SNAP4CITY

www.snap4city.org
www.snap4solutions.org

UNIVERSITÀ DEGLI STUDI FIRENZE
DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE
DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

KM4CITY

www.km4city.org

Challenges and opportunities within urban networks: the Snap4City Platform Best Practices

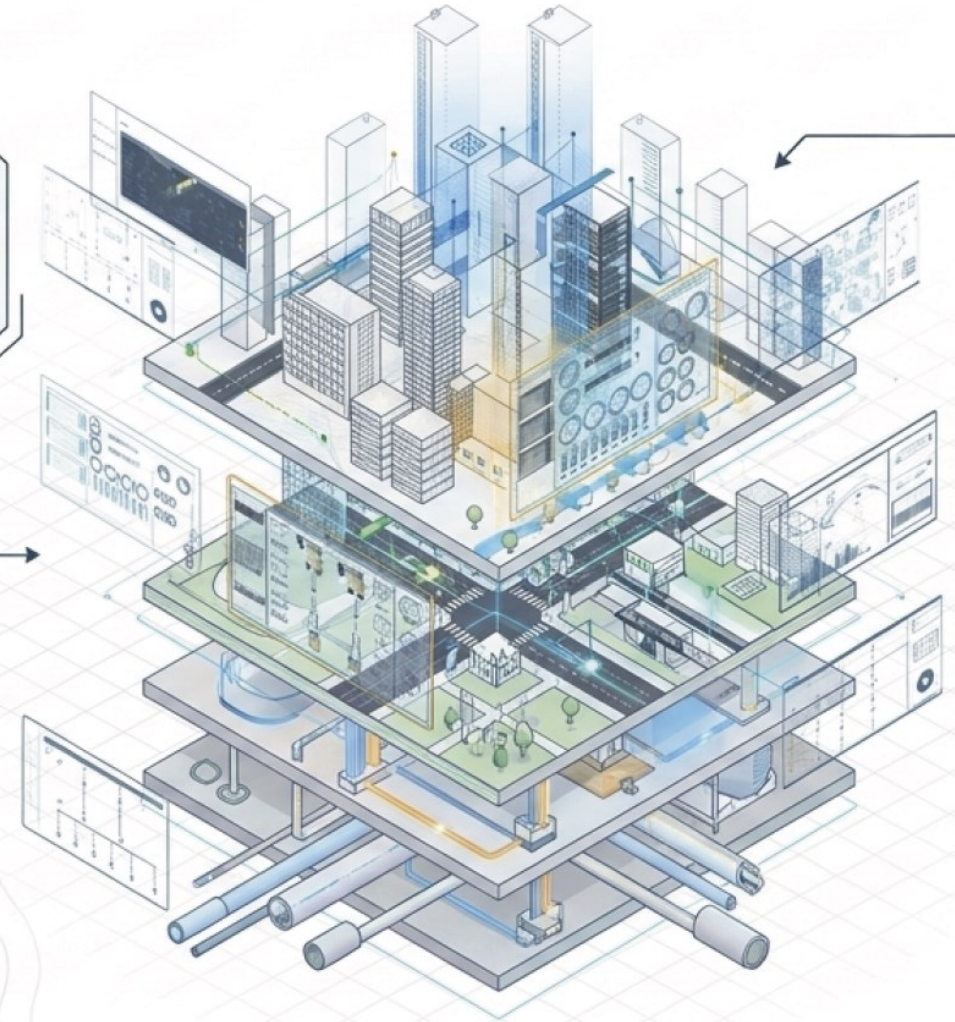
Paolo.Nesi@unifi.it

AI Digital Twin Platform to set-up Sustainable Decision Support Systems & Business Intelligence

#snap4city
#km4city
#disitlab
@snap4city

Shattering Silos with Global 3D Digital Twins

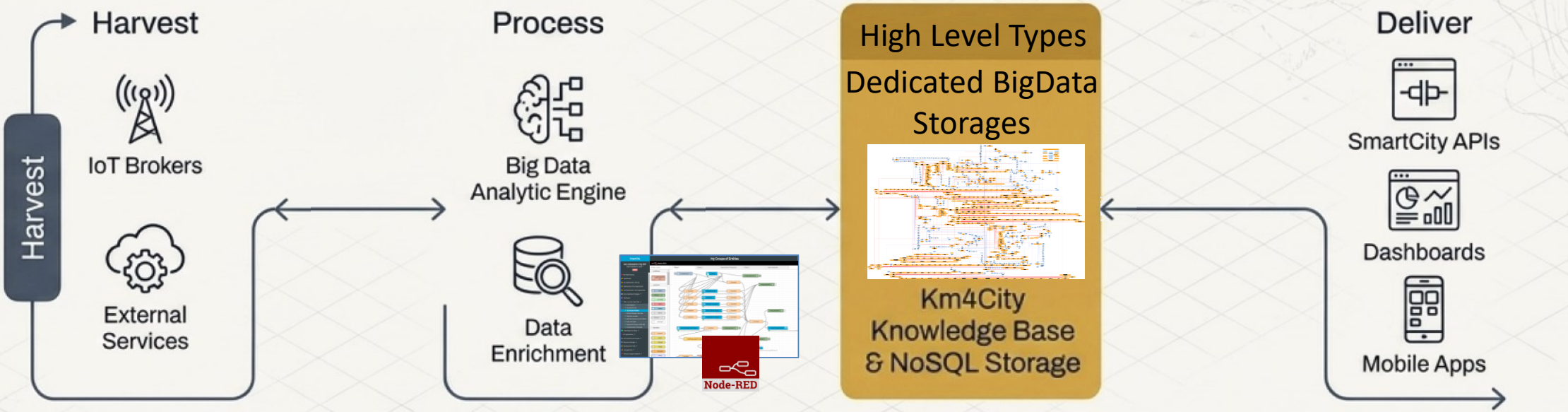
A multi-domain, multi-tenant platform designed to ingest any data type while respecting its original semantic meaning.



Transitions urban management from reactive, event-driven monitoring to proactive, holistic 3D simulation.

Unifies the fragmented city into a single, highly searchable and actionable Knowledge Base.

End-to-End Intelligence Architecture



The entire pipeline ensures strict GDPR compliance, encompassing robust authentication and authorization at every level.

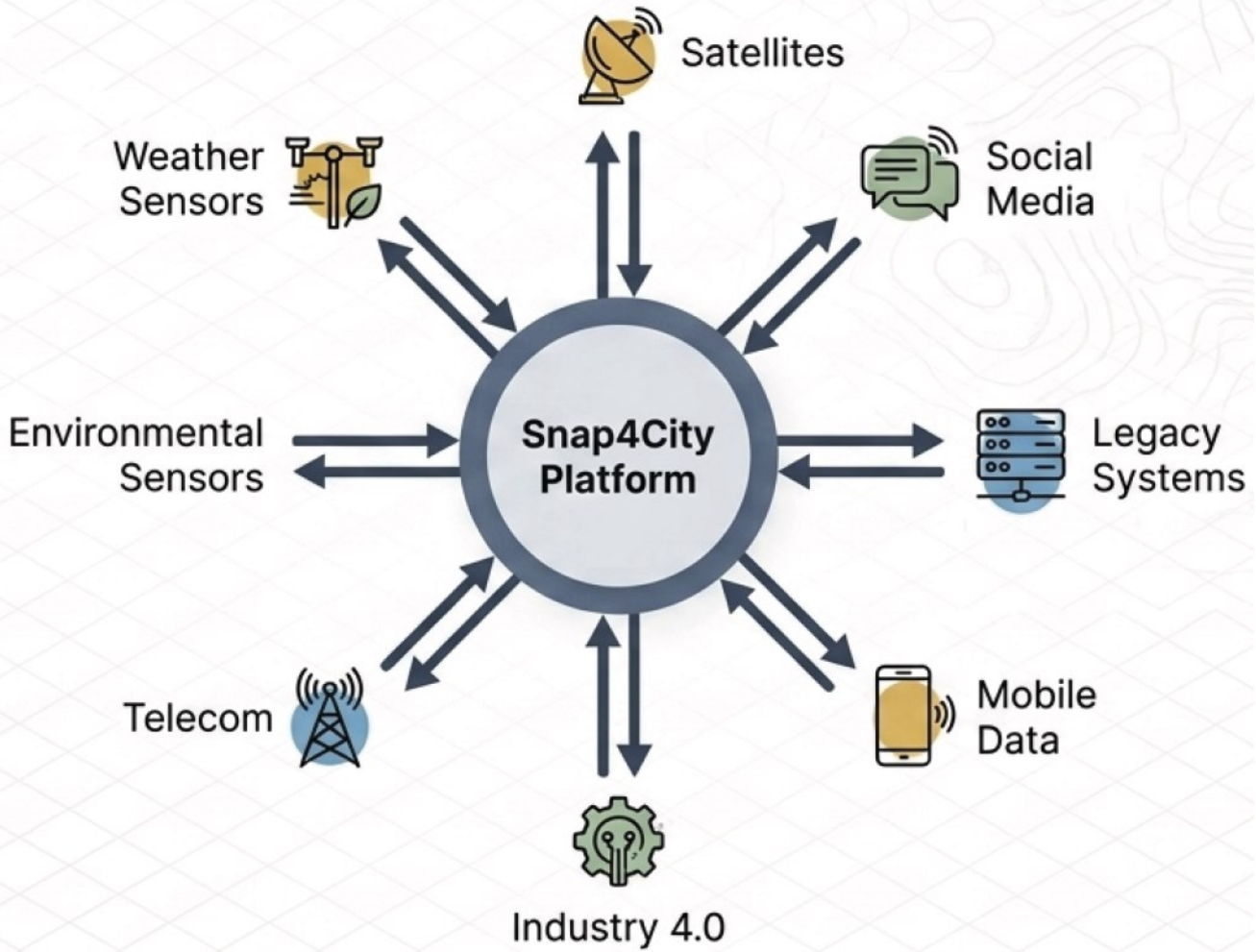
Universal, Bidirectional Data Ingestion

Protocol Agnostic

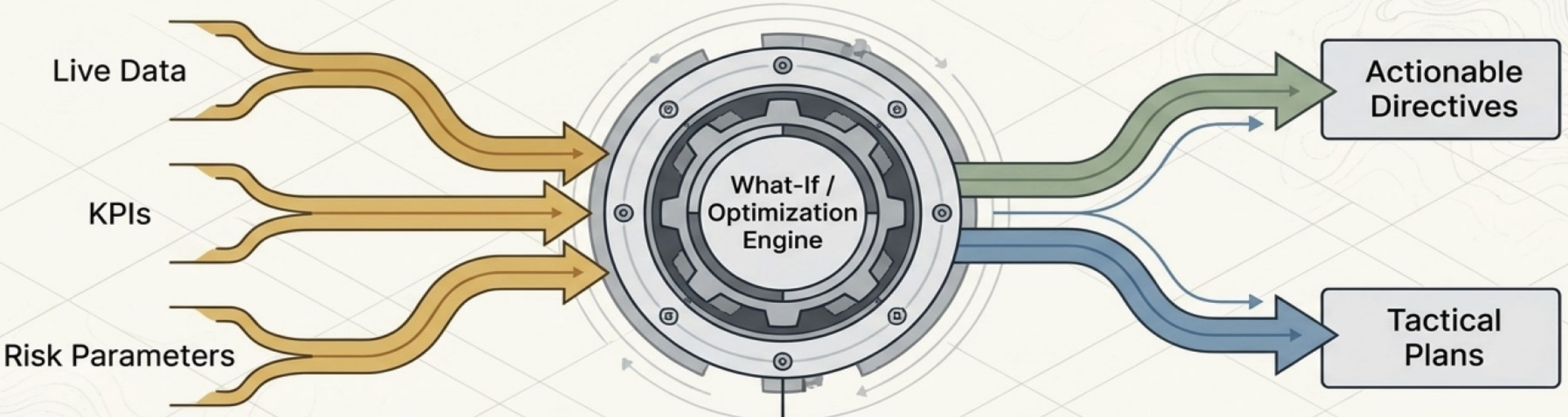
Seamlessly adapts to existing IoT networks, legacy databases, proprietary vendor solutions, and Open Data portals.

Bidirectional Capability

Snap4City does not merely read data; it actively produces and pushes entities, prescriptions, and warnings back through any channel or protocol.



Decision Support Systems

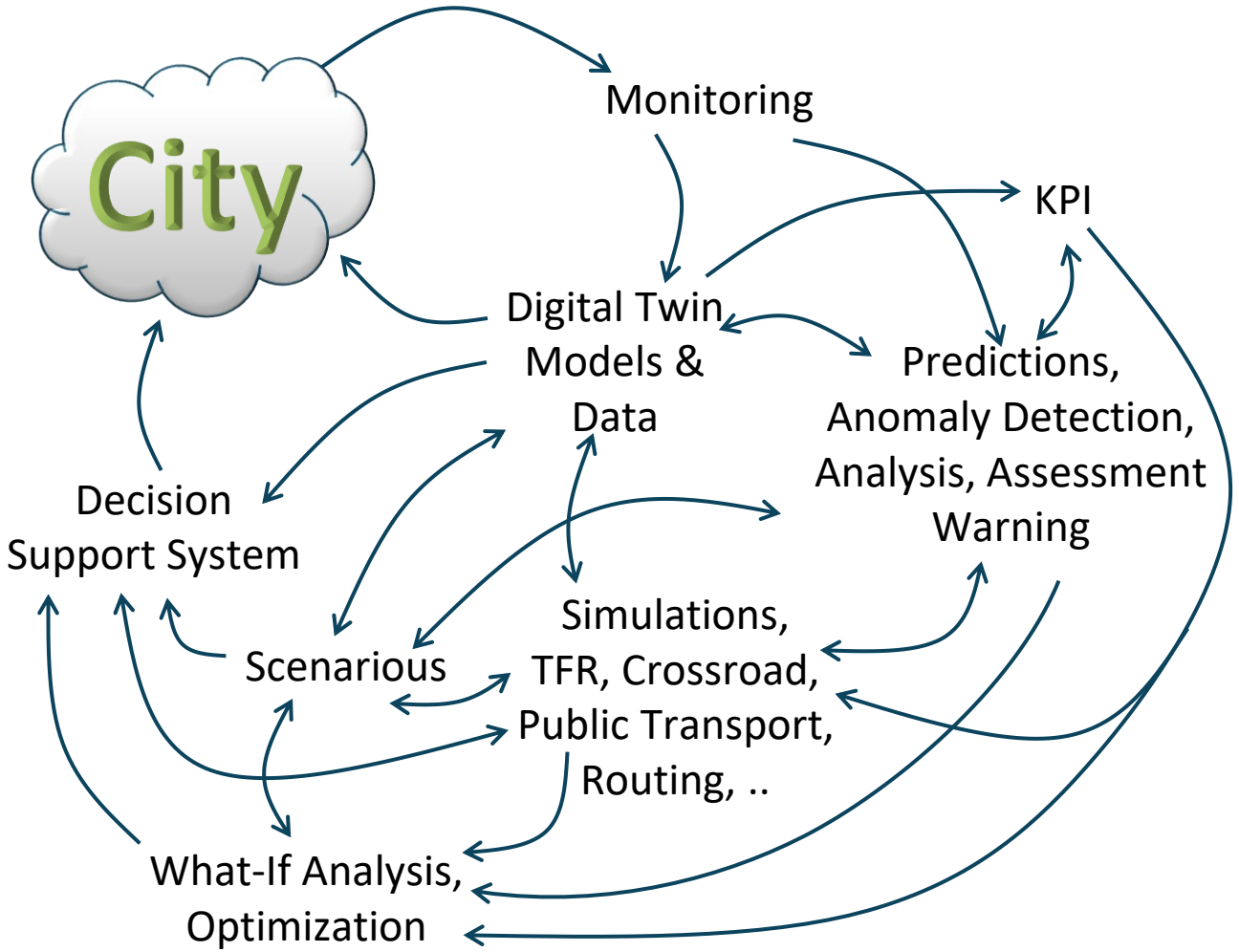


What-If Analysis:
Grounded on robust predictive algorithms and simulations.

Scenario-Based Optimization:
Test traffic light plan optimizations digitally. Evaluate major traffic infrastructure changes. Assess tactical risks and generate prescriptions before spending public funds.

Main tasks

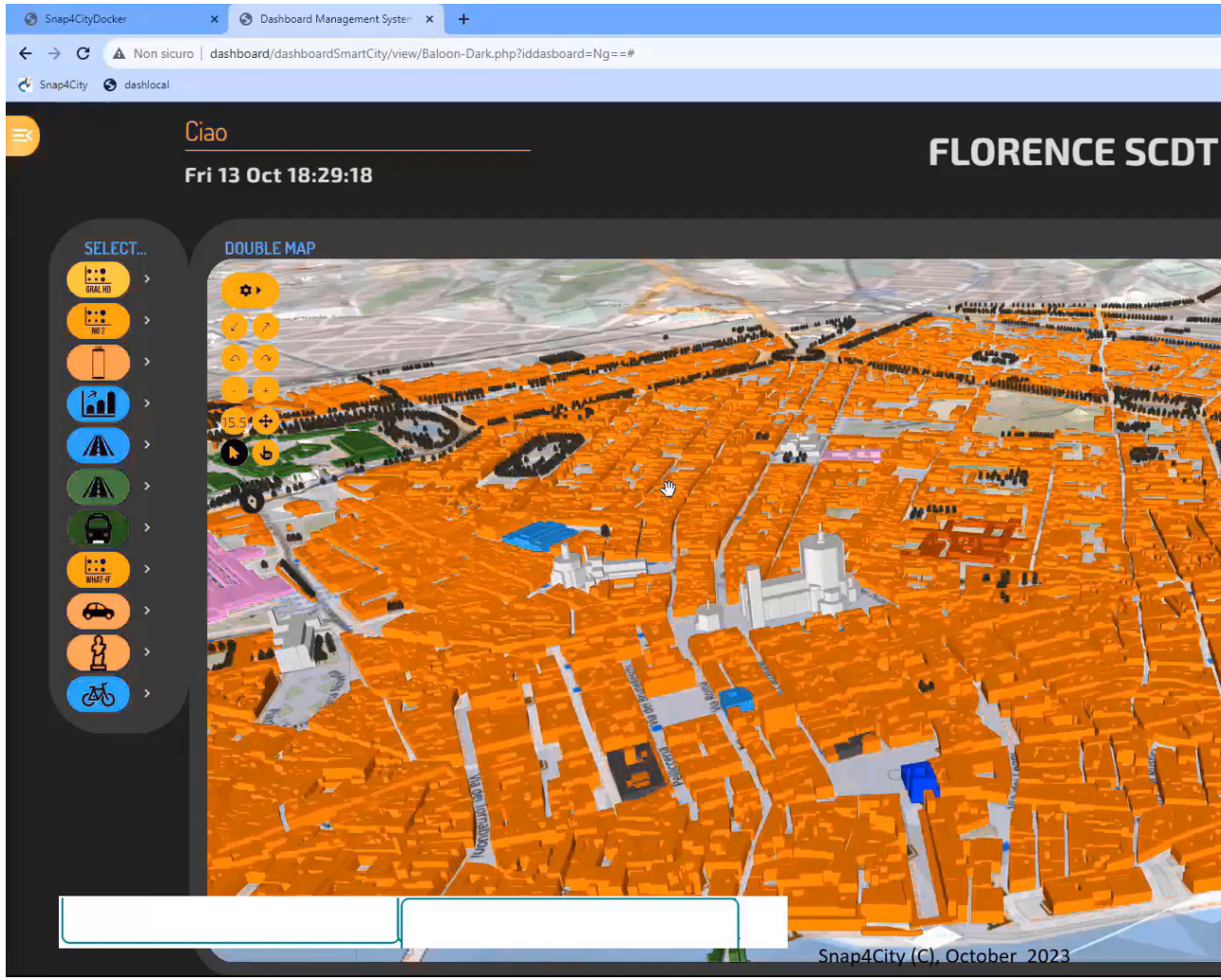
- **Controlling Status: management, and operational**
  - Monitoring via KPI
  - Predictions vs KPI
  - Anomaly detection
  - Neuro-Symbolic analysis
  - Risk assessment
  - Early warning on critical conditions
  - Fast What-if analysis
- **Making plan: tactic and strategic, medium and long range, micro/macro**
  - Simulation & optimization
  - Generative AI Prescriptions, scenarios
  - Resilience to Unexpected unknows
  - What-if analysis wrt scenarios
  - Collaboration with stakeholders



Digital Services and Offering: Digital Twin

Operation and Planning tool

- **What-IF analysis – Simulation, prediction, 2D/3D**
- **Operation, planning tactic and strategic / optim.**
- Key Performance Indicators, any kind
- Micro, Meso e macro scales
- Interactive Data Representation, any kind
- Any Data TYPE, any data source, any protocol
- Data analytics → artificial intelligence, AI/XAI
- Data Ethics, AI Ethics, GDPR
- Sustainable, shared, open source 100%



100% OPEN SOURCE

THE POWER OF ARTIFICIAL INTELLIGENCE AT THE SERVICE OF YOUR OPERATION AND PLAN

SNAP4CITY KM4CITY

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Powered by FIWARE

FREE TRIAL

PEN Test Passed

EU GDPR COMPLIANT

SNAP4 Appliances and Dockers Installations

EUROPEAN OPEN SCIENCE CLOUD

Node-RED

JS Foundation

EØ15 digital ecosystem

NVIDIA

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

HORIZONTAL AI PLATFORM

MOBILITY AND TRANSPORT

SMART ENERGY AND SMART BUILDING

ENVIRONMENT AND WASTE MANAGEMENT

CITY USER'S SERVICES AND TOURISM MANAGEMENT

SNAPADVISOR

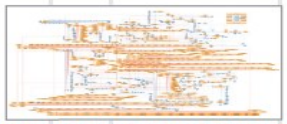
BUSINESS INTELLIGENCE - SIMULATIONS - VISUAL ANALYTICS - SYNOPTICS - GRAPHICAL WIDGETS - ANALYTICS

DASHBOARDS, WIDGETS
TEMPLATES

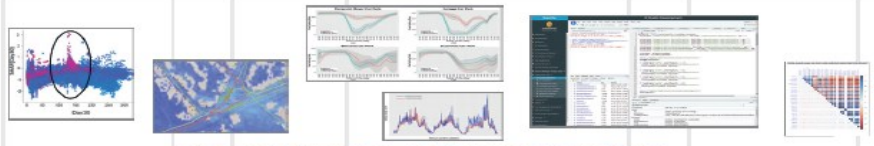
PREDICTION - ANOMALY DETECTION - CLUSTERING - ROUTING - SENTIMENT NLP - TRAFFIC FLOW - PEOPLE FLOWS - SDG
15 MIN CITY INDEX - KPI - HEATMAPS - ORIGIN DESTINATION - MAPS - VECTOR FIELD - ETC...

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

- DEVELOMENT ENVIRONMENT AND METHODOLOGY
- VISUAL PROGRAMMING, ML, AI, HPC
- TRAINING COURSES



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



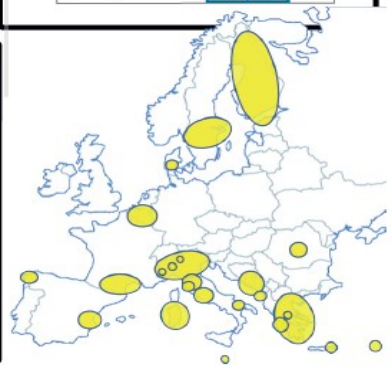
BIG DATA ANALYTICS, ARTIFICIAL INTELLIGENCE
EXPLAINABLE AI, MACHINE LEARNING, GENERATIVE AI
OPERATIVE RESEARCH, STATISTICS

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

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

NATIVE AND EXTERNAL APPLICATIONS

- Smart Parking
- Smart Light
- Smart Waste
- Smart Energy
- Smart Building
- Smart Tourism
- ...



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/

Mobility and Transport Goals

Decongestion

Safety

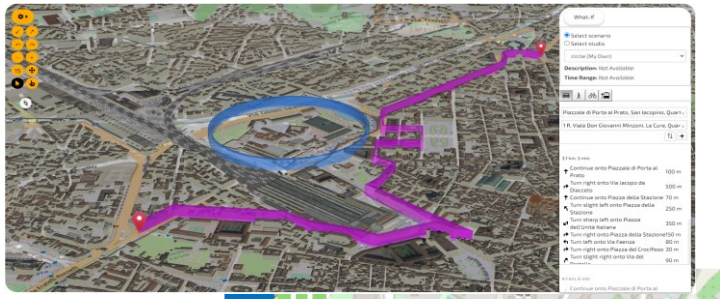
Accessibility

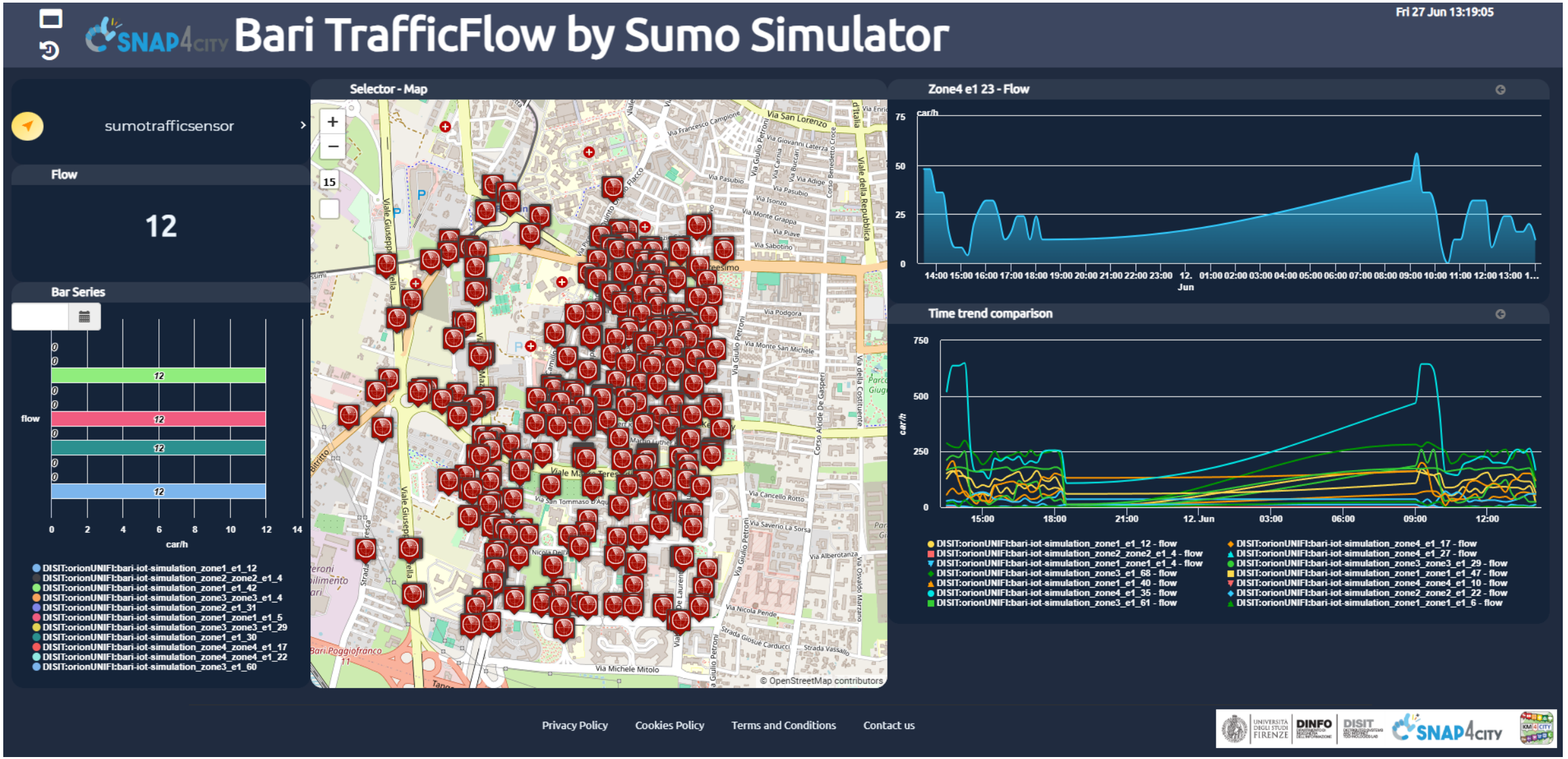
Cost Reduction

Decarbonization

Mobility & Transport

- **Goals:**
  - Decongestion, Decarbonization, costs reductions
  - Improve Accessibility to services
  - Improve Security/Safety of city users
- **Operation and Plan**:
  - Traffic monitoring, prediction, reconstruction, identification of critical conditions (early warning), fleet management, dynamic routing, multimodal routing, city user behaviour analysis
- **Optimization and what-if analysis traffic light plans, infrastructure**
  - **Reduction**: travel time, waiting time, # stops, CO2 emissions, consume fuel, travel time for tramways and busses
- **Public Transport**: analysis of Mobility Demand vs Offer of Transportation
- **Parking Management:** monitoring, prediction, any payments, on/off-road
- **Sharing / Pooling Management**: eShare and mobile app, bikesharing, smart bike, fleet management
- **KPI:** SUMI/SUMP, travel time, emissions, traffic status, accessibility, ..
- **Mobile App**: final users and operators
  - Info Mobility, traffic reconstruction, charging, participation,
  - Parking, payments, overparking, fine reporting, ..
- **Participatory**: problem reporting, ticketing, etc.
- **Data Integration of any kind: env, weather. Tickets, presences, POI, sat, etc.**




Bari TrafficFlow by Sumo Simulator
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Privacy Policy
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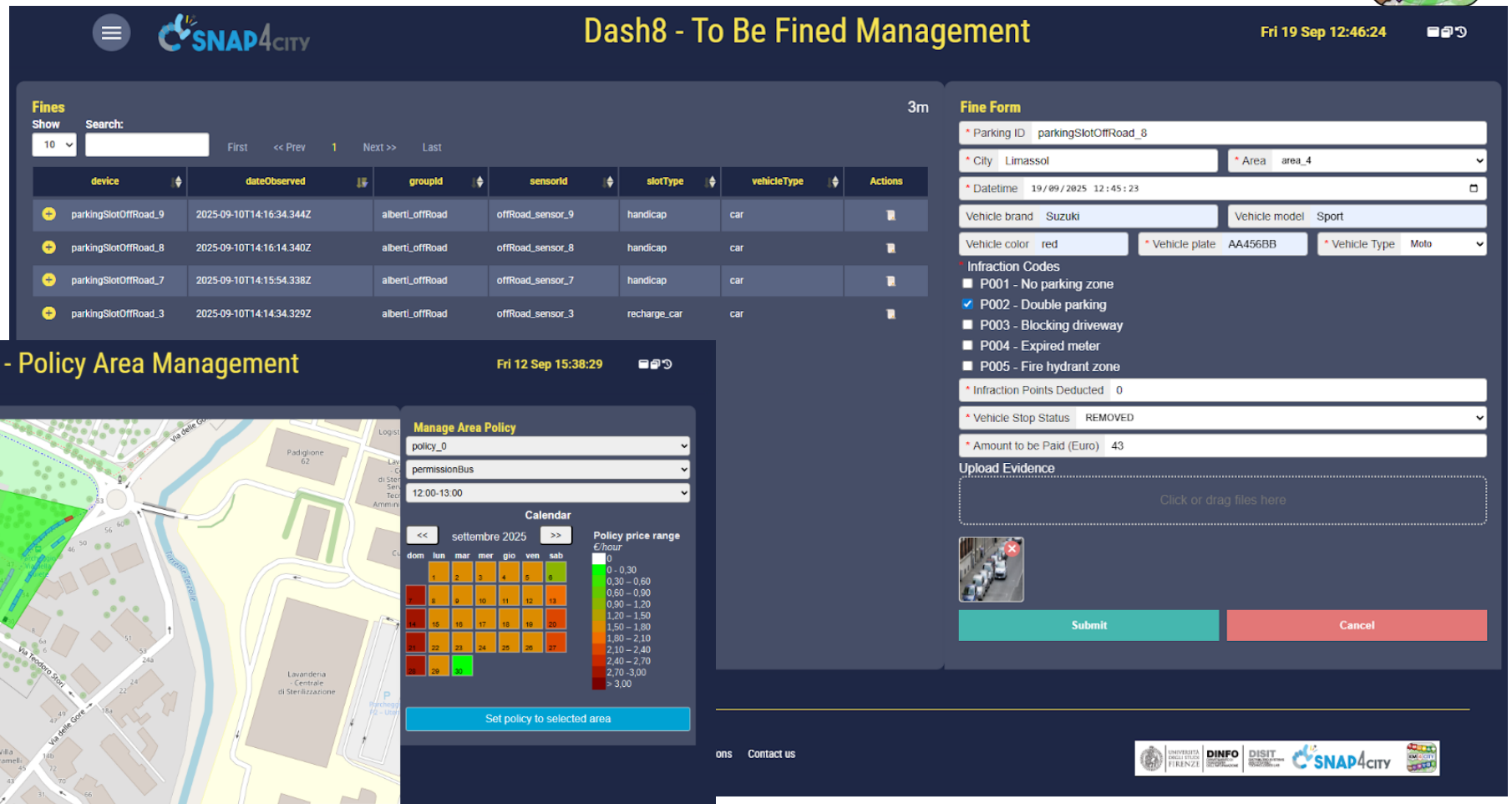
Snap4Parking

Smart Parking

-- payments, profiles

-- Fines

-- mobile for parking



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SNAP4CITY KM4CITY

Traffic Simulation-K8S

Sun 22 Jun 11:53:30

Ext

STOP PAUSE HELP

slow fast

Delay: 30.0 ms

Stats

time: 0.000 s
payload: 0.0 KB
simulate: 0.00 ms
snapshot: 0.00 ms

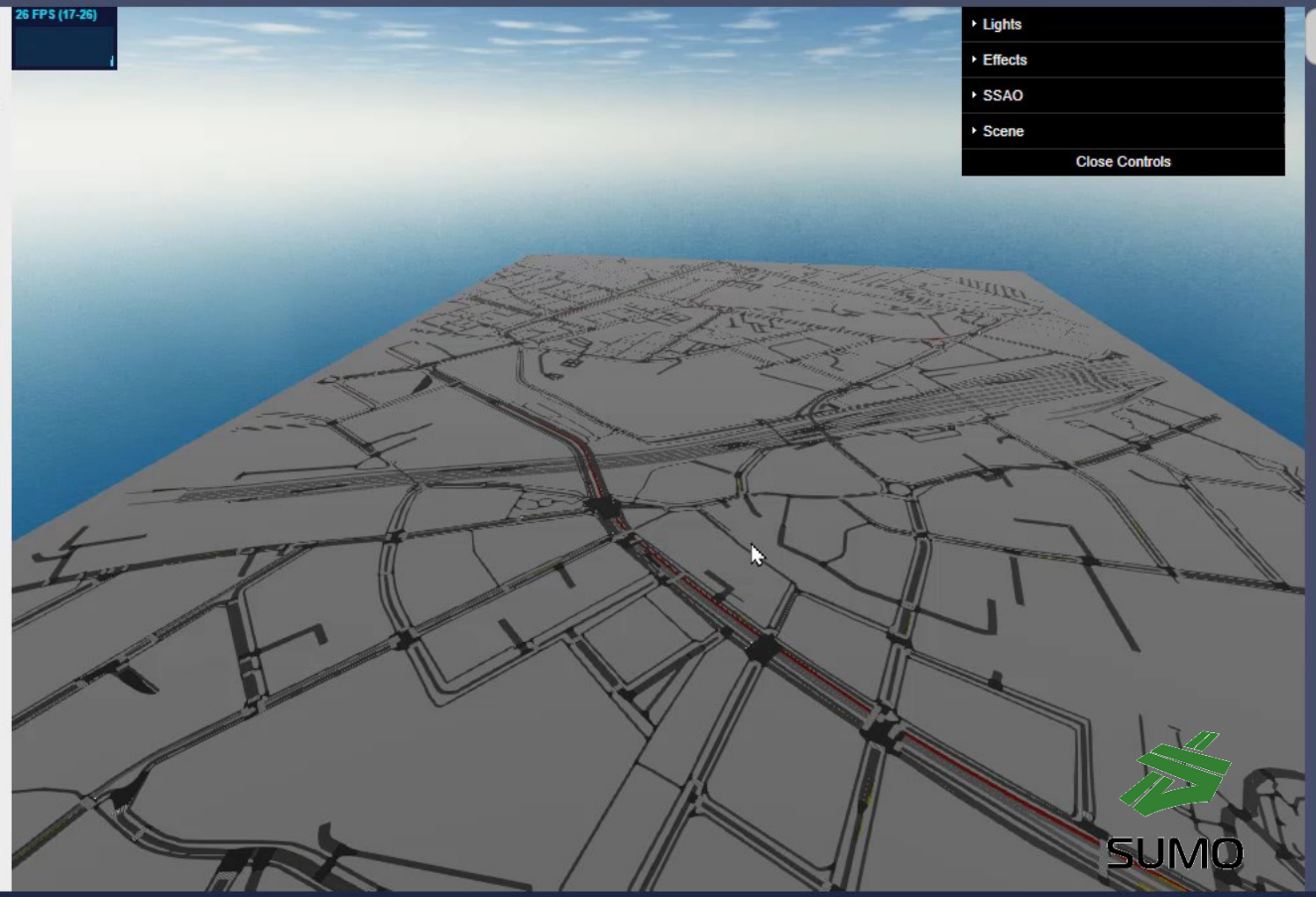
Vehicle Summary

Quick Find

ID Edge / Lat, Long (float, float) / X,Y (int, int)

SEARCH

CAR BIKE TRAIN TRAM PERSON BUS LIGHT



Wid

Prepare Simulation | Execute Simulation | KPI Simulation

Simulation:

firenzeodbus

Execute

Simulation: 2025/06/22 11:53:27

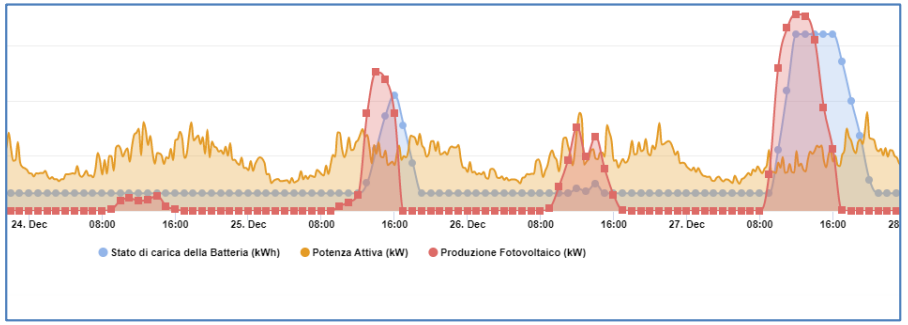
My Profile

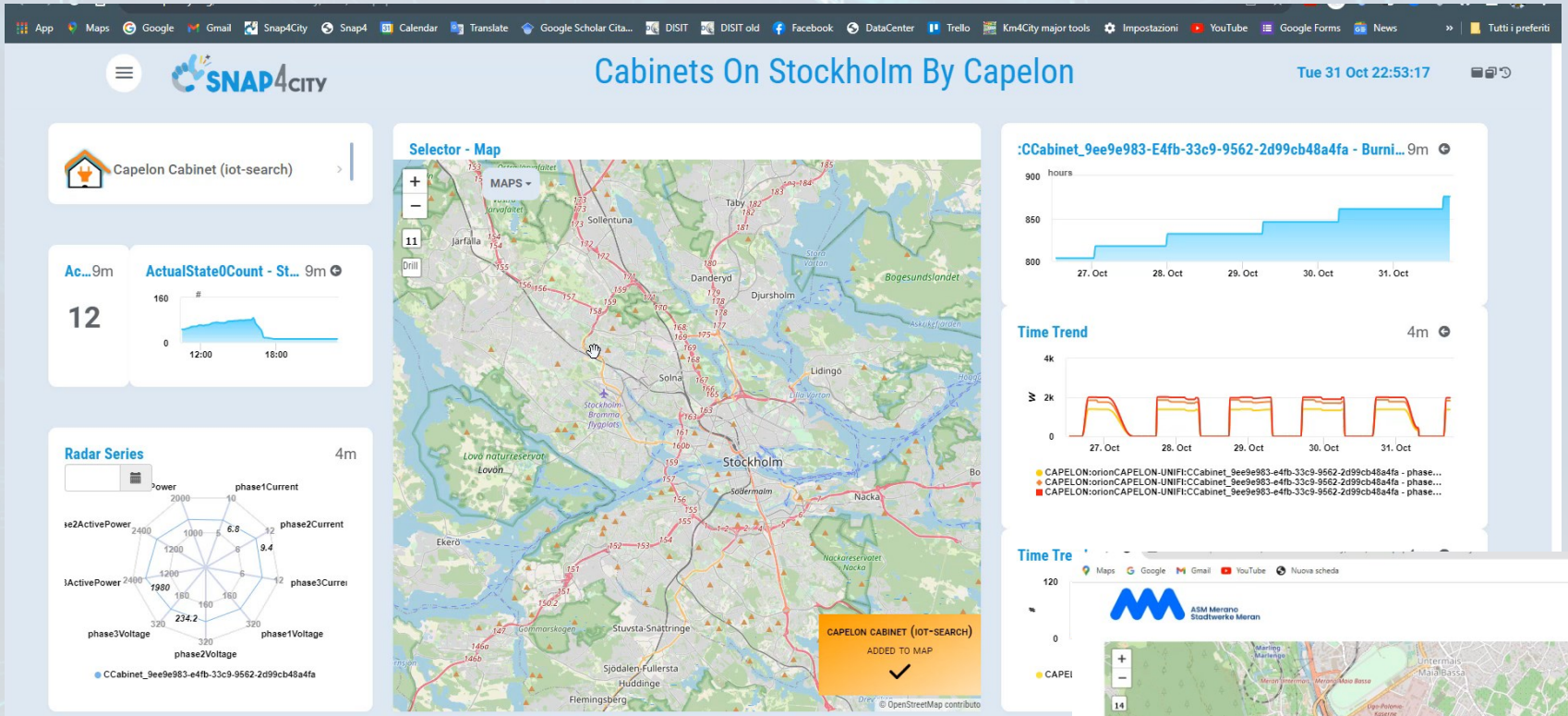
Smart Energy and Smart Building

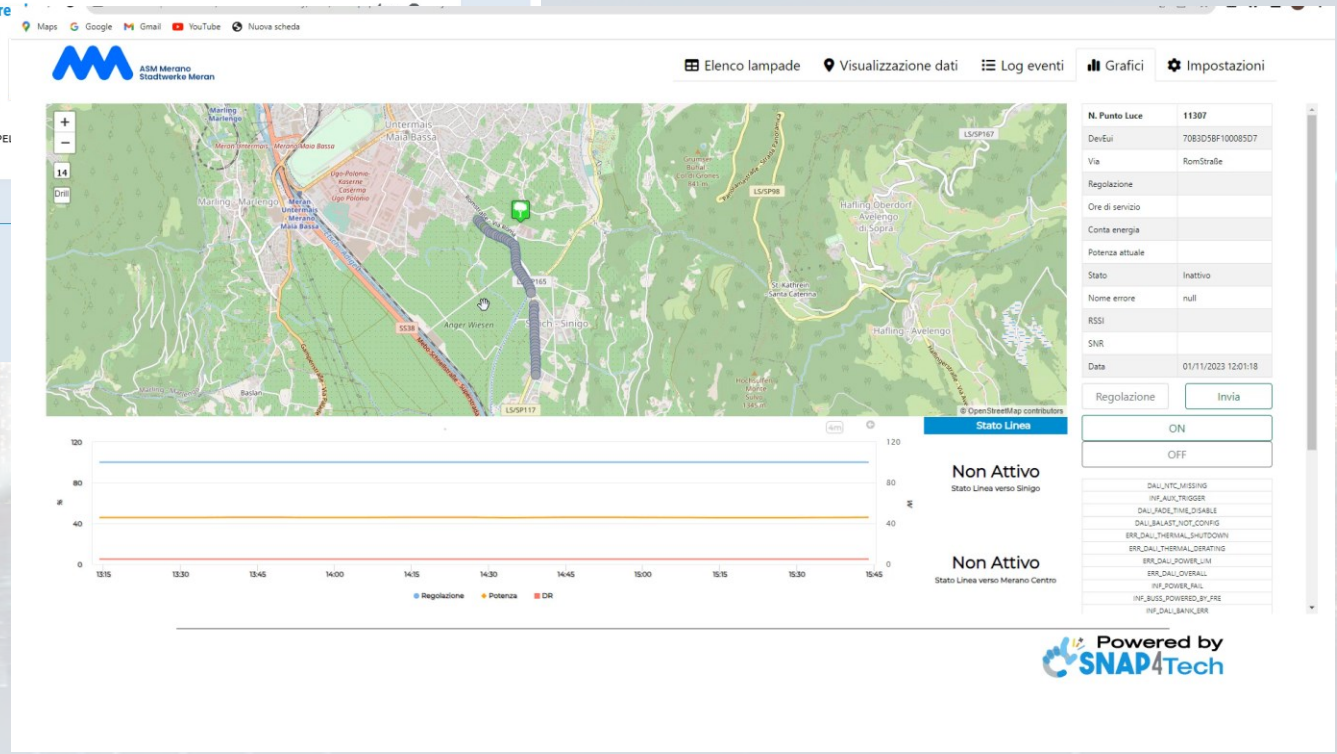
- Energy consumption reduction,
- increment of efficiency,
- Areas and building sustainability
- Improve accessibility to services,
- security and safety

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**







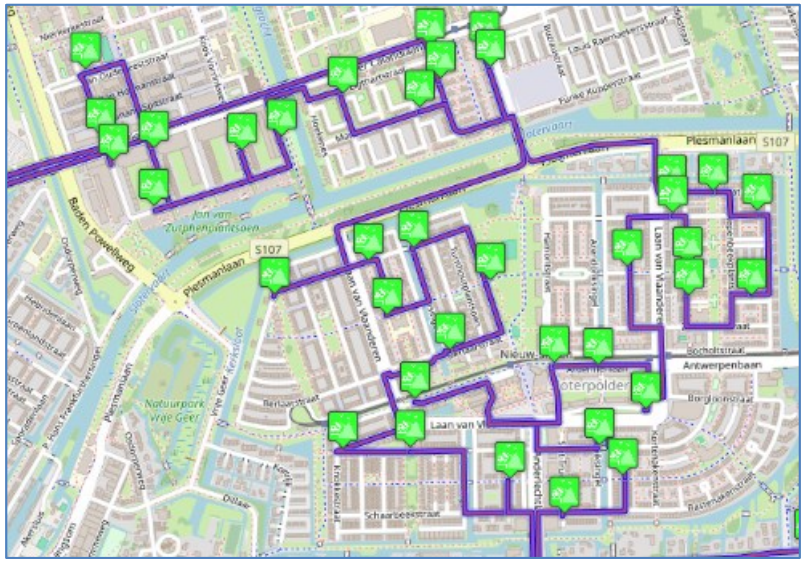
Smart Light Management

Environment and Waste Management goals

- *Control of emissions*
- *Reduction of emissions*
- *Early warning*
- *Meet the EC targets*
- *Reduction of EC taxation*

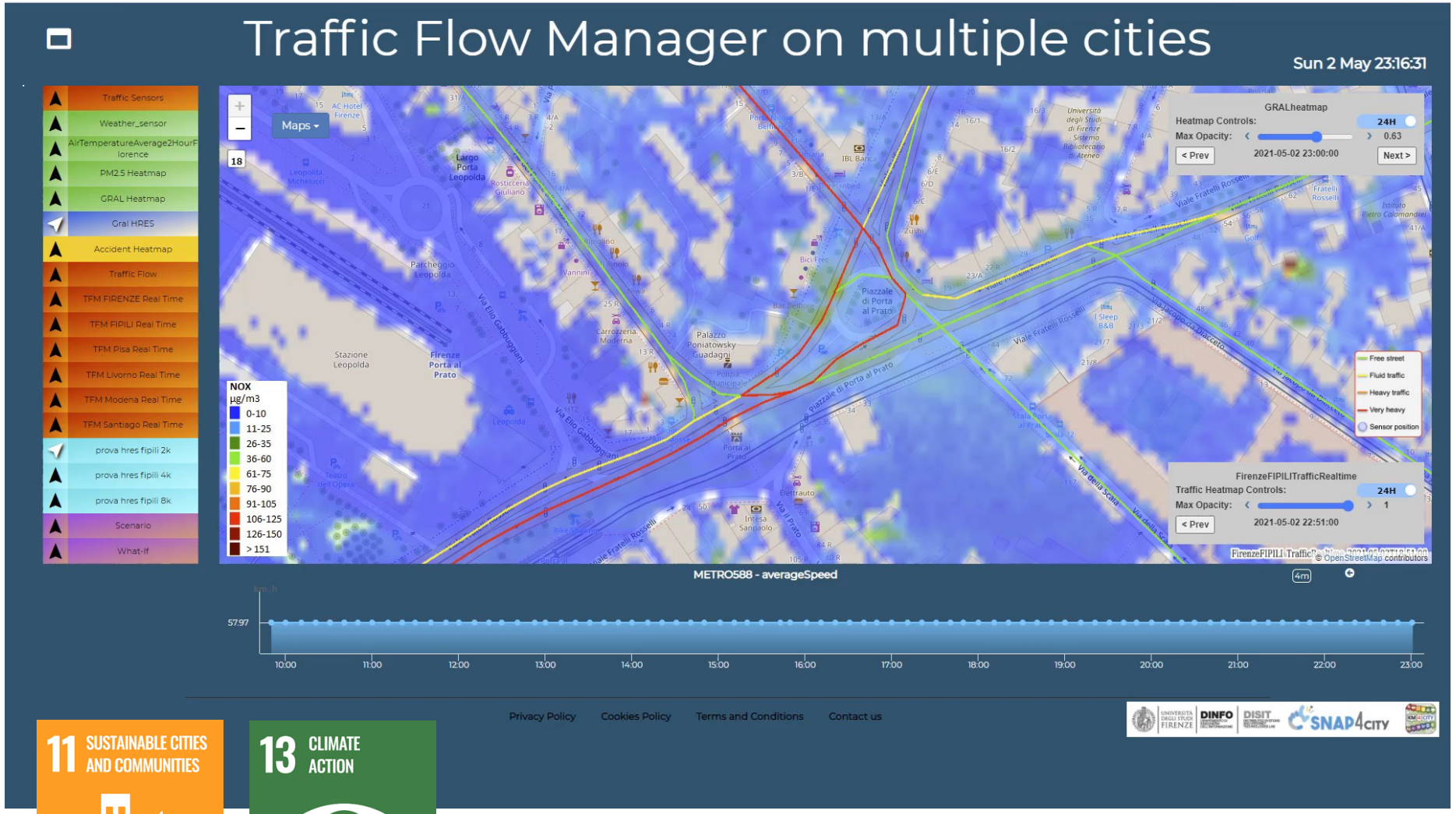
Environment and Waste

- **Goals:**
  - Reduction of emissions and EC taxations
  - Cost reduction for waste collection,
  - reduction of waste collection impact on mobility
- **AIR quality (Indexes) monitoring and warning**
- **Environment Management & producing predictions/prescriptions:**
  - Monitoring, long and short-term predictions, warning for:
    - GHG, emissions, pollutants, aerosol, chemical plants analysis
  - Traffic Flow impact emissions, predictions
  - Sea conditions, UV conditions, etc.
- **Land slide prediction warning**
- **Coastal erosion monitoring and analysis**
- **Smart Waste Management and Optimisation:**
  - costs reduction, optimal routing production, pay as you throw,
  - avoiding out of bins, predictions of waste production on bins, alarms
- **KPI:** SDG, 15MinCityIndex, QOS, costs, Km, colleting time, EC KPI, emissions
- **Mobile App**: final users services/informing and operators
  - Info Waste for operators, participation, optimal routing, RAEE Collection, ..
- **Participatory**: problem reporting, ticketing, etc.
- **Integration of any kind: env/weather, mobility, ticketing, presences, POI, ..**



Environment

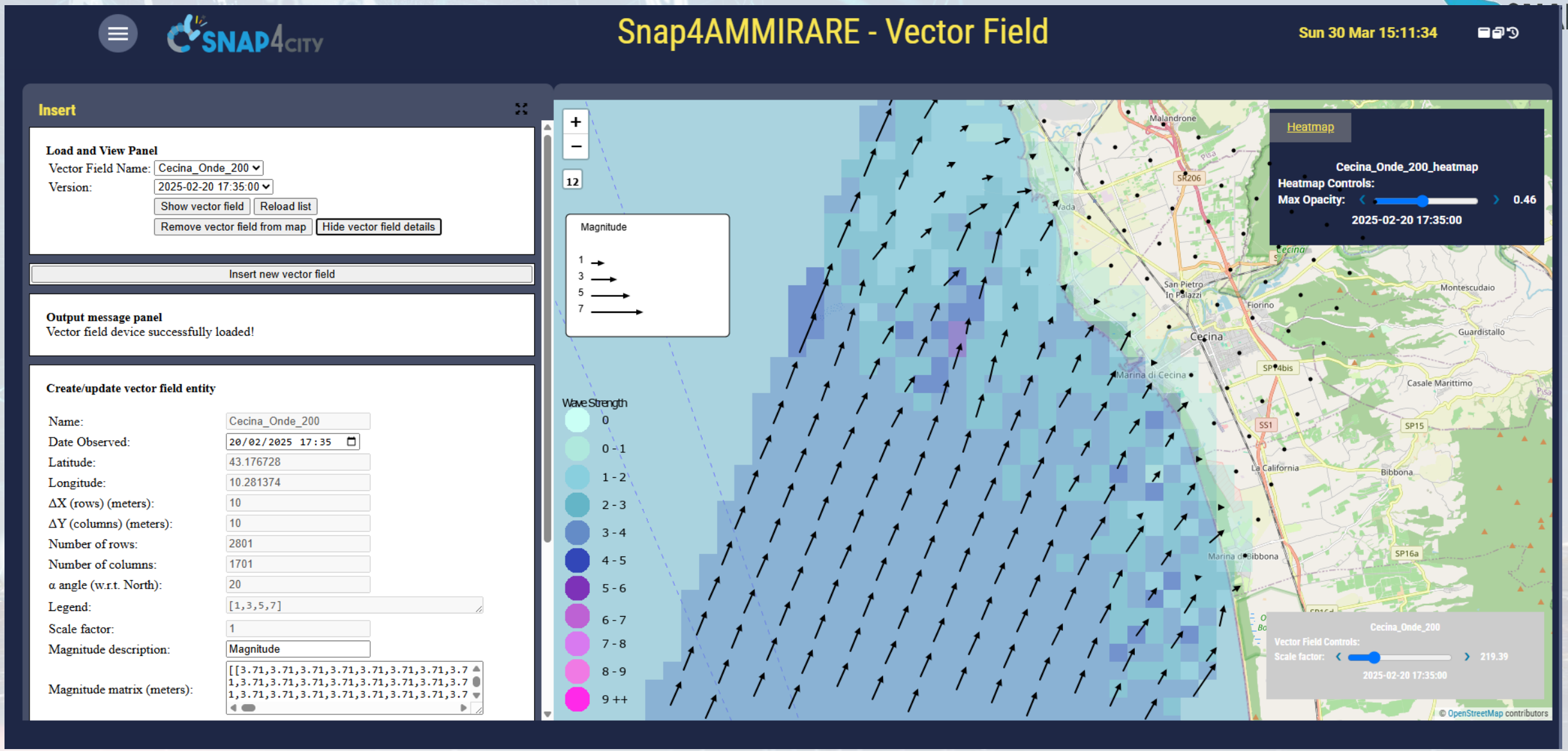
- **Prediction**
  - **NOX Pollutant** diffusion on the basis of Traffic Flow (prediction), weather and 3D structure
  - **NO2 progressive average** (Long term)
- **Project:**
  - **Trafair** CEF EC
  - Mixed solutions of Fluidinamics modeling and AI



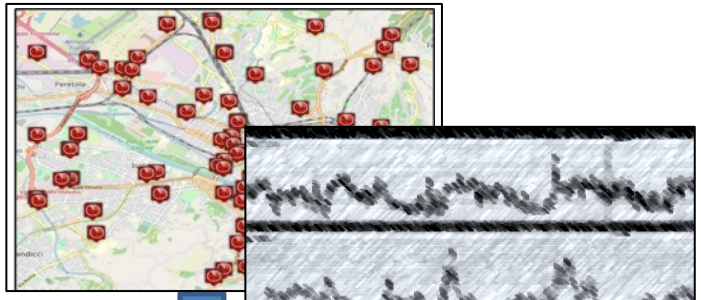
11 SUSTAINABLE CITIES AND COMMUNITIES

13 CLIMATE ACTION

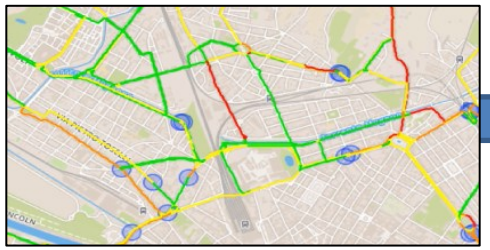
Monitoring Costal Bathymetry and Waves



Estimating City Local CO2 from Traffic Flow Data



Computing Traffic Flow into CO2 sensor area



Traffic Flow data

- Traffic Flow is one the main source of CO2 **(ton of CO2 x Km x Vehicle)**
  - **K1: Fluid Flow**
  - **K2: Stop and Go**
- **Dense estimation of CO2 into the city** is very useful to know to target EC's KPIs

Computing CO2 on the basis of traffic flow data

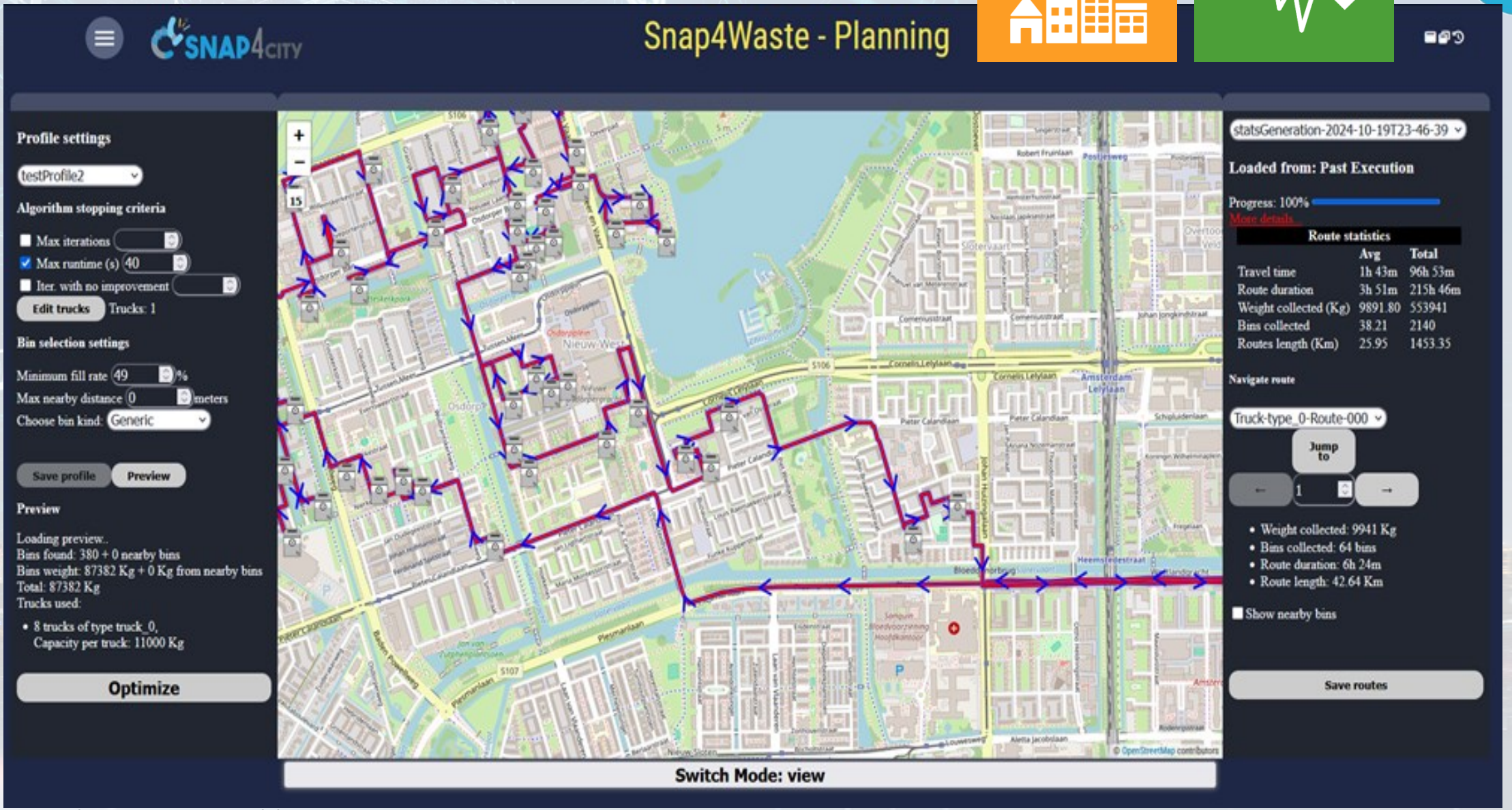
CO2 estimation

S. Bilotta, P. Nesi, "Estimating CO2 Emissions from IoT Traffic Flow Sensors and Reconstruction", Sensors, MDPI, 2022. https://www.mdpi.com/1424-8220/22/9/3382/

Waste Collection Optimization

11 SUSTAINABLE CITIES AND COMMUNITIES

3 GOOD HEALTH AND WELL-BEING



City Users' Services and Tourism Management

- Improve Quality of Life and quality of services,
- Over tourism mitigation, sustainability
- Costs reduction of services
- Improve accessibility to services: citizens, Tourists, commuters, etc.
- Improve Security/Safety of city users

Assistants on taking decision and for training/development

SNAP4CITY roadmap

2020

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

- Smart Mobility
- PISA, PUMS
- Living lab

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2021

Smart Ambulance (2021-22)

Enterprise (2021-22) Industry 4.0

Contract

Contract

PC4City (2020-21) Monitoring Terrain

Winner of Open Data Challenge of

- Smart Light
- Sweden

2022

Almafluida Industry 4.0 (2021-22)

AMPERE (2021-22) Industry 4.0

SYN-RG-AI SmartCity

Industry 4.0

SmartCity, 2021-23

AXIS collab SmartCity

Asymmetrica Smart City, 2022-23

Contract, 2022-23

Italferr, Smart City

2023

Contract, 2022-23

2022-2023

Contract, 15min

Security and Risk

Km4City 1.6.8

CN MOST, 2022-26

EI THE, 2022-26

G. Agile, 2021-23

2023-26

Merano, smart light

OceanRace, Genova, AWS

Cuneo, smart city

2024

TOURISMO

ELLIE IA 2025-2027

UrbanDT4TF

Contract, 2024-25

CAI4DSA

Future Artificial Intelligence Research

OPTIFaaS

SASUAM

Rhodes, smart city

eShare

UNIFI TUSS

AMMIRARE

Co-funded by the European Union

Currently 2026

- **ISPRA JRC contract**, EC: DSS, SOC, control room, energy, https://www.snap4city.org/drupal/node/970
- **TOURISMO**, Interreg, EC: Tourism, NLP, DSS, https://www.snap4city.org/drupal/node/1001
- **ELLIE**, Horizon Europe, EC: AI, VR, https://www.snap4city.org/drupal/node/1056
- **AMMIRARE**, Interreg, EC: AI, environment, Big Data, https://www.snap4city.org/drupal/node/1002
- **Reg4IA**, LLM, DL AI for regional public administration, A project of presidency of national council
- **BullVIT**, RT, conv: Agentic AI, NLP, LLM on commercial phases
- **Energia**, RT, conv: Federated Learning, AI, PINN, DSS, on manufacturing
- **CN MOST**, PNRR: sustainable mobility, AI, platform, https://www.snap4city.org/drupal/node/1050
- **SADI-MIAC**, RT, partner: AI predictions, Tourism, Retail, Computer Vision, https://www.snap4city.org/drupal/node/1055
- **MUSEOAct**, Deep Learning AI for condition deformation predictions wrt environmental aspects
- **LIBROCO**, AI for predicting events effects on commerce, LLM
- **Reverberi**, Smart Parking monitoring
- **RFI contract**: mobility, AI, DSS

Closed in 2025-early 2026

- **UrbanDT4TF**, CN HPC: Digital Twin mobility, https://www.snap4city.org/drupal/node/1057
- **DI-DTPlatform**, CN HPC: Digital Twin, mobility, environment, https://www.snap4city.org/drupal/node/1097
- **Sasuam**, CN MOST, PNRR: AI, mobility, https://www.snap4city.org/drupal/node/999
- **OPTIFaaS**, CN MOST, PNRR: AI, mobility, DSS, https://www.snap4city.org/drupal/node/1008
- **LeverageOPTIFaaS**, CN MOST: PNRR, mobility, https://www.snap4city.org/drupal/node/1064
- **CAI4DSA**, FAIR PE1, PNRR: AI, Neuro-Symbolic, PINN, NG-DSS, https://www.snap4city.org/drupal/node/1016
- **SMART3R,** PRIN UNICagliari: mobility, DSS, https://www.snap4city.org/drupal/node/1087
- **Tuscany X.0, EDIH,** TestBeforeInvest, Training on AI, Big Data, Security, HPC: https://www.tuscanyx.eu/
- **SmartCyprus**, a project of Cyprus Ministry of Digital Innovation and Policy
- **The IE**, PNRR: AI, NLP, LLM, Legal Aspects, SnapAdivisor, RAG LLM
- **Salerno Port**: AI for container ID recognition and tracking
- **Talent Hub**, ECRF, conv: NLP, match demand vs offer

booklets

- Smart City

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

- Industry

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

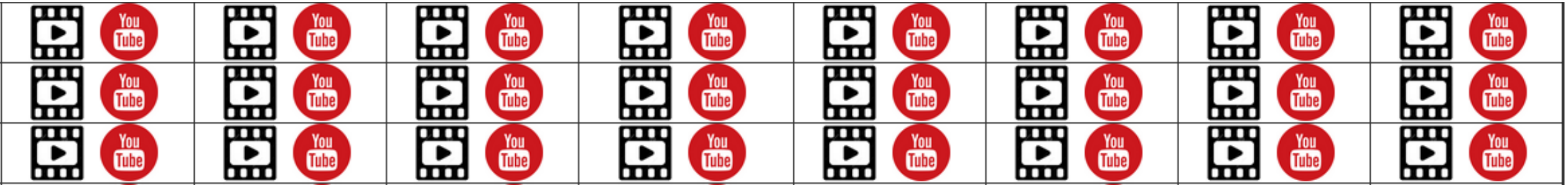
- Artificial Intelligence

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

https://www.snap4city.org/944

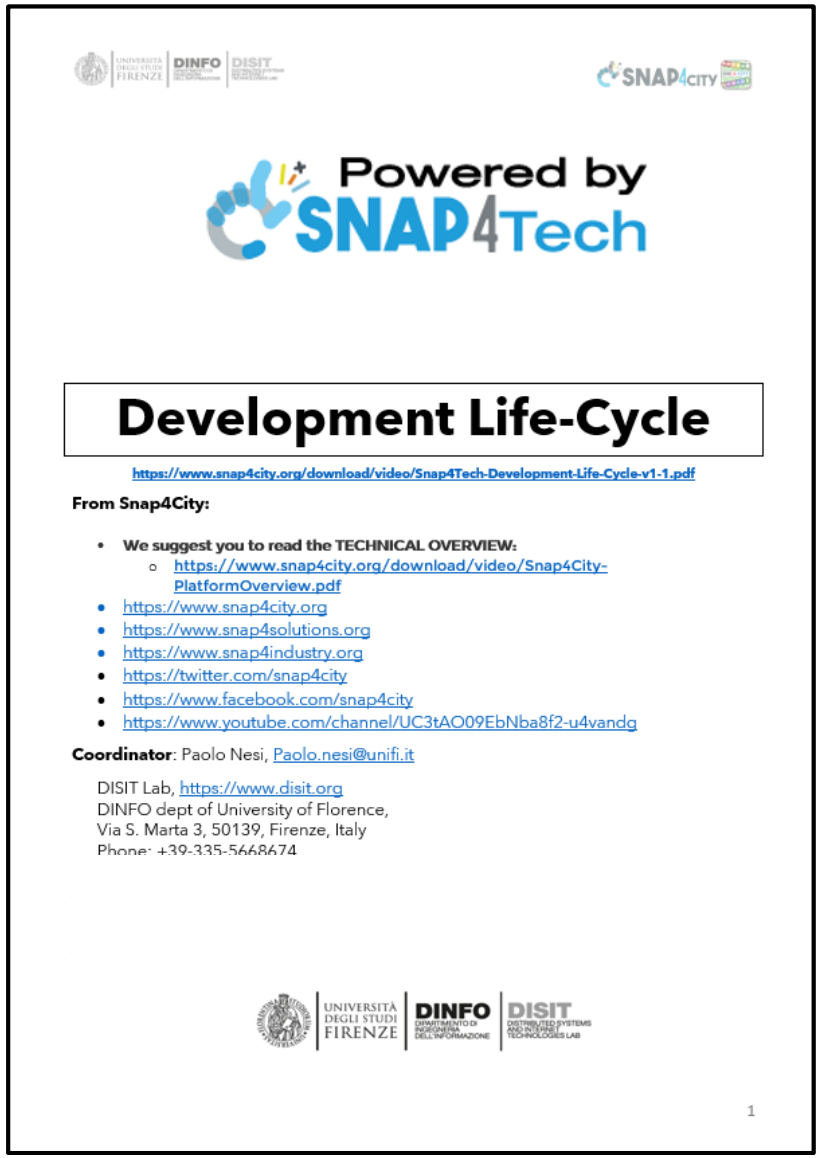
On Line Training Material (free of charge)

1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
							
							



Development

https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf



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Development Life-Cycle

https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle-v1-1.pdf

From Snap4City:

- **We suggest you to read the TECHNICAL OVERVIEW:**
  - https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf
- https://www.snap4city.org
- https://www.snap4solutions.org
- https://www.snap4industry.org
- https://twitter.com/snap4city
- https://www.facebook.com/snap4city
- https://www.youtube.com/channel/UC3tAO09EbNba8f2-u4vandg

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