How to Prioritize Strategic Projects for Better Net-Zero Industrial Policy

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Introduction

In order to support a transition to net-zero carbon emissions by 2050 and meet Paris Agreement commitments, governments around the world have employed a variety of industrial policy tools to promote innovation, investment, and uptake in green technologies. Major initiatives include the US Inflation Reduction Act, the European Green Deal, Australia's Net Zero Plan, and Japan's Green Transformation Act.

Canada has adopted many of the same tools as its peers, providing a combination of 'carrots' via subsidies, tax credits, loans and grants; and 'sticks' via regulations, mandates and carbon pricing. Unlike many of its peers, however, Canada has not developed an overarching strategy to coordinate this mix of policies to concentrate support on projects that maximize both emission reductions and economic growth opportunities in net-zero sectors and technologies.

Without a strategic framework for prioritizing projects, Canada risks ad-hoc decision making, increasing the likelihood of wasteful spending and rent-seeking behaviour, which could also undermine support for pursuing emissions reductions. The government can and must get better at assessing the relative importance of various clean growth projects.

To aid policy makers in Canada with this task, this brief proposes a framework to prioritise net-zero initiatives that can both enhance Canadian economic competitiveness and demonstrate potential for significant, scalable impact towards reducing emissions, consistent with net-zero pathways.

A Framework for Prioritising Public Investment in Net-Zero Projects

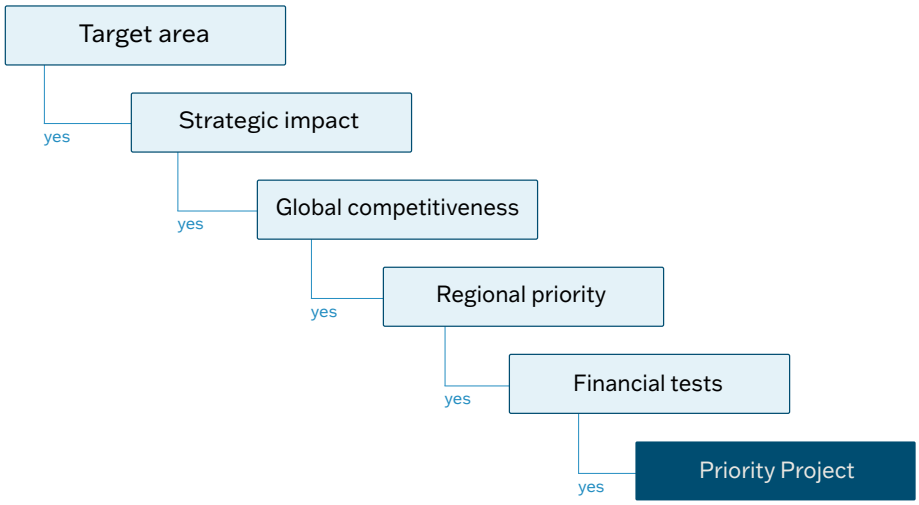
Canada has a number of programs and funds designed to catalyze the transition to a net-zero economy. These funds have not been strategically directed to seize Canada's opportunities in the transition. They have been passive and opportunistic rather than active and focused. They have not been coordinated across departments.

Climate programs have tended to target near-term greenhouse gas reductions, rather than catalyze net-zero energy systems or bolster the technologies that would create prosperity and drive decarbonization. In economic programs, it is not clear that rigorous analyses of economic value-added and productivity growth—key drivers of long-term economic prosperity—are used as the basis of evaluation.

To correct this and create more support for projects that add up to more than the sum of their parts, the Government of Canada needs a strategic framework to help it prioritize which projects will secure Canadian competitiveness and produce transformative outcomes.

Key questions this framework seeks to address:

- Which energy and resource projects will drive Canadian competitiveness over the long run?
- Which projects are likely to have catalytic effects on supply chain formation and long-term economic value-added?
- Should the government take a more active role in project origination?
- How can the government determine the appropriate amount of federal investment required to make a project viable?



This framework articulates the foundations of strategic investments in net-zero systems and supply chains. Strategic investments:

- Actively deploy capital to seize economic opportunities and produce transformative effects.
- Aim to build systems and supply chains in accordance with an overarching vision.
- Enable emerging clean industries to overcome the chicken-and-egg problem between supply and demand that often plagues new markets.
- Are rooted in a system-level understanding of the interconnections between projects and sectors to effectively allocate inputs and align assets.

The framework can be thought of in two ways:

1. As the elements of a good project that must be actively constructed;
2. As five branches of a decision tree that helps to assess whether the project is worthy of public support in strategically directed programs (see figure). Note that projects that do not meet all these criteria could still be considered for support in undirected programs.

The framework requires further operationalization, i.e., identifying specific criteria and metrics on which to evaluate projects. But as a matrix for identifying where scarce public resources should be most efficiently applied, it can be a useful tool.

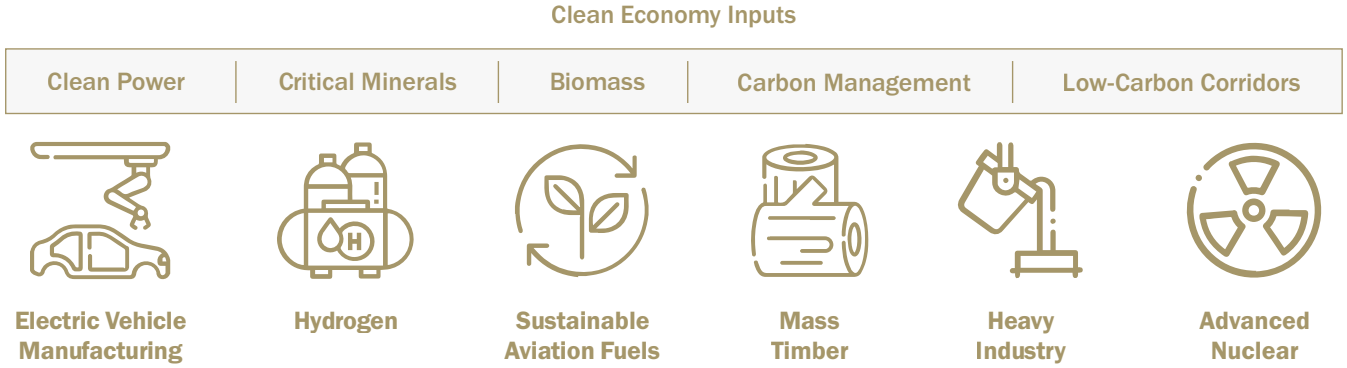
1. Targets and high priority opportunity areas

Does the project contribute to a target of national significance?

The creation of targets is a critical step to a more strategic approach. These targets could take the form of net-zero competitiveness goals.

- These goals should be concrete economic targets that refer to the production, deployment, or improvement of technologies.
- They should be net-zero compatible in the sense that targets should track true net-zero pathways and avoid dead-end technologies that are incompatible with a net-zero energy system in that they only provide near-term reductions and delay capital expenditures needed to achieve net zero. Luckily, there is now more certainty than uncertainty on the role of technologies that are consistent with net-zero pathways .[1]
- The competitiveness component of the goal means benchmarking Canada's production to a position in global supply chains. For example, one target would be that Canada seeks to maintain its current 10% share of North American vehicle assembly through the transition to EVs.

1 https://transitionaccelerator.ca/reports/pathways-to-net-zero-a-decision-support-tool/



These targets should be set in high priority opportunity areas. Existing studies of Canada's opportunities have identified seven consensus areas that will experience growing demand as the world transitions to net-zero by 2050[2]:

- EVs and the battery supply chain
- Carbon capture, utilisation, and storage
- Hydrogen
- Biofuels
- Value-added agriculture (e.g., alternative proteins)
- Value-added forestry (e.g., mass timber)
- Critical minerals

Several reports have also identified advanced nuclear as an opportunity area where Canada has potential to secure leadership.[3]

Other critical inputs to the green economy can be added to this list: assets that enable deep decarbonization or make downstream industries lower carbon and more competitive (clean power, biomass logistics, and low-carbon transportation corridors).

Each of these needs to be modeled as a vertical or supply chain with sub-targets for the various components and downstream markets. Targets in each of these areas can be interconnected, such that the hydrogen production targets inform the electricity and CCUS targets. Targets provide both general and highly specific sorting devices. At the general level, they help focus funds in high priority areas. At the specific level, they provide a concrete list of projects that should be built.

Identifying appropriate targets and the relevant actions

2 Bentley Allan conducted a review of existing studies on Canada's opportunities for NZAB. The results support these sector choices. See: Allan, Bentley et al. 2022. Canada's Future in a Net-zero World: Securing Canada's Place in the Global Green Economy. https://institute.smartprosperity.ca/publications/CanadasFuture; Canadian Institute for Climate Choices. 2021. Sink or Swim: Transforming Canada's economy for a global low-carbon future. https://climateinstitute.ca/reports/sink-or-swim/; BCG. 2021. Canada can Lead the World https://www.bcg.com/en-ca/publications/2021/canada-can-lead-in-low-carbon-technology; Duruflé, G., and Carbonneau, L. 2016. Forging a Cleaner and More Innovative Economy in Canada. Sustainable Development Technology Canada and Cycle Capital Management; RBC Economics. 2021. Trading Places: Canada's place in a changing global economy. https://royal-bank-of-canada-2124.docs.contently.com/v/trading-places-canadas-place-in-a-changing-global-economy-pdf; RBC Economics. 2021. The $2 Trillion Transition: Canada's Road to Net Zero. https://thoughtleadership.rbc.com/the-2-trillion-transition/; Canada's Industry Strategy Council. 2020. Restart, Recover, and Reimagine Prosperity for all Canadians: An Ambitious Growth Plan for Building a Digital, Sustainable, and Innovative Economy.

3 Business Council of Canada. 2023. Canada in the New Energy Landscape. https://www.thebusinesscouncil.ca/report/canada-in-the-new-energy-landscape/; SISMA. 2024. Advanced Manufacturing for Small Modular Reactors. https://simsa.ca/wp-content/uploads/Utilising-Advanced-Manufacturing-for-SMRs-SIMSA-April-2024-1.pdf; Prairies Economic Development Canada. 2022. Assessment of Alberta andSaskatchewan's industrial potential to participate in an emerging Canadian SMR supply chain. https://albertainnovates.ca/wp-content/uploads/2022/05/SMR-Supply-Chain-Study-Executive-Summary-Final-Report-2022-05.pdf; Canada has potential to scale Canadian firms in the supply chain for nuclear small modular reactors that is currently underexploited. Upstream, Cameco operates in most parts of the upstream segments, from mining and milling to refining, conversion and fuel fabrication for the CANDU reactors. Enriched uranium for SMRs is a distinct technology pathway that Canada has yet to develop. It is possible that Canadian knowledge and experience could provide a competitive advantage in this emerging area. In the downstream, Canada has three potential opportunities: (1) Expand the CANDU footprint (a project is being explore in Romania); (2) Develop new SMR technology (such as Canadian-headquartered firm Moltex which is positioning itself as a leading innovator in molten salt SMR reactor technology); (3) Establish a services play by gaining expertise in the deployment of foreign technology (such as through early adoption of the new GE-Hitachi technology at the Darlington plant by Ontario Power Generation and the prospect of a US-based ARC Clean Technology project with New Brunswick Power). Each of these is a modest opportunity at present, but with a focused strategic effort, any of them could generate real value-added for the Canadian economy and create a foothold that could scale domestic champions into global exporters.

by public and private actors needed to achieve them cannot be an exercise in top-down central planning by government technocrats. Private sector expertise must be at the heart of any successful industrial policy, as these actors are best placed to identify the technoeconomic opportunities and challenges associated with each net-zero technology. This is why the most successful countries currently dominating net-zero supply chains have long-established industrial policies that are co-created and coordinated with industry via mechanisms for public-private information exchange.[4]

The table on the page below from Accelerate's recently published Canadian Battery Innovation Roadmap (2024) illustrates how leading countries in battery innovation have industrial policies working to achieve specific targets that deploy policy mixes comprising a wide range of policy instruments, guided by strong information exchange via public-private coordination forums.[5]

What should a Canadian version of this approach look like? The core elements for a Canadian net-zero industrial strategy are rooted in the principles of effective modern industrial policy.[6] The core elements are:

- Bold and clear net-zero competitiveness goals in priority opportunity areas.
- Strategic collaborations to bring together Indigenous peoples, labour, universities, governments, industry, finance, and civil society.
- Ongoing deliberations to create sectoral strategies, set and revise targets, and identify smart investments.
- Goals to guide policy and focus public and private investment.

For example, Canada's Battery Innovation Roadmap articulated several targets to inform Canadian industrial policy for the battery sector:

Innovation Infrastructure:

- $3 billion invested in battery innovation through public and private funding;
- Canada's battery R&D centers and national labs contribute significantly to achieving the innovation metrics goals laid out in the roadmap;
- By 2035, train and integrate over 10,000 skilled professionals into Canada's battery industry, with at least 500 graduates annually from specialized training programs.

Industrial Policy:

- By 2035, increase the number of Canadian-owned firms in the battery sector tenfold, contributing to 20% of the North American battery value chain;
- Secure 1,000 patents in battery technology by 2035.

The Transition Accelerator has also partnered with industry leaders in other net-zero sectors to identify suitable targets, as well as to co-design roadmaps laying out the actions from policymakers and industry that would bolster Canadian competitiveness. For example, The Transition Accelerator partnered with Canadian Council for Sustainable Aviation Fuels and the Energy Futures Lab to produce the C-SAF Roadmap,[7] which establishes the following goal: one billion litres of SAF production by 2030, achieving a minimum 50% reduction in life cycle greenhouse gas emissions compared to conventional jet fuel, which would represent a reduction of about 1.6 million tonnes of GHG emissions. This goal builds on the goal in Canada's Aviation Action Plan (2022) that SAF should be 10% of projected Canadian jet fuel use.[8] Another target was articulated in partnership with Forest Products Association of Canada and the Canadian Wood Council in the Mass Timber Roadmap (2024): increase mass timber market value to $1.2 billion by 2030

4 Thurbon, E., Kim, S. Y., Tan, H., & Mathews, J. A. (2023). Developmental environmentalism: state ambition and creative destruction in East Asia's green energy transition. Oxford University Press.

5 https://bir.acceleratezev.ca/

6 https://transitionaccelerator.ca/reports/white-paper-taking-a-strategic-approach-to-industrial-transition/

7 https://transitionaccelerator.ca/reports/the-c-saf-roadmap/

8 https://tc.canada.ca/en/corporate-services/policies/canada-s-aviation-climate-action-plan

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The Transition Accelerator

MLI

China	United States	European Union	South Korea	Japan
SETTING TARGETS				
Production Targets				
Raise domestic content of core components and materials to 40 percent by 2020 and 70% by 2025	Capture 60% of domestic demand by 2030	• Capture 90% of domestic demand (550 GWh) by 2030 • 2030 targets for domestic critical mineral extraction (10%), processing (40%), recycling (25%)	• 40% of global battery market and 20% of materials/parts/ equipment market by 2030 • 4x cathode production capacity and triple exports of battery-making equipment the next five years	• 600 GWh (or 20% share of the global battery market) by 2030 • 150GWh domestic production by 2030
Innovation Targets				
Next-gen battery energy density of 500 Wh/kg by 2025	Solid-state and Li-metal production cost <60 $/kWh, 500 Wh/kg, cobalt/nickel-free by 2030	• Increase energy density (+60% compared to 2019 values) • Reduce cost by 60% compared to 2019 values • Improve cycle lifetime (at least by a factor of 2 compared to 2019)	• 800 km single charge by 2026 • Lithium-sulfur batteries commercialized by 2025, solid-state by 2027, and lithium-metal by 2028 • Recycling 100% domestic secondary battery closed-loop by 2030	Full commercialization of solid-state batteries by 2030
INDUSTRIAL POLICY MIXES AND COORDINATION FORUMS				
Supply Push				
• Joint Venture FDI requirements • R&D investments • Loans for mineral supply chain	• DoE R&D funds • DoE Loan Program • IRA tax credits	• Horizon Europe R&D • European Investment Bank • Important Projects of Common European Interest	• Public-private 'battery alliance' R&D fund • Loans & guarantees for critical minerals • Battery-specific tax credit bonuses	NEDO R&D consortiums
Demand Pull				
• Transit procurement • Purchase subsidies • EV mandate & credit system	IRA EV consumer incentive thresholds for domestic supply chains	• Procurement thresholds for domestic supply chains • Fit-for-55 2035 ICE phase out • EU Batteries Regulation	EV purchase incentive technical eligibility criteria	EV infrastructure investment
Public-Private Coordination				
China EV100	Li-bridge	• European Battery Alliance • InnoEnergy • BATT4EU	Korean Battery Alliance	Storage Battery Industry Strategy Council

and double that to $2.4 billion by 2035, with Canada's mass timber sector serving 25 percent of world mass timber market.[9] Finally, a target was set in partnership with the Battery Metals Association of Canada, Energy Futures Lab, and Accelerate: produce 1,300,000 electric vehicles in Canada by 2030 as well as the raw materials, processed metals, and batteries for 100 GWh of battery capacity.[10]

2. Strategic impact

Is this a strategic investment that will catalyze the development of a supply chain, build innovation ecosystems, or drive long-term transformation?

Strategic investments actively deploy capital to seize economic opportunities and produce catalytic effects on supply chains, ecosystems, and transformative outcomes. A project should have a clear strategic rationale.

First, strategic investments need to contribute to seize economic opportunities by catalyzing the creation of supply chains that build economic value-added or productivity. Rather than exporting raw goods, adding processing and manufacturing value-added can create economic benefits. Productivity is a function of technological deployment.

Strategic investments create net-zero supply chains by connecting upstream production to downstream markets. In order to assess these catalytic effects, you must have deep knowledge of how supply chains are put together. It requires understanding how linking projects together will unlock value and create spillovers.

Net-zero supply chains can also be kickstarted by projects that demonstrate a technology or illustrate how a Canadian project can compete. All else equal, first commercial projects are more valuable than other projects. For example, the United States has signalled the importance of first-of-a-kind (FOAK) demonstrations at scale in the Bipartisan Infrastructure Law and the Inflation Reduction Act (IRA), committing over $26 billion USD to create the Department of Energy's (DOE) Office of Clean Energy Demonstrations (OCED).[11]

Second, strategic investments establish innovative net-zero energy systems by clustering clean economy assets. This clustering creates symbiotic ecosystems that can drive innovation over the course of the transition.

Innovation ecosystems benefit from homegrown capacity: scaling and positioning Canadian firms in global supply chains. This is because Canadian firms are more likely to locate research and development capacity in Canada. Relying on FDI struggles to create these spillovers because foreign firms are more likely to locate research assets abroad. So even in the case of FDI, project evaluation needs to assess whether Canadian technology providers are benefitting, whether there is a collective learning component, and so on.

Third, projects should contribute to long-term transformation of the economic realities and stakeholder dynamics of clean energy production and use.

A key aspect of transformative potential is, as the draft Investment Policy Statement argues, the creation of cheap inputs for downstream sectors or enabling fuel-switching. Such clean growth projects could include:

1. Projects that increase the supply of low-carbon fuel (hydrogen, biofuels).
2. Projects that increase the supply of low-carbon electricity (from non-emitting sources such as wind and solar and game-changing technologies such as small modular nuclear reactors (SMRs)).
3. Projects that increase the mining, extraction, and processing of critical minerals required to support the net-zero transition.
4. Projects that enable fuel switching, electrification or the removal of carbon dioxide (i.e. energy storage, distribution infrastructure, carbon dioxide transportation or storage infrastructure).

9 https://transitionaccelerator.ca/reports/the-mass-timber-roadmap/

10 https://transitionaccelerator.ca/reports/a-roadmap-for-canadas-battery-value-chain/

11 https://www.energy.gov/sites/default/files/2023-08/OCED%202023%20Multi-Year%20Program%20Plan.pdf

But economic transformation potential is also a function of cost reductions. Capital can be strategically used to make inputs and technologies cheaper. Deployments drive such cost reductions. Projects that promise to reduce the costs of a technology in a target area will have a broader impact.

But to really get at long-term impact we need to get away from thinking about technologies and start thinking about how to deploy industrial policy investments that will build coalitions of industry actors (technology developers, adopters, manufacturers, investors, and service providers) who understand that a shift to net-zero emissions will improve their competitiveness and provide shareholder value.[12] As these firms gain market share and expand, citizens also begin seeing their region's economic future as benefitting from the transition, causing them to become more supportive of net-zero policies.[13] Sometimes this means funding a startup and sometimes it means supporting an incumbent to diversify.

In the battery supply chain, investing in the midstream stage of chemical production is increasingly the best intervention point to simultaneously catalyze supply chain development, build long-term economic value, and build geopolitical resilience.

- Building the midstream helps the whole supply chain by driving demand-pull for upstream mining and providing the supply-push needed to feed downstream production.
- The midstream is essential to long-term innovation, so building expertise here will pay off over decades. As battery chemistries change, capacity in chemicals production will remain relevant and allow the supply chain to adapt.
- The midstream is critical to geopolitical resilience as it is the midstream of the battery materials and permanent magnets supply chain that is dominated by China.

3. Global competitiveness

Is the project economically competitive with global peers or does it make other priority sectors more competitive?

Mid-sized, open economies like Canada need to carefully assess which industries are going to be competitive. Canada must identify areas where it has long-term competitive advantages or where industry will be relatively protected from intense global competition. This is difficult to assess in the midst of a rapid and uneven transition. Still, a project must be assessed according to what proposed national resource or innovation advantage it possesses.

For example, many countries have lithium deposits. What will give Canadian lithium an advantage in a competitive landscape? The project economics might work, but what basis do we have for believing the asset will be globally competitive in 2035? Is there a strong government commitment to the sector that will be backed by policy (e.g., a Carbon Border Adjustment Mechanism to level the playing field with global competitors offering more carbon-intensive products)?

If an industry is too nascent to make a clear determination about competitive advantages, then the existence of innovation assets that will support adjustment and cost reductions can be considered.

4. Regional contribution

Does the project contribute to regional economic transformation or build a cluster of innovative green assets?

An assessment of contribution to regional economic transformation begins with an analysis of the region's economy today, its transition plays, and its long-term potential in the 2050 net-zero economy. The goal is a regional pathway to decarbonization and economic prosperity. This links national targets to specific regional locations.

12 https://www.pnas.org/doi/10.1073/pnas.2207727120

13 https://www.science.org/doi/abs/10.1126/science.aab1336

But a standalone project, even if justified by targets and a regional pathway assessment, is of less value than a project that is co-located with other assets. The goal should be to put assets together into clusters that lower the carbon intensity of production processes, increase collective efficiency, and make use of shared assets. The innovation ecosystems listed under 2. are best built in regional clusters.

A critical question is whether the enabling conditions are in place (skilled workforce, housing for workers, roads, ports, innovation ecosystem), or could be put in place through a series of projects in conjunction with provincial-territorial and local partners.

Clustering assets has another benefit. Place-based economic development theory suggests that the foundation of successful long-term manufacturing and processing is a dense set of interactions in production networks. Firms and researchers need to come together and exchange ideas in order to solve problems and innovate over time. This is the foundation of what economists call "agglomeration effects": the benefits that accrue when assets are co-located.

5. Financial tests

Do the project economics warrant public support?

Finally, financial modelling can help determine whether a project warrants public support and what level of public support is needed.

Financial modeling should seek to ensure that government finance is additive. Simply put, if the project is a mature commercial project that already clears an internal rate of return threshold, or is competitive with other jurisdictions without support, then it likely does not require support.

Factors 1-3 in this framework advocate supporting riskier projects (scaling; early commercial). In these cases, government dollars are additive. If these have high upside, then they could be regarded as efficient uses of government capital even if heavily discounted. But that raises questions about who benefits from government risk-taking. If the government is taking on the risk, then it should take an equity stake in the project.

Government must develop its own tools for assessing project economics and cannot simply take the term sheets from firms at face value. Building up expertise in project economics in other jurisdictions, as well as the rigorous analysis of existing Canadian projects, will allow Canada to make more refined decisions on project finance.

Finally, the financial modelling should lead back to a broader policy conversation. Would the sector benefit from a policy or regulatory change instead of a direct subsidy? If it is a priority sector and the technology has already achieved first-commercial stage, then perhaps a universal, undirected measure is better. For example, regulatory changes can boost demand for nascent industries where the technological capability is proven, such as sustainable aviation fuel and mass timber construction, enabling further cost reductions as economies of scale form to meet enhanced demand. Further price certainty can also be achieved via other instruments such as contracts for difference.

Conclusion

Positioning Canada as a leader in emerging clean technologies is a key part of the country's future competitiveness as the global energy transition continues.

At least part of the solution is to apply more rigorous standards to evaluating whether projects should be prioritised for public investment—standards that take account of strategic economic considerations as well as contribution to net-zero pathways. This is necessary to ensure fair value to taxpayers and to position domestic firms with the best opportunity for success in a competitive global market. The framework proposed here identifies the criteria we believe are most likely to accomplish these goals.