



# From terminating to transforming: The role of phase-out in sustainability transitions

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## ABSTRACT

Phase-out is rapidly gaining traction as a central part of practical efforts to address sustainability challenges. However, the way it has been conceived of in policy debates and some academic work is problematic in that it (1) tends to be narrowly focused on substitution; (2) underexposes the bi-directional relationship between phase-outs and innovation; and (3) pays insufficient attention to political challenges. To fully reap the potential of phase-out in sustainability transitions, we call for a more integrative body of scholarship. We identify three important avenues to advance this agenda: First, shifting the unit of analysis to socio-technical systems and the reconfiguration of entire regimes will help to elucidate the multiple logics underlying phase-outs. Second, deepening insights on the timing and interaction between phase-out and innovation will unveil the potential of phase-outs in accelerating transitions. Finally, engaging with issues of power, political legitimacy, and equity is required to mitigate political challenges.

## 1. Introduction

*Phase-outs* are attracting rising interest among scholars and practitioners as a critical response to sustainability crises, from plastic pollution to climate change (Fig. 1). Phase-outs are governance interventions aimed at terminating specific technologies, substances, processes, or practices that are considered harmful (Rosenbloom and Rinscheid, 2020). Ultimately, such interventions tend to be enacted through public policy instruments, including bans, taxation, subsidy removal, or performance standards. Take, for example, laws to phase-out coal-fired power in Germany or the Canadian province of Ontario. While phase-outs emphasize the role of the state (Langhelle et al., 2019), they also implicate broader actors and responses. Consider, for instance, societal calls for major banks to phase-out lending for fossil fuel projects or voluntary efforts by some automakers to phase-out internal combustion engines.

Despite much interest in phase-out, the way it has been conceived of in policy debates and some academic work raises several problems. First, phase-out policies tend to be narrowly focused on the substitution of specific system components such as technologies (e.g., nuclear power), substances (e.g., ozone depleting substances), or practices (e.g., marine dumping). This risks diverting attention

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from the broader systemic changes required. For instance, phasing out combustion engines may be an important step in decarbonizing transportation, but it remains limited unless combined with comprehensive changes in road space allocation, urban planning, public transport, etc.

Second, insufficient attention has been paid to the bi-directional relationship between phase-outs and innovation (Turnheim and

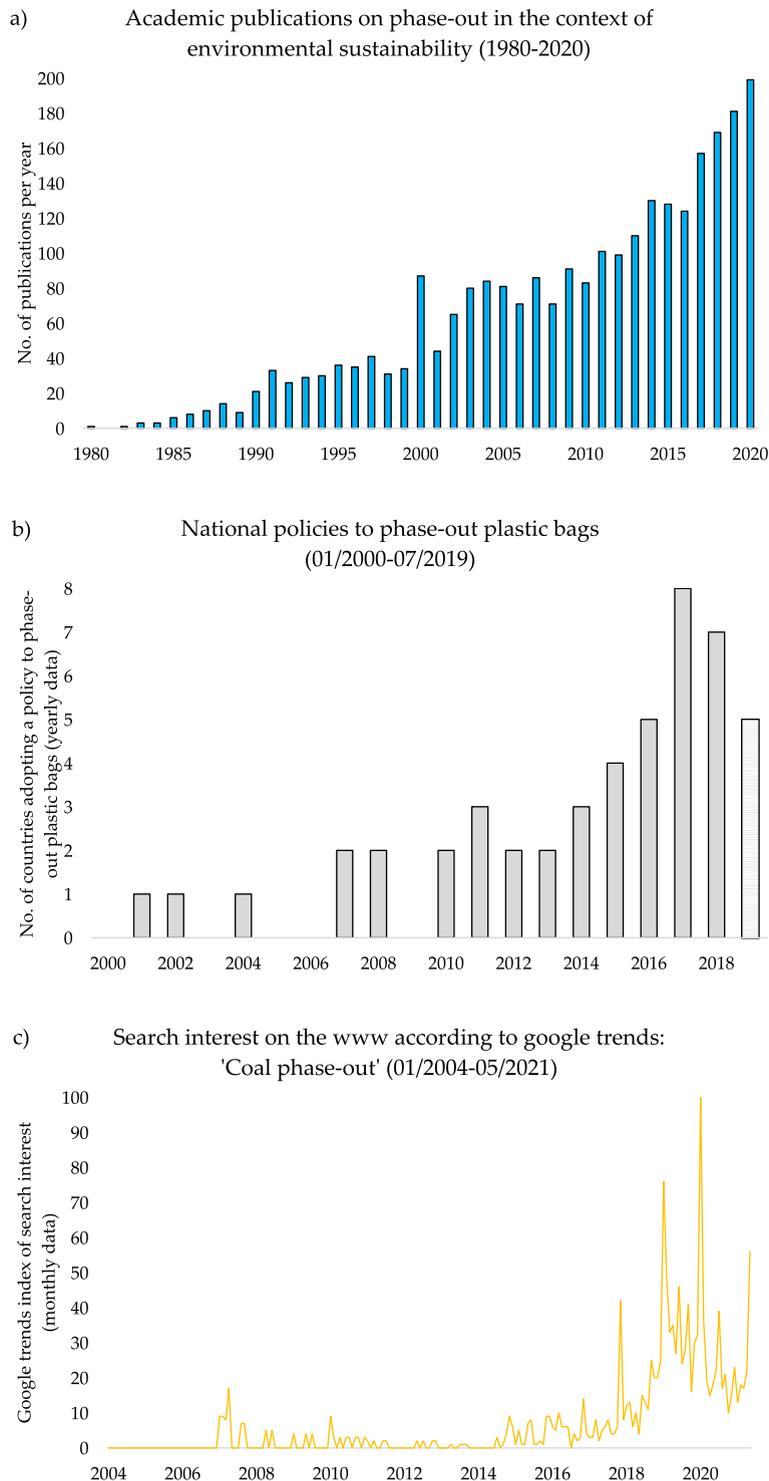


Fig. 1. Prominence of phase-out in the context of sustainability transitions over time. See appendix for information on data sources.

Geels, 2012). If implemented in isolation, phase-out may fail to take hold or even lead to reversals, as has happened with the nuclear phase-out in Sweden (Roßegger and Ramin, 2013). Moreover, the timing and pace of phase-out interventions may be decisive in preventing new lock-ins (e.g., the dash from coal to gas in the power sector).

Third, phase-out presents underestimated political challenges. While sustainability transitions are always normative, concentrating on terminating established technologies and practices can stoke tensions between ‘winners’ and ‘losers.’ It is well understood that incumbent actors are likely to resist these measures (Turnheim and Geels, 2013; Rinscheid, 2020), but less attention has been paid to vulnerable communities and places bound up in struggles over old and new (Johnstone and Hielscher, 2017).

Our core argument is that to fully reap the potential of phase-outs in sustainability transitions, a more integrative body of scholarship is needed. Three issues are particularly crucial to advance this agenda: embedding phase-out within systems change; understanding its interactions with innovation; and elucidating political challenges. The remainder of our viewpoint sketches the contours of each of these themes and proposes directions for future research.

## 2. Systems change

Phase-out must be embedded within a broader conceptual and practical enterprise geared at realizing systems change. This is important because extant research indicates that phase-out policies do not inherently enable systems change and instead may reinforce lock-ins (Haas, 2020). In the UK, for instance, government commitment to coal phase-out, along with emission regulations, carbon pricing and the availability of alternatives, enabled the removal of coal from power generation (Isoaho and Markard, 2020). Nevertheless, many problematic regime structures continue to support the widespread use of natural gas (Geels et al., 2016), thereby preventing transformative change. Similarly, in the case of DDT (a powerful pesticide), bans led to the development of new regulatory regimes for substance authorization which coincided with significant growth in pesticides production and use (Joly et al., 2021).

Hence, while phase-outs may be successful at removing individual elements (e.g., technologies, substances, practices), our plea is that practitioners and scholars shift the unit of analysis to socio-technical systems and the destabilization and reconfiguration of entire regimes. That is, the aim should be transforming the system that is producing sustainability crises rather than switching out some of its elements. Such a system focus will help to elucidate the multiple logics underlying phase-outs – e.g., as long-term signals of change, tipping points for regime destabilization, ways to put out dying embers (i.e., preventing the reemergence of problematic arrangements), or conversely as part of regime *re*-stabilization. The following questions may help guide such a reorientation: under what conditions can phase-outs trigger tipping points to transform socio-technical systems (Sharpe and Lenton, 2021); when is phase-out used as a fig leaf to fend off societal pressure; and, when and how does phase-out create new lock-ins?

## 3. Interactions with innovation

As innovation and destabilization mutually shape each other (Turnheim and Geels, 2012, 2013), future work will need to deepen insights on the timing and interaction between phase-out and innovation. It is the availability of alternatives and the degree of system destabilization that *together* influence the possibility and pace of transitions (Andersen and Gulbrandsen, 2020; Rogge and Johnstone, 2017). In contrast, where timing and interaction are not accounted for, phase-outs may result in new lock-ins and poor sustainability outcomes. Consider Japan’s plans to phase out conventional cars by 2035, which hinges on the country’s vision of becoming a ‘hydrogen society’. Yet, Japan is making massive investments in long-lived hydrogen production facilities, most of which rely on high-carbon sources like Australian lignite (Trencher et al., 2020).

Transitions research suggests that phase-outs work best if combined with policies that encourage reorientation and innovation (Kivimaa and Kern, 2016; Rosenbloom et al., 2020), but critical questions remain: how can phase-out measures be designed and sequenced with innovation policies to foster long-term sustainable outcomes; at what time and pace should phase-outs be enacted to avoid re-emergence of targeted elements (Koretsky and van Lente, 2020); and, how might the design and implementation of phase-outs reflect the challenges of different transition phases (Markard, 2018)?

## 4. Political challenges

Phase-out is politically difficult (Stegmaier et al., 2014), place-dependent, and riddled with issues of power, political legitimacy, and equity. The geographical and immediate concentration of economic and social losses induced by some phase-outs suggests that they can intensify preexisting societal inequalities, contribute to right-wing populism, and fuel resistance to sustainability transitions (Lockwood, 2018). Societal deliberation, more just forms of representation, and anticipation of the negative socio-economic effects of industry decline is likely to enhance the transformative potential of phase-out (Asquith et al., 2017).

Critical questions in this area include: how can winning coalitions (Meckling et al., 2015) for phase-out and broader transformation be built; how can phase-out be coupled with regional conversion strategies; what governance approaches ensure that concerns of affected communities are considered; and, how do contending interests influence, and potentially instrumentalize, the design and implementation of phase-outs?

## 5. Moving forward

A deeper and more integrated engagement with phase-out emerges as a critical direction for transition research over the coming decade. Not only will such an agenda further embed phase-out in transition thinking but it will also be central to informing its use in

practice and broader scientific discourse. Such engagement with phase-out begins by interrogating issues of systems change, interaction, and politics. In doing so, it is our hope that insights from transition scholarship will strengthen phase-out efforts and align them with the transformation of systems toward sustainability.

### Declaration of Competing Interest

There are no competing interests.

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### Supplementary materials

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