



# Pathways: An emerging concept for the theory and governance of low-carbon transitions



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## ABSTRACT

The concept of “pathways” has increasingly come to frame the challenge of transitioning to low-carbon societies. It also shows promise as a bridging concept, encouraging constructive dialogue among the diverse perspectives and constituencies evoking its use. However, its interpretations and attributes are rarely explicit and have yet to be subject to serious scrutiny. This raises important questions for both theory and governance as the way in which a problem is framed shapes how it is understood and addressed, structuring the possibilities considered and privileging certain responses. Therefore, this study explores the concept of pathways in the context of low-carbon transitions, exposing its conceptions, maturation, and implications. Based on a survey of the relevant climate change mitigation literature, this analysis uncovers three core conceptions of pathways in the context of low-carbon transitions: (1) biophysical, (2) techno-economic, and (3) socio-technical. Constituted by diverse perspectives and approaches, each of these three core conceptions emphasize different yet interconnected dimensions of the decarbonization challenge. This analysis also points to several key attributes and functions of the concept of pathways. Yet, while the concept may possess a variety of features that recommend its use as a critical problem frame for low-carbon transitions, it also raises issues that suggest a need for further reflexivity. If the concept is cast too strongly in terms of individual core conceptions, there may be a tendency to emphasize certain dynamics while paying somewhat less attention to others, inadvertently diminishing the complexity of the decarbonization challenge. Beyond this, there are other facets of the concept that have to date received more limited attention, including the implications of choices at critical junctures and the evolving character of social practices. So, there is room for the concept of pathways to engage more fully with the range of complexities embodied by low-carbon transitions.

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## 1. Introduction

If the most severe impacts of climate change are to be avoided, societal systems such as transport and electric power will need to transition rapidly to low-carbon arrangements over the coming decades (IPCC, 2014). While rhetoric has to date outstripped concrete action, global leaders have increasingly recognized the necessity of a societal low-carbon transition (UNFCCC, 2015). Central to this transition is the project of deliberately moving from existing carbon-intensive arrangements toward low-carbon future states in 2030, 2050, and beyond. Within the policy and scholarly debate surrounding low-carbon transitions, the challenge of envisioning and moving toward desirable decarbonized futures has increasingly been framed in terms of *pathways* (Wise et al.,

2014; Wiseman et al., 2013). Political leaders have, for instance, used pathways to recast development priorities in terms of long-term climate targets (G7, 2015; G8, 2008). Advanced industrial economies such as France and Britain have invoked pathways to animate post-carbon strategies (Wiseman et al., 2013). Among core intergovernmental bodies, pathways have been used to explore “time-dependent projections of atmospheric greenhouse gas (GHG) concentrations” (Moss et al., 2008, p. 4). Pathways have also received mounting attention across scholarly disciplines investigating the complexities of low-carbon transitions (Geels et al., 2016a; Morrison et al., 2015; Turnheim et al., 2015). Taken together, the concept of “pathways” has become increasingly tethered to the theory and practice of climate change mitigation and has been taken up by broad constituencies as a critical problem frame for low-carbon transitions.

Despite this preoccupation with pathways, its interpretations and attributes are rarely explicit and have yet to be subject to

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**Table 1**  
Prominent actors contributing to the climate change mitigation debate.

Actors	
Intergovernmental and quasi-governmental organizations	Environmental think tanks
Group of 7/8 (G7/8)	World Resources Institute
International Energy Agency (IEA)	Stockholm Environment Institute
Intergovernmental Panel on Climate Change (IPCC)	Worldwatch Institute
Organisation for Economic Co-operation and Development (OECD)	Brookings Institution
United Nations Environment Programme (UNEP)	Center for Climate and Energy Solutions
United Nations Framework Convention on Climate Change (UNFCCC)	Chatham House
World Meteorological Organization (WMO)	Ecologic Institute

Organizations are adapted from [Shaw and Nerlich \(2015\)](#) and think tanks are drawn from [McGann \(2015\)](#).

serious scrutiny. This is particularly problematic for governance as concepts such as pathways shape the way we think about, structure, and act upon complex policy issues ([Fischer and Forester, 1993](#); [Stone, 2001](#)). That is, concepts help to frame policy problems and may suggest particular courses of action while masking others ([Schön, 1993](#)). In this fashion, frames act as “a central organizing idea or storyline that provides meaning to an unfolding strip of events, weaving a connection among them” ([Gamson and Modigliani, 1987, p. 143](#)). Similarly, framing can be understood as a kind of world-making “from which an amorphous ill-defined, problematic situation can be made sense of and acted on” ([Rein and Schön, 1993, p. 146](#)). And, as reality is complex and multiple interpretations coexist simultaneously, actors can creatively leverage concepts in diverging ways to frame policy issues in such a fashion as to privilege particular solutions and interests ([Rosenbloom et al., 2016](#); [Shaw and Nerlich, 2015](#)). Indeed, key policy concepts are subject to continual processes of reinterpretation and contestation ([Collier et al., 2006](#); [Meadowcroft and Fiorino, forthcoming](#)), suggesting that there is an important role for self-reflection around their use in framing problems and orienting interventions.

Given the rising importance of the concept of pathways for framing low-carbon transitions, a careful interrogation of what this concept may suggest for contemplating and acting upon this challenge is merited. Thus, this study seeks to further scrutinize the concept of pathways in the context of low-carbon transitions, posing three central questions: (1) how is the concept variously understood across the diverse constituencies evoking its use; (2) what are the dynamics that mark the development of these different conceptions over time; and (3) where might this concept lead us in regards to the pursuit of low-carbon transitions? In addressing these questions, a core objective of this analysis is to provoke additional reflexivity and bridging opportunities among the constituencies deploying the concept of pathways. To this end, this study employs an exploratory literature survey to uncover and interrogate the contrasting conceptions of pathways that are emerging within the debate surrounding low-carbon transitions, shedding light on the multiple applications of the concept as well as the strands of research in which they are constituted. Findings reveal three core conceptions of pathways and suggest that while the concept is helping to bridge diverse perspectives (consider [Davoudi et al., 2012](#); [Paehle, 2005](#) for a discussion of “bridging concepts”), it also raises important issues for the theory and governance of low-carbon transitions.

The argument in this paper proceeds in the following steps. The study begins by outlining the literature survey approach. Following this, the analysis presents three core conceptions of pathways. The paper concludes by underlining the attributes, implications, and functions of the concept as well as areas meriting further attention.

## 2. Approach: surveying the literature on pathways in the context of low-carbon transitions

In line with the aims of this study (i.e., to explore a multi-layered concept with emergent and contested properties), an exploratory literature survey was conducted to collect and analyze written sources contributing to the diverging conceptions of pathways in the context of low-carbon transitions. A date range of 1990 to 2016 was selected to coincide with the popularization of pathways in the work of the IPCC and its rising usage to this day. A mixed data collection strategy was employed to triangulate the identification and inclusion of relevant written sources. First, scholarly written sources were collected based on a keyword search<sup>1</sup> of peer-reviewed journal articles from relevant disciplines indexed in the SCOPUS database. After eliminating false positives, this step yielded an initial sample of 474 academic contributions. Second, written sources from the policy and practice domain were captured by selecting a set of prominent actors contributing to the climate change mitigation debate (see [Table 1](#)) and querying their online document libraries using the keywords “climate change” and “pathways”. After removing false positives, this yielded an initial sample of 231 policy and practice documents. Third, the initial samples were further supplemented and crosschecked through reference tracking (examining the works cited by selected sources) and exposure to expert opinion (the comments offered during the 2016 International Sustainability Transitions Conference and the peer review process). Together, a total sample of over 725 written sources was amassed.

The analysis of written sources proceeded in an inductive, iterative, and interpretive fashion (consider [Saini and Shlonsky, 2012](#) for an overview of interpretive survey approaches). Written sources were first scanned for pathways formulations and applications using search functions (“pathway”). This permitted the initial identification of emerging categories surrounding: (1) conceptions of pathways; (2) analytical approaches; and (3) emphases on particular dimensions of low-carbon transitions. From this, over 100 written sources with more substantive treatments of pathways were identified, subject to more in-depth analysis, and mapped according to emerging categories (see [Appendix A](#)). Throughout, categories were continually revisited and refined. To be sure, the literature maps derived from this process are not exhaustive but rather begin to shed light on the contrasting conceptions of pathways emerging within prominent strands of the literature surrounding low-carbon transitions.

<sup>1</sup> The following search string was used: (TITLE-ABS-KEY("low-carbon pathway" OR "decarbonisation pathway" OR "concentration pathway" OR "emission pathway" OR "transition pathway")) AND DOCTYPE(ar) AND SUBJAREA(MULT OR ENER OR ENVI OR ARTS OR BUSI OR ECON OR SOCI) AND LANGUAGE(english).

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