1.5°C Research Submission to the Talanoa Dialogue

Based on three Insight Briefs:

1) Implications of the IPCC Special Report on 1.5 degrees for scaling up Nationally Determined Contributions (NDCs) under the Paris Agreement[1]

2) Policy dialogues in integrated assessment modelling (IAM) to strengthen climate change mitigation and adaptation[2]

3) Achieving 1.5 degrees in the real world: Opportunities, barriers and trade-offs[3]

In October 2018, the IPCC Special Report on Global Warming of 1.5°C (SR15) was published. It stresses that both international and national climate policy efforts need to intensify to limit global warming to 1.5°C above pre-industrial levels. These efforts will require the scaling up of ambition within and beyond current Nationally Determined Contributions (NDCs) under the Paris Agreement, including transformative systematic change in policy, technology and behaviour across all regions and sectors.

Climate Strategies has prepared three *Insight Briefs* that cover key topics regarding SR15: (i) Implications of the report's findings for strengthening NDCs to meet the Paris Agreement goals; (ii) How the process of Integrated Assessment Modelling (IAM) could be improved to better inform climate policy; and (iii) Opportunities, barriers and trade-offs that must be faced in order to achieve a 1.5°C world.

In order to begin the process of strengthening their NDCs in line with 1.5°C pathways, governments need to conduct a gap analysis at the national level, using the global baseline of SR15. Based on this, they will need to identify key priority actions, both for themselves and those that will be undertaken by non-state actors such as cities and businesses. This requires a framework for comparing the costs and benefits of different types of options, including both mitigation and adaptation in the short and long term.

Integrated Assessment Models (IAMs) can help inform these analyses; however, current IAMs are limited in both their scope and approach, and do not reflect real-world policy-making. IAMs should take a more facilitative, bottom-up approach, using indicators that are tailored and applicable to the relevant audience and context. Bilateral feedback loops should be created between researchers and policymakers to establish a continuous policy dialogue regarding the policies and measures that will be useful to, and implementable by, stakeholders.

A mixture of policies is needed to drive disruptive low carbon innovation, along with strengthened governance at all levels, from the global to the local. Many implementation activities are likely to be undertaken at the sectoral and subnational level, and many actions that can help to significantly scale-up ambition will need to be delivered by non-state actors.

Of particular urgency is the need for governments and funders (including multilateral funding agencies) to withdraw financial and fiscal support from fossil fuels, and instead direct this capital toward low and zero-carbon energy development, production and consumption.

Efforts to strengthen climate policy in line with 1.5°C pathways will also require increasing the capacities of relevant institutions, and mobilising additional financial flows, at an unprecedented speed and scale. For strong 'coalitions of the willing' to form, those who are willing also have to be enabled. Care must be taken to address each specific barrier to action that a country and region faces in order to avoid social and economic trade-offs that could perpetuate inequalities and ultimately undermine the transition.

These three insight briefs are submitted to the Talanoa Dialogue to help policymakers and other relevant stakeholders better understand the implications of SR15 for NDCs and global climate policy.

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[1] Peter Newell and Dian Phylipsen (2018).
[2] Oscar van Vliet and Takeshi Takama (2018).
[3] Michael Mehling and Ambuj D. Sagar (2018).

Implications of the IPCC Special Report on 1.5 degrees for scaling up Nationally Determined Contributions (NDCs) under the Paris Agreement

Authors: Peter Newell[1] and Dian Phylipsen[2]

KEY MESSAGES

- SR15 makes clear the need to intensify and scale up efforts within and beyond Nationally Determined Contributions (NDCs). Limiting warming to 1.5°C requires transformative systemic change, involving the upscaling and acceleration of far-reaching climate mitigation across all regions and sectors.
- Accelerated and stronger short-term action, and enhanced longer-term ambition going beyond the current round of NDCs, is needed for 1.5°C-consistent pathways.
- Governments need to conduct a gap analysis at the national level to assess how to strengthen their NDCs in line with 1.5°C pathways, identifying key priority actions for themselves and those that will be undertaken by non-state actors such as cities and businesses.
- A mixture of policies is needed to drive disruptive low carbon innovation, change behaviour and finance rapid transitions compatible with a 1.5°C pathway, as well as to strengthen governance at all levels.
- Governments, as well as national and international funders, as a matter of urgency, need to plan for the accelerated withdrawal of support to fossil fuels.

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Climate Strategies

About Climate Strategies

Climate Strategies is an independent, not-for-profit organisation that aims to improve policy in the fields of climate change, energy and sustainable development by bridging the gap between decision-makers and researchers across Europe and internationally. It has three roles:

1. **Inspirer**: To identify and test with stakeholders, funders and researchers new research topics, preferably multi-disciplinary and always with potential policy leverage
2. **Convener**: To find suitable and fundable topics for projects, conferences and other events where researchers and policy-makers can come together
3. **Translator**: To interpret and publicly communicate research outputs so that they can be used by policy makers, business stakeholders and civil society

"Limiting warming to 1.5°C requires transformative systemic change."

1. Introduction

Realising the ambition of the 2015 Paris Agreement to keep global warming below 1.5°C requires a dramatic re-wiring of the global economy and wider changes in society to ensure deep decarbonisation and enhanced resilience to the effects of climate change. This briefing note summarises key findings of the Intergovernmental Panel on Climate Change (IPCC) Special Report on Global Warming of 1.5°C (SR15)[3] and spells out what they mean for scaling up the ambition of countries' Nationally Determined Contributions (NDCs) under the Paris Agreement.

Emission pathways leading to a maximum warming of 1.5°C all require reaching carbon neutrality by mid-century. This means that the NDCs alone are not sufficient to achieve this goal since they are not yet ambitious enough, often only have a time horizon until 2030, are not legally binding internationally, and are often weak on the implementation detail. Accelerated and stronger short-term action and enhanced longer-term ambition going beyond the current round of NDCs is needed for 1.5°C-consistent pathways. For this reason, some of the recommendations in this briefing go beyond NDCs. But NDCs do represent one key near-term means of getting countries onto 1.5°C-compatible pathways. The main objective of this briefing note, therefore, is to indicate what can be done to align NDCs with such pathways.

We identify the main messages from SR15 in Section 2, including the relative contributions and required rates of change for different sectors and measures. In Section 3, we describe how this information can be used by governments to compare their national context and shorter-term plans, including their NDCs, against long-term, global requirements. The section outlines steps that governments need to take to ensure that the next round of NDCs – to be adopted in 2020 – are in line with 1.5°C-compatible pathways.

2. Where are we now? Main messages from SR15

SR15 makes very clear that staying below a 1.5˚C warming limit cannot be achieved through business-as-usual economics, politics and behaviour. It shows that:

- **The 1.5°C goal is still feasible, though hugely challenging.** Limiting warming to 1.5°C requires transformative systemic change, involving the upscaling and acceleration of far-reaching climate mitigation across regions and sectors.
- **Substantial additional effort is required to bring NDCs in line with the 1.5°C goal.** Assuming full implementation of unconditional NDCs[4], and a continuation of climate action similar to that of the existing NDCs, global average temperature will increase 2.9–3.4°C above preindustrial levels. While transitions are underway in various countries, limiting warming to 1.5°C will require a greater scale and pace of change to transform energy, land, urban and industrial systems globally.
- **Progress is being made, but not fast enough.** There is an urgent need for more rapid and deeper transitions to limit warming to 1.5°C. Such transitions have been observed in the past within specific sectors and technologies. But the

[3] *Global Warming of 1.5°C, an IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.*

[4] Unconditional targets are considered implementable without outside support. More ambitious conditional targets are assumed to be dependent on either financial support, or supportive climate-related policies pursued by other countries.

geographical and economic scales at which the required rates of change in energy, land, urban, infrastructure and industrial systems would now need to take place, are larger and have no documented historic precedent.

Table 1 summarises SR15's main conclusions regarding the potential contribution of different sectors and mitigation measures, their challenges and potential co-benefits, including adaptation, and the required rates of change. This can form a basis for national discussions on prioritisation and sequencing of actions, as discussed in the next section. In line with the lessons learned by the IPCC over the years regarding how to deal with uncertainty in the outcome of different impact assessments, SR15 presents a range of outcomes from various models, scenarios and sector studies, reflecting different approaches and assumptions. As a result, interpreting the results can be complicated for policy makers. It does, however, avoid the false perception of certainty that a single outcome, or an average estimate, might project (see also discussion in Box 1).

Table 1: Overview of potential contribution of different sectors and mitigation measures, their challenges and potential co-benefits and the required rates of change

System, measure, technology[5]	Status/potential	Barrier/drawback	Sustainable development/ co-benefits/synergies	Rate of change[6]
Energy systems				**Final energy demand: +39 to -15% by 2030 relative to 2010, +44 to -32% by 2050***
Renewable energy	For solar, wind & electricity storage technologies, feasibility has strongly improved	Depends on geography, public acceptance. For biomass, potential negative impacts on land use, water, food production, biodiversity, air quality	Reduction of other air pollutants, health benefits, reduced import dependency on fossil fuels	Share in primary energy: 20–50% by 2030; 29–100% by 2050. Share biomass: +36 to -11% by 2030 relative to 2010, +418 to -16% by 2050*
Renewable electricity	Depends on storage capacity		Contributes to energy access	Share in electricity: 25–78% by 2030; 63–100% by 2050
Nuclear and Carbon capture and storage (CCS)	No significant improvement in feasibility. CCS could contribute to cost-effective achievement of 1.5°C, but limited demonstration to date	Public acceptability, financing constraints. CCS depends on availability of storage sites. Cost effectiveness depends on financial incentives	CCS can extend plant lifetime, reducing stranded assets and job losses	

[5] SR15 only discusses progress compared to the IPCC's Fifth Assessment Report (AR5) (2014), so not all technologies are shown here.

[6] The range shown reflects different scenarios from integrated assessment models as well as sectoral studies from SR15, mainly Table 4.1 (using median value for the category of 'OS' (overshoot) scenarios shown there). Entries marked with * are based on Figure SPM3b of the SR15 Summary for Policy Makers. The lowest end of the range – lowest decrease or highest increase – mostly represents the 'high overshoot' (P4) scenario, that is, temperatures would temporarily rise above 1.5°C, before falling back down. See the discussion above, and in Box 1, for a discussion on how to deal with the range in potential outcomes.

System, measure, technology	Status/potential	Barrier/drawback	Sustainable development/ co-benefits/synergies	Rate of change
Reduction of primary energy from fossil fuels	Very large, technical and economic potential (and costs of replacement) depending on sector/ application	Stranded assets, job losses in specific regions, leading to resistance	Reduction of other air pollutants, health benefits, reduced import dependency on fossil fuels	From coal: -59 to -78% by 2030 relative to 2010, -73 to -97% by 2050* From oil: +86 to -37% by 2030, -32 to -87% by 2050* From gas: +37 to -25% by 2030, +21 to -74% by 2050*
Reduction of fossil fuel investments		Stranded assets, job losses in specific regions, leading to resistance	Reducing costs of fossil fuel subsidies	Down by US$0.3–0.85 trillion for fossil fuel extraction and unabated power generation over 2016–50, unabated (without CCS) coal to zero by 2030
Energy storage	Strong growth, mainly in battery storage due to cost reduction. More work needed on hydro-, gas-based storage and thermal/ chemical systems	Potential limitations on availability and environmental impacts of required resources (metals). Alternatives still expensive	Positive impact on energy security, access. For hydro-based storage, potential co-benefit of water management. Synergy with development of electric vehicles	
Land & ecosystems				**Agriculture: Conversion of 0.5–12 million km² land for food/feed crops into 1–7 million km² for energy crops by 2050 relative to 2010. Forestry: -1 million km² to +10 million km² increase in forest cover by 2050 relative to 2010**
Low-carbon agriculture, forestry practices	Depends on region, geography. Long-term studies suggest limited availability	Risks for current ecosystem services, food, water, livelihoods. Limited social acceptability	Benefits for local community, sustainable landscapes, biodiversity	Agricultural methane (CH_4) emissions: +14 to -48% by 2030 relative to 2010, +2 to -69% by 2050* Agricultural nitrous oxide (N_2O) emissions: +15 to -26% by 2030 relative to 2010, +39 to -26% by 2050*

System, measure, technology	Status/potential	Barrier/drawback	Sustainable development/ co-benefits/synergies	Rate of change
Improved food production[7]	Options to reduce absolute emissions are limited unless paired with demand-side measures	Requires technological innovation including biotechnology (with safeguards) to increase potential	Increased food security, poverty reduction, reduced pressure on land use	
Dietary choices, food waste reduction	Evidence of successful policies is limited	Requires substantial behavioural changes with limited public acceptability	Increased food security, poverty reduction, health benefits, reduced pressure on land use	
Urban & infrastructure systems				
Buildings	Electrification, renewables, end-user efficiency are reducing emissions. Rapid change is needed in de-motorisation and decarbonization in transport and high-efficiency appliances	Requires enforcement. May not reach informal urban settlements	Access to clean energy, indoor air quality, adaptation synergies	+40 to -17% change in energy demand relative to 2010 by 2030; +45 to -37% by 2050; -80 to -90% in emissions by 2050, new construction to be zero fossil energy by 2020, refurbishment rate +5%/yr in OECD
Transport		Requires strong governance to overcome financial, behavioural, institutional, legal barriers	Less congestion, local air pollution, road fatalities, health benefits	Share low-carbon fuels[8] 3–16% by 2030; 26–98% by 2050, -40% in energy use by 2050. Phase-out fossil fuel vehicle sales by 2035–2050
Industrial systems				
Electrification, hydrogen, bio substitution	Potential for large emission reductions, further technological development needed	Institutional, economic, technical barriers, potentially leading to financial risks and resistance	If renewables based, see under 'Energy systems'. Reduction in other air pollutants	Emissions –14 to -49% below current levels[9] by 2030; -70 to 80% by 2050
Energy efficiency	Economically feasible. Insufficient without decarbonization or carbon dioxide removal (CDR)	See under 'Energy systems'	See under 'Energy systems'	

7 Increased efficiency, closing yield gaps.
8 Including electricity, hydrogen, biofuels.
9 No year specified in SR15.

System, measure, technology	Status/potential	Barrier/drawback	Sustainable development/ co-benefits/synergies	Rate of change
Specific technologies & practices				
Short-Lived Climate Forcers (SLCF)[10]	**Significant potential in short term**	**Economic, social feasibility as SLCF mitigation in itself does not reduce global warming, only delays it, which may lead to trade-offs between short-term SLCF benefits and lock in of long-term warming**	**Reduced air pollution, improved health. Often co-emitted with greenhouse gases (GHGs)**	
Solar Radiation Modification (SRM)	**Too early to evaluate**	**Only supported for gaps in deep mitigation scenarios**		
Carbon dioxide removal (CDR)	**Varying feasibility across options**			
Afforestation, Reforestation	Technically, geophysically feasible. Depends on region	Lack of public acceptance, economic incentives, competition for land. Potential reduces over time, risks of non-permanency of storage	Benefits for biodiversity, soil quality. See also under 'Land & Ecosystems', agricultural & forestry practices	
Bioenergy with CCS (BECCS)	Potentially large contribution, technically, geophysically feasible	Potential supply of sustainable bio-energy constraints, public acceptance, costs	See under 'Energy systems'	
Direct Air Carbon Capture and Storage (DACCS), weathering	Early stage, large differences in estimated potential. No demonstration yet with storage	High energy requirements, costs. Depends on availability of storage sites	No competition for land	
Soil carbon sequestration	Limited global feasibility and cost-effectiveness	Soil sinks saturate over time	Co-benefits with agriculture, locally cost-effective as stand-alone policy	No figures for CDR potential or change rates in SR15[11]

[10] Short-lived climate forcers (also, short-lived climate pollutants (SLCP) or near-term climate forcers (NTCF) in the AR5) are a set of compounds whose impact on climate occurs primarily within the first decade after their emission. This set of compounds includes methane, ozone and aerosols, or their precursors, and some halogenated species (Annex 3 Glossary, Working Group I contribution to AR5).

[11] SR15 states explicitly that mitigation options for AFOLU (Agriculture, Forestry and Land Use) have 'so far not been extensively integrated in the mitigation pathway literature' (chapter 2).

3. How do we get there? Relevance of SR15 for NDC strengthening

3.1 SR15 as the start of a national process

The Paris Agreement calls for the preparation and communication of successive NDCs every five years from 2020, with each representing a progression from the one before, and reflecting the country's 'highest possible ambition'. The findings of SR15 underscore the need for countries to aim for higher ambition now, and in their revised NDCs.

Strengthening NDCs in line with SR15 could involve the following:[12]

- **Performing a gap analysis:** The global picture from SR15 (see Table 1) could be used as a baseline to conduct a gap analysis at the national level. Translating from the generic baseline to the national context, as well as back-casting from long-term requirements to the current NDC time horizon, would help to identify policy gaps and the steps needed to bridge them in the short and long-term. This would include identifying capacity gaps and legal changes that may be required to raise ambition. Box 1 below explains further how this could be done.
- **Prioritising actions:** To fill the identified gaps, each ministry will need to consult internally and with relevant stakeholders within and beyond government to produce a revised list of actions and contributions around accelerated and deeper sectoral and economy-wide interventions. Priorities should include systemic actions that support transitions spanning mitigation and adaptation, and attainment of the UN Sustainable Development Goals (SDGs). This may require comparing very different options, including policies across several sectors with varying costs and benefits for diverse stakeholders along distinct timelines. A common base for such a comparison will be needed to assess the (net) costs and benefits of the different options and the associated resource needs, as well as to effectively communicate with stakeholders and decide on the prioritisation and sequencing of actions given resource constraints.
- **Addressing the social dimensions of accelerated action**: Building ownership, inclusion and civic participation is vital to make sure that promising new pathways in line with SR15 are not subsequently abandoned or subject to rollback. Targeted 'big win' interventions that generate a series of co-benefits are useful in this regard. For example, improving air quality brings health and local environmental benefits, as well as reductions in GHGs, helping to address a number of SDGs.
- **Assessing resource needs**: It is important to clearly identify the level and type of financing (public and private) that will be required to enable enhanced ambition, as well as short-term strategies for securing those funds. This might include revisions to climate investment plans which outline budgetary support to climate initiatives across government. Given the need for enhanced levels of private finance, dialogue with private actors will be critical, and additional requests for multilateral funding from the Green Climate Fund (GCF), the Adaptation Fund (AF) or the Global Environment Facility (GEF), for example, may be required.
- **Improving governance frameworks:** There is a clear need for greater policy integration and alignment with climate change policy objectives. Such mainstreaming involves the integration of climate change considerations in

"Building ownership, inclusion and civic participation is vital to make sure that promising new pathways in line with SR15 are not subsequently abandoned."

[12] For examples of how countries have sought to tackle some of these issues to date in the development and implementation of their NDCs, see *CDKN Planning for NDC Implementation*, https://www.cdkn.org/ndc-guide/

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"Current status, implementation potentials, challenges and co-benefits will strongly depend on national and local circumstances."

planning, budgeting, implementation and monitoring processes for all sectors of the economy. The majority of implementation activities are also likely to be undertaken at the sectoral and subnational level, and many actions that can help to significantly scale-up ambition will need to be delivered by non-state actors.

BOX 1: RELEVANCE OF SR15 FOR INDIVIDUAL COUNTRIES: TRANSLATING THE LONG-TERM GENERIC BASELINE TO THE NDC CONTEXT

The picture presented in SR15 (and summarized in Table 1) is a generic one, which will be different in many respects to that in a given country. Current status, implementation potentials, challenges and co-benefits will strongly depend on national and local circumstances. Therefore, the long-term contributions of the various actions, and the rates of change required to achieve such contributions, are context-specific. Nevertheless, this generic picture can be used as a starting point in the process of NDC strengthening, that is, as a baseline against which to contrast the national situation and back-cast long-term ambitions to short-term actions.

This national process of baseline comparison and back-casting would aim to address the question of how a country's national circumstances differ from the generic baseline and how this would impact upon the costs and benefits of actions, and their prioritisation and sequencing, in strengthened NDCs. It would address questions such as:

- How does the national economic structure deviate from the generic baseline, that is, are sectors and activities with large potentials similarly important, or are some options not applicable nationally?
- Is geography and/or the availability of natural resources substantially different from the generic baseline? E.g. some countries will have fewer domestic renewable energy resources than others, and some may be more vulnerable to certain climate impacts.
- How are potential barriers to certain options different from the generic baseline? E.g. there may be more competition for water and land in some countries, or a larger part of the workforce may be negatively impacted by the main mitigation options.
- Are potential co-benefits substantially different from the generic baseline? E.g. some countries may be more dependent on fossil fuel imports, or local air pollution may be a worse health threat.
- How are cultural values different from the generic baseline? Are certain options more or less socially acceptable than in other countries? E.g. different cultural or religious values may be placed on certain activities, locations or species, or public perceptions of (in)action and responsibilities may vary.
- Are the indicated rates of change realistic or are there reasons why they would be more challenging nationally than for other countries? E.g. due to specific population or urbanization trends or stronger prevalence of specific barriers.

BOX 1: CONTINUED...

While answering the above questions will not provide quantitative estimates of the impacts of potential actions, or determine exactly which of the options would need to be implemented by when, it would help in positioning options in relative terms, to feed into the national prioritisation process. It would also help to understand the extent to which rates of change likely need to increase compared to the NDC.

The national process should also take into account the range of outcomes and rates of changes included in the baseline. Ideally, countries also have their own scenarios and impact assessments, allowing them to select a similar approach from among the baseline range. If not, countries could select one that best matches their national context or preferences, use an average of the range, or use the range as a whole to account for uncertainties. In many cases, the whole range will represent a considerable acceleration over the rates of change underlying the NDC targets. The main aim is to obtain a big picture comparison, stimulating countries to place their planned actions into the wider context of global and long-term requirements.

"Getting anywhere near to a 1.5°C-compatible pathway will require significant efforts to strengthen governance and institutional capacity at all levels."

3.2 Acting on priority areas

SR15 highlights several priority areas where accelerated and deeper action towards a 1.5˚C-consistent pathway is required. Below, we describe a number of concrete actions in these priority areas that could be included in strengthened NDCs, as well as developed through other climate policy interventions covering both mitigation and adaptation.

Strengthening governance: Getting anywhere near to a 1.5°C-compatible pathway will require significant efforts to strengthen governance and institutional capacity at all levels. As part of the process of revising their NDCs, governments can identify gaps and weaknesses in governance at the various levels and develop measures to address these.

In terms of national governance, there is a key role for planning and regulation to facilitate and drive accelerated transitions. Examples might be building codes and fuel efficiency standards or strong policies to reduce deforestation. Cities are particularly exposed to the risks associated with climate impacts and play an important role in urban planning, influencing transport and adaptation options as well as enforcing legislation locally. Integrating climate change adaptation, mitigation and disaster risk management at the city-scale is key. Governments also need to engage with and scale up climate change initiatives under the Paris Agreement led by non-state actors such as cities, businesses and civil society, to ensure that NDCs add value to, and complement, them. For the NDC, this could mean mapping the different roles in the development, implementation and enforcement of mitigation and adaptation actions at the different governance levels. Subsequently, existing institutions and processes could be realigned accordingly, with national government taking overall responsibility for ensuring that climate objectives are adequately mainstreamed across all areas of governance and intervening where this is not the

"Shifting onto a pathway compatible with 1.5°C is impossible without also withdrawing financial and fiscal support for the fossil fuel economy."

case. SR15 highlights the need for clear and regular reporting on actions towards agreed scenarios that are compatible with a 1.5°C pathway at the national level, and enhanced accountability mechanisms so that responsible actors in both the public and private sector can be held to account for non-compliance.

BOX 2: WITHDRAWING SUPPORT FOR FOSSIL FUELS

SR15 makes very clear that shifting onto a pathway compatible with 1.5°C is impossible without also withdrawing financial and fiscal support for the fossil fuel economy. This requires governments to dramatically reduce subsidies for the production and consumption of fossil fuels and, except for some least developed countries, abandoning most plans to expand the extraction and processing of fossil fuels (on fossil fuel subsidies, see Figure 1). The long life-spans of new investments in industries and infrastructures mean that high carbon trajectories could be locked in for decades in a way that is incompatible with a 1.5°C scenario. Beyond NDCs, this will also require multilateral funding agencies, such as the World Bank, as well as private financial institutions, to move their investment portfolios away from fossil fuels and strengthen their approach to climate impact liabilities in their lending portfolios. Donor countries can reinforce this process by requiring that their contributions are earmarked only for low-carbon investments. Governments also need to consider multilateral channels to arrive at collective agreement on how to leave fossil fuels in the ground. In addition, there is a critical need to mainstream climate change much more systematically into the operations of other international economic institutions such as the World Trade Organisation (WTO), the International Monetary Fund (IMF) and regional economic organisations.

Building climate resilience: All policies and measures presented in NDCs will have to take into account their viability in a warming world and the growing need for transformational adaptation. This has implications for planning in relation to energy, transport, agriculture and forestry. Accelerated mitigation actions in line with SR15 will have impacts on adaptation efforts, and so scenarios will need to be revised regarding anticipated impacts and costs. Concretely, impact assessments that 'climate-proof' new policies, investments and proposals for infrastructure are needed to ensure both that they are compatible with the enhanced ambition of mitigation objectives and incorporate the costs of adapting to the effects of future climate change. Across-the-board requirements for such assessments as part of national and local decision-making processes could be adopted as part of the NDC.

Supporting behavioural change: Most 1.5°C-consistent pathways require substantial changes in individual behaviour, especially if increased reliance on Carbon Dioxide Removal (CDR) is to be limited or avoided. Therefore, NDCs need to include strategies to promote and enable behavioural change. Policies can enable and strengthen individual motivation to act on climate change via a suite of top-down or bottom-up approaches, including through informational campaigns, regulatory measures, financial (dis)incentives, infrastructural and technological changes, and legal requirements to stimulate production and consumption patterns that are low-carbon and climate resilient. Governments also need to pay much more attention to demand management and reducing consumption across a range of sectors from energy, industry and transport, to food and agriculture.

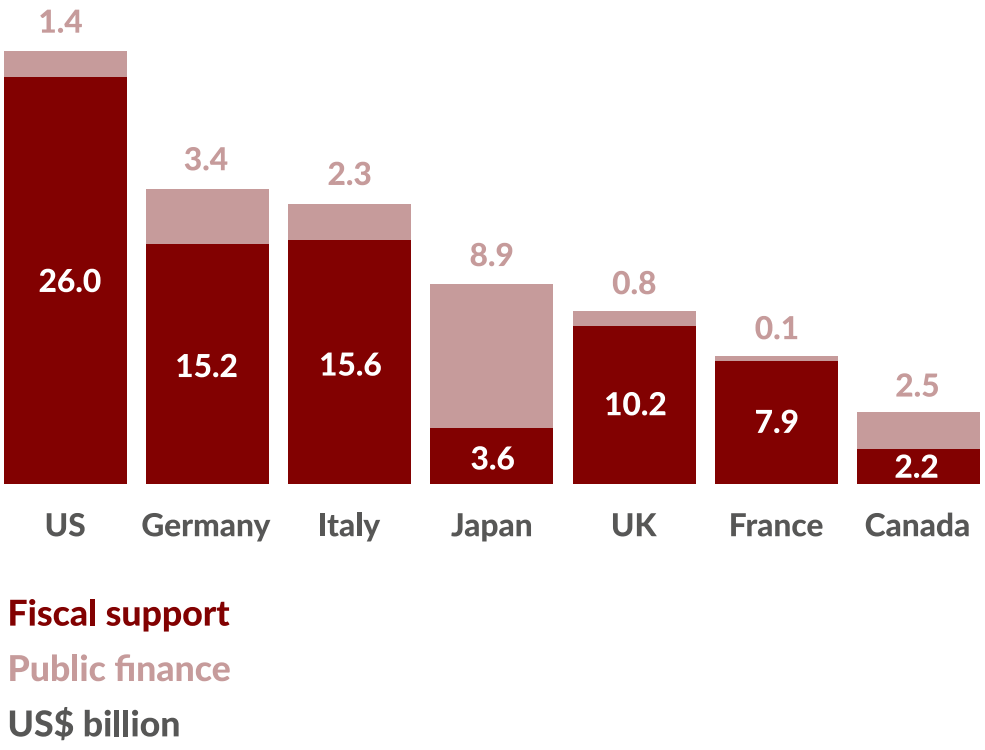

Figure 1: G7 countries continue to provide at least $100 billion a year supporting fossil fuels

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"Governments now need to align their financial support and R&D activities towards only those technologies and innovations that have a role to play in bringing down GHG emissions."

Disruptive innovation: A variety of technological developments will contribute to 1.5°C-consistent climate action. To strengthen their NDCs in line with 1.5°C pathways, governments now need to align their financial support and R&D (research and development) activities towards only those technologies and innovations that have a role to play in bringing down GHG emissions. This would also mean the adoption of more proactive state industrial and economic strategies to steer production onto a drastically lower carbon footing. Such strategies might include the removal of fossil fuel subsidies and support to infant low carbon industries. They could also include tax regimes that promote the development and deployment of low carbon technologies, including the removal of industry exemptions and switching the tax base from employment and income, to one more based on the consumption of energy, materials and services, and the production of waste and pollutants.

'Mission-driven'[13] innovation policies based on national priorities might play a role here to clarify the goals of innovation and discontinue support to technology and innovation incompatible with a 1.5°C pathway. Governments can play a role in advancing climate technology via both 'technology push' on the technology supply side (e.g. R&D subsidies), and 'demand pull' (e.g. energy efficiency regulation). The back-casting exercise discussed above could help to identify where and when unconventional options will be needed to fill the gap in key policy areas. This could, in turn, help shape technology and innovation policies, and anchor the longer-term policies in the shorter-term NDC process.

[13] For more on mission-oriented innovation policy, see https://marianamazzucato.com/projects/mission-oriented-innovation-policy/

Financing transitions: A 1.5°C-consistent pathway requires a transformation in the *volume* of climate investments and in the *direction* of finance towards a low-emission and climate-resilient economy[14]. In terms of volume, the total incremental investment for a 2°C-consistent pathway is estimated by SR15 at 2.5% of global gross fixed capital formation. In terms of direction, it is crucial to avoid further assets being 'stranded' as the ambition of climate policy is increased over time[15]. Governments, as part of their NDCs, will need to develop climate investment plans to assess resource needs to generate the volume of new funds needed to upscale ambition and to redirect existing funds away from fossil fuels and into lower carbon forms of energy. Governments will need to strengthen requirements on private financiers to decarbonise their portfolios by requiring them to assess and report to their shareholders and the public on the carbon and climate impact liabilities of their investments. Going forward, governments will also need to consider de-risking policy instruments to enable low-emission investment such as interest rate subsidies, tax breaks, concessional loans from development banks and public investment funds.

4. Conclusions

SR15 makes clearer than ever before the need to intensify and scale up efforts within and beyond NDCs to raise the ambition in our responses to climate change. It sets out many challenges, some of which are unprecedented. But it also shows that progress is being made across sectors and regions of the world by a growing array of actors. Learning from those experiences, and linking national strategies and NDCs to long-term 1.5˚C-consistent pathways, will help facilitate an understanding of gaps and the required efforts to strengthen NDCs. NDCs will only be successful if they integrate low-carbon, climate-resilient planning into each country's mainstream development plans and SDG strategies.

SR15, however, also shows that accelerated and deeper change is needed, beyond strengthened NDCs. Re-wiring the global economy and society around the dual needs for deep decarbonisation and enhanced resilience in line with the SDGs ultimately means re-writing the rules of the game at all governance levels around trade, investment, competition, taxation and regulation. Such transformational change is a prerequisite to ensuring that strong, consistent and lasting signals are sent out to governments, business and the public alike that climate incompatible development is a thing of the past.

[14] UNEP (2015) *The Financial System We Need: Aligning the Financial System with Sustainable Development*. Nairobi: UNEP.

[15] McGlade, C. and P. Ekins (2015) The geographical distribution of fossil fuels unused when limiting global warming to 2°C. *Nature*, 517(7533), 187–190.

Climate Strategies ClimateWorks FOUNDATION

Reviewer: Heleen de Coninck
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Policy dialogues in integrated assessment modelling (IAM) to strengthen climate change mitigation and adaptation

Authors: Oscar van Vliet[1] and Takeshi Takama[2]

KEY MESSAGES

- Current integrated assessment modelling (IAM) results are biased towards mitigation in emerging and developing economies, and towards market-based policies like carbon taxes.
- Pathways in SR15 are not explicitly based on preferred policies of national governments, industry groups, or NGOs.
- Low-carbon transition policies are more likely to be made for reasons tangentially related to climate change, including job creation and public health.
- IAM needs to take a more facilitative and bottom-up approach to modelling, with indicators that speak to the intended audience.
- Researchers need to approach policy assessment using IAM as a continuous policy dialogue that begins by discussing the policies and measures that stakeholders are willing, and able, to implement.
- The 'fit-for-purpose' IAM approach outlined in this brief will be especially needed in coastal areas and cities, where many human and natural systems compete.

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Climate Strategies

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Image: su-re.co

"The scenarios in SR15 do not represent how decisions on climate change policy are actually arrived at."

1. Introduction

Integrated Assessment Models (IAMs) are an integral part of the Intergovernmental Panel on Climate Change (IPCC) Special Report on Global Warming of 1.5°C (SR15)[3] and the IPCC Assessment Reports before it, providing a framework to compare different possible measures to limit the level of global warming that is currently anticipated. In this briefing note, we describe how IAMs could be more effectively applied to support the design and assessment of low-carbon emission strategies, using a transdisciplinary approach that starts from the policies and measures that stakeholders are willing, and able, to implement.

In section 2, we discuss the IAM used in SR15. In section 3, we propose a new 'fit-for-purpose' modelling approach. In section 4, we highlight areas and themes that could benefit from our new approach, and in the final section 5, we summarise and present final conclusions.

2. Integrated assessment models in SR15

SR15 suggests that global warming can still be kept below 1.5°C, and that this would make the UN Sustainable Development Goals (SDGs) much more achievable.

However, this is an unprecedented task and will require an intense effort of rapid decarbonisation across many sectors. Various pathways are possible for achieving this, but the overall message to all stakeholders is that global greenhouse gas (GHG) emissions must be cut by half before 2030 compared to 2010, with the long term aim of net zero carbon dioxide (CO_2) emissions by 2050. SR15 also states that Carbon Dioxide Removal (CDR) technologies that lead to 'negative' emissions will need to be deployed in the second half of the century, especially if global temperatures temporarily overshoot the 1.5°C limit. However, the report does not describe a business model through which these 'negative' emissions might be funded.

The various pathways in SR15 are variants of model scenarios, with coherent 'assumptions regarding future trends in population, consumption of goods and services (including food), economic growth, behaviour, technology, policies and institutions' (chapter 2, section 2.1.1). They are used in SR15 to explore many different technological and behavioural changes needed to limit climate change, often at an *aggregated* scale, and reflect on the economic and environmental impacts of those changes[4]. These changes include electrification of transport and heating, efficiency increases in industrial process and appliances, reduced food loss and waste, and promotion of sustainable behaviours and lifestyles (e.g. increased use of non-motorised and public transport).

However, the scenarios in SR15 do not represent how decisions on climate change policy are actually arrived at. In reality, low-carbon transition policies are more likely to be made for reasons tangentially related to climate change, such as job creation or improving public health. They are also highly dependent on the local context. There can be no single global blueprint, and every community – with its own local priorities and considerations – will require a tailored policy portfolio.

[3] *Global Warming of 1.5°C, an IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.*

[4] Huppmann, D. et al. (2018) IAMC 1.5°C Scenario Explorer and Data. https://data.ene.iiasa.ac.at/iamc-1.5c-explorer.

The root cause of this mismatch between the scenarios in SR15 and realities on-the-ground is the modelling work that underpins the basis of the report (and, more generally, the research within the IPCC's Assessment Reports). The modelling approach taken is often from a global perspective, and conceptualisation of scenarios is undertaken by a small community of IAM experts.

In general, the IAM community has proposed 'optimal' low-carbon scenarios since before the IPCC's First Assessment Report of 1990. Specifically, the pathways are designed around aspects for which IAMs provide relevant information. As 'optimal' is usually implemented as global least-cost or maximum utility within a specific emissions budget, current IAM results are biased towards mitigation in emerging and developing economies, and market-based policies like carbon taxes. While these model scenarios provide useful background information and 'what-if' explorations, the results are rarely reproduced in real-world policymaking. This is especially true for modelling on energy and general economic developments.

IAMs, by necessity and by design, do not seem to reflect diverse, context-specific priorities, even at the national level, or the social and institutional barriers blocking transitions to low carbon societies. This is reflected in figures 1 and 3 in the Summary for Policy Makers (SPM) of SR15, which show many pathways to limiting global warming to approximately 1.5°C. However, none of these pathways are explicitly based on the preferred policies of national governments, industry groups, NGOs and others. Many of those policies would lead to global warming (far) above 1.5°C, but the current modelling paradigm obscures this fact.

We assert that the real-world applicability of IAM could be enhanced by improving the process by which it is carried out (as opposed to improving the models themselves). This would make IAMs more fit for their professed purpose: to assess and help design policy strategies that address climate change and other global problems.

"The real-world applicability of IAM could be enhanced by improving the process by which it is carried out."

3. Improving the national and international policy relevance of IAMs

The first requirement for improving the national and international policy relevance of IAMs would be to use the most appropriate model for the relevant question. That is, the model(s) should be selected based on the questions that need to be answered, rather than fitting the question to the model(s), as is common practice today. Models are inherently a simplification of reality, and no model fits every topic and context. However, the scope and detail of IAMs and their simulations vary greatly. Those that best cover the themes and context of a specific policy strategy can be extremely useful for exploring specific questions and options relating to low carbon transitions. Choosing the most suitable IAM(s) is a first step for modellers to present convincing, consistent and coherent illustrations of possible future developments.

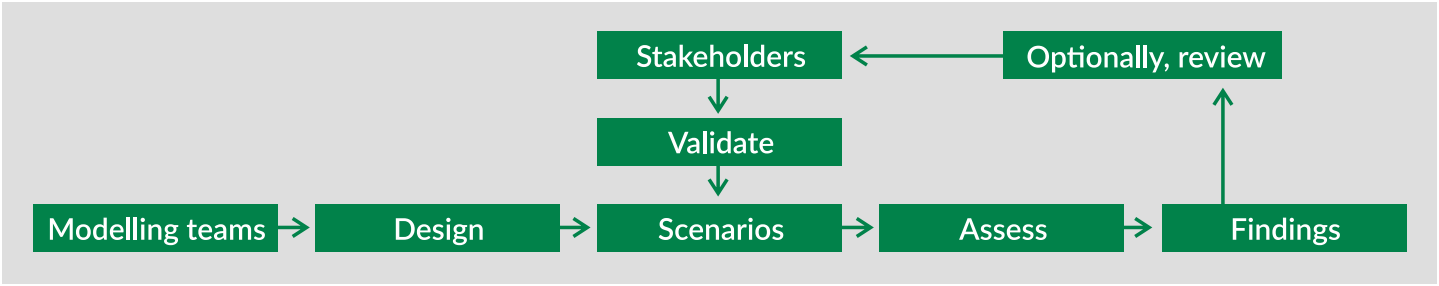
Using specific models to answer context-specific questions about proposed policies requires that stakeholders explicitly ask those questions[5]. Answering stakeholders' questions about policies also requires suitable indicators that speak to the intended audience. For example, local stakeholders in an industrial town will

[5] Prell, C. et al. (2007) If you have a hammer everything looks like a nail: traditional versus participatory model building. *Interdisciplinary Science Reviews*, 32(3), 263–82. https://doi.org/10.1179/030801807X211720

have limited interest in national GDP projections, but will be more concerned about projections of jobs created and lost in specific industries (see Box 1 below on Biogas in Indonesia). Incorporating the issues raised by stakeholders into policy assessment has been found to widen the range of negative outcomes and barriers to policy implementation that can be taken into account by some 75%[6]; if we only rely on experts, these issues would be left unaddressed.

Working with stakeholders would also allow modellers to validate both the inputs and outputs of their models before the results are used for policymaking. As modelling is a specialist craft, this requires organised and repeated interaction to build both the personal rapport and the professional understanding needed for modellers and stakeholders to ask each other the right questions. The entire process is summarised in Figure 1 below. The end results will not only be assessments that are fit for their stated purpose, but also a deeper understanding for the researchers and stakeholders of the trade-offs in policymaking. Furthermore, any questions on policies and measures that cannot be answered with models should still be included in the assessment by other means, using known qualitative methods that complement the modelling.

Traditional modelling from global context:



'Fit-for-purpose' modelling in context:

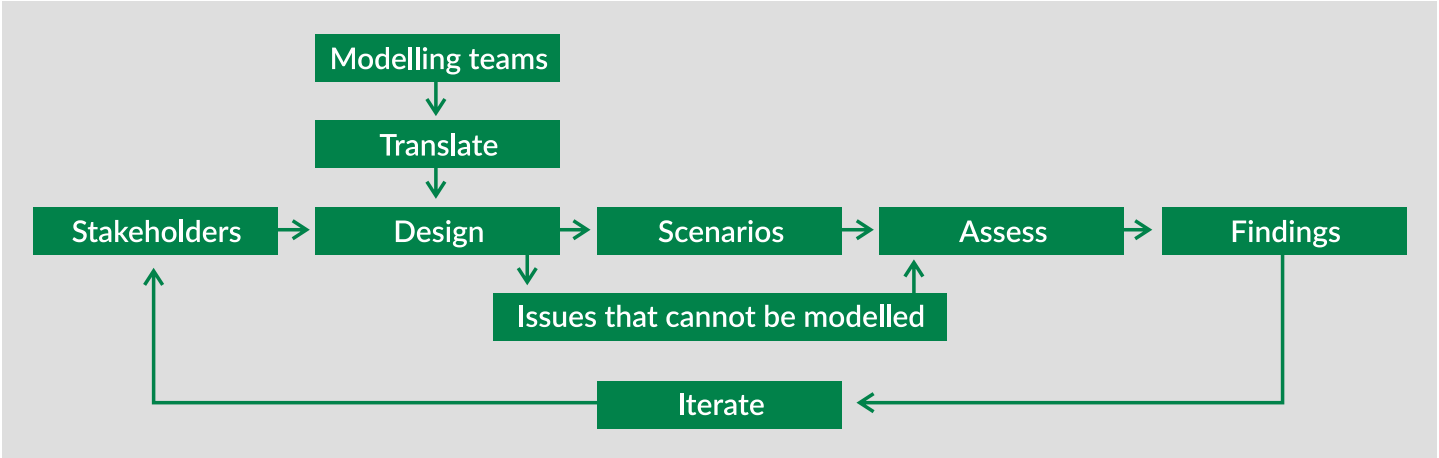


Figure 1: Traditional compared with 'fit-for-purpose' integrated assessment modelling

[6] van Vliet, O.P.R., et al. (in review) The importance of stakeholders in scoping risk assessments – lessons from low-carbon transitions. *Environmental Innovation and Societal Transitions*.

If low-carbon transitions are to be voluntary and inclusive of the interests and viewpoints of a diverse range of stakeholders, as SR15 suggests they must be, then modelling should follow suit. The days when modelling could only focus on drawing up optimal pathways, working backwards from one single goal to the present day, have passed. Instead, a truly transdisciplinary approach is needed, integrated with a continuous policy dialogue that begins with discussing the policies and measures that stakeholders are willing and capable of implementing. Such a modelling effort needs to be grounded in the here-and-now, and provide modellers and stakeholders with an opportunity to grow new solutions that stretch and expand their ambitions to limit climate change and achieve other SDGs. This transdisciplinary approach matches the ambitions set for international policy, just as the Paris Agreement promotes constructive cooperation and synergies.

"The need for stakeholder-driven, 'fit-for-purpose' IAMs is particularly apparent in coastal areas and cities."

BOX 1: 'FIT-FOR-PURPOSE' MODELLING: BIOGAS IN INDONESIA

Several research groups are supporting biogas development and deployment scenarios in Indonesia. There are multiple co-benefits associated with biogas, in addition to cutting back on the use of fossil fuels (e.g. coal being replaced by biogas electrification plants, and liquified petroleum gas (LPG) being replaced by household biogas digesters). Expanded use of biogas will also reduce: i) government subsidies to support fossil fuels; ii) the amount of organic waste produced; iii) ineffective sanitation in urban areas; iv) effort spent on firewood collection by women and children; and v) indoor house pollution (which globally kills more people than malaria and HIV together). The latter benefits are tightly connected to the SDGs, both of Indonesia and developing countries more widely.

IAMs can be used to accurately explain and understand these multiple benefits. In Indonesia, scenarios for biogas development were developed out of a policy dialogue with the Indonesian government and a range of local partners. IAMs were used to make the scenarios easier to understand, specifically the interconnected impacts from the different policies and measures that could be taken to support biogas development.

4. Potential areas of focus

The need for stakeholder-driven, 'fit-for-purpose' IAMs is particularly apparent in coastal areas and cities. In these regions, many human and natural systems collide and compete even more than anywhere else in our complex world. Coastal areas and cities have higher population densities than elsewhere, leading to more pressure on ecosystems and the services that they provide, while they are also most vulnerable to adverse effects of climate change, including floods and heat waves. Modelling approaches that can provide insight into the complex interconnections between measures and impacts in these areas will be invaluable to resolve the concurrent challenges they face, while minimising negative impacts on vulnerable people and the surrounding environment.

One example of how the assessment of climate change mitigation and adaptation policies could be made more applicable by including existing IAMs in a different

process, is to examine issues that the IPCC has so far not investigated in detail for political reasons. Some local stakeholders actively promote investigation of these issues, including:

- Inertia as a result of incumbent power (e.g. fossil fuel companies, dictatorships).
- Removing market-based economic structures that are counterproductive, e.g. poorly-designed carbon markets and investment subsidies for fossil fuel extraction (in addition to removing subsidies for carbon-intensive technologies and resources).
- Promoting human development beyond increasing GDP and consumption (e.g. increased emphasis on well-being, education, and employment).

Making these three issues explicit in policy assessments that use IAMs may open up new and constructive options to limit climate change and support the SDGs.

5. Conclusions

The new IAM paradigm we propose – 'fit-for-purpose' modelling – does not necessarily require the use of new models, but it does require a new, *more facilitative and bottom-up approach to modelling*. It needs to start from interactions with communities rather than impose targets that have not factored in local priorities. As different policies are connected, a holistic systems approach should be taken to design applicable strategies for deep mitigation and effective adaptation. This requires a process that involves a wider range of scientific disciplines and a wider range of stakeholders than is current practice in IAM.

Researchers should revise their modelling approaches to take on the improvements suggested in this brief, in general and specifically for the preparation process of the IPCC's Sixth Assessment Report (AR6)[7] and later iterations, and the Global Stocktake[8] under the Paris Agreement. The 'fit-for-purpose' modelling we propose is conceptually simple but will take a lot of practical work to implement. Doing so would require the institutions who provide resources for IAM projects (such as the European Commission) to acknowledge that a transdisciplinary IAM paradigm entails a different effort from previous projects, and to specifically incentivise and call for such a transdisciplinary approach.

Shifting to transdisciplinary, 'fit-for-purpose' modelling is hard work, but this is a small price to pay for climate policy assessments that make better real-world sense.

[7] Early drafting on the AR6 has already started, and the report is due for release in 2021. See https://wg1.ipcc.ch/AR6/AR6.html.

[8] Article 14 of the Paris Agreement requires its members to periodically take stock of the implementation of the Paris Agreement and to assess collective progress towards mitigation of and adaptation to climate change. This process is called the Global Stocktake. For more information, see https://unfccc.int/topics/science/workstreams/global-stocktake-referred-to-in-article-14-of-the-paris-agreement.

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Achieving 1.5 degrees in the real world: Opportunities, barriers and trade-offs

Authors: Michael Mehling[1] and Ambuj D. Sagar[2]

KEY MESSAGES

- Limiting global warming to 1.5°C will require mobilisation of financial flows at unprecedented speed and scale.
- While efforts (and longer-term ambitions) to reduce greenhouse gas emissions have greatly increased in recent years, these are far from sufficient to meet the 1.5°C target.
- Unfavourable political dynamics at the international and domestic level pose considerable challenges for greater climate ambition and effort.
- Insufficient institutional capacities to guide, manage, and support a transition to a low-carbon economy are a reality in many parts of the world.
- Focusing on rapid and deep decarbonisation without addressing these barriers risks problematic trade-offs with social and economic development objectives.
- Care has to be taken to ensure that rapid and deep decarbonisation does not perpetuate current inequities and undermine public acceptance.
- Not all countries will participate equally in decarbonisation efforts, highlighting the importance of multi-level governance that includes non-state actors.
- Financial and technical support, including from the philanthropic community, should focus on strengthening capacities in disadvantaged communities.

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"For strong 'coalitions of the willing' to form, those who are willing also have to be enabled."

1. Introduction

In its Special Report on Global Warming of 1.5°C (SR15)[3], the Intergovernmental Panel on Climate Change (IPCC) shows that avoiding global warming of 1.5°C above pre-industrial levels is both critical to averting major environmental and socioeconomic disruption, and achievable with existing technologies. Yet political and economic realities stand in the way of deploying these solutions at the necessary speed and scale. Barriers range from nationalist entrenchment in key countries to competitiveness concerns in the private sector and sheer administrative, technical and financial capacity constraints in many parts of the developing world.

If the 1.5°C goal is to be met, cooperation at the pace of the slowest actor is not an option. A pragmatic way forward has to leverage contributions of progressive actors across all sectors and levels of governance while tackling difficult questions of coordination, legitimacy and accountability. Even so, rapid decarbonisation faces tensions with the equitable social and economic development of less advanced economies and disadvantaged segments of society. Securing a just and inclusive transition is imperative, therefore, highlighting the critical role of technology transfer, financial assistance, and capacity building. For strong 'coalitions of the willing' to form, those who are willing also have to be enabled.

This briefing note reflects, in section 2, on the scale of the challenge to achieve the 1.5°C goal as described in SR15 and contrasts that with current political realities – including fault lines in international cooperation and concerns about the competitiveness of domestic constituencies – that stand in the way of mobilising resources at the required level. In section 3, it highlights some key issues relating to rapid, deep decarbonisation in developing countries such as human, institutional, knowledge, and financial capacity constraints and potential tensions with legitimate developmental interests, such as growing domestic industries and expanding energy access. To help overcome these challenges, section 4 charts a way forwards, proposing strategic collective action at all levels of governance, coupled with financial and technical support to build the necessary capacity for action in less-advantaged regions and communities.

2. Scale of the challenge

SR15 highlights the potentially catastrophic impacts of global warming of 1.5°C above pre-industrial levels, and also identifies technology and policy options to remain below that critical temperature threshold. Such options include energy demand reduction, greater penetration of low-emission and carbon-free technologies, electrification of transport and industry, and reduction of land-use change. As the report goes on to affirm, however, 'very few countries, regions, cities, communities or businesses' can currently claim to be implementing solutions that are 'consistent with 1.5°C pathways' (SR15, chapter 4, p. 4–5).

Achieving the required transformation is, in no small measure, a challenge of mobilising financial flows at unprecedented speed and scale. As SR15 estimates, an annual incremental investment of global Gross Fixed Capital Formation (GFCF) between 1% and 1.5% for the energy sector, and between 1.7% and 2.5% for other

[3] *Global Warming of 1.5°C, an IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.*

development infrastructure, will be needed to meet the 1.5°C objective. In terms of capital revenue, this involves a potential redirection of 5 to 10% of annual paid interests plus increases in asset value. For the energy sector alone, meeting the 1.5°C target will thus require an estimated additional $458 billion annually through to 2030[4].

While the benefits of such investment are expected to greatly outweigh the costs, SR15 finds that the economic scale of change across the energy, land, urban, infrastructure and industrial systems, taken together, have 'no documented historic precedent' (SR15, p.SPM–21). Climate finance flows continue to fall short of the required levels. In fact, recent data actually shows a drop in climate finance (see Figure 1), which, although partly due to falling technology costs, is also due to a weakening of incentives for clean investment in many regions.

Considerable efforts have therefore been made in recent years to identify policies that can catalyse investment in clean technology and infrastructure, track flows of public and private climate finance, and measure the remaining 'clean investment gap'. As a result, the existence of potential funding sources and availability of policy incentives has by now been amply documented[5].

What is still lacking, however, is the political will to advance enabling policy frameworks for a sustained transition away from carbon intensive to low carbon technologies and infrastructure, along with a commitment to provide adequate financial support and technology transfer for those countries and communities with limited economic and institutional capacity. Achieving the 1.5°C objective will not be as simple as scaling up investment to aggregate thresholds. Moreover, alternative investment choices will have varying distributional consequences, and in some cases, will be accompanied by difficult trade-offs. Such barriers to action and potential trade-offs are discussed in greater detail in the next section.

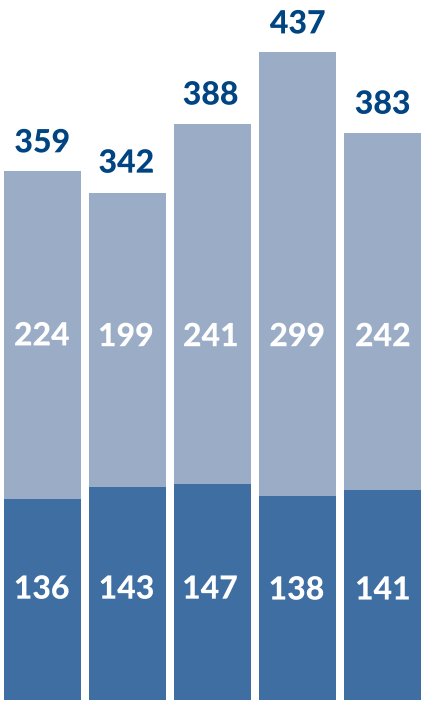

Figure 1: Recent trends in global climate finance (US$ billion)

Source: Climate Policy Initiative. *Global Landscape of Climate Finance 2017*. San Francisco.

3. Barriers and trade-offs

3.1 International and domestic 'realpolitik'

That climate change poses a particular challenge to cooperation between sovereign states – often expressed in terms of a free-rider or prisoner's dilemma – has been known in the literature from before the international climate regime took shape.[6] It required over two decades to agree on a negotiated framework for climate action that calls for specific contributions to climate change mitigation by all countries. Even so, the 2015 Paris Agreement has achieved breadth of participation only by weakening the strength and depth of its commitments. As evidenced by the announced defection of the United States, moreover, this flexibility has still proved unable to guarantee universal engagement.

4 McCollum, D.L., Zhou, W., Bertram, C., de Boer, H.-S., Bosetti, V., Busch, S., … Riahi, K. (2018) Energy Investment Needs for Fulfilling the Paris Agreement and Achieving the Sustainable Development Goals. *Nature Energy*, 3, 589–599.

5 For example, see High-level Advisory Group on Climate Change Financing (2010) *Report of the High-level Advisory Group on Climate Change Financing*. Bonn: UNFCCC; Ceres (2018) *In Sight of the Clean Trillion: Update on an Expanding Landscape of Investor Opportunities*. Boston, MA; and Global Commission on the Economy and Climate (2018) *Unlocking the Inclusive Growth Story of the 21st Century*. Washington, DC: World Resources Institute et al.

6 The failure of political decision makers to act on policy recommendations from epistemic communities is illustrated by the fact that William D. Nordhaus, recipient of the 2018 Nobel Memorial Prize in Economic Sciences, first identified all important mitigation options listed in SR15 – including a price on carbon emissions, carbon capture and sequestration technologies, fossil fuel phase-out mandates, and geoengineering – over four decades ago. See Nordhaus, W.D. (1975) *Can We Control Carbon Dioxide?* https://pure.iiasa.ac.at/id/eprint/365/1/WP-75-063.pdf.

"Many governments and other stakeholders may possess the political will for an ambitious climate response, but lack the technical, financial and institutional capacity to act thereon."

Negotiations on the Paris Agreement's implementation guidelines – its rulebook – remain burdened by the same disagreements about distributional issues that have hampered cooperation from the outset.

On the domestic front, meanwhile, the recent surge of populist movements in many countries has prompted nationalist entrenchment in different areas of international cooperation, at times accompanied by a tendency to question the urgency of climate action. In the United States, for instance, this has lately manifested itself in a sweeping rollback of climate and environmental policy measures of previous administrations. But resistance against an ambitious climate response is by no means limited to countries with populist leadership. Because of the economic cost imposed by carbon constraints on various sectors, concerns about competitiveness in global markets and displacement of production, investment and employment have persistently afflicted efforts to advance climate action. Energy-intensive and trade-exposed industries, in particular, have often been vocal and effective detractors of greater climate ambition. Any pathway to achievement of the 1.5°C objective will have to navigate these difficult political realities.

3.2 Economic and institutional capacity constraints

As SR15 also highlights, greater ambition in tackling climate change will require improved institutional capabilities in all countries. In fact, the level and complexity of institutional capacities needed to guide, manage, and support a transition to a low-carbon economy cannot be overstated. Ensuring these capacities will require personnel with expertise ranging from the sciences and policy analysis to technical, managerial, and operational skills. On the technology front, this also requires the ability to support activities ranging from strategic analysis of technology pathways, to the coordination of rapid, smooth and effective policy implementation, to technology development, adaptation, and market development, and lastly large-scale diffusion – all in a very short timeframe. Many governments and other stakeholders may possess the political will for an ambitious climate response, but lack the technical, financial, and institutional capacity to act thereon. Achieving the 1.5°C objective thus also necessitates a collective effort to deploy technology and finance at the required scale and pace.

3.3 Tensions between climate and development goals

Finally, climate action has important distributional effects, which, in many cases, can involve trade-offs with other important social and economic goals (see, for example, SR15, Figure SPM-4). Areas of potential trade-offs can include expanding clean household energy access by moving from biomass to liquid petroleum gas, and increasing biomass production for commercial energy and as carbon sinks, which can compromise land use, water resources, food production, biodiversity, and air quality. Ensuring the governance, finance and social support needed to manage such trade-offs, in the context of multiple objectives and the need for careful timing, will prove challenging.

While the overall objective of staying within 1.5°C is laudable, deciding how the burden of meeting this goal will be shared among nations (the perennial dilemma of international climate policy and negotiations) is key to its achievement. To take an example, the International Energy Agency (IEA) projections in their influential World Energy Outlook[7] indicate that following a 'Sustainable Development' scenario will

[7] International Energy Agency (2017). *World Energy Outlook 2017*. Paris: IEA

mean that, in 2040, countries in the Organisation for Economic Co-operation and Development (OECD) (developed countries) will generate 37% of their electricity from solar PV and wind, while the equivalent number for non-OECD (developing) countries is 17%. That seems eminently reasonable until one looks at the targets in absolute numbers and the compound annual growth rate (CAGR) needed to get there. As shown in Table 1, non-OECD countries are expected to pursue a much higher CAGR of electricity generation from these renewables than OECD countries in the next few decades. Furthermore, since achieving the 1.5°C target requires 'bending the emissions curve' in the near term, it also means that deployment of these renewables is much more front-loaded for the non-OECD countries, which has significant implications in terms of costs (since they do not get the benefit of cost reduction due to 'learning').

	Electricity Generation (TWh)				CAGR %			
Solar PV	**2016**	**2025**	**2030**	**2040**	**2016-25**	**2025-30**	**2030-2040**	**2016-2040**
OECD	216	626	889	1446	12.6	7.3	5.0	8.2
Non-OECD	87	1002	1844	3819	31.2	13.0	7.6	17.1
Wind	**2016**	**2025**	**2030**	**2040**	**2016-25**	**2025-30**	**2030-2040**	**2016-2040**
OECD	622	1365	1943	3073	9.1	7.3	4.7	6.9
Non-OECD	359	1420	2249	3877	16.5	9.6	5.6	10.4

Table 1: Growth rates for electricity generation from Solar PV and Wind in OECD and non-OECD countries to follow the World Energy Outlook Sustainable Development Scenario

Source: International Energy Agency (2017). *World Energy Outlook 2017*. Paris.

This raises questions not just of feasibility (that is, whether these countries have the capability to manage such a swift transition), but also surrounding the potentially negative implications of focusing attention on rapid deployment rather than managing a 'green industrial transformation' directed at simultaneously meeting developmental and climate goals. In other words, a single-minded focus on meeting steep climate goals, while globally beneficial, might cause developing countries to compromise on some aspects of sustainable development. A well-managed 'green industrial transformation' could become a major co-benefit in both economic and social terms of a climate mitigation agenda.

Given the need to significantly reduce the rise in greenhouse forcing in the near term to meet the 1.5°C goal, SR15 also highlights the potential contribution from a reduction of Short-Lived Climate Forcers (SLCFs[8]), such as methane and black carbon, with concomitant gains in other co-benefits (such as air quality), which, of course, again puts the focus on developing countries since they are major emitters of these pollutants. But as SR15 itself recognizes, this line of attack on greenhouse forcing is constrained by economic and social feasibility. For example, combating ambient air pollution, which offers an outstanding opportunity for climate and health gains, turns out to be notoriously difficult, given the wide range of contributors to the problem, ranging from

[8] Short-lived climate forcers are a set of compounds whose impact on climate occurs primarily within the first decade after their emission.

Image: Nicole S Glass / Shutterstock.com

"This openness to new forms of cooperation under the Paris Agreement offers a unique opportunity, but also poses new challenges."

household biomass burning, automobiles, industry, road and construction dust, and other dispersed sources. This also suggests that reducing the emphasis on targets for developing countries and focusing more on progressing the ambition for developed countries will likely be needed.

All in all, unpacking the 1.5°C goal reveals a host of issues that, while not insurmountable, do raise questions about both its feasibility and its equity implications. This is not to say that the goal should be abandoned. As SR15 makes abundantly clear, there is a strong case to be made for minimizing the level of climate disruption. But doing so will require a significant deviation from current emission pathways, which in turn will require a significant deviation from business-as-usual in policy domains for all countries but, in particular, developed ones, in terms of enhanced domestic action as well as international cooperation.

4. Conclusions

In view of the real-world barriers, capacity constraints, and trade-offs outlined in the preceding section, a realistic pathway towards 1.5°C necessitates a paradigm shift in climate cooperation. A framework premised on consensus of all actors – the traditional paradigm of international climate cooperation – faces clear limitations when it synchronises collective action with the pace of the least ambitious actor. Already, the international climate regime, in particular through the Paris Agreement, has evolved towards greater flexibility and accommodation of actors other than traditional states. Recognising this, SR15 describes an 'effective governance framework' as one that encompasses 'accountable multi-level governance that includes non-state actors such as industry, civil society and scientific institutions' and that enables 'collaborative multi-stakeholder partnerships' (SR15, p. 4–8).

This openness to new forms of cooperation under the Paris Agreement offers a unique opportunity, but also poses new challenges. Any hope of achieving the transformation needed to meet the 1.5°C objective will depend on the ability to spur 'coalitions of the willing' across all sectors and levels of governance, while simultaneously empowering and enabling those countries and communities that have the will to act, but lack institutional and financial capacity to do so. Transnational stakeholder events, such as the Global Climate Action Summit [9] in San Francisco USA (September, 2018), offer evidence of a promising dynamic at the level of regions and municipalities, private enterprises, and civil society organisations. Still, their welcome engagement gives rise to questions of legitimacy, accountability, and coordination.

For the time being, at least, such initiatives may be unable to secure the collective effort needed to compensate for shortfalls in national action and the entrenchment of key states. As SR15 observes, a key governance challenge will therefore lie not only in scaling up stakeholder initiatives, but also in ensuring the alignment and coordination of global, national and sub-national efforts, and helping different actors and processes to reinforce each other.

Philanthropic organisations and (bilateral and multilateral) donor agencies can play a key role in facilitating rapid and transformational action on the part of developing countries. They can do this, in particular, by providing support to strengthen capacities both for domestic policy analysis and implementation, and for international engagement. These issues arise time and again as being central to an effective climate and sustainable

[9] https://www.globalclimateactionsummit.org/

development transition in developing countries, yet are often overlooked by the traditional project-oriented approaches of donor agencies, or by private actors where the main goal is GHG mitigation rather than capacity building. Philanthropic organisations and donor agencies played a key role in the Green Revolution starting in the 1960s. An ambitious climate goal such as 1.5 °C gives them an opportunity to catalyse yet another 'green revolution'.

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