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Considering the role of urban types in coproduced policy guidance for sustainability transitions

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Abstract

The imperative to massively and quickly scale sustainability transitions in urban areas globally stands in tension with the sustained commitments required of grounded coproduction efforts that seek to deliver locally credible, relevant, and legitimate pathways for place-specific transitions. Is it possible to develop policy guidance that meets the magnitude of the urban transitions challenge while still leveraging the benefits of coproduction? We suggest that coproducing urban transitions guidance around relevant types of cities, as compared to specific individual cities, offers a potential pathway for scaling the impact of such guidance. However, little work has been done to explicitly interrogate how concepts of credibility, relevance and legitimacy are implicated by relying on urban types in coproduction processes. In this frontiers discussion, we describe what greater emphasis on the use of types and proxies in urban transitions coproduction might entail. Elaborating the concept of 'coproduction-by-proxy', we articulate six key premises and draw on two real-world instances of science-policy dialogue to illustrate its operative features. This frontiers discussion aims to supply more structured language for framing debate about whether, and how best, to strategically construct and deploy urban types in coproduction processes for developing urban transitions guidance, with an emphasis on maximizing generalization and impact, while maintaining both technical and political credibility. The discussion argues that exploring the role (and limits) of urban types and proxies in coproduction processes is a key frontier for the iterative science and practice of urban transitions, with implications for advancing both overall urban systems knowledge and place-specific sustainability transitions.

Keywords: Urban typologies, Coproduction, Sustainability transitions, Science-policy dialogue

Science highlights

- The science behind developing and deploying urban types for use in transitions coproduction efforts is underdeveloped.
- There is a need to explicitly debate the validity of type-based urban knowledge claims for transfer across context.

- Scientific validity is only one element of evaluating credibility for type-based coproduction.
- Iteratively moving from place-specific to type-based coproduction, and vice versa, can yield new science on urban systems.

Policy and practice recommendations

- Coproduction-by-proxy, around urban types, is a possible strategy for scaling the impact of transitions guidance.
- Validity of type-based claims is partly contingent on policymaker perception.
- Practice-oriented debate is needed around matching coproduced guidance to urban types in ways that are 'good enough.'

Introduction

There is a growing body of scholarship explicitly focused on urban coproduction—of knowledge, values, and interventions—advising that relevant and lasting urban sustainability transitions are most effectively shaped by meaningfully engaging diverse stakeholders and end users (McCormick et al. 2013; Muñoz-Erickson 2014; Patel et al. 2015; Frantzeskaki and Kabisch 2016; Dunn et al. 2017; ACERE 2018). This includes working with both technical and non-technical stakeholders from across research, policy, civil society, and industry communities, as well as members of the general urban public at large, in the process of grappling with diverse knowledge bases, visioning future scenarios, imagining and devising implementation pathways, and building the political will and capacity to pursue those pathways.

In the broader sustainability science literature, such user-engaged coproduction is mobilized in an effort to respond to many of the same solution-oriented imperatives that are also relevant to specifically *urban* transition processes. Those imperatives principally revolve around a desire to better account for, and negotiate across, social and technical complexity spanning diverse values, norms, and knowledge bases (Lang et al. 2012; Mauser et al. 2013; van der Hel 2016; Tengo et al. 2017). Across urban and non-urban contexts alike, those interested in science-policy interface, including those explicitly concerned with coproduction, have variously grappled with potential mechanisms for enhancing the credibility (validity), relevance (level of fit), and legitimacy (representation of diverse interests)—often referred to collectively as 'CRELE' attributes—of the knowledge emerging from such processes (Cash et al. 2003; Lemos and Morehouse 2005; Kunseler et al. 2015). Borrowing insights from Sarkki et al. (2015), we understand the perceived CRELE attributes of coproduced knowledge to be intimately bound up with the perceived CRELE attributes of science-policy or science-society engagement processes, in part dependent on the quality of iteration and interaction across engaged parties. Moreover, we consider the CRELE attributes of coproduction processes to be conceptually linked to potentially achieving both increased "accountability," understood as a reflection of a compact between science and society, and "impact," due to reduced skepticism and greater likelihood of intervention uptake (van der Hel 2016).

In this light, we actively champion the role of coproduction as an important and necessary mechanism for urban transitions efforts. However, we point out that the urgency and magnitude of the challenge to initiate and see through urban sustainability

transitions on a massive global scale stands in tension with the resources required (technical capacity, sustained socio-political commitment, financial resources, etc.) of intensive coproduction efforts. As one potential corrective for this tension, we suggest that coproducing urban transitions guidance oriented toward relevant urban types, as compared to specific individual cities, offers a potential pathway for scaling the impact of guidance. However, little work has been done to explicitly interrogate how CRELE attributes are implicated by relying on urban types in such processes. In this frontiers discussion, we describe what greater emphasis on the use of types and proxies in urban transitions coproduction efforts might entail, elaborating the concept of 'coproduction-by-proxy.'

In what follows, we put forth an initial rationale for type-based coproduction-by-proxy. We then present a discussion of scaling and transfer efforts to-date when it comes to generalized urban sustainability knowledge claims emanating from urban transitions experimentation and laboratory literatures, followed by a discussion of the possible parameters of urban difference around which urban types have been, or could be, constructed specifically in the context of urban transitions challenges. We then articulate six key premises to more fully elaborate the essential elements of 'coproduction-by-proxy' and use two real-world examples to illustrate the operative concepts at work in actual practice. Finally, we offer reflections on the contours of debate that we argue still needs to be more fully and openly had across research and practice communities as related to the role, and limits, of using urban types in developing and mobilizing coproduced transitions-related policy guidance across diverse urban contexts.

A rationale for, and description of, coproduction-by-proxy

Given that urban coproduction efforts are often premised on deep investment in relationships built in specific places over long periods of time (Patel et al. 2015; Frantzeskaki and Kabisch 2016; Dunn et al. 2017; Frantzeskaki and Rok 2018), there is a question as to whether resource-intensive coproduction can be (or is likely to be) mobilized in all of the urban areas that will need to undergo sustainability transitions, within relatively narrow timeframes of action. The magnitude of the urban transitions challenge is daunting not simply because of the intensity and complexity of transitions themselves. It is also daunting because of the number of communities in which diverse transitions action will be necessary, considering both existing and emerging urban communities in both fast growing and consolidated contexts, spanning all world regions.

A key question arises: Does every community need its own fully localized coproduction process, from start to finish, in order to successfully inform place-based transitions action? Or alternatively framed, is every community likely to have the resources, capacity and/or will to engage in coproduction processes around sustainability transitions? While we consider the first question open to debate, based on our understanding of current global political economies around questions of urban infrastructure and sustainability transitions, we believe the answer to the second question is clearly no. Thus, if it is not currently likely that *all* urban areas will undertake sustained coproduction efforts in support of larger urban transitions processes, are there ways to design more *generalized* coproduction efforts so that even places not undertaking their own place-specific coproduction process can still benefit from coproduced transitions knowledge and guidance?

Here, we suggest that orienting coproduction processes toward strategically constructed urban types, rather than specific individual cities, may provide a pathway for dramatically increasing the number of urban areas that might be able to utilize coproduced knowledge and insights. Type-based coproduction, as envisioned here, represents a possible middle ground resulting in transitions guidance that is *less calibrated* than would be generated by a process totally specific to an individual urban context but *substantially more calibrated* than guidance derived from science-policy dialogue around a fully general conception of 'the urban'. However, if centering coproduction on well-constructed urban types may permit a degree of generalizability and scaling, can the use of urban types in coproduction processes result in guidance that is credible, relevant and legitimate? Undertaking coproduction focused on urban types is a process we describe as 'coproduction-by-proxy.' We posit the challenge of constructing and deploying meaningful urban types in coproduction processes—in short, the challenge of advancing the science of coproduction-by-proxy—to be a critical frontier for urban transitions research and practice. Ultimately, the end goal of any such effort is to honor urban diversity and difference while still being able to engage in deliberation about differentiated and semi-generalized pathways of action that might have a greater chance of success when appropriately matched with a particular "type" of urban environment.

Urban sustainability knowledge claims: applicability, translation, and transfer across contexts

In the world of urban experimentation, there is increasing attention being paid to the "external change orientation" (Bulkeley et al. 2018) of such experiments, leading to calls for more direct consideration of how findings and processes from urban experiments might transfer across contexts and/or be scaled-up to "broader application" (Luederitz et al. 2017). In conceptually adjacent work emerging from the urban laboratories literature, there is an overt acknowledgement of tension with respect to the question of transfer when mobilizing the language of "laboratories" (Karvonen and van Heur 2014). This tension is premised on the contradiction of acknowledging, on the one hand, that "the power of the laboratory" to produce general knowledge "depends upon placelessness and the ability to replicate experimental results anywhere and at any time," while, on the other hand, acknowledging the argument that urban experiments are "situated in particular places at particular times, and thus incapable of producing generally valid knowledge" (Evans and Karvonen, 2014, p. 416). Work on urban transitions and transformation more generally has also begun to demonstrate an interest in broadly understanding scaling and transfer dynamics (McCormick et al. 2013; Lam et al. 2020). At the level of specific initiatives, such work has included more direct consideration of the "knowledge consolidating" phases within urban coproduction processes (Frantzeskaki and Kabisch 2016), such that dissemination of lessons and guidance via "horizontal diffusion" to cities beyond those originally involved in a given urban coproduction, experimentation, or laboratory initiative might become possible (von Wirth et al. 2019). These bodies of work, however, generally stop short of articulating an explicit consideration of how to systematically evaluate—from a CRELE perspective—efforts to account for urban diversity in processes of scaling-out or translating coproduced lessons and findings from one urban area to others.

Sustainability science more generally is also grappling with the challenge of scaling "generalized knowledge claims" and, as a field, has started to articulate questions that help shape consideration of transferring generalized claims, specifically invoking consideration of scale, conditionality, and context (Caniglia et al. 2017; Magliocca et al. 2018). As a specific subset of larger sustainability transitions challenges, we believe that the question of how to generalize knowledge for specifically *urban* transitions requires direct consideration of the material and social parameters of diverse urban environments. We see an imperative to more intentionally deliberate how policy and practice communities evaluate the credibility, both politically and scientifically, of coproducing and transferring semi-generalized urban knowledge claims across context. The increasingly bound up nature of coproduction and sustainability transitions in the urban arena, coupled with the imperative to scale-out transitions action to many urban areas, creates a compelling interest in explicitly joining up questions of contextually appropriate urban policy translation, type-based representation, and the intentional design of coproduction processes.

Mechanisms of urban policy transfer, translation, and replication are already variously at work in the world, implicitly or explicitly mediating between two ends of a localization-generalization spectrum. On the one hand, seemingly de-territorialized one-size-fits-all "best practice" and "fast policy" claims travel national or global urban policy circuits, albeit potentially subject to substantial transformation and re-articulation (McCann 2011; McCann and Ward 2012; Clarke 2012), and, on the other hand, fully endogenous approaches are proposed as antidotes to the ills of generalized "best practice" and are asserted as being valid only in the specific context in which they are developed (Patel et al. 2015).

Debate around urban "best practices" (Bulkeley 2006; Harrison 2015; Patel et al. 2015; Tomlinson 2015) and urban "policy mobility" (Peck and Theodore, 2010; Clarke 2012; McCann and Ward 2012; Crivello 2015; Jokinen et al. 2018) is contentious and rich, particularly in the context of global comparative urbanism (Robinson 2006). Presumably, most best practices or policy models are indeed a best practice somewhere, at some time, in someone's estimation. The potential challenge is in making claims about the translation, transferability, and adaptability of any so-called best practice across diverse urban contexts and with respect to differentially positioned urban constituencies.

Our intention here is not to wade too deeply into the debate about best practices and urban policy mobility, generally. Rather we acknowledge them as real phenomena at work in the world, regularly informing urban policy guidance. Distinctly, our interest is in framing a conversation about how coproduction processes can be structured more explicitly around urban types as one possible mechanism to help mediate discussion and debate around the inter-urban applicability and appropriateness of translating guidance across contexts. Such an approach can be bolstered by using common frameworks for technical analysis, wherein standardized methods and approaches are applied to different urban contexts, implicitly constituting types, in turn yielding calibrated strategy guidance corresponding to those types. But the question remains, can actors in the urban transitions field introduce consideration of context-specific parameters into explicit type-based coproduction efforts in ways that meaningfully respond to legitimate concerns about the credibility of transferring and translating full or partial urban policy guidance across contexts?

Mobilizing urban types for coproduction-by-proxy

We contend that there is operational and analytical value in more concretely grappling with cross-context urban difference mediated by urban types. By invoking types, the focus is on reducing complexity so as to increase potential generalizability while still facilitating valid description of meaningful variation in the urban problem-contexts around which transitions-related policy guidance might be formulated. We invoke types loosely following the tradition of purposively constructed types as used in sociology, drawing from both empirics and theory to yield types built around sets of relevant variables that are grounded in reality but which may be abstracted or accentuated to aid in descriptive clarity (McKinney 1957; Bailey 1973). For our purposes, types are meant to be constructed from distilled parameters or variables judged to be most consequential in affecting guidance and strategy with respect to a particular urban transitions challenge or policy topic. Such types (and their constitutive parameters) can and likely will need to be different depending on the specific urban transitions challenge at hand. An air pollution mitigation challenge is different from a water conservation challenge, which is different from an intersectoral management challenge (even if in some circumstances such challenges might be interrelated). Our invocation of types should not be read as a move toward universalization nor as a desire to advocate for a singularly typical, standard, or ideal city as an object-type worthy of emulation and imitation (Lathouri 2011). Moreover, we reject any effort to make value judgements or assign hierarchical value on the basis of urban type and classification (Robinson 2006). We do, however, maintain that urban classification and typification schema can provide analytic value. Again, our focus is on valid description and operability for the purposes of scaling impact via appropriately calibrated translation and transfer across contexts.

Urban types are, implicitly or explicitly, already regularly mobilized across disciplines to articulate and make sense of various understandings of urban difference in ways potentially relevant to transitions-related action. Prominent parameters of urban diversity around which urban typologies have been, or could be, constructed often span social, political, and economic contours, on the one hand, and material, physical, and spatial parameters on the other, with interaction and intersection possible, if not likely, among such parameters.

Regularly highlighted in comparative urban studies literature is a broad distinction between cities of the so-described global North and global South (Watson 2009; Roy 2009a; Parnell and Robinson, 2012). Embedded within the urban North/South construct are diverse considerations of how cities might demonstrate characteristics along continuums of: green vs. brown sustainability agendas (Gandy 2004; Yazdani and Dola 2013); formal and informal infrastructure configurations and assemblages, spanning material, social and political infrastructures (Simone 2004; McFarlane 2008; McFarlane and Rutherford 2008; Anand 2011, 2012); formal and informal urban economic structures (Roy and AlSayyad 2004; Parnell and Pieterse 2015); weak vs. strong legal planning authority and capacity (Roy 2005, 2009b; Minnery et al. 2012); and/or fragile vs. stable physical security and economic livelihood conditions (Davis 2008; Muggah 2014). These represent just a sampling of the more prominent and potentially transitions-relevant contours at play within the North/South construct, in which it is also recognized that there is substantial diversity across and within urban sites of the so-called global South (Robinson 2006; McFarlane et al. 2017).

Additional social, political, and economic distinctions often made between urban contexts include those relative to modes of urban governance and configurations of urban regimes (Stoker and Mossberger 1994; Hall and Hubbard 1996; Pierre 1999, 2014), as well as those made between "global cities" or "world cities" and differently positioned "ordinary cities" (Robinson 2002, 2006; Sassen 2005), bound up though the latter might be in questions of "worlding" (Roy and Ong 2011). Relatedly, but often focused within national urban hierarchies, is a consideration of how the economic, cultural and political clout of cities becomes enmeshed with considerations of primary, secondary, or tertiary city status (Roberts 2015), often, but not always, connected to considerations of city population size spanning small-, medium-, large and mega-cities. Procedural and political questions relating to the type of multi-level governance regimes in which an urban area and its transitions challenges are embedded are also often highly relevant (Bulkeley and Bestill 2005; Bestill and Bulkeley 2006).

Key distinctions across material, physical, and spatial parameters that might be relevant to urban transitions challenges include the rate at which urban populations are growing, combined with consideration as to whether urban areas are densifying or de-densifying as they grow (Schneider and Woodcock 2008; Angel et al. 2012; Schneider et al. 2015); whether physical growth is contained within or spills beyond urban administrative boundaries (World Bank 2015); the nature of vertical urban growth (Mahendra and Seto 2019); the spatial concentration/dispersion of residential and economic activity according to patterns of mono- or poly-centricity (Kloosterman and Musterd 2001; Lee 2007); patterns of resource use connected with urban form and dominant travel modes along a compact-to-sprawling city spectrum (Camagni et al. 2002; Lohrey and Creutzig 2015; Thomson and Newman 2018); and patterns of urban resource use as connected to either world regions and relative affluence (Creutzig et al. 2015; Currie and Musango 2016) or to general urban economic structure (Chavez and Ramaswami 2013; Ramaswami et al. 2017).

Geography and climate also regularly play a role in urban typology considerations spanning questions of coastal vs. inland cities, hot vs. cool climates, fertile vs. infertile agricultural surroundings, and water-rich vs. water-scarce environments. Moreover, such geographic and climatic variables are often bound up in consideration of natural hazard risk spanning sea level rise, storm events, and acute water or food shortages. As highlighted at length in urban resilience and vulnerability literatures, the physical, geographic, and climatic contours of cities that might be used to construct a profile of an urban area's hazard exposure also clearly interact with political, economic and social contours when considering resilience as both a function of hazard risk as well as capacity to mitigate and cope with and/or recover from shock or stress (Campanella 2006; Leichenko 2011; Meerow et al. 2016).

Finally, for transitions related purposes, it can also be highly relevant to consider diversity in the configuration of infrastructure and provisioning systems that functionally service urban areas (Graham and Marvin 2001; Guy et al. 2001; Coutard and Rutherford 2015). In such cases, key relevant contours can include whether a system is owned/operated publicly or privately (or via some hybrid approach) and whether a system is premised on enclave or "splintered" provision of infrastructure services vs. a near-universal provision paradigm. Whether urban infrastructure systems physically span urban administrative boundaries, such that they can be said to be transboundary, also represents a potentially critical differentiation (Ramaswami et al. 2016).

All of the parameters of urban difference described across this brief and non-exhaustive review, could be relevant when thinking about contextual variables that might influence urban transitions action in a given urban environment, depending on the transitions topic at hand. There are obvious challenges in trying to neatly separate consideration of material, physical, and spatial urban parameters from relevant social, political, and economic parameters. Any effort to construct meaningful urban types will likely require assembling *composite* types that account for the most important combined variables in relation to the unique dynamics of a particular urban transitions question or policy topic. Figure 1 demonstrates the possible position of urban types in the multi-directional information flow for urban knowledge claims along a specific-to-general spectrum. It is our contention that the constructed urban types at the center of Fig. 1 represent a possible analytical unit around which urban transitions policy guidance might be fruitfully and intentionally coproduced.

While still largely emergent, there appears to be mounting interest in urban typology studies across transitions-relevant disciplines, particularly around questions of urban climate change mitigation and adaptation, often with an emphasis on resource flows (Solecki et al. 2015; Currie et al. 2015; Creutzig 2015; ACERE 2018). However, much of the emergent work in the urban sustainability space is focused on quantitatively derived types. It is less well understood how such work might be productively and meaningfully joined up with other, more qualitative urban context variables to inform sustainability transitions policy guidance. Most importantly, from the perspective of this discussion, there has been little explicit deliberation to-date about systematically evaluating the role and limits of urban types as they relate to the CRELE attributes of proxy coproduction efforts happening in actual urban practice. Getting the construction of such types right, both technically and politically, and ensuring sufficiently representative type-

Directionality of urban transitions knowledge flows (solid arrows) from deep place-based engagement to engagement relevant to a much larger set of communities, or from fully generalized 'urban' engagement to a more calibrated engagement relative to a narrower set of communities.

Fig. 1 Positioning Urban Types in Science-Policy Urban Knowledge Flows for Transitions

specific participation in transitions-related coproduction processes so that CRELE attributes remain sufficiently intact, is the challenge at hand.

Premises and practices of coproduction-by-proxy for urban transitions guidance

Below, we present six tentative premises which we suggest broadly characterize type-based coproduction-by-proxy. These premises are articulated in an effort to supply language that captures the essential elements of coproduction-by-proxy. In naming core premises, the goal is to facilitate more direct deliberation about how each interacts with, and might affect, the CRELE attributes of any such coproduction-by-proxy effort. We then present two real-world examples of science-policy engagement processes that we consider represent instances of operationalizing various features of coproduction-by-proxy, in turn illustrating aspects of the premises we articulate. The first example describes a process of moving from localized and place-specific engagement to type-based engagement in the development of a nationally applicable greenhouse gas (GHG) accounting protocol. The second example describes a process of "regionalizing" the recommended transitions levers of a global urban policy document, translating broad guidance to a more narrowly conceived range of national and urban-regional contexts. First, the premises of coproduction-by-proxy:

- *Premise 1- Sampled Perspectives*: Not all of the communities that are the ultimately envisioned "end-users" of the guidance being coproduced are represented in the deliberations and rounds of input-seeking that shape a final product. The value of coproduction-by-proxy revolves around sampling diverse perspectives via the participation of qualitatively representative types, eventually settling on a coproduction participation sample that is 'good enough' in terms of both wider representativeness across types and closeness-of-fit with respect to specific types.
- *Premise 2- Place-Informed Input*: Participants involved in coproduction-by-proxy efforts all come from a specific place or institutional/societal perspective. Despite engaging in a type-based discussion, rather than a discussion about a specific place, the participants themselves are not placeless. Matching the place-informed backgrounds of participants to appropriately representative types is a critical process for type-based coproduction.
- *Premise 3- Explicit 'External Change Orientation'*: Facilitators and individual participants understand that they are considering common challenges experienced in *many* urban areas, not just their own. They are intentionally seeking to develop guidance that is relevant beyond their own community.
- *Premise 4– Making Use of Generalizable Technical Analysis Frameworks*: Coproduction-by-proxy efforts can put to use general technical analysis frameworks, understood as broad methods or approaches, that are scientifically applicable across a wide range of urban contexts, but which will yield substantially different results and strategic priorities responding to the specific contexts they are variously used to analyze.
- *Premise 5- Values and Identity Are at Play:* The scientific or technical validity of transitions-related policy guidance is never the *only* consideration at play in informing how place-specific decisionmakers will respond to such guidance. Consideration

of values, identity, public perception, and ultimately, whether decisionmakers see their community's most pressing needs, interests, and constraints meaningfully accounted for, by proxy, in a supposedly representative urban type are also at play. This question of perceived representation is contingent not just on the diversity of types deployed in a process, as construed by process facilitators or those otherwise charged with constructing such types, but also on the degree to which non-involved decision makers who might be on the eventual 'receiving end' of copro-duced policy guidance will agree with the characterizations and construction of an urban type that purportedly corresponds to that decisionmaker's community.

- *Premise 6- Science and Practice Advancement through Iteration*: Iterative movement from place-based coproduction to type-based, generalizable coproduction-by-proxy, and vice-versa, can yield new science findings that create a cycle generating both in-creased fundamental understanding of urban systems and insights for refining the practice of constructing and matching urban types to broad categories of actual communities for the purpose of developing appropriate transitions guidance and support that can be applied in real places.

We have outlined these premises to help name the functional aspects of coproduction-by-proxy and to offer a foundation for more systematically considering the component parts of designing and structuring such efforts, all with an eye toward evaluating the role of urban types in supporting or undermining the CRELE attributes of coproduced transitions guidance.

Here we turn to exploring two instances of science-policy dialogue that put into prac-tice certain elements of the coproduction-by-proxy concept, to varying degrees. Our goal is not necessarily to characterize these examples as substantially novel, to com-ment on their ultimate successes or shortcomings, or to present them as ideal or fully comprehensive models of coproduction-by-proxy. Rather, the goal is to locate the con-cepts we have been discussing in real-world processes, with an eye toward what it means to consider type-based representativeness in urban science-policy dialogues that are meant to yield semi-generalizable guidance suitable for possible transfer and trans-lation across contexts. Questions of scientific/technical validity as well as policy-oriented political credibility are both explicitly of interest. The two examples described here are quite different, and there are undoubtedly many more potential configurations by which coproduction-by-proxy might take shape, following either of the directional progressions outlined here, from more place-specific to more general, or from more general to more place-specific (see Fig. 1).

Innovating, standardizing and mainstreaming GHG accounting protocols for local governments in the USA

Background

Between 2006 and 2008, second author was engaged in local-level advisory work around developing and improving GHG accounting methodologies with the Depart-ment of Public Health and Environment for the City and County of Denver (USA). This work eventually began to generate traction and raise interest in urban communities outside of the immediate context of Denver. The original work in Denver led to the

clarification and articulation of new conceptual understandings of cities as open systems, revealing transboundary travel, trade, and imports of key energy and material resources as exerting significant impact on GHG emissions associated with cities. These theoretical advancements were coupled with corresponding practical advances in quantifying carbon flows associated with key urban production and consumption activities, a solid understanding of which is essential for developing action and policy as part of low-carbon transition planning (Ramaswami et al. 2008, 2011). The GHG emission inventory methodology developed was accompanied by a generalizable GHG wedge analysis tool, both of which provided a common approach for measuring and prioritizing low-carbon strategies; the approach is translatable to new contexts but yields vastly different GHG footprints and action priorities in different types of cities.

While this work began as a focused coproduction effort in Denver specifically, it was subsequently replicated and tested in seven additional cities, in which researchers worked closely with city officials to gather bottom-up data (Hillman and Ramaswami 2010). The expansion to additional cities allowed for the development of GHG-relevant typologies around net-consuming, net-exporting, and trade-balanced communities in the USA (Chavez and Ramaswami 2013). The process of moving from city-specific work, to work with a larger set of cities that allowed for the development of a relevant typology laid the groundwork for a broader coproduction-by-proxy effort for developing and mainstreaming a national GHG accounting protocol for local communities.

A turn to coproduction-by-proxy

The initial base of co-produced work undertaken directly in Denver and elsewhere, described above, soon came to inform a larger standardization and mainstreaming process to make sense out of differing GHG accounting perspectives. This larger process was led and convened by the USA chapter of ICLEI-Local Governments for Sustainability, ultimately resulting in the establishment of an advisory committee for elaborating the first US Community Protocol for GHG Accounting (ICLEI 2012). The committee included researchers working closely with cities, including second author and her experience working with Denver on community-wide GHG accounting, as well as additional researchers from the Stockholm Environment Institute working with King County, Washington (the county in which Seattle is located) on consumption-based GHG accounting. The bulk of the committee consisted of representatives from cities of different types (spanning diverse population sizes and geographies), civil society actors, and state agency representatives. The transition from direct place-based work with cities to work with ICLEI and a nationally assembled working group marked a departure from deeply place-engaged coproduction to proxy-based work with the goal of developing guidance that would be relevant to diverse types of urban communities nationally. The proxy-based work revolved around taking learnings from place-engaged work and testing and adapting those learnings via iterative engagement with stakeholders representing communities from across the USA, again of various size and geographic location, such that they could develop and apply a nationally-standardized protocol for GHG emissions accounting for local communities (Zborel et al. 2012). An important implicit goal of this effort was to ensure sufficiently representative participation from a wide variety of community types, such that the guidance being generated could reflect the needs and constraints of as wide a pool as possible

of potential future end-user communities. The protocol itself was premised on flexibility for use across differently situated communities in that it specified a core minimum of required data reporting necessary to implement at the most basic level, with the option to add reporting categories for more ambitious protocol implementation based on data availability for a given community. Detailed instructions for a range of data availability and reporting options were included based on practitioner experience in order to broaden eventual uptake of the protocol across diverse communities. This emphasis on flexibility was specifically born out of the working group's efforts to consider implementation realties across a range of community types.

The coproduction process, because it brought together a geographically dispersed working group, happened largely via conference calls, progressing from jointly framing the challenge and elaborating shared values around what a national protocol might accomplish, to considering relevant science advances, to engaging with the practical and political priorities of differently situated communities and policy actors, functionally serving as types. Additional in-person meetings were an important part of building final consensus. Ultimately, the committee 'learned-by-doing' via an iterative process wherein the different potential methodologies were applied to different cities, serving implicitly as representative urban types, with practitioners experimenting with different data sets as well as developing different corresponding policy narratives. Committee members co-wrote, reviewed and updated multiple drafts of the protocol, which was also eventually subject to comment and review by ICLEI USA's wider membership before being finalized. The resulting protocol has been mainstreamed as the standard of practice in the USA for local community GHG accounting and is reviewed periodically for refining and updating.

'Regionalizing' global science-policy guidance for urban infrastructure transitions
Background
In 2016, the International Resource Panel, a standing body of global scientists hosted by UN Environment, began work on a report that would consider the material resource requirements of global urbanization and identify broad strategies as a general analytical framework for multiplicative resource efficiency levers in cities (IRP 2018). The report stated that the proposed pathways, when fully implemented, could theoretically yield reductions in overall urban resource use by at least a factor of five, and potentially by as much as a factor of ten. The broad pathways included a foundational focus on compact urban form, followed by a layering on of both single-sector and cross-sector efficiency strategies, high renewable energy penetration, and widespread adoption of sustainable consumption behaviors at the level of households, firms and individuals. The report was intentionally global and aspirational in nature, outlining, in intentionally broad and conceptual strokes, what sustainable urban infrastructure transition pathways might look like, more or less, in fully general terms. While examples from real cities were cited in the report, the guidance offered in the global document was designed to be relevant to urban areas generally, rather than to narrowly specific types of urban areas.

A turn to coproduction-by-proxy
A subset of the team involved in the global report, including the authors of this article, was tasked to work on a regionally specific report for Southeast Asia, meant as a regional

contextualization exercise to further narrow and target the global pathways in a way that made sense for urban contexts across the ten countries making up the Association of Southeast Asian Nations (ASEAN) (UN Environment 2018). The pivot to a region-specific, implicitly type-based contextualization effort began with an initial workshop to jointly frame the challenges and opportunities faced by urban contexts across the region. A core dilemma in the contextualization process was considering how to deal with intra-regional diversity, in this case, a region spanning ten nations, with dramatically different wealth, development, and governance profiles, all while paying attention to the variations in urban context across small, medium, and mega urban agglomerations *within* each country, as well as across the region more generally. Moreover, there was ample discussion about the appropriateness of drawing examples from well-studied cases in India and China, which, while neither nation is of the region, were understood as relevant and contrasting reference points representing a wide spectrum of urban growth and governance examples that might be able to meaning-fully speak to a variety of urban types across the ASEAN bloc. The appropriateness of the contexts from which examples were being drawn was of substantive concern, both in terms of technical validity and political legitimacy, with high priority placed on taking examples from contexts within the larger regional context of Southeast Asia, or neighboring cases from India and China. The initial framing workshop included participation from re-searchers, former national government representatives, and staff from multi-city organiza-tions, local governments, and multi-lateral agencies. The workshop considered relevant science advances, data needs, and existing local government initiatives and constraints across a range of national and urban-regional contexts.

Following the first workshop, a draft of the regional guidance document was developed in close collaboration with multi-lateral agency representatives and researchers in advance of a second workshop. The second workshop again included staff from multi-lateral agen-cies, local government, and multi-city organizations, as well as researchers. New categories of participants represented in the follow-on workshop included an elected mayor as well as representatives from a housing and community development advocacy organization. The second workshop was convened adjacent to a regional convening of mayors from across Southeast Asia, which allowed research staff to conduct additional interviews with political leaders that did not directly participate in the workshop. The final guidance document was substantially updated to reflect the content from the second workshop, the mayoral interviews, as well as international peer-review comments. The final published version of the 'regionalized' guidance document was introduced and discussed at key glo-bal and international urban policy fora over the course of the following year.

Discussion and future directions

In each of the described cases, questions of implicit type-based representativeness were certainly of substantive interest but were handled more as an ad hoc or intuitive con-sideration. They were not necessarily subject to formally and systematically explicated criteria or variables directly linked to the CRELE attributes of coproduction and science-policy engagement more generally. To more directly link CRELE attributes with consideration of how to strategically build high-impact urban types that can be assem-bled into meaningful units of analysis for proxy-based coproduction, it is necessary to ask evaluative questions relevant to each CRELE pillar.

For credibility, there are questions of division of labor within a proxy-based coproduction process. What is the appropriate balance across represented actors spanning scale, place, and knowledge domains so as to render type-derived conclusions valid? Moreover, what elements of coproduced transitions guidance can be credibly jumpstarted and supported by semi-generalizable type-based efforts, and what elements of a transition effort need to be developed locally? For relevance, there are questions of nearness of type and getting to 'good enough.' At what point, and for which urban transitions challenges, does emphasizing difference and context-specific nuance start to yield diminishing returns, specifically from the perspective of offering actionable policy guidance? And finally, for legitimacy, there are questions of authority, voice, and representation, both real and perceived. Who is making decisions about the above-mentioned considerations of both credibility and relevance vis-a-vis types, and how might one determine if they have the stature necessary to make decisions on representation that win the confidence of uninvolved end-users such that those end-users see their interests, by proxy, as having been sufficiently represented in the deliberations that might lead to any eventual policy guidance? Furthermore, who is benefitting from the construction of types in particular ways for particular transitions challenges, and who may be losing?

Future research might consider assembling past instances of urban transitions science-policy engagement that conform to the premises of coproduction-by-proxy outlined here, and subsequently undertaking *retrospective* evaluations relative to their CRELE performance for the purposes of identifying factors that have influenced the successes or shortcomings of such efforts. Alternatively, future work might *prospectively* consider optimal process designs, as well as the mapping out of transitions topics that appear most ripe for type-based deliberative coproduction. Such future work, either retrospective or prospective in orientation, would need to explicitly consider the metrics by which we might judge the technical and political validity of constructing, matching, and deploying types in ways that meaningfully allow coproduced guidance to achieve a degree of generalizability and applicability across multiple contexts. Answering these questions will likely require ongoing, iterative reassessment based on evolving application to new and different transitions topics, with new and different urban universes in mind in terms of the types of cities and communities one might be interested in influencing via coproduced guidance. Such work around developing metrics, itself, will likely methodologically require the deployment of coproduction processes, as it is the end-users of any such type-based coproduced policy guidance that will ultimately have to be convinced of its credibility, relevance, and legitimacy. Specifically, such work would need to ask: what do place-based decisionmakers feel negatively or positively impacts the CRELE attributes of type-derived guidance? And more pointedly, are they likely to put coproduced type-based guidance to work in their communities?

Conclusion

Ultimately, we have outlined more questions than answers in terms of how to understand the use of types in proxy-based coproduction. After establishing an interest in, and a rationale for, type-based coproduction of urban policy guidance in the face of the magnitude of the urban transitions challenge globally, we have elaborated illustrative examples and tentative core premises of coproduction-by-proxy in order to facilitate debate about how we might engage with the idea of proxies and types as a way to mediate between general

and specific coproduced policy guidance, constituting a potential middle path. Importantly though, we consider the questions raised in this discussion unsettled, rightfully open to both ongoing debate and iterative reassessment.

Our intention has been to frame a conversation about where we believe there is more work to be done, representing a frontier of sustainable urban systems science and its capacity to help inform, support and/or accelerate real-world, place-based, and contextually specific urban sustainability transitions. We consider the emerging role of urban typology studies, linked with both science and practice-informed considerations of CRELE attributes associated with coproduction, to hold great promise for the way in which we think about how working with proxies and types might help increase the impact of coproduced guidance for urban transitions as well as to advance our scientific understanding or urban systems more generally.

Abbreviations
CRELE: Credibility, relevance, legitimacy; GHG: Greenhouse Gas

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