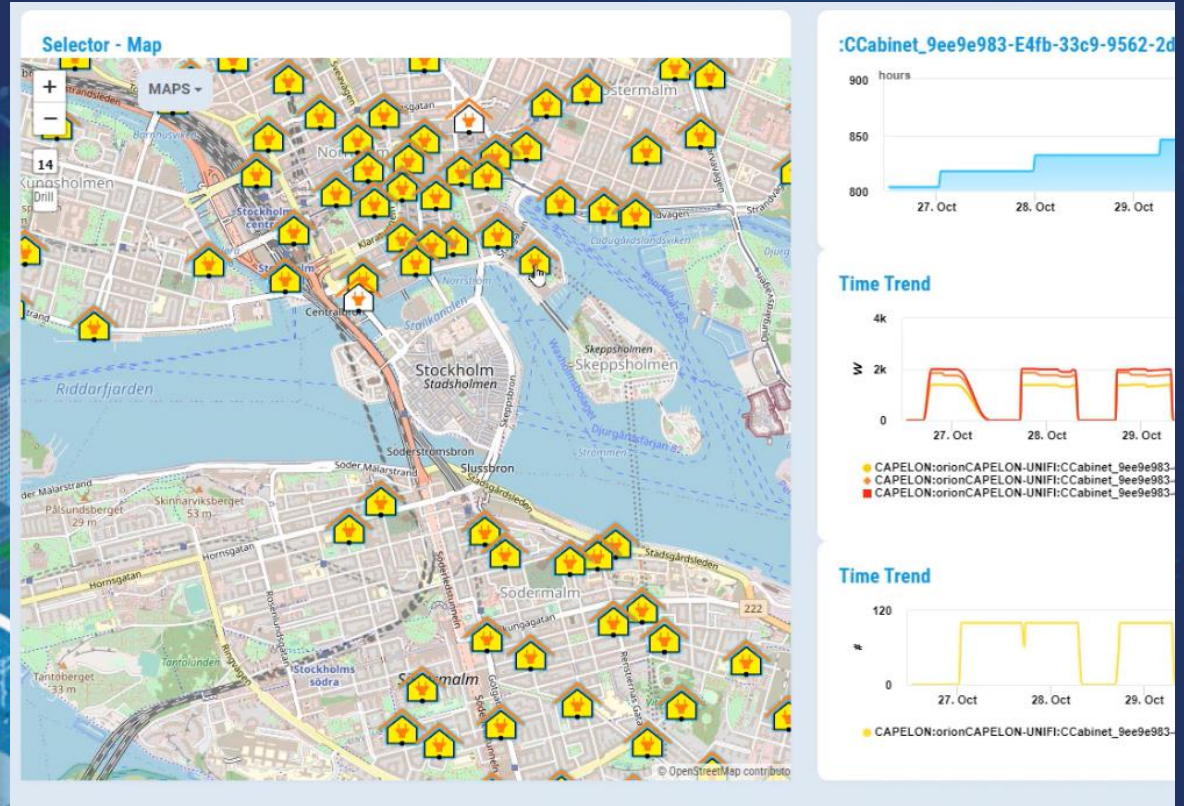




www.snap4city.org  
www.snap4solutions.org



Light and Energy  
overview

#snap4city  
#km4city  
#disitlab  
@snap4city

DIGITAL TWIN SOLUTIONS TO SETUP SUSTAINABLE DECISION SUPPORT SYSTEMS AND BUSINESS INTELLIGENCE

# Smart Energy

FROM CITY DASHBOARD TO APPLICATIONS

DATA AND KNOWLEDGE



# Key Performance Indicators, KPI



- **United Nations Sustainable Development Goals, SDGs** (for which cities can do more to achieve some of the 17 SDGs, <https://sdgs.un.org/goals>);
- **15 minutes cities** (where primary services must be accessible within 15 minutes on foot);
- **objectives of the European Commission** in terms of pollutant emissions for: NO2, PM10, PM2.5 ([https://environment.ec.europa.eu/topics/air\\_en](https://environment.ec.europa.eu/topics/air_en));
- **SUMI: mobility and transport vs env**
  - <https://www.snap4city.org/951>
- **SUMP/PUMS: mobility and transport vs env.**
- **ISO indicators:** city smartness, digitization, tech level.
- **Low Level/Real Time:** global traffic, quality of service, betweenness, centrality, queue, time to travel, etc.

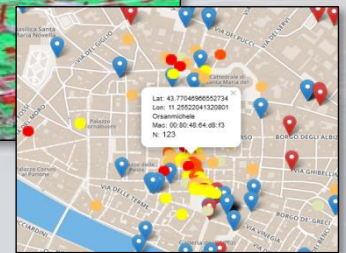
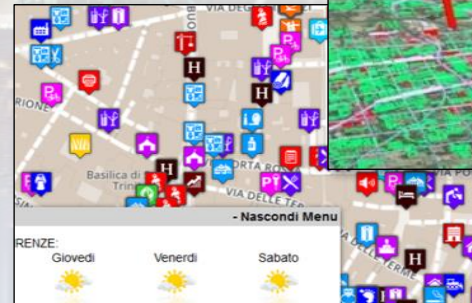
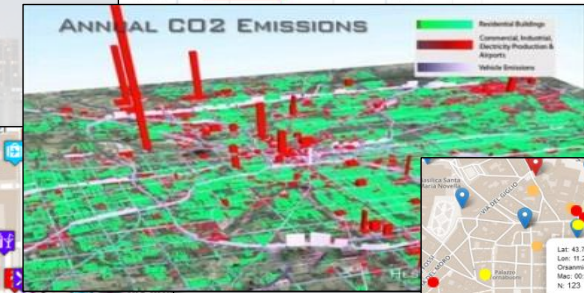
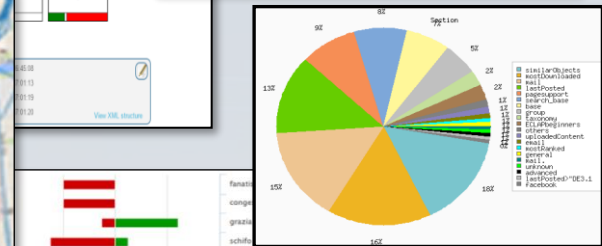
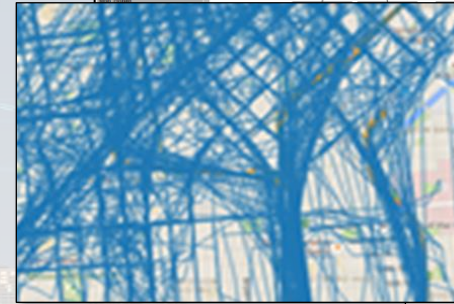
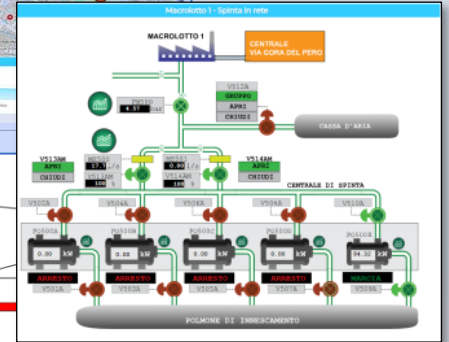
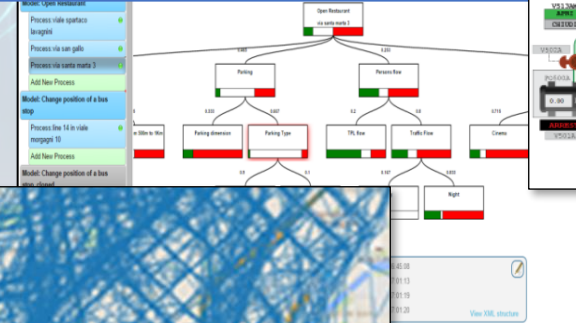
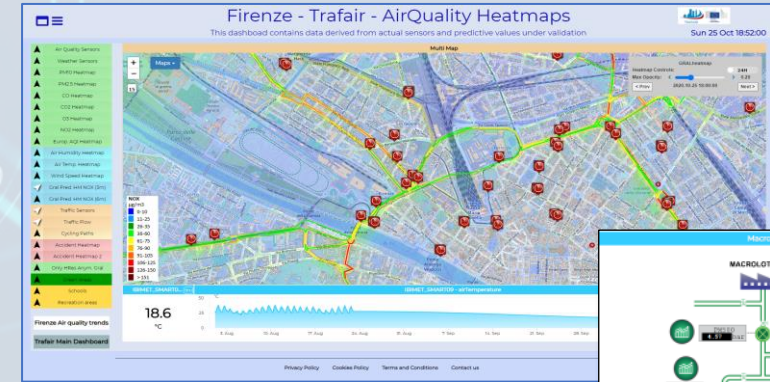
Global  
&  
Local  
  
Periodic  
&  
Realtime

Air Quality Directive				WHO guidelines	
Pollutant	Averaging period	Objective and legal nature and concentration	Comments	Concentration	Comments
PM <sub>2.5</sub>	One day			25 µg/m <sup>3</sup> (*)	99 <sup>th</sup> percentile (3 days/year)
PM <sub>2.5</sub>	Calendar year	Target value, 25 µg/m <sup>3</sup>	The target value has become a limit value since 1 January 2015	10 µg/m <sup>3</sup>	
PM <sub>10</sub>	One day	Limit value, 50 µg/m <sup>3</sup>	Not to be exceeded on more than 35 days per year.	50 µg/m <sup>3</sup> (*)	99 <sup>th</sup> percentile (3 days/year)
PM <sub>10</sub>	Calendar year	Limit value, 40 µg/m <sup>3</sup> (*)		20 µg/m <sup>3</sup>	
O <sub>3</sub>	Maximum daily 8-hour mean	Target value, 120 µg/m <sup>3</sup>	Not to be exceeded on more than 25 days per year, averaged over three years	100 µg/m <sup>3</sup>	
NO <sub>2</sub>	One hour	Limit value, 200 µg/m <sup>3</sup> (*)	Not to be exceeded more than 18 times a calendar year	200 µg/m <sup>3</sup> (*)	
NO <sub>2</sub>	Calendar year	Limit value, 40 µg/m <sup>3</sup>		40 µg/m <sup>3</sup>	

# Data Driven Decision Support



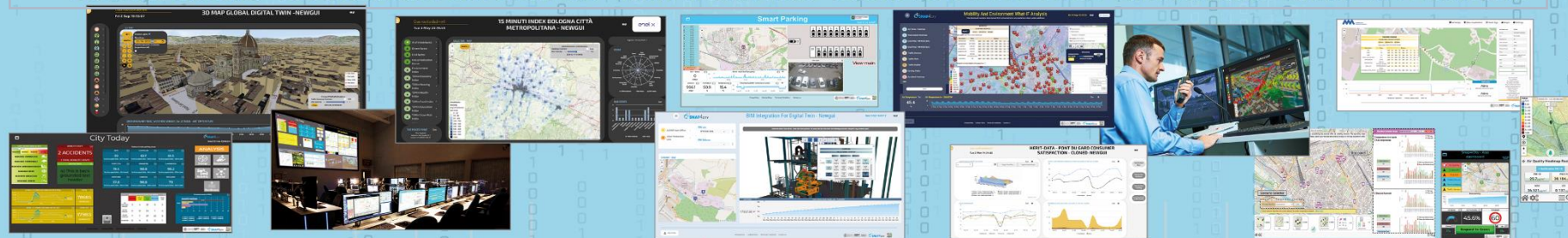
- Decision Support system
- Assessment / Strategies
- Data Rendering,
  - visual analytics, business intel..
- Data Analytics, ML, AI
- Data aggregation, Storage, indexing
- Data Ingestion



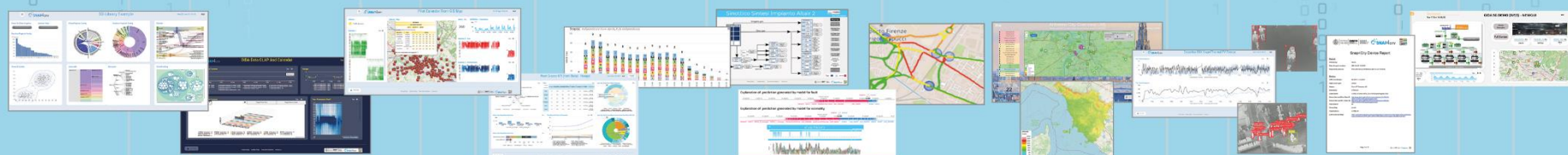


# Smart Solutions and Decision Support Systems

CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS - BUSINESS INTELLIGENCE - SIMULATIONS - SMART APPLICATIONS



DASHBOARDS - VISUAL ANALYTICS - SYNOPTICS - DIGITAL TWIN - GRAPHICAL WIDGETS - ANALYTICS - GUI CUSTOM STYLES - VISUAL PROGRAMMING



DASHBOARDS, WIDGETS  
TEMPLATES

PREDICTION - ANOMALY DETECTION - CLUSTERING - ROUTING - SENTIMENT NLP - TRAFFIC FLOW  
PEOPLE FLOWS - SDG - 15 MIN CITY INDEX - KPI - HEATMAPS - ORIGIN DESTINATION - ETC...

API - MICROSERVICES - GIS - BPM  
VIDEO - REPORTS - MAPS - 3D ...

ANY: DATA, BROKER, NETWORK AND VERTICAL

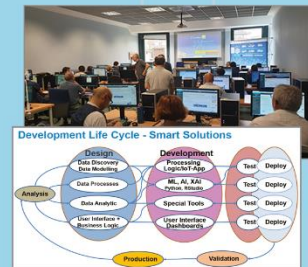
EXPERT SYSTEM, KNOWLEDGE BASE  
SEMANTIC REASONING  
SMART DATA MODEL  
IOT DEVICE MODELS, STORAGE

BIG DATA ANALYTICS, ARTIFICIAL INTELLIGENCE  
EXPLAINABLE AI, MACHINE LEARNING  
OPERATIVE RESEARCH, STATISTICS

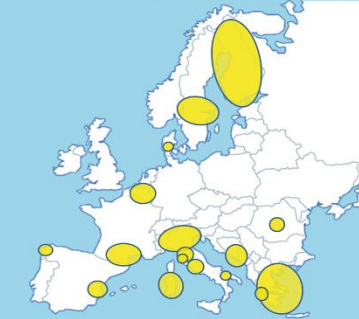
VISUAL PROGRAMMING, ADAPTERS  
DATA FLOWS, WORKFLOWS  
PARALLEL DISTRIBUTED PROCESSING  
EVENT DRIVEN

**Native and External Smart Applications**

- Mobility & Transport
- Light & Energy
- Waste | Environment
- Building | Tourism
- Asset Management
- Security and Safety
- Social Media



METHODOLOGIES  
LIVING LABS  
COURSES AND COMMUNITY  
DEVELOPMENT TOOLS



Powered by  
**FIWARE**

FREE  
TRIAL

PEN Test  
Passed

EU GDPR  
COMPLIANT

SNAP4  
Appliances and Dockers  
Installations

EUROPEAN OPEN  
SCIENCE CLOUD

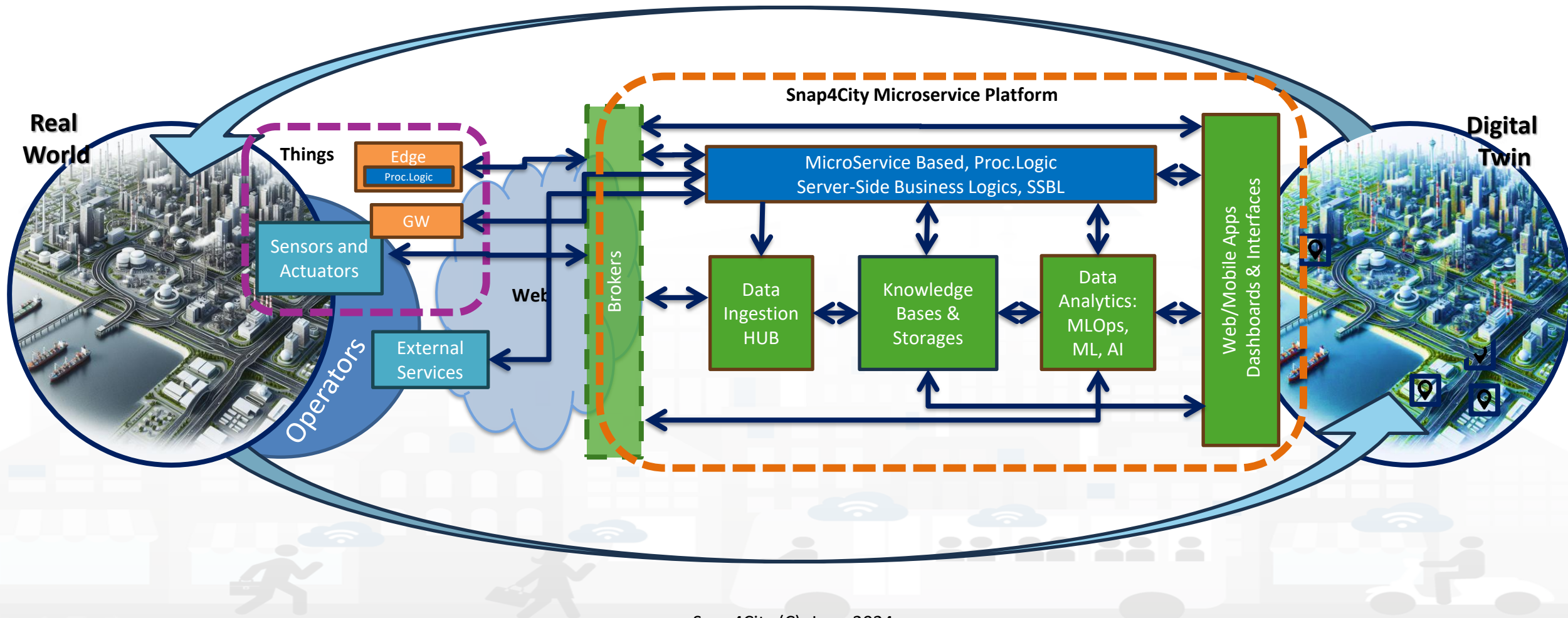
Node-RED

JS Foundation

E015  
digital ecosystem

NVIDIA

# Digital Twin Development Platform



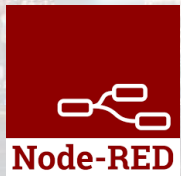
# Standards and Interoperability (6/2023)



## Compliant with:

- **IoT:** NGSI V2/LD, LoRa, LoRaWan, MQTT, AMQP, COAP, OneM2M, TheThingsNetwork, SigFOX, Libelium, IBIMET/IBE, Enocean, Zigbee, DALI, ISEMC, Alexa, Sonoff, HUE Philips, Tplink, BACnet, TALQ, Protocol Buffer, KNX, OBD2, Proximus, ..
- **IoT model:** FIWARE Smart Data Model, Snap4City IoT Device Models
- **General:** HTTP, HTTPS, TLS, Rest Call, SMTP, TCP, UDP, SOAP, WSDL, FTP, FTPS, WebSocket, WebSocket Secure, GML, WFS, WMS, RTSP, ONVIF, AXIS TVCam, CISCO Meraki, OSM, Copernicus, The Weather Channel, Open Weather, OLAP, VMS, ....
- **Formats:** JSON, GeoJSON, XML, CSV, GeoTIFF, OWL, WKT, KML, SHP, db, XLS, XLSX, TXT, HTML, CSS, SVG, IFC, XPDL, OSM, Enfuser FMI, Lidar, gITF, GLB, DTM, GDAL, Satellite, D3 JSON, ...
- **Database:** Open Search, MySQL, Mongo, HBASE, SOLR, SPARQL, ODBC, JDBC, Elastic Search, Phoenix, PostGres, MS Azure, ..
- **Industry:** OPC/OPC-UA, OLAP, ModBUS, RS485, RS232,..
- **Mobility:** DATEX, GTFS, Transmodel, ETSI, NeTEx, ..
- **Social:** Twitter, FaceBook, Telegram, ..
- **Events:** SMS, EMAIL, CAP, RSS Feed, ..
- **OS:** Linux, Windows, Android, Raspberry Pi, Local File System, AXIS, ESP32, etc.

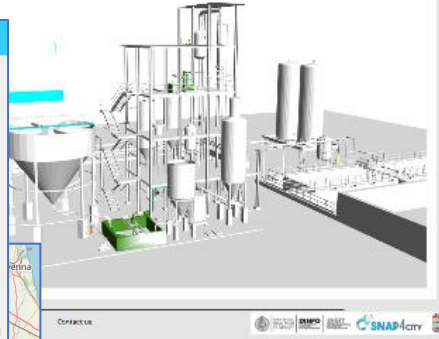
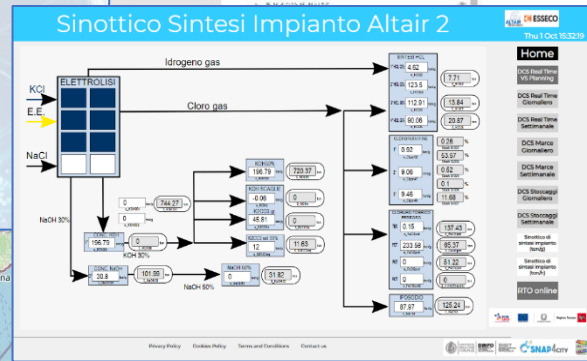
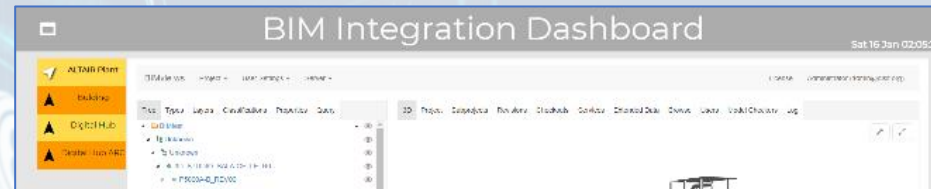
<https://www.snap4city.org/65>



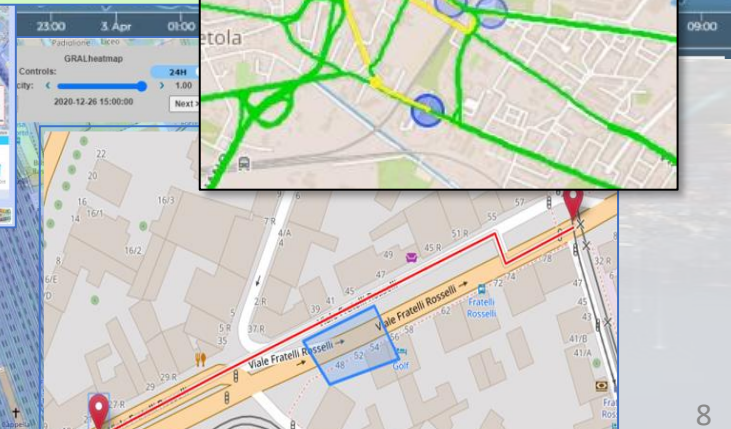
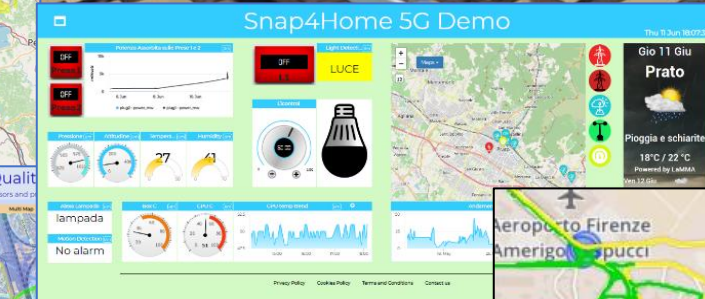
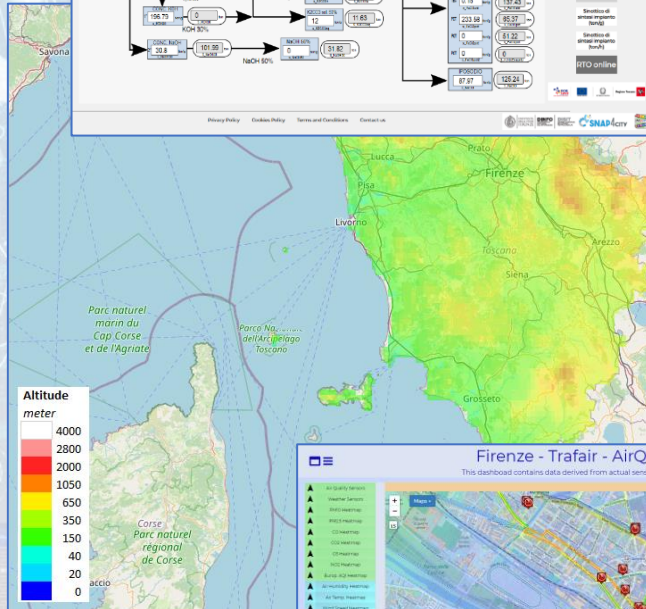
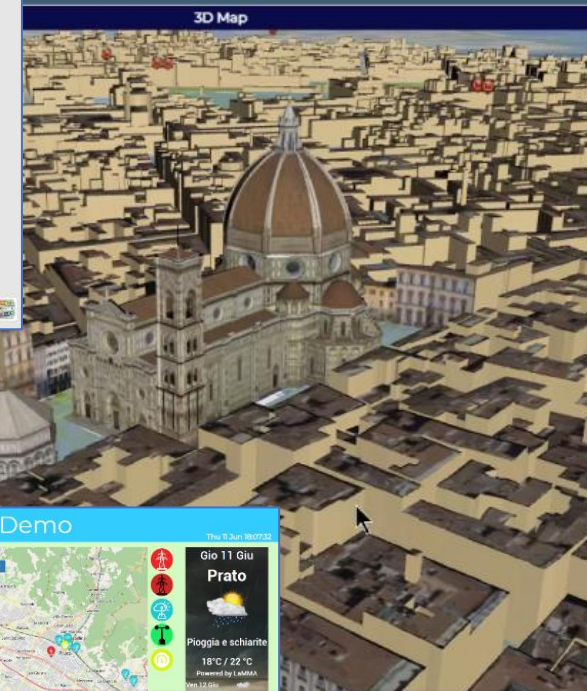
# High Level Types

Snap4City (C), June 2024

- POI, IOT Devices, shapes, ...
  - FIWARE Smart Data Models,
  - IoT Device Models
- GIS, maps, orthomaps, WFS/WMS, GeoTiff, calibrated heatmaps, ...
- Satellite data, ...
- traffic flow, typical trends, ...
- trajectories, events, Workflow, ...
- 3D Models, BIM, Digital Twins, ...
- OD Matrices of several kinds, ...
- Dynamic icons/pins, ...
- Synoptics, animations, ...
- KPI, personal KPI, ...
- social media data, TV Stream, ...
- routing, multimodal, constraints, ...
- decision scenarios, ....
- etc.



**SNAP4CITY**  
- Digital Twin Global - Fire  
demonstrator



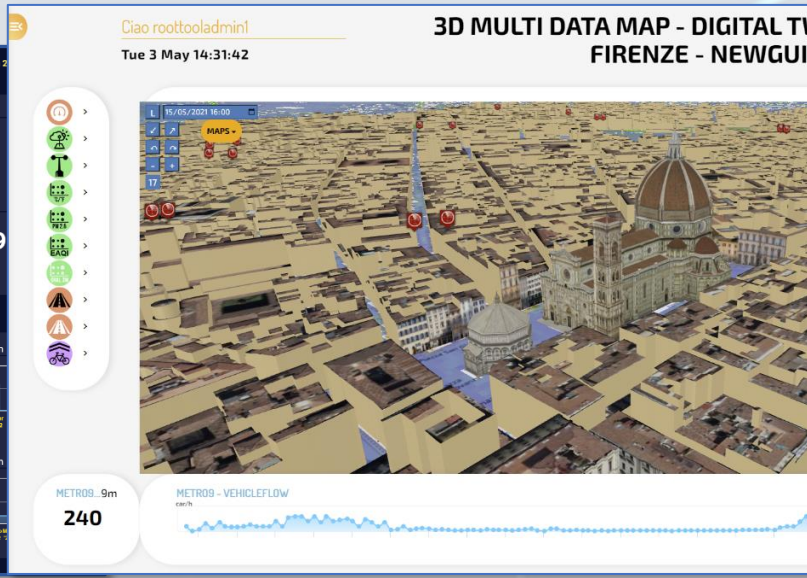
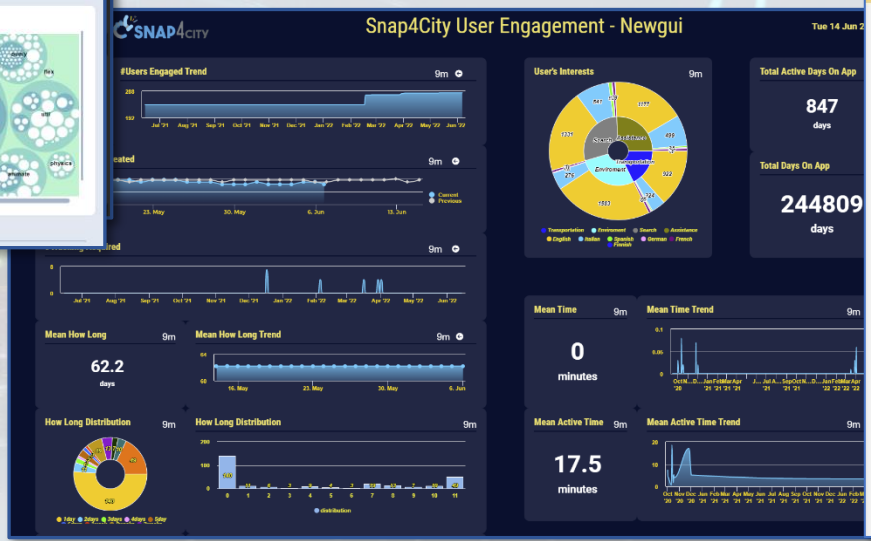
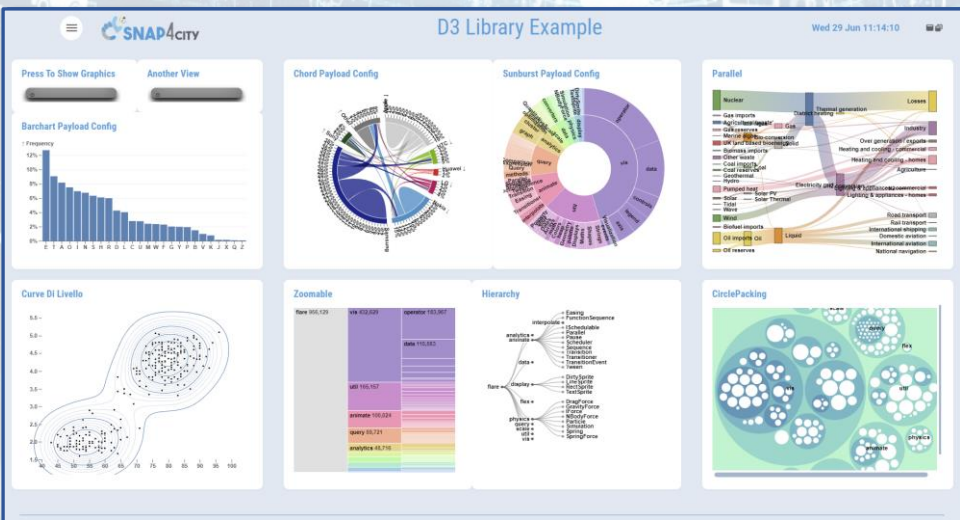
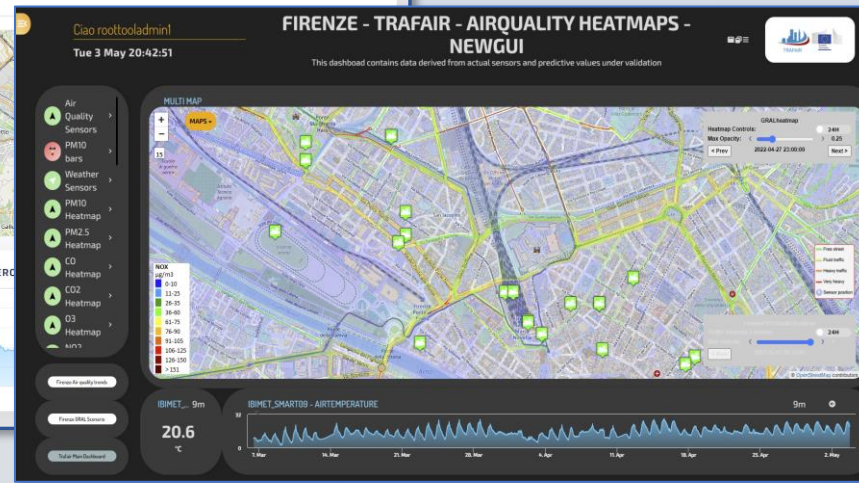
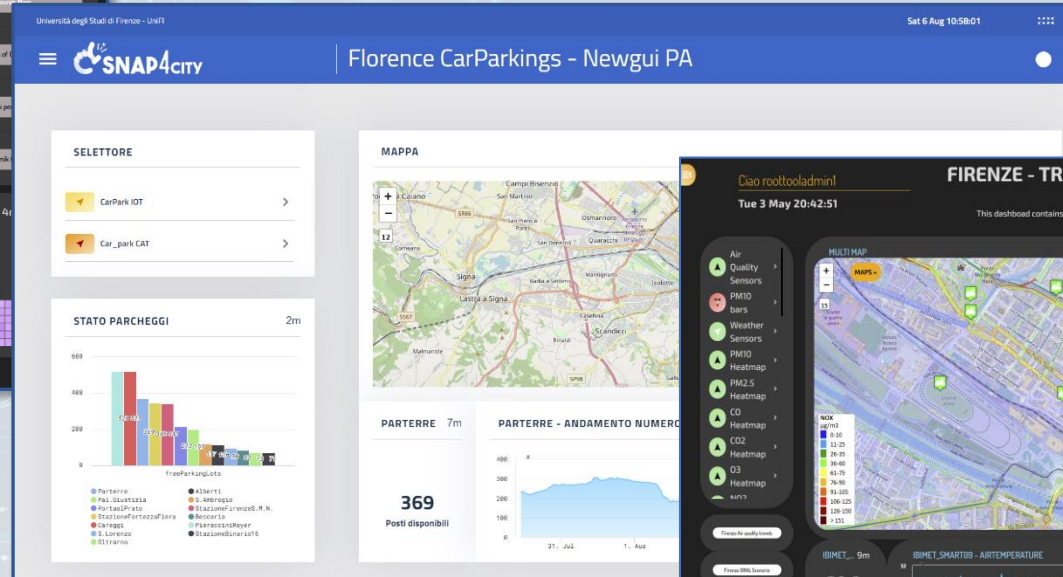
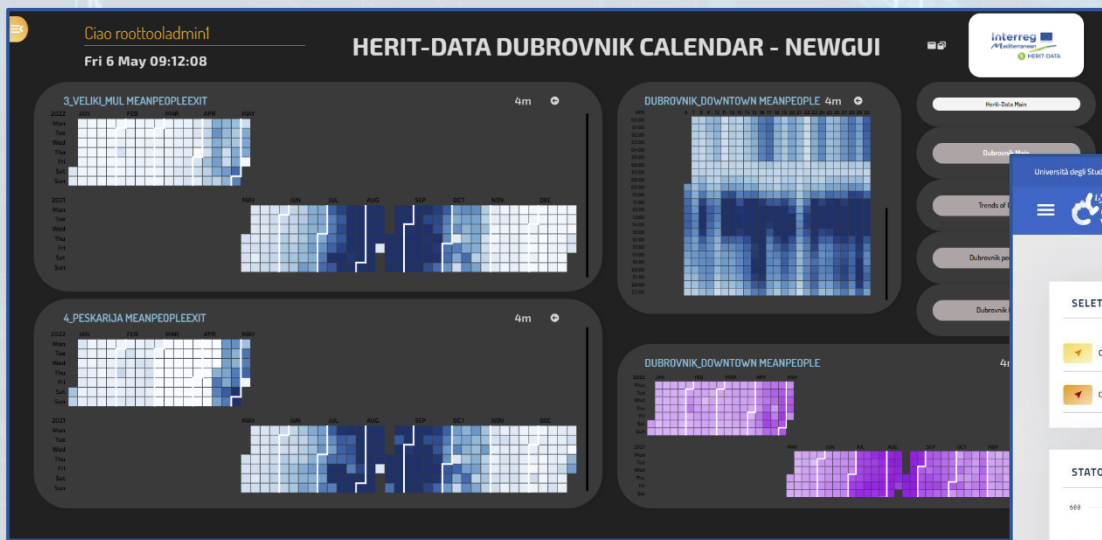
UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB

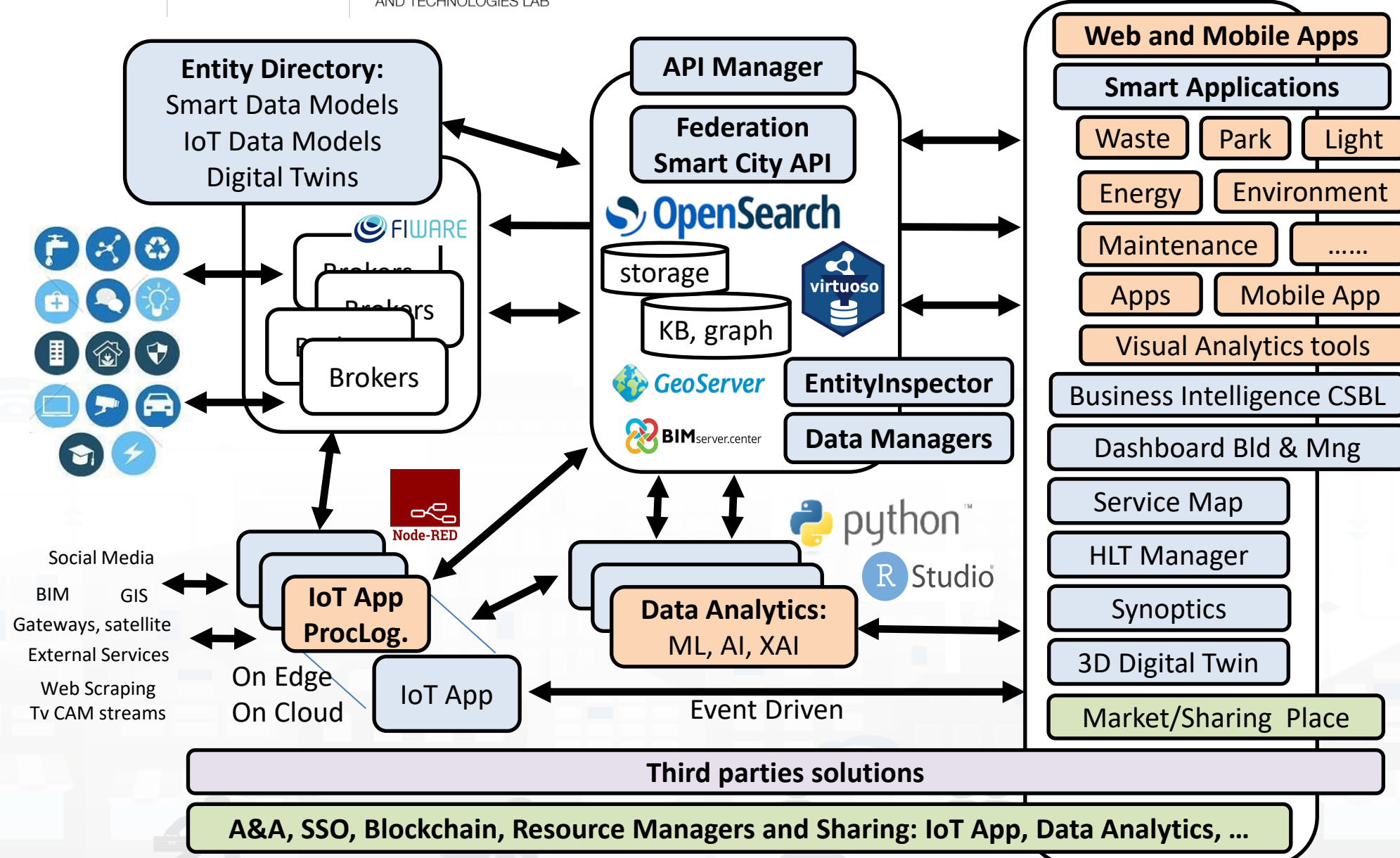


# Different Themes



New styles/themes can be developed by specializing a few files from open source

<https://www.snap4city.org/793>



TOP

# Monitoring and control

FROM CITY DASHBOARD TO APPLICATIONS

FORGING & MANAGING OPEN AND FRIENDLY WITH INDUSTRY MAP

IOT APPLICATIONS VS IOT EDGE DEVICES

SNAP4CITY FOR BEGINNERS

SNAP4CITY ARCHITECTURE AND SYSTEMS. OPEN TO DEVELOPERS AND STAKEHOLDERS

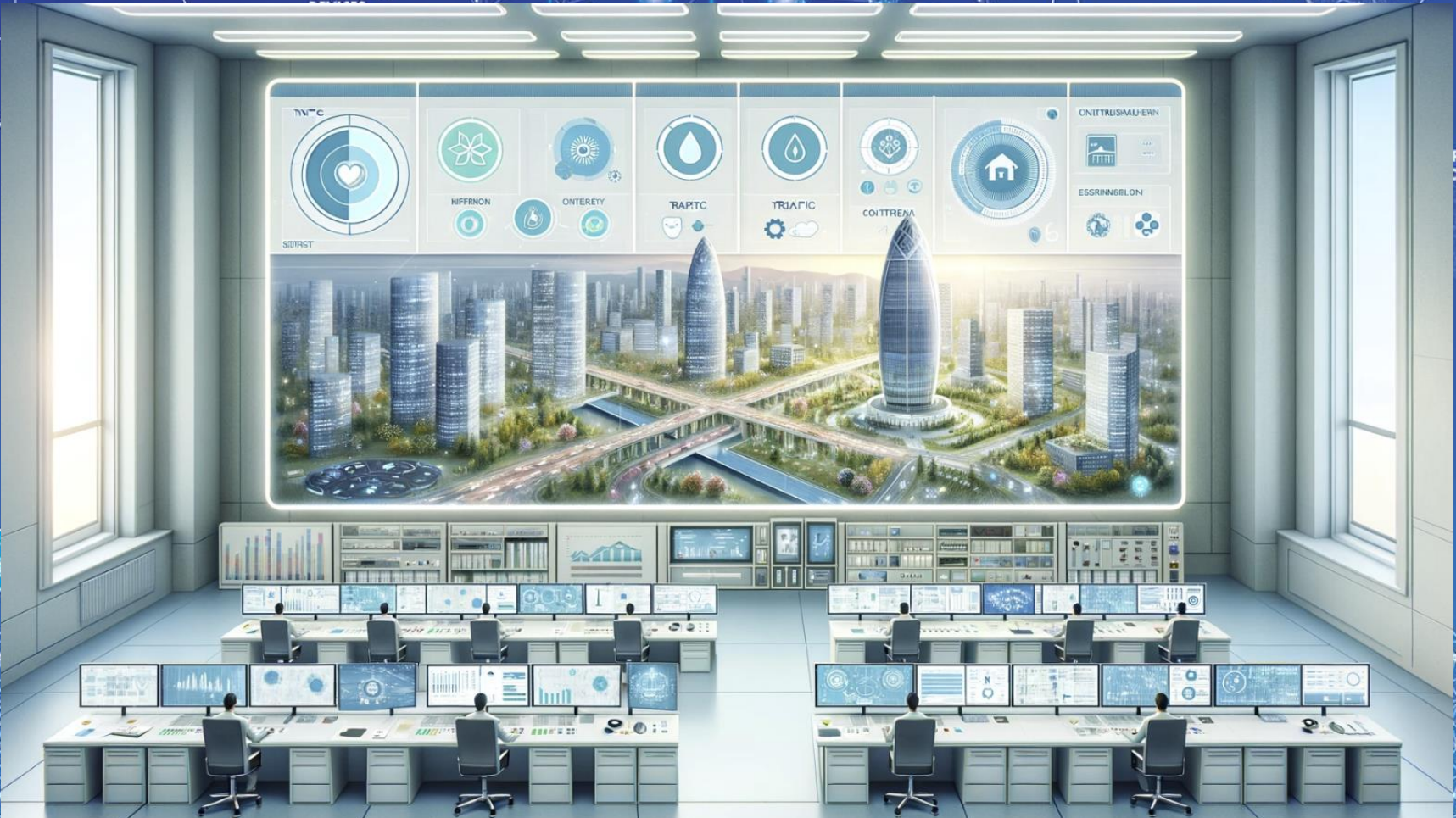
TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS

SNAP4CITY AND KM4CITY PROJECTS

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

SNAP4CITY THE VIEW OF THE ADMINISTRATORS



100% OPEN SOURCE



Building / Floor / Parking:

Building

All / Single Building:

All

Variable:

occupancy

Popup on Shape Click

Add To Map



Ispra - Occupancy 8m

883

Ispra - Occupancy



ISPRA Site



- Date Observed: 10/23/2023, 12:30:01 PM
- Capacity: 2936 #
- Allocation: 1995 #
- Occupancy: 883 #
  - DAC: -941 #
  - DOA: -1112 #
  - DOC: -2053 #
  - PAC: 67.95 %
  - POA: 44.26 %
  - POC: 30.07 %
- Energy Hot: 4473978 kWh
- Energy Cold: 916361 kWh
- Power Hot: 36 kW
- Power Cold: 0 kW
- Outdoor Temperature: 14.07 °C
- Total Number of Buildings: 76 of 304 #
- Total Number of Floors: 104 #
- Total Number of Zones: 139 #
- Total Number of Parking Areas: 4 #

See Trends

Parking Overview

person My Profile

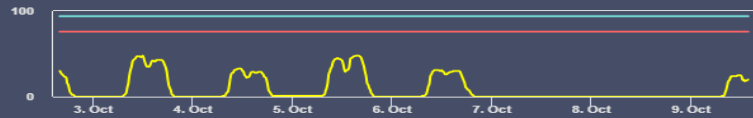


### Actual 4m



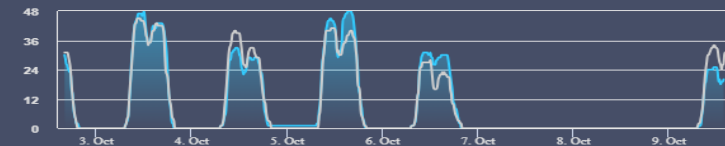
● Capacity  
● Occupancy  
● Allocation

### Capacity - Allocation - Occupancy 4m



● capacity ● occupancy ● allocation

### Occupancy Weekly Time Trend Compare 9m



● Current  
● Previous

### Office Mq 9m

803.9 m<sup>2</sup>

### Temp. 9m

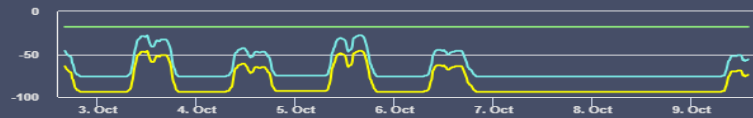
20.6 °C

### Difference 4m



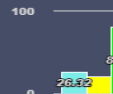
● DOA  
● DOC  
● DAC

### DOA - DOC - DAC 4m



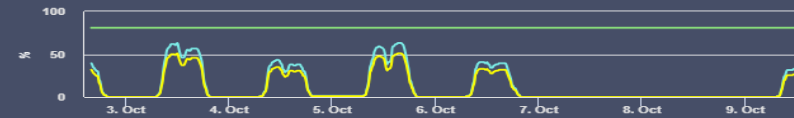
● DOA ● DOC ● DAC

### Percentage 4m



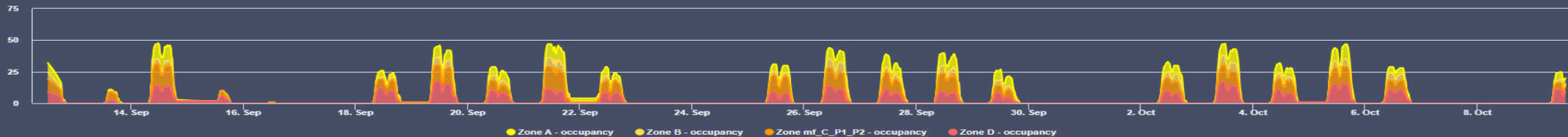
● POA  
● POC  
● PAC

### POA - POC - PAC 4m



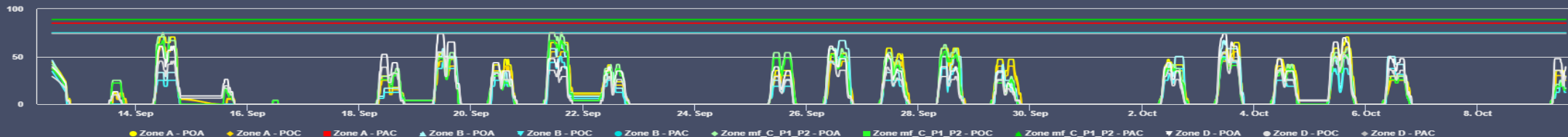
● POA ● POC ● PAC

### Occupancy Per Zones - Monthly Time Trend Comparison Stacked 4m



● Zone A - occupancy ● Zone B - occupancy ● Zone mf\_C\_P1\_P2 - occupancy ● Zone D - occupancy

### Percentage Per Zones - Monthly Time Trend Comparison 4m



● Zone A - POA ● Zone A - POC ● Zone A - PAC ● Zone B - POA ● Zone B - POC ● Zone B - PAC ● Zone mf\_C\_P1\_P2 - POA ● Zone mf\_C\_P1\_P2 - POC ● Zone mf\_C\_P1\_P2 - PAC ● Zone D - POA ● Zone D - POC ● Zone D - PAC

### Heat Power 9m

0 kW

### Heat Energy 9m

1931279 kWh

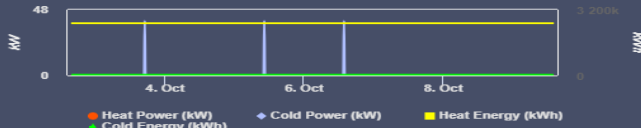
### Cold Power 9m

0 kW

### Cold Energy 9m

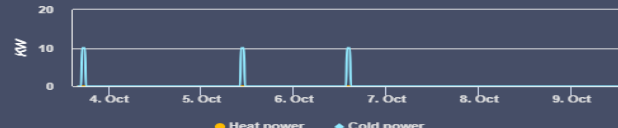
888311 kWh

### Energy Trends 4m



● Heat Power (kW) ● Cold Power (kW) ● Heat Energy (kWh)

### Average Hourly Power 4m



● Heat power ● Cold power

### En./Mq 9m

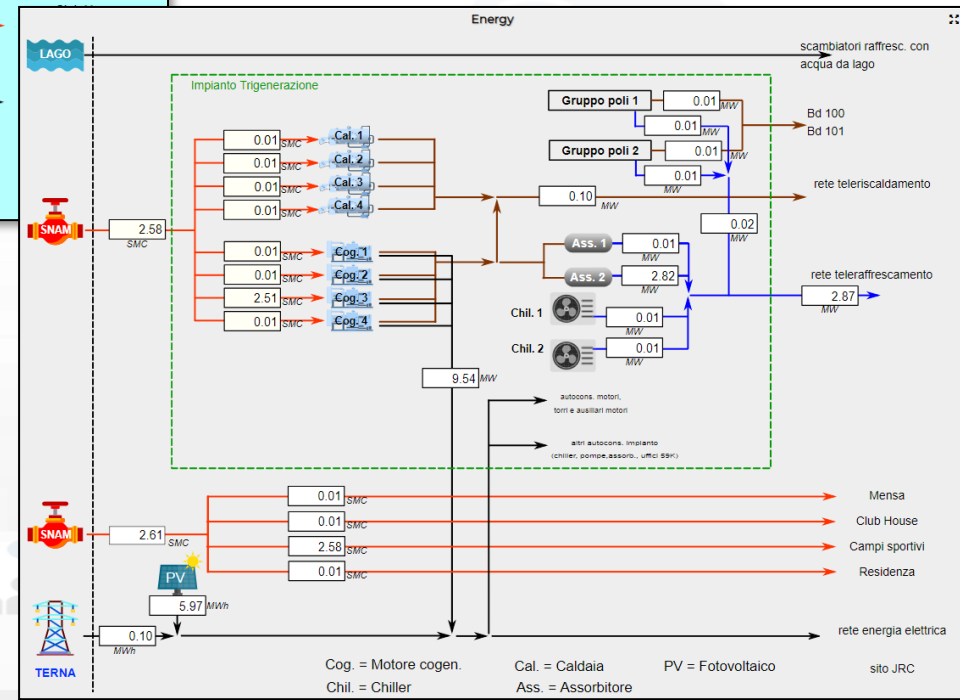
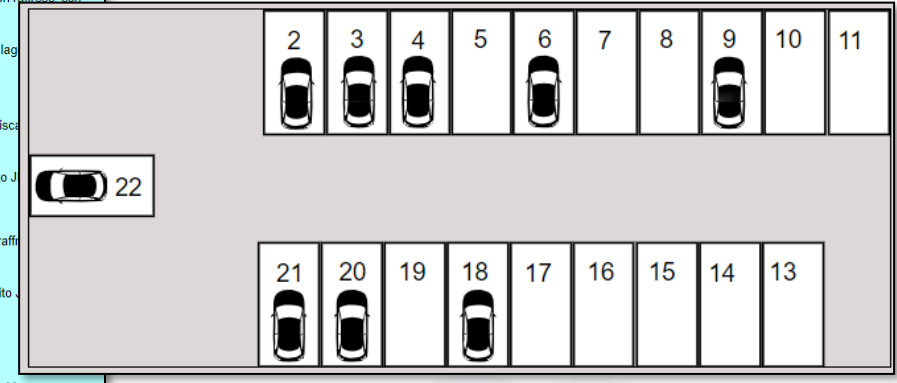
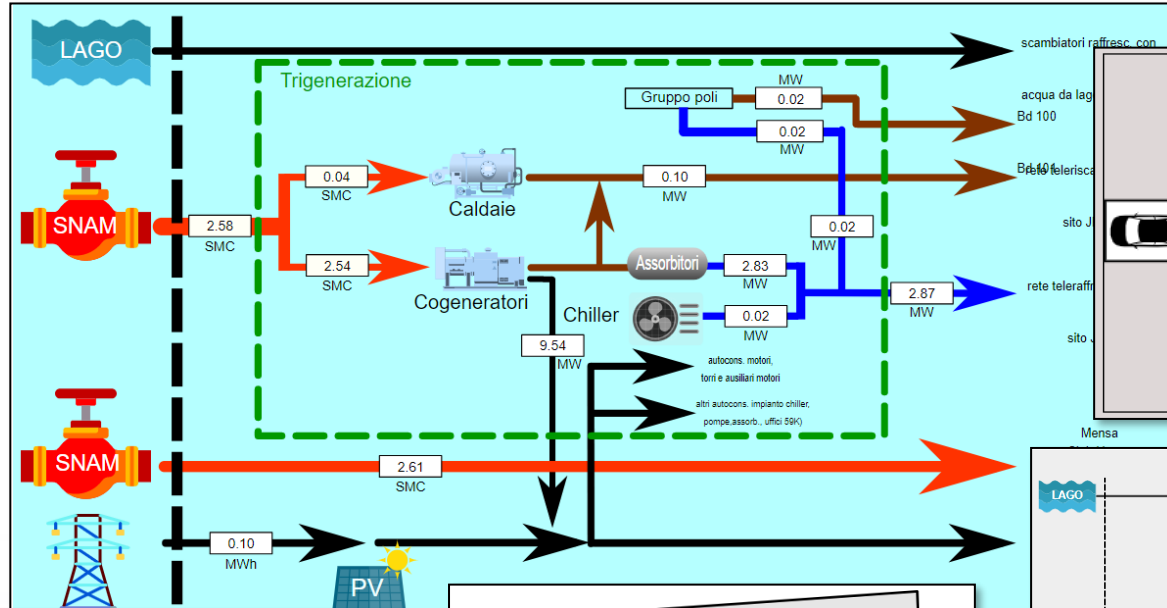
0 kWh

### En./Pax 9m

0 kWh

# Special Custom Widgets

- Smart parking
- Smart Energy
- Smart Light
- Smart ....
- Energy View
- Custom Controls



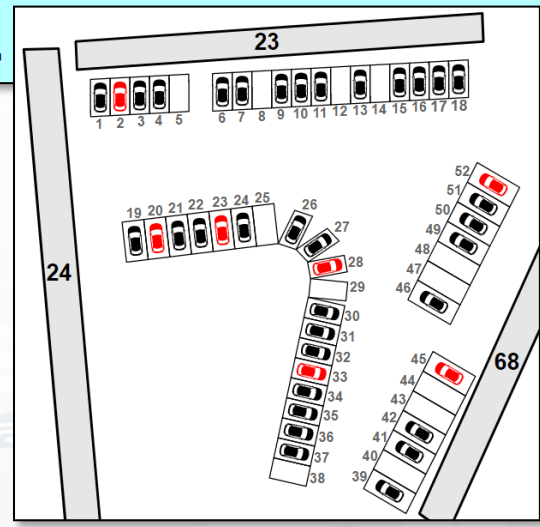
Custom Controls widget showing a row of five smiley faces (from sad to happy) and two data boxes:

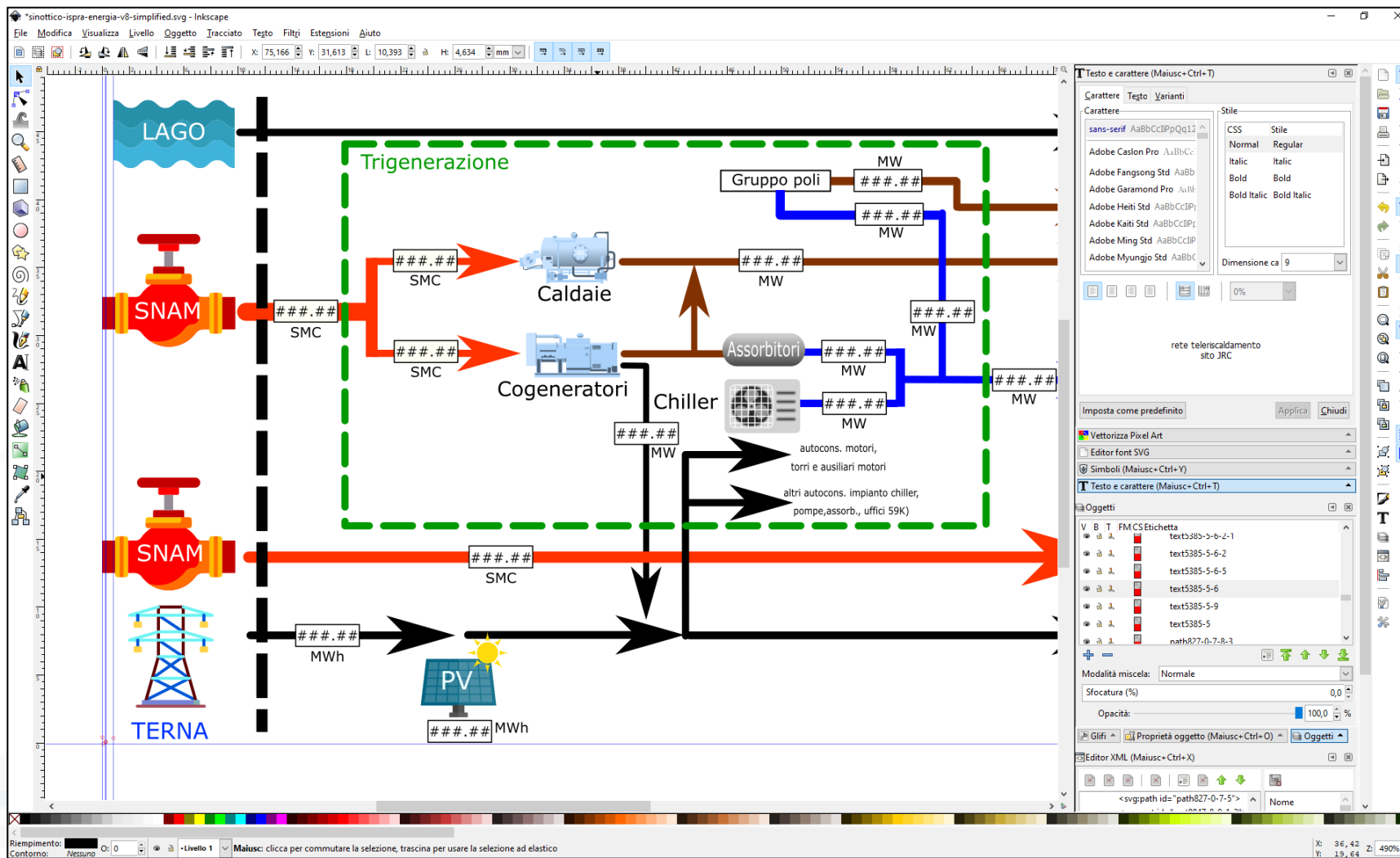
- Total clicks: 6
- Mean rate value: 0.00

Custom Controls widget showing a time range selector:

- Begin: 17:00
- Finish: 4:00

Custom Controls widget showing a grid of smiley faces (from sad to happy) for user interaction.





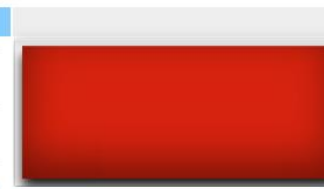
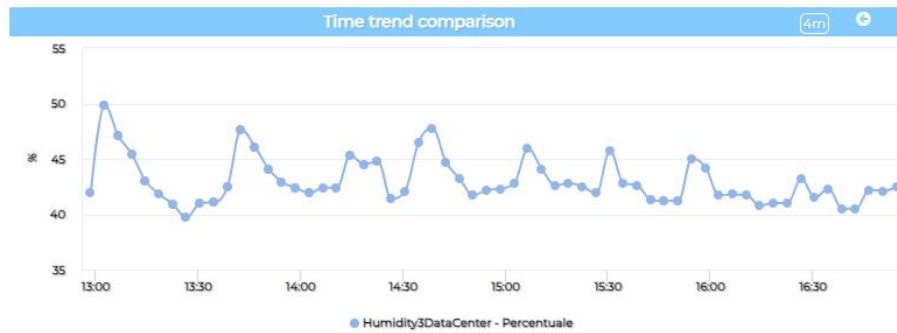
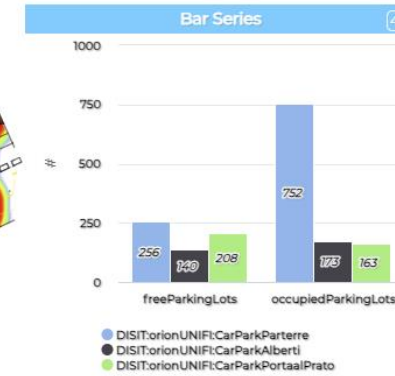
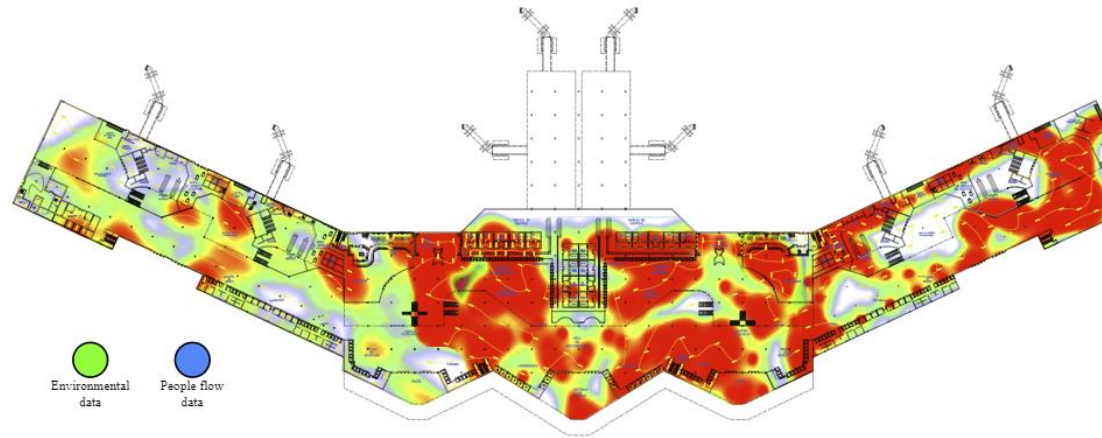
How to  
create a  
custom  
Widget



- User manual on: <https://www.snap4city.org/595>

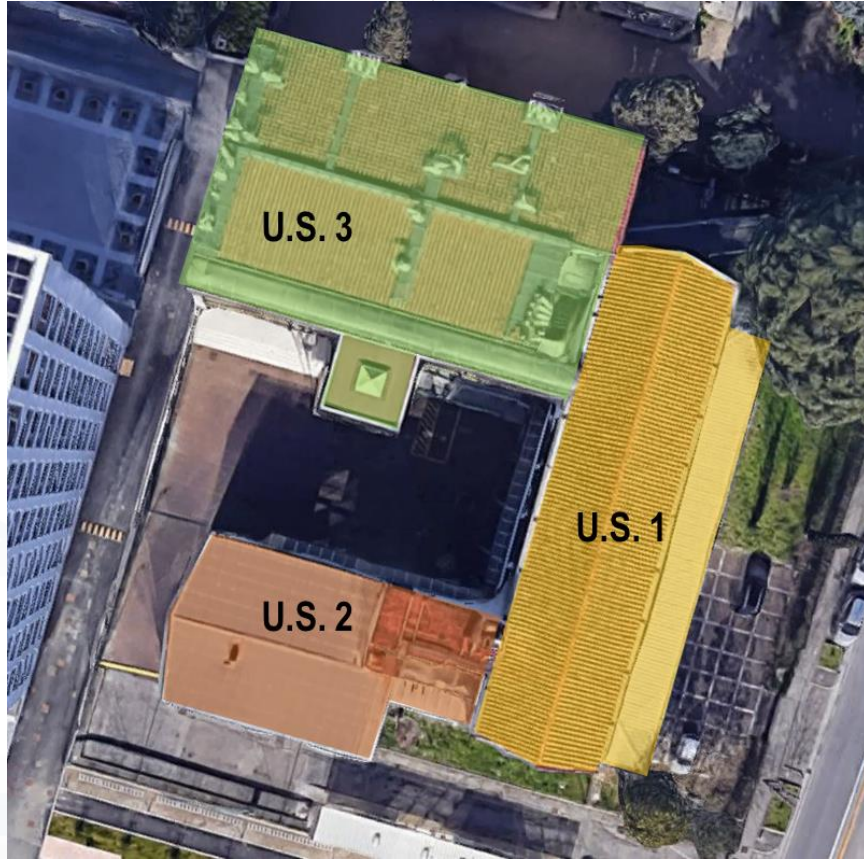
# Floor status monitoring with heatmaps

svg\_embed1





# Digital Twin Local

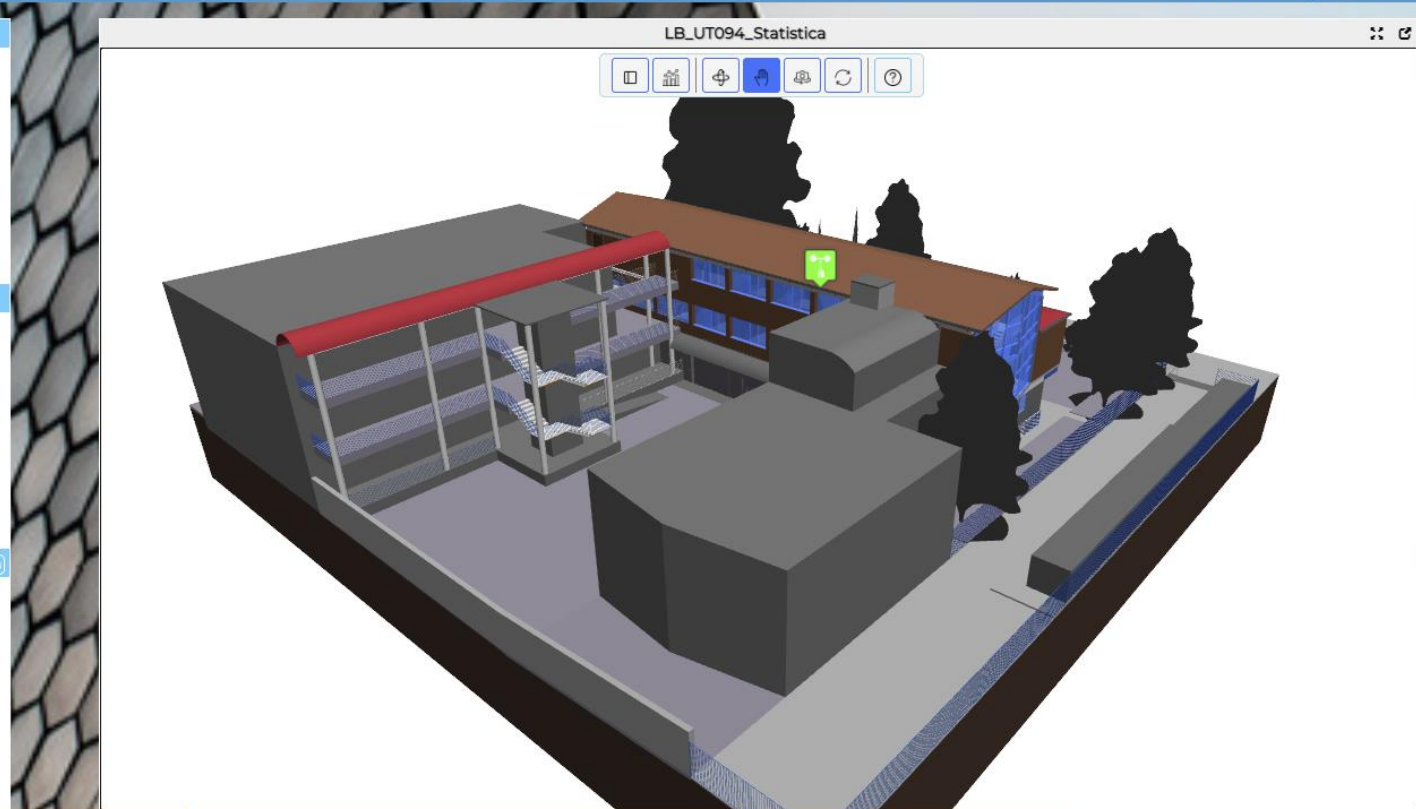
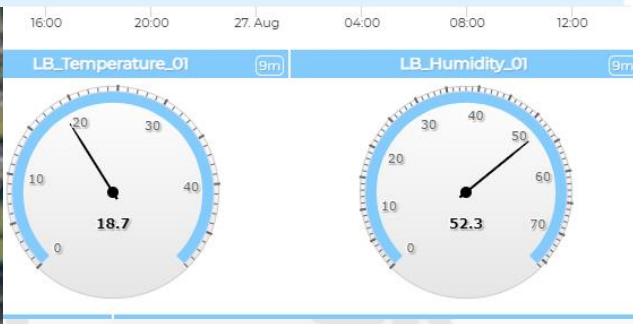
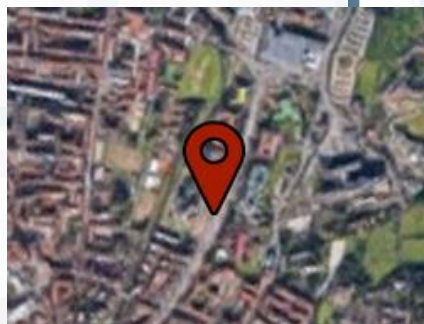


LB\_LaboratorioBIM\_v01

Laboratorio LIA-BIM



Sat 27 Aug 14:00:52



TOP

# Decision Support Tactic and Strategic Plans What-if Analysis

FROM CITY DASHBOARD TO APPLICATIONS

DATA, THE AND CITY DATA KNOWLEDGE MANAGEMENT

FORGING & MANAGING CITY AND FLEXIBLE WEB AND MOBILE APPS

IoT APPLICATIONS VS IoT EDGE DEVICES

EDGE DEVICES AND NETWORKS

ADVANCE SMART CITY MICRO-APPLICATIONS AND LOGIC AND THE SMARTIES

ENABLING FOR

SNAP4CITY ARCHITECTURE AND SYSTEM. OPENED TO DEVELOPERS AND STAKEHOLDERS

DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT-IF AND SIMULATION

TWITTER VIGILANCE SOCIAL MEDIA ANALYSIS

DECISION SUPPORT SYSTEM AND CITY RESILIENCE

SNAP4CITY AND KM4CITY PROJECTS

HOW TO ADOPT SNAP4CITY, AND YOUR ROADMAP

SNAP4CITY THE VIEW OF THE ADMINISTRATORS

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK





# Available AI Solutions on Snap4City

<https://www.snap4city.org/997>

More than 80 Available Solutions & 300 AI applic.

- Mobility and Transport
- Environment, Weather, Waste, Water
- City Users Behaviour and Social analysis
- Energy and Control
- Tourism and People
- Security and Safety
- High Level Decision Support Solutions
  - Asset management
  - Resilience and Risks Analysis
- Low level Techniques



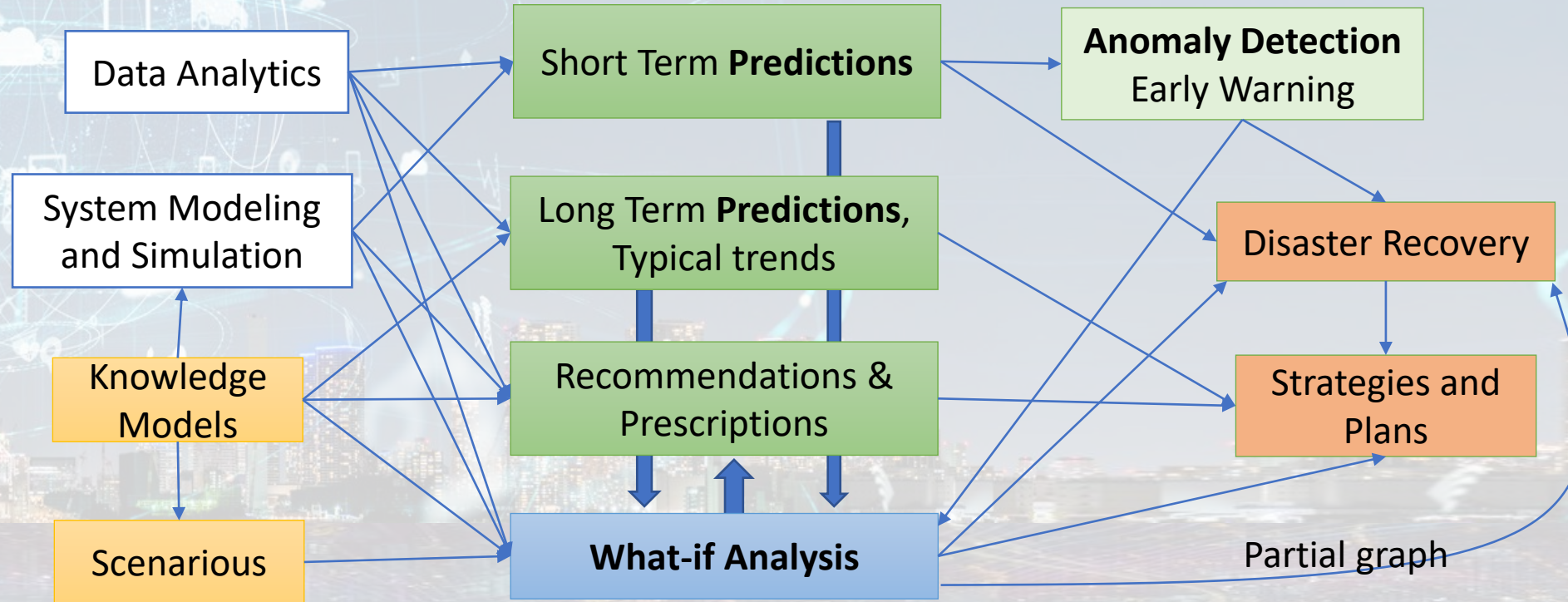
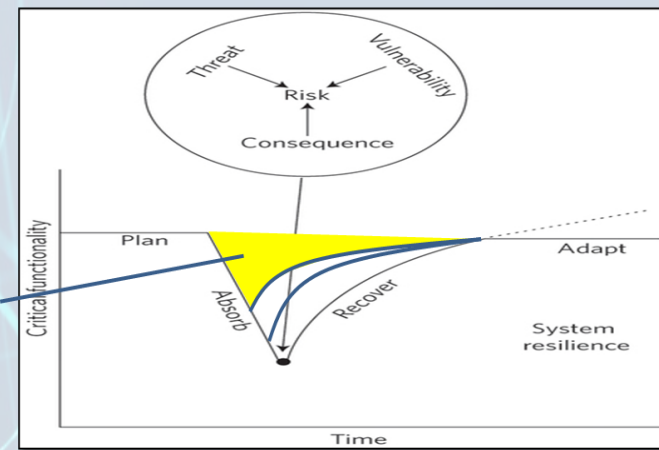
[https://www.snap4city.org/download/video/DPL\\_SNAP4SOLU.pdf](https://www.snap4city.org/download/video/DPL_SNAP4SOLU.pdf)

<https://www.snap4city.org/download/video/course/p4/>

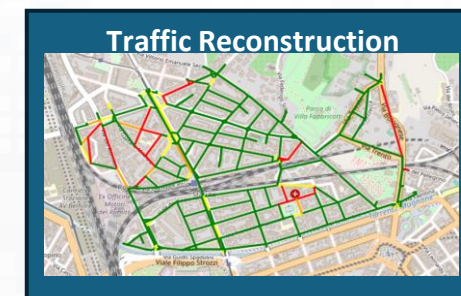
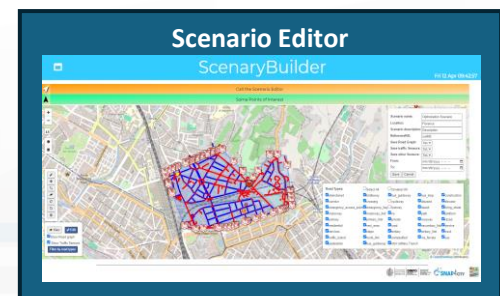
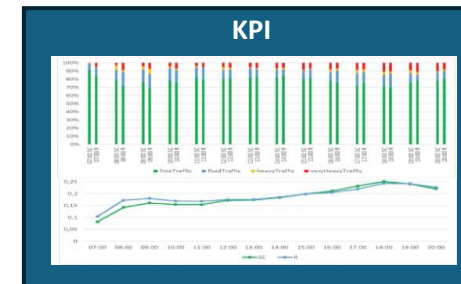
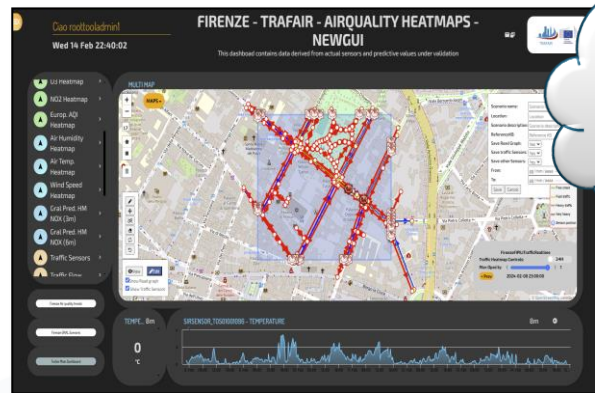
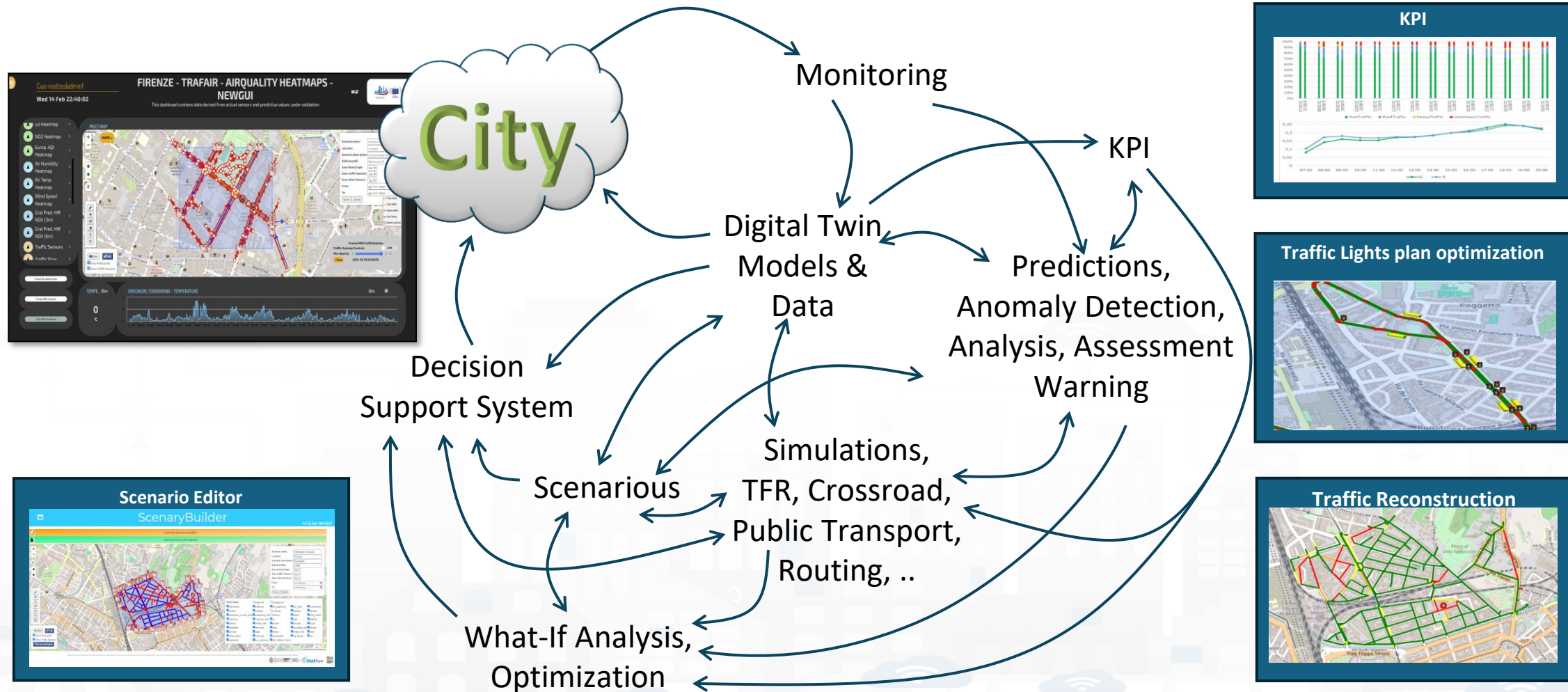
# Snap4City What-If

- Decision support systems
- Improvement of life quality
- Sustainable Solutions
- Reduction of costs
- Risk Assessment
- Resilience

**P**repare  
**A**bsorb  
**R**ecover  
**A**dapt



**Decision Support System: neuro-symbolic reasoning**  
 targeting Indicators: Quality of Life, PUMS, SUMI, KPI, SDG, 15MinIndex,...





• **15 Minute City Index:**

- 13 subindexes: energy, slow mobility, fast mobility, housing, economy education, culture and cults, health, entertainment, gov, food, security...



- Monitoring and Prediction of energy consumption
- Stimulating: Bike sharing, e-bikes, car charge, etc.
- Community of Energy, planning energy plant



- Industry 4.0 integrated solutions
- Decisions Support Systems
- Process optimization, control
- Predictive maintenance



- Smart City infrastructure: monitoring and resilience, long terms predictions
- Effective and Low cost smart solutions
- What-if analysis, Simulations
- Origin Destination matrices computation



- business intelligence tools for decision makers
- Reduction production costs
- Monitoring resource consumption
- Optimization of Waste Collection



- Monitoring and Predicting: NO2, NOX, CO2, Traffic flow, pollutant, landslide, waste, etc.
- Traffic flow reconstruction
- Demand vs Offer of Mobility analysis



- Shortening justice time
- Anonymization and indexing legal docs.
- Prediction of mediation proneness
- Ethical Explainable Artificial Intelligence

TOP

# Data Analytic Energy consumption monitoring and planning

FROM CITY DASHBOARD TO APPLICATIONS

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

IoT APPLICATIONS VS IoT EDGE DEVICES

IoT DEVICES AND NETWORKS

SNAP4CITY FOR BUSINESS

SNAP4CITY ARCHITECTURE AND ECOSYSTEM. OPENED TO DEVELOPERS AND STAKEHOLDERS

TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS

SNAP4CITY AND KM4CITY PROJECTS

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

DECISION SUPPORT SYSTEM AND CITY RESILIENCE

SNAP4CITY THE VIEW OF THE ADMINISTRATORS

DATA ANALYTICS, INTELLIGENCE, WHAT-IF AND SIMULATION

ADVANCED SMART MICRO-SCALE SNAP4CITY

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK



# Energy Domain (2024)

- **Goals:**
  - Efficiency, costs
  - Accessibility to services
- **Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)**
  - Monitoring energy consumption (heating, cooling, prod.,...), conditions, charging stations, etc.
  - Managing Smart Light for city: dimming, programming, traffic control, controllers, legacy, etc.
  - Early detection/warning, alarm, of critical conditions
  - Managing smart services: cabinets, lockers, etc.
  - Production of suggestions, nudging
  - Global and local 3D/2D representations of area and buildings
  - Managing Communities of Energy, certification via Blockchain
  - Computing predictions of any kind
- **Solutions for Planning (optimization and what-if analysis)**
  - Reduction of energy costs, via optimization
  - Identification of roofs with better orientation
  - Optimization of battery storage size for PV plants
  - Community of Energy planning and viability
- **Algorithms and computational solutions, see next slide**



# Tools: Energy Domain (2024)

- Monitoring Energy Consumption in single building, area and per zone
- Matching Energy consumption with respect to the actual usage
- Computing Roof orientation for Photovoltaic installations
- Optimisation of Photovoltaic installations to identify the best parameters of size and storage
- **Smart Light management**, unicast and multi cast management, smart light controlled by **traffic flow data**
- Collecting and managing **Communities of Energy**
- Monitoring Energy provisioning on **recharging station**
- Optimization of battery life
- Computing **KPI**
- Etc.



reference

# Smart Light Control of **CAPÉLON**

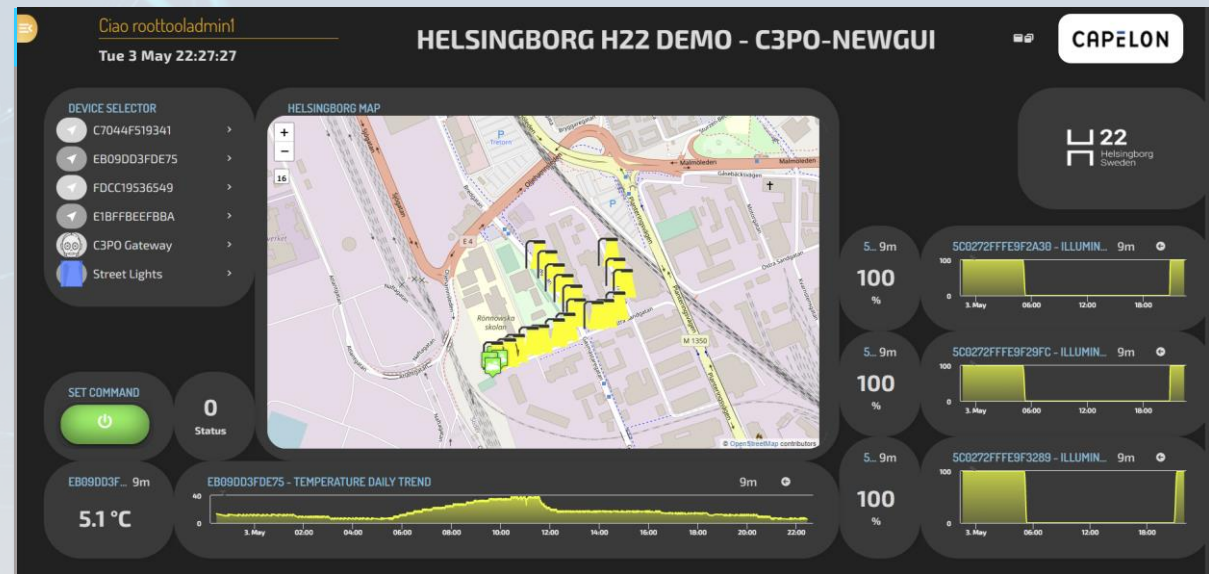
## • Energy Domain

- Smart Light, MQTT, ....
- IoT Orion Broker FIWARE



## • Dashboards

- Map coverage on Sweden
- Monitoring and real time control
- Energy control, analytics
- Direct control

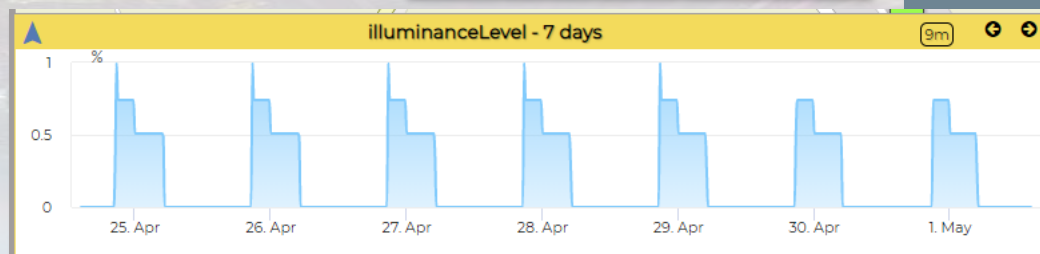
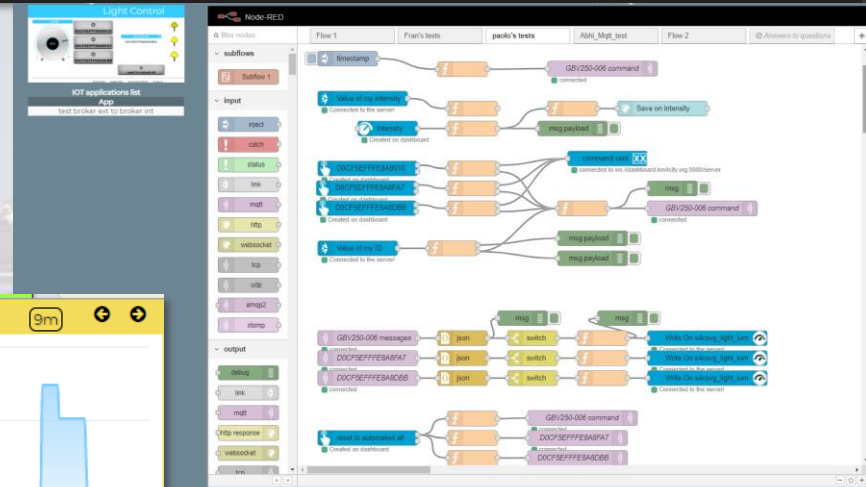
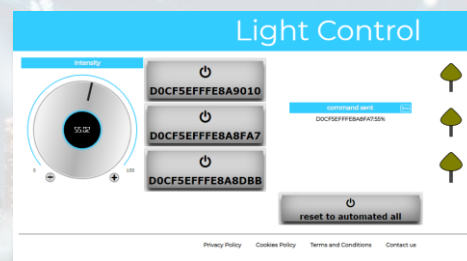


## • Historical and Real Time data

## • Services Exploited on:

- Multiple Levels, API
- Dashboards

## • Since 2020



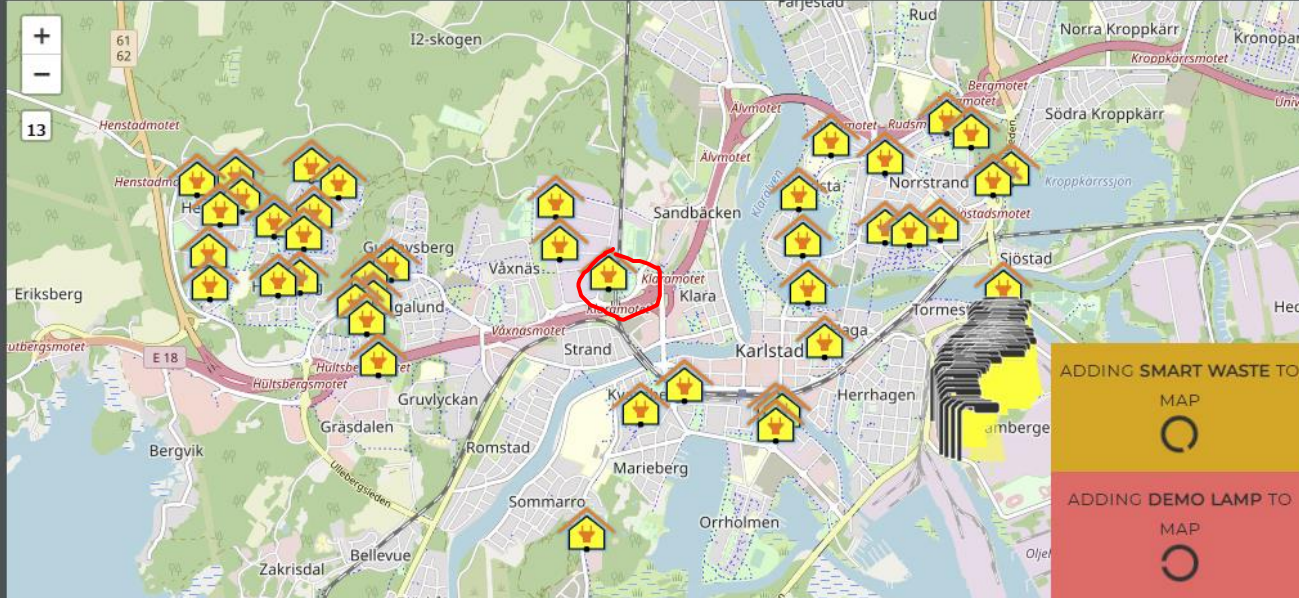


## Karlstad - Capelon

CAPELON

Sun 28 Nov 20:02:16

- Cabinet
- Smart Light
- Demo Lamp
- Smart Waste

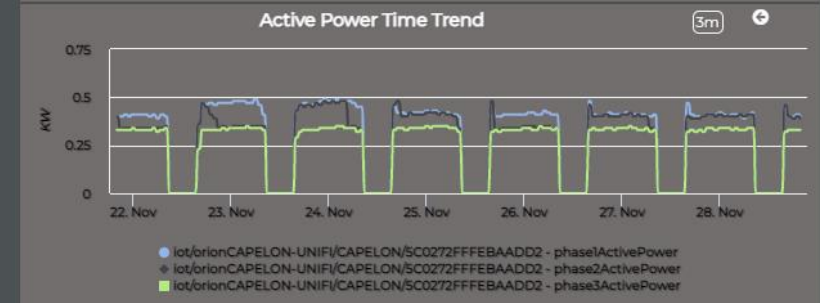
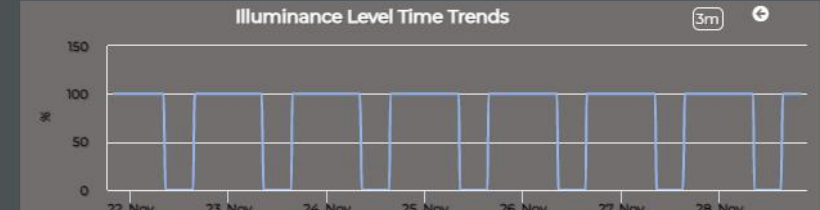
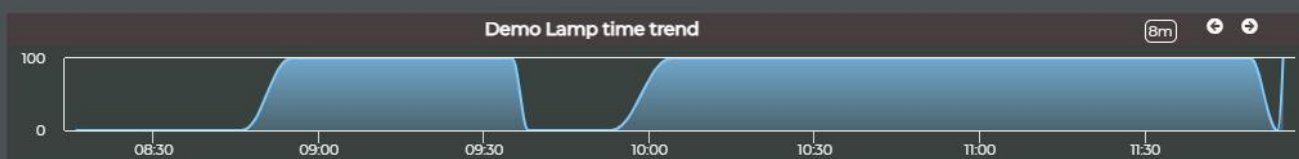


ADDING SMART WASTE TO MAP

ADDING DEMO LAMP TO MAP

Lamp ON

Lamp OFF



# Cabinets' Monitoring in Stockholm

# CAPELON

SNAP4CITY



App Maps Google Gmail Snap4City Snap4 Calendar Translate Google Scholar Cita... DISIT DISIT old Facebook DataCenter Trello Km4City major tools Impostazioni YouTube Google Forms News Tutti i preferiti



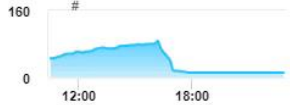
## Cabinets On Stockholm By Capelon

Tue 31 Oct 22:53:17

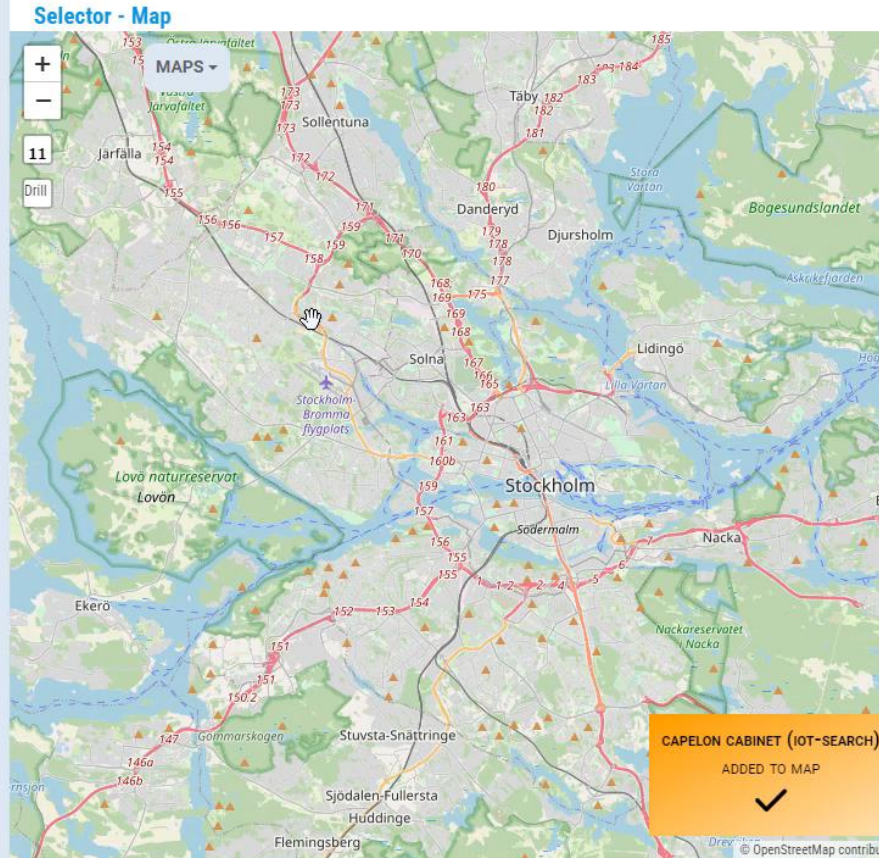
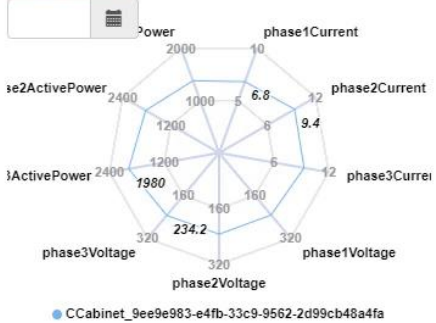
Capelon Cabinet (iot-search)

Ac...9m ActualState0Count - St... 9m

12



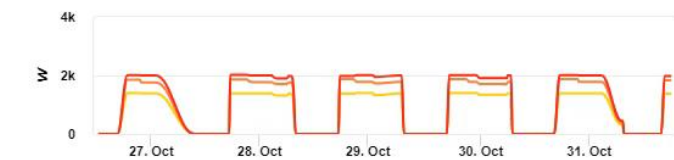
Radar Series 4m



:CCabinet\_9ee9e983-E4fb-33c9-9562-2d99cb48a4fa - Burni... 9m

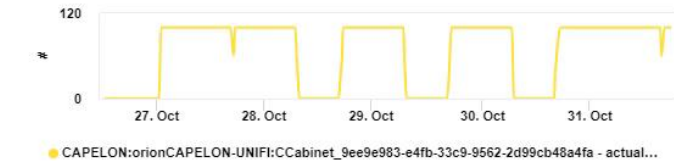


Time Trend 4m



Legend:  
● CAPELON:orionCAPELON-UNIFI:CCabinet\_9ee9e983-e4fb-33c9-9562-2d99cb48a4fa - phase...  
● CAPELON:orionCAPELON-UNIFI:CCabinet\_9ee9e983-e4fb-33c9-9562-2d99cb48a4fa - phase...  
● CAPELON:orionCAPELON-UNIFI:CCabinet\_9ee9e983-e4fb-33c9-9562-2d99cb48a4fa - phase...

Time Trend 4m



My Profile

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Capelon Cabinet (iot-search)

Ac...9m ActualState0Count - St... 9m

12

Radar Series 4m

● CCabinet\_9ee9e983-e4fb-33c9-9562-2d99cb48a4fa

Selector - Map

:CCabinet\_9ee9e983-E4fb-33c9-9562-2d99cb48a4fa - Burni...9m

Time Trend 4m

● CAPELON:torionCAPELON-UNIFI:CCabinet\_9ee9e983-e4fb-33c9-9562-2d99cb48a4fa - phase...  
 ● CAPELON:torionCAPELON-UNIFI:CCabinet\_9ee9e983-e4fb-33c9-9562-2d99cb48a4fa - phase...  
 ● CAPELON:torionCAPELON-UNIFI:CCabinet\_9ee9e983-e4fb-33c9-9562-2d99cb48a4fa - phase...

My Profile

ASM Merano Stadtwerke Merano

Elenco lampade Visualizzazione dati Log eventi Grafici Impostazioni

N. Punto Luce	11307
DevEui	7083D58F100085D7
Via	RomStraÙe
Regolazione	
Ore di servizio	
Conta energia	
Potenza attuale	
Stato	Inattivo
Nome errore	null
RSSI	
SNR	
Data	01/11/2023 12:01:18

Regolazione

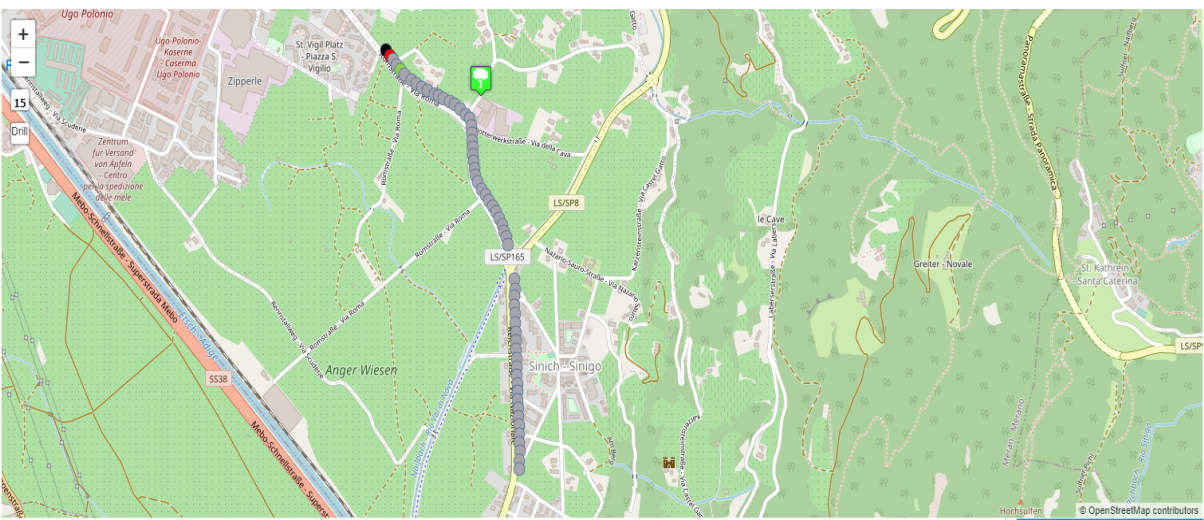
Stato Linea  
 Non Attivo  
 Stato Linea verso Sinigo

Stato Linea  
 Non Attivo  
 Stato Linea verso Merano Centro

DAL_NTC_MISSING	
INF_AJL_TRIGGER	
DAL_BADE_TIME_DISAIBL	
DAL_BALAST_NOT_CONFIG	
ERR_DAL_THERMAL_SHUTDOWN	
ERR_DAL_THERMAL_DERATING	
ERR_DAL_POWER_LIM	
ERR_DAL_OVERALL	
INF_POWER_FAIL	
INF_BUS_POWERED_BY_FREE	
INF_DAL_BANK_ERR	

# Smart Light Management

# Smart Light Management in Merano, Italy



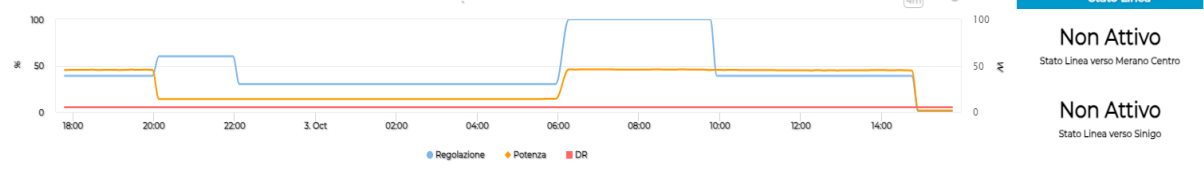
All lamps Data visualization Event logs Graph Settings

N. Punto Luce	11251
DevEui	7083D5BF100085DB
Via	Romstraße
Regolazione	100
Ore di servizio	1440
Conta energia	28709
Potenza attuale	24
Stato	ON
Nome errore	INF_DALI LAMPON
RSSI	-42
SNR	10.5
Data	03/10/2023 15:42:43

ON

OFF

- DALI\_NTIC\_MISSING
- INF\_AUX\_TRIGGER
- DALI\_FADE\_TIME\_DISABLE
- DALI\_LAST\_NOT\_CONFIG
- ERR\_DALI\_THERMAL\_SHUTDOWN
- ERR\_DALI\_THERMAL\_DERATING
- ERR\_DALI\_POWER\_LIM
- ERR\_DALI\_OVERALL
- INF\_POWER\_FAIL
- INF\_BUSS\_POWERED\_BY\_FRE
- INF\_DALI\_BANK\_ERR
- INF\_PHOTOCELL\_DISABLED
- INF\_SCHEDULER\_DISABLED
- INF\_LL\_CHANGED



Non Attivo  
Stato Linea verso Merano Centro

Non Attivo  
Stato Linea verso Sinigoi

- Managing DALI 2 devices FlashNet via LoraWan
- programming SmartLight via UniCast and MultiCast
- Controlling devices
- Automation of Smart Luminaries on the basis of Traffic Flow
- Usage of Chirpstack as net server



Add device to multicast

Multicast2

DevEui

Multicast address

Multicast network session key

Multicast application session key

Salva

Multicast configuration

Multicast2

Set UTC timestamp

Set cpPush

Set configuration

Salva

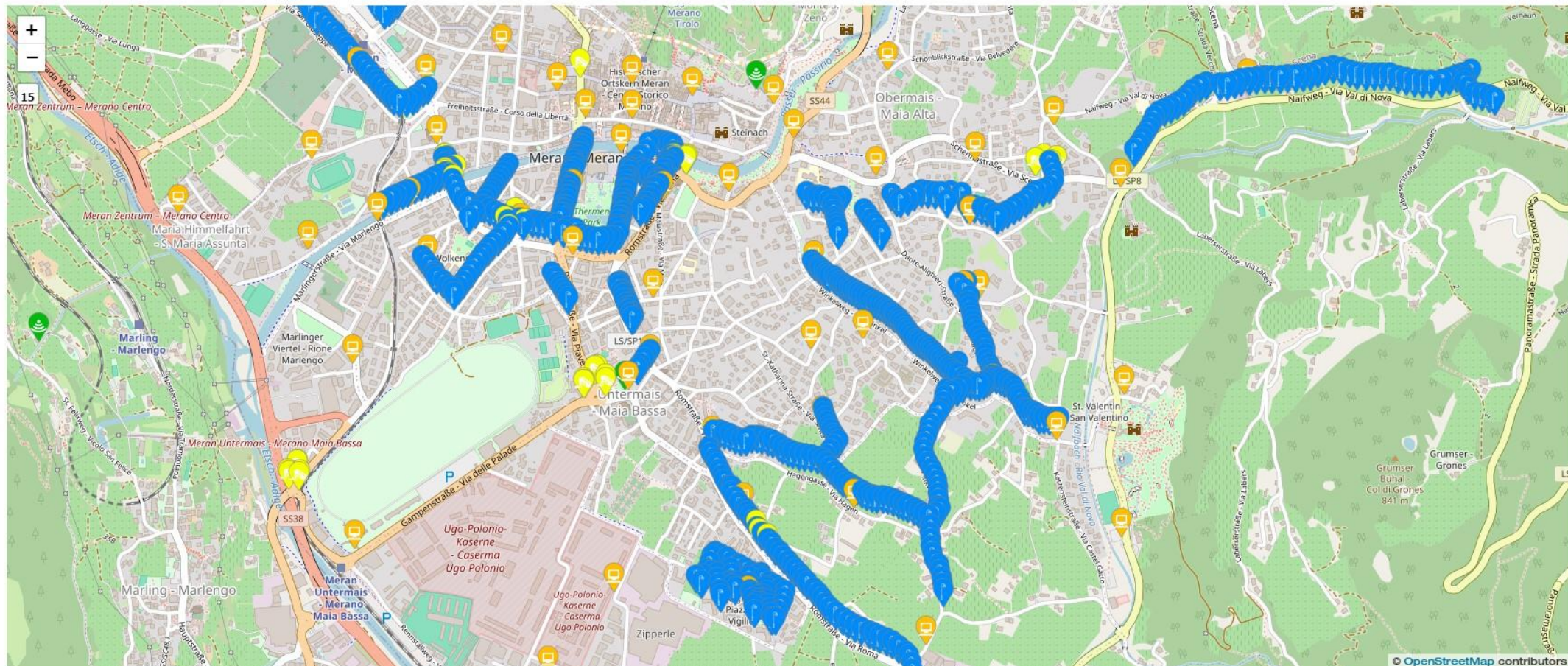
<https://www.snap4city.org/968>

# Smart Light in Merano



## Merano - tutti i servizi

Wed 13 Dec 15:34:57



© OpenStreetMap contributors





# Monitoraggio Generale

Fri 2 Feb 17:08:24

- CameraModelP1448-LE
- UpsModelRiello
- UpsModelSeltec
- SwitchModelMicrosense
- SwitchModelNetonix

**SWITCH027**  
VALUE NAME: 1721615236

DETAILS DESCRIPTION RT DATA

Last update: 2024-02-02 14:05:50 176Z

Description	Value	Buttons
dateObserved	02/02/24, 03:05:50 PM	Last 4h 24h 7d 30d 6m 1y 2y 10y
fanSpeed	6165	Last 4h 24h 7d 30d 6m 1y 2y 10y
generalStatus	0	Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue1	48	Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue2	48	Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue3	0	Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue4	0	Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue5	0	Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue6	0	Last 4h 24h 7d 30d 6m 1y 2y 10y

**Legenda**

Valore	Significato	Simbolo
0	Buono stato	●
1	Non raggiungibile	●
2	Raggiungibile, dati non disponibili	●
3	Identificata anomalia	●

**Stato Attuale** 9m

**1721612145 - GeneralStatus - Andamento Settimanale**

**Legenda**

- 181
- 9
- 22
- 0

**Selector - Map**

TC01010  
VALUE NAME: 172

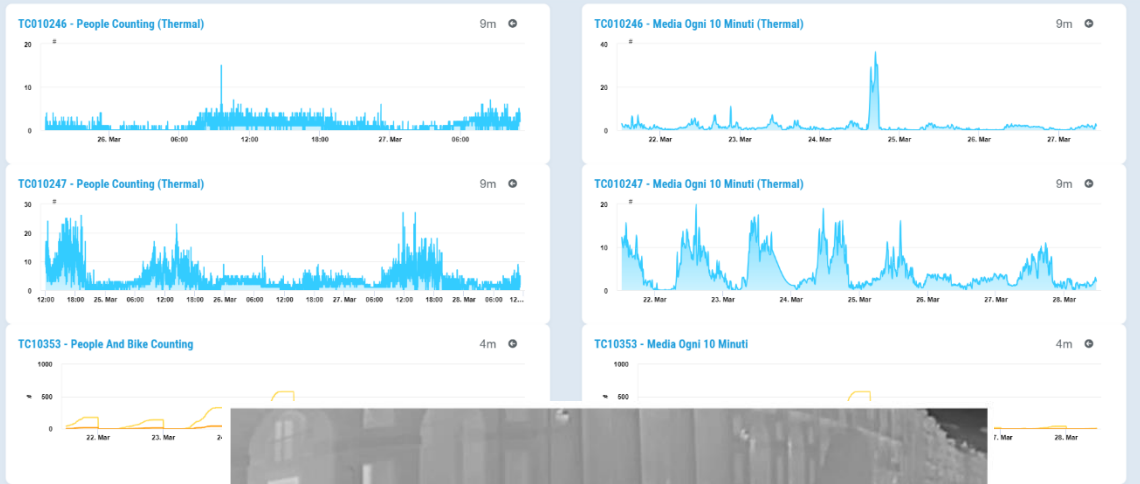
Last update: 2024-02-02 14:05:50 101Z

Description	Value
dateObserved	02/02/24, 03:05:50 PM
generalStatus	2

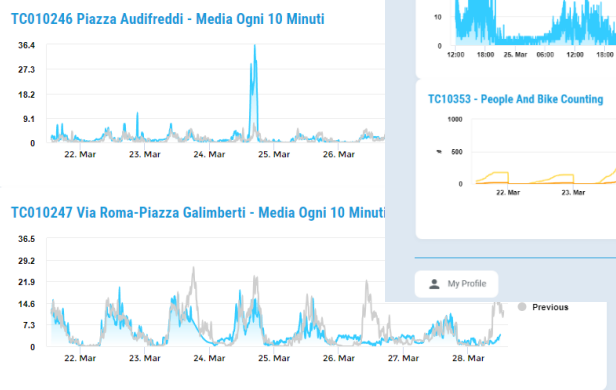
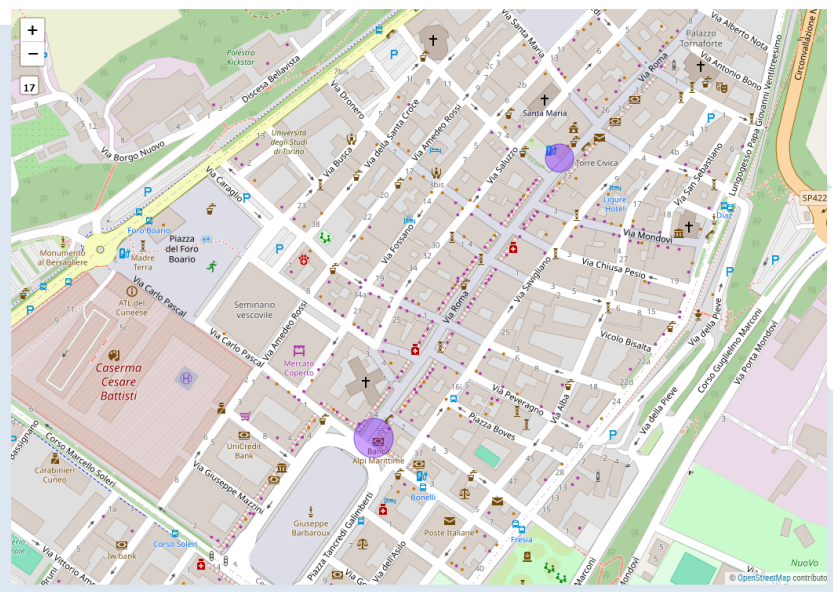
Keep data on target widget(s) after popup close:

## Telecamere Cuneo

Thu 28 Mar 11:18:02



## Conteggi Telecamere



Powered by SNAP4Tech



TOP

# Community of Energy and Photovoltaic Plant Simulator

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

FROM CITY DASHBOARD TO APPLICATIONS

DATA GATHERING AND CITY DATA MANAGEMENT

IOT/IOE DEVICES AND NETWORKS

IOT APPLICATIONS AND SERVICES

IOT APPLICATIONS, THE LOGIC AND THE SMARTNESS

ADVANCED SMART CITY API, MICROSERVICES, SNAP4CITY API

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK

SNAP4CITY FOR BEGINNERS

SNAP4CITY ARCHITECTURE AND ECOSYSTEM. OPENED TO DEVELOPERS AND STAKEHOLDERS

DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT CAN YOU DO WITH THE DATA

TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS

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SNAP4CITY AND KM4CITY PROJECTS

SNAP4CITY THE VIEW OF THE ADMINISTRATORS



<https://www.snap4city.org/dashboardSmartCity/view/Baloon.php?iddashboard=MzczNg==>

Ciao roottooladmin!

Sat 11 Nov 17:26:28

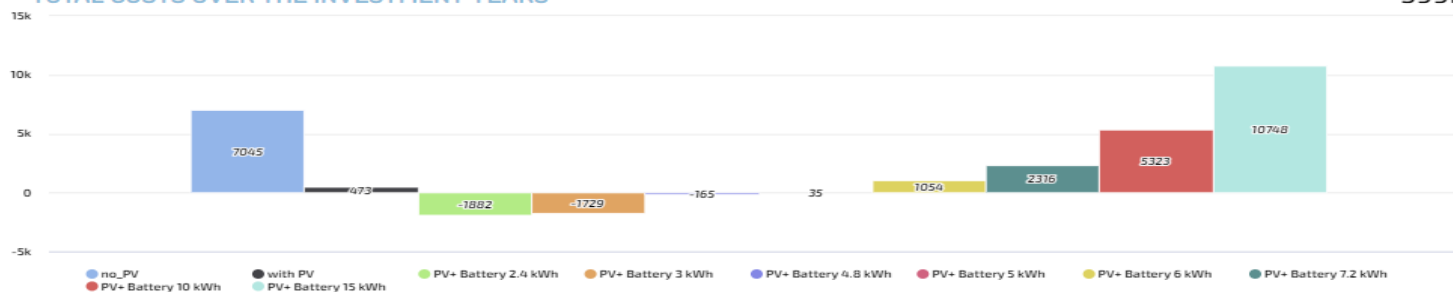
## ONLINE PHOTOVOLTAIC SYSTEM SIMULATOR

User Manual

Italian Version

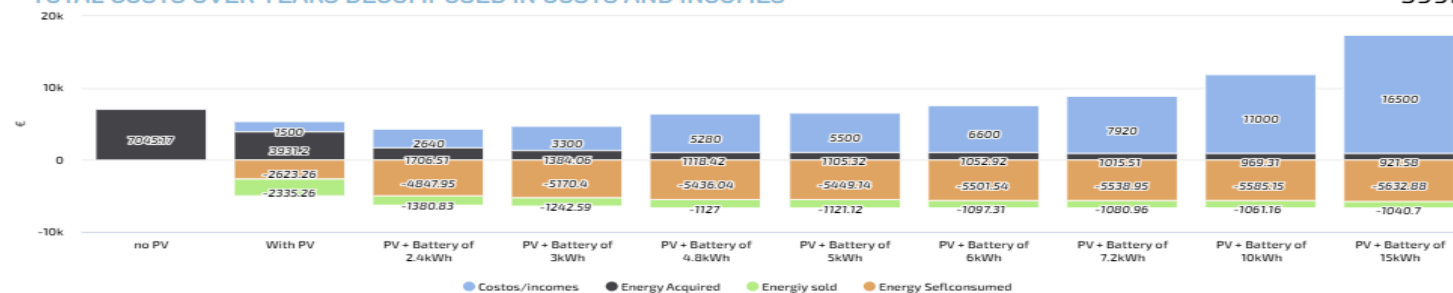
### TOTAL COSTS OVER THE INVESTMENT YEARS

599m



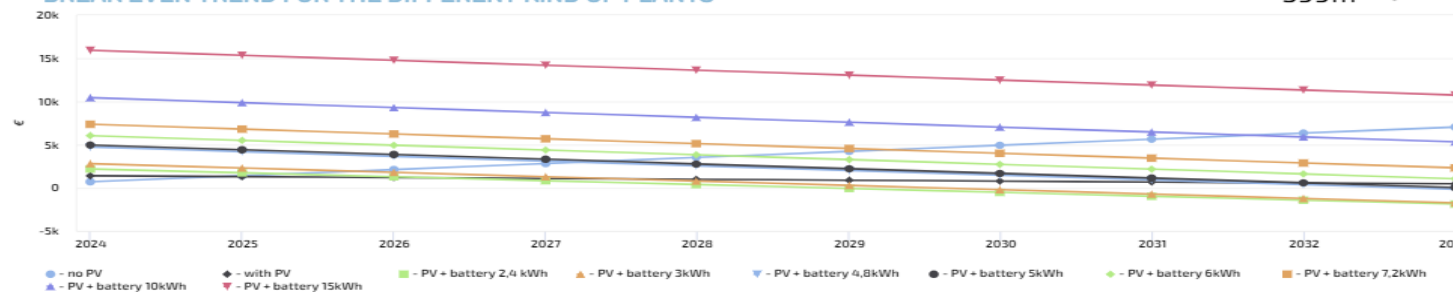
### TOTAL COSTS OVER YEARS DECOMPOSED IN COSTS AND INCOMES

599m



### BREAK EVEN TREND FOR THE DIFFERENT KIND OF PLANTS

599m



### PARAMETERS OF YOUR PV PLANT

We suggest you PV plus battery of 2.4 kWh

Annual Consumption

Price of energy sold (€/kWh)

Price of Energy Acquired (€/kWh)

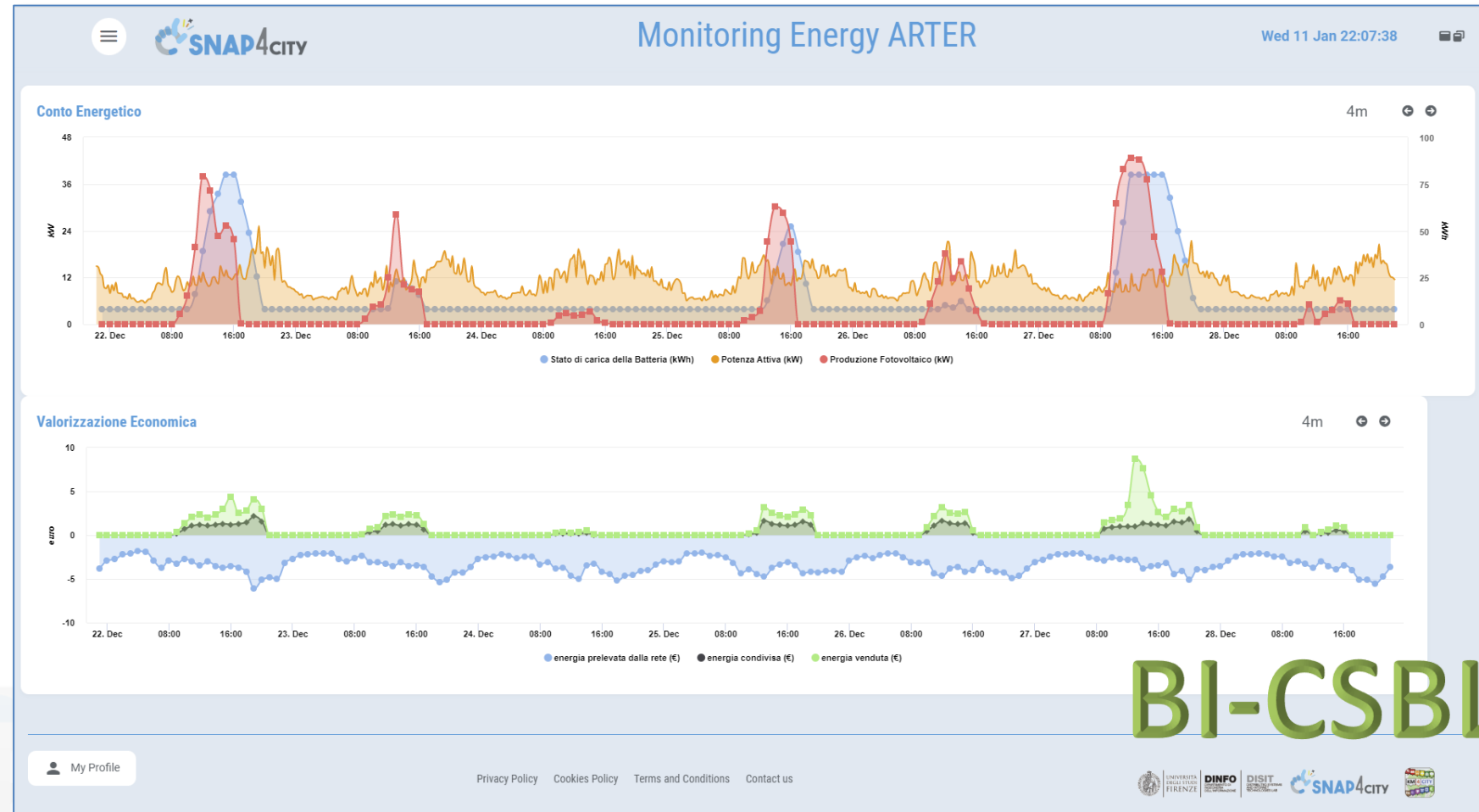
Years of Investment

Months for typical trends

Compute



- **Field-tested energy community: the self-consumer condominium**
- The Self User project creates in the pilot condominium, through the collection and analysis of data, a model for calculating and enhancing the impact of an energy community on a community of people, with a view to actions to combat energy poverty



BI-CSBL

<https://www.selfuser.it>



# SELF USER

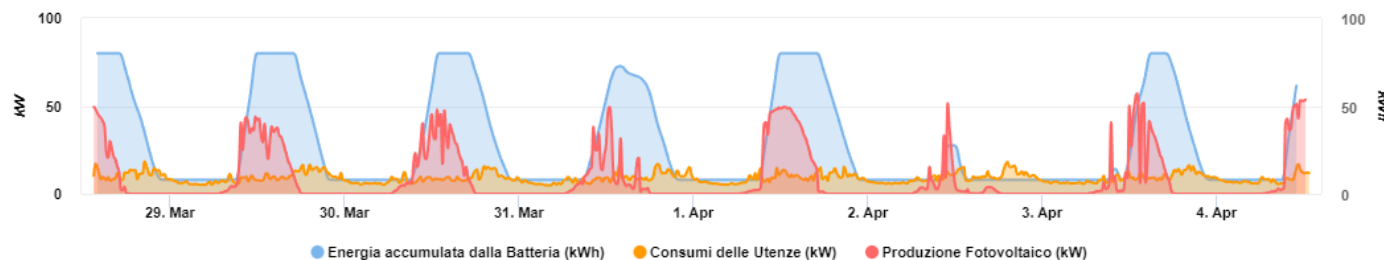
Monitoraggio in tempo reale della comunità energetica condominiale

Tue 4 Apr 13:20:04



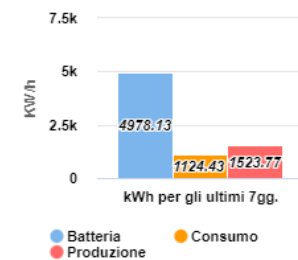
## Conto Energetico

4m



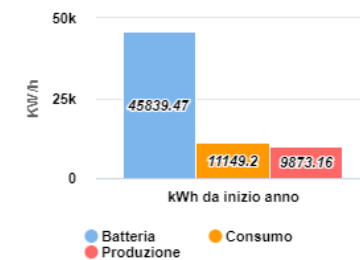
## KWh Ultimi 7 Gg.

4m



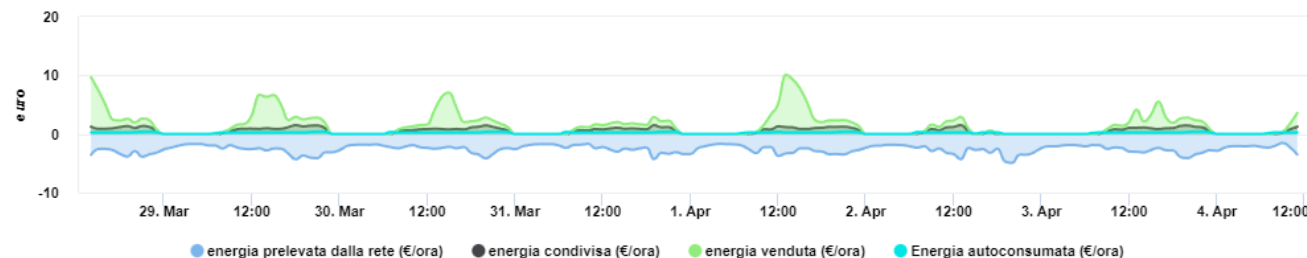
## KWh Da Inizio Anno

4m



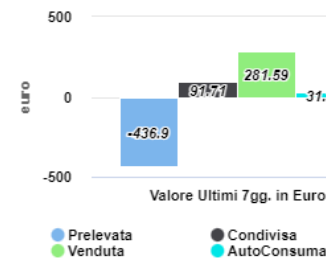
## Valorizzazione Economica

4m



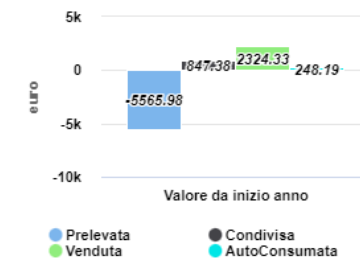
## Valore Ultimi 7gg.

4m



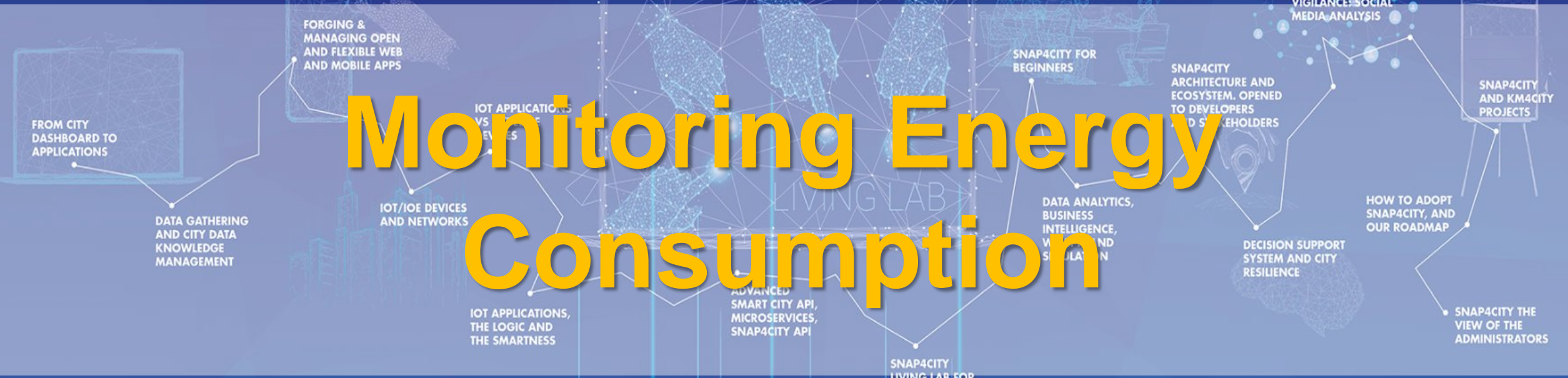
## Valore Da Inizio Anno

4m



TOP

# Monitoring Energy Consumption



# Energy monitoring and business intelligence

## Green and Data Driven District

Aggregated KPI JuicePark SmartPole CityAnalytics

<b>Energy produced to date</b> JuicePark <input type="text" value="0"/> kWh SmartPole <input type="text" value="27.341"/> kWh	<b>CityAnalytics insight</b> Average daily people <input type="text" value="9845.3"/> Average Milan resident over tourist ratio <input type="text" value="1.57"/>	<b>Videoanalysis - KPI to date</b> People counted <input type="text" value="0"/> Vehicle counted <input type="text" value="520"/> People aggregation <input type="text" value="0"/>
<b>WiFi sessions daily peak</b> Max connected devices <input type="text" value="0"/>	<b>SOS events to date</b> SmartPole requests <input type="text" value="0"/> JuicePark requests <input type="text" value="0"/> AED requests <input type="text" value="0"/>	<b>Vehicle charging sessions to date</b> EV car <input type="text" value="0"/>

**Juice Park**  
Detailed KPIs

**Smart Pole**  
Detailed KPIs

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**7 AFFORDABLE AND CLEAN ENERGY**

**11 SUSTAINABLE CITIES AND COMMUNITIES**

main
smart pole

**Charging Station**

Number of Daily Ses... <input type="text" value="0 #"/>	Daily Energy Consumpt... <input type="text" value="0 kWh"/>
Number of Total Ses... <input type="text" value="10 #"/>	Total Energy Consumed <input type="text" value="15 kWh"/>

**Video Analysis**

People Counts (hourly)

People in Forbidden Area

People Aggregation

Last Event: 21/04/2022 10:48

**SOS - Number of Pushes**

SOS - Last button us...

SOS - Daily Number of Button Pus...

**Power Meter - Energy Consumed**

**Power Meter - Energy Produced**

**WiFi - Connections per Day**

Last Event: 21/04/2022 10:47

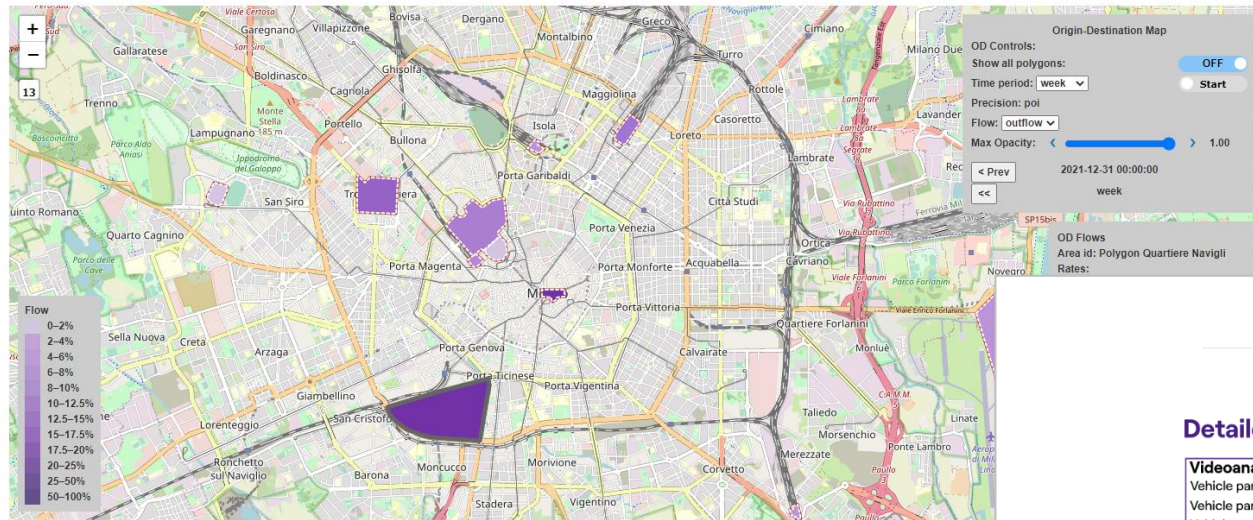
21/04/2022 10:48

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## Green and Data Driven District

Aggregated KPI JuicePark SmartPole CityAnalytics

POI - OD POI - PRESENZE POI - PRESENZE (TS) ACE - PRESENZE ACE - PRESENZE (TS)



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## Green and Data Driven District

Aggregated KPI JuicePark SmartPole CityAnalytics

### Detailed KPIs

#### Videoanalysis

People counted daily: 0  
 People counted to date: 0  
 People aggregation daily: 0  
 People aggregation to date: 0  
 Vehicle counted daily: 0  
 Vehicle counted to date: 21

#### Power meter

Daily energy consumed: 9.024 kWh  
 Energy consumed to date: 27.341 kWh  
 Daily energy produced: 1.409 kWh  
 Energy produced to date: 4.252 kWh

#### WiFi

Max number of connected devices in the last day: 0  
 Hourly average connected devices: #####

#### eBike

Daily number of sessions: 0  
 Number of sessions to date: 0  
 Total Energy consumed: 0  
 Average energy consumed: 0  
 Last charger session: 17/06/2022 11:25

#### Emergency

SOS requests to date: 0  
 SOS request daily: 0  
 AED requests to date: 0  
 AED requests to daily: 0

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## Green and Data Driven District

Aggregated KPI JuicePark SmartPole CityAnalytics

### Detailed KPIs

#### Videoanalysis

Vehicle parked daily: 8  
 Vehicle parked to date: 87  
 Vehicle count daily: 24  
 Vehicle count to date: 520

#### Power meter

Energy consumed daily: 0 kWh  
 Energy consumed to date: 0 kWh  
 Energy produced daily: 0 kWh  
 Energy produced to date: 0 kWh

#### WiFi

Max number of connected devices in the last day: 0  
 Hourly average connected devices: #####

#### Emergency

SOS Requests to date: 0  
 SOS request daily: 0

#### EV charged

Number of sessions daily: 0  
 Number of sessions to date: 0  
 Total Energy consumed: 0  
 Average energy consumed: 0  
 Last charger session: 0

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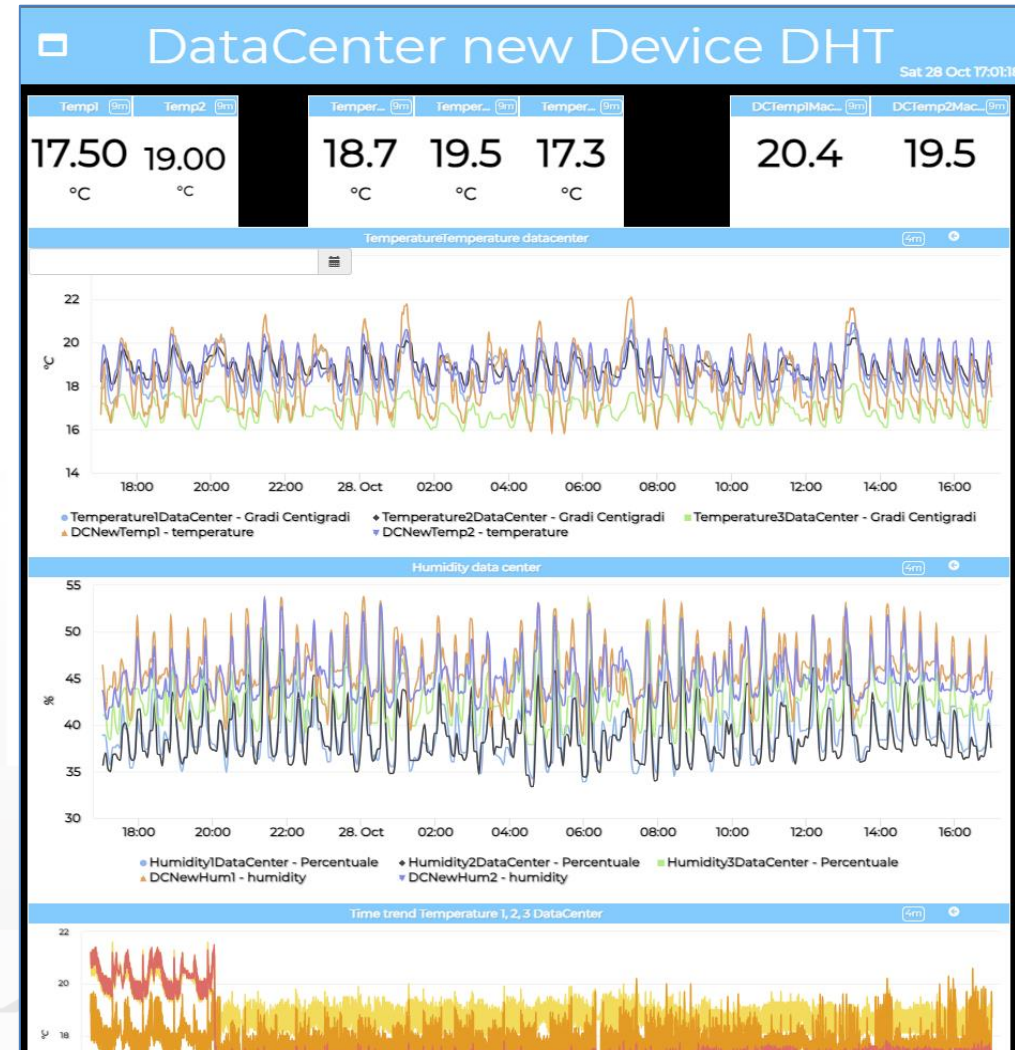
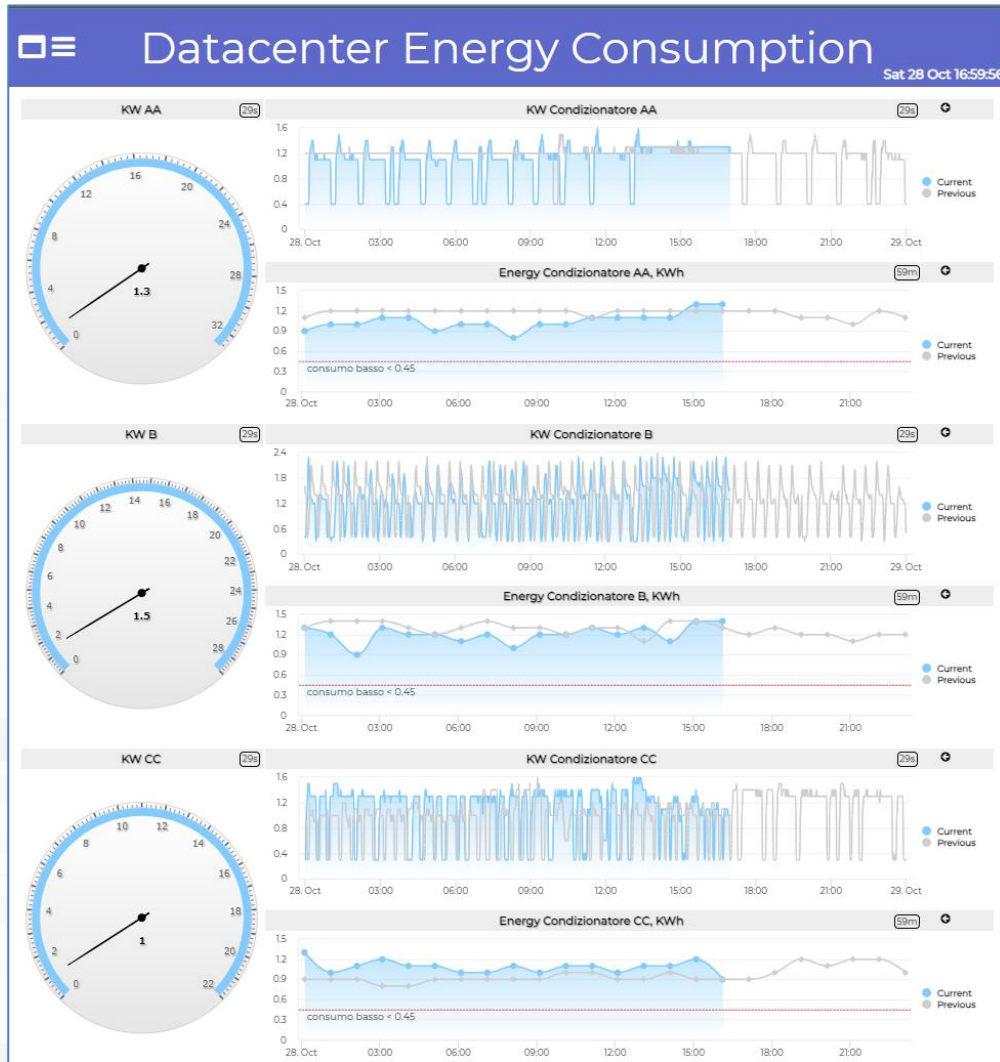
7 AFFORDABLE AND CLEAN ENERGY



11 SUSTAINABLE CITIES AND COMMUNITIES



# Data Center monitoring





TOP

# Industry Domain predictive maintenance



# Workflow for Ticket management

Consumptions/productions

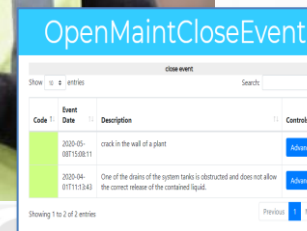
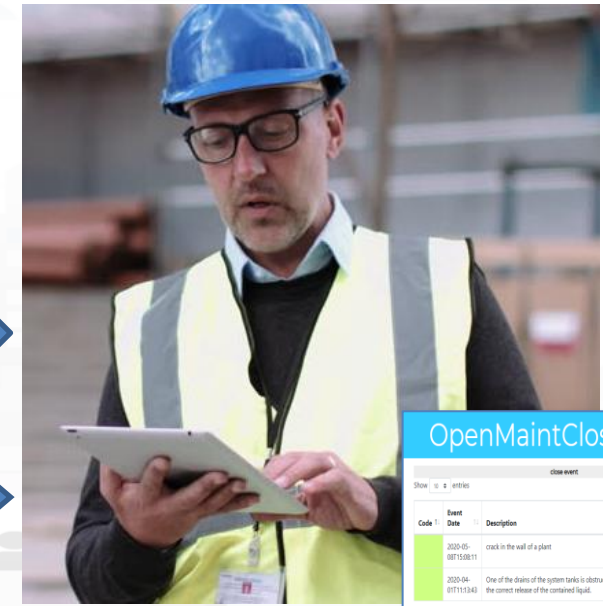
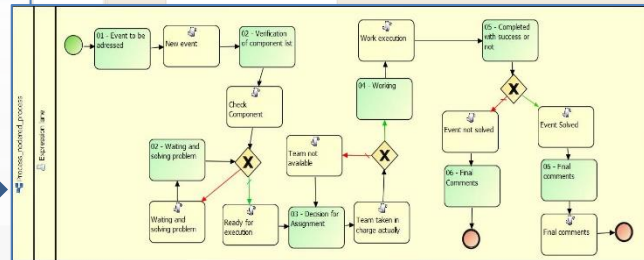
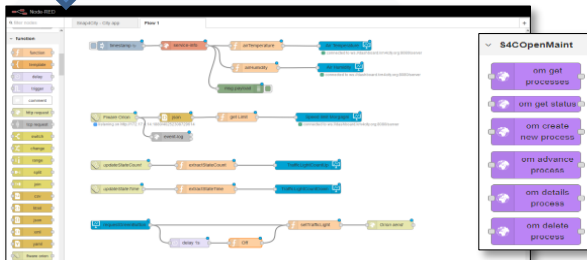
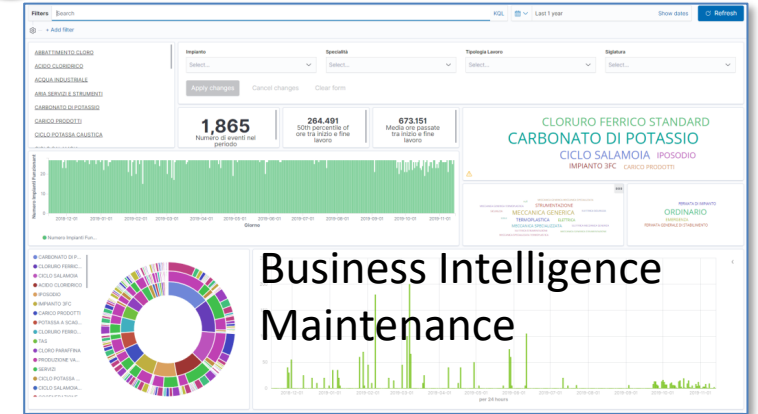
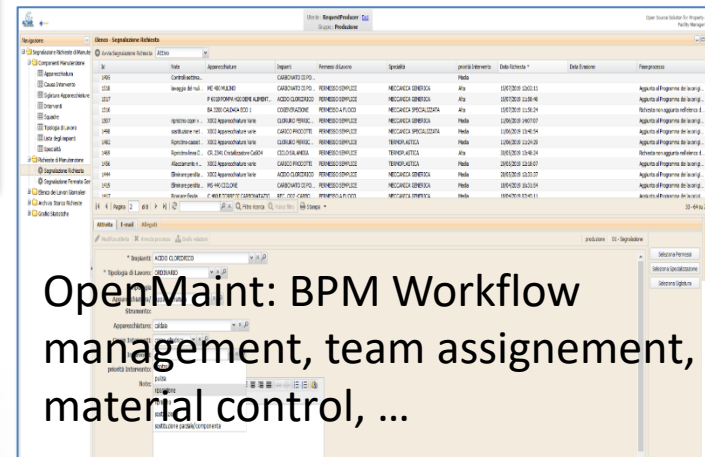
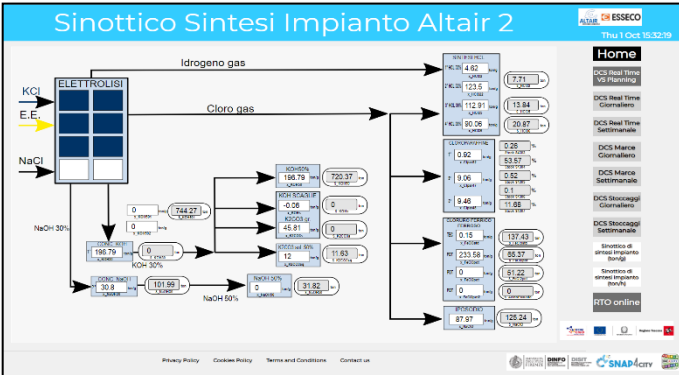
Events/actions

Business Intelligence  
Maintenance

Dashboards and actions

OpenMaint: BPM Workflow  
management, team assignment,  
material control, ...

IOT App, Data  
event firing,  
event detection  
and firing  
Critical event  
management



# Digital Twin Local, 3D vs Real Time Data



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TECHNOLOGIES LAB

Tue 8 Jun 11:04:55

## BIM Integration for Digital Twin

device list  
Valve 786 with trend ▾

Selector - Map

BIM view

CORPISA					
VALUE NAME: CORPISA					
	DETAILS	DESCRIPTION	RT DATA		
1- 0.000Z	Last value	Last 4 hours	Last 24 hours	Last 7 days	Last 30 days
	Last value	Last 4 hours	Last 24 hours	Last 7 days	Last 30 days
	Last value	Last 4 hours	Last 24 hours	Last 7 days	Last 30 days

Time Trend Chart: totale\_casi - 6 months



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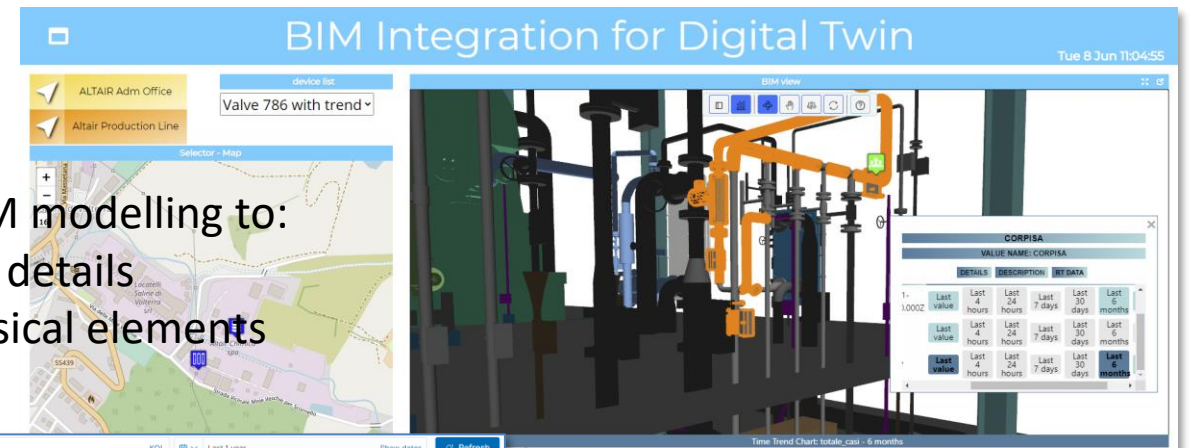
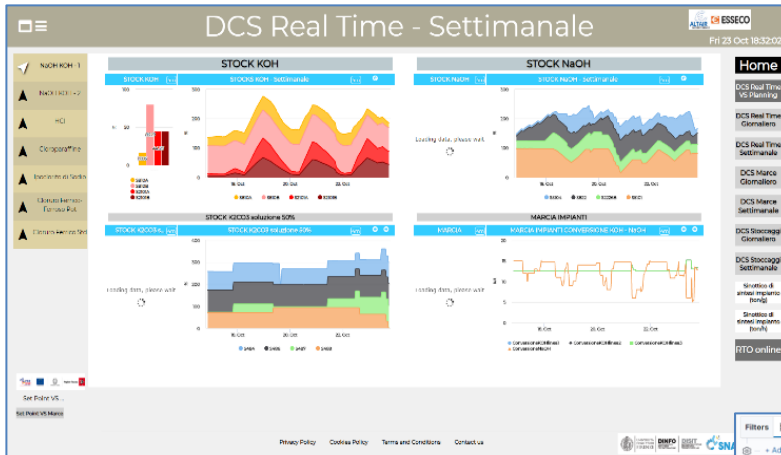
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INGEGNERIA  
DELL'INFORMAZIONE

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DISTRIBUTED SYSTEMS  
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**SNAP4CITY**

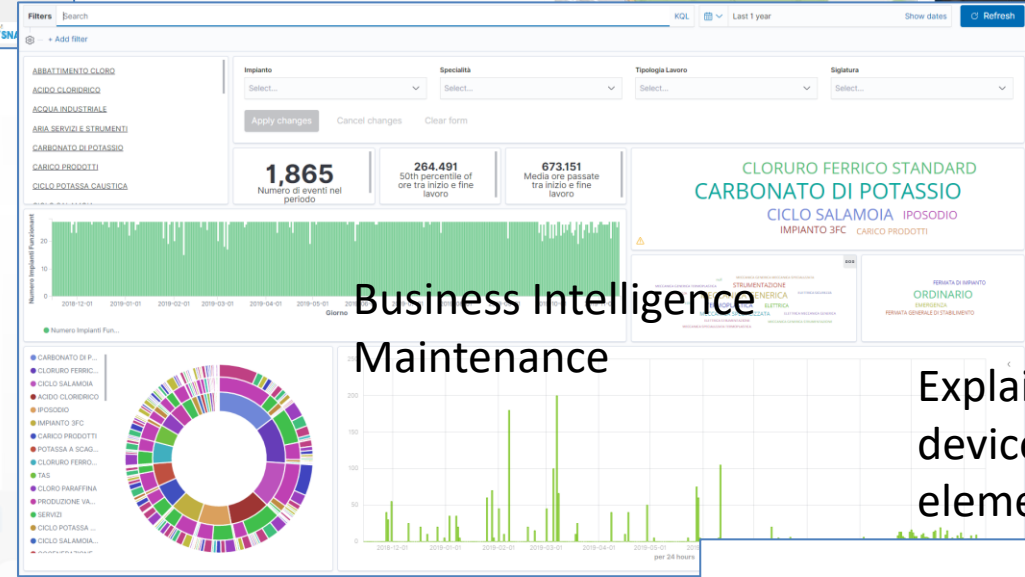
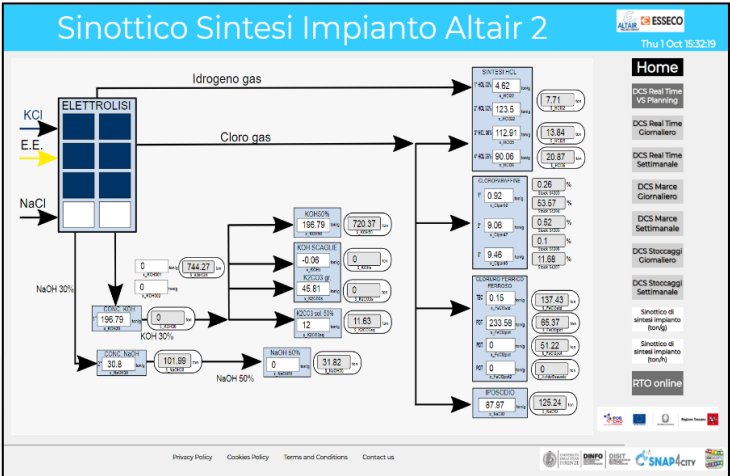


# Closing the loop

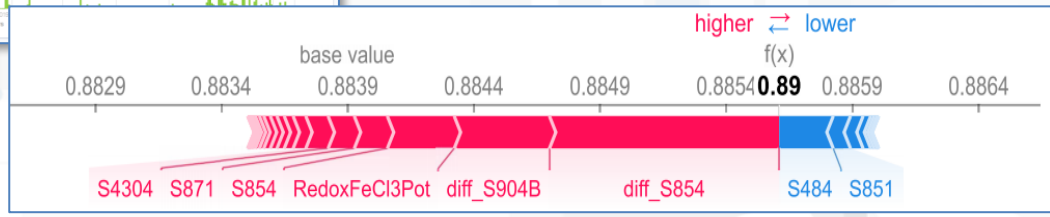


Historical and Real Time Data

Synoptics for real time monitoring



Explainable AI to map critical values of devices and detection to physical elements in the plant



<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MzA1NA==>

## Sinottico Impianto Presse - Autoclave

### Stato Presse

### Select Pressa

PRESSA 6

Press to update the list

### Status

NO STATUS

### Tempo Vulcanizzazione Pressa

### Tempo Preriscaldamento Pressa

### Temperatura Settore Pressa

### Pressione Pressa

### Temperatura Piani Pressa

### Stato autoclave

USCITA\_PRESSIONE: 100 %

INGRESSO\_VAPORE: 0 %

Internal pressure: 0.027999997 BAR

Air Temp.: 28.666666 °C

Hitc Temp.: 27 °C

Lotc Temp.: 27 °C

SP Air Temp.: 0 °C

Motor: 0 A, 0 rpm, 0 kW

TEMP\_MOTORE\_VENT: 27.1 °C

TEMP\_RAFFREDDAMENTO: 27.7 °C

NOME RICETTA: Cilindri ebanite aria calda

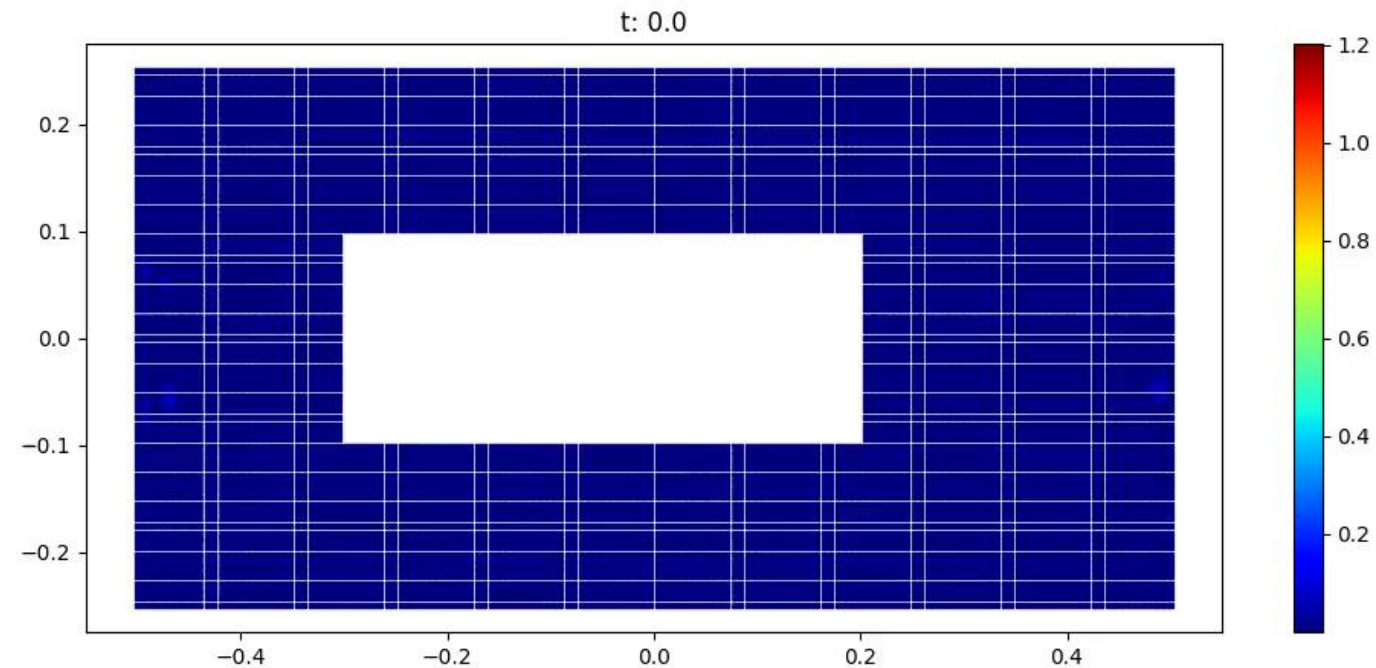
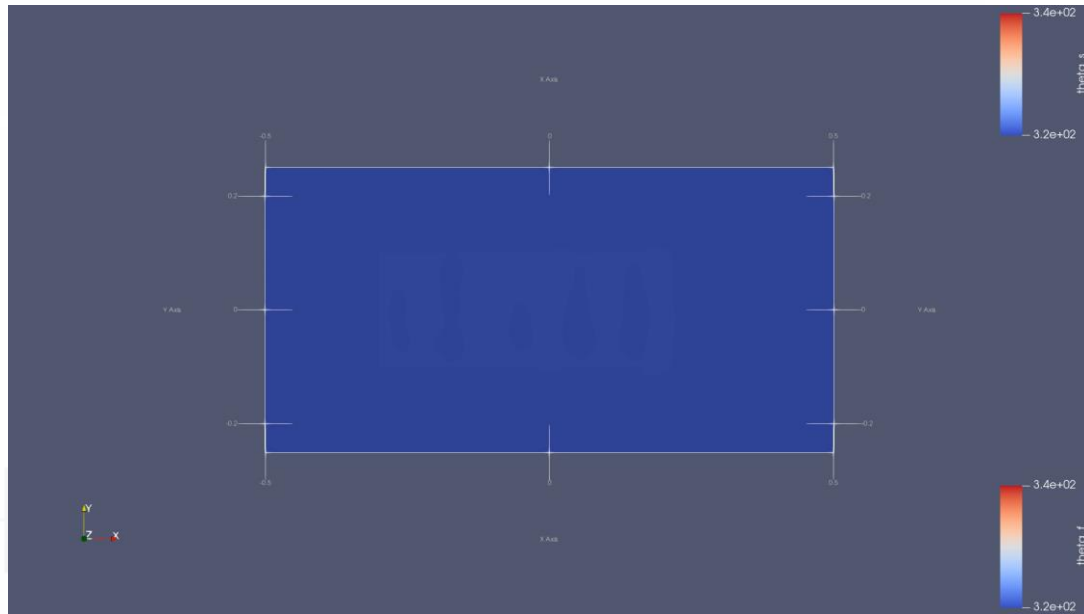
- Main Dashboard
- Autoclave db - Weekly
- Autoclave KPI - Weekly
- Impianto Presse - Weekly
- OpcUaValues - Weekly
- OpcUaValues and Historian

<http://dashboard/dashboardSmartCity/view/index.php?iddashboard=MTk=>



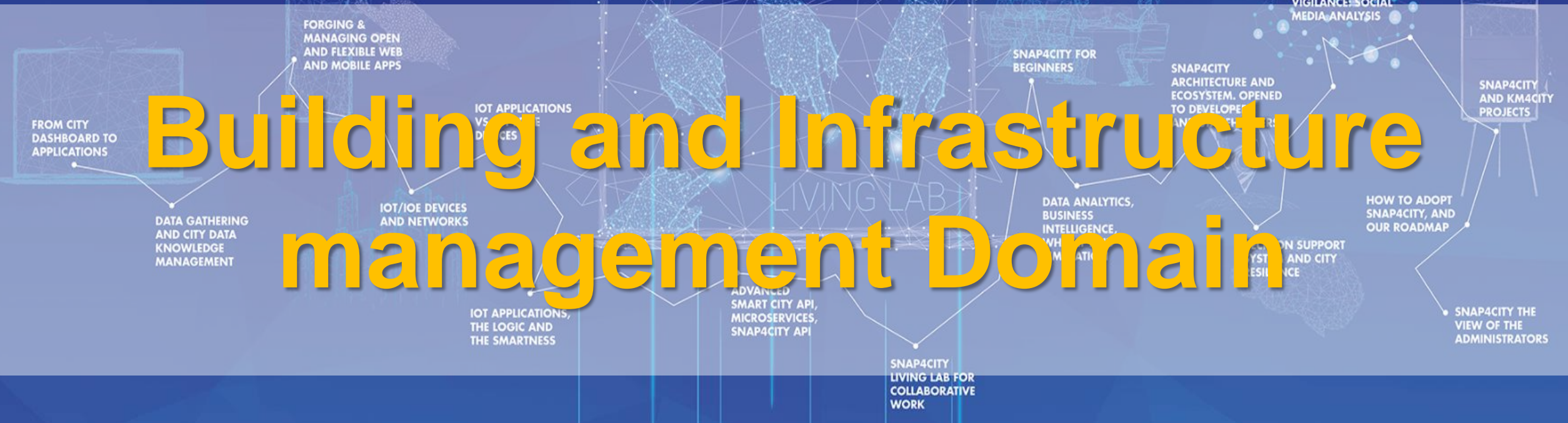
# Physics-informed neural networks (PINN)

Solve complex fluid-dynamic problems based on **partial differential equation (PDE)** using neural networks



TOP

# Building and Infrastructure management Domain



# Smart Building

FROM CITY DASHBOARD TO APPLICATIONS





# Snap4Building Domain (2024)

- **Goals:**
  - Efficiency, costs
  - Accessibility to services
  - Security/Safety
- **Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)**
  - Monitoring usage, energy consumption, environmental conditions, people flows, services, etc.
  - Early detection/warning, alarm, of critical conditions
  - Production of suggestions, nudging
  - Managing smart services: cabinets, dispenser, lockers, etc.
  - Global and local 3D/2D representations of area and buildings
  - Integration with Video Management Systems
  - Computing predictions of any kind
- **Solutions for Planning (optimization and what-if analysis)**
  - Reduction of energy costs, via optimization
- **Algorithms and computational solutions, see next slide**

# Tools: Smart Buildings, Snap4Building (2024)

- **Digital Twin for monitor, control and manage distributed infrastructures**
  - 2D/3D representations of the whole set of buildings, BIM modeling
  - Entities (building, floors, rooms, parking, charging stations, gates, etc.) with their shapes and descriptors, and data monitoring the allocation to office, meeting, cafeteria, storage, stairs, elevator, etc.
- **Monitoring and computing KPI on real time for**
  - **energy** consumed or produced (hot/cold), **parking, logistic, presences, cleaning, air quality, departments, subareas, maintenance, etc.**
  - **allocation/designation**, dispositions, heating, cooling, temperature, equipment, etc.
  - **grouped in Zones**

Ciao roottooladmin!

Tue 3 May 14:37:14

## DIDA DATA 2 - NEWGUI

**7** AFFORDABLE AND  
CLEAN ENERGY

**11** SUSTAINABLE CITIES  
AND COMMUNITIES

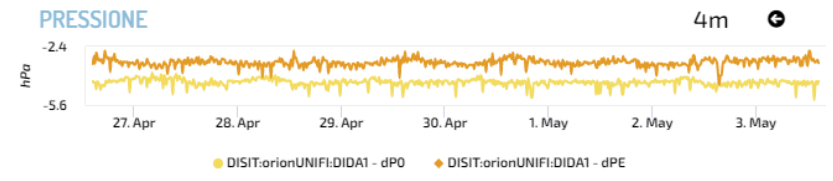
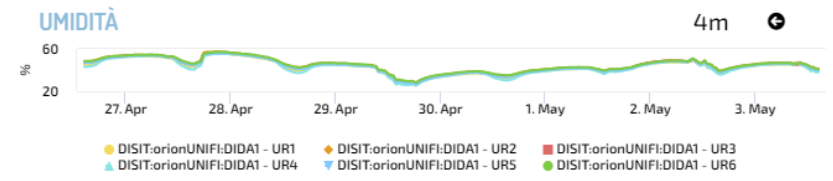
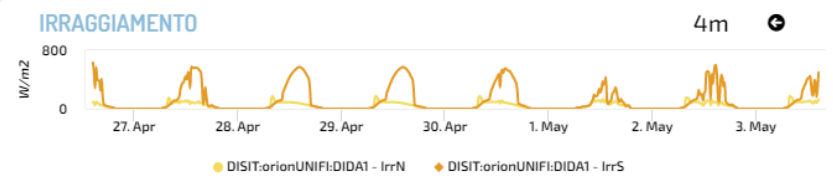
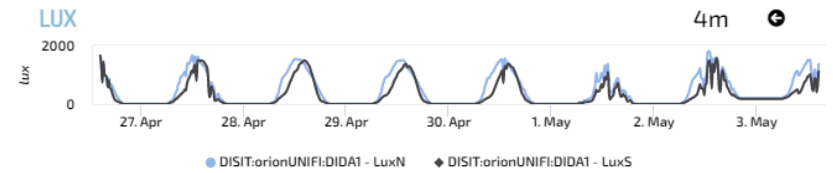
to see BIM log as user: info@disit.org, passwd: guest

### BIM SANTA VERDIANA



Last Value

Time Trend Chart: Glob - Day



<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MzI4OA==>

# Snap4ISPRA POC

- **Set up a Snap4Ispra demonstration to:**
  - Enable the analysis at level of building, floors/zones for Zones' Occupancy vs Energy consumption
  - Enable the analysis of parking areas
  - Conformance with EU Login
  - Exploiting heterogenous data coming from multiple sources

# Ispra Site, Buildings And Services

Mon 23 Oct 12:42:28

Building / Floor / Parking:  
**Building**

All / Single Building:  
**All**

Variable:  
**occupancy**

Popup on Shape Click

[Add To Map](#)

**ISPRA Site**

- Date Observed: 10/23/2023, 12:30:01 PM
- Capacity: 2936 #
- Allocation: 1995 #
- Occupancy: 883 #
  - DAC: -941 #
  - DOA: -1112 #
  - DOC: -2053 #
  - PAC: 67.95 %
  - POA: 44.26 %
  - POC: 30.07 %
- Energy Hot: 4473978 kWh
- Energy Cold: 916361 kWh
- Power Hot: 36 kW
- Power Cold: 0 kW
- Outdoor Temperature: 14.07 °C
- Total Number of Buildings: 76 of 304 #
- Total Number of Floors: 104 #
- Total Number of Zones: 139 #
- Total Number of Parking Areas: 4 #

[See Trends](#)

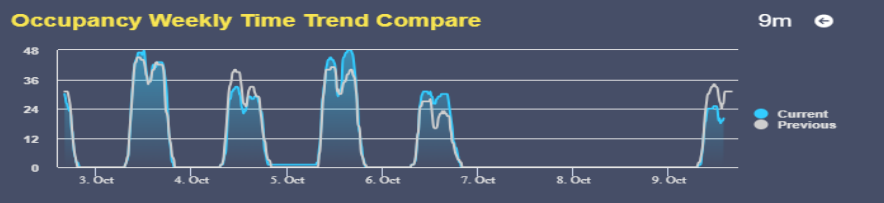
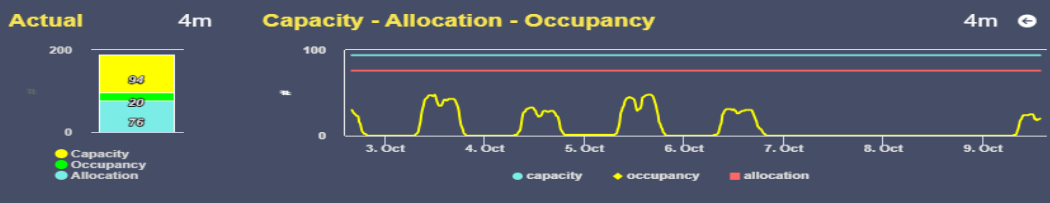
[Parking Overview](#)

**Ispra - Occupancy 8m**

883

**Ispra - Occupancy** 8m

person My Profile

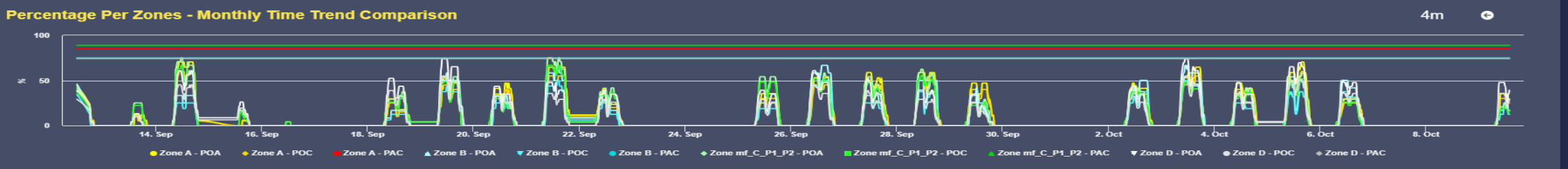
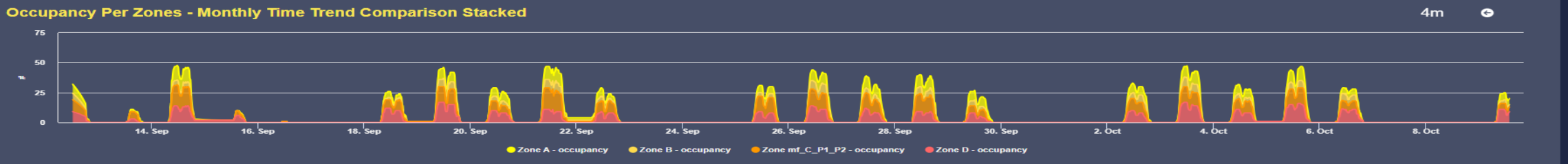
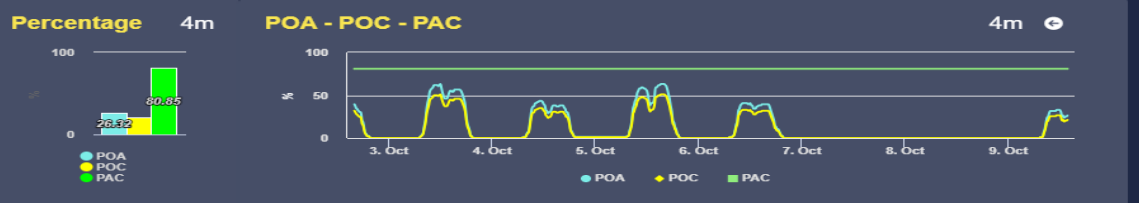
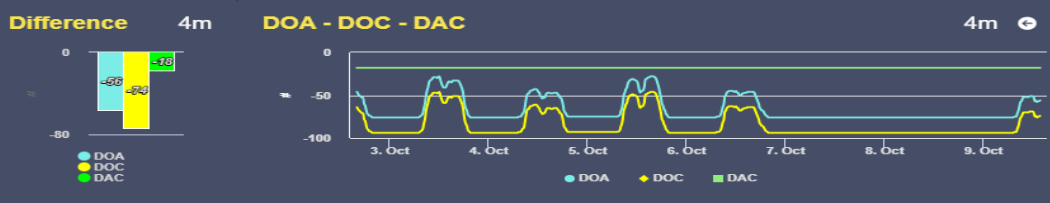


### Office Mq 9m

803.9 m<sup>2</sup>

### Temp. 9m

20.6 °C



### Heat Power 9m

0 kW

### Heat Energy 9m

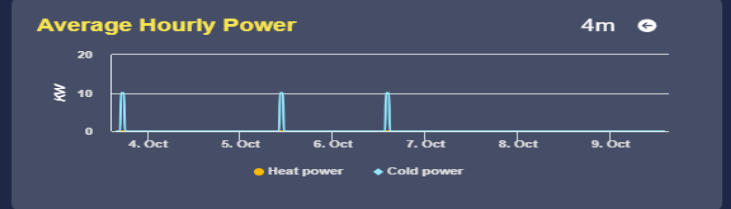
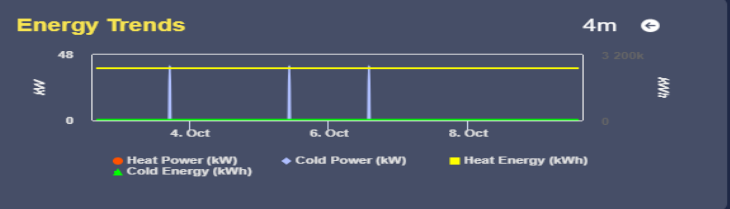
1931279 kWh

### Cold Power 9m

0 kW

### Cold Energy 9m

888311 kWh



### En./Mq 9m

0 kWh

### En./Pax 9m

0 kWh

# Floor Details

### Ispra Floor, Zone And Room Details

Fri 6 Oct 18:41:54

**Allocation Number**

- >50
- 25-50
- 13-25
- 5-13
- 0-5

#### Floor PT of Building 58A

- Date Observed: 10/6/2023, 6:30:02 PM
- Capacity: 37
- Allocation: 31
- Occupancy: 1
  - DAC: -6 #
  - DOA: -30 #
  - DOC: -36 #
  - PAC: 83.78 %
  - POA: 3.23 %
  - POC: 2.7 %

[See Trends](#)

Select a Zone metric: Allocation

#### Room 017

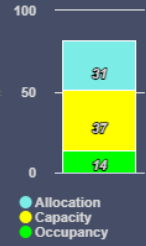
- Date Observed: 10/6/2023, 12:01:00 PM
- Zone Id: 58A\_PT\_B
- Capacity: 1
- Allocation: 0
- mq: 12.16
- Average hourly temp. Xi: 24.07°C
- Average hourly temp. Xs: 20.92°C
- Average hourly temp. Xt: 6.00°C
- Heat Start temp.: 17.92°C
- Cold Start temp.: 23.92°C

[See Trends](#)

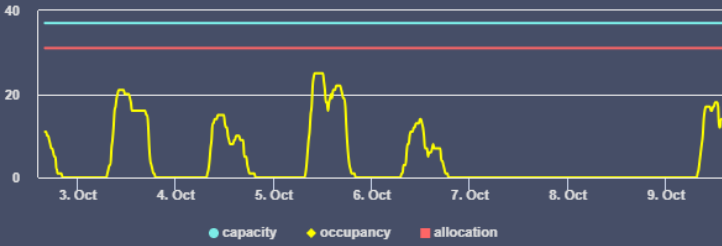
# Building 58A PT Trends

Mon 9 Oct 13:51:30

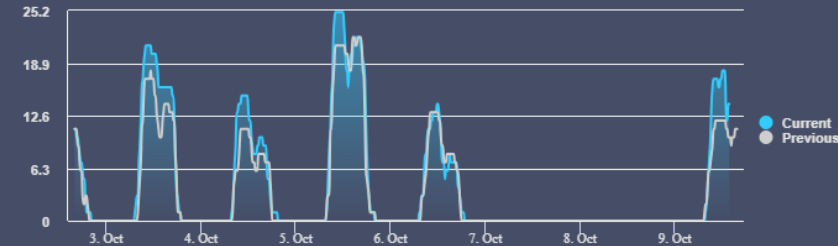
## Actual 4m



## Capacity - Allocation - Occupancy 4m



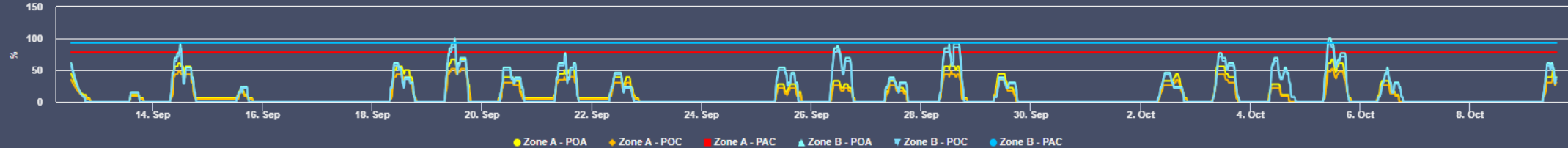
## Organization: Orion-1: Floor2\_58A\_PT - Occupancy 9m



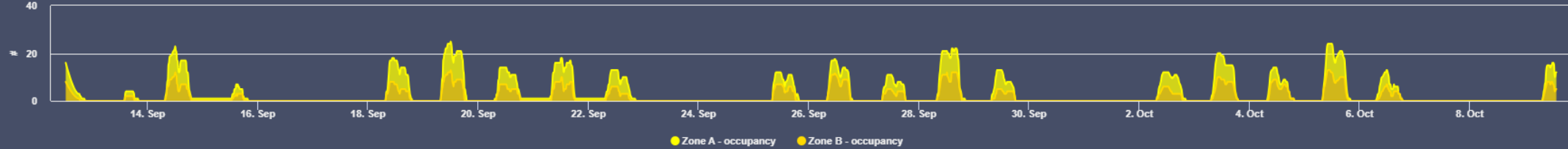
## Temp. 9m

21.7 °C

## Percentage Per Zones - Monthly Time Trend Comparison 4m



## Occupancy Per Zones - Monthly Time Trend Comparison Stacked 4m



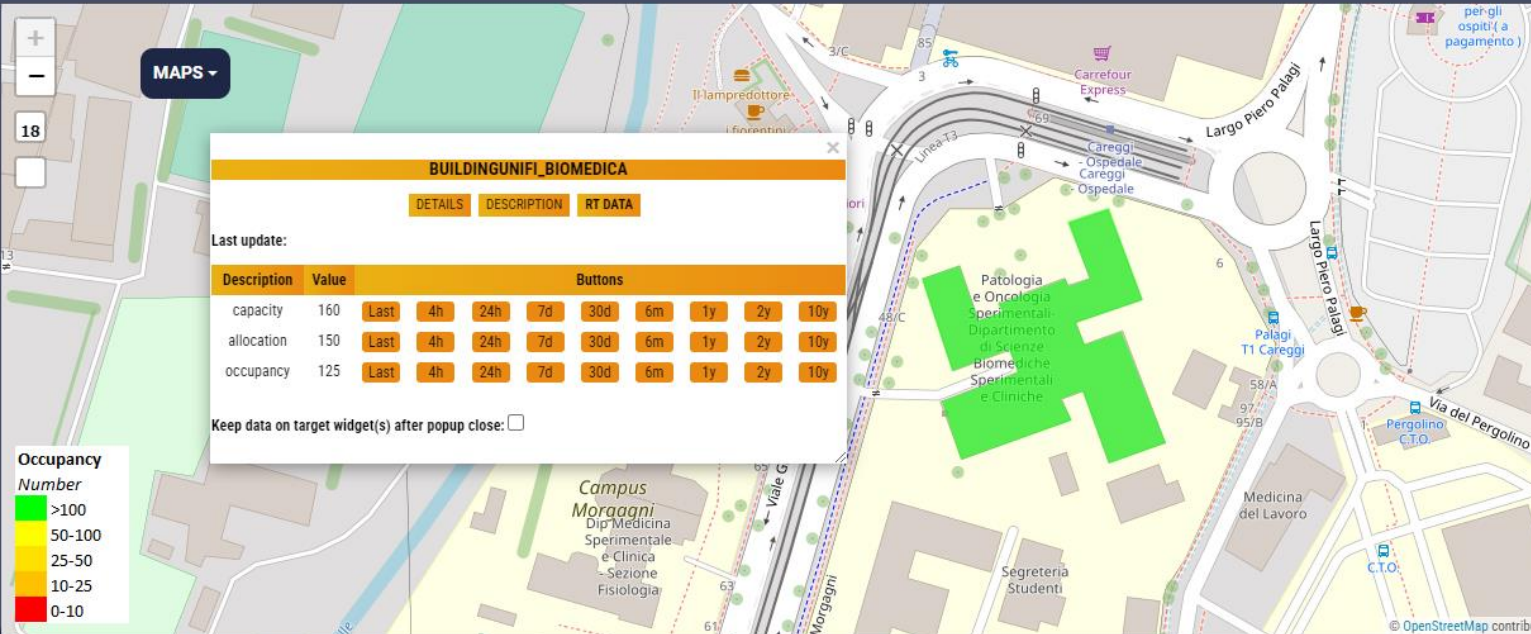


## Smart Building

Building ID:  
UniFI Biomedica

Variable:  
occupancy

Popup on Shape Click



BuildingUniFI Biomedica



- Date Observed: 1/11/2023, 10:11:01
- Capacity: 160 #
- Allocation: 150 #
- Occupancy: 125 #
  - DAC: 100 #
  - DOA: 90 #
  - DOC: 80 #
  - PAC: 80 %
  - POA: %
  - POC: 60 %
- Energy Hot: 160 kWh
- Energy Cold: 140 kWh
- Power Hot: 24 kW
- Power Cold: kW
- Outdoor Temperature: 19 °C

See Trends

Energy Production 1m

17.8  
kW

Energy Production Weekly Trend



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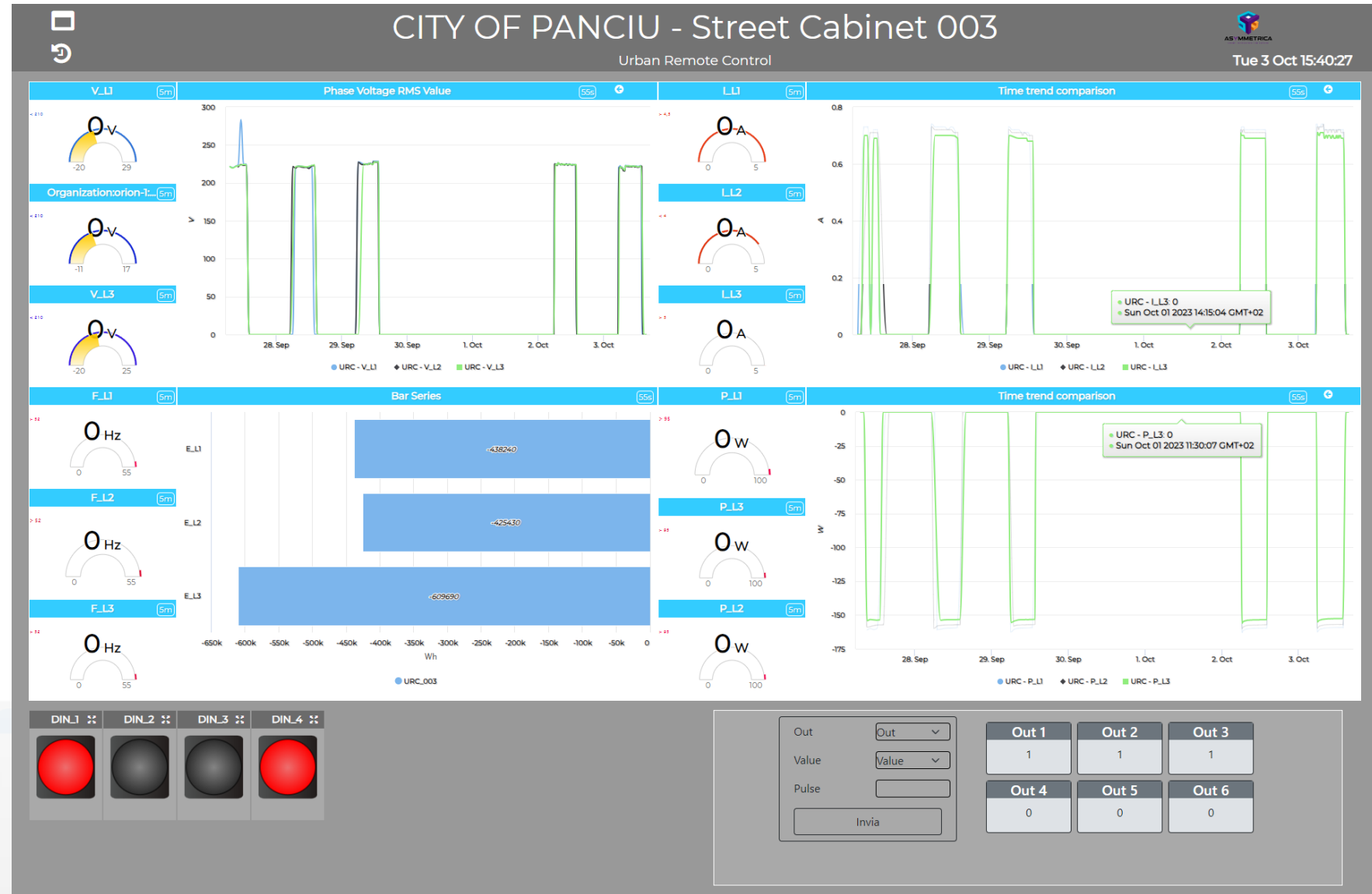
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DISTRIBUTED DATA INTELLIGENCE  
AND TECHNOLOGIES LAB

**SNAP4CITY**



# City of Panciu in Romania

By  
**Asymmetrica**  
and Snap4



TOP

# References



# 2023 booklets



- Smart City



[https://www.snap4city.org/download/video/DPL\\_SNAP4CITY.pdf](https://www.snap4city.org/download/video/DPL_SNAP4CITY.pdf)

- Industry

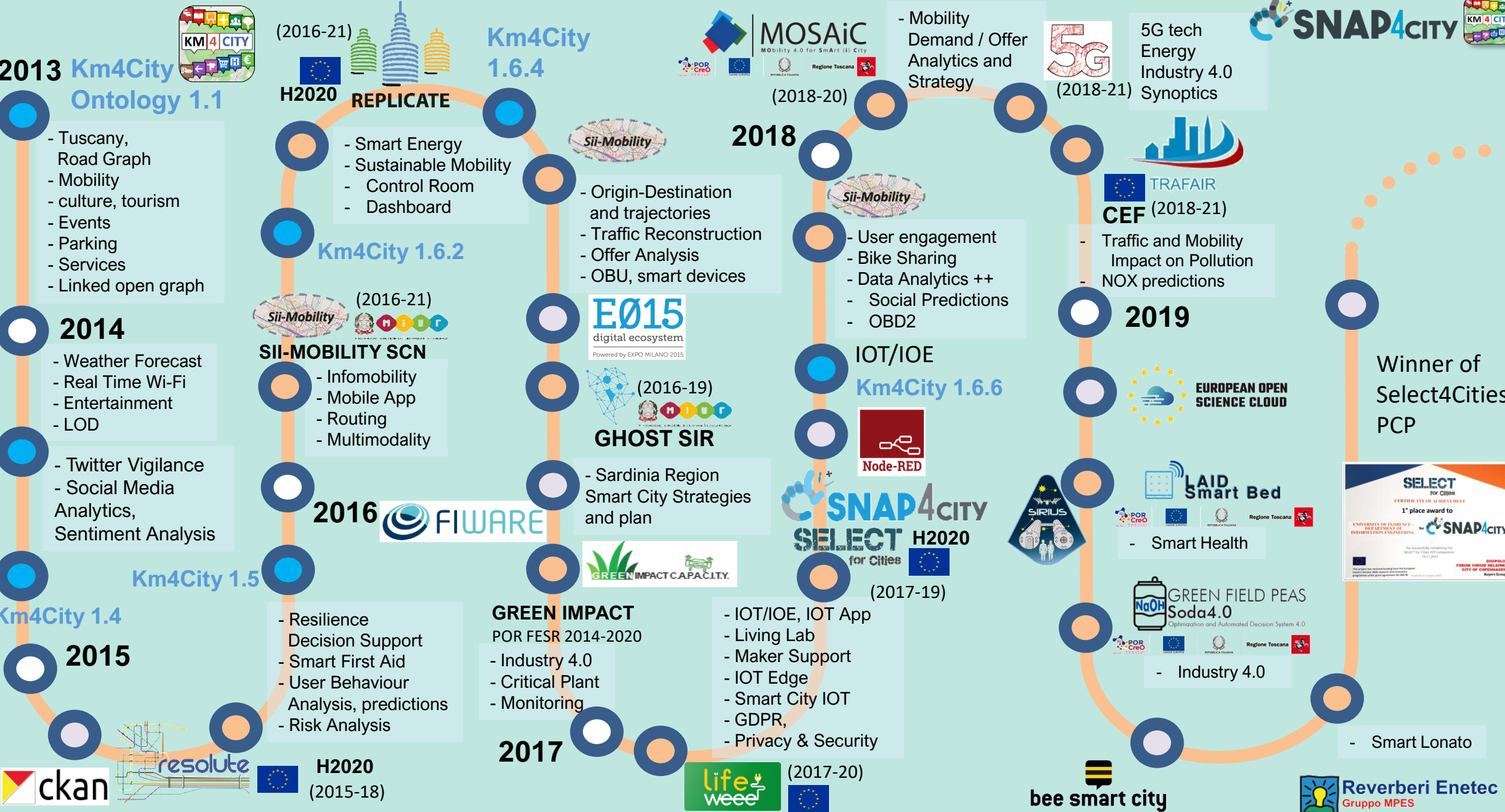


[https://www.snap4city.org/download/video/DPL\\_SNAP4INDUSTRY.pdf](https://www.snap4city.org/download/video/DPL_SNAP4INDUSTRY.pdf)

- Artificial Intelligence



[https://www.snap4city.org/download/video/DPL\\_SNAP4SOLU.pdf](https://www.snap4city.org/download/video/DPL_SNAP4SOLU.pdf)



## 2013 Km4City Ontology 1.1

- Tuscany, Road Graph
- Mobility
- culture, tourism
- Events
- Parking
- Services
- Linked open graph

## 2014

- Weather Forecast
- Real Time Wi-Fi
- Entertainment
- LOD

- Twitter Vigilance
- Social Media Analytics, Sentiment Analysis

## Km4City 1.4

## 2015

- Resilience Decision Support
- Smart First Aid
- User Behaviour Analysis, predictions
- Risk Analysis



# DISIT lab roadmap vs model and tools' usage

## (2016-21) H2020 REPLICATE Km4City 1.6.4

- Smart Energy
- Sustainable Mobility
- Control Room
- Dashboard

## Km4City 1.6.2

- (2016-21) Sii-Mobility
- ### SII-MOBILITY SCN
- Infomobility
  - Mobile App
  - Routing
  - Multimodality

## 2016 FIWARE

- Resilience Decision Support
- Smart First Aid
- User Behaviour Analysis, predictions
- Risk Analysis

## GREEN IMPACT POR FESR 2014-2020

- Industry 4.0
- Critical Plant
- Monitoring

## 2017

- Smart Waste

## MOSAiC Mobility 4.0 for Smart (II) City (2018-20)

- Origin-Destination and trajectories
- Traffic Reconstruction
- Offer Analysis
- OBU, smart devices

## E015 digital ecosystem (2016-19)

- ### GHOST SIR
- Sardinia Region Smart City Strategies and plan

## SNAP4CITY SELECT for Cities H2020 (2017-19)

- IOT/IOE, IOT App
- Living Lab
- Maker Support
- IOT Edge
- Smart City IOT
- GDPR, Privacy & Security

- Smart Waste

## 5G tech Energy Industry 4.0 Synoptics (2018-21)

- Traffic and Mobility Impact on Pollution
- NOX predictions

## 2019



- Smart Health

- Industry 4.0

- Smart Lonato



Winner of Select4Cities PCP





**2020**



- Smart Tourism
- 6 Pilots
- Data Analytics
- Extended platform



- Smart Mobility
- PISA, PUMS
- Living lab



**Km4City 1.6.7**

Smart Ambulance (2021-22)

Enterprise (2021-22)  
Industry 4.0



**2021**

PC4City (2020-21)  
Monitoring Terrain

Winner of Open Data Challenge of  
**enel x**

**CAPĒLON**

- Smart Light
- Sweden

Almafluida Industry 4.0 (2021-22)

AMPERE (2021-22)  
Industry 4.0

SYN-RG-AI  
SmartCity



Industry 4.0

**uni.systems**

SmartCity, 2021-23



AXIS collab  
SmartCity

**2022**



Asymmetrica  
Smart City, 2022-23



Italferr, Smart City

**2023**



Contract, 2022-23



2022-2023



Security and Risk



Contract, 2022-23



CN MOST, 2022-26



EI THE, 2022-26



G. Agile, 2021-23



2023-26 Finanziato dall'Unione europea NextGenerationEU

Merano, smart light

OceanRace, Genova, AWS

Cuneo, smart city

**2024**



TOURISMO

ELLIE IA 2024-2027



CAI4DSA



Rhodes, smart city

eShare UNIFI TUSS

AMMIRARE

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*Be smart in a SNAP!*



**SMARTCITY**

EXPO WORLD CONGRESS

7-9 November 2023, Barcelona, Spain

Visit Snap4City in Hall 1

## CONTACT

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Università degli Studi di Firenze - School of Engineering

Via S. Marta, 3 - 50139 Firenze, ITALY  
<https://www.disit.org>

[www.snap4city.org](http://www.snap4city.org)

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**Installations**

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