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Mediating the science-policy interface: Insights from the urban water sector in Melbourne, Australia

G. Dunn[a,*], J.J. Bos[b], R.R. Brown[b]

[a] School of Social Sciences and Cooperative Research Centre for Water Sensitive Cities, Monash University, Melbourne, Australia
[b] Monash Sustainable Development Institute, Monash University, Melbourne, Australia

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ABSTRACT

This paper empirically examines through a single case study three theoretical models of science-policy interactions identified in the literature: science-push, policy-pull and co-production. Although the literature is clear that reliance on orderly linear models of knowledge transfer from science into policy is ineffective, more precise guidance is needed for those in the scientific community interested in effectively mediating the science-policy interface to inform policy and decision-making. We examine the case of urban water management in Melbourne, Australia, which is widely regarded as a frontrunner in sustainable urban water practices. We find the prominent (interlinked) features of Melbourne's science-policy interface are actors, networks and relationships, and funding. Overall, science-policy interactions in Melbourne are highly complex and do not neatly fit into one specific theoretical model. Prominent framings of each model vary depending on context, history and time-scale. There are strong indications however that a collaborative approach is increasingly being embraced at Melbourne's water-management interface. This could be attributed to Melbourne's highly network-based science-policy culture, which facilitates strong collaboration between policy-makers and scientists. We explore how the three models of interaction identified in the literature combined with insights from Melbourne can be used to frame strategies to effectively mediate the science-policy interface. These insights increase our understandings of the science-policy interface and provide practical insights and strategies for researchers interested in effective engagement with policy communities.

1. Introduction and background

Interest in the relationship between science and policy is increasing, particularly in the complex and often contentious arena of environmental governance (Hellström, 2000; van Enst et al., 2014). Science plays an important role in shaping understanding of environmental issues and evaluating possible solutions. Policy-makers constitute a key audience for environmental science, which can enrich decision-making and facilitate targeted policy responses (Bielak et al., 2008). While it is broadly agreed that good science and shared understanding is vital to inform environmental policy and decision-making, the literature consistently shows that the transfer of research findings into policy and practice is often slow and inconsistent (Brundtland, 1997; Nursey-Bray et al., 2014; Rodela et al., 2015). Scientists[1] are often perplexed by the limited impact scientific evidence can have on policy-making, while policy-makers[2] are often vexed by scientists' failure to synthesize and contextualize research that addresses real-world problems (Gluckman, 2016). Thus, the importance of effective interactions between researchers and policy-makers is increasingly recognized in the literature (see, e.g., Farrelly and Brown, 2011; Moore et al., 2014; Pahl-Wostl et al., 2008).

The intersection of scientists and other policy actors—often referred to as the science-policy interface (SPI)—has become an unavoidable topic as both government agencies and scholars seek to understand the factors that shape the use of information and identify keys ways to strengthen interactions (van den Hove, 2007, p. 824; Bielak et al., 2008). The literature conceptualizes three main models of science-policy interaction: science-push, policy-pull and co-production (Dilling and Lemos, 2011; see Fig. 1).

In the science-push conception, researchers and information providers set the agenda for producing and disseminating science. Research is conducted separately from the needs and considerations of society,

* Corresponding author.
E-mail address: gdunn@uisce.ca (G. Dunn).

[1] Actors in science are primarily scientists themselves. They work in an array of public and private organisations such as universities, research institutes, government agencies and NGOs (van den Hove, 2007).

[2] The label of policy-maker is usually applied to public servants and elected officials and spans a variety of scales from local (municipal) to state (regional) or national.

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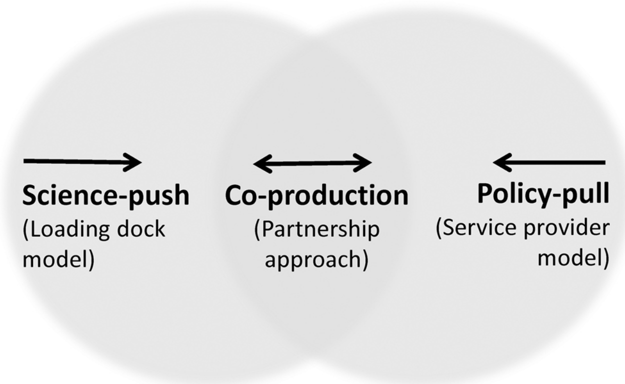

Fig. 1. Three literature models of science-policy interactions.

with a deep-rooted assumption that it will be inherently useful and applicable to myriad societal problems (Dilling, 2007). The pursuit of knowledge—rather than knowledge applicability—is the core driver. In this "loading-dock" model, science and policy are treated as two separate spheres and the interactions between them are regarded as linear, rational processes—a unidirectional model of knowledge transfer from science into policy (Hellström, 2000; Leith et al., 2014; Wesselink et al., 2013).

Scholars argue this model is outdated and ineffective at informing decision-making: First, it focuses only on the supply of information—deferring responsibility to others to pick up the information left at the "loading dock" and relies on serendipity that the information is needed and useable (Dilling, 2007; Dilling and Lemos, 2011). Second, it assumes sharp, hermetically sealed boundaries, which in reality are fuzzy and permeable (Jasanoff, 1990; van den Hove, 2007). Moreover, science is assumed to be politically neutral and free from social influence. The model also ignores numerous other factors (outside the purview of science-policy) that can impede uptake of information—such as values, ethics, organizational culture, regulatory environment, resources, bargaining and entrenched commitments (Head, 2010; Forsyth, 2003). Third, it is increasingly recognized that the dominant Cartesian positivist underpinnings of the scientific method (such as reductionism, determinism and predictability) inadequately address our myriad complex, uncertain, unpredictable societal problems such as climate change (Dunn et al., 2016; Forsyth, 2003; Jasanoff and Wynne, 1998). Scientific and policy discourses are often framed around predictability and certainty; however, environmental (and societal) issues are highly complex, non-linear, uncertain and constantly evolving (unpredictable), as highlighted by developments in systems thinking and complexity science (Dunn et al., 2016). Complexity, indeterminism and uncertainty are particularly significant in the SPI context, as the characterizations and strategies for coping with them differ dramatically between the policy and scientific communities (Kinzig and Starrett, 2003).

The policy-pull conception also represents a linear relationship, in which demand for policy-relevant knowledge pulls science to identify better-targeted responses to address policy issues. Potential users of knowledge drive the research agenda, reflecting a service-provider model wherein science might be commissioned (or tasked) to better understand an issue, provide evidence, or propose a solution to a problem (Bielak et al., 2008). The policy-pull model necessitates policy-makers be receptive to science and have access to information and expertise (Holmes and Clark, 2008). Critics of this model argue that information may not be feasible to produce or scientifically robust (Sarewitz and Pielke, 2007). Moreover, the strategic or selective production of knowledge for decision-making can be regarded as manipulative and highly problematic, especially in controversial issues (van Enst et al., 2014). Overall, the literature on policy pull is largely underdeveloped (Bielak et al., 2008).

In reality, the relationship between science and policy is much more complex, unstructured and dynamic. Rather than a one-way push from science or pull from policy, knowledge sharing is more interactive and nuanced. Thus, the third SPI conception–co-production—reflects a combination of science-push and policy pull (Dilling and Lemos, 2011). Useable knowledge is developed through a collaborative process (an active exchange and negotiation of ideas) between knowledge users and producers (Frantzeskaki and Kabisch, 2016). However, the term co-production lacks definition and conceptual clarity (Voorberg et al., 2015). For example, the distinction between collaboration and co-production is blurred; co-production is often used interchangeably with co-creation (ibid); the *process* of co-production is unclear, as well as the breadth of participants that should be involved.

Lemos and Morehouse (2005) argue co-production is a partnership approach in which the research agenda is an ongoing and highly interactive, iterative and reflexive process. There is a continuous dialogue between the actors involved to define the problem, research questions, methods, data evaluation and dissemination of results. Co-production thus requires mutual trust, respect, reciprocity, participation and commitment from all those involved (Perry and Atherton, 2017). Moreover, this partnership approach necessitates capability on all sides to both sustain and respond to the multi-directional flow of knowledge.

Beyond the sphere of science-policy, the breadth of actors that should be involved in co-production is unclear from the literature. Some scholars suggest co-production involves scientists (from a variety of disciplines), policy-makers and actors with a stake in the research project (van Enst et al., 2016). Others argue that co-production is the coming together of science and society in a collective search for solutions, thus necessitating citizen participation (Lemos and Morehouse, 2005; Fernández 2016). Jasanoff (2004) suggests co-production is an idiom rather than a theory. Critiques of this participatory process highlight concerns regarding knowledge politics: closer co-operation between researchers and policy-makers runs the risk of co-optation through attempts to regulate, manage, control and direct science (Perry and Atherton, 2017).

The majority of the literature focuses on knowledge production (the supply side), rather than the demand side—the needs of policy- and decision-makers (Dunn and Laing, 2017; Archie et al., 2014; McNie, 2007). While a significant number of studies identify specific practices and processes that facilitate useable knowledge transfer–such as knowledge brokering (Michaels, 2009), knowledge translation (Graham et al., 2006), boundary organizations and social learning (Pahl-Wostl et al., 2011)–there remains limited pragmatic advice on when and how to mediate the science-policy interface. Although the literature clearly shows the ineffectiveness of reliance on an orderly linear model of knowledge transfer from science into policy, limited practical insights exist on ways to build a policy-pull SPI or foster collaboration and/or co-production. Few studies give practical descriptions of applied theories, case studies of existing interfaces, or assessments of science-policy interfaces in practice (Bielak et al., 2007; van den Hove, 2007). More precise guidance is needed for those in the scientific community interested in effectively mediating the science-policy interface and informing policy- and decision-making (Hoppe, 2005; Runhaar et al., 2016).

Against this background, this paper examines the science-policy interface in urban water management in Melbourne, Australia, which is widely regarded as a frontrunner in sustainable urban water practices (Roy et al., 2008; Barker et al., 2011). Most cities remain bound to conventional urban water management approaches, with centralized, large-scale, single-purpose, single-use infrastructure (Dunn et al., 2016). Melbourne has diversified its urban water infrastructure to include integrated multi-purpose technologies such as stormwater harvesting and re-use (wetlands, rain gardens, swales and sediment ponds), permeable surfaces, infiltration, desalination and grey-water recycling. What makes the Melbourne case particularly significant is that the literature identifies science as a key player in driving changes to policy,