 Sep 11:59:28

- ▲ Train station
- ▲ Charging Stations
- ▲ Bus Stops
- ▲ Fuel stations
- ▲ Cultural Activities
- ▲ Education
- ▲ Entertainment
- ▲ Government
- ▲ Healthcare
- ▲ Shopping
- ▲ Bike Racks
- ▲ Wine and Food
- ▲ Emergency Services
- ▲ Air Quality Stations
- ▲ Air Temperature Heatmap
- ▲ Humidity Heatmap
- ▲ Global Vegetation Index Heatmap
- ▲ Altitude Index Heatmap
- ▲ Fractional Cloud Cover Heatmap
- ▲ SciHub CO
- ▲ SciHub NO2
- ▲ SciHub O3
- ▲ SciHub SO2
- ▲ # of Inhabitants
- ▲ Green factor
- ▲ Civil factor
- ▲ Industrialization factor
- ▲ Environment Index
- ▲ 15Min Economy Index
- ▲ 15Min Housing Index
- ▲ 15Min Health Index
- ▲ 15Min Food Index
- ▲ 15Min Education Index
- ▲ 15Min Slow Mob Index
- ▲ 15Min Government Index
- ▲ 15Min Safety Index
- ▲ 15Min Culture and Cults Index
- ▲ 15Min Entertainment Index
- ▲ 15Min Fast Mobility
- ▲ 15Min Sport Index
- ▲ CityIndex MP1



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15MinCityIndex on Bologna

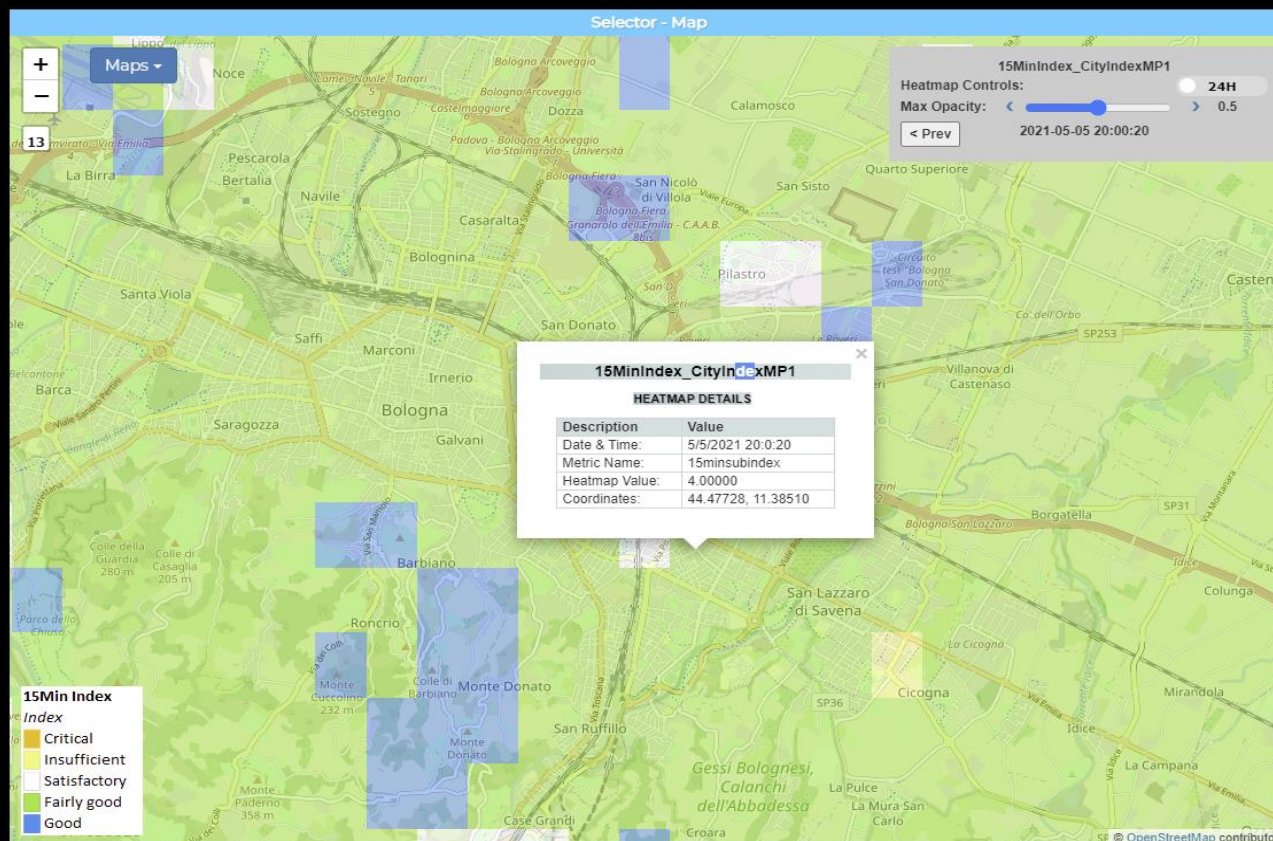
prototype

15 minuti index – Bologna Città Metropolitana (beta)

- ▲ # of Inhabitants
- ▲ Green factor
- ▲ Civil factor
- ▲ Industrialization factor
- ▲ Environment Index
- ▲ 15Min Economy Index
- ▲ 15Min Housing Index
- ▲ 15Min Health Index
- ▲ 15Min Food Index
- ▲ 15Min Education Index
- ▲ 15Min Slow Mob Index
- ▲ 15Min Government Index
- ▲ 15Min Safety Index
- ▲ 15Min Culture and Cults Index
- ▲ 15Min Entertainment Index
- ▲ 15Min Fast Mobility
- ▲ 15Min Sport Index
- CityIndex MP1
- BolognaAirHumidity

The picked Point (8m)

Province: Bologna
City: Bologna
Address: Via Lombardia N. 16
lat,lon: 44.47728,11.38510



From Prototype to Product: National Scale Up



Main Challenges



Validation, transparency & trust

Goal: support Public Administration in their sustainability transition with cross validated and transparent KPIs

Solution: Robustness check on each Sub-Indexes and Components, Internal and External Correlation analysis. University of Florence support in final validation path

Models, institutional benches and statistical approach

Goal: grant an objective evaluation of 15 min city readiness

Solution: Identification of Italian/European norms, guidelines and best practice to compute each KPIs and normalize open data values. Natural Breaks approach to assign Likert Scale.

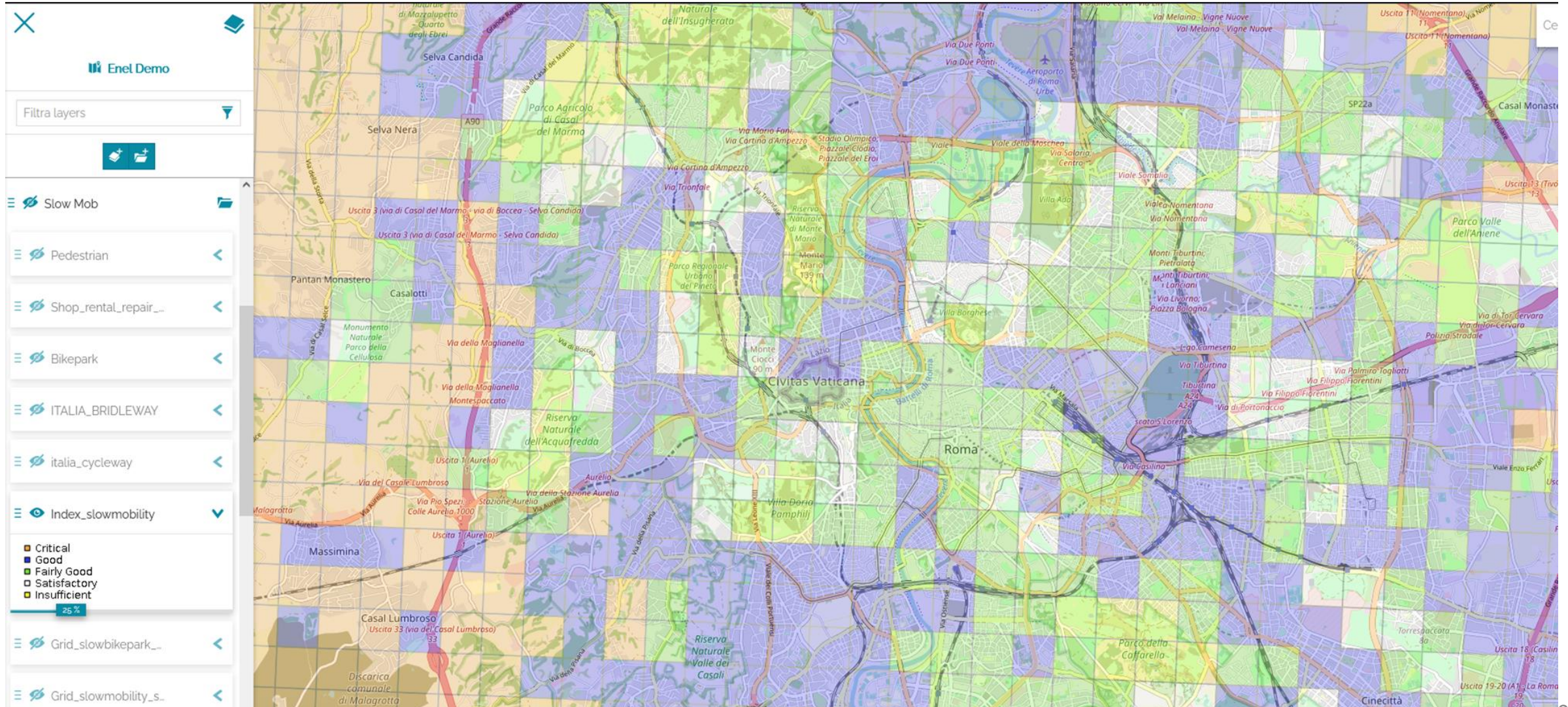
Open Data, massive discovery & assesement

- Goal: identify relevant source that can grant consistency and balance open data fragmentation among all 7.904 italian munis
- Solution: collection of Nation Wide Available open data with adequate granularity and update— leveraging Institutional Portals as well as Satellite Imagery and Open Source Community (ie. OSM)

15 minutes City Index – National Scale Up Preview



Soon available to registered PA in Enel X YoUrban Portal



Conclusions

- **The 15MinCityIndex** has been
 - defined in terms of its subindexes, only using Open Data
 - developed taking into account the needs of local services as in the main Lockdown period in march 2020
 - validated in a large are of 800.000 inhabitants on Florence area
- **The Solution** in the presented form has been
 - the winner of the International Open Data Challenge 2020 of ENEL-X
 - Co-developed with Enel X on Bologna Metro Area exploiting data ingestion and computing capabilities of Snap4City infrastructure and tool, making it affordable.
 - Also using the IoT App for data ingestion and business intelligence on dashboard making them interactive
 - Scaled up by Enel X to address a Nation wide analysis