

Innovation toward Urban Digital Twin and Green Transition

NEC Laboratories Europe

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Green Transition through Distributed Intelligence

Green Transition

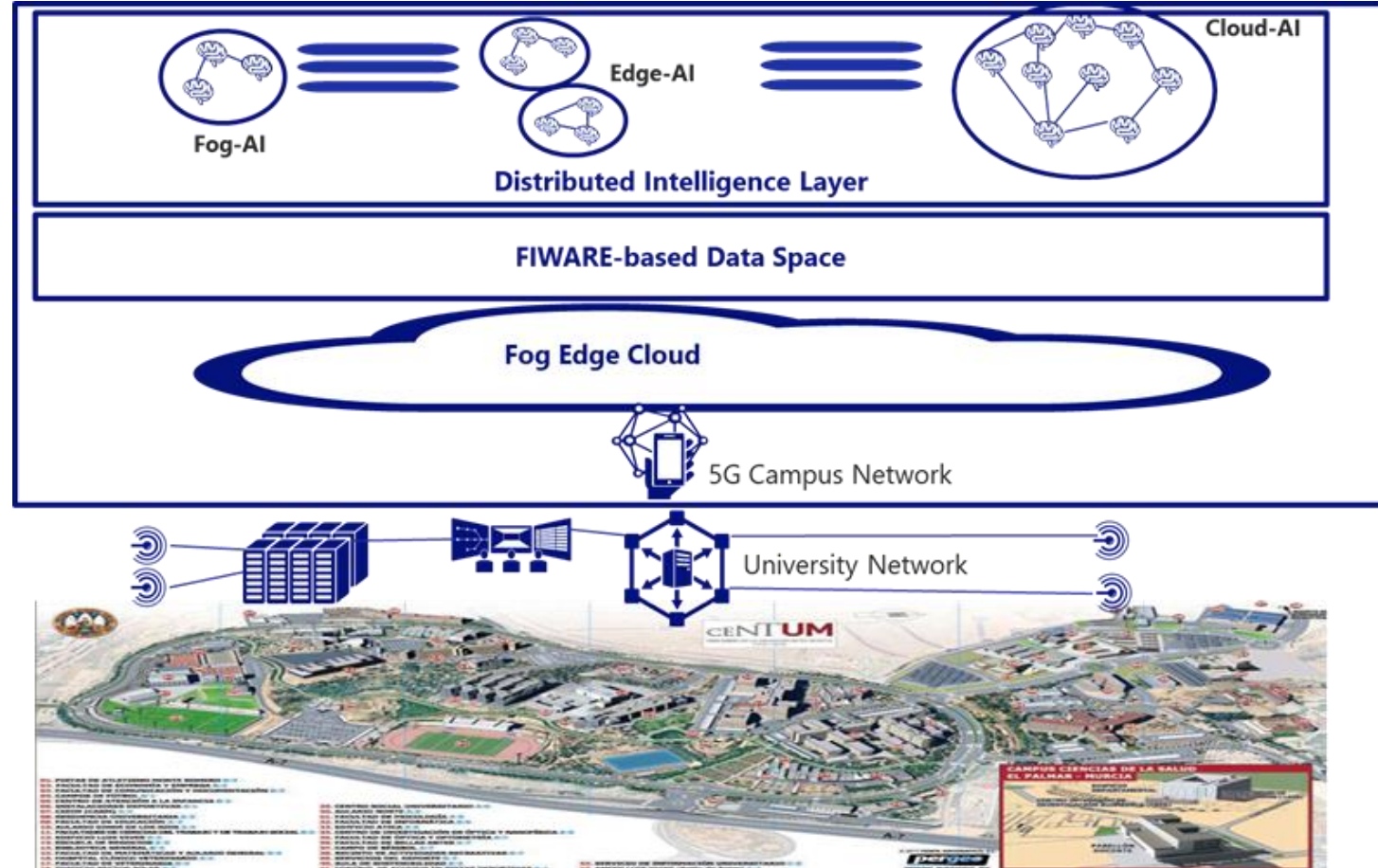
- ◆ Europe 2050: carbon neutral society
- ◆ needs: „Green Transition“ on all levels
- ◆ ICT technology is key, distributed & collaborating Digital Twin provide the needed intelligence

5/6 G (wireless) + IOWN (optical)

- ◆ **connectivity:** high-volume, ultra-connected Fog-Edge Clouds as execution environment
- ◆ **network slicing and MEC:** deploying computing where it is needed
- ◆ **data spaces:** data sharing on top of strong network security

Collaborating Digital Twin

- ◆ realizing a Digital Twin ensemble of a University campus @ Murcia University



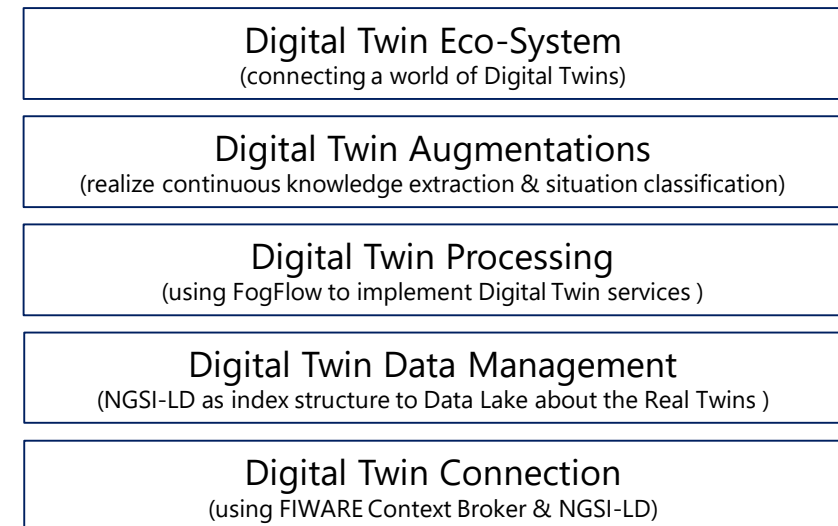
What do we want to achieve: Collaborating Digital Twins

Vision for 2030

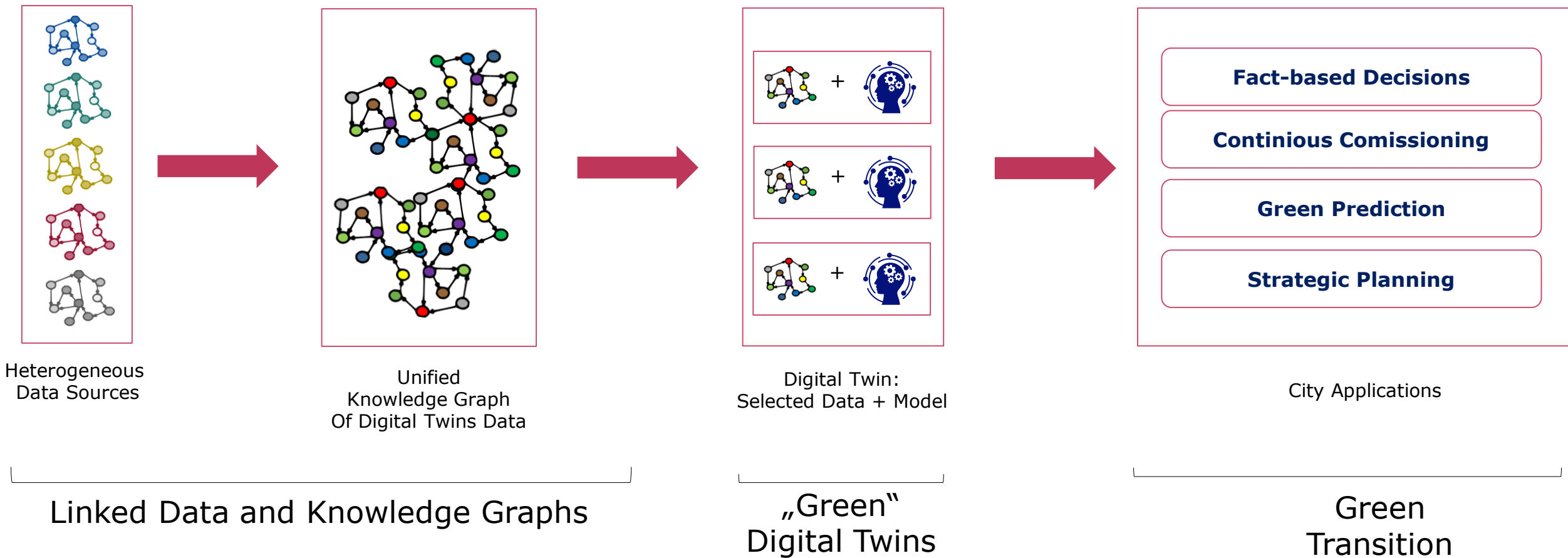
- ◆ Digital Twins will represent every major element in the Smart City
- ◆ Overlay Digital Twin will combine the work of individual Digital Twins
- ◆ Digital Twins Computing creates the needed ubiquitous intelligence for Green Transition

Benefits of Digital Twin

- ◆ **Insights** – detailed understanding of that activities in the Smart City
- ◆ **Prediction** – comprehensive and heigh-accurate forecasting
- ◆ **Simulation** – „what-if“ prediction
- ◆ **Optimization** – short, medium and long term optimizations loops



How can we achieve collaborating Digital Twins?



Green Twins will drive the Green Transition of Cities

Innovations from NEC

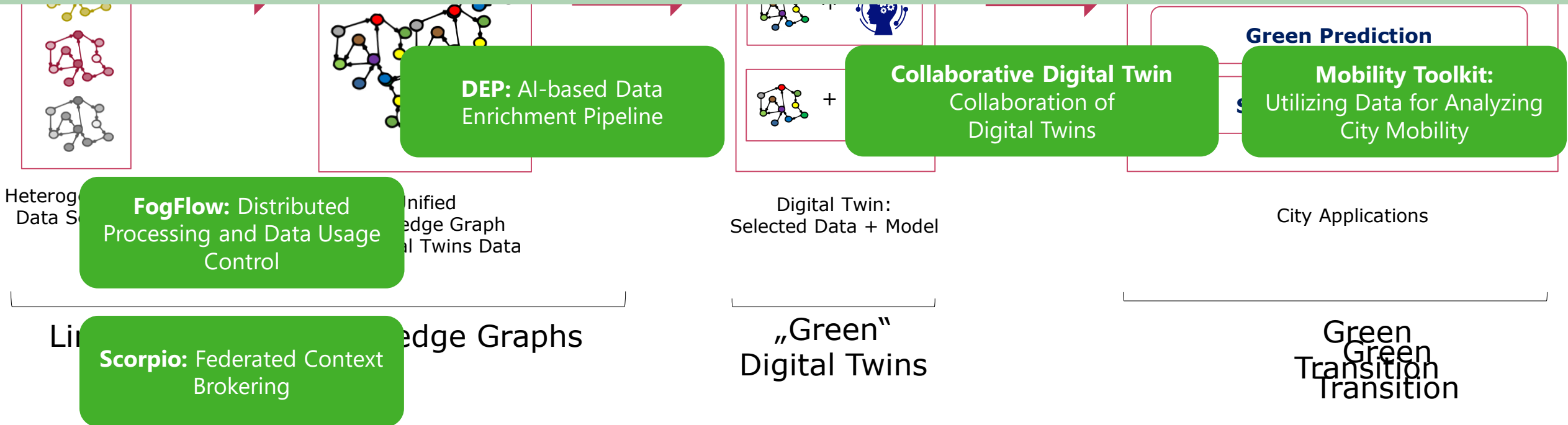
Heidelberg, Kiel, St. Quentin, ...
(ODALA)

Murcia
(DCI)

Santander
(CEF Salted)

Aarhus, Odense, Bergen
(KMD, Twin4Build)

Lisbon, Porto, Santander, Cordoba, ... (Commercial)



Green Twins will drive the Green Transition of Cities

Mobility Toolkit

Individual CO2 Footprint

Crowdsourced Mobility Data Collection (NREL OpenPATH)

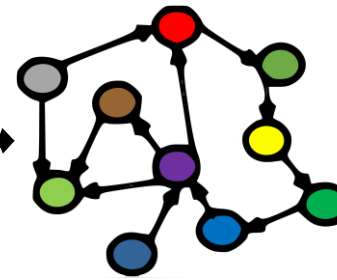
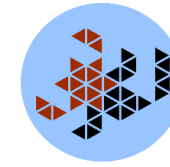


Carbon Accounting for a City District



- Magnetic Loop Sensors
- Traffic Cameras
- Bicycle Counters
- Crowd Behavior

NGSI-LD Scorpio Broker



Collaborating Digital Twins

Flexible CO2 Computation

City Dashboard

Individual CO2



OpenStreetMap Context Data

Mobility Toolkit is an Open-Source Component made available by the CEF ODALA project



How can Digital Twin reduce Carbon Emission in Buildings

Next Talk:

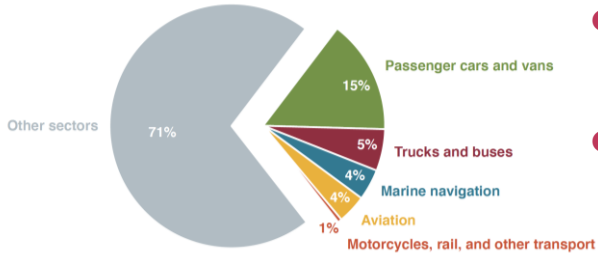


\Orchestrating a brighter world

NEC

Green Transport Twin - Estimating fine-grained Mobility CO2 Footprints for Cities to Initiate Informed Demand and Supply Changes (EU CEF ODALA Project)

Context and Motivation: Mobility is a major driver of CO2 Emissions

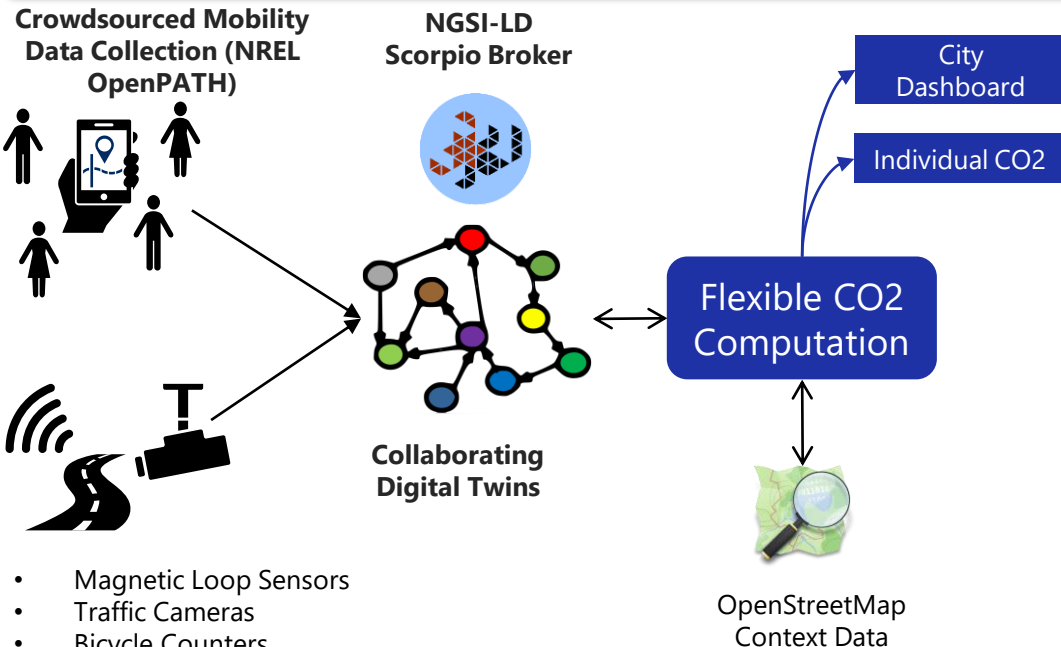


- 29% of total economy-wide greenhouse gas emissions in the US and EU (Japan: 17%).
- Since 1990, transport emissions in the EU have grown by 33% even as other sectors have reduced emissions by 32%.



Mobility is major reason for **carbon emission** and therefore a key domain to fight climate change. Individuals and cities are not aware of their own mobility CO2 footprints. We need **data-centric, ML supported solutions** that compute fine-grained CO2 footprints. These footprints can provide incentives to change individual behavior and inform city-wide demand and supply changes (e.g., new bus routes, infrastructure changes).

Green Transport Twin: Flexible CO2 Computation based on FIWARE Data Models from crowd-sourced data and infrastructure based sensors.



- Magnetic Loop Sensors
- Traffic Cameras
- Bicycle Counters
- Crowd Behavior
- ...

1. EU/country standard values for trip lengths of different modes.

2. City specific survey data, e.g., from SrV, www.srv2018.de

3. Crowdsourced based calibration for increased accuracy and live updates on CO2 emissions.

Increasingly accurate and timely data

- ◆ Our solution enables cities to start their deployment without additional effort/commitment besides making their existing fixed sensor infrastructure accessible.
- ◆ Our solution is flexible and becomes more accurate & timely when city specific survey data is available or individual mobility traces are collected from citizens mobile phones.

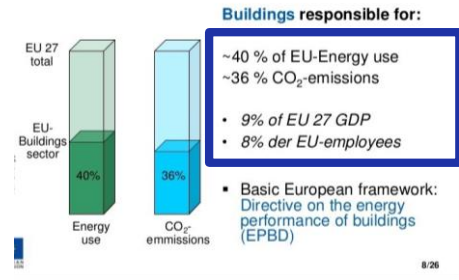
Collaborations



Green Building Twin – BIM based buildings twins for improved energy models and basis for decarbonization applications (Twin4Build project)

Context and Motivation: (Non-residential) buildings are a major driver of CO2 Emissions

Energy efficiency – EU buildings sector

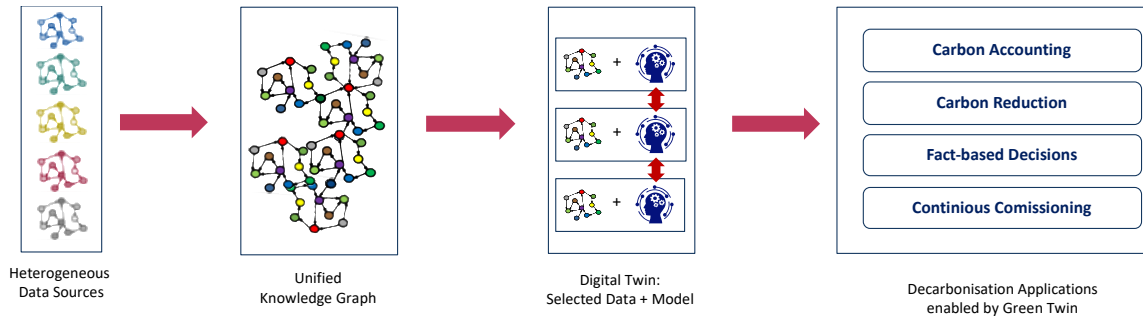


- From 17.5% to 40% of energy use (36% CO₂ emissions in EU).
- People spend 90% of their times indoors.



Buildings are a major reason for **carbon emission** and therefore a key to fight climate change. It is relatively straightforward to compute CO₂ emissions for a whole building, however it is harder to pin-point emissions to concrete building components (e.g., “this old power-hungry router in the basement”) and find **efficient carbon reduction actions** mainly because of disintegrated, **siload subsystems** and **inconsistent** and **incomplete meta data**.

Green Building Twin: Digital Twin construction from BIM data (IFC) and other building data sources



- **NLE TrioNet** data integration technology for ontology, schema and entity matching to deal with heterogenous data sources.
- **Physics based energy model** created by SDU domain experts on top of BIM and NGSi-LD.
- Three deployment sites in Scandinavia.
- Many customers are quite interested to better understand the CO₂ footprint of a building and to make data driven decisions for how to reduce it.

3 Factors for Success

- 1** FIWARE Runtime
- 2** Rapid evolving Data Preparation technologies
- 3** Green Digital Twin: AI + Simulation + Real-Time Optim.

- NGSi-LD to model digital twins based on FIWARE smart data models and other relevant ontologies.
- **Scorpio** Context Broker to enable federated digital twins in NGSi-LD across departments and organizations.
- **FogFlow** to trigger executions based on arrival of new data.

- Automatic Semantic Matching and Enrichment (TrioNet with Ontology Matching, Entity Matching)
- Including data on „performed operational actions“

- Target of the Twin4Build project

Collaborations

