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The ecosystem services concept in urban planning: the criteria for practical fit

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ABSTRACT

Application of the ecosystem services (ES) concept in urban planning has potential for improving environmental and human health outcomes in cities. We aimed to narrow an identified ES implementation gap by identifying the criteria for the practical fit of the ES concept in urban planning. We found that local relevance and adaptability within current planning approaches were core criteria for practical fit. If not met immediately, these criteria may be met over time through policy entrepreneurship. Further research in different locations and planning systems would increase understanding of the enabling factors for applying ES in urban planning.

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Introduction

Urban planners are under pressure to respond to the emerging and complex challenges of urbanization processes, environmental degradation, and climate change mitigation and adaptation. As a result, planners are looking for novel policy options and more powerful arguments to justify stronger urban environmental policies.

The application of the ecosystem services (ES) concept at the local level is an emerging area of environmental policy. ES are the benefits that nature provides for human well-being. Globally, ES science has been highly effective when applied at a conceptual level, as a strategy to communicate the value of nature, and in broadening ecological research to its human dimensions (Lele *et al.*, 2013).

Urban ES are ‘directly provided by ecological structures within urban areas or peri-urban regions’ (Luederitz *et al.*, 2015, p. 99). These ecological structures are associated with public and private green spaces, individual parks, park networks, urban forests, and vacant land. Natural and managed hydrological features such as wetlands, rivers, streams, drainage channels, and lakes, as well as engineered structures such as swales and stormwater retention areas also provide ES (Grunewald & Bastian, 2017). Important ES supplied to urban residents from these features include stormwater mitigation by wetlands, local climate regulation by urban forests, and mental and physical health benefits from urban parks (McPhearson *et al.*, 2015). In addition, ES sources and sinks outside the urban

area are critical to urban functioning (Jansson, 2013). For example, there is extensive ‘transboundary environmental trade’, consisting of the export of urban waste in various forms and the import of food and water (Douglas, 2012, p. 386).

Some urban planners are interested in applying ES-based approaches as routes to urban sustainability, for example, in addressing climate change adaptation, or for assessing trade-offs between land uses and ecosystem functions (Tang Kai *et al.*, 2022). A few planners have begun to adopt aspects of the ES concept, for example, in communicating, assessing, and valuing the contributions of aspects of urban nature to urban residents (Grunewald *et al.*, 2021). Likewise, sustainability researchers identify urban planning as having significant potential for applying ES science and contributing to urban sustainability (Cortinovis & Geneletti, 2018).

Despite its international and national currency, and overall optimism about its potential, the ES concept has proved difficult to translate into local-level policy and practice. Consequently, planners who seek to adopt ES-based approaches in practice and in policy recommendations find little practical guidance from within planning contexts.

Research reveals a broad set of factors implicated in impeding local-level adoption of the ES concept, including the knowledge and values of municipal staff, and the fiscal and technical capacity of municipal governments (BenDor *et al.*, 2017; Boulton *et al.*, 2018). Political context, leadership, and organizational culture also appear to be important for implementation of the ES concept (Rall *et al.*, 2015; Boulton *et al.*, 2018). There is also evidence that the framing of the concept may influence its uptake (Opdam *et al.*, 2015).

Once a new concept like ES is introduced into the policy-making realm, its adoption is dependent on passing practicality or ‘fitness’ tests (Meadowcroft & Fiorino, 2017). The most basic tests for policy concept fitness are alignment with the values and identities of the users (normative fit) and the ability to be applied in practice (practical fit) (Stevenson *et al.*, 2021). Widespread interest in the ES concept for planning (Ronchi, 2021), and extensive acceptance of the ES concept by researchers and organizations (Stevenson *et al.*, 2021) indicate that the ES concept passes the normative fitness test. Identifying the criteria for its practical fit will be central to increasing its adoption.

This research aims to narrow the gap in ES implementation by identifying criteria for the practical application of the ES concept in urban planning in Canada and elsewhere. We conducted our inquiry into ES use by interviewing urban planning practitioners in three Canadian cities. We analyzed planners’ perceptions of challenges with ES adoption, and their insights about the opportunities for more use of the concept. We then identified the criteria for the practical fit of the ES concept. Planners and researchers can use the criteria to increase the application of the ES concept in urban planning.

The research will be of interest to both urban planning practitioners and ES researchers in identifying routes to more substantive adoption of ES thinking in local municipal contexts. The study focused on the ES managed by cities within their boundaries. Although there are also ES in rural areas that serve cities, they fall beyond the scope of this study. Our proposed model of the practical fit of the ES concept may potentially be useful in other areas of policy adoption.

Background

ES

The term ES conveys the notion that nature provides beneficial services to humans (Danley & Widmark, 2016). The ES concept has been embraced in some areas of environmental science and management as novel and game-changing, but ideas analogous to ES have been embedded in other disciplines, including planning, for decades (Thompson *et al.*, 2020).

The hope of those who developed the ES concept was that increasing people's understanding of nature's supporting role in human well-being would translate into improved attitudes toward nature, eventually leading to better public policies and thus positive outcomes in environmental decision-making (Opdam *et al.*, 2015). While the ES concept is often cited by government and organizations at the international and national levels, and ES research has burgeoned, the ES concept has yet to be implemented significantly at the local level (Stevenson *et al.*, 2021).

Identifying the 'real world factors of implementation' (Rall *et al.*, 2015, p. 231) appears to be the central problem to resolve in relation to the integration of ES thinking in urban decision-making. There is research exploring the ES implementation gap (for example, Kerr *et al.*, 2021). Some researchers have commented that ES research outputs do not provide useful guidance for operationalizing the ES concept (Olander *et al.*, 2017; Ronchi, 2021; Edler *et al.*, 2022). In addition, multiple barriers impeding local-level ES adoption have been identified, including limited capacity among those tasked with implementation (Kaczorowska *et al.*, 2016), the need for policies requiring ES thinking to be fully integrated across government departments and with other levels of governance (Schleyer *et al.*, 2015), the requirement for stakeholders to be involved in identifying and assessing relevant ES (Schleyer *et al.*, 2015), and a lack of agreed-upon approaches to assess and value ES at the local level (Blicharska & Hilding-Rydevik, 2018). In addition, researchers have noted the lack of agreement on a definition for ES, leading to conceptual incoherence and possibly contributing to slow progress in the adoption of ES thinking (Danley & Widmark, 2016). Finally, although ES valuation activities are an important application of the ES concept in decision contexts involving cost-benefit analysis (albeit requiring improvement) (Jacobs *et al.*, 2016), ES valuation often elicits strong negative reactions, such as claims regarding the commodification of nature (Schröter *et al.*, 2014).

ES for urban planning

Human land use has a significant impact on the quantity and quality of urban ecosystems, and thus on urban ES and their flows. Urban planning initiatives can increase the potential for urban land to supply ES; for example, via natural and constructed wetlands for regulating stormwater flows, and in public open space for supporting food production. Therefore, urban planning has been identified as an important route for operationalizing the ES concept. In addition, planners, based on their training and roles in a dynamic urban system, are well-positioned to develop, test, and apply ES ideas.

Besides the benefits that accrue to humans from ES supplies, it has been suggested that ES thinking has additional value during planning processes. The ES concept helps the public and politicians understand the value of conservation, and ES rhetoric can justify

investments in green infrastructure (GI) (Thompson *et al.*, 2024). ES ideas may draw together diverse perspectives to increase collaboration on sustainability (Ainscough *et al.*, 2019; Spyra *et al.*, 2019), be used to facilitate communication and networking among planning professionals (Hysing, 2021), and for integrating environmental policies across institutional silos (Rall *et al.*, 2015). ES assessments also provide crucial information about the trade-offs between urban development and land conservation (Tang Kai *et al.*, 2022). The use of ES thinking by planners is also consistent with current planning ideas concerning the central importance of environmental sustainability (Tang Kai *et al.*, 2022).

Historically, urban planning included consideration of urban nature for its protection or conservation, but mainly to provide space for human restoration, recreation, social interaction, and exercise (for example, in urban parks) (Lapintie & di Marino, 2020). Measurements of ecosystem quality and health, such as those carried out in ES assessments, have not typically been used to inform planning processes; instead, the environmental data that inform plans usually include only a 'basic assessment of quality', such as area of open space or wetlands, or length of trails (BenDor *et al.*, 2017, p. 261). These simplified ways of including urban nature in planning do not allow for consideration of how ecosystems may deliver services to humans (BenDor *et al.*, 2017; Tang Kai *et al.*, 2022).

Although most planning approaches do not provide detailed insight on ecosystem quality or health, nor on human beneficiaries, some traditional environmental planning approaches such as suitability and sensitivity analyses are based on ideas analogous to ES (Thompson *et al.*, 2019), and ES has been identified as an implicit concept in urban plans (e.g. Cortinovis & Geneletti, 2018; Thompson *et al.*, 2019). However, ES is far from being mainstreamed in urban planning.

The development of novel ideas and tools tied to the ES concept has been growing in urban planning practice and scholarship in recent years. Aspects of ES are being taken up explicitly but gradually by urban planners interested in improving environmental decision-making in cities (Lam & Conway, 2018; Grunewald *et al.*, 2021; Ronchi, 2021). Planning practitioners are increasingly turning to unconventional means of service provision in cities, such as GI, in pursuit of creating livable and sustainable places, especially in the face of climate challenges (Tang Kai *et al.*, 2022). Another notable new development is nature-based solution (NbS) approaches that employ ecological components producing ES flows to respond to challenges such as flooding or increased heat in cities (Remme *et al.*, 2024). These related approaches have created many opportunities for sustainable planning practices, but at the same time, their similarities and overlaps have produced some uncertainty around their use for urban planning (Hansen *et al.*, 2021).

Multiple studies have been directed toward understanding how the ES concept is applied in real-world decision-making processes, and what this means for successful application in the future (e.g. McKenzie *et al.*, 2014; Rall *et al.*, 2015; Ruckelshaus *et al.*, 2015; Thompson *et al.*, 2024). In planning contexts, ES uptake has been studied using a framework that organizes the many ways that ES is employed into conceptual, strategic, and instrumental modes of use (McKenzie *et al.*, 2014; Thompson *et al.*, 2024). Conceptual ES use (for example, for awareness-raising about the important role of nature in human well-being) prevails during early adoption in planning as knowledge of ES

concepts and tools expands (McKenzie *et al.*, 2014; Thompson *et al.*, 2024). Strategic use (where planners may employ ES rhetoric to obtain public and political buy-in, for example) is used concurrently with instrumental use (in which ES information is introduced into planning policy to increase the quality of environmental considerations, or ES-based tools inform planning decisions) in later stages of ES uptake (Thompson *et al.*, 2024). Ruckelshaus *et al.* (2015) suggest that successful application of the ES concept would include knowledge production and dissemination about the importance of ES for humans and the environment, increased understanding about ES, incorporation of ES considerations into policy, and ultimately, improvements in biodiversity, ES supply, and human well-being.

The practical fit of new ideas in public policy

New ideas enter the planning profession through various social learning processes, that is, by planners engaging with colleagues, those in other disciplines, and the public in ‘developing knowledge (including skills and experiences) through human interaction’ (von Schönfeld *et al.*, 2020, p. 411). Urban planning practitioners also rely on practice-based case studies and experts (Henderson, 2016; Thomas & Bertolini, 2020), and best practices developed in other geographic and policy contexts (Patel *et al.*, 2015). Experimentation has been used in planning (often in covert ways) for the adoption of new ideas and practices (Scholl & de Kraker, 2021). In addition, the movement of planning professionals across disciplines, between different localities, and among public and private sector organizations contributes to the acquisition and development (and the loss) of planning knowledge and its application within planning offices (Muldoon-Smith & McGuinness, 2020).

Depending on their personality, location, position, and seniority, planners have varying degrees of agency, willingness, and ability to innovate, influence other actors, and recommend new policies. In addition, they are constrained by numerous informal and formal institutional structures, including municipal departments, working groups of planners, communities of practice, professional planning institutions and their ethical and professional guidance, consulting planning groups, land-use legislation and regulatory tools, the norms and practices of each municipality and planning department, the norms of the local community, and larger social norms and practices (Healey, 2018). These multiple institutional layers produce and maintain ‘rigidity traps’ (Angeles *et al.*, 2021) that limit planners’ ability to anticipate change and innovate.

Extensive and rapid environmental change around the globe is prompting the generation of novel approaches to address complex, emerging problems. The public policy realm is increasingly subject to the influx of new ideas (Craig *et al.*, 2019; Stevenson *et al.*, 2021; Nylén & Jokinen, 2023). As an idea is introduced into public policy discussions, immediate or eventual adoption cannot be assumed. A new idea must compete with other ideas and prove its fitness before it can be adopted for policy (Meadowcroft & Fiorino, 2017).

Numerous criteria are involved in the fitness test for ideas. Kingdon (2003) proposed technical and fiscal feasibility, along with political and public acceptability as the ‘criteria for survival’ (p. 131) of an idea in the public policy realm. Relatedly, Stevenson *et al.* (2021) proposed that ideas must possess both ‘normative fit’ (alignment with an actor’s

or a group's identity and values) and 'practical fit' (ability to be applied in practice) to be taken up by policy actors. In other words, the extent to which a new idea is adopted is related to the idea, the adopter (or group of adopters), and their contexts (Wejnert, 2002). Kingdon also suggested a key role for 'policy entrepreneurs', actors who use various tactics, such as attention-shaping, demonstrating, and rhetoric, to advocate for new ideas and policy change during the public policy process (Kingdon, 2003; Mintrom & Norman, 2009).

Fitness of ES for use in sustainability

To advance understanding of the reasons for the weak operationalization of ES, Stevenson *et al.* (2021) claimed that, although ES has normative fit in global governance, its practical fit is poor. Similarly, Allan *et al.* (2022) argued that the success of ES as a 'frame but not a programme of action' is because of the difficulty of translating the idea of ES into practice, which would involve 'the complex steps of *recognizing* the myriad ways in which nature supports human wellbeing and economic development, *measuring* the value of these functions, and *integrating* these values into decision-making processes and on-the-ground practices' (p. 71). Therefore, attention on the practical fit of the ES concept offers a way to understand how to make progress in its adoption.

Relatedly, sustainability researchers have explored factors enabling knowledge transfer from research to practice to inform decisions on environmental sustainability. The work of boundary organizations, 'designed to facilitate collaboration and information-flow between the research and public policy communities' (Parker & Crona, 2012, p. 263), figures prominently in such work. Case study research, including investigations of ES application, supports Cash *et al.* (2003) hypothesis that boundary work facilitates the knowledge transfer process when it meets three criteria: stakeholders must perceive the knowledge to be salient (relevant to the user), credible (deemed adequate as technical evidence or argument) and legitimate (seen as unbiased and fair, and respecting stakeholder values and beliefs) (Clark *et al.*, 2016; Adem Esmail *et al.*, 2022; Adem Esmail & Geneletti, 2017). van Oudenhoven *et al.* (2018) synthesized a checklist of indicators for quality and quantity of ES from the scientific literature based around the same three categories. Following Schröter *et al.* (2015) example, they urged the addition of a feasibility criterion (related to data, time, resource availability, and adaptability) to further ensure indicator uptake. Posner *et al.* (2016) concluded that legitimacy of ES knowledge, scientist and decision-maker interaction, institutional capacity, and local knowledge appear to be important in predicting the policy impact of ES.

The uptake of ES in urban planning

Research on progress in the application of the ES concept in urban planning has centred in cities in the European Union (EU). Analysis of urban plan content has revealed a focus on a few ES, for example, regulating services such as stormwater runoff, and cultural services such as recreation (Cortinovis & Geneletti, 2018; Sang *et al.*, 2021). Urban plan content analysis in the EU and the US (Hansen *et al.*, 2015) and interviews with stakeholders in Finland (Rinne & Primmer, 2016) showed there was little explicit use of ES concepts. An extensive review of Swedish municipal plans and interviews with

Swedish practitioners revealed that although attention to ES has increased in comprehensive plans, there is still an implementation gap at the local level (Khoshkar *et al.*, 2020).

Mirroring the situation in the EU, an ES implementation gap has been observed in Canada (Kerr *et al.*, 2021). For example, Lam and Conway's (2018) review of planning documents in Ontario showed that explicit reference to ES was rare; among those plans that incorporated ES concepts, cultural and supporting ES were most identified. Thompson *et al.* (2019) found more implicit than explicit attention to ES in Canadian municipal plans, and the ES most identified were stormwater regulation, food and drinking water provision, aesthetics, and recreation.

Increasingly severe climate change impacts are forcing Canadian cities to adapt swiftly, and to apply innovative solutions to increasingly complex problems (Baynham & Stevens, 2014; Hill, 2016). ES has caught the attention of Canadian urban planners because it offers solutions to emerging problems. Yet many planners have little detailed knowledge about ES and its potential (Tang Kai *et al.*, 2022). As most of the research on the adoption of ES in planning has occurred in the EU, studying Canadian experiences can provide support for Canadian planners faced with rapidly emerging issues. In addition, an understanding of ES use in the North American context expands the general understanding of ES use and may provide lessons for ES researchers aiming to encourage the use of ES locally.

In summary, the ES concept has received ample attention at the global level, and ES research has proliferated. Urban planners are interested in applying ES, and ES holds promise for planners to create more-sustainable places. Although the adoption of ES has been explored in various locations, and impediments to its uptake have been delineated, it is still not adequately understood why ES is not well incorporated into urban planning. Understanding the experiences and perspectives of planners who are engaged with adopting the ES concept is vital to identify the criteria for the practical fit of ES, and ultimately for improving outcomes for such current challenges as climate change adaptation and environmental sustainability. The purpose of the research was to identify the criteria for the practical fit of the ES concept in urban planning to contribute to narrowing the ES implementation gap.

Some points of clarification around the ES concept and its application are warranted here. We are aware there are many ways to think about 'application' of the ES concept, but we chose a broad view encompassing conceptual, strategic, and instrumental modes as described earlier (McKenzie *et al.*, 2014; Thompson *et al.*, 2024). Each mode influences decision-making during planning processes, and has a significant but different purpose for the various actors in a planning process. We also recognize that the ES concept is closely tied to many other concepts and tools, such as GI, natural capital, and NbS, and often the terms are confused or used interchangeably (Kerr *et al.*, 2021). Given the early-stage uptake of the ES concept and approaches in Canadian urban planning, we expected to encounter the use of such related concepts alongside ES terminology, and evidence of the uptake of the ES idea because of these related concepts. Therefore, our understanding of narrowing the implementation gap for ES implied that associated approaches and their terminology were employed, and we included those concepts as ES in our analysis.

Materials and methods

A qualitative, multiple case-study method was selected for this exploratory study because the various and complex contexts of planning are key to understanding planners' work (Yin, 2009; Flyvbjerg, 2010). Selection of the three case cities (Table 1) was guided by a previous research project that investigated the use of ES concepts in municipal plans (blinded for review). A content analysis of the official plans of 19 Canadian cities revealed more use of ES ideas – explicitly and implicitly – in the selected cities than other municipalities (blinded for review). An additional screening via phone interviews with planners in several Canadian cities located cities where there was interest in ES and related concepts such as GI and natural capital.

Halifax Regional Municipality (Halifax) was identified for the study because Halifax's Regional Municipal Planning Strategy contained multiple references to the values and services of nature (blinded for review); Halifax was selected as the pilot case (to test and refine the research design and the procedures for participant selection and data collection (Yin, 2009)) for reasons of convenience and access. Calgary was identified for the study because Calgary's Municipal Development Plan made frequent reference to ES-related ideas, including LID techniques and GI (blinded for review). Finally, Metro Vancouver (Vancouver) was identified as a case city because the region and some of its municipalities were early innovators and adopters of natural asset approaches.

Purposive sampling (Creswell, 2014) was used to locate key participants with awareness of the ES concept and associated approaches, or experience with ES tools, methods, and implementation. Further participants were located by referral (snowball sampling) from key participants. All participants were involved with urban planning processes or decision-making. Most participants were working for a municipal department directly involved with planning and were supportive of the introduction of ES thinking. Several were consultants to such departments and were more critical.

Interview and focus-group questions explored the understanding and adoption of the ES concept by the participants in their work. Participants were not queried about the specific ES they sought to advance in their work. The interviewer (first author) had worked and taught in planning and established a rapport with participants that elicited robust and insightful responses. Participants were encouraged to explore avenues of conversation beyond the planned line of questioning.

A total of 31 people from various urban planning functions participated (Table 2). Individual semi-structured interviews of approximately 1 h were conducted with 24 participants. Due to COVID-19 pandemic travel restrictions, interviews were conducted online. An additional seven people participated in two focus-group sessions (one online) of approximately one-and-a-half hours. The interviews and focus groups were audio

Table 1. Cities selected for the case studies.

City	2021 Population (Statistics Canada, 2023)	Municipal Structure
Halifax, Nova Scotia	439,819	Regional Municipality
Calgary, Alberta	1,306,784	Regional Municipality
Metro Vancouver, British Columbia	2,642,825	Federation of 23 local authorities: 21 municipalities, one electoral area, and one treaty First Nation

Table 2. Roles of participants in their municipalities.

Halifax	interviews: parks policy and planning manager regional planning policy program manager energy and environment program manager urban forester planning applications manager city councillor focus group: regional planning manager; principal planner, environmental planner
Calgary	interviews: planning policy coordinator climate adaptation planner resilience & infrastructure planner drainage technical lead watershed planner ENGO (stormwater) director consulting planner
Vancouver	interviews: senior environmental planner sustainability specialist (planning) parks planner consulting planner biodiversity conservation planner drainage and utilities manager climate adaptation coordinator financial director; MNAI Board Member focus group: principal planner (2), agricultural planner, environmental planner

recorded and transcribed. Each participant was assigned an alpha-numeric code; for example, ‘H1’ indicates a Halifax participant.

Qualitative analysis applied both inductive and deductive techniques (Bingham & Witkowsky, 2021) (Figure 1) with the assistance of NVivo 13 software (QSR International Pty Ltd, 2020). Transcriptions and research memos (Silverman & Patterson, 2015) were inductively analyzed through open coding (Silverman & Patterson, 2015) and focussed coding to generate themes and subthemes related to the lessons from the participants’ experiences. The body of data was also deductively analyzed, using the themes from the interview questions to understand the level of adoption, sources of ES knowledge, and

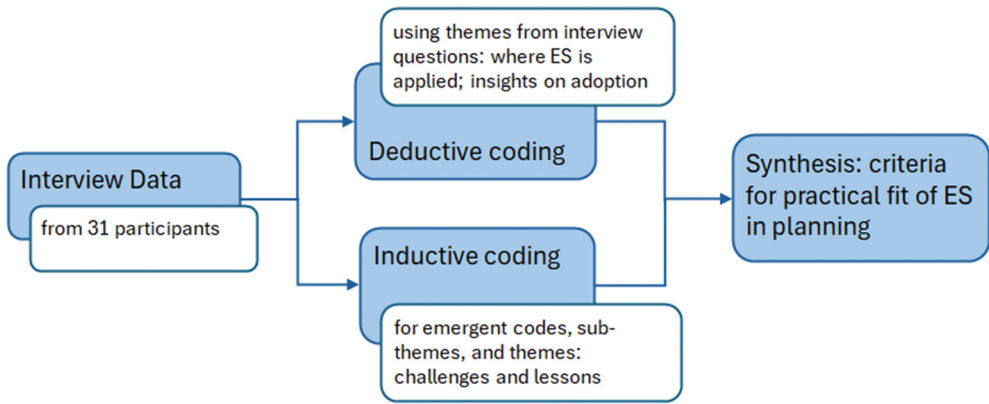


Figure 1. Data analysis procedure.

where ES thinking was applied. Although the interview and focus group questions were not oriented toward the idea of understanding practical fit, we applied it as a lens during the data analysis process and in structuring our results. We synthesized our findings into a model for understanding the criteria for practical fit of ES in urban planning.

Results

Here, we provide a general picture of the practical fit of the ES concept, or how it was being incorporated into the work of the participants and some of their colleagues. We summarize what we learned about the penetration of ES thinking into the participants' work, how they learned about the ES concept, and their motivations for considering its adoption. We also provide a synopsis of what participants offered as challenges and barriers to the adoption of ES thinking, and their insights about its adoption so far in planning.

Level of adoption and sources of knowledge about the ES concept

In general, participants in the study looked favourably on the ES concept, and revealed how they were working toward ES thinking as 'the normal thing to do' (C2). Most felt that the ES concept had the potential to inform and improve urban planning. ES thinking was viewed as an 'holistic' (V2) and 'integrated' (V5) idea, in keeping with progressive thinking by urban planners. Most suggested that ES thinking had the capacity to expand the conversation about the importance of urban nature.

The varying degree of penetration of ES thinking was indicated by participant responses to the question: 'what does ES mean to you?'. In Halifax, modest appreciation for ES and associated ideas was indicated by the *ad hoc* definitions offered by participants. In contrast, familiarity with the ES concept in Calgary was reflected by more detailed responses. A theme among Calgary participants was that ES '[aligns] with municipal services' (C1). In Vancouver, participant definitions were similar, suggesting a common source: a short definition in guidance documents disseminated within Vancouver for over a decade.

Participants from all three cities mentioned education and workplace experiences most often as sources of knowledge on ES. Many participants had a background in environmental studies or a related field and had acquired foundational knowledge on ES and similar concepts through formal education. Their interest in ES concepts was enhanced because they had a personal investment – sometimes expressed as a 'passion' – in environmental matters. They reported ES knowledge sharing within their workplace and professional networks via: 'collaboration circles' (C1); 'convening on [ES and similar] topics, acquiring data, distributing that data, that knowledge-sharing and information-sharing piece' (V3); and the 'interface and interchange of collaborative policy and communication' (V3). We observed a minority of individuals in all cities to be more knowledgeable about the ES concept than the rest, and more persistent and more invested in facilitating its adoption.

We inquired where in planning was ES thinking being applied in each city (Table 3). Participants mainly referred to the ES concept playing a supporting role within new or traditional planning approaches, for example, in work on climate

Table 3. Main areas of planning where ES was applied.

	Halifax	Calgary	Vancouver
ES-explicit approaches			
ES assessment and asset management	x	x	x
ES valuation	x	x	x
Existing planning approaches			
GI	x	x	x
climate change	x	x	x
urban forest	x	x	x
stormwater		x	x
biodiversity		x	x
coastal and marine	x		x
restoration	x	x	x
parks		x	x
naturalization	x	x	
resilience		x	x
source water management		x	
wetland protection		x	

change adaptation, urban forest planning, stormwater management, biodiversity planning, and planning for coastal and marine areas. Most participants thought of ES as a new term describing the benefits produced from GI. Pilot GI projects were being organized collaboratively, helping the public, local politicians, and skeptical colleagues to become comfortable with the idea of nature's services. The ES concept was supplementary to other approaches in helping to legitimate and justify decisions to protect urban ecosystems. However, ES thinking or tools did not play a critical role in these approaches.

The adoption of new ES-explicit approaches or tools was most evident in Calgary and Vancouver, where ES assessments and valuations, mainly carried out by external consultants, were used for input to decision-making in planning and for municipal asset management. The Municipal Natural Assets Initiative (MNAI) was a relatively well-known Canadian organization that engaged with municipalities (Stanley *et al.*, 2019) and provided technical support for participants. Natural asset management was recognized by the participants in all three cities as an area of focus for planning, and they anticipated it would be mandated in future. Although ES assessments were part of urban forest management in Halifax at the time of the interviews, other ES approaches were not yet integrated into urban planning.

Participants were aware of the 'buffet' (V6) of ES tools being promoted internationally. However, Canadian-based approaches such as MNAI were regarded most positively. As V6 expressed: 'where am I going to invest my time and resources? . . . With organisations and partners . . . providing relevant resources and support, and knowledge to my local situation'.

Challenges with adoption of ES

Participants volunteered their opinion on a variety of challenges they had experienced, had observed others experiencing, or anticipated with the ES concept or its tools. We

present these challenges in two categories: individual-level and systemic (the latter includes institutional, governance and organizational challenges).

Individual-level challenges

Although most participants had a favourable view of the ES concept, some commented that this view was not shared by all their colleagues (Table 4). Specifically, and frequently, participants noted that municipal engineers associated a large degree of risk with ES-related approaches like GI because they were perceived to be unconventional, unproven, and unquantifiable. A couple of participants noted generational differences among their planning colleagues: older planners were seen as less apt to adopt ES thinking.

Aware of their colleagues' risk aversion, some participants spoke about moving slowly to introduce the ES concept. For example, planner C1 spoke of being 'cautious' about 'pushing the language' until there was 'more readiness'. H6, V2, and V6 referred to sowing ES ideas by introducing ES terminology via plan updates and guidance documents. As well, Canadian ES-based approaches, like MNAI, helped to alleviate the perception of risk, and demonstrated to decision-makers that ES approaches were feasible and capable of being implemented in the municipal context. The adoption of well-publicized 'best practices' (associated with natural assets management in Gibsons, BC, and the Credit Valley Conservation Authority in ON, for example) also provided an added layer of respectability and credibility.

Monetary valuation of ES appeared to be a concern for some participants. For example, consultant C7 commented: 'putting a dollar value on it just abstracts it into a level that more easily fits onto a budget sheet as a line item, without really addressing the irreplaceable nature of natural systems'. A few participants in Vancouver suggested that other potential participants in this research chose not to participate because they were opposed to monetary valuation of ES, an approach often conflated with the ES concept. Other critiques of monetary valuation included that the ES concept 'makes it easier to ignore areas outside of human experience' (C7), and that it could be 'alienating' (V5).

Table 4. Individual level challenges to adoption of the ES concept, illustrated with sample quotes.

Sub-themes	Examples
Disagreement about approaches	<i>Admittedly [ES is] not fully recognized or adopted by all key decision makers and that's not necessarily due to the ... political side or ideological side. That's also within our organization. Sometimes we deal with challenges due to generational/professional perspectives. (V6)</i>
Discomfort with valuation	<i>Land prices are so high ... I'm worried that we're gonna value all these services and it's still not gonna equal land values ... we could still sell this property and make more if it's residential. (V2)</i>
Risk aversion	<i>We think we should just come out of the gate fully formed – and that's a function of our risk averse society ... How do we become less risk averse? Or ... what's the fall back position, instead of this 'we don't know'? And so what then? How do we make progress? (C5)</i>
Discomfort with imprecision and loss of control by engineers	<i>Many engineers ... [are reticent] to do it because it's different, or it's potentially risky, or you're not sure. You can't quite quantify it, you can't put your finger on that precise value, or you just haven't made the tool yet that tells you how to do that. (C2)</i>

Table 5. Systemic challenges to adoption of the ES concept related to institutions and governance.

Sub-themes	Examples
Institutional rigidity	<i>Our ability to respond right now seems really limited. We . . . say 'Hey – why can't we do this? Can we fix that? Can we do that?' [But] . . . that'll take you two years of planning process in Council and public consultation – it's all very, very, very rigid. (H6)</i>
Institutional fragmentation	<i>You probably have champions who understand it, get it, and might be trying to advance it . . . But that doesn't mean that the person in the next cube over [is]. It's my gut that it's somewhat ad hoc. . . . We don't have a clear group or champion for this natural infrastructure work. (C3)</i>
Provincial impediments	<i>We don't have the ability to collect information. We don't even know which information to collect and we don't have necessarily that partnership with the province. (H2)</i>
Cross-jurisdictional challenges	<i>How [do] you have influence over those that you don't have jurisdiction over? And that's why the planners within a jurisdiction aren't necessarily the key folks who have to drive it. (C5)</i>

Systemic challenges

Other impediments to ES adoption were systemic. They included obstructions such as institutional inertia, rigidity, and siloing, as well as governance obstacles (Table 5). Although ES thinking was filtering into individual practice, participants in all cities spoke about the lack of general adoption of ES ideas and tools within planning departments and related municipal departments, and a lack of integration of ES ideas across other municipal departments and in municipal policies. Participants also cited governance-related barriers to adoption of the ES concept: the historic and chronic lack of cooperation in establishing mutual agreement on environmental policies across jurisdictional boundaries (for example, between adjoining municipalities); and municipal-provincial rifts in relation to environmental planning and management (for example, differences in priorities and unclear areas of responsibility).

Another set of interconnected challenges (Table 6) hindering adoption of the ES concept included the low priority of the environment in municipal decision-making, the overall lack of municipal investment to address environmental issues, and a lack of knowledge and expertise among planners on environmental matters. In Halifax and some small constituent municipalities in the Vancouver region, participants noted challenges with their capacity to collect environmental data, and to understand how to interpret and use them; on the other hand, regional planners in Calgary and Vancouver did not voice capacity concerns. In addition, the substantial responsibilities of planners in Halifax and the smaller Vancouver municipalities were barriers to addressing environmental considerations, specifically, the breadth of topics that planners must account for when making proposals to Council; adding to this burden was daunting: 'They've asked for a social lens and ecological lens and a risk lens and a financial lens and a gender lens and diversity and inclusion . . . ' (H6).

Holistic insights

Some participants provided particularly cogent insights based in their experiences with the ES concept. Consultants especially had broad, substantive, and generally critical views about ES in planning based on experiences in many municipalities. For example, C5 spoke about the difficulties in linking the idea of ES with its implementation:

Table 6. Systemic challenges to adoption of ES related to municipal priorities, knowledge, and resourcing.

Sub-themes	Example	
Environment ranks low in municipal decision-making processes	lack of attention to natural values in planning	<i>In a new planners' orientation ... one of the senior people said ... they start with land that has no value and through the planning and development process they create value. And I was [shocked] because [this] is exactly counter to what we should be thinking. (C8)</i>
	the environment has low priority	<i>[In Halifax] there's a lot of priority on vehicle movement so we have a great number of resources on traffic. In my job I'll talk to traffic engineers everyday. The number of times I talk to someone in the energy and environment group is few and far between. (H7)</i>
Lack of ES knowledge or expertise	complexity of ES and similar approaches	<i>There are so many different aspects that come into play, and you're constantly playing with dominoes ... it's so interrelated, and a hundred other things can happen. ... what we do, it's not rocket science – not at all – but these interconnections, that puzzle, people are struggling with. (C4)</i>
	lack of understanding how to implement	<i>Everybody's [saying] 'how do we move from theory to implementation?' The technical stuff is coming, and now we know how to do it – but: Where do we put it? When do we put it? How do we have the mandate? What is the planning framework it lives in? (C5)</i>
	lack of expertise	<i>One of the barriers is that there aren't scientists in municipal government. ... You really need scientists and planners to work together. ... Numbers are a challenge for planners. And I get scared about that sometimes. (H10)</i>
	lack of knowledge about ES	<i>I would say even though these things [naturalization projects, GI] are all happening, I don't feel like there's a lot of discussion about the fact that these are ecosystem services ... with that language. (H5)</i>
Lack of Resourcing	scarce human and financial resources	<i>As a small municipality ... our asset management office is very small, and our asset management planning here is very immature. ... As a municipality, we still don't have inventories of any of our hard infrastructure assets ... It still takes money and investment to inventory what we know we've got, let alone value it. (H9)</i>
	lack of environmental data	<i>There's a lack of reliable, up-to-date data that would be really helpful ... we have the Green Network Plan ... that was a pretty large effort, but I think we could use some more on that. (H6)</i>
	lack of ability to analyze and interpret data	<i>Municipalities rarely have a lot of capacity for ongoing analysis. Even if they have a GIS department they're generally more focused on just providing data and not necessarily analyzing or interpreting data. (C7)</i>

I think the term has been too big to translate down into the different ways it has to be enabled or acknowledged or implemented. ... This nebulous ecosystem services thing—somehow, it's just too difficult to deal with.

Getting the asset on the books [is] the pivotal element to it—whether or not ecosystem services as a term or concept is ever invoked.

C5 was not committed to the ES concept, suggested that the role of planning in its municipal adoption was not yet clear:

That's the decade we're in right now: how do we translate what we are learning from science, what we know we want to see on the landscape, and what the planners have at their disposal to make that [happen], or at least not get in the way of it happening? ... Whose court are

these different things in? ... Maybe it's a provisioning kind of thing ... a making space thing ... it could be in the wording, the ability for some [map] overlay to come in ...

Consultant V5 was more optimistic, including about the ability of the ES concept to connect planning with the public, yet saw room for improvement:

There is a common language that's spoken now, even though not it's not very well understood. ... From a climate adaptation perspective, it works well because those services are so clearly felt.

I'm always looking for ... new tools we can use, or new ways we can use spatial data to try and convey those services—and make them measurable, visual, narrative.

However, like C5, V5 was not convinced that the ES concept could be integrated into conventional municipal infrastructure planning:

Ecosystem services tools are still trying to lever into the engineering world, to try to elevate green infrastructure ... into this system that isn't built to accommodate it ... ultimately, there might need to be a subversive rethinking of these things.

Discussion

The picture of adoption of the ES concept in our study resembled what researchers have observed in other locations: with some exceptions, there was general enthusiasm about the ES concept and its potential in planning (Beery *et al.*, 2016; Dick *et al.*, 2018). Since participants were selected for the study because of their interest in or use of ES, the interest was not surprising. However, they balanced their enthusiasm with criticisms about valuation, terminology that was confusing and alienating, the complexity of the concept, and the lack of guidance on applying it. These criticisms reflect observations elsewhere, that ES as an approach was not yet fully embraced or implemented in planning and why that might be (Hysing, 2021; Ronchi, 2021).

Adoption of ES thinking was not extensive, as we had anticipated and as noted by others (Grunewald *et al.*, 2021). Although these are relatively early days for ES adoption, and partial uptake would be anticipated, the challenges that participants identified closely resembled those identified by other researchers – such as limited capacity (Kaczorowska *et al.*, 2016) and the need for policy integration (Schleyer *et al.*, 2015) – and so were likely playing a part in the limited degree of uptake. In other words, the level of departmental adoption of the ES concept did not match the level of planner acceptance and enthusiasm for the idea and its potential for planning. As we will discuss, participants found it difficult to fit the ES concept into their working contexts – but some were making significant progress.

Normative and practical fit of the ES concept

It was clear that the ES concept had a good normative fit among interviewees: most of their values in relation to the environment were strongly aligned with the key idea underlying ES (i.e. the need to acknowledge and protect the supporting role of nature in human well-being, barring its implementation through monetary valuation) and many

felt responsible for promoting ES ideas and approaches. The normative fit of the ES concept in the broader urban decision-making context was less certain, judging from participant accounts of the low priority placed on the environment, and the limited resources provided for environmental planning. Other authors attribute the slow progress on environmental sustainability in Canadian municipal planning to lack of political will (Epstein, 2017) and under-resourcing (Grant *et al.*, 2018).

While the normative fit of the ES concept was generally strong, issues with practical fit were evident from the relatively low level of adoption and the multiple barriers described to more extensive adoption. Although not voiced by other participants, C5's opinion about the gulf between the big idea of ES science and implementation in municipal planning accurately captured our general sense of how ES adoption was playing out in the contexts we studied.

Participants noted various levels of success with ES adoption: for example, where the concept was invoked to support existing environmental planning work, and in ES assessments, when supported by municipal initiatives (including by municipal bureaucrats) to fully account for municipal assets. Along with the challenges in adopting ES thinking, these modest successes provided insight into the routes through which the ES concept was being adopted, and how more adoption might occur.

Where the ES concept had been adopted in some way, the actors involved saw the idea of ES or ES tools as being relevant to the work they were doing or to the local context. For example, the MNAI was the most popular approach participants described that explicitly employed the ES concept. Some use of the ES concept was spurred by organizational mandates related to climate change adaptation. Conversely, where there was less local understanding of the ES concept, or where the environment was a low priority, ES approaches were not seen to 'fit'.

In addition, we noted the ES concept was being introduced in ways that did not disrupt planning practices; they could be described as adoption paths of least resistance. For example, ES language was adopted to supplement but not disrupt current environmental planning methods; for instance, ES concepts were included in limited scope, such as experimental use of GI, to test the waters and slowly build trust. Studies of adoption processes in the field of agricultural innovation revealed a similar pattern of new practice discovery, trialing, and evaluation (Montes de Oca Munguia *et al.*, 2021). Trialing is used for evaluation and can reduce uncertainty about innovative practices; demonstrating the relevance of new practices to the user is key to eventual adoption (Montes de Oca Munguia *et al.*, 2021).

Although most participants were receptive to the use of ES, certain individuals stood out as having more drive to adopt ES thinking and facilitate its widespread uptake. In their efforts to revise and improve urban environmental practices and policies, they were less discouraged by the barriers they encountered, partly because they had a greater sense of environmental agency in their work than others. Some of these individuals were responsible for the experimental aspects of ES adoption, exploring and testing how to bridge the gap between ES science and implementation (as also found by Stevenson *et al.*, 2021). Such individuals were using tactics such as knowledge sharing, piloting of GI, and establishing high-level ES policies. We believe that these individuals can be categorized as policy entrepreneurs (Kingdon, 2003), and discuss them more fully elsewhere (blinded for review).

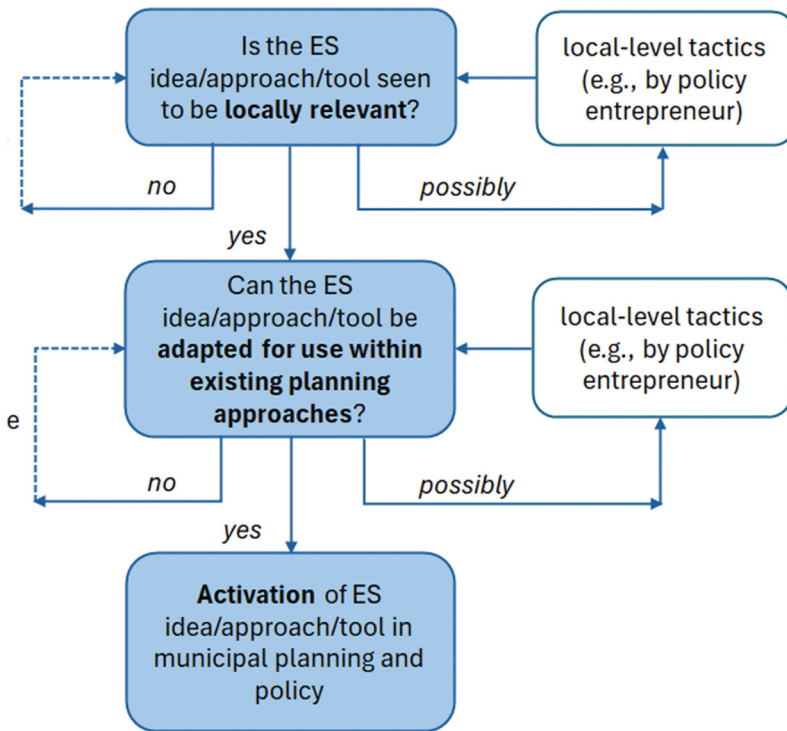


Figure 2. Implicit decision process for practical fit of ES.

We suggest that at least two criteria were at play in whether an aspect of the ES concept was used to any extent in planning practice or policy in the study – that is, whether there was a practical fit: the perception of local relevance and the ability to be adapted for use within existing planning approaches (Figure 2). In addition, the tactics or interventions of actors such as policy entrepreneurs, were observed to exert a controlling influence (Figure 2).

The first criterion in the practical fitness test – that the ES concept must be seen to be locally relevant – is obvious, yet complex and critical to the process of adoption. The perceived relevance of a policy idea may be influenced by many factors, including the user's (or groups of users') knowledge, institutional and governance contexts, the idea's ability to solve a perceived problem, fortunate timing, whether the idea is externally validated, and novelty. Meadowcroft and Fiorino (2017) suggested that three factors are most at play in an idea's policy relevance: its ability to respond to a 'perceived need; the ability to appeal to a variety of constituencies; and some affinity with dominant ideas and practices' (p. 341). Saliency has also been shown to be an enabling criterion, with credibility and legitimacy, in knowledge transfer from research to practice (Clark *et al.*, 2016).

For most participants with high ES awareness, its relevance was clear and reinforced by external validation from colleagues in other locations. In addition, these participants were interested in novel ideas like the ES concept to replace conventional solutions that

were considered no longer adequate for emerging problems. The low relevance of the ES concept in the local institutional contexts was apparent from some of the challenges to ES adoption that participants voiced. These included: the low priority of the environment means ES is less likely to be seen to solve a perceived problem in municipal decision-making, and the consequent lack of resourcing by the municipality for data gathering and knowledge dissemination.

The model presented in [Figure 2](#) suggests that even if the criterion of relevance is not met initially, over time, decision contexts may change (for example, with increasingly severe climate-change impacts) and ES may eventually become perceived as relevant. In addition, our study suggests that policy entrepreneurs are important in making ideas relevant, for example, drawing on Kingdon's description of policy entrepreneurs (2003), through tactics like active persuasion using ES rhetoric, or the presentation of accepted conditions as problems and offering ES approaches as solutions.

The second criterion in the practical fitness test is adaptability, or the ease in shaping an approach to fit existing practices. Here, the often-critiqued conceptual malleability of ES offers an advantage. Rather than radically changing established planning practices, the individuals we identified as policy entrepreneurs were involved in adapting ES approaches to their various planning contexts. This was exemplified in our study by the incremental addition of salient elements of ES, such as the ES language invoked when introducing GI projects. A parallel has been observed in the health care field, where the adoption of innovative practices was found to be most successful over the long-term when the practices were allowed to evolve to adapt to each local application context (Onie *et al.*, 2018). van Oudenhoven *et al.* (2018) have also suggested that indicators of ES quantity and quality must be adaptable, to ensure they remain feasible and relevant over time, even under changing social, technological, political, and economic conditions.

The potential for ES in urban planning: recommendations for practice and research

Wholesale adoption of ES in urban planning is unlikely in the short term, given the substantial number of challenges identified by participants, most significantly those created within institutional contexts. However, a transformation may occur if urban planning undergoes a radical shift toward an environmental focus, spurred by a major, disruptive, driving force such as climate change (Hill, 2016).

As we had anticipated at the outset of the study, the ES concept was strongly associated with other approaches and terminology, especially GI and natural assets. The existing planning approaches that incorporated ES, including climate-change, urban forest, and stormwater planning ([Table 3](#)), will, we expect, continue to be applied. These associations bode well for the continuation of ES thinking in these planning contexts. That said, further research could explore whether other, related terminology has more potential to close the implementation gap.

There was a general desire among participants for increasing use of the ES concept in planning. The following recommendations for those seeking to foster the adoption of ES seem generally relevant to the introduction of other novel ideas as well:

- Although ES has been thought to offer some promise in helping with integration of environmental policies across municipal departments, in fact, institutional hurdles impede ES adoption (Jordan & Lenschow, 2010; Adlakha & John, 2022). Dismantling the persistent barriers to change in municipal policy would help in increasing ES adoption.
 - (a) Policy or institutional entrepreneurship will likely be part of a response to dismantling systemic barriers related to laws and regulations (Meadowcroft & Fiorino, 2017; Rahman *et al.*, 2019). Urban planning directors seeking to innovate within planning departments should search for entrepreneurial qualities in new employees and cultivate entrepreneurial traits among others.
 - (b) Furthermore, research is needed on understanding the role of policy entrepreneurs in leading other practitioners, politicians, and the public toward understanding of and engagement with ES and other novel ideas.
- Based on participants' perspectives, and as our model indicates, we suggest the development of locally relevant solutions using ES (as also suggested by Tusznió *et al.*, 2020).
 - (a) These initiatives will require experimentation, which needs to be acknowledged as a valid process for innovation in planning (Patel *et al.*, 2015; Scholl and Kraker, 2021). Municipalities with limited capacity may wish to pursue partnerships with neighbouring municipalities, universities, or environmental non-governmental organizations, as Murphy *et al.* (2023) describe for management of marine vegetated ecosystems in Canada.
 - (b) Some participants were making inroads toward local solutions by developing, piloting, and evaluating locally developed GI projects supported by ES rationale. These solutions also served to increase ES knowledge among municipal colleagues, the public, and politicians. Their findings should be disseminated within communities of practice in the planning profession.
- The lack of technical knowledge at the local level about the application of ES is a knowledge and resource problem (Allan *et al.*, 2022).
 - (a) In our study, this problem appeared to be exacerbated because ES work was being outsourced to consultants. Therefore, we suggest overcoming ES knowledge and experience gaps in municipalities through municipal planners collaborating with ES knowledge brokers (e.g. ecologists), as also suggested by Jax *et al.* (2018).
 - (b) Although participants recounted learning about ES through their work experiences, formal education on environmental topics was important for supporting and justifying new initiatives. Therefore, we suggest enhanced content on ES and linked environmental topics in planning education, and continuing professional education for planners.
- The enthusiasm about ES and the agreement among participants about its utility may be attributed at least partly to the sampling process, which selected for those participants who had knowledge or awareness of ES. It would be fruitful to sample more broadly to collect the perceptions of participants with diverse experiences with ES and its utility.
- The findings of the study are limited by scope (selected planning practitioners in three cities) and context (Canadian municipalities of medium-to-large size) and the

relative novelty of the ES concept in planning, which meant that it was difficult to identify those with sufficient ES experience to contribute substantively. The findings should therefore be tested in different locations, planning systems, and in cities of different sizes.

Conclusions

The ES concept has attracted the attention of urban planners, and its adoption is promoted by ES researchers because it promises many benefits, including improved response to climate change and increased environmental sustainability in cities. Why ES has not been implemented to a significant degree at the local level is not adequately understood. Our goal in this research was to contribute to narrowing the ES implementation gap by identifying what criteria the ES concept must meet for adoption, or practical fit, in urban planning. We found that the ES concept must be, first, seen to be locally relevant and, second, adaptable within the existing planning approaches. If not met immediately, these criteria may be met over time through the efforts of actors such as policy entrepreneurs, who are dedicated to the ES concept and its potential.

There are no off-the-shelf solutions to the mounting environmental issues facing cities, and the ES concept must be tailored to the local context for practical fit. Our study found that, despite numerous challenges for ES adoption, participants' optimism about the potential for ES in urban planning was clear. For ES to grow in planning practice, its adoption challenges must be acknowledged and addressed. Furthermore, the ES concept can be both relevant and adaptable for planning if planners and their municipal colleagues make investments in education, cooperation, and encouraging openness to new initiatives.

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