URBAN SOLUTIONS AND SUSTAINABILITY
R&D CONGRESS 2023
BUILDING SUSTAINABLE, RESILIENT, AND LIVEABLE CITIES OF TOMORROW
4TH – 5TH OCTOBER 2023

# From Urban Mining to Urban Harvesting

## Building Shared Frameworks for Circular Future Cities

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Circular Future Cities
Semantic Urban Elements

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CREATE ETH zürich

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE NUS National University of Singapore SUTD SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

(FCL) FUTURE CITIES LABORATORY GLOBAL

# Understanding each other might be the most crucial aspect of successful multi- and transdisciplinary collaborations

Circular Cities?

Regenerative Cities?

Urban Mining?

Urban Harvesting?

A recurring part of my work is establishing shared understandings and creating common languages.

**We need:**

- shared definitions
- shared categorisations
- shared frameworks
- shared ontologies

I will illustrate this with **examples**.

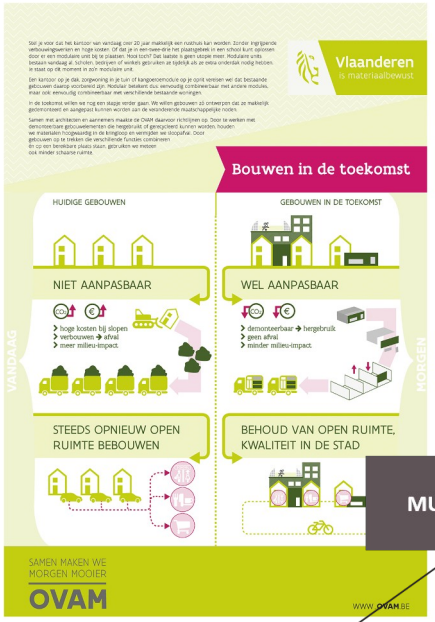
Naturally, **the terms we use change** as our understanding and goals evolve.

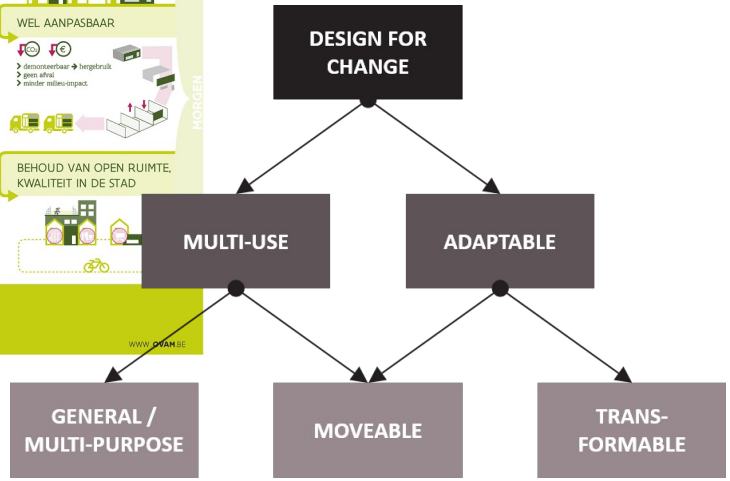
But it is crucial to be able to clearly and explicitly describe our aims, both in old and new terms.

# Developing a common language for Design for Change
## for the Public Waste Agency of Flanders (OVAM)


> ovam.vlaanderen.be
> Debacker, W., et al. (2015). Design for Change: development of a policy and transition framework. Technical report, OVAM.
> Galle, W. & Herthogs, P. (2015). Design for Change: a common language. Technical report, OVAM.




**What is Design for Change?** (Galle & Herthogs, 2015)
Dutch: Veranderingsgericht Bouwen

Design for Change (DfC) is an umbrella term for those design and construction strategies acknowledging that the needs and requirements of our built environment will always change. Its aim is to create buildings and infrastructure that support change more efficiently.

CLICK ON THE ICON TO INSERT AN IMAGE


Circular
Economy
(in construction)
Design
for Change

# The Circular Future Cities module studies Circular Economy in construction
## at the settlement systems scale

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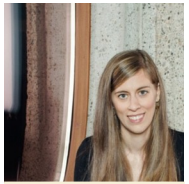
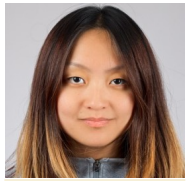


Asst. Prof.
**Catherine De Wolf**

ETH Zürich

Co-Investigator



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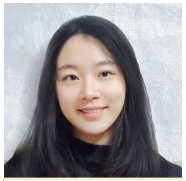
ETH Zürich

Module Coordinator

**David Bucher**

ETH Zürich

Researcher



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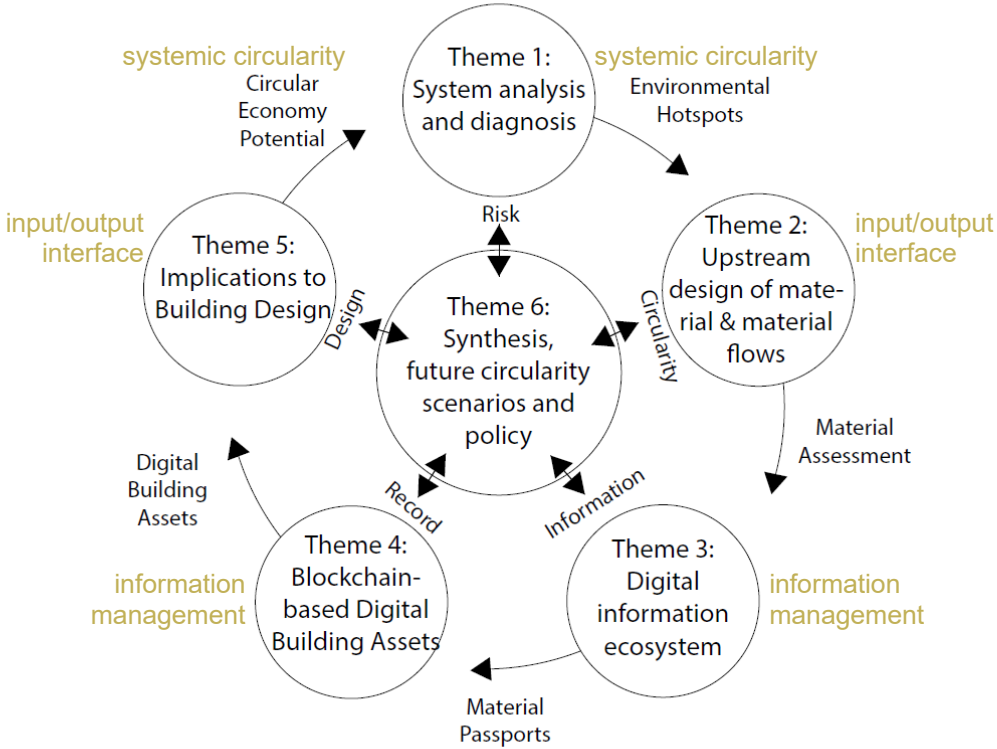
# The Circular Future Cities module studies Circular Economy in construction
## at the settlement systems scale

Each theme studies a key enabling technology, focusing on three urban-systemic perspectives:

- The **systemic circularity** perspective
  i.e. flows and economies in space and time
- The **input/output interface** perspective
  i.e. material flows between buildings and the CE
- The **information management** perspective
  i.e. how information flows and qualities are managed systemically




Urban
Harvesting
Urban
Mining

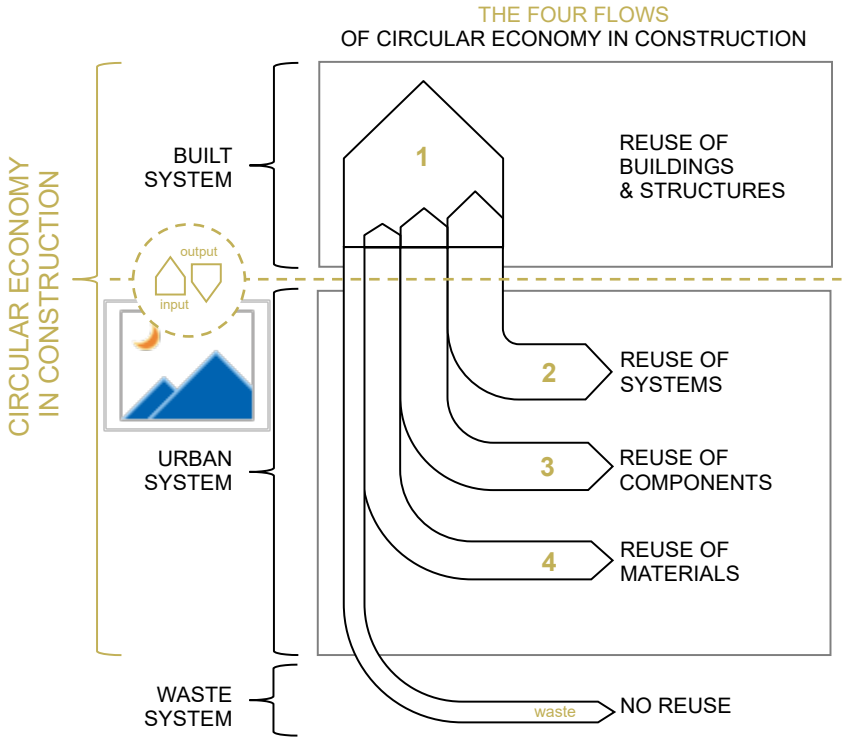
# Planning Circular Future Cities requires understanding
## how building design affects reuse flows (and waste flows)

Four Flows
of Circular Economy in Construction
Credit: Herthogs & Sanchez, 2022

The Circular Economy Potential (CEP) **model** links configurational properties to reuse flows.

- CEP is a general framework to plug in configurational evaluation models.
- We started from existing quantitative models.

The CEP **tool**, a BIM Application Programming Interface (API) under development, will help users evaluate and improve design proposals.

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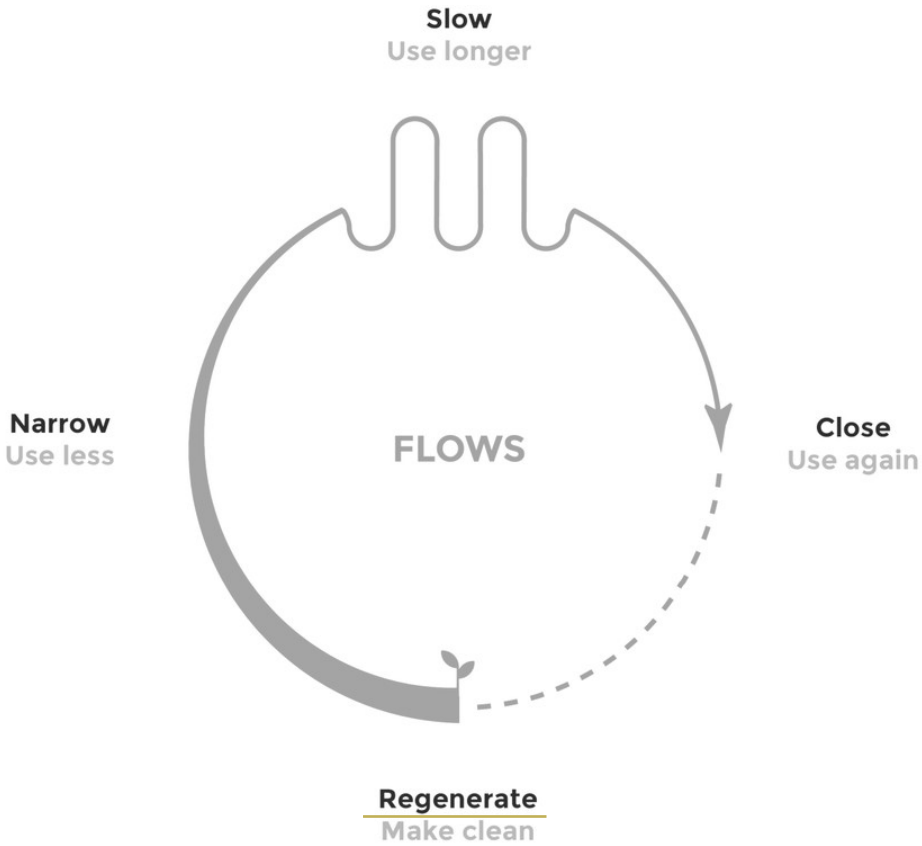
Regenerative Cities
Circular Cities

# Are Circular Cities Regenerative?
## Are Regenerative Cities Circular?

Diagram: Jan Konietzko et al., ‘Circular ecosystem innovation: An initial set of principles’, 2020.

### Four types of Circular Economy
(Konietzko et al., 2020)

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# Are Circular Cities Regenerative?
## Are Regenerative Cities Circular?

Unno, G., von Richthofen, A., & Herthogs, P. (2023). Is the Smart Circular City emerging? Mapping policies and initiatives in 12 cities. Livable Cities - NY, AMPS.

- Singapore
- Zurich
- Oslo
- Taipei

The top ranked 4 cities in the Smart City Index 2021.

- London
- Paris
- Brussels
- Berlin

Cities recognised as having advanced Circular Economy initiatives by POLITICO (news media in the US).

- Iskandar
- Makassar
- Manila
- Bangkok

Upper and lower-middle income SEA cities that have Smart City projects with estimated budgets over 2 billion USD.

CLICK ON THE ICON TO INSERT AN IMAGE

# Are Circular Cities Regenerative? We can map this using an evaluation framework defining 160 types of circularity.

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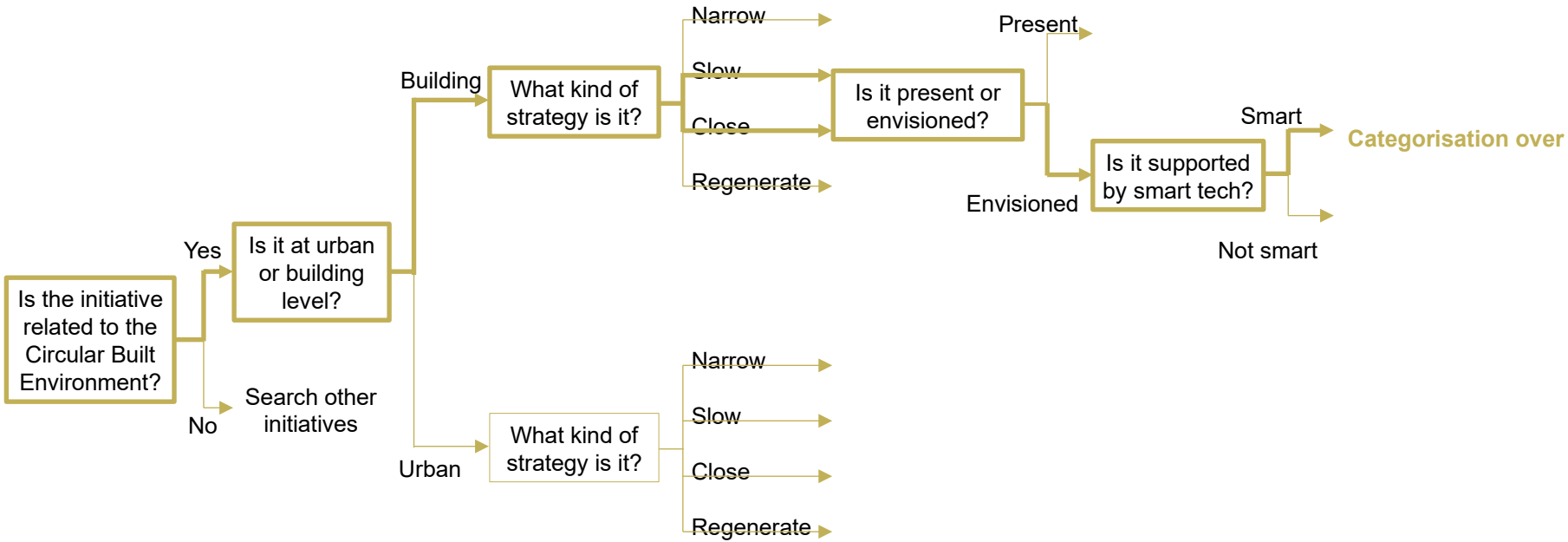

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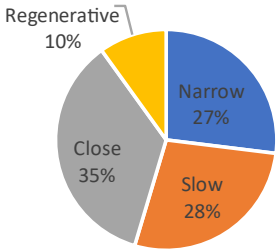
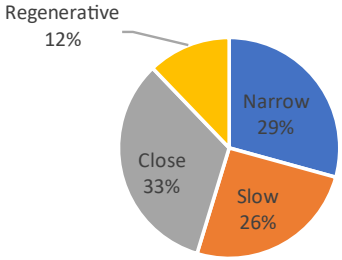
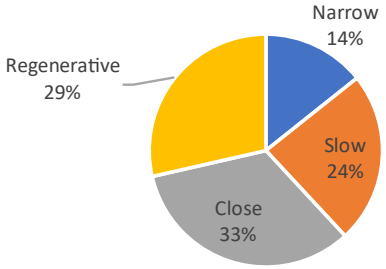
Urban level Initiatives (present)



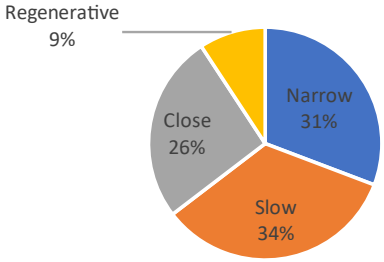

Urban level Initiatives (envisioned)




Building level Initiatives (present)




Building level Initiatives (envisioned)

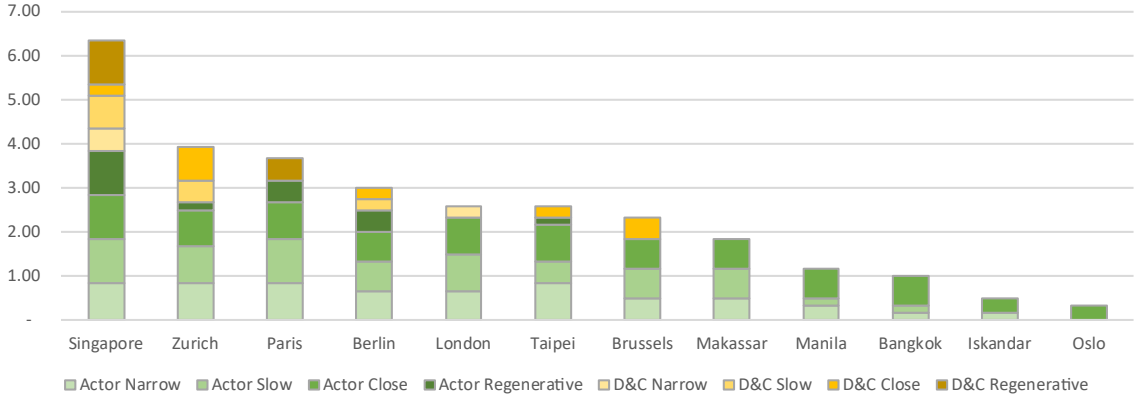


# Are Circular Cities Regenerative?

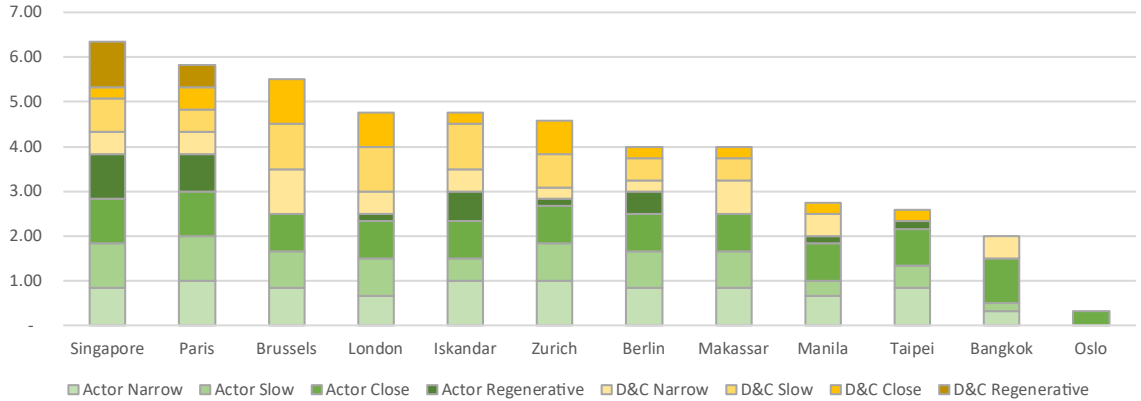
## Results including regenerative initiatives

Unno, G., von Richthofen, A., & Herthogs, P. (2023). Is the Smart Circular City emerging? Mapping policies and initiatives in 12 cities. Livable Cities - NY, AMPS.

Present




Present + Envisioned

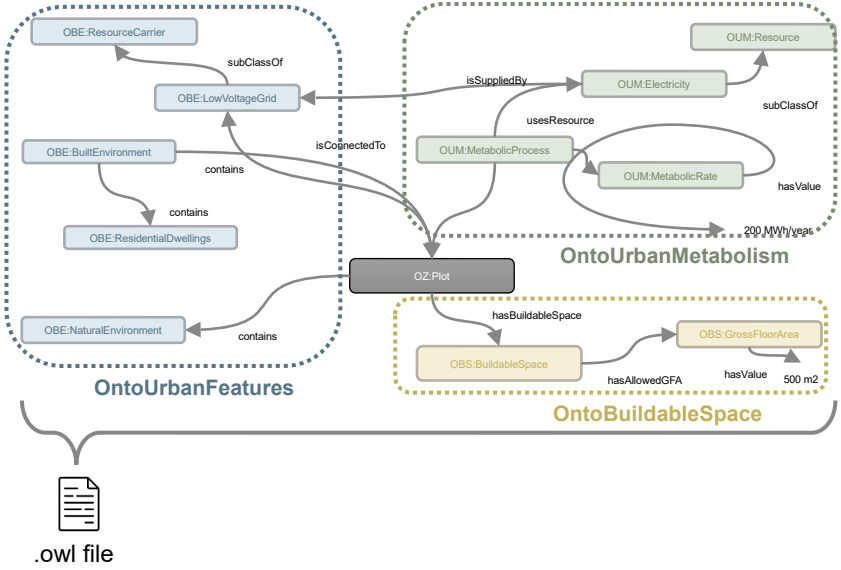


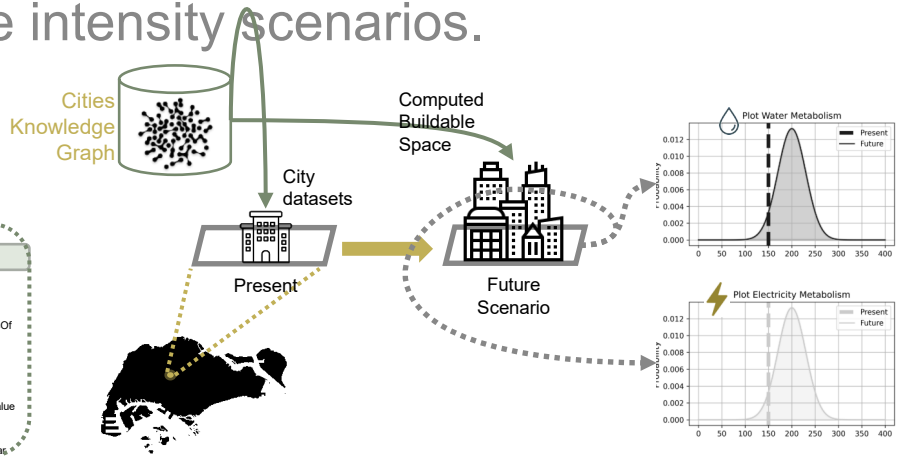

Net
Positive
Net
Zero

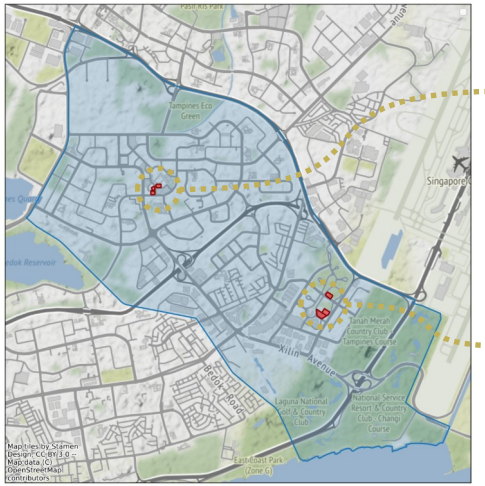
# Defining the core concepts of Urban Metabolism

## for present and future resource use intensity scenarios.

Work in progress images of Urban Metabolism workflows. Credit: Bartolini, Grisiute, & Herthogs, 2023.



- landuse: COMMERCIAL
- totalGFA_existing: 34872 m2

- totalGFA_allowable: **+30%**
- electricityUM_future: **+6074 MWh**
- waterUM_future: **+10462 m3**

- landuse: BUSINESS PARK
- totalGFA_existing: 61431 m2

- totalGFA_allowable: **+24%**
- electricityUM_future: **+612 MWh**
- waterUM_future: **+14792 m3**

# Defining the core concepts of Urban Metabolism

## for present and future resource use intensity scenarios.

Work in progress images of Urban Metabolism workflows. Credit: Bartolini, Grisiute, & Herthogs, 2023.

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| 2 | Andrea BARTOLINI | An ontological framework to model urban metabolisms for future urban scenarios | |
| 3 | Song CHEN | Urban Modelling for Singapore's Weather and Climate | |
| 4 | Franciso CHINESTA & Marida DI CROSTA | Physics Aware Digital Twins as Reliable, Responsible Tools to Predict and Manage Disruptions in Urban Complex Systems | **Panel 1:** Science-based Approach to Future Scenario Planning |
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