Dead-end Pathways

A decision-maker's guide

This brief offers decision-makers a compact wayfinding tool to navigate the flood of decarbonization proposals they face, helping them quickly filter out options incompatible with climate commitments and that, if pursued, would waste scarce time and resources.

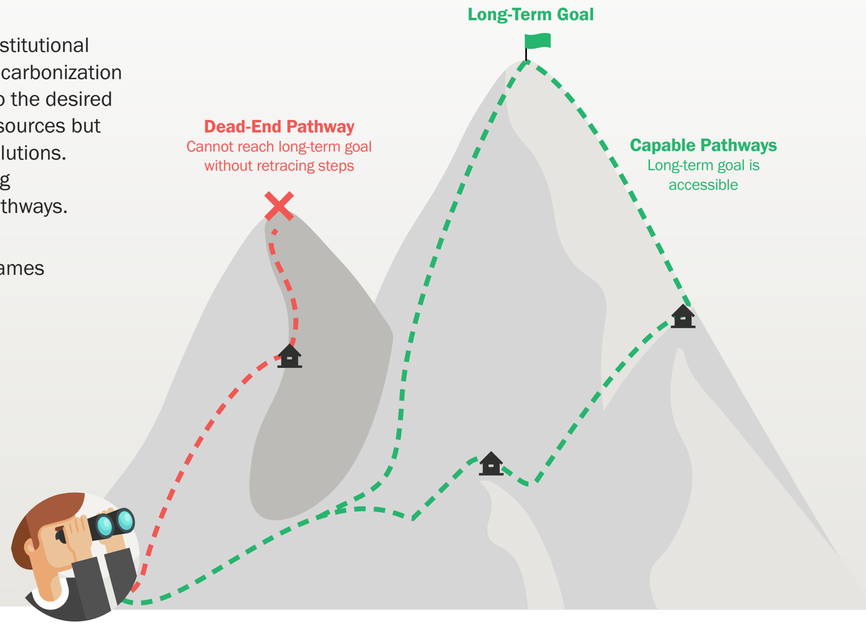
Dead-end pathways are potentially promising options for decarbonization that upon closer scrutiny cannot effectively address the climate challenge and if nevertheless pursued would waste scarce societal resources.

Why it matters

Time, money, political capital and institutional attention are limited. Investing in decarbonization options that cannot lead a system to the desired end state not only wastes scarce resources but also diverts attention from viable solutions. The consequence is a delay pursuing genuinely scalable, deep-abating pathways.

The idea of dead-end pathways reframes decision-making: instead of asking *"How much does this cut emissions today and at what price?"* we ask *"Can this plausibly build toward a pathway that virtually eliminates emissions in the long run?"*.

Our approach helps identify and avoid detours that appear initially attractive so that scarce resources can be focused on genuine solutions.



Authors:

Professor Daniel Rosenbloom
Professor James Meadowcroft
Carleton University

Dr. Jochen Markard
ETH Zurich

Moe Kabbara
The Transition Accelerator

Approach:

Screen decarbonization options based on three sequentially applied diagnostics of **depth**, **breadth**, and **timeliness**. Filter out those that fail on one or more criteria.

Depth:

Does the option possess the potential to build toward near-zero emissions for the system in question?

If not, it very likely constitutes a dead-end.

Breadth:

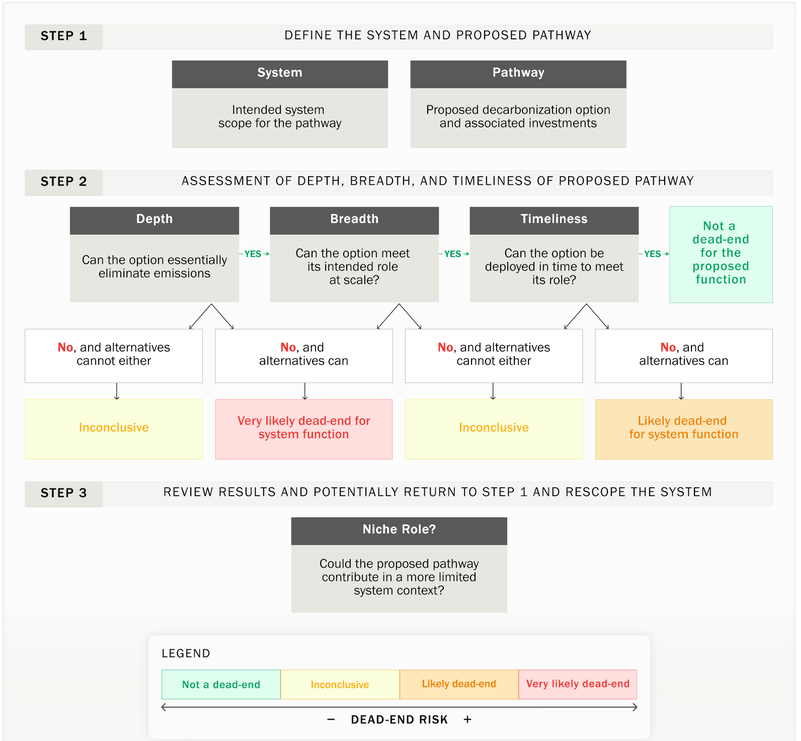
Can the option be applied at scale to meet its intended role (e.g., heating residential homes)?

Failure here indicates a very likely dead-end. Where a pathway fails on breadth, the framework explicitly asks whether a narrower, niche application could be viable.

Timeliness:

For pathways that clear depth and breadth, *can deployment occur rapidly enough to meet mid-century climate commitments?*

If an approach will only be viable many decades into the future whereas alternatives can deliver now, it is a likely dead-end.



Proposed Pathway	Key Failure	Explanation
Compressed natural gas for heavy trucking	Depth	Reduces CO_2 vs diesel but cannot plausibly offer deep enough reductions without retiring assets and radical retooling; other superior options (e.g., battery-electric and hydrogen fuel cells) already in early diffusion.
Renewable natural gas for residential heating	Breadth	Biomass supply, land, and resource constraints prevent scaling to the entire housing stock; superior options (e.g., heat pumps) are already diffusing.
Direct air capture removals to maintain status quo operation of heavy industry	Timeliness	In principle can deliver sizeable removals, but massive infrastructure, land, and energy demand make climate-relevant removals unlikely by mid-century in the context of superior options (e.g., electrification of steel and aluminum production, alternative chemistries for cement) that are more advanced.
Renewable energy technologies for electricity provision	Pass	Strong depth and breadth potential, and already diffusing rapidly across global power systems.

Note: *these are illustrative, high-level assessments using the approach; local socio-technical studies are needed for definitive classification.*

Source for framework: *Rosenbloom, D., Meadowcroft, J., Markard, J., Landry, J.-S., Kabbara, M., 2025. Dead-end pathways: Conceptualizing, assessing, avoiding. PLOS Climate 4, e0000693. https://doi.org/10.1371/journal.pclm.0000693*

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