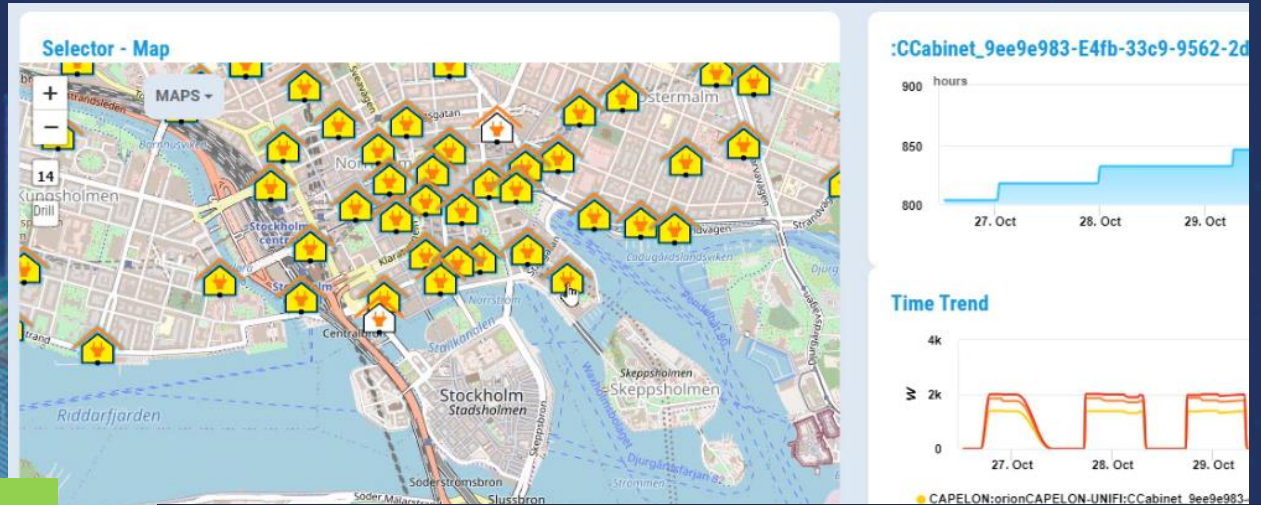
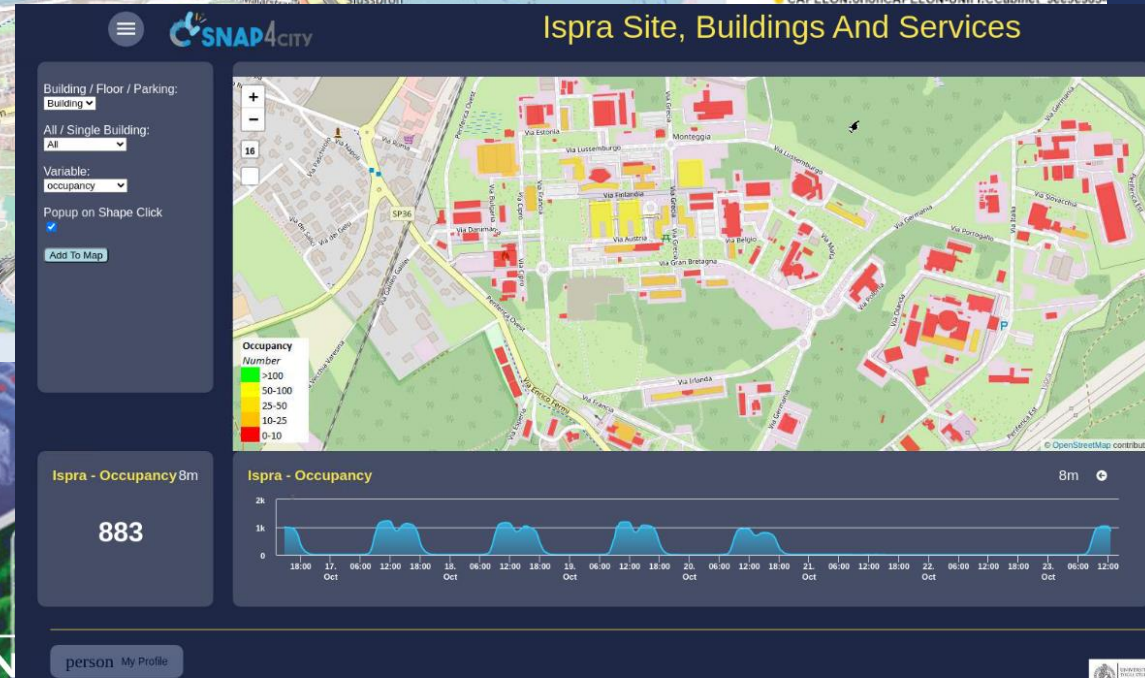




www.snap4city.org
www.snap4solutions.org



Smart Energy and Smart Buildings Operation and Plan Digital Twin



UNIVERSITÀ DEGLI STUDI FIRENZE

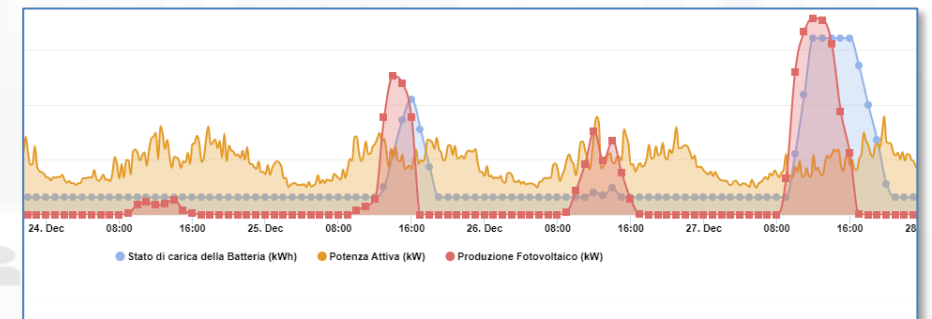
DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB



City Energy and Buildings

- **Goals:**
 - Energy consumption reduction, increment of efficiency,
 - Areas and building sustainability
 - Improve accessibility to services, security and safety
- **Energy Monitoring:** Building, floors, rooms, recharging poles, cabinets, Community of Energy, Data centers, Energy for Hot / cold, air condition, energy vs temperature and usage, etc.
- **Energy Management:** Predictions, early warning, identification of critical conditions
- **Smart Light Management:** LED/mixt, cabinets, lights vs traffic, lights vs security, energy saving, luminaries profiling, group management.
- **Smart Building Management:** consumption, number of people, etc.
 - Communities of Energy, Photovoltaic plants, sustainability
 - What-if analysis, optimisation tools
- **KPI: Energy consumption, efficiency, pros/cons**
 - Light profiling and adaptation
 - Autoclave industrial plants simulation, Photovoltaic plant simulation
 - consumption / usage, energy vs temperature
- **Mobile App:** monitoring, info-recharge, eSharing, booking, ..
- **Participatory:** problem reporting, ticketing, etc.
- **Integration of any kind**



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);
- **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

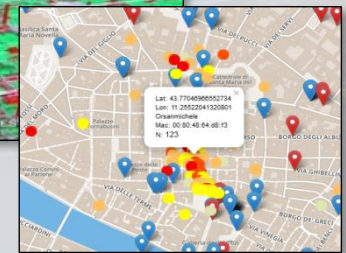
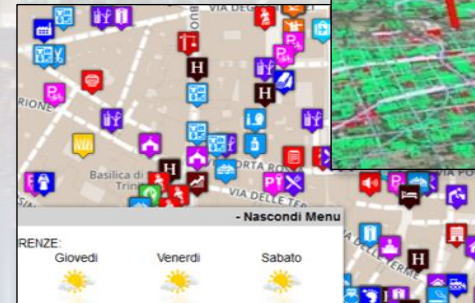
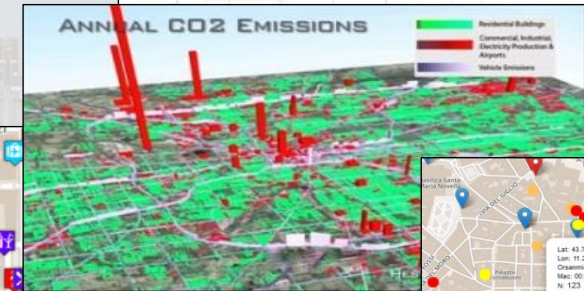
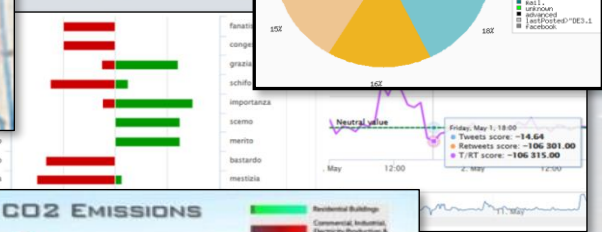
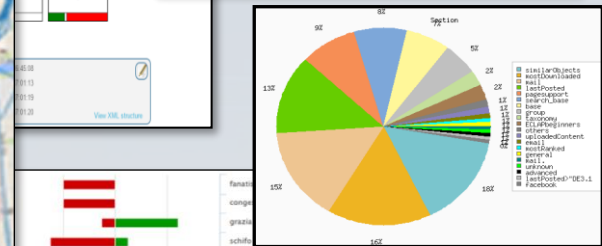
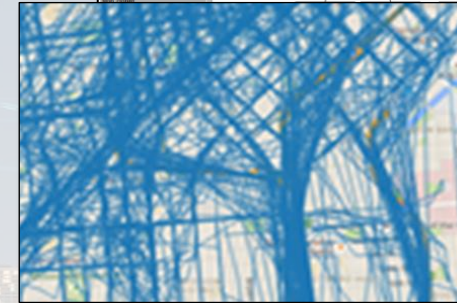
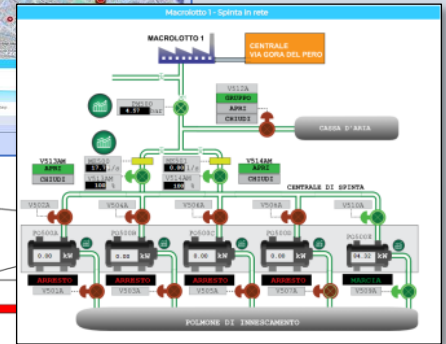
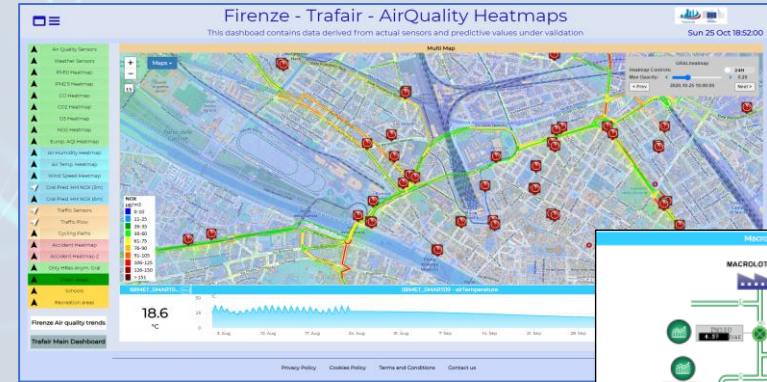
Periodic
&
Realtime

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

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





Digital Twin Solutions for Sustainability

OPERATION AND PLAN - CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS - OPTIMIZATION - APPLICATIONS

CONTROL AND PLAN

MOBILITY AND TRANSPORT

SMART ENERGY AND SMART BUILDING

ENVIRONMENT AND WASTE MANAGEMENT

CITY USER'S SERVICES AND TOURISM MANAGEMENT

- DEVELOPMENT ENVIRONMENT AND METHODOLOGY
- VISUAL PROGRAMMING, ML, AI, HPC
- TRAINING COURSES
- LIVING LABS
- GUI CUSTOM STYLES
- FULL APPLICATIONS, DASHBOARDS AND VIEWS
- MOBILE APPS



VISUAL ANALYTICS - SYNOPTICS - GRAPHICAL WIDGETS - ANALYTICS - BUSINESS INTELLIGENCE - SIMULATIONS

DASHBOARDS, WIDGETS TEMPLATES

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

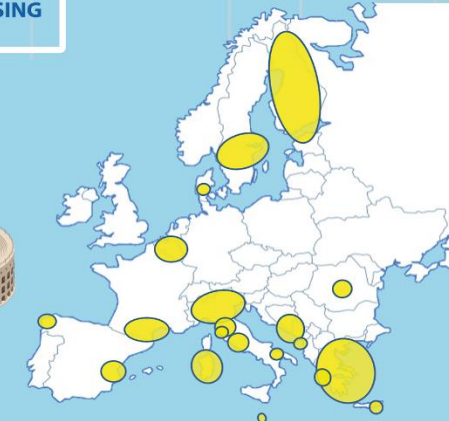
API - MICROSERVICES - GIS - BPM
VIDEO - REPORTS - MAPS - 3D ...

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

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

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

FULL INTEROPERABILITY, ANY: DATA, BROKERS, NETWORKS AND VERTICALS



Powered by **FIWARE**

FREE TRIAL

PEN Test Passed

EU GDPR COMPLIANT

SNAP4 Appliances and Dockers Installations

EUROPEAN OPEN SCIENCE CLOUD

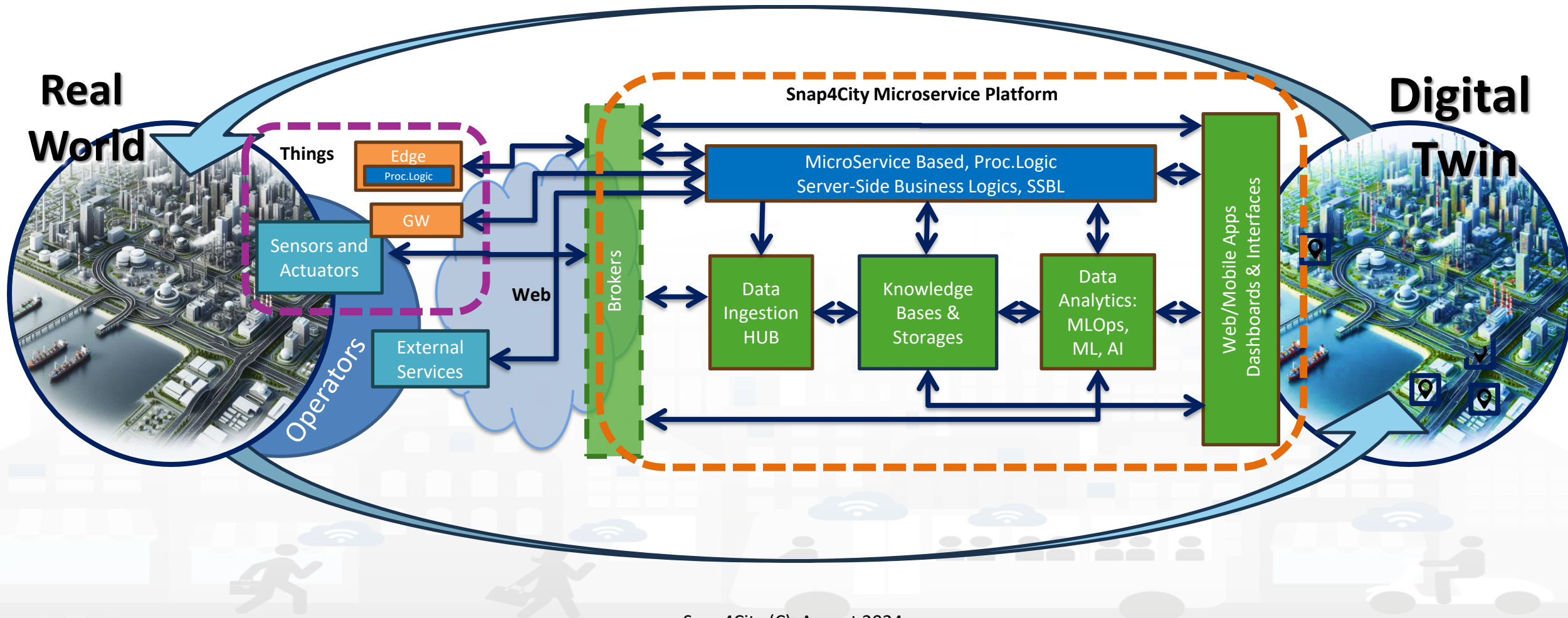
Node-RED

JS Foundation

E015 digital ecosystem

NVIDIA

Digital Twin Development Platform



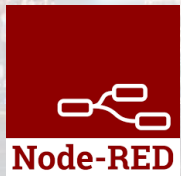
Standards and Interoperability (6/2023)



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.

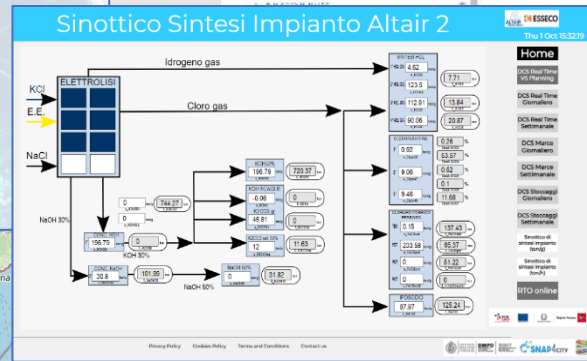
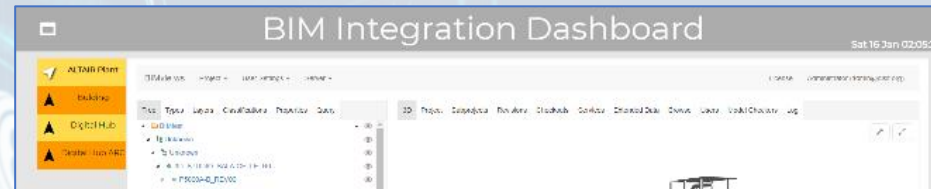
<https://www.snap4city.org/65>



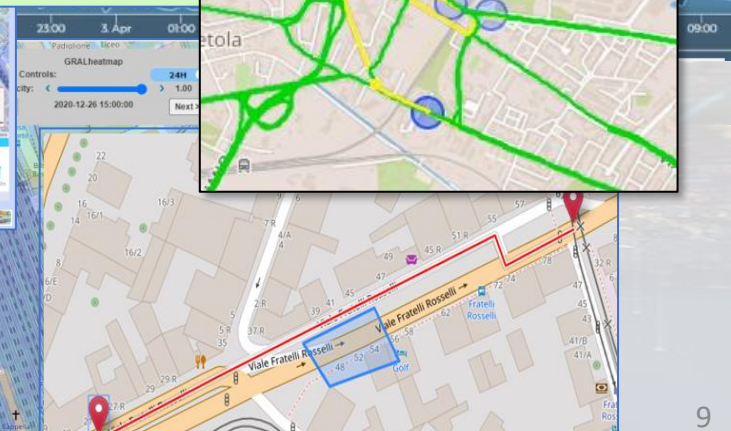
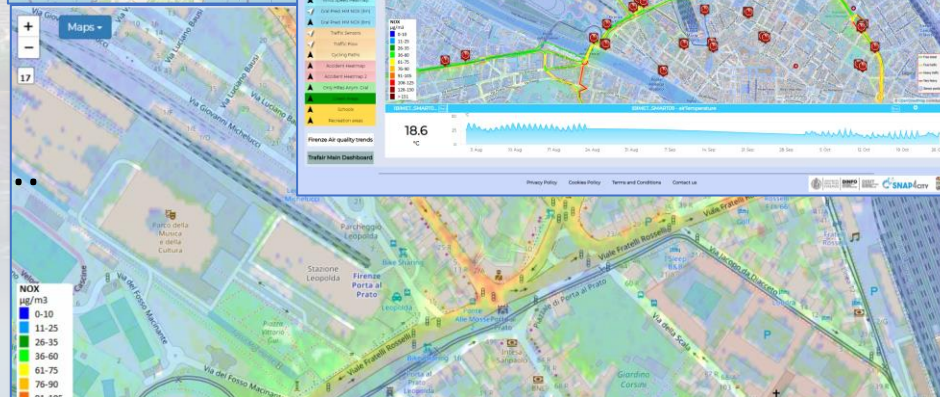
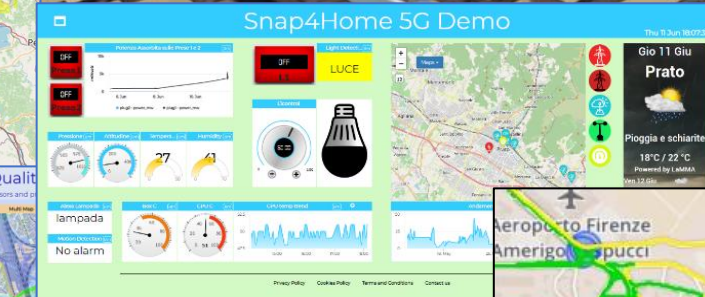
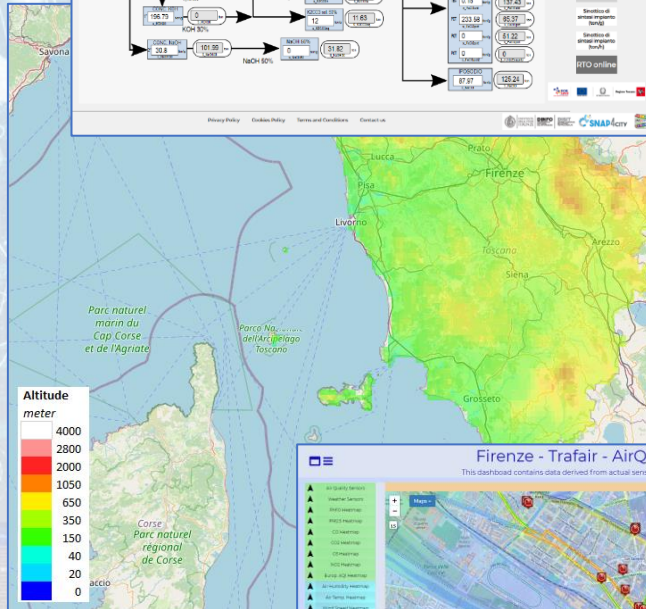
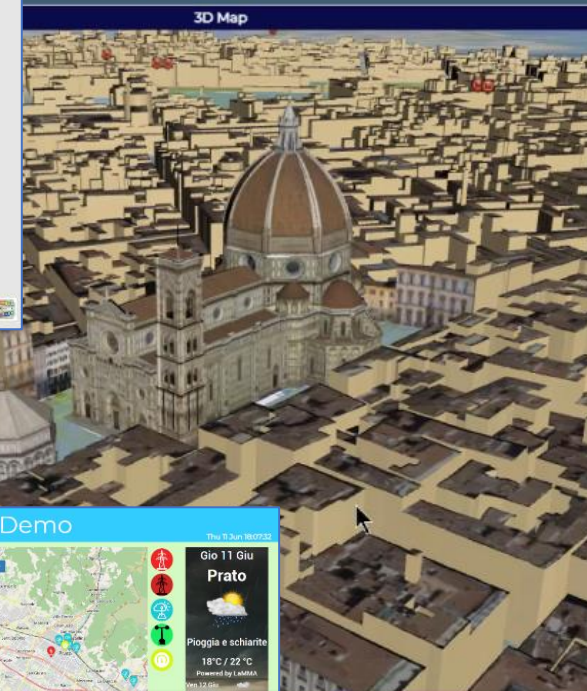
High Level Types

Snap4City (C), August 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

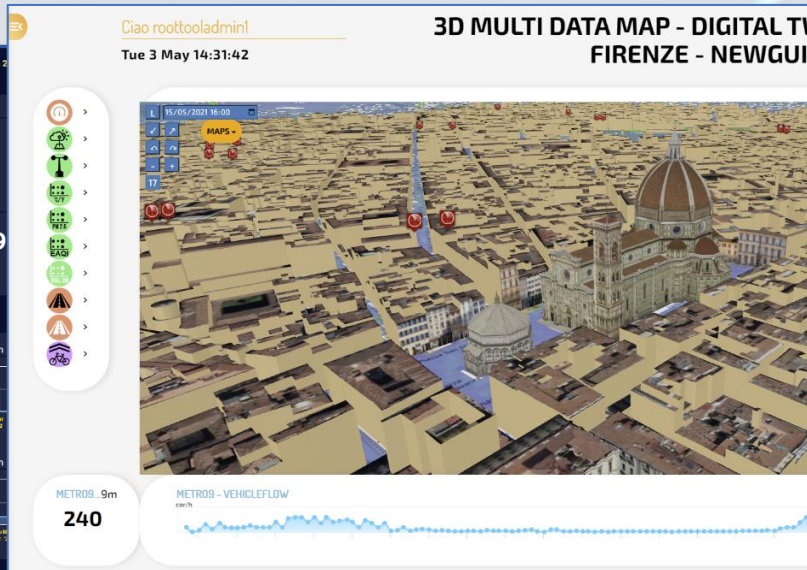
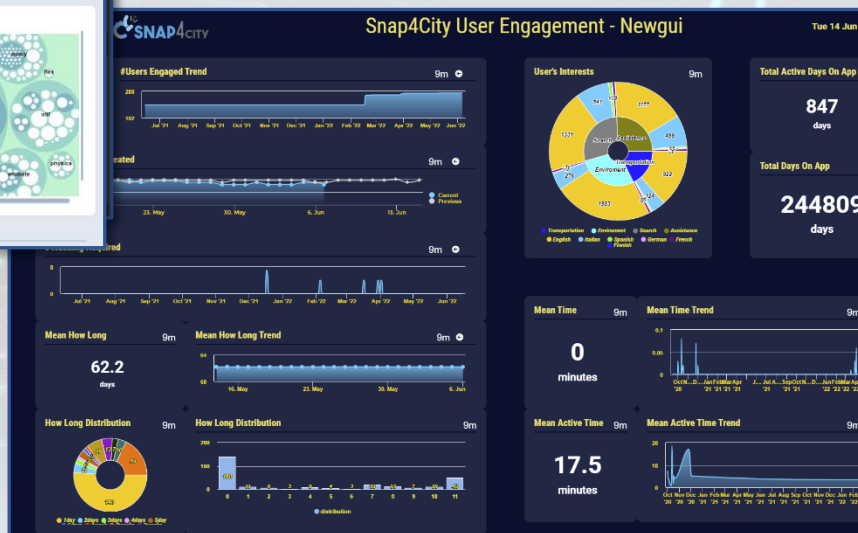
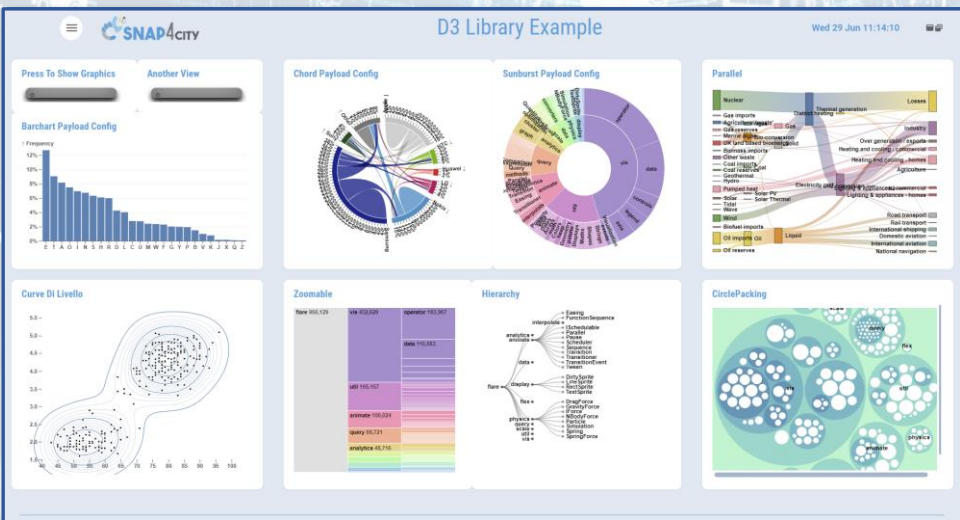
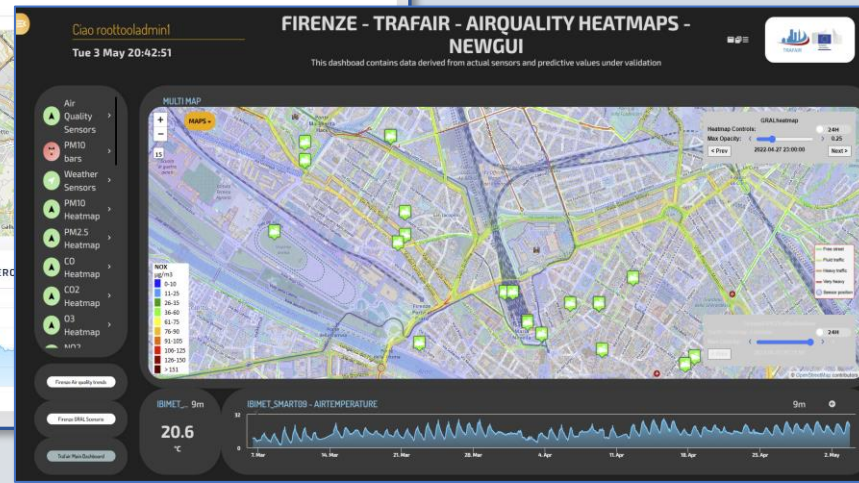
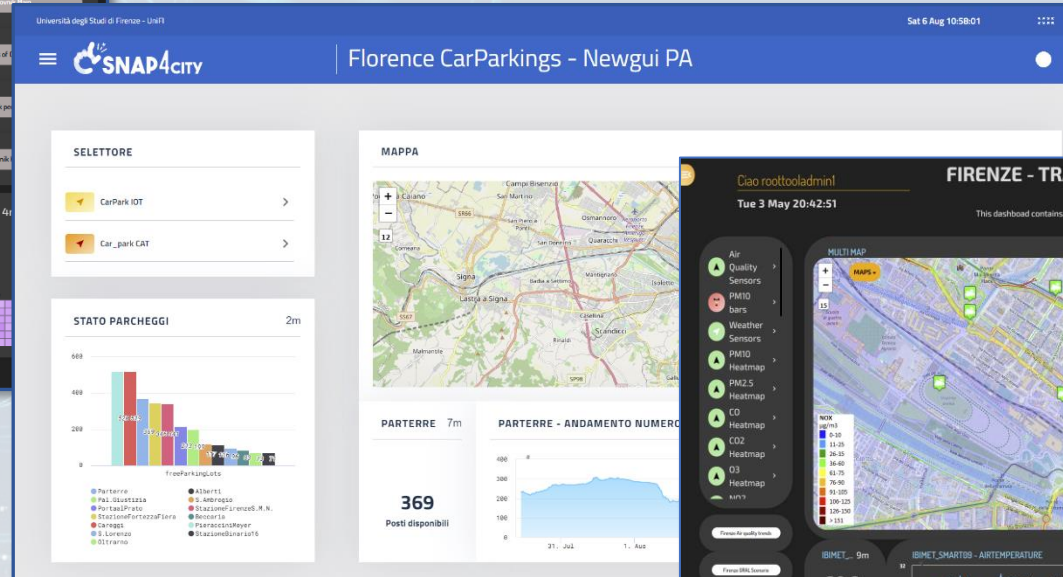
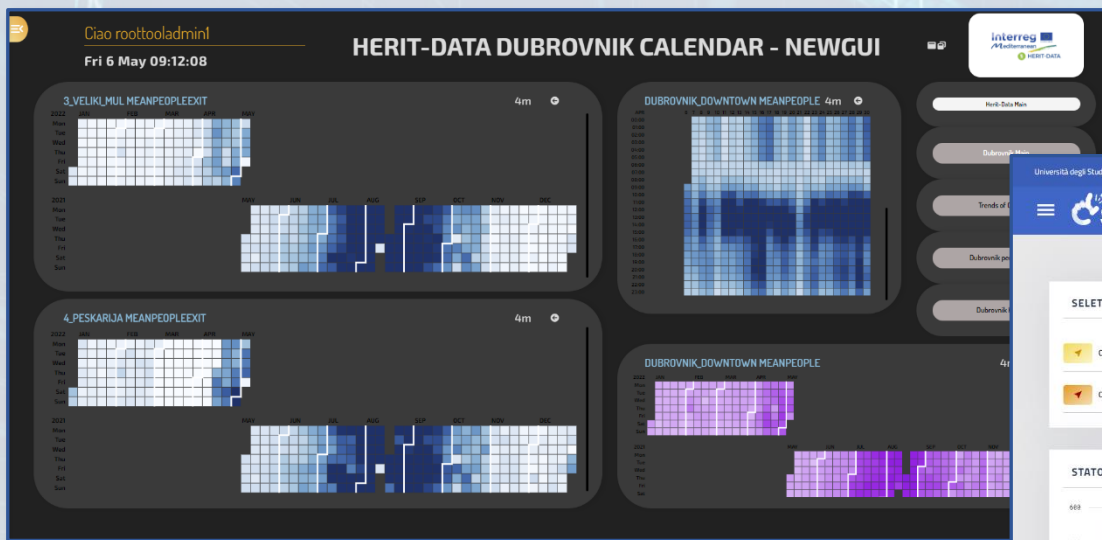


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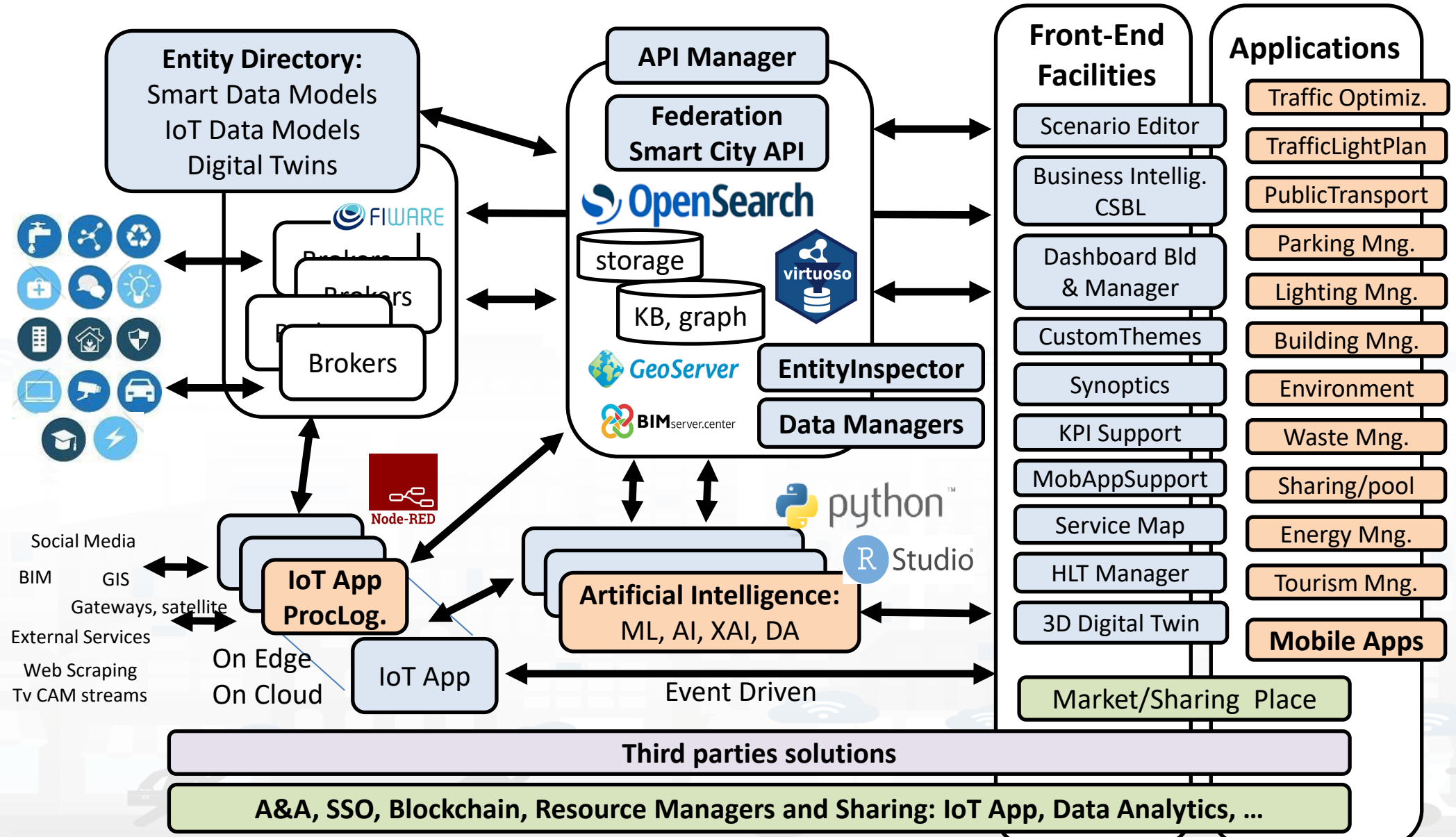
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DISTRIBUTED SYSTEMS
AND INTERNET
TECHNOLOGIES LAB

Different Themes



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

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



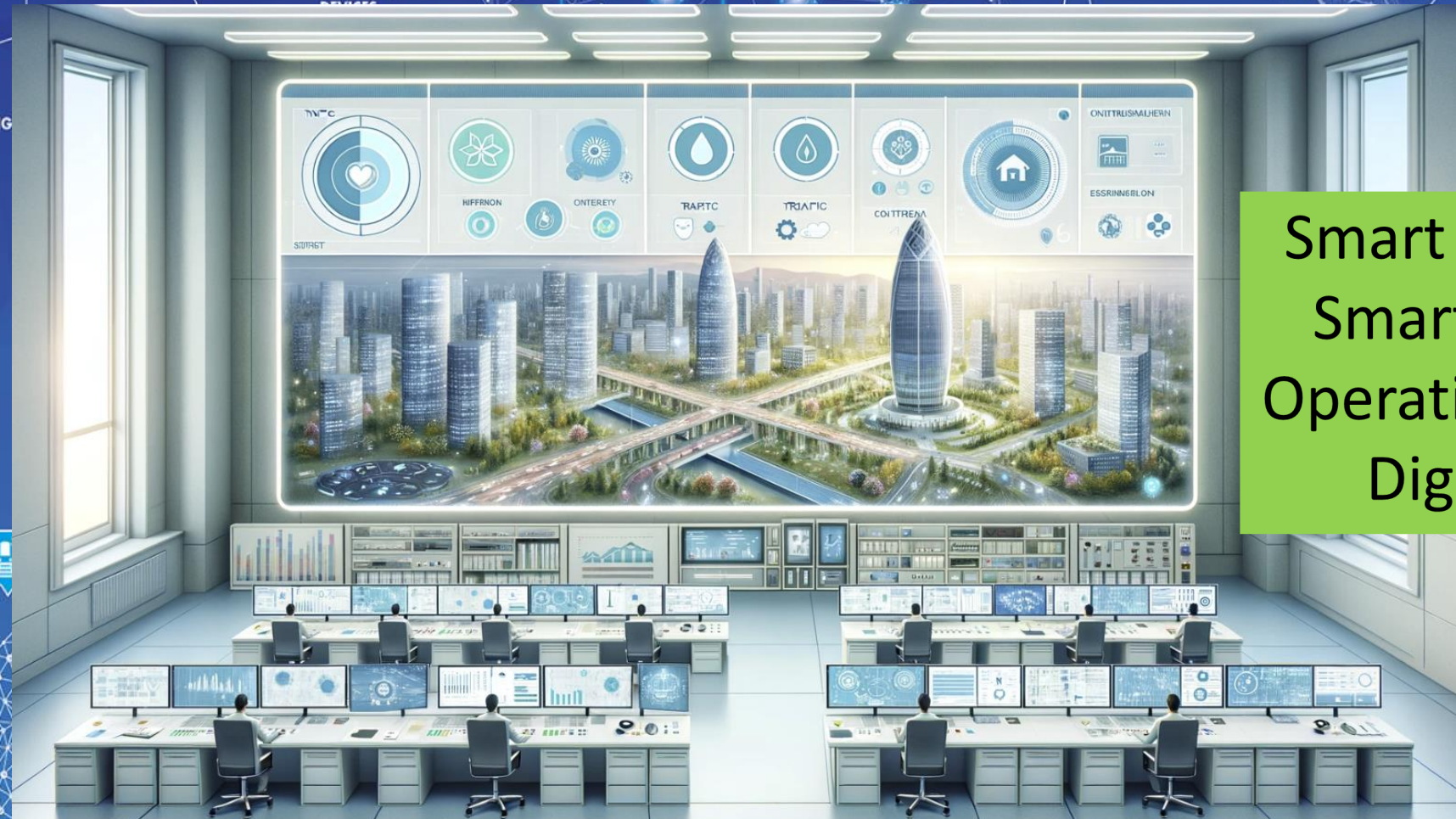
TOP

Monitoring and control

FROM CITY DASHBOARD TO APPLICATIONS

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

100% OPEN SOURCE



Smart Energy and Smart Buildings Operation and Plan Digital Twin

FORGING & MANAGING OPEN AND FLEXIBLE WITHIN A MOBILE APP

IOT APPLICATIONS VS IOT EDGE DEVICES

TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS

SNAP4CITY ARCHITECTURE AND SYSTEMS. OPEN TO DEVELOPERS AND STAKEHOLDERS

SNAP4CITY AND KM4CITY PROJECTS

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

PORT CITY



Smart Light in Merano



Merano - tutti i servizi

Wed 13 Dec 15:34:57



© OpenStreetMap contributors



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



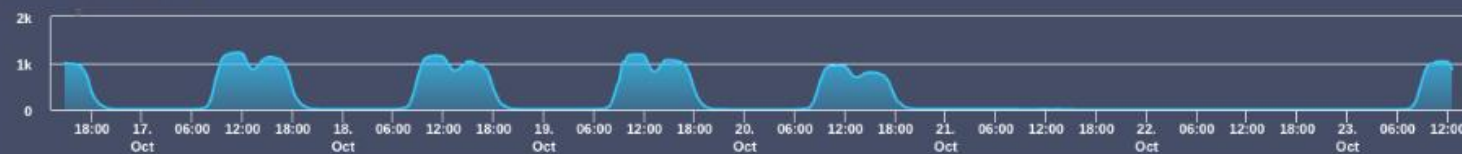
Add To Map



Ispra - Occupancy 8m

883

Ispra - Occupancy



8m

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 #

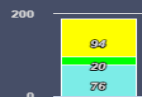
See Trends

Parking Overview

person My Profile

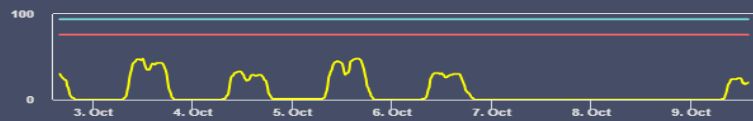


Actual 4m



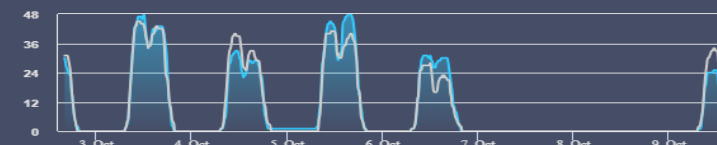
● Capacity
● Occupancy
● Allocation

Capacity - Allocation - Occupancy 4m



● capacity ● occupancy ● allocation

Occupancy Weekly Time Trend Compare 9m



● Current
● Previous

Office Mq 9m

803.9 m²

Temp. 9m

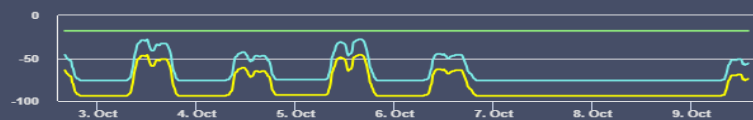
20.6 °C

Difference 4m



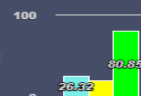
● DOA
● DOC
● DAC

DOA - DOC - DAC 4m



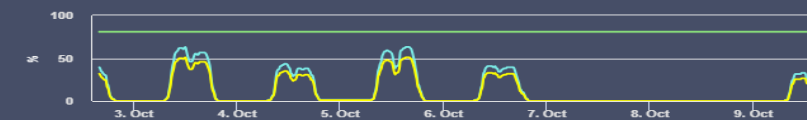
● DOA ● DOC ● DAC

Percentage 4m



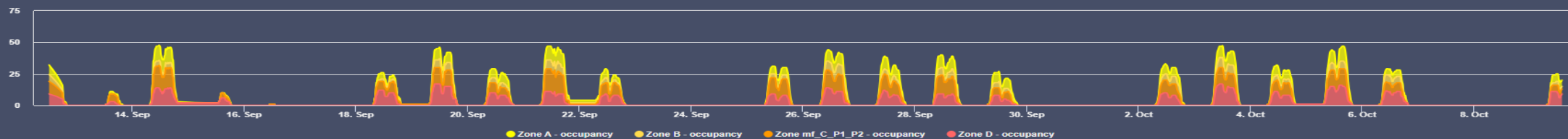
● POA
● POC
● PAC

POA - POC - PAC 4m



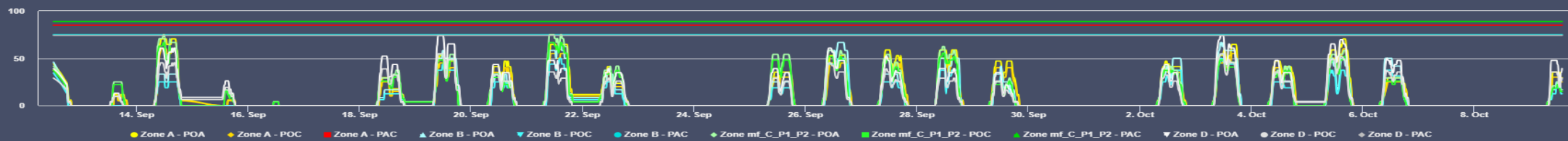
● POA ● POC ● PAC

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

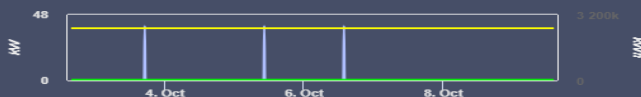
Cold Power 9m

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

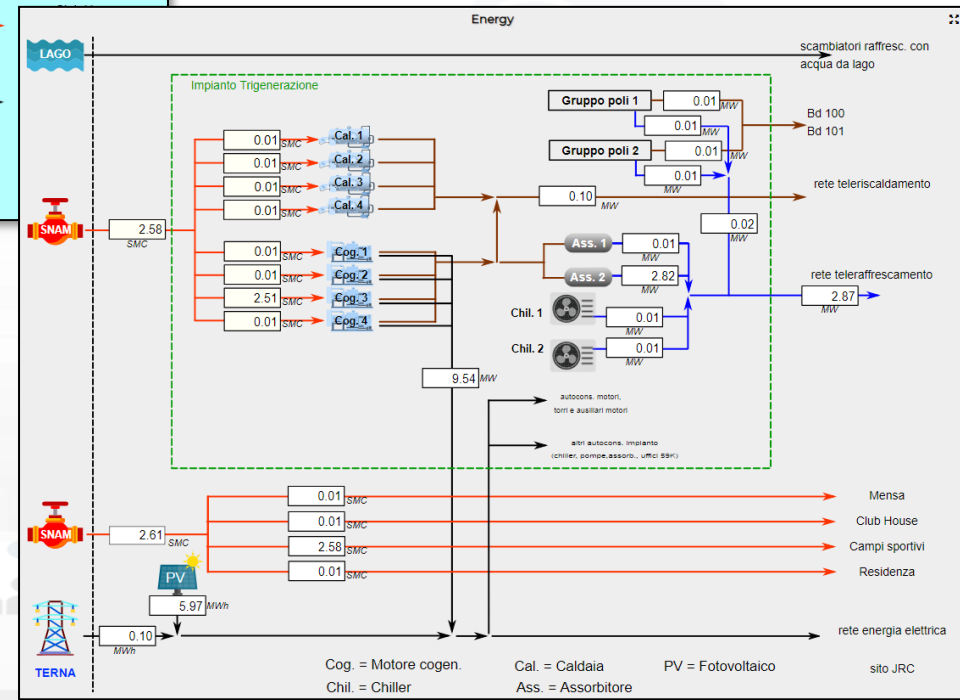
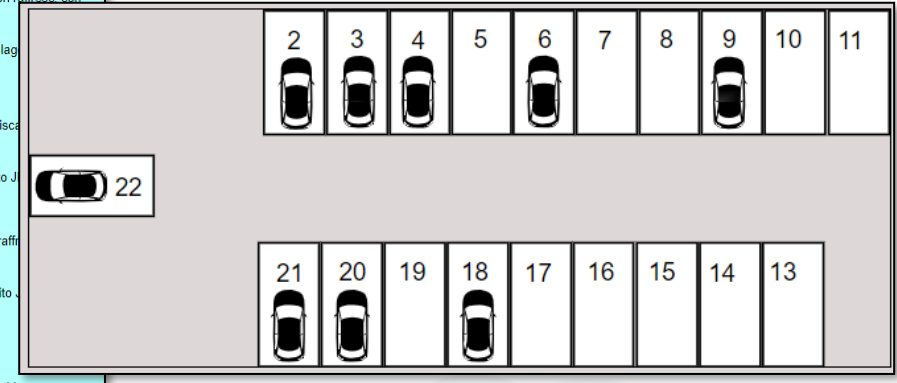
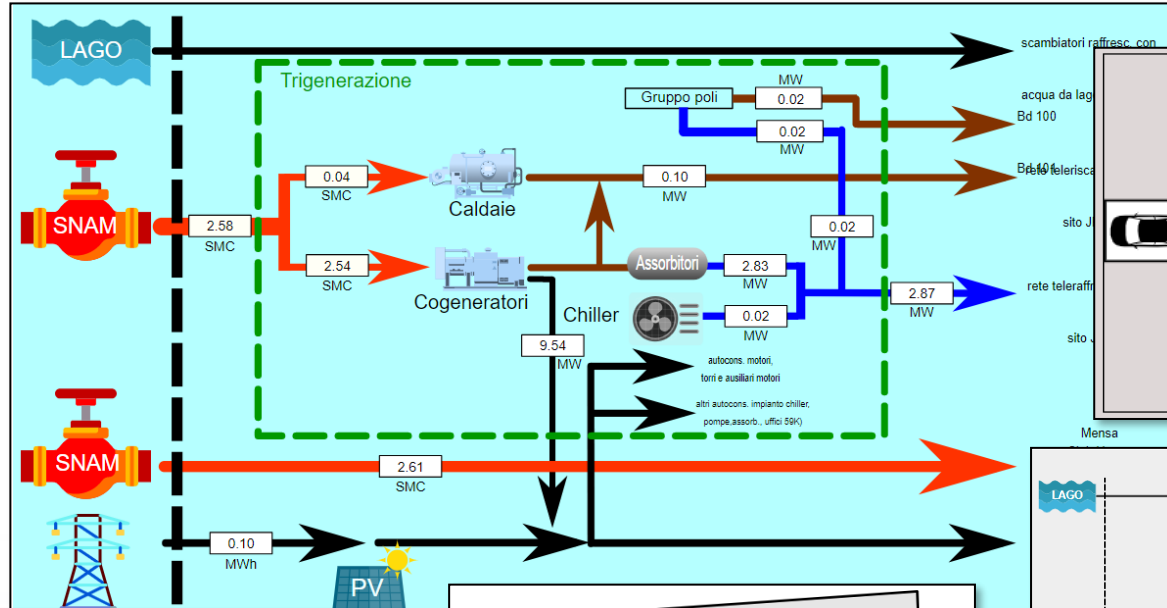
0 kWh

En./Pax 9m

0 kWh

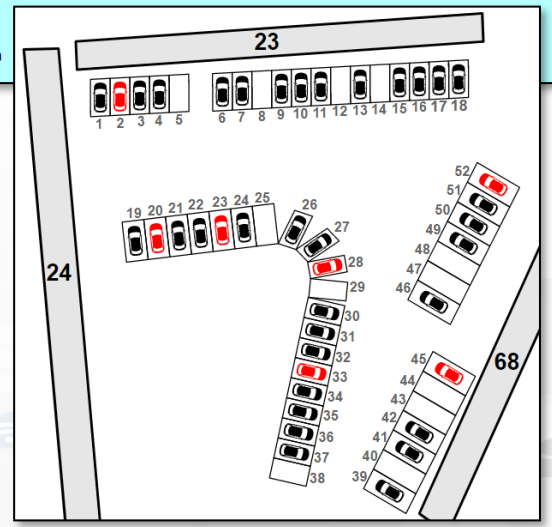
Special Custom Widgets

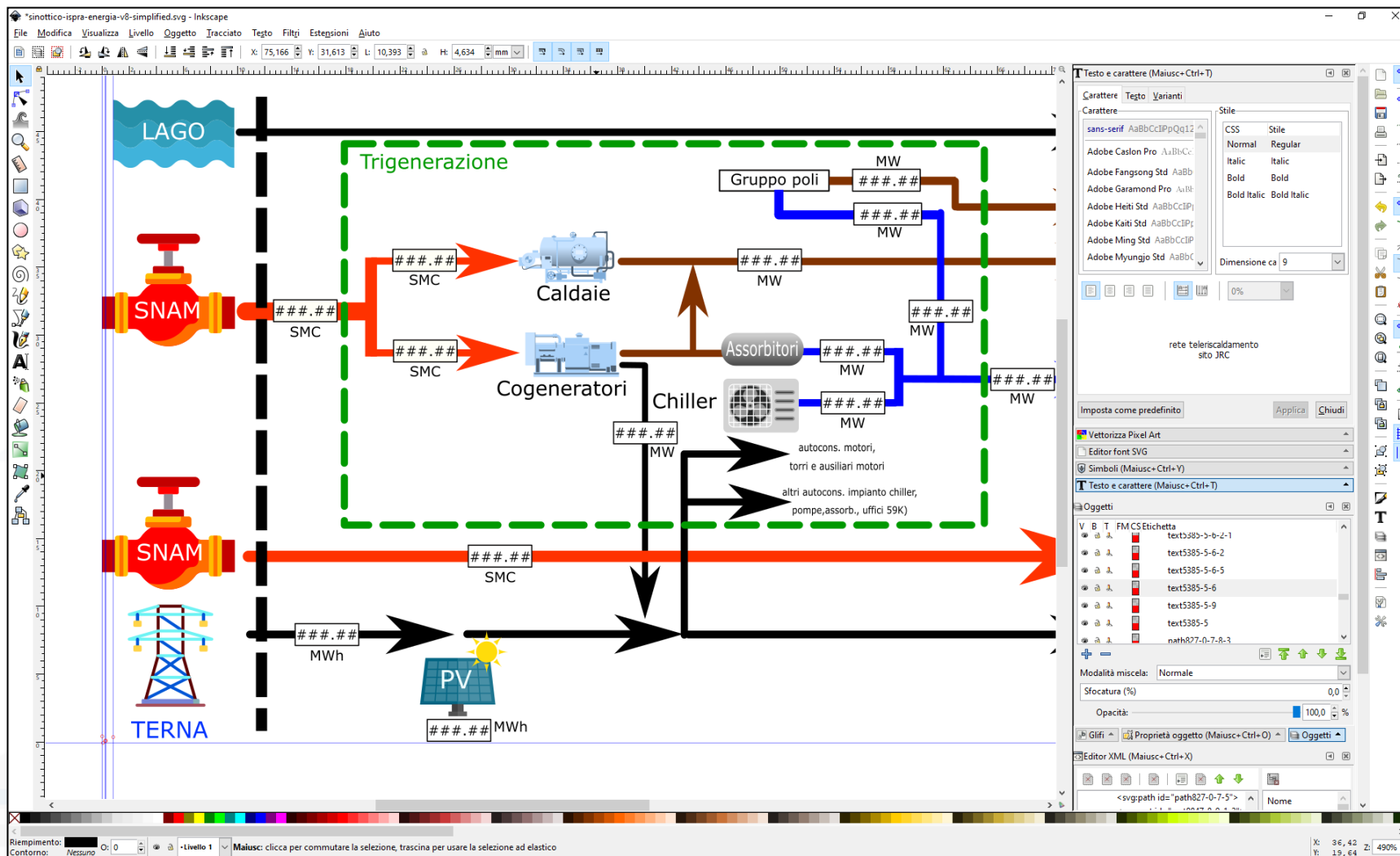
- Smart parking
- Smart Energy
- Smart Light
- Smart
- Energy View
- Custom Controls



Control panel for the Smart Energy widget. It features a row of five smiley faces representing a scale from -2 (angry) to 2 (happy). Below the faces, the text "Total clicks" is followed by a box containing the number "6". To the right, "Mean rate value" is followed by a box containing "0.00".

Control panel for the Smart Light widget. It features a "Begin" field with the time "17:00" and a "Finish" field with the time "4:00". Each field has a "+" and "-" button. To the right of the time fields are two rows of smiley faces representing light intensity levels.





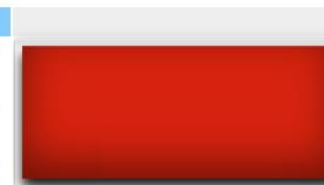
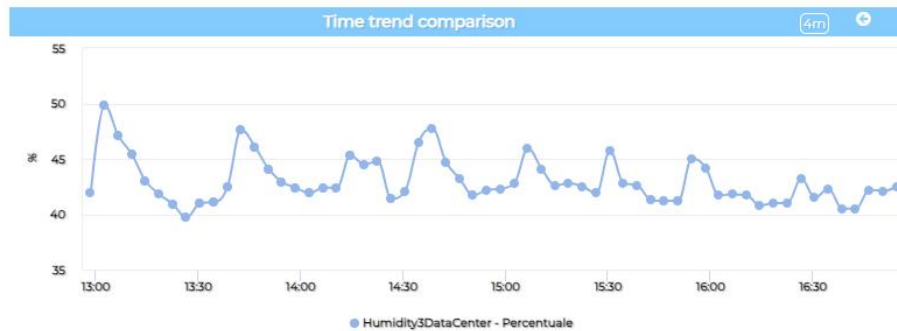
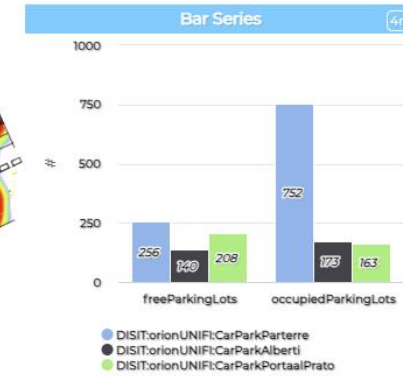
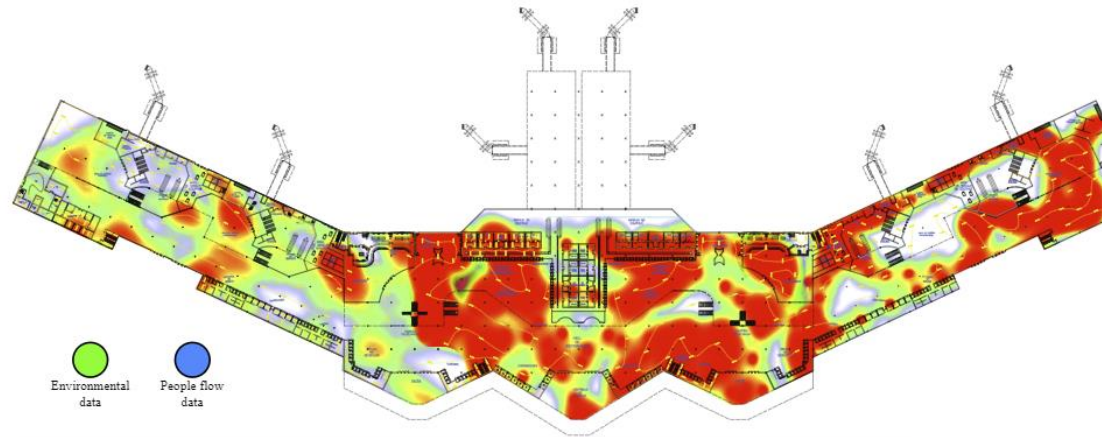
How to
create a
custom
Widget



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

Floor status monitoring with heatmaps

svg_embed1

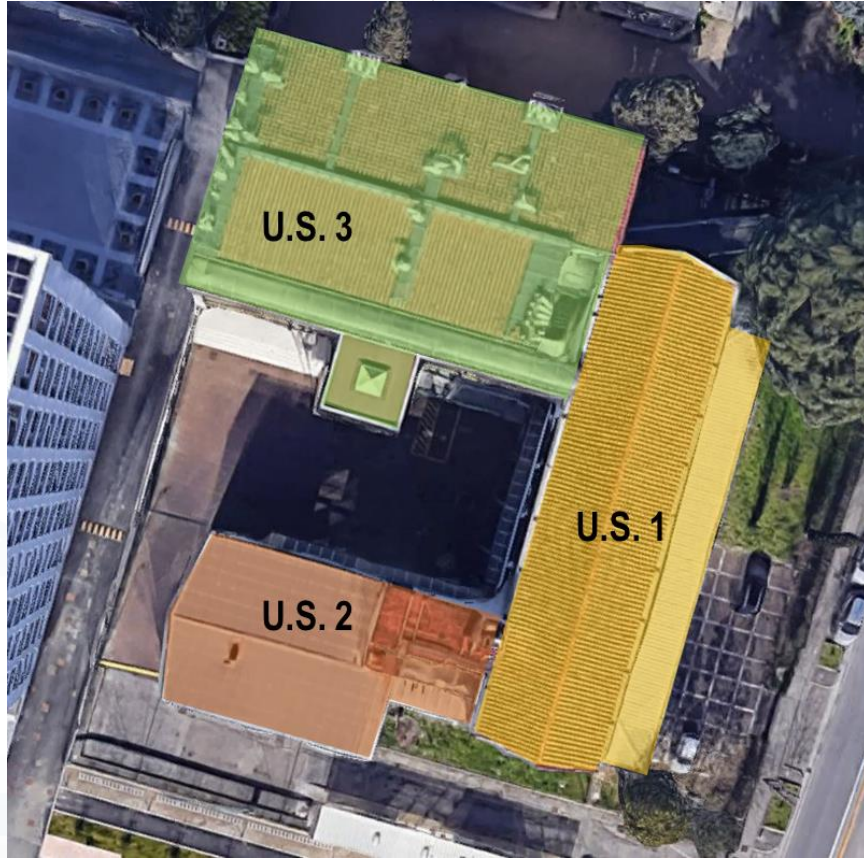


button1



button1

Digital Twin Local

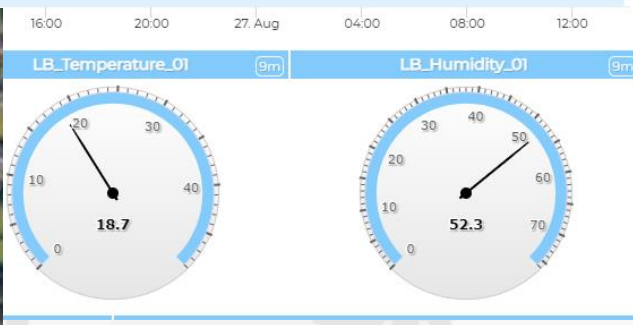
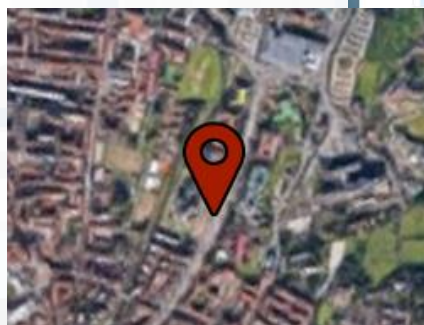


LB_LaboratorioBIM_v01

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 MICROSERVICES SNAP4CITY

DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT-IF AND SIMULATION

SNAP4CITY ARCHITECTURE AND SYSTEM. OPENED TO DEVELOPERS AND STAKEHOLDERS

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

Smart Energy and Smart Buildings Operation and Plan Digital Twin





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**

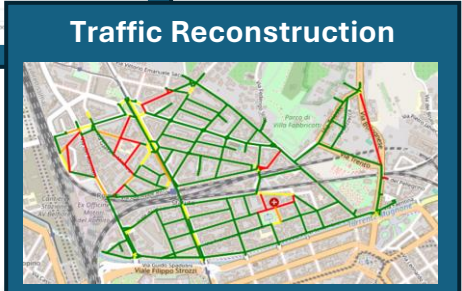
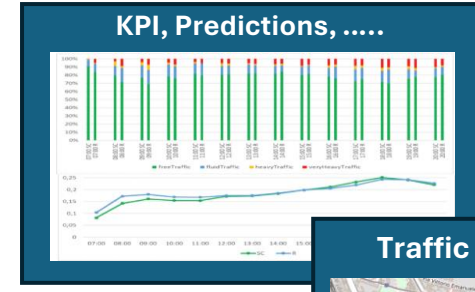


https://www.snap4city.org/download/video/DPL_SNAP4SOLU.pdf

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



Monitoring



Digital Twin
Models &
Data

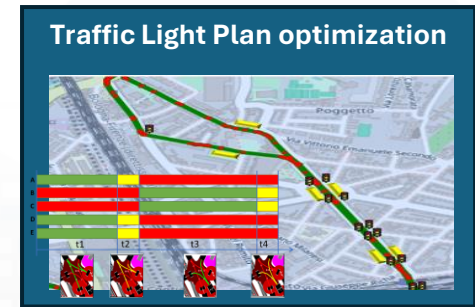
Predictions,
Anomaly Detection,
Analysis, Assessment
Warning

Decision
Support System

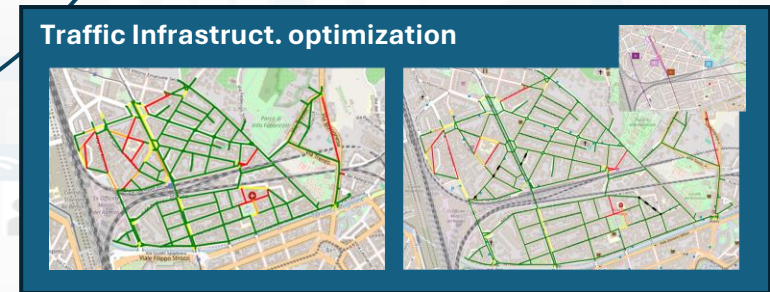
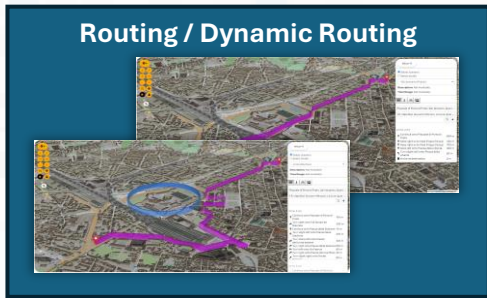


Scenarios

Simulations,
TFR, Crossroad,
Public Transport,
Routing, ..



What-If Analysis,
Optimization





• **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, NO_x, 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

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ADVANCED SMART INFRASTRUCTURE

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK



Smart Energy and Smart Buildings Operation and Plan Digital Twin

SNAP4
Appliances and Dockers
Installations

Energy Domain (2024/8)

- **Goals:**
 - Energy consumption reduction, increment of efficiency, sustainability
 - 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: dimering, 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 (2024/8)

- Monitoring Energy Consumption in single building, area and per zone
- Smart Light management, unicast and multi cast management, smart light controlled by traffic flow data
- Monitoring Energy provisioning on recharging station
- 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
- Collecting and managing Communities of Energy
- Computing KPI
- Etc.



reference

Smart Light Control of CAPÉLON

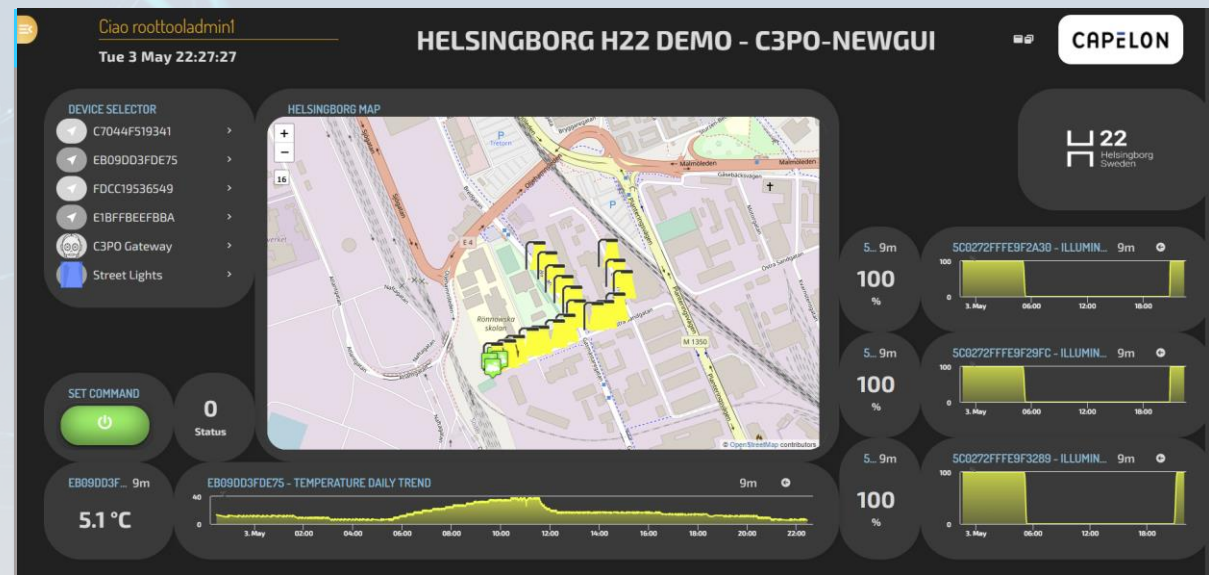
• Energy Domain

- Smart Light, MQTT,
- IoT Orion Broker FIWARE



• Dashboards

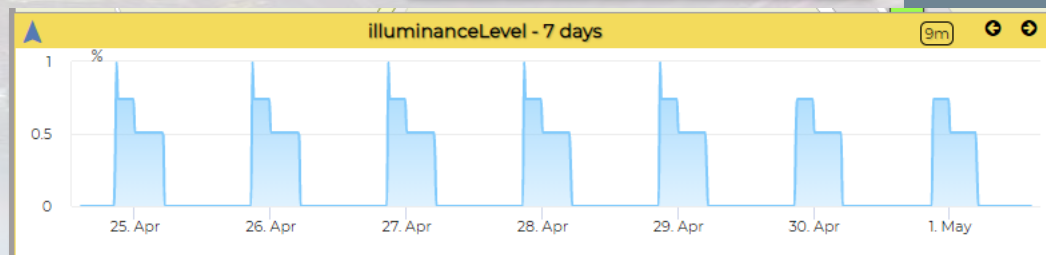
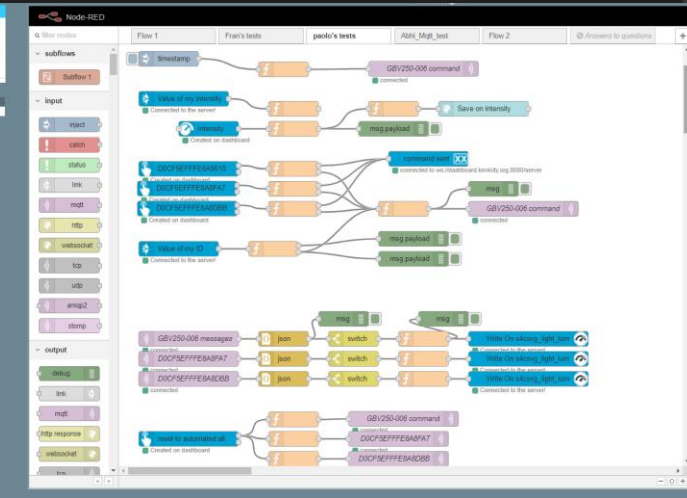
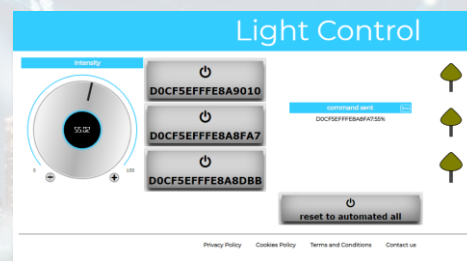
- Map coverage on Sweden
- Monitoring and real time control
- Energy control, analytics
- Direct control



• Historical and Real Time data

• Services Exploited on:

- Multiple Levels, API
- Dashboards



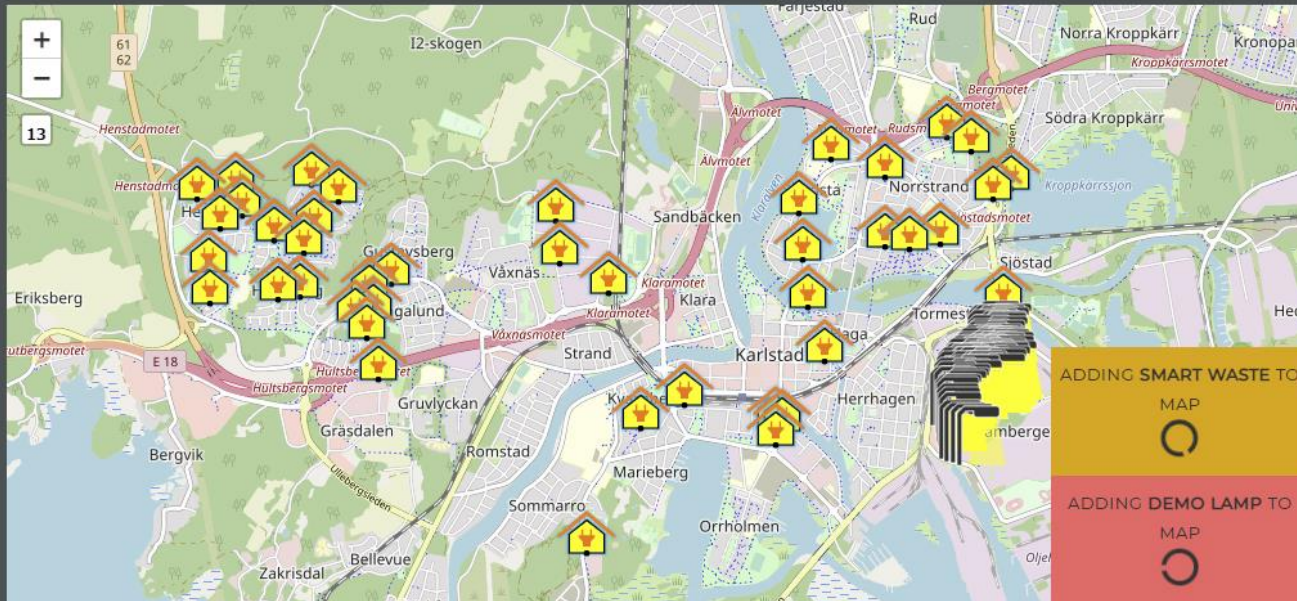


Karlstad - Capelon

CAPELON

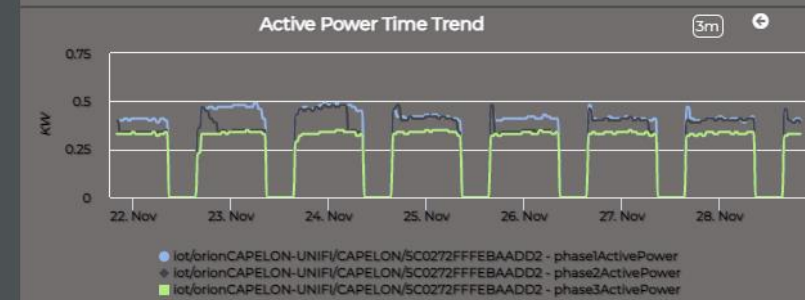
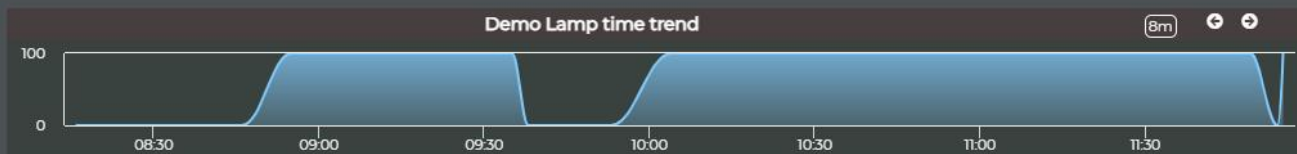
Sun 28 Nov 20:02:16

- Cabinet
- Smart Light
- Demo Lamp
- Smart Waste



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



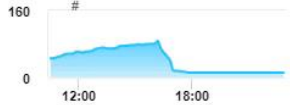
Cabinets On Stockholm By Capelon

Tue 31 Oct 22:53:17

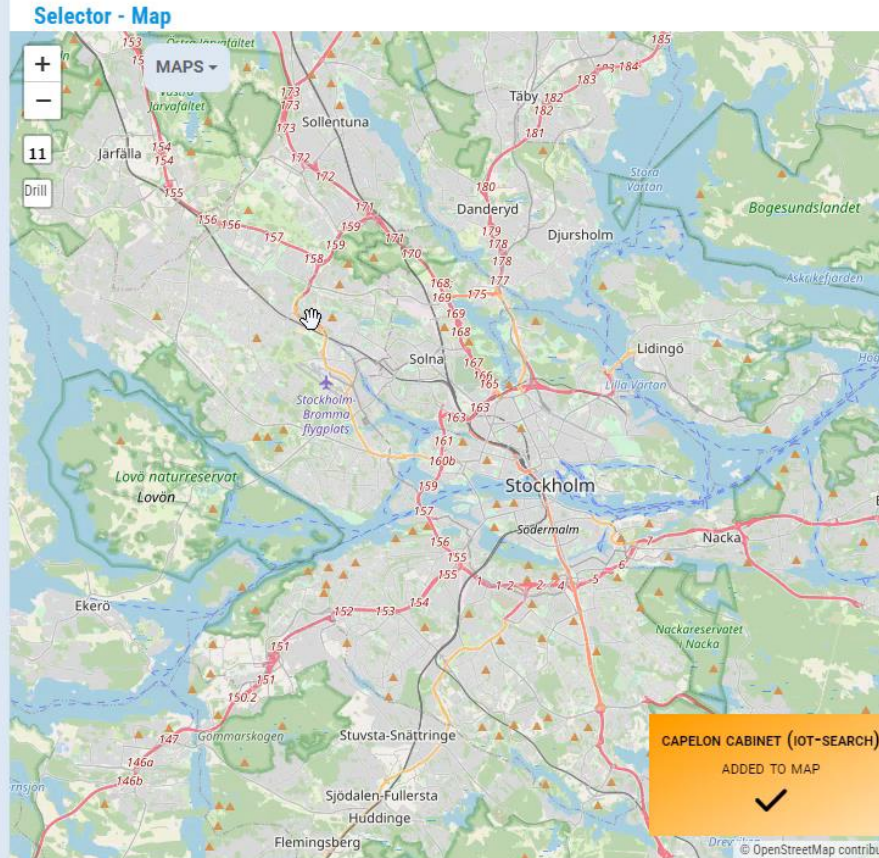
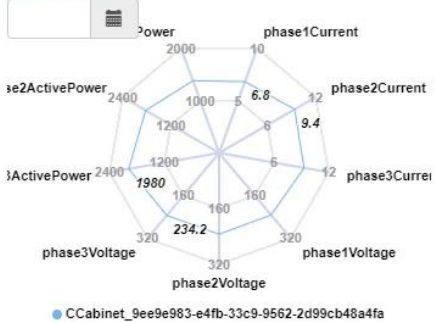
Capelon Cabinet (iot-search)

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

12



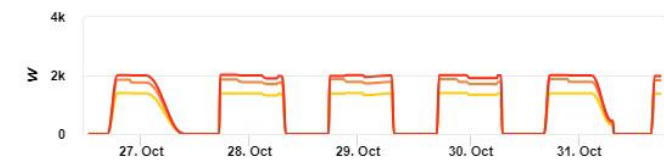
Radar Series 4m



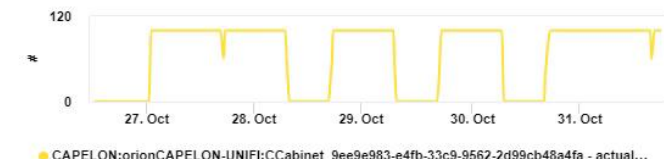
:CCabinet_9ee9e983-E4fb-33c9-9562-2d99cb48a4fa - Burni... 9m



Time Trend 4m



Time Trend 4m



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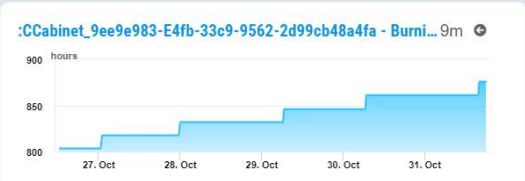
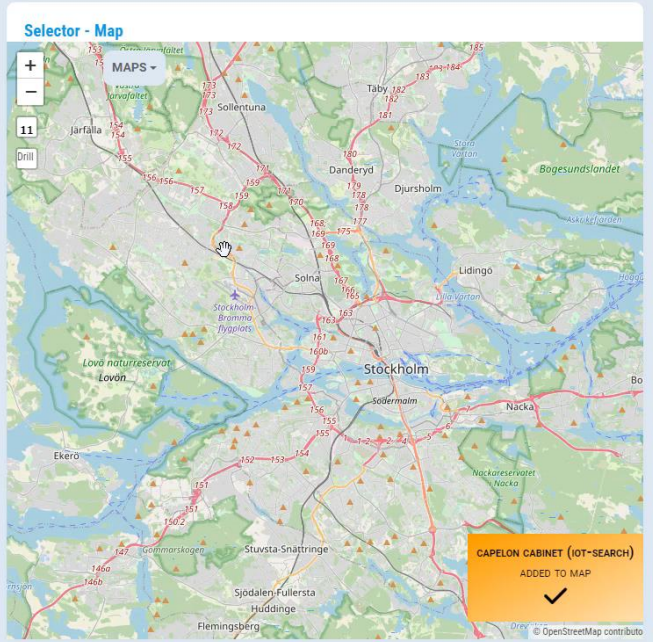
Capelon Cabinet (iot-search)

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

12

Radar Series 4m

● CCabinet_9ee9e983-e4fb-33c9-9562-2d99cb48a4fa

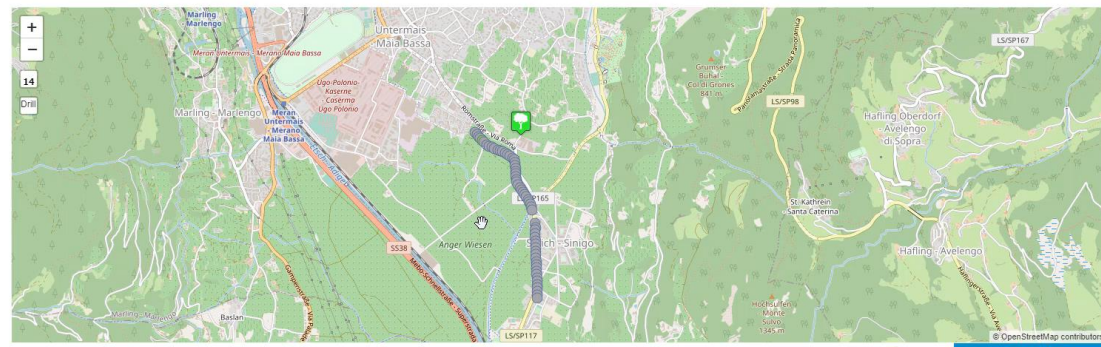


- CAPELON:lorionCAPELON-UNIFI:CCabinet_9ee9e983-e4fb-33c9-9562-2d99cb48a4fa - phase...
- CAPELON:lorionCAPELON-UNIFI:CCabinet_9ee9e983-e4fb-33c9-9562-2d99cb48a4fa - phase...
- CAPELON:lorionCAPELON-UNIFI:CCabinet_9ee9e983-e4fb-33c9-9562-2d99cb48a4fa - phase...

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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	<input type="button" value="Invia"/>
	<input type="button" value="ON"/>
	<input type="button" value="OFF"/>



Stato Linea

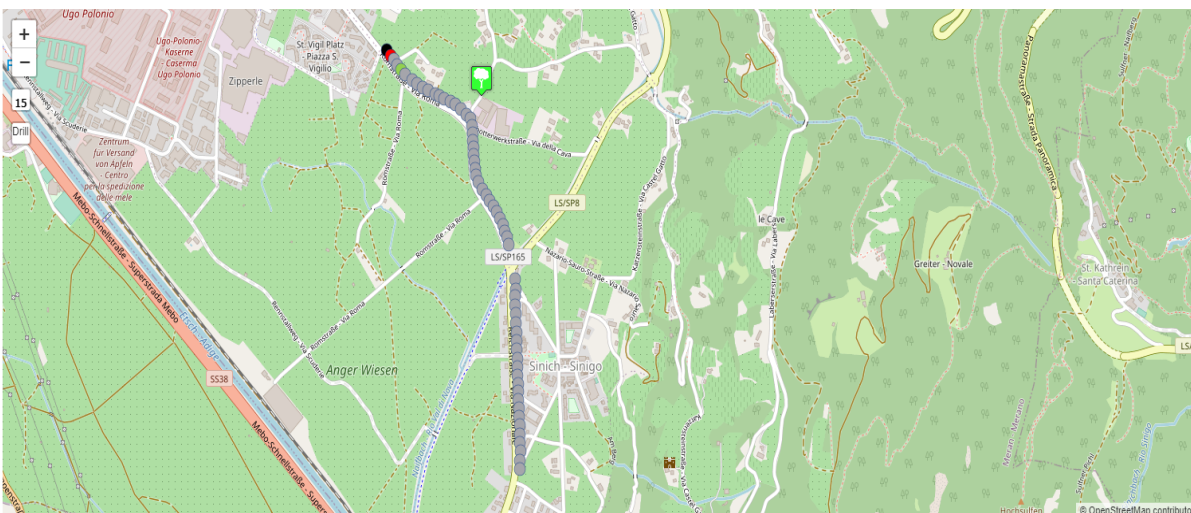
Non Attivo
Stato Linea verso Sinigo

Non Attivo
Stato Linea verso Merano Centro

DAL_NTC_MISSING	
INF_AJL_TRIGGER	
DAL_BAL_STIME_DISAIBL	
DAL_BAL_LAST_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



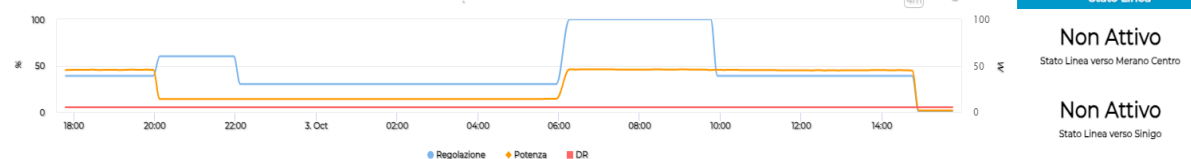
All lamps Data visualization Event logs Graph Settings

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

- DAI1_NTC_MISSING
- INF_AUX_TRIGGER
- DAI1_FADE_TIME_DISABLE
- DAI1_BA_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



Add device to multicast

Multicast2:

DevEui:

Multicast address:

Multicast network session key:

Multicast application session key:

Multicast configuration

Multicast2:

Set UTC timestamp

Set cpPush

Set configuration

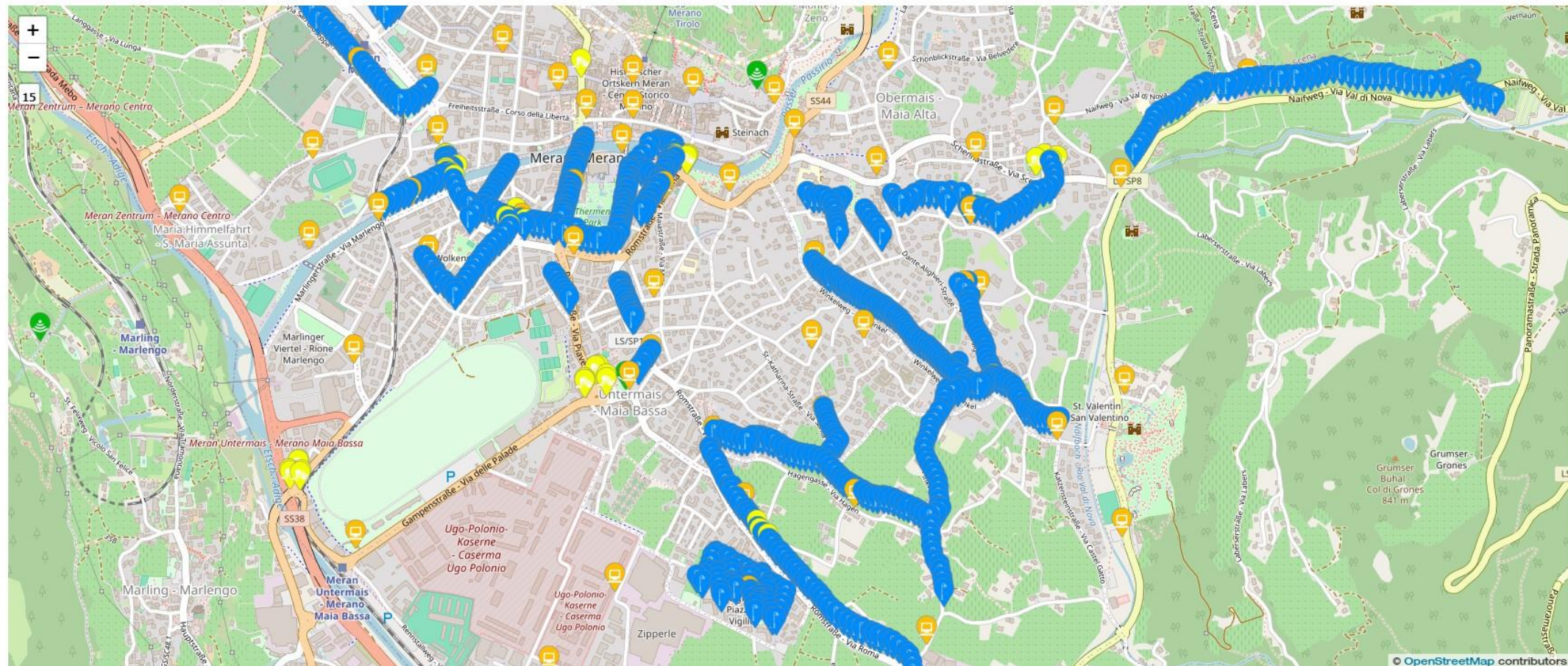
<https://www.snap4city.org/968>

Smart Light in Merano



Merano - tutti i servizi

Wed 13 Dec 15:34:57



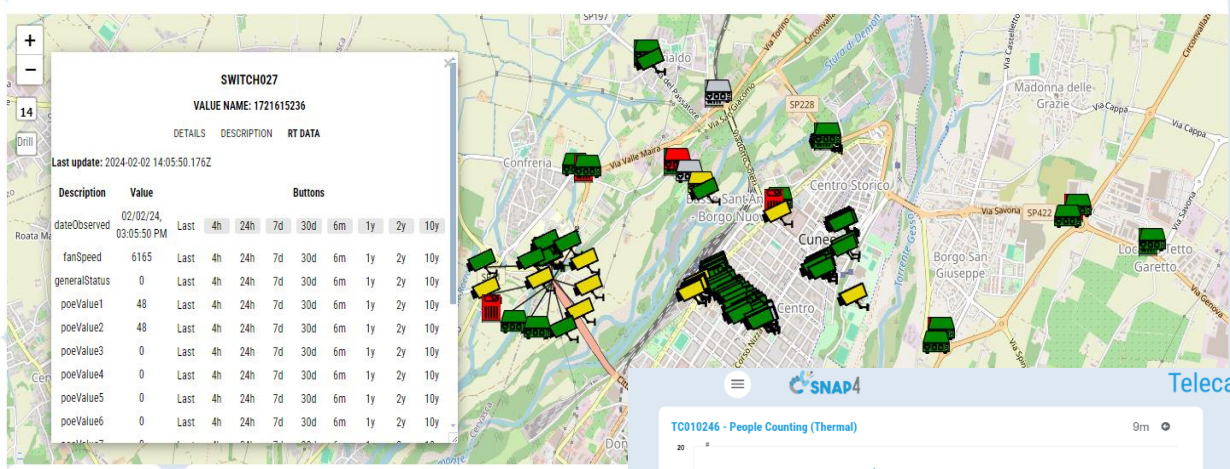
© OpenStreetMap contributors



Monitoraggio Generale

Fri 2 Feb 17:08:24

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



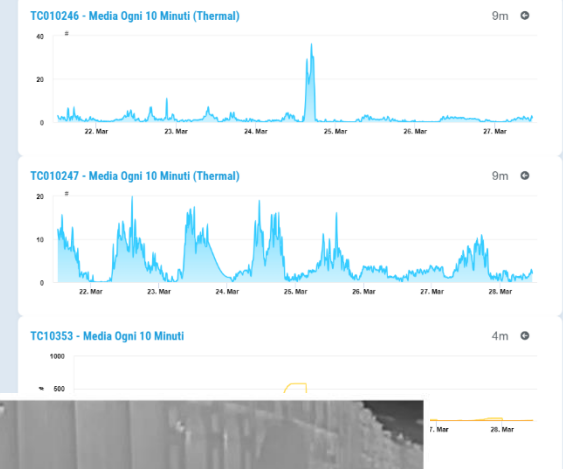
Legenda

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

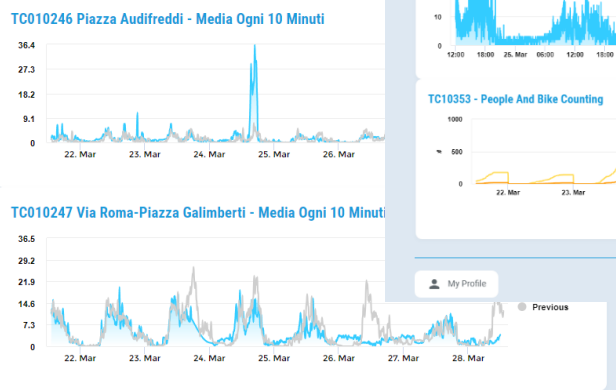
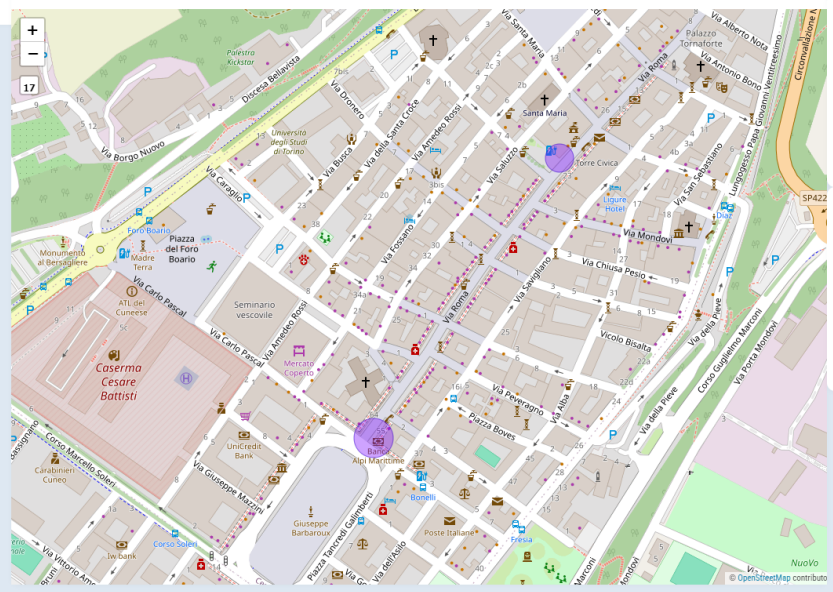


Telecamere Cuneo

Thu 28 Mar 11:18:02



Conteggi Telecamere



Powered by SNAP4Tech

SNAP4

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:

SNAP4

My Profile

TOP

Building and Infrastructure management Domain



<https://www.snap4city.org/970>



Smart Building

FROM CITY DASHBOARD TO APPLICATIONS



Snap4Building Domain (2024/8)

- **Goals:**
 - increase efficiency, cost reduction, sustainability
 - Accessibility to services
 - Security/Safety
- **Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)**
 - Monitoring: usage, energy, environmental conditions, people flows, services, etc.
 - Early detection/warning, alarm, of critical conditions, notifications, decision support
 - Production of suggestions/prescriptions, 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**

Smart Buildings, Snap4Building (2024/8)

- **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 KPIs 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

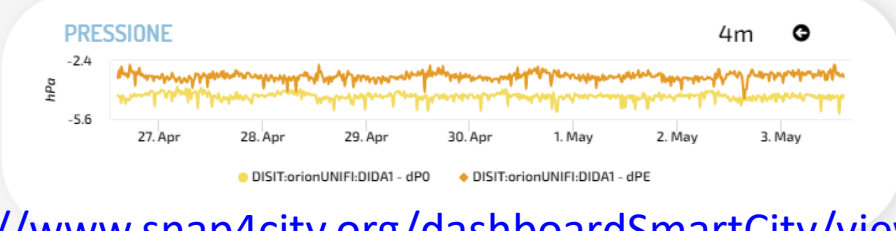
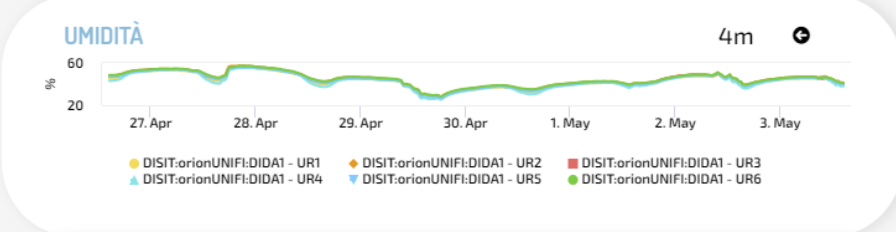
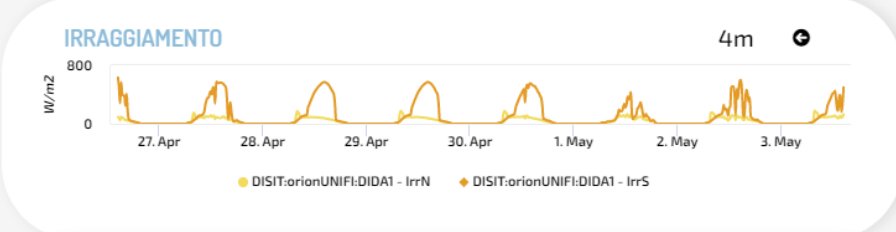
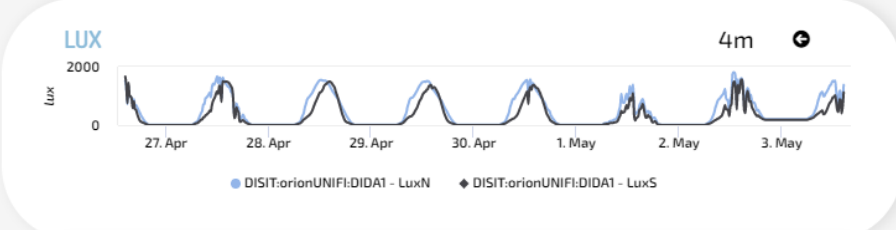
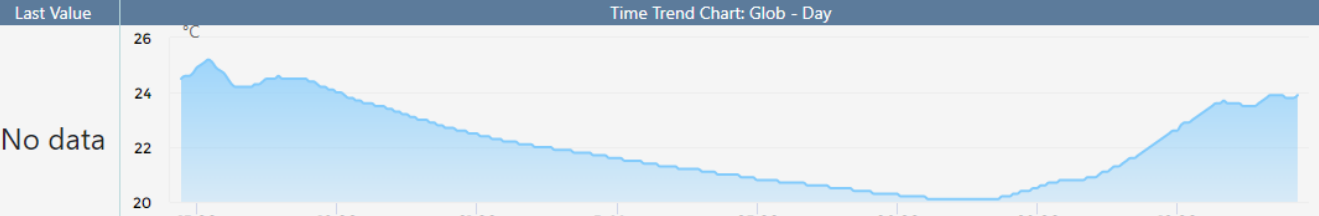
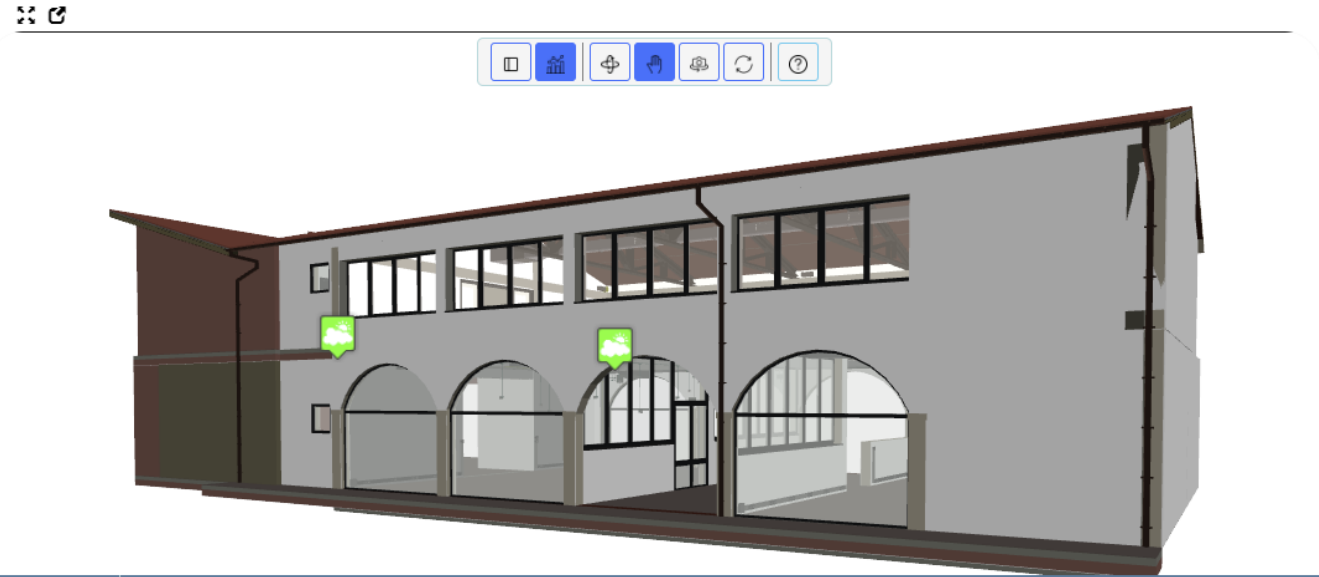
DIDA DATA 2 - NEWGUI

7 AFFORDABLE AND
CLEAN ENERGY

11 SUSTAINABLE CITIES
AND COMMUNITIES

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

BIM SANTA VERDIANA



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

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

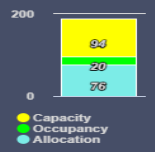
883

Ispra - Occupancy 8m

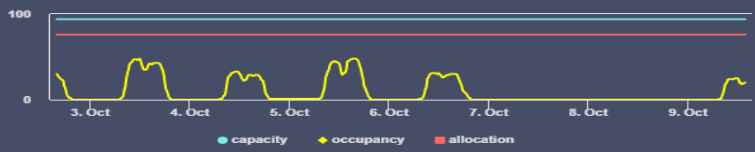
person My Profile



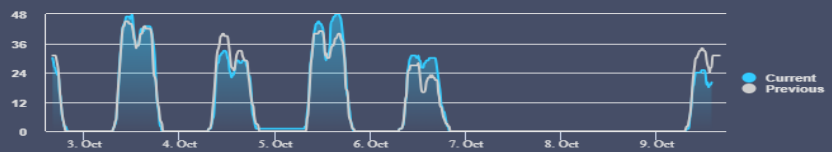
Actual 4m



Capacity - Allocation - Occupancy 4m



Occupancy Weekly Time Trend Compare 9m



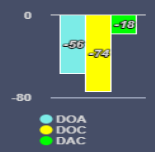
Office Mq 9m

803.9 m²

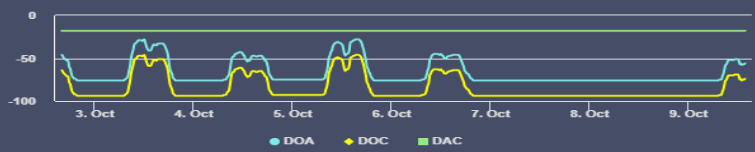
Temp. 9m

20.6 °C

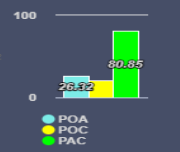
Difference 4m



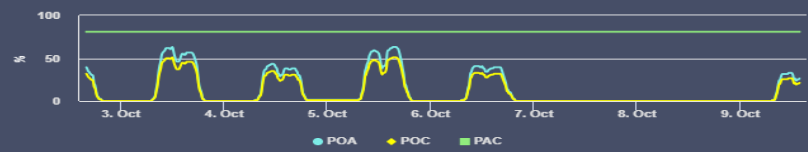
DOA - DOC - DAC 4m



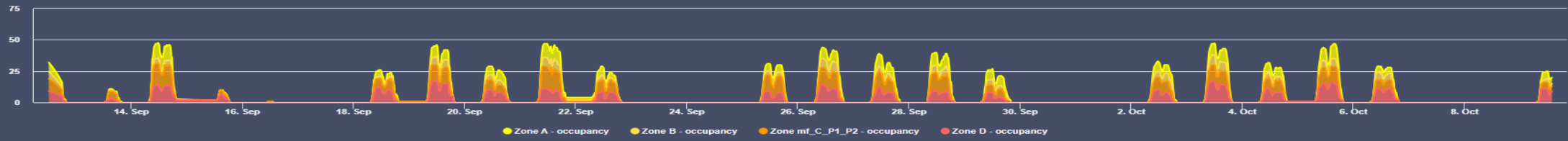
Percentage 4m



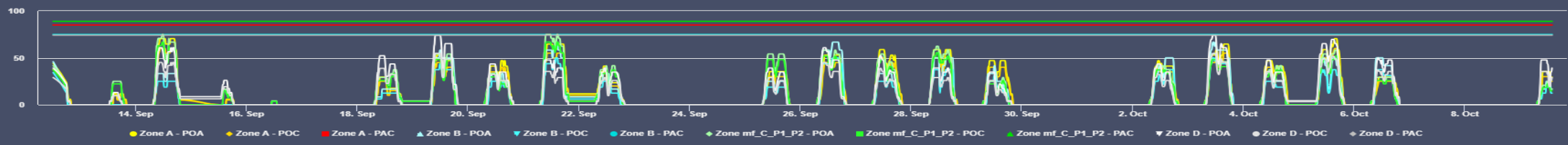
POA - POC - PAC 4m



Occupancy Per Zones - Monthly Time Trend Comparison Stacked 4m



Percentage Per Zones - Monthly Time Trend Comparison 4m



Heat Power 9m

0 kW

Heat Energy 9m

1931279 kWh

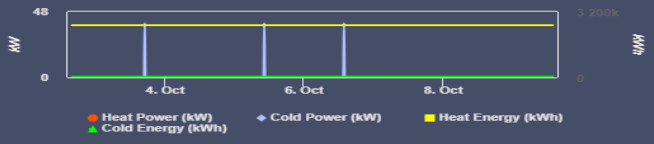
Cold Power 9m

0 kW

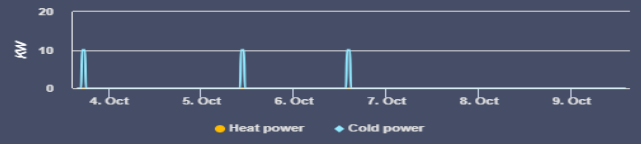
Cold Energy 9m

888311 kWh

Energy Trends 4m



Average Hourly Power 4m



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

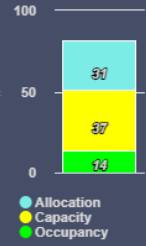
- Date Observed: 10/6/2023, 12:01:00 PM
- Zone Id: 58A_PT_B
- Capacity: 1
- Allocation: 0
- mq: 12.16
- Average hourly temp. Xi: 24.07°C
- Average hourly temp. Xs: 20.92°C
- Average hourly temp. Xt: 6.00°C
- Heat Start temp.: 17.92°C
- Cold Start temp: 23.92°C

[See Trends](#)

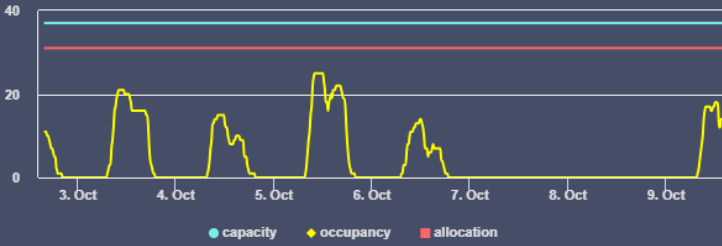
Building 58A PT Trends

Mon 9 Oct 13:51:30

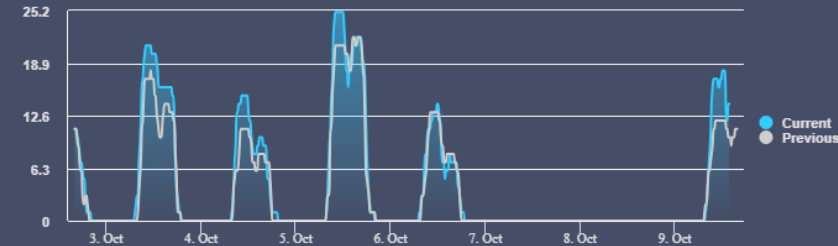
Actual 4m



Capacity - Allocation - Occupancy 4m



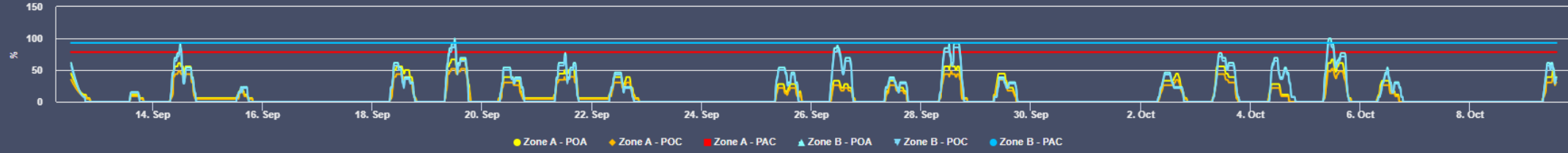
Organization: Orion-1: Floor2_58A_PT - Occupancy 9m



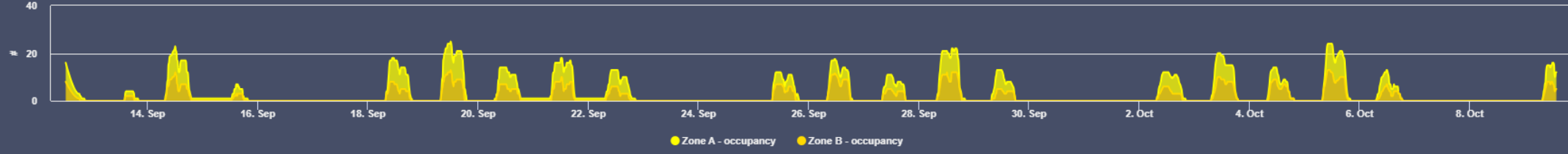
Temp. 9m

21.7 °C

Percentage Per Zones - Monthly Time Trend Comparison 4m



Occupancy Per Zones - Monthly Time Trend Comparison Stacked 4m

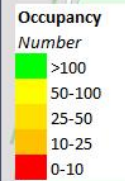
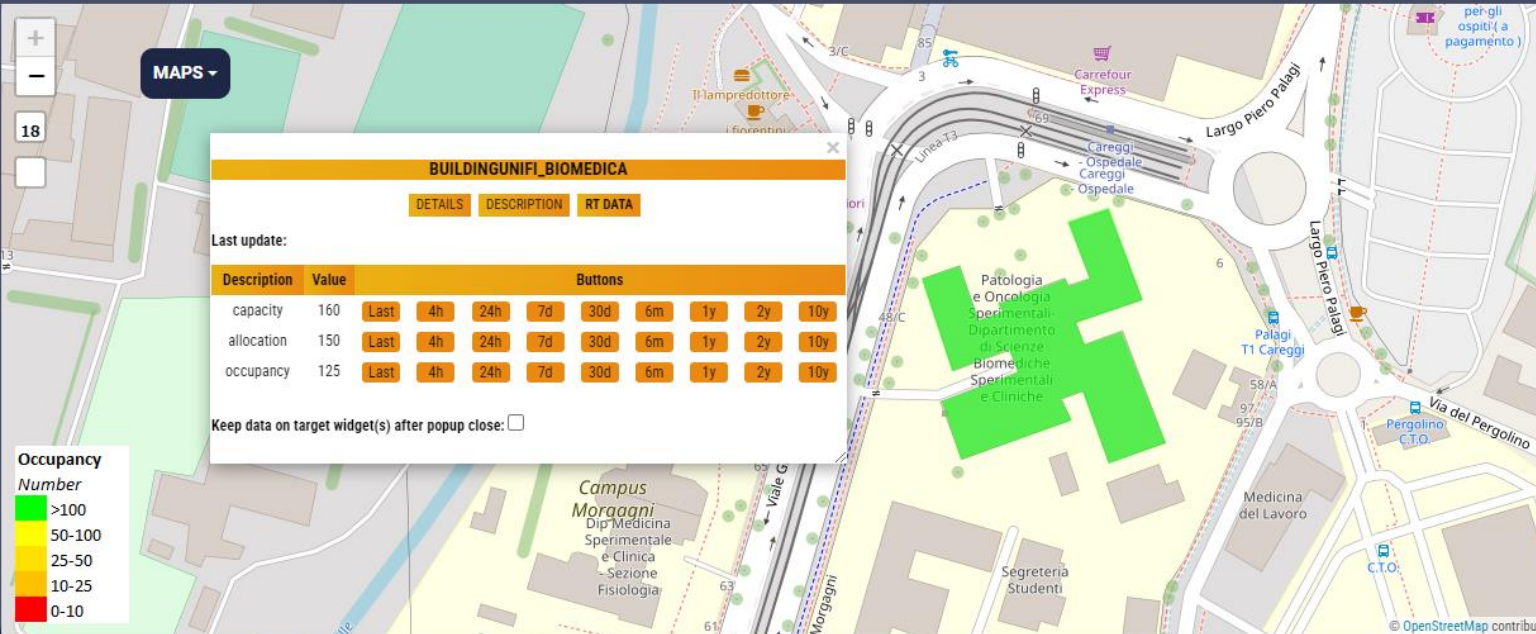


Smart Building

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



My Profile



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INGEGNERIA
DELL'INFORMAZIONE

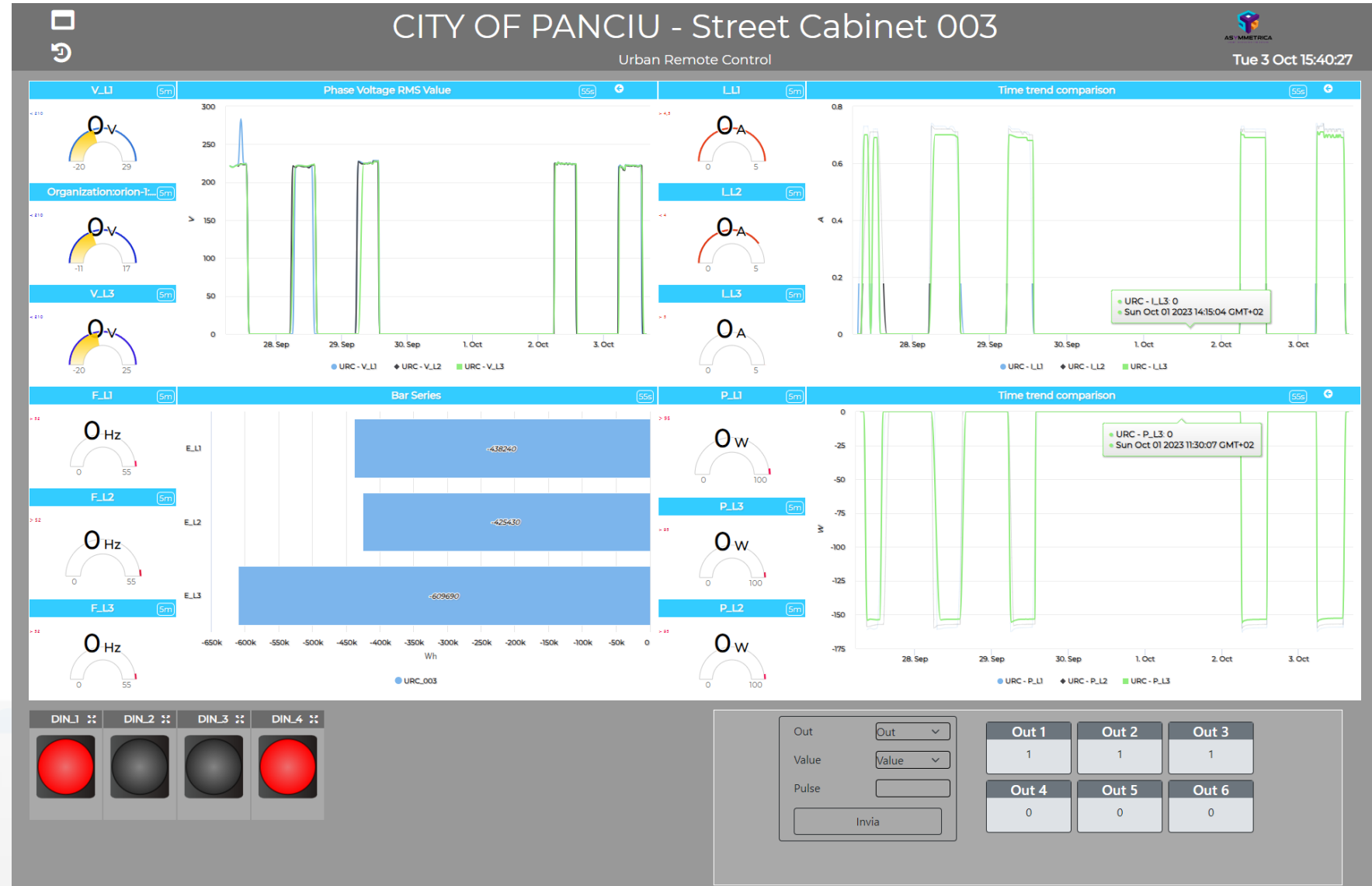
DISIT
DISTRIBUTED SYSTEMS AND
INTERNET TECHNOLOGIES LAB
DISTRIBUTED DATA INTELLIGENCE
AND TECHNOLOGIES LAB

SNAP4CITY



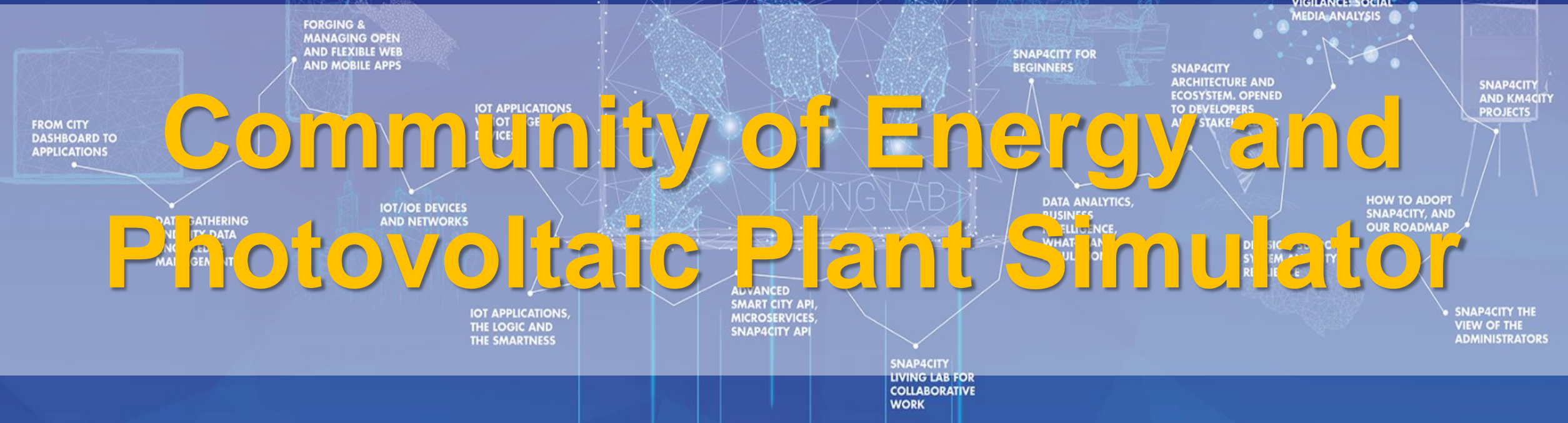
City of Panciu in Romania

By
Asymmetrica
and Snap4



TOP

Community of Energy and Photovoltaic Plant Simulator



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

Ciao roottooladmin!

Sat 11 Nov 17:26:28

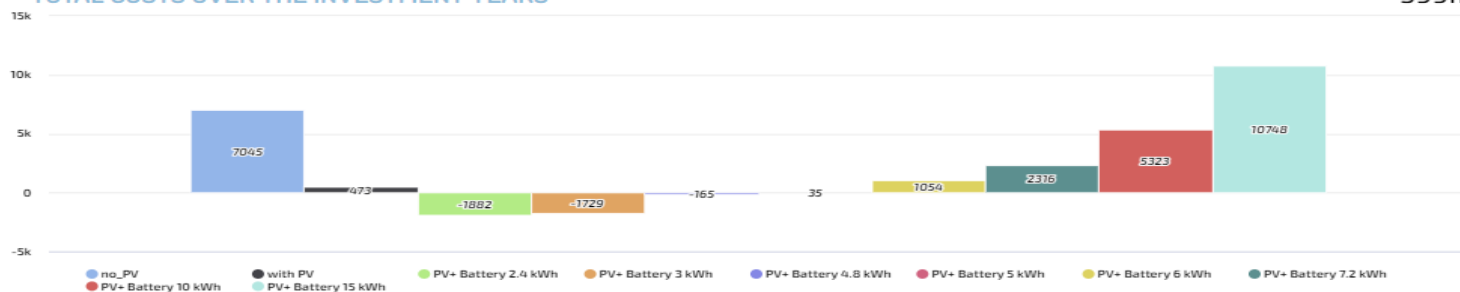
ONLINE PHOTOVOLTAIC SYSTEM SIMULATOR

User Manual

Italian Version

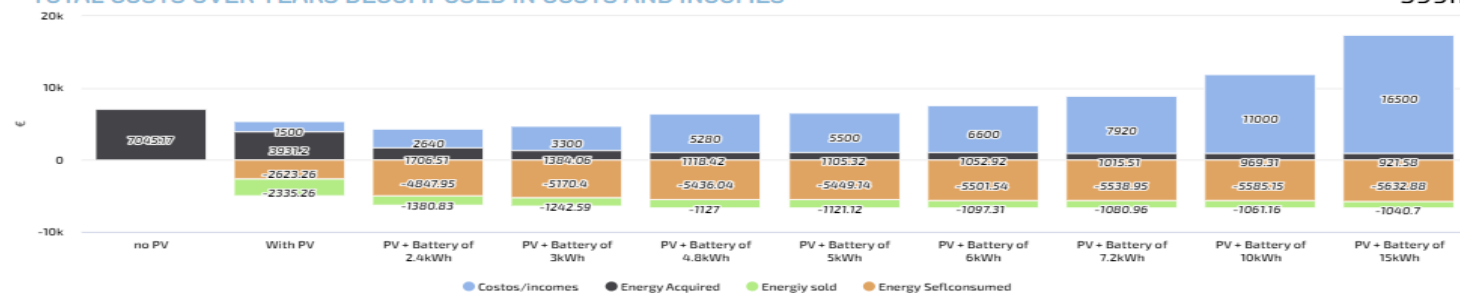
TOTAL COSTS OVER THE INVESTMENT YEARS

599m



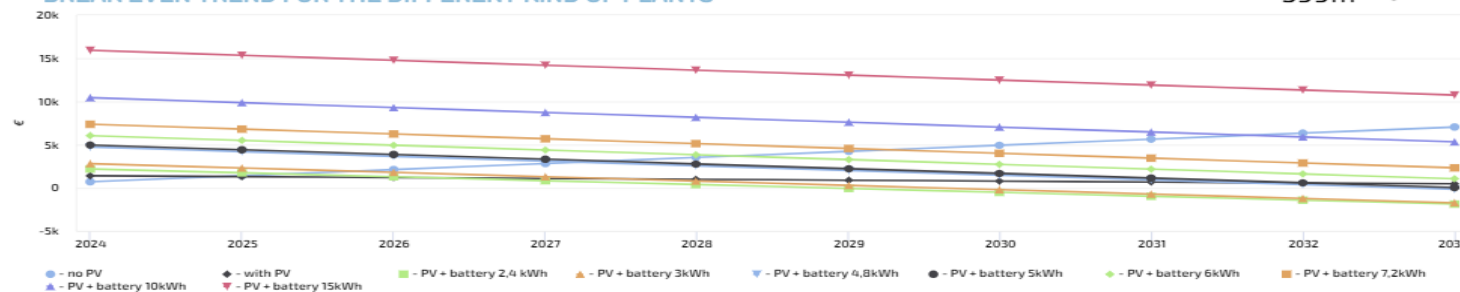
TOTAL COSTS OVER YEARS DECOMPOSED IN COSTS AND INCOMES

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

7 AFFORDABLE AND
CLEAN ENERGY





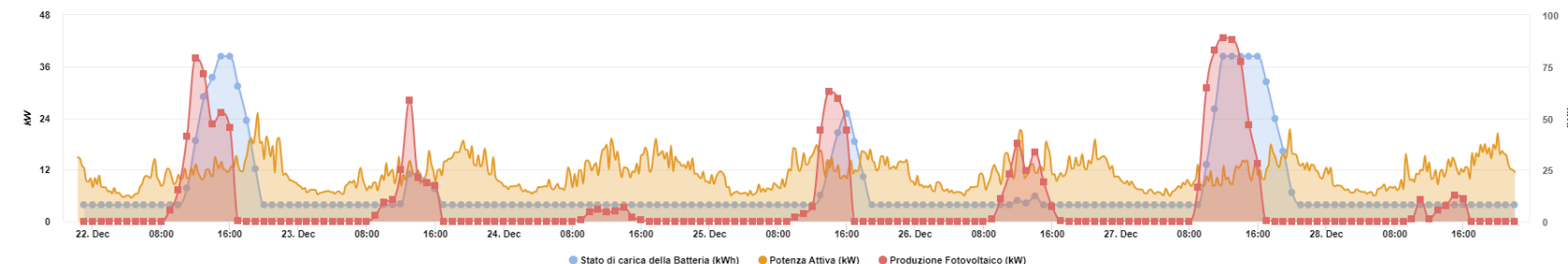
energy ARTER

Regione Emilia-Romagna

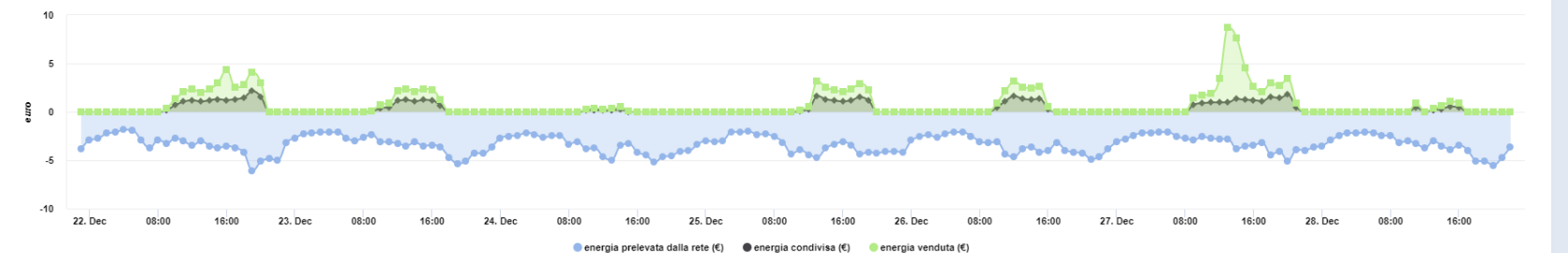
Wed 11 Jan 22:07:28

4m

Conto Energetico



Valorizzazione Economica



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BI-CSBL

- **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

<https://www.selfuser.it>





SELF USER

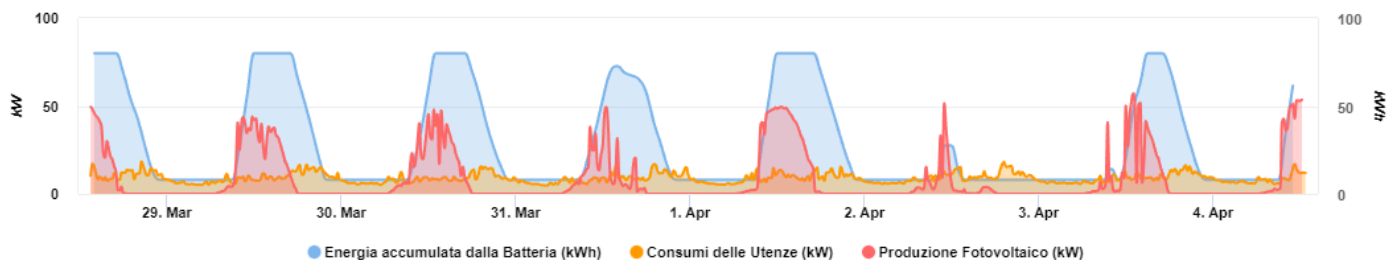
Monitoraggio in tempo reale della comunità energetica condominiale

Tue 4 Apr 13:20:04



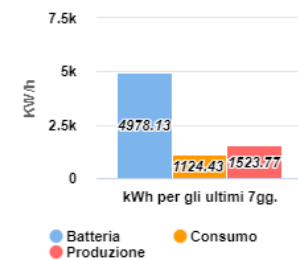
Conto Energetico

4m



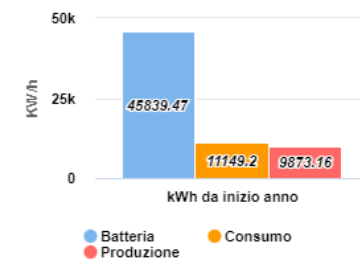
KWh Ultimi 7 Gg.

4m



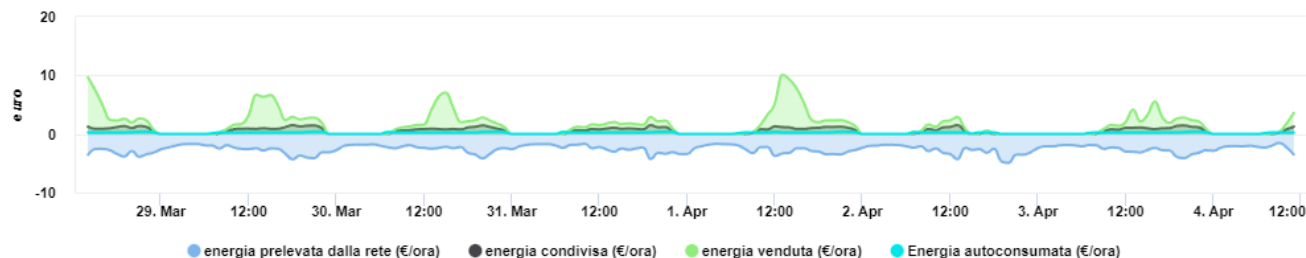
KWh Da Inizio Anno

4m



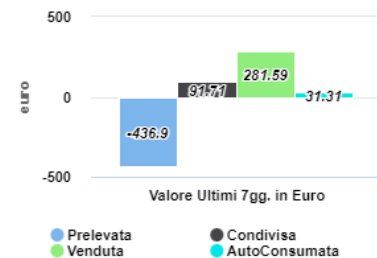
Valorizzazione Economica

4m



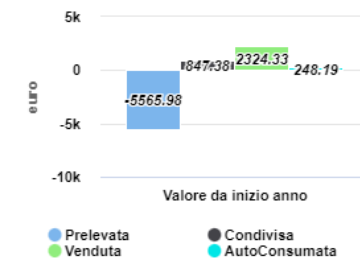
Valore Ultimi 7gg.

4m



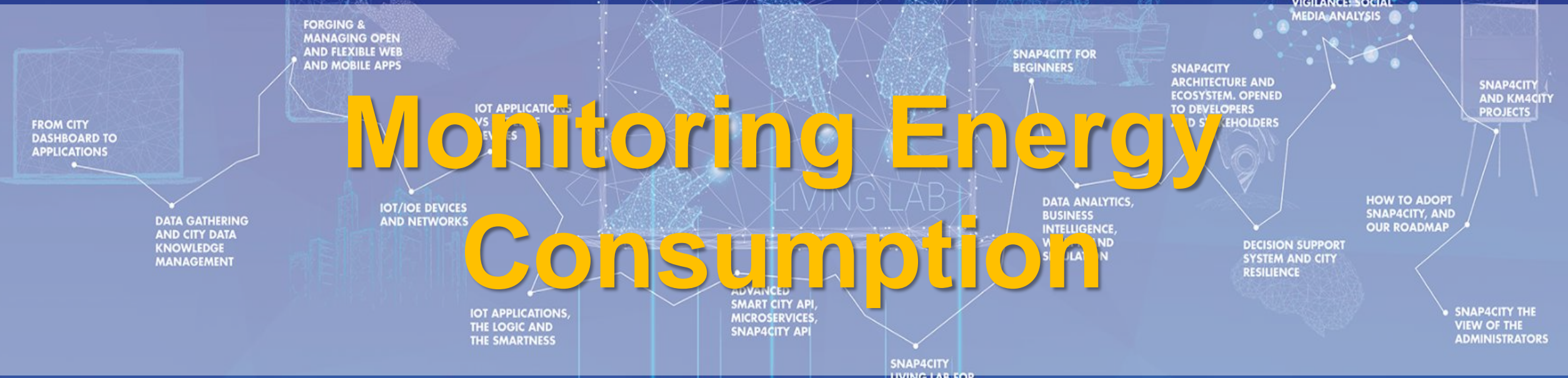
Valore Da Inizio Anno

4m



TOP

Monitoring Energy Consumption



Energy monitoring and business intelligence

Green and Data Driven District

Aggregated KPI JuicePark SmartPole CityAnalytics

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

Juice Park
Detailed KPIs

Smart Pole
Detailed KPIs

[Privacy Policy](#) [Cookies Policy](#) [Terms and Conditions](#)



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

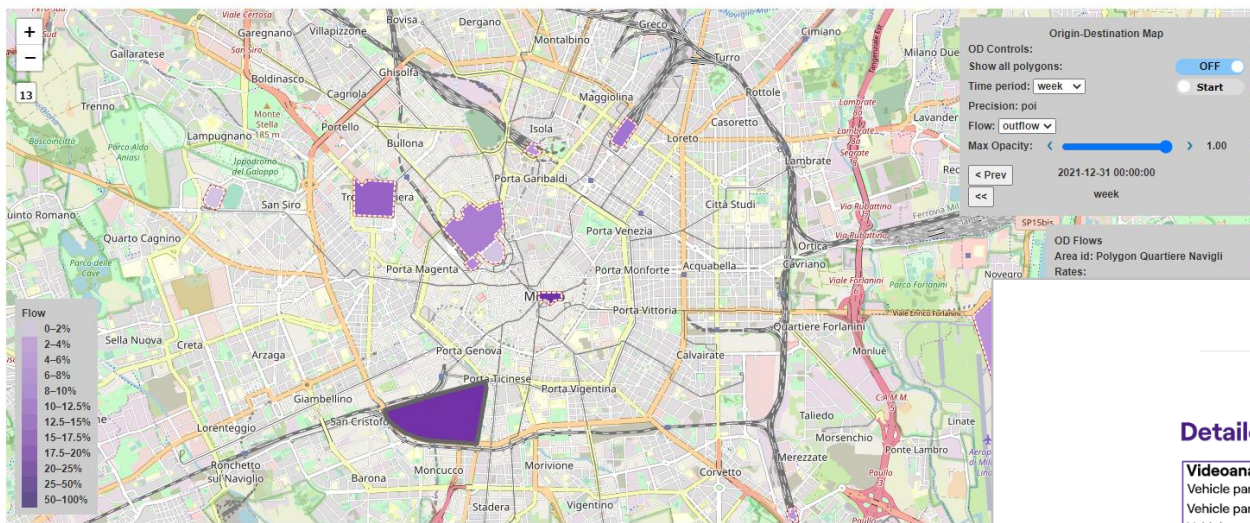
21/04/2022 10:48

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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: 17/05/2022 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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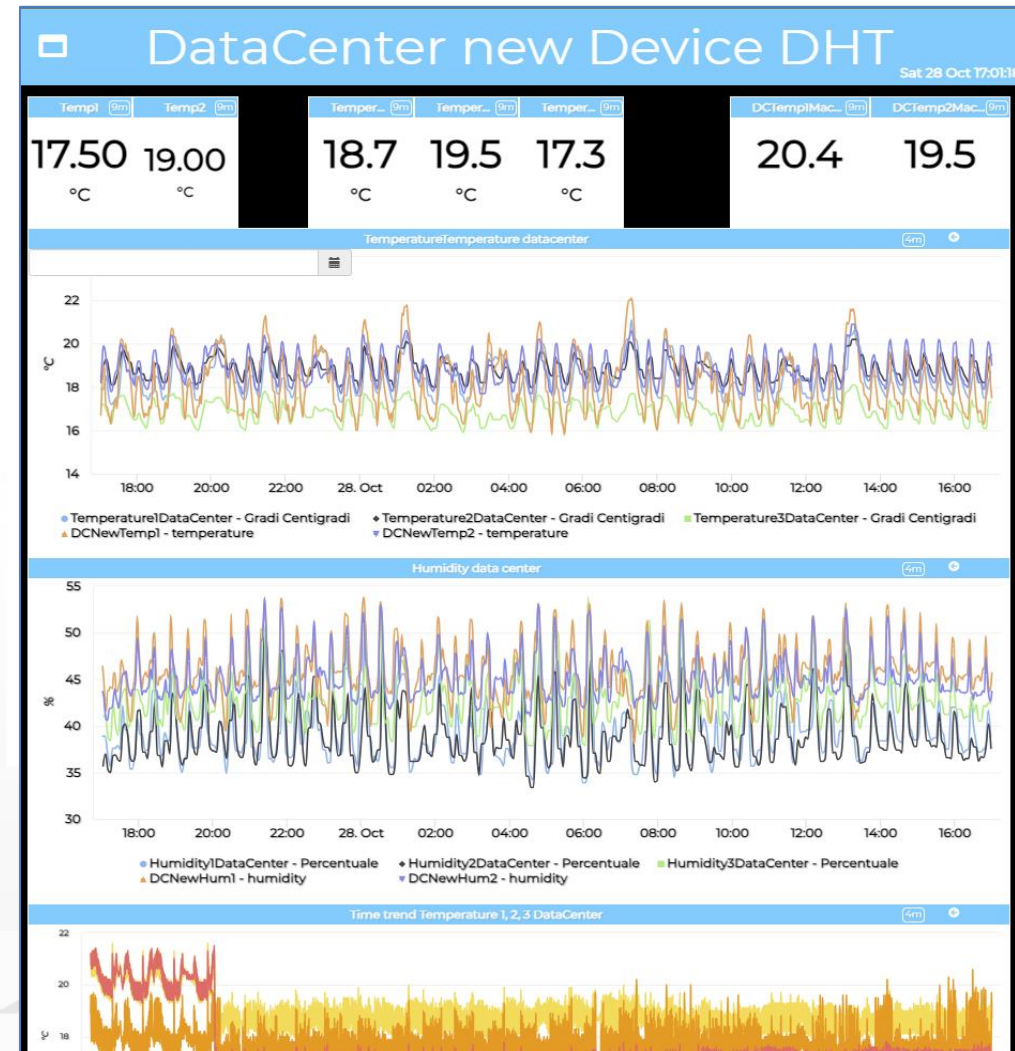
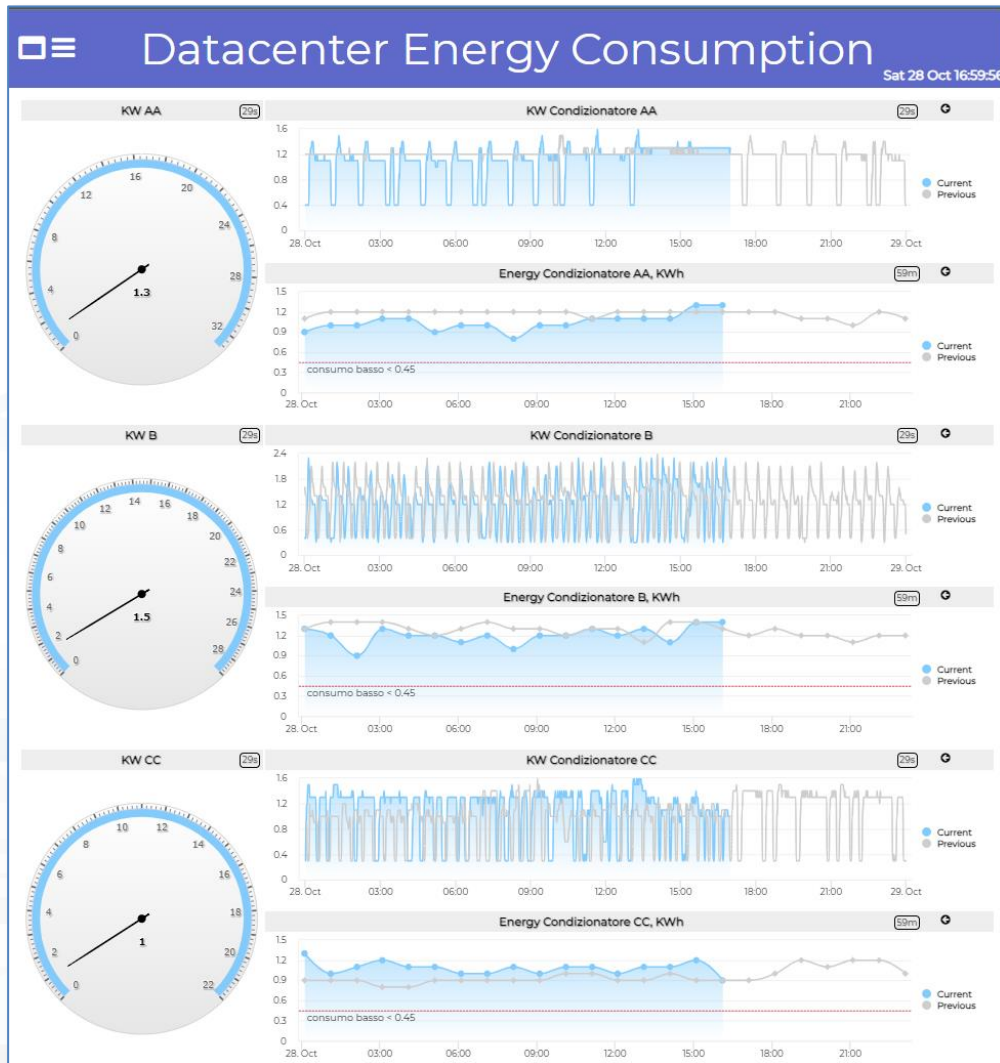
7 AFFORDABLE AND CLEAN ENERGY



11 SUSTAINABLE CITIES AND COMMUNITIES

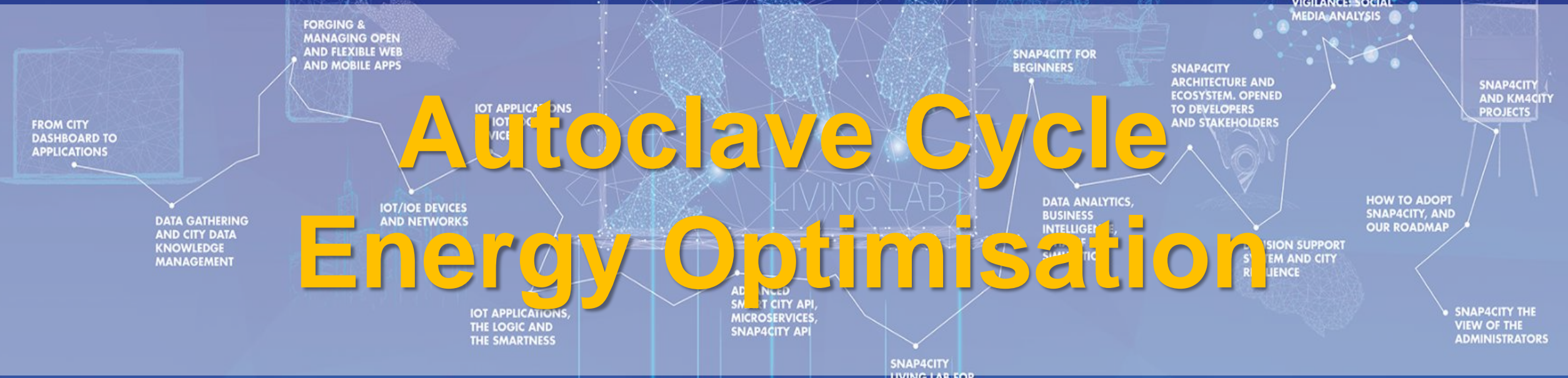


Data Center monitoring



TOP

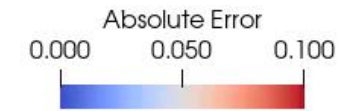
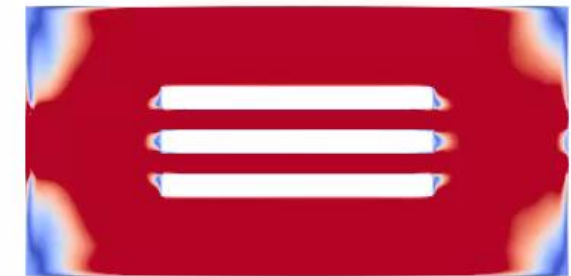
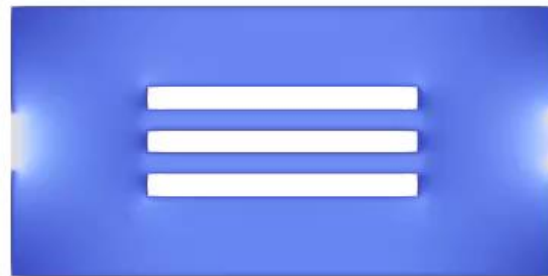
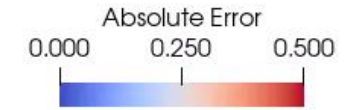
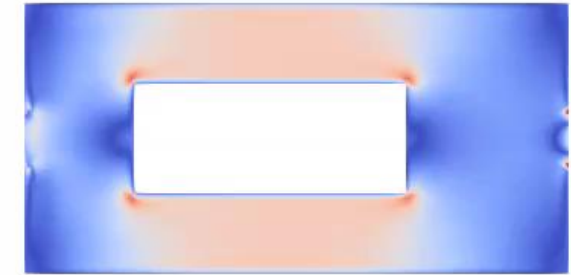
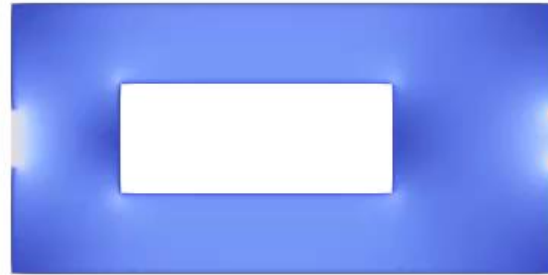
Autoclave Cycle Energy Optimisation



PINN: Physically Informed Neural Networks Models

- **Solving Navier-Stokes PDE** (partial differential equations) equation, **via PINN** approach
 - Reduction of computing costs for simulating load effect into the autoclaves curing process
 - Validation wrt Open Foam
 - Precision on steady and transitory cases
 - Definition of Transfer Learning techniques
- Videos on <https://www.snap4city.org/1010>

Comparison of PINN vs OpenFoam and error



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

SP Air Temp.: 0 °C

Lotc Temp.: 27 °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 Comparison



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

TOP

Industry Domain predictive maintenance



Workflow for Ticket management

Consumptions/productions

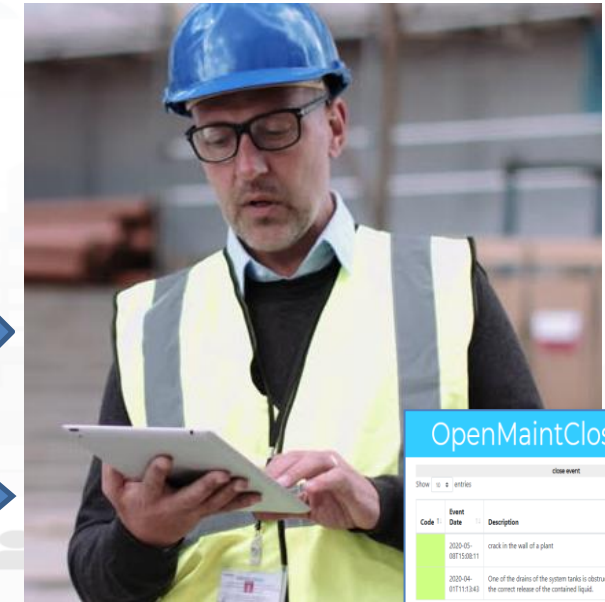
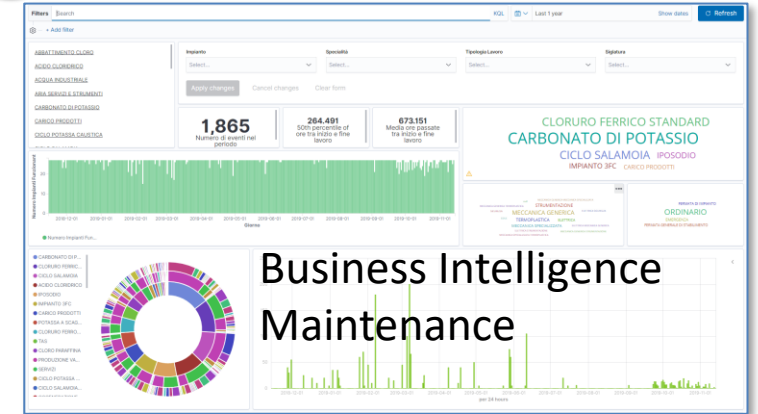
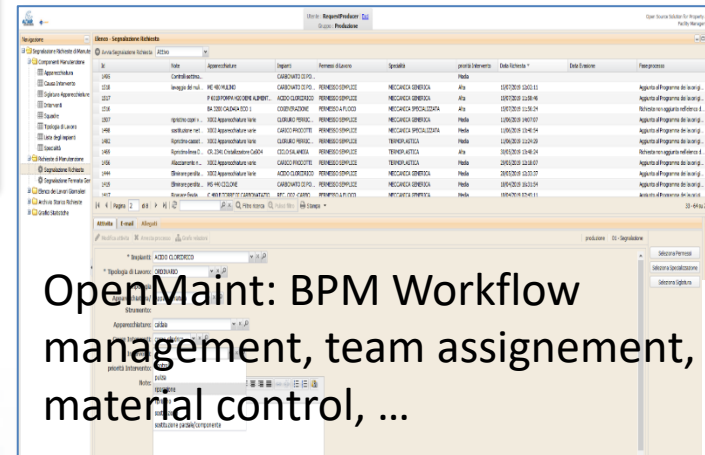
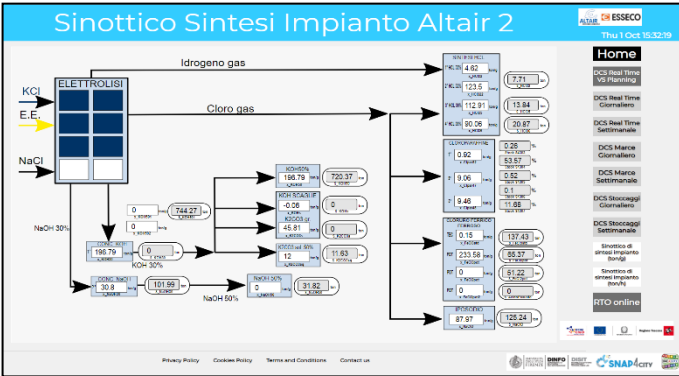
Events/actions

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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DISTRIBUTED SYSTEMS
AND INTERNET
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			
1-0000Z	Last value	Last 4 hours	Last 24 hours	Last 7 days	Last 30 days	Last 6 months
	Last value	Last 4 hours	Last 24 hours	Last 7 days	Last 30 days	Last 6 months
	Last value	Last 4 hours	Last 24 hours	Last 7 days	Last 30 days	Last 6 months

Last Value | Time Trend Chart: totale_casi - 6 months

base value $f(x)$

0.8809 0.8814 0.8819 0.8824 0.8829 0.8834 0.8839 0.8844 0.8849 0.8854 **0.89** 0.8859 0.8864

higher ↔ lower

S4304 S871 S854 RedoxFeCl3Pot diff_S904B diff_S854 S484 S851



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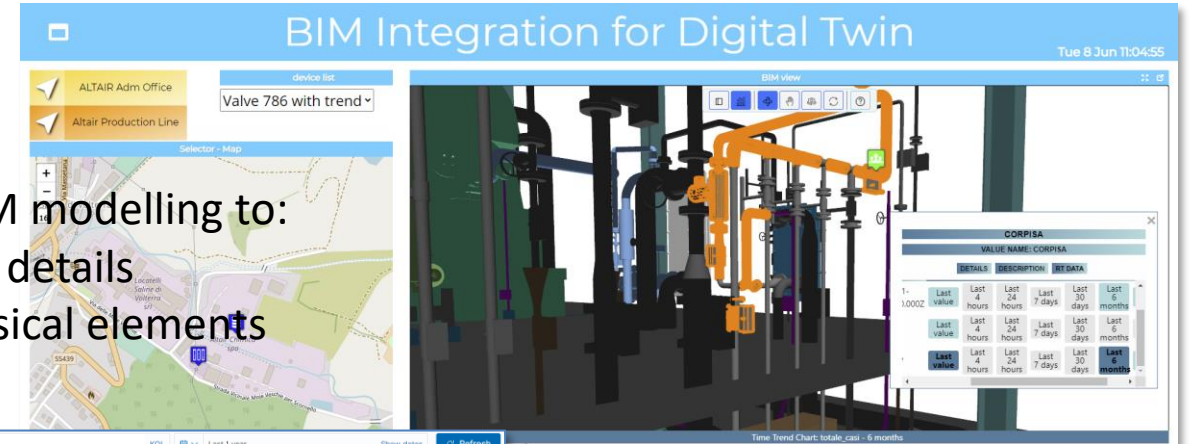
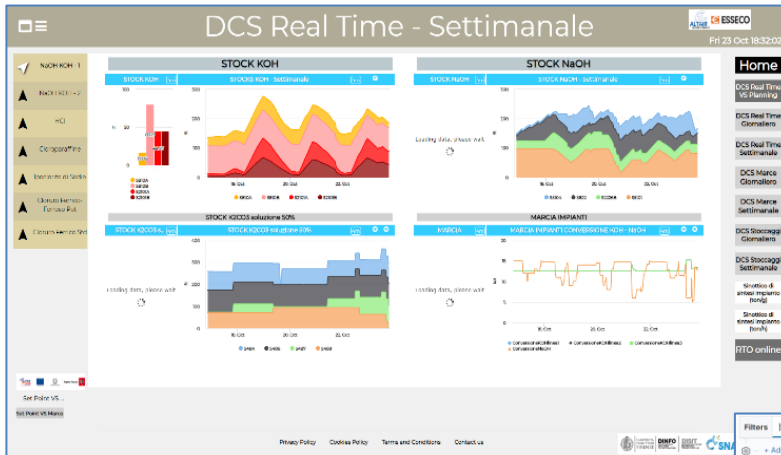
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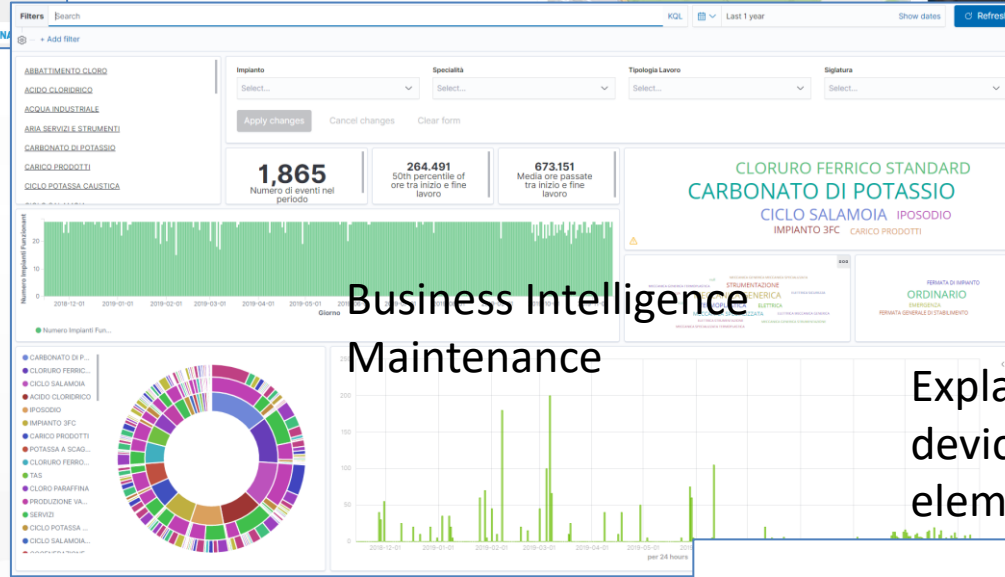
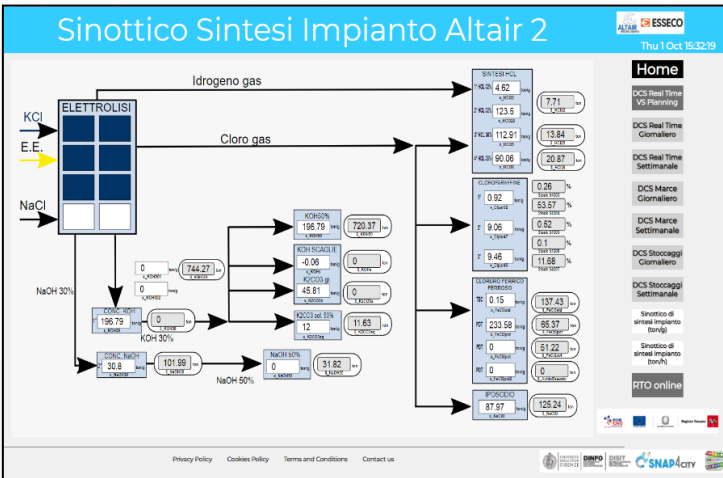
Closing the loop



Map and 3D BIM modelling to:
-- represent the details
-- associate physical elements with data

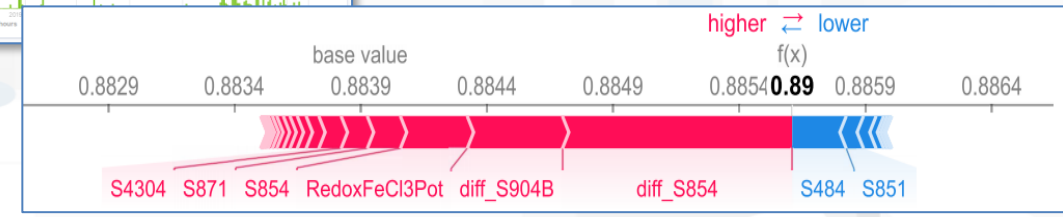
Historical and Real Time Data

Synoptics for real time monitoring



Business Intelligence
Maintenance

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==>

TOP

References



2023 booklets



- Smart City



https://www.snap4city.org/download/video/DPL_SNAP4CITY.pdf

- Industry

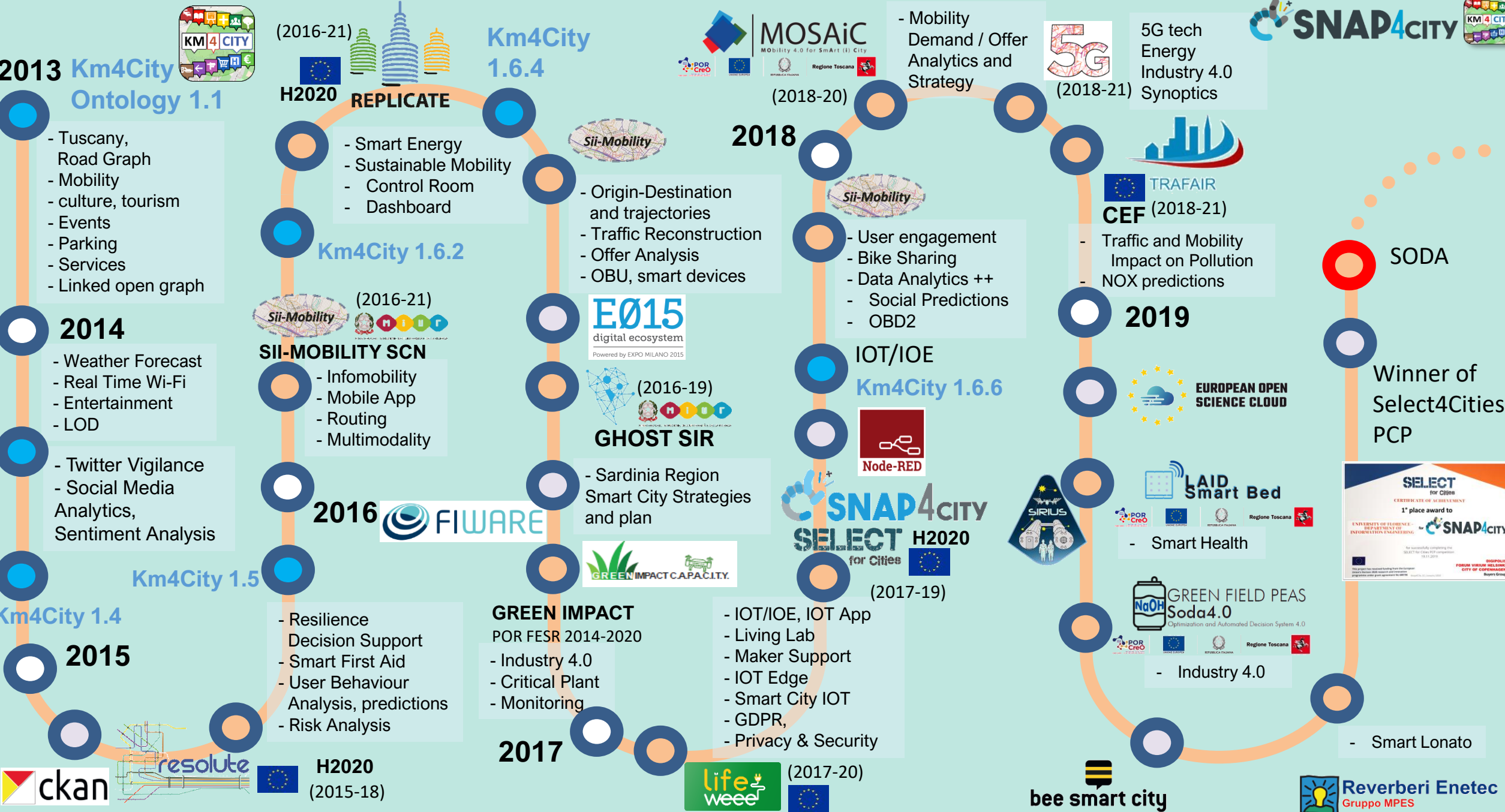


https://www.snap4city.org/download/video/DPL_SNAP4INDUSTRY.pdf

- Artificial Intelligence



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



(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

Km4City 1.5

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

MOSAiC (2018-20) - Mobility Demand / Offer Analytics and Strategy

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

E015 digital ecosystem Powered by EXPO MILANO 2015

(2016-19) GHOST SIR

- Sardinia Region Smart City Strategies and plan

GREEN IMPACT CAPACITY. POR FESR 2014-2020

2017

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

(2017-20) life weee

2018

- User engagement
- Bike Sharing
- Data Analytics ++
- Social Predictions
- OBD2

IOT/IOE Km4City 1.6.6

Node-RED

SNAP4CITY SELECT for Cities H2020 (2017-19)

- Smart Waste

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

TRAFAIR CEF (2018-21)

- Traffic and Mobility Impact on Pollution
- NOX predictions

2019

EUROPEAN OPEN SCIENCE CLOUD

LAI Smart Bed

- Smart Health

GREEN FIELD PEAS Soda4.0 Optimization and Automated Decision System 4.0

- Industry 4.0

bee smart city



SODA

Winner of Select4Cities PCP

SELECT for Cities CERTIFICATE OF MERIT 1st place award to SNAP4CITY

Smart Lonato

Reverberi Enetec Gruppo MPES

DISIT lab roadmap vs model and tools' usage



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



Contract

2021

PC4City (2020-21)
Monitoring Terrain

Winner of Open Data Challenge of
enel x

CAPELON

- 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



Contract, 2022-23

2023



Contract, 2022-23



2022-2023



Security and Risk



2024



Italferr, Smart City



CN MOST, 2022-26



EI THE, 2022-26



G. Agile, 2021-23



2023-26



Merano, smart light

OceanRace,
Genova, AWS

Cuneo,
smart city

TOURISMO



Co-funded by
the European Union



AMMIRARE

ELLIE IA
2025-2027



Contract, 2024-25

CAI4DSA



Rhodes,
smart city

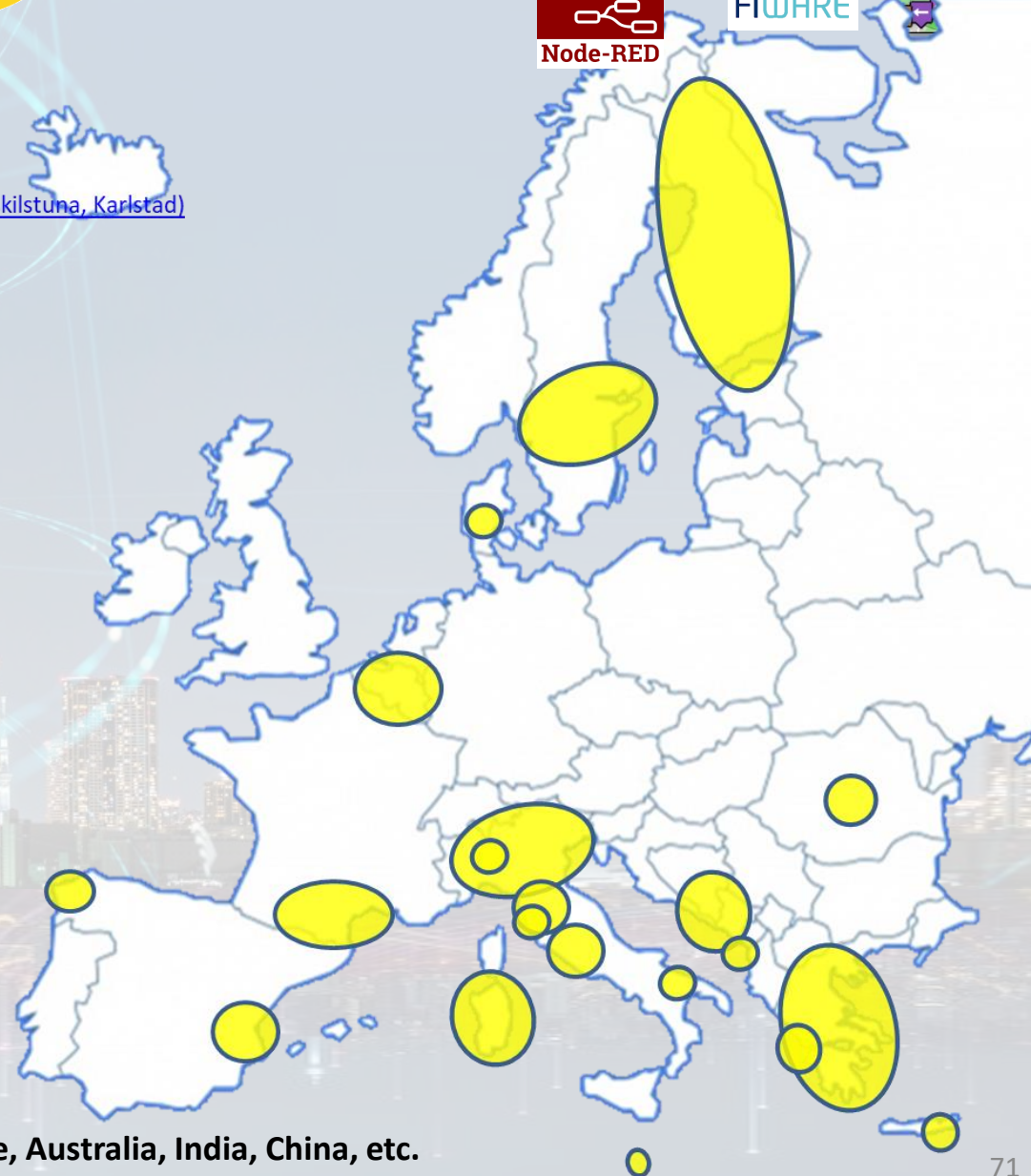
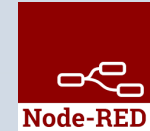
eShare
UNIFI TUSS



PEN Test
Passed



EU GDPR
COMPLIANT



Main Organizations/areas

- [Antwerp area \(Be\)](#)
- [Bari \(I\)](#)
- [Bisevo, Croatia](#)
- [Bologna \(I\)](#)
- Brasov (Ro)
- [Capelon \(Sweden: Västerås, Eskilstuna, Karlstad\)](#)
- [Cuneo \(I\)](#)
- [DISIT demo \(multiple\)](#)
- [Dubrovnik, Croatia](#)
- [Firenze area \(I\)](#)
- [Garda Lake area \(I\)](#)
- [Greece \(Gr\)](#)
- [Helsinki area \(Fin\)](#)
- [Limassol \(Cy\)](#)
- [Livorno area \(I\)](#)
- [Lonato del Garda \(I\)](#)
- Malta (Malta)
- Merano (I)
- [Modena \(I\)](#)
- [Mostar, Bosnia-Herzegovina](#)
- [Oslo & Padova \(Impetus\)](#)
- [Pisa area \(I\)](#)
- [Pistoia \(I\)](#)
- [Pont du Gard, Occitanie \(Fr\)](#)
- [Prato \(I\)](#)
- [Rhodes \(Gr\)](#)
- [Roma \(I\)](#)
- [Santiago de Compostela \(S\)](#)
- [Sardegna Region \(I\)](#)
- [Siena \(I\)](#)
- SmartBed (multiple)
- [Toscana Region \(I\), SM](#)
- [Valencia \(S\)](#)
- [Venezia area \(I\)](#)
- [WestGreece area \(Gr\)](#)

- 11 running installations in Europe
 - Snap4.city.org, Greece, Merano, Cuneo, ...
 - Toscana, Pisa, Sweden, ISPRA, Snap4.eu,
 - Altair, Italmatic, Romania,
- 16 projects, 12 pilots on 10 Countries
 - >40 cities/area
- **Widest MULTI-tenant deploy has**
 - 24 Organizations / tenant
 - > 8850 users on
 - > 1800 Dashboards
 - > 17 mobile Apps
 - **> 2.2 Million of structured data per day**
 - > 580 IoT Applications/node-RED
 - > 750 web pages with training
 - > 75 videos, training videos

• + Israel, Colombia, Brasile, Australia, India, China, etc.

TOP



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SMARTCITY

EXPO WORLD CONGRESS

7-9 November 2023, Barcelona, Spain

Visit Snap4City in Hall 1

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