ECONOMICS OF ENERGY INNOVATION
AND SYSTEM TRANSITION

CLIMATE Strategies

Call for inputs to the first global stocktake

Submitted by

Climate strategies on behalf of

The Economics of Energy Innovation and System Transition project

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In Response to the Call for inputs from Parties and observer States, UN Agencies and other international organizations and non-Party Stakeholders and observer Organizations, to the first global stocktake.

Decision 19/CMA.1, paragraph 19: requested the Chairs of the Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation to issue a call for the inputs referred to in paragraphs 36 and 37 of the same decision, taking into account that such inputs should be submitted at least three months before their consideration in the technical assessment;

Executive summary

Meeting the goals of the Paris Agreement requires unprecedented, policy-led transformations in multiple technologies and sectors. Along with rising climate impacts, the last decade has seen radical developments in low-carbon technologies challenging the use of traditional economic appraisals when we pursue goals of transformational change.

The Economics of Energy Innovation and System Transition (hereafter – EEIST) project was set up to develop cutting edge complexity-based modelling solutions to support government decision making around low-carbon innovation and technological change, aiming to facilitate a rapid low-carbon transition. To inform a robust Global Stocktake outcome, EEIST provides the summarised key messages of two flagship reports developed by world-leading experts in complex systems modelling, economics and climate and environmental policy.

The project's first report, 'The New Economics of Innovation and Transition: Evaluating Opportunities and Risks', reviews evidence and theory to explain the limitations of traditional policy appraisal methods and the rationale for a new approach. It is concluded that the greatest successes achieved so far in the low-carbon transition in China, Brazil, India, the UK and the EU were generally implemented despite – not because of – predominant economic analysis and advice. Building on this, EEIST developed the ten principles for successful policymaking on low carbon transitions. Based on detailed empirical evidence, these principles overturn conventional wisdom and suggest a new way forward that can help countries accelerate innovation, job-creation, and cost reduction in the shift from fossil fuels to clean technologies.

We hope that this submission, introducing a set of tools and principles to support policy-making and appraisal, will advance international cooperation on low-carbon transitions.

The New Economics of Innovation And Transition: Evaluating Opportunities and Risks[1]

The project's first report reviews evidence and theory to explain the limitations of traditional appraisal methods and the rationale for the Risk-Opportunity Analysis (ROA), illustrating the framework across a series of case studies.

First, the report looks at each of the three historical cases – Wind Energy in the UK and Brazil, Solar PV in Germany and China and Transforming Lighting Efficiency in India, indicating that recent transitions to clean energy technologies have succeeded beyond expectations. The report then outlines alternative approaches to an economic appraisal which better captures the dynamics of energy innovation and transition, particularly in relation to the challenge of deep decarbonisation. Lastly, the report presents forward-looking case studies, exploring the prospects and strategies for Electric Vehicles and for low-carbon steel, demonstrating how these new ways of thinking can inform low carbon strategies for other sectors.

Access the full report here.

Key messages:

- Policies central to some of the most outstanding successes in low-carbon transitions so far were generally implemented despite – not because of – predominant economic analysis and advice.
- The most critical role in low-carbon transitions played policies that targeted resources directly at the deployment of these technologies – through subsidies, cheap finance and public procurement, instead of public R&D or instruments that economists typically recommend as the 'most efficient'.
- A focus on current knowledge of costs and benefits overlooks the effects that policies can have on processes of change in the economy. This can neglect risks and opportunities, ignore the potential for policies to have self-amplifying or self-limiting effects, and miss the potential to trigger 'tipping points' and cascading changes.
- Risk-opportunity analysis (ROA) offers a new way of assessing options, which can include looking for 'sensitive intervention points' where modest actions can have large effects.
- With informed and targeted efforts, domestically and internationally, society could greatly accelerate progress in each of the emitting sectors of the global economy.

Implications for international collaboration:

- Coordinated development and testing of new technologies: in the early stages of technology development, sharing learning between countries and industries can accelerate progress towards identifying viable solutions.

[1] Michael Grubb, Paul Drummond, Jean-Francois Mercure, Cameron Hepburn, Peter Barbrook-Johnson, João Carlos Ferraz, Alex Clark, Laura Diaz Anadon, Doyne Farmer, Ben Hinder, Matt Ives, Aled Jones, Gao Jun, Ulka Kelkar, Sergey Kolesnikov, Aileen Lam, Ritu Mathur, Roberto Pasqualino, Cristina Penasco, Hector Pollitt, Luma Ramos, Andrea Roventini, Pablo Salas, Simon Sharpe, Zhu Songli, Pim Vercoulen, Kamna Waghray, Zhang Xiliang

- Coordinated policies to expand deployment: as zero-emission technologies become more mature, coordinated policy measures can accelerate their spread through global markets, increasing economies of scale and accelerating their cost reduction.
- A financial transition: to accelerate global adoption, the terms of low-carbon finance available to developing countries will be important to overcome the 'finance trap' of high interest rates.
- Coordinated standards and incentives: Coordination on standards could help to overcome the barriers to first deployment created by international competition, especially in sectors where zero-emission technologies appear likely to be more expensive than fossil fuels for the foreseeable future.

Ten Principles for Policymaking in the Energy Transition: Lessons from Experience[2]

Many of the economic principles, models, and decision-making tools used by governments are designed for use within contexts of 'marginal' or incremental change, where technologies, markets and other economic structures are relatively stable. However, when the aims and context of the policy include widespread innovation and structural change, as in the energy transition, different tools are needed to guide policy.

Drawing on experience and evidence from the academic literature and from the work of partners in China, India, Brazil, the European Union and the United Kingdom, EEIST outlined ten evidence-based principles for successful policymaking on the energy transition. Applying these principles can help countries achieve a faster energy transition, accelerating innovation, job-creation, and economic growth.

Full explanations of each Principle and the supporting evidence can be found in the report.

Key messages:

- Evidence shows that to achieve the energy transition, governments have a key role to play in making technology choices, regulating to bring down costs, and investing to de-risk markets.
- Government policies to incentivise clean technologies can reduce costs, accelerate deployment and create greater economic opportunities than technology-neutral policies.
- Market-shaping policies can reduce the risks hindering private investment and create demand, increasing the deployment of clean technologies faster than the private sector alone.
- Implementing these principles in appropriate ways could address many of the barriers identified in scaling up clean technology investment and could help to refresh our way of thinking around what works and what doesn't in fostering a rapid zero-carbon transition.

[2] Laura Diaz Anadon*, Aled Jones*, Cristina Peñasco*, Simon Sharpe#, Michael Grubb#, Sanchit Aggarwal†, Nelson Henrique Barbosa Filho†, Raktimava Bose†, Andrea Cabello†, Saswata Chaudhury†, Paul Drummond†, Doyne Farmer†, Chris Foulds†, Daniela Freddo†, Cameron Hepburn†, Vidhu Kapur†, Jiang Kejun†, Aileen Lam†, Jean-Francois Mercure†, Lúcia Helena Michels Freitas†, Sarah Royston†, Pablo Salas†, Jorge Viñuales†, Songli Zhu†
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The 10 Principles for Policy, in summary:

1. Technology choices need to be made: In a context of innovation and structural change, policies will almost always advantage some technologies more than others. It is better to choose deliberately rather than accidentally, supporting innovation in low-carbon directions. Some policies intended to be neutral can have a bias towards incumbents, and incremental change.

   Case study 1 (p. 11) on wind power in the UK illustrates how creating technology-specific deployment policies, first for onshore wind and solar and later for offshore wind, resulted in large public benefits in terms of innovation and cost reductions.

2. Invest and regulate to bring down costs: Well-designed investment and regulation policies can bring down the cost of clean technologies, by creating a 'demand pull' for innovation that complements the 'supply push' of research, development and demonstration, strengthening learning-by-doing feedbacks in technology development, deployment and diffusion.

   Case study 2 (p. 16) explores the government intervention in wind turbines in Brazil that created incentives to develop infrastructure and made onshore wind generation cost-competitive in the country.

3. Actively manage risks to crowd-in investment: Low-carbon transitions involve many sources of uncertainty. Efforts to reduce the risks of private investment in clean technologies, including public finance acting as a lead investor, can reduce technology risk and financing costs and greatly increase rates of investment and deployment.

   Case study 3 (p. 23) illustrates how feed-in tariffs and internationally funded top-ups for small hydropower in Uganda reduced risks and financing costs and attracted private-sector investment.

4. Target tipping points: Well targeted interventions can activate tipping points in technology competitiveness, consumer preference, investor confidence, or social support for transitions, where a small input leads to a large change. This can inform the targeting and level of subsidies and taxes, as well as the stringency of regulations.

   Case study 4 (p. 28) explores how triggering the electricity transition with Electricity Market Reform and a carbon price floor in the UK contributed to achieving the fastest power sector decarbonisation in the world over the period 2010 to 2019, with an annual rate of reduction in carbon intensity around eight times the global average.

5. Combine policies for better outcomes: A combination of policies will be needed to drive each low-carbon transition. Since the effect of each policy depends on its interactions with others, assessing policies individually can be misleading. Assessing policies as a package can identify those that are mutually reinforcing, generating outcomes 'greater than the sum of the parts'.

   Case study 5 (p. 34) describes the package of policies supporting China's electric vehicle development working across three policymaking areas (supporting both supply and demand for EVs and investing in the enabling infrastructure). The effect of combined policies has been a fast growth of EV sales in China, from just 6,023 in 2010 to over 3 million in 2021.

6. Policy should be adaptive: There are many paths along which economies can develop over time. It is often impossible in practice to identify which is 'best' in terms of public goals, or even 'least cost' economically, which implies there may be no single 'optimal' policy. Given also the potential to learn from experience, policy should be designed to be adaptive, so that it can more easily respond to unforeseen changes, exploit opportunities and manage risks.

   Case study 6 (p. 40) illustrates how following a slow start, the efforts in the adaptive design of solar PV policy in Brazil created incentives for the adoption of clean and sustainable technologies. Between 2017 and 2022, the expansion of solar PV in the country experienced an exponential increase in the installed capacity of solar technologies.

7. Put distributional issues at the centre: Low-carbon transitions inevitably involve transfers of economic resources. Distributional issues should be central to policy analysis, since they are important for environmental, economic and social goals, and are likely to have a strong bearing on social support for the transition.

   Case study 7 (p. 45) highlights the importance of incorporating welfare and distribution aspects in the assessment of policies before implementation, drawing on the lessons deriving from the Carbon road fuel taxes and the 'Gilets Jaunes' movement in France.

8. Coordinate internationally to grow clean technology markets: Countries should coordinate internationally to grow clean technology markets in each of the emitting sectors of the global economy. This can lead to faster innovation and larger economies of scale, accelerating the cost reduction of clean technologies, with benefits for all countries.

   Case study 8 (p. 49) demonstrates how international coordination to grow the global market for electrical vehicles can result in faster cost reductions and cost parity between electric vehicles (EVs) and internal combustion engine vehicles (ICEVs).

9. Assess opportunities and risks: Policy appraisal should consider risks and opportunities, not just costs and benefits, when unquantifiable or very uncertain factors are likely to be important. Where the aim is transformational change, appraisal should consider the effects of policies on processes of change in the economy, alongside their expected outcomes.

   Case study 9 (p. 53) on India's transformation of LED demand aggregation through procurement demonstrates how considering risks and opportunities can provide a stronger rationale for action and a more transparent presentation of interests and trade-offs than cost-benefit analysis.

10. Know your biases: The construction of economic models unavoidably involves many choices that will influence their outputs, in which there are no 'correct' answers. We should be aware of our biases, make model choices transparently and, where possible, use a range of models instead of a single one.

    Case study 10 (p. 58), drawing on the example of the European 2030 renewable energy targets, highlights the importance of critically examining model assumptions, comparing the projections of different models and using the broader information gained through the process to support policy choices, rather than taking the output of any model at face value.

About the EEIST project

The ambition

The Economics of Energy Innovation and System Transition (EEIST) project develops cutting-edge energy innovation analysis to support government decision making around low-carbon innovation and technological change.

By engaging with policymakers and stakeholders in Brazil, China, India, the UK and the EU, the project aims to contribute to the economic development of emerging nations and support sustainable development globally.

The consortium

Led by the University of Exeter, EEIST brings together an international team of world-leading research institutions across Brazil, China, India, the UK and the EU.

The consortium of institutions are UK: University of Exeter, University of Oxford, University of Cambridge, University College London, Anglia Ruskin University, Cambridge Econometrics, Climate Strategies, India: The Energy and Resources Institute, World Resources Institute, China: Tsinghua University, Energy Research Institute, Beijing Normal University; Brazil: Federal University of Rio de Janeiro, University of Brasilia, Universidade Estadual de Campinas (UNICAMP) EU: Scuola Superiore di Studi Universitari e di Perfezionamento Sant'Anna.

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