LAJAVANESS

KAYRROS

nexqt.
turning data & science into climate action

Carbon-intelligent.City

Turning science and untapped urban data into climate action insights for all

AI4CITIES

Midterm Meeting

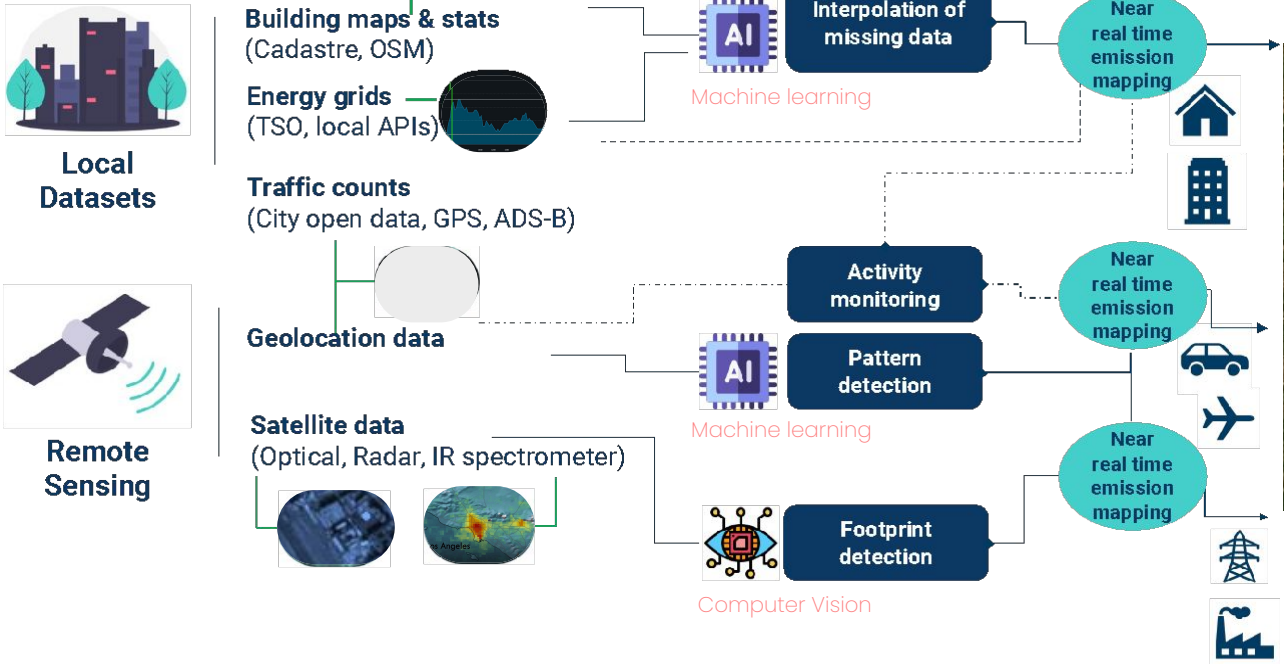
14 June 2022

This is part of the AI4Cities project that has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 871914.

Challenge: **What does it mean to be on track to -55% of CO2 emission by 2030 for a 100,000 inhab. city?**

Where to monitor, target and track this in my city?

Solution: **A cutting edge ai-powered technology chain to unleash climate intelligence for all**



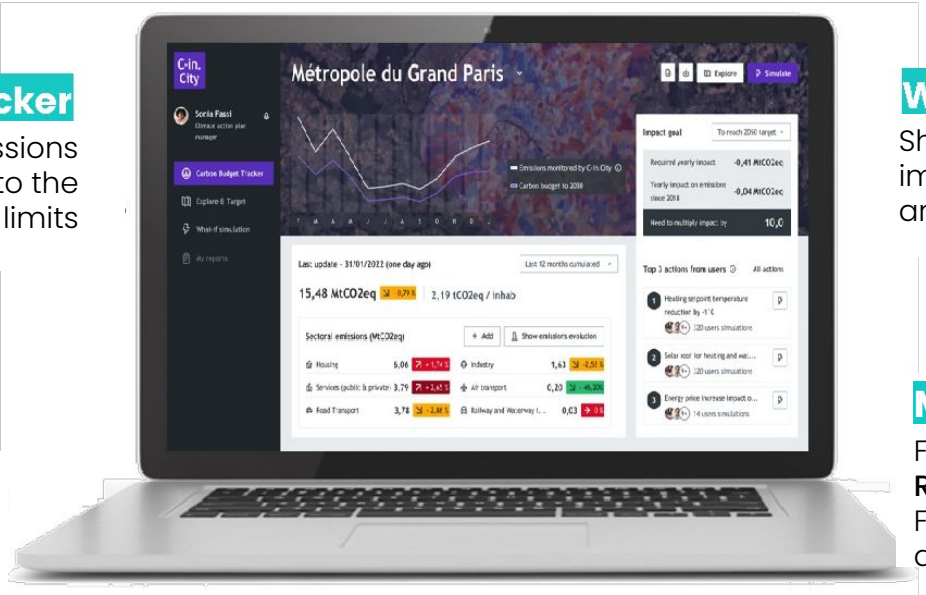
The smart & climate neutral city cockpit

Carbon Budget Tracker

Near real-time CO_2 emissions **monitoring** compared to the City Carbon Budget limits

Explore & Target

Best Massive reduction opportunity locations in **housing, services, transports & energy sectors**



What-if Simulation

Show the global and located impacts of **technical** solutions and **behavioral** changes

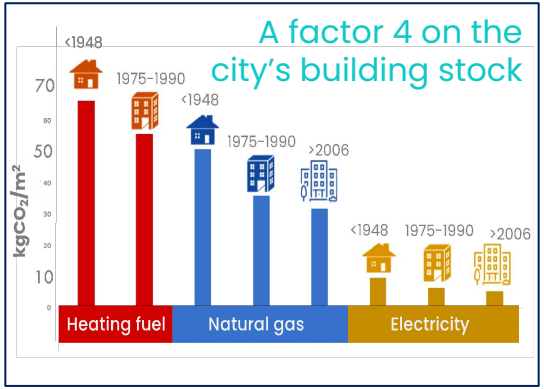
Multi-scale information

From **City** to **District** to **Building** & **Road** level
From Monthly to **hourly** data delivery

Emission reduction: where are my low-hanging fruits? The housing renovation example

Building level

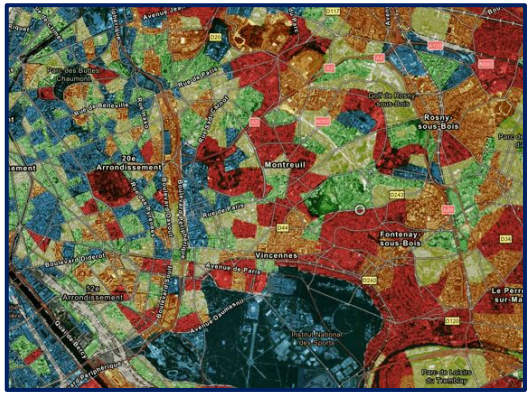
How much?



Profiling the CO2 performance

District level

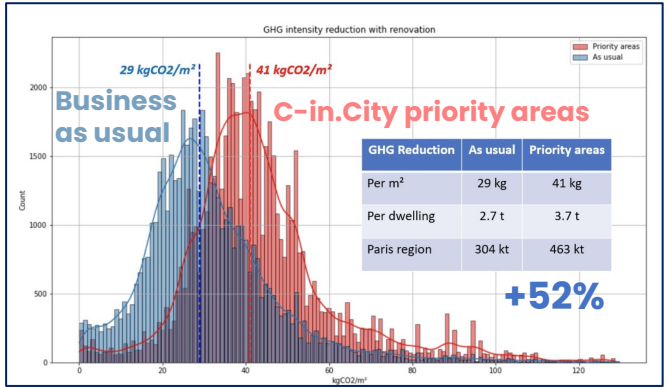
Where?



Finding the best renovation clusters

Global impact

What if?



Optimizing the city renovation budget

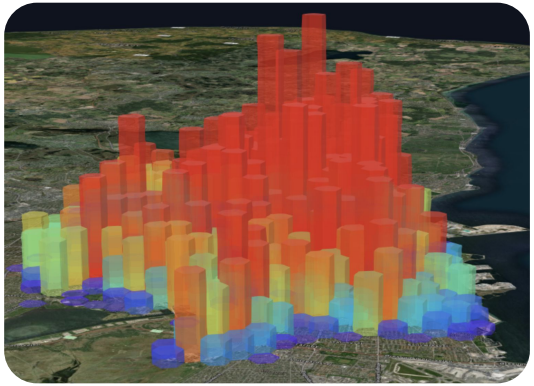
District heating

Road traffic

Carbon sinks

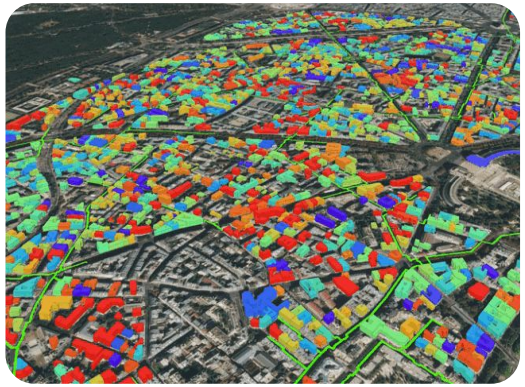
Some first results…

Carbon Budget Tracker



Carbon budget & hotspots at district scale

Explore & Target

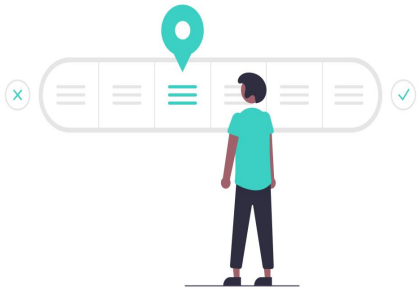


Fossil fuel heated buildings close to the district heati network

What-if Simulation

What if the city implements diesel [illegible] in 2024?

Development status



		Paris Region	Copenhagen
WP-1	**Additional Data sourcing - Fine-tuning of the local GHG emission balance**	**Completed**	**Completed**
Task 1	Consolidation collection data to ensure comparability with other EU cities and the country level	✓	✓
Task 2	Implementation of the C-in.City EU-scale data collection chain	✓	✓
Task 3	Identification of local data source to deepen the GHG model to building and street levels	✓	✓
WP-2	**Enrichment: Integration of user databases**	**Completed**	**In-progress**
Task 1	Proposal of a list of critical databases to be collected by the city	✓	✓
Task 2	Technical integration of these databases into the platform	✓	23/06/2022
WP-3	**Adaptation to the user context (Carbon budget tracker & What-if scenarios)**	**In-progress**	**In-progress**
Task 1	Definition of the city carbon budget and milestones to 2030	✓	✓
Task 2	Transmission of a list of scenarios	✓	✓
Task 3	Strategy and technical meetings to elaborate on the list	✓	30/06/2022
Task 4	Feasibility analysis of the selected scenarios for each city and finalization of the list	✓	10/07/2022
Task 5	Scenario analyses and discussion on the context for each city	21/07/2022	16/08/2022
WP-4	**Front-end : Refinement and development of the user interface**	**In-progress**	**In-progress**
Task 1	Revision of the Figma model (end of Phase 2 prototype) - UX/UI improvements	✓	✓
Task 2	Release of the refined interface (V0.5 - Viva tech)	✓	27/06/2022
Task 3	Integration of user feedback in V0.5 and definition of the final V1 interface	27/06/2022	07/07/2022
Task 4	Final development of the V1 front-end, adjustments for each scenarios	19/08/2022	31/08/2022
WP-5	**Back-end : Architecture, Deployment and algorithm integration**	**In-progress**	**In-progress**
Task 1	Architecture definition	✓	✓
Task 2	Full cloud storage and computing deployment	✓	✓
Task 3	Automated ETL process	04/07/2022	18/07/2022
Task 4	Automated scheduled processings	05/08/2022	12/08/2022
Task 5	Development of algorithms for each scenario, testing and validation, back-end integration	12/08/2022	23/08/2022
WP-6	**Sustaining the C-in.City experimentation**	**To-Do**	**To-Do**
Task 1	Proposal of sustainable financing modes for the use of the platform by the city	21/07/2022	31/08/2022
Task 2	Training session for the users of each city (+ tutorial)	05/09/2022	12/09/2022

Fitting with challenging contexts

Multi-actor and Multi-purpose

Phase 2
Phase 3

Métropole du Grand Paris

131 municipalities

CO_2 Emission reduction goals
-40% by **2030**
Carbon neutrality by **2050**

4 pilot cities

center	south-east	south-west	north-east
Ville de Paris	Mairie d'Arcueil	Issy-les-Moulineaux	Aulnay-sous-Bois
Consumption-based footprint (scope 3)	Local energy production	Housing energy performance	Local energy production
Energy poverty alleviation	Decarbonised mobility for all	Carbon sink development	Behavioral change

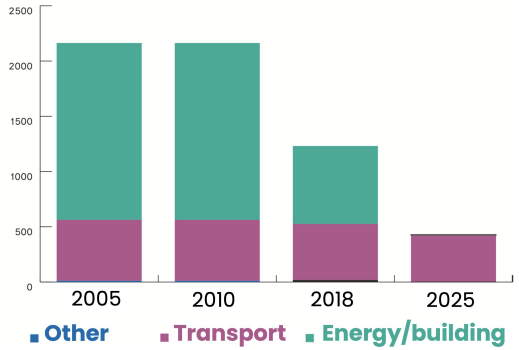
Beyond energy and building

Phase 3

City of Copenhagen

1 municipality

CO_2 Emission reduction goals
-80% by **2025**
Carbon neutrality by **2030** (including scope 3)



Adressing specific expectations

Carbon Budget Tracker | Explore & Target | What-if Simulation

3 scenario categories

Solution-Driven 9

District heating, renovation, low emission zone, trees, etc.

Behavior-Driven 8

Heating T° setpoint, low carbon diet, eco-driving, etc.

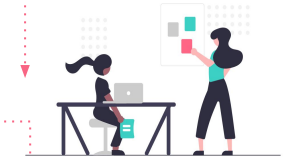
No-Decision 5

Energy poverty, Urban heat island effect, air quality, etc.

The process

Group meeting with the 4 cities

- Presentation of 22 scenario options
- Selection of 2 preferred scenarios per city



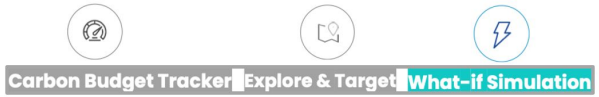
2 individual meetings with each city

- Identification of additional data needs
- Scenario refinement and adaptation

Consolidation by C-in.City

- Synthesis, coherence and impact analyses
- Final validation with city experts

Covering needs and demo purposes



Métropole du Grand Paris

The selection

	Climate Action scenario 1	Climate Action scenario 2
Arcueil	S Integrated net-zero energy/building planning strategy	B Mobility shifts assessment through O/D geolocation data analysis
Aulnay-sous-Bois	S Integrated net-zero energy/building planning strategy	B Impact of awareness policy on heating temperature setpoints
Ville de Paris	N Monitoring and proactive targeting of energy poverty belts	B Impact of a shift to a lower carbon diet at district scale
Issy	S Integrated net-zero energy/building planning strategy	S Urban carbon sinks improvement through optimal tree plantings

S Solution driven B Behavior driven N No Decision

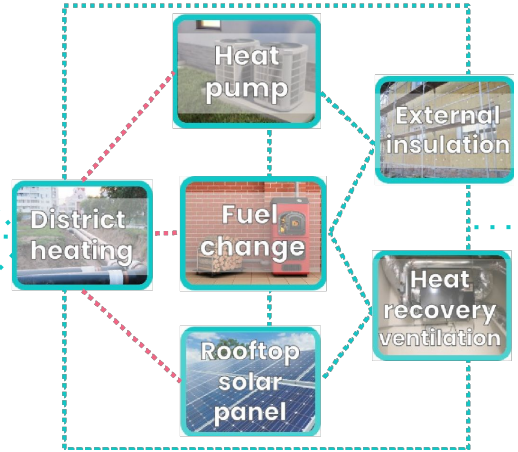
Deep dive: integrated net-zero energy/building scenario

Carbon Budget Tracker | Explore & Target | What-if Simulation

Housing classification
- Condominium size
- Social housing ownership
- Single- family house neighborhood

Energy performance
- Building code period
- Estimated Energy performance label

Income category
- Below the poverty line
- Below median income
- Threshold of housing public agency



1 **User criteria** to fit with city's priorities

2 **Solution combination** towards Net zero emission building (NZEB)

3 **Mapping** at district scale of most cost-effective NZEB clusters

Demonstrating Scalability and Adaptability

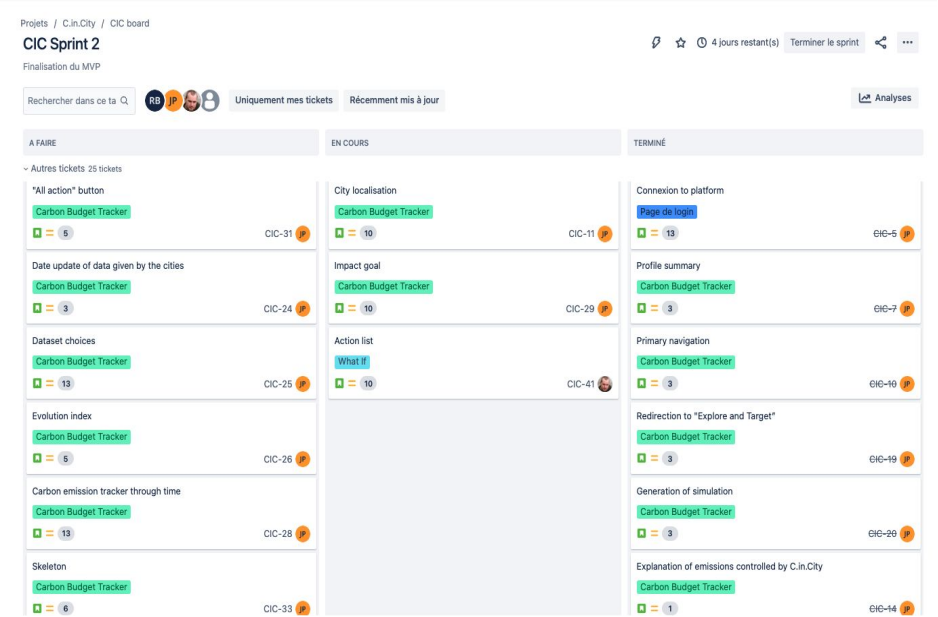
- Implementation of the C-in.City EU-scale data collection chain (building, mobilities, energy, industries), Consistency check with existing CPH GHG emission inventories
- Integration of CPH City GIS platform layers, support from the Data Dept for external data collection
- In-person workshop with Copenhagen Climate action officers about the transformative capacity of C-in.City (monitoring, tracking, simulation)
- Tests and selection by the City of what-if scenarios to support the ongoing development of the Copenhagen 2030 Climate Action Plan.
- Use of the prototype and Training sessions

Climate Action scenarios (1st round)

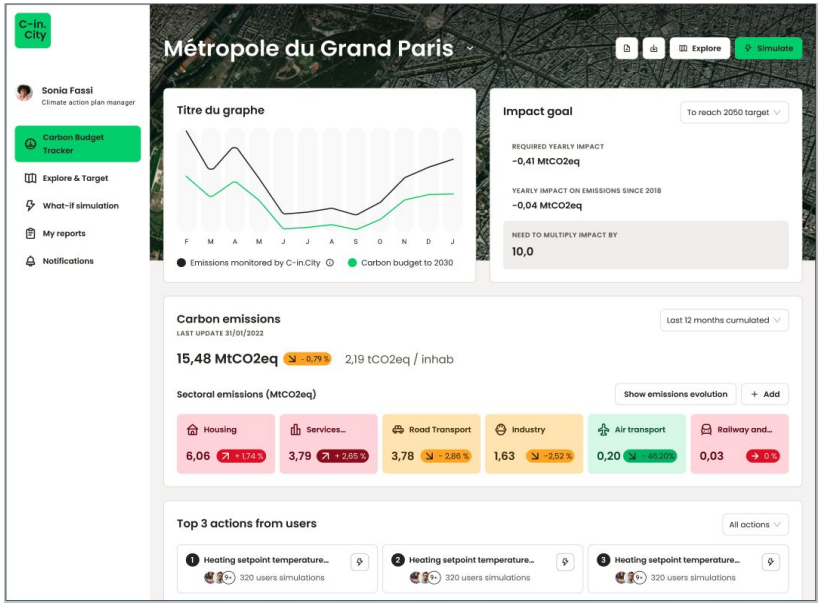
- S Targeting of high-impact building renovation clusters
- S Test of different what-if scenarios for the road transport
- B Exploration of what-if scenarios on scope 3 challenges (food, consumption)

S Solution driven B Behavior driven N No Decision

Frontend development



New interface



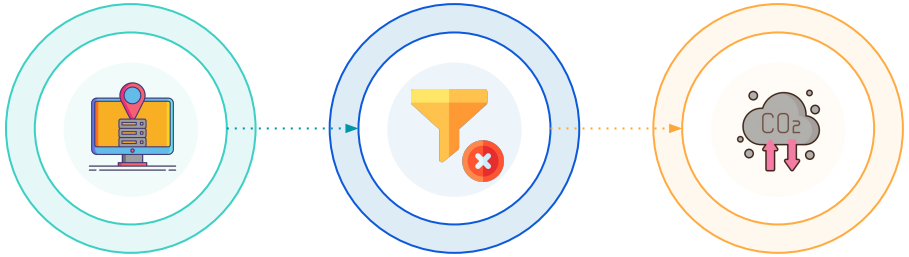
Frontend elements:

- Language: Typescript
- Framework: React
- Version node: 16
- Style: SCSS
- Library: Antd

Deep dive: Geolocation data processing for Road tranport

Data validation

Data processing



Gathering of public dataset that maps the AOI's streets (ie. Paris) and collection of geolocation points

Filter application to remove pedestrians and anomalies. Proceed to normalize the data set and apply a multiplier factor to obtain a better estimation of the number of cars

Use of coefficient (emission factor) to convert activity data (geolocation) into GHG emissions

→ Improved Phase 2 results in Paris with more coverage and daily tiers 3 data.

→ First results in Copenhagen with daily tiers 3 data.

CHALLENGES

Dataset size : Storage and search within the dataset are complicated. → Use of **Hbase** with a specific partitioning and an **internally developed library**

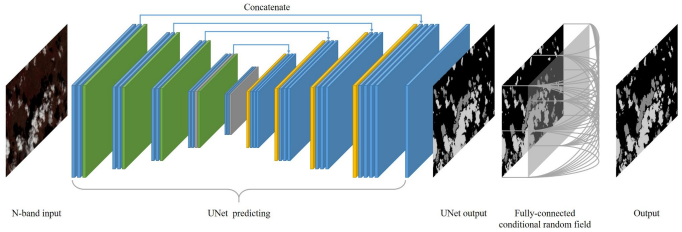
Identification of the function that allow to generalize our results → Under process

Deep dive: Geospatial data processing for accurate Carbon sink assesment

Tree counting application

High resolution satellite imagery

Segmentation U-Net



Tree crowns > 3m² (~3 years old trees)

Biomass **carbon sink** down to the tree level

CHALLENGES

Building obstruction
(ie. Sky scraper shadows)
High resolution image price

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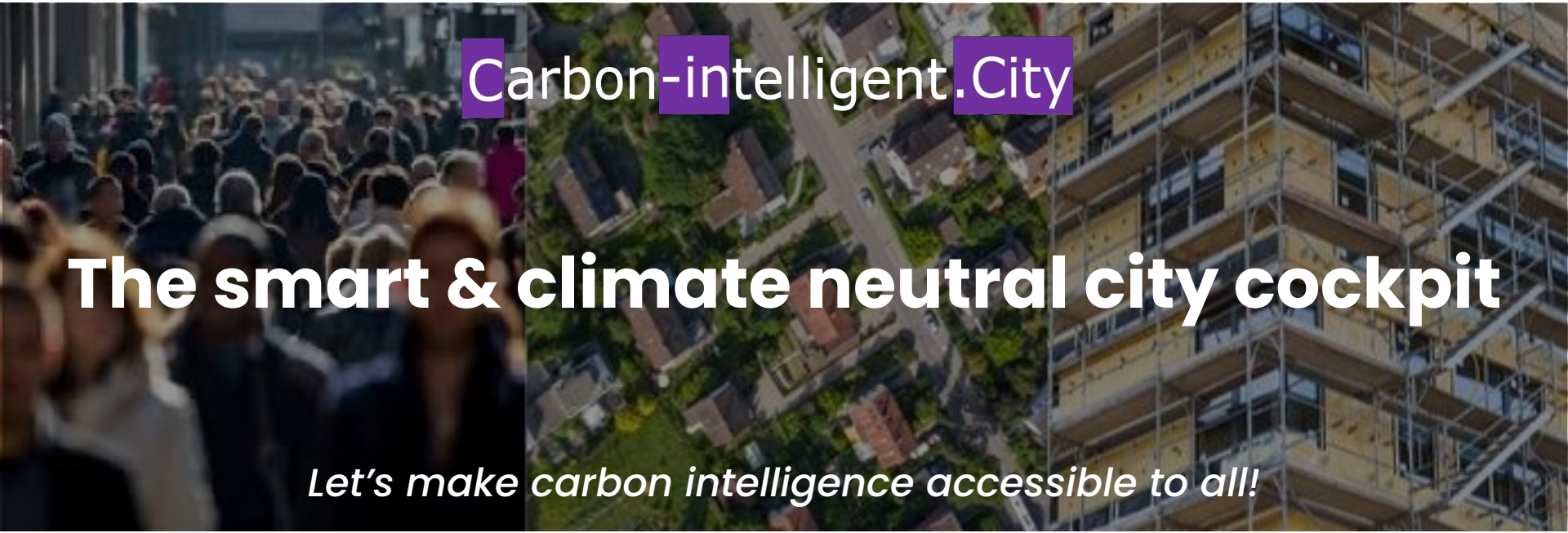

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Let's make carbon intelligence accessible to all!

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