



### 03. Definition

#### Urban Metabolism

Dr. Alex Wandl

*Associate Professor, Section of Environmental Technology and Design*

*Department of Urbanism*

*Human metabolism*, and its myriad chemical reactions, is responsible for processing food, and providing the body with energy and eliminating waste. Like all nature's organisms, cities too have a definable metabolism. Let's see how this metaphor used in urban planning and design changed over the last centuries.

In the second half of the 19 century, Marx and Liebig described the metabolic relationship between human activities and nature and how human actions aim to regulate and control the metabolism between settlements and their surroundings. Nevertheless, in the decades after that, simple figurative translation from medicine to urban planning dominated the discussion. Calling the centre of a city the buzzing heart, or large roads arteries are reminders of this simple approach until today.

It took until 1965 and the beginning of the environmental movement when Abel Wolman published *The Metabolism of Cities* and applied ecological thinking to his study of a hypothetical American city of one million. He quantified the relations between the inflow of energy, material and water and its relation to air and water pollution and waste generation. He described the *linear metabolism* of industrialised cities of his time.

The rising awareness of the environmental burdens

of cities and the sustainability movement gave rise to the concept of *circular urban metabolism*. The underlying idea is that *closing material and energy loops within cities reduces urbanisation's negative environmental impact and contributes to a more balanced relationship with the surrounding ecosystems*. Central to the idea were integral approaches to *harvesting synergies using inputs and outputs from different functions* and activities to *create local energy and material cycles*. This means that spatial relations and infrastructures of exchange became crucial.

In the early 21st century, the ongoing dynamics of globalisation and planetary urbanisation emphasised the discussion about at which scale closing cycles is best. It became apparent that *the footprint of cities is not enough to sustain their needs*. Similar to the broader discussion on the circular economy, approaches beyond closing loops, focusing on slowing down: keeping materials longer in the loop, and narrowing loops: using fewer materials to sustain our needs, became more apparent. With *regenerative urban development, cities are imagined as producers of resources and ecosystem services and not only consumers*.

Contemporary urban metabolism research tends to separate into two schools, one a biophysical sciences engagement, ranging across the



## Circularity for Educators

engineering and sustainability sciences, which focuses on the quantification of the amounts of *materials and energy that flow through a city and its environments*, and a second focusing on social sciences engagement, drawing from geography, sociology and political economy, which looks at the *ways flows of energy and matter shape the urbanisation process*.

As designers, we here in Delft try to bridge these two schools of thinking; we understand the process of designing the built environment and the spatial qualities it should provide as a means for facilitating a circular and sustainable use of resources and a way to encourage sustainable behaviour, as well as a part of the bigger question on how we want to live together in future cities.