Studying the metabolism of resilient communities: urban practices, micronarratives, and their agency.

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Urban metabolism and resilience practices

Urban Metabolism is an interdisciplinary field of knowledge which investigates drivers of resource demand in cities through the quantification of energy, materials, water, and nutrient flows. In industrial ecology (the predominant urban metabolism approach nowadays), cities are studied as open systems whose metabolism is the result of the interactions with other - close or remote - anthropogenic systems and the natural environment. Since its outset in the 1960s (Wolman, 1965), urban metabolism research has provided analytical tools and methods to assess the resource-intensity of urban systems (and the associated emissions) and to inform sustainable resource management and low-carbon policy (Kennedy et al., 2011). Furthermore, recent years have seen the rise of a wide range of applications of "urban metabolism thinking" in spatial planning and design (Galan and Perrotti, 2019).

In order to use the urban metabolism holistic approach to enhance resilience practices across communities with different goals and ambitions, it is essential to apprehend the nexus and interdependencies between material input-output flows (e.g. fossil fuels, minerals, metals, biomass) and biophysical cycles (substances/nutrients) occurring in urban systems (Perrotti and Iuorio, 2019). Consensus-building across urban disciplines is essential to bridge the divide between "Green" and "Gray" infrastructure which has dominated the debate on urban flows classification and assessment over the last decades (Perrotti, 2020). First efforts to synergistically consider and assess material flows and biophysical cycles date back to the 1970s. For example, the work of urban ecologist Paul Duvigneaud and his team on the Brussels and Charleroi "urban ecosystems" (Duvigneaud and Denayeyer-De Smet, 1977; Duvigneaud et al., 1984) represents a first attempt to synthesize the magnitude of inflows and outflows of technical energy and piped drinking and waste water alongside solar radiations, rainwater, human/animal/plant biomass and nutrient flows in the same knowledge framework (Figure 1). Recent years have seen significant efforts to work towards the development of integrated urban metabolism assessment methods across urban and industrial ecology, such as the ecosystem-service extended Material Flow Analysis (Perrotti and Stremke, 2018). Cross-disciplinary aspirations and analytical efforts to develop integrated approaches to economic and biophysical accounts are essential to break silos in science and the profession and jointly advance community resilience practices (Perrotti, 2020).

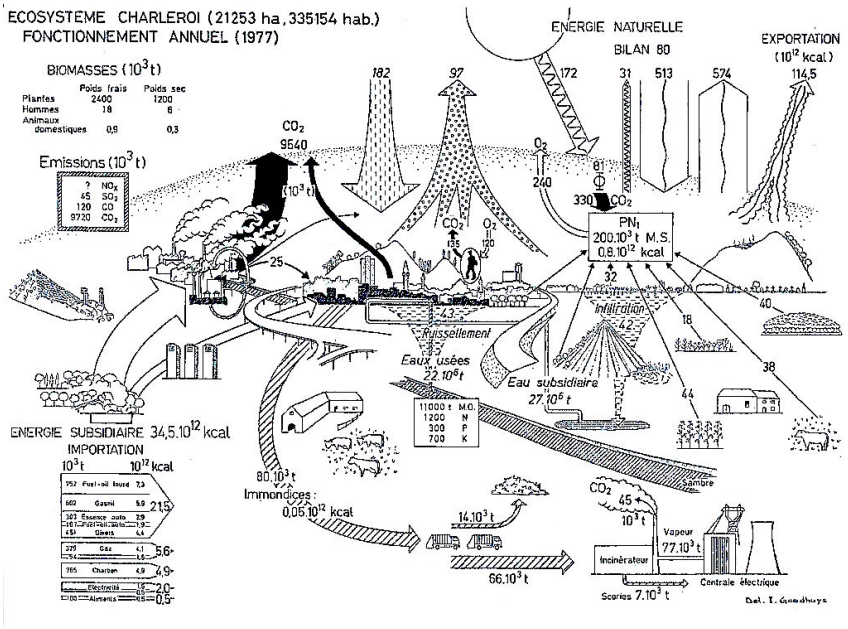

Figure 1: The Charleroi Ecosystem – Annual functioning (1977). Source. Duvigneaud et al. 1986

Recent interdisciplinary efforts have fostered methodological harmonization across the field (Bai, 2016) and helped identify novel research frontiers for urban metabolism research to support community resilience practices. For example, significant areas of improvement revolve around the optimization of data mining processes in the compilation of urban resource datasets as well as the development of more agile data management strategies across science, policy, and society. Centralized data management systems and platforms are key to the optimization of knowledge transfer processes between research and professional practice and among policy sectors (Perrotti, 2019). This links also back to the growing demand for citizen participation in resource management policy and the progressive establishment of citizen science approaches and crowdsourcing techniques as a basis for more far-reaching urban metabolism science and policy (Perrotti, 2012). When applied to the management of material and biophysical flows in cities, open-source data platforms can be seen as an opportunity to broaden participatory bases and a way forward for more inclusive urban resource governance models. For example, this can be provided through systematic monitoring of bottom-up urban ecology initiatives occurring in a given context.

Urban metabolism micronarratives

Another key research frontier consists in exploring the potential for integrated urban metabolism management strategies to generate new urban "micronarratives" (Lyotard, 1984) of the resilient communities of the past, present, and future. Micronarratives are defined as verbal or visual representations of stories describing an action or sequence of events (Saletta et al., 2020) and are increasingly used as instruments of knowledge and sensemaking in several fields and emergent research methods, including intelligence analysis, digital ethnography, foresight methodologies and design fiction (Baerten, 2019). A micronarrative approach is central to urban political ecology agendas which favor the flourishing of new forms of "agency, materiality, or imagination" as a means to open novel socio-ecological and technological pathways alternative to those traced through the "functionalist imperative of capitalist urbanization" (Gandy, 2018). Urban studies based on intra-urban comparison of infrastructural politics in cities across the globe have used a similar approach to reveal

the diverse practices that shape communities' relations to urban infrastructure as opposed to overarching metanarratives of "singular economic systems and divisions between public and privately provisioned services" (McFarlane et al., 2016, p. 1412-1413).

The embodiment of new micronarratives into multiple (individual and collective) physical experiences is essential to foster resilience practices that can improve the management and governance of urban resource cycles (Perrotti, Hyde and Otero Peña, 2020). The urban public space provides an ever-growing reservoir of techniques and tactics to experiment with ecologically and economically optimized cities and to raise awareness of the linkages and interdependence between natural cycles and socioeconomic flows. Examples include low-tech rainwater harvesting systems at the household and plot level constructed by resilient dwellers in Mexico City to jointly adress drinking water scarcity an ever-present flooding risk (Isla Urbana, 2019). Urban micronarratives of ancient resilience practices can inform and inspire the present and the future. For example, in Mediterranean regions, collective and "bottom-up" water governance systems were led by the communities themselves through what we would define today as a water-stewardship approach. In some cases, utility infrastructures were physically nested and belonged to the everyday landscape of the urban public space and their vestiges still inhabit the public realm nowadays (Figure 2). Resilience practices of the present can also involve living in balance with the powerful geothermal activity of a volcano and its geysers as a part of the ecology and the economy of a community (Figure 3). Micronarratives of communities living resiliently with metabolic flows as a support to everyday practices and to an economy of proximity can be revealed each time the scientist or the flâneur is willing to detect their existence. It is perhaps in these micropolitics of desire (Guattari, 2000) that a new engagement between metabolic flows and resilience practices can see the light and find fertile ground for (re-)negotiating a shared agenda for the community resilience to be.

Figure 2: Ancient drinking-water community well "Ain Touila" ("The deep source") in the historic center of the village Sidi-Bou Said, Tunisia. Locals report that the well was one of the oldest in the region and its water had therapeutic properties.

It has been closed since the 1970s with the construction of the modern distribution network and dramatic increase in water demand due to the rise of tourism in the village (©Daniela Perrotti 2019)

In sum, micronarratives do not only express the different types and modes of agency that foster resilience practices and community-led resource governance systems. They also have agency themselves. Through their agency, micronarratives of the urban metabolism can not only open to new modes of inquiry and novel scientific descriptions of production-consumption dynamics. They can also play a role in the shaping of alternative metabolic dynamics that better express individual and collective aspirations and desires than "business-as-usual" models. The concept of "circular dynamics" illustrated in Chapter 9 provides a glimpse about this process.

Figure 3: The center of the village of Furnas on the volcanic island of Sao Miguel, Azores, Portugal, nested into eight "calderas" - geysers, hot-springs and fumaroles resulting from the geothermal activity of the historically active Volcanic Complex of Furnas (©Daniela Perrotti 2019).

The agency of metabolic micronarratives

So, what role can micronarratives play in assembling potentially alternative and desirable metabolic (production-consumption) dynamics? And, through this, how can they help consolidate novel interpretations of the urban metabolism? As for postmodernism philosopher Jean-François Lyotard (1984), when addressing the end of the "metanarratives" (or "grand narratives"), this is first and foremost a question for science and a quest for alternative paths to the validation of scientific (metabolic) models and their discourses. In this sense, a micro-narrative perspective can act as a stimulus for reviewing the way metabolic models are designed and applied. This recalls a similar dynamic as that Lyotard described for the postmodern condition, in which a

catalyst for change came from the end of metanarratives such as the emancipation of humanity through freedom and choice brought by the redeployment of advanced liberal capitalism since the 1960s (with the dismissal of the "communist alternative" and the "valorisation of the individual enjoyment of goods and services"). "The grand narratives allow the society in which they are told, on the one hand, to define its criteria of competence and, on the other, to evaluate according to those criteria what is performed or can be performed within it [….] The areas of competence whose criteria the narrative supplies or applies are thus tightly woven together in the web it forms, ordered by the unified viewpoint characteristic of this kind of knowledge. [….] We no longer have recourse to the grand narratives - we can resort neither to the dialectic of Spirit nor even to as a validation for postmodern scientific discourse. But as we have just seen, the micronarrative [petit récit] remains the quintessential form of imaginative invention, most particularly in science." (Lyotard 1984, p.20 and 60).

Lyotard's words can be read as a hint for urban metabolism research to engage with the collection and systematization of localized micronarratives as a means to retrieve and make meaning of the multiple agencies (and their contingencies) that configure community resilience dynamics. By bringing into focus individuals' actions and capacities to act in specific local contexts, these micronarratives can stage the diversity of human experience and a multiplicity of standpoints and wills as opposed to all-encompassing perspectives and grand narratives. When understood as such, micronarratives can "change the meaning of the word knowledge, while expressing how such a change can take place" and stage "a model of legitimation that has nothing to do with maximized performance" (Lyotard 1984, p. 60). In urban metabolism research, a micronarrative approach can function as a mining mechanism for the retrieval and recovery of localized, individual actions and affects that drive resilience dynamics in a given context and the multiple socioecological, technological, and ideological entanglements underpinning the urban as "a space of multiple possibilities", driven by other forces than just the logic of capital (Gandy 2018). It can connect the heterogeneity of urban life and urban politics to more global understandings of cities as critical nodes in a community resilience "fabric" worldwide. Finally, these micronarratives of community resilience can become building blocks for new knowledge systems and modes of inquiry in metabolic investigations on a local level as well serve as vehicles for new production-consumption dynamics - and, ultimately, an alternative urban metabolism - to come into existence.

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