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The role of technology in the low-emission transition: Insights from the 1.5C IPCC Report

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The landmark [IPCC report on “Global Warming of 1.5°C”](#) highlights that achieving the Climate Paris Agreement objectives implies rapid and far-reaching transitions in energy, land and ecosystems, industry and urban and infrastructure systems. Even if not the silver bullet to the challenge, technological change is an important enabler of these transformations. This blogpost, as a summary of [an article published by three authors of the IPCC report \(including Henri Waisman, IDDRI\) in *Environmental Research Letters*](#), provides eight robust conclusions regarding the role of technologies in the low-emission transition in the context of sustainable development.

Three layers of assessment underpin the IPCC report's insights in technological enablers of the needed transition to a low-carbon world: (1) techno-economic modelling which provides global technology trends (Chapter 2); (2)

feasibility assessments which analyse the economic, institutional, cultural or socio-economic changes required to remove barriers and provide a context conducive to wider technological deployment (Chapter 4); and (3) the analysis of synergies and tradeoffs between different technology options and sustainable development dimensions (Chapter 5). The first type of assessment often receives the core of attention by users of the SR1.5, including those in government, the private sector and civil society, as well as the media that translate the findings to a wider audience. However, these three distinct but complementary assessment methods must be considered jointly in order to ensure correct interpretation of the results and hence provide rounded policy-relevant conclusions.

Conclusion #1. Technologies that support lower energy demand enable more pronounced synergies and a lower number of trade-offs with respect to sustainable development. This includes notably options for energy efficiency, such as more efficient industrial motors, vehicles, appliances or building envelope. These technologies are generally more technologically mature than other mitigation technologies, and, when appropriately incentivised, ease the deployment of low-carbon supply-side options, because they reduce the absolute value of required production and hence the scale of capacity increase.

2. By 2050, drastic increases of renewables to 70 to 85% of electricity production and decreases of unabated fossil sources to near-zero in the case of coal are necessary in the power generation sector. The extent of the reliance on other low-emission technologies varies across scenarios and thus reflects an area where choices can be made. These choices are made at the national, local or individual level and depend upon a number of parameters, among which societal characteristics and preferences, behaviour, institutional capacity and finance. These, for example, partly explain diverging approaches to the deployment of nuclear energy across countries.

3. Short-term action on technologies should combine the fast deployment of existing low-emission technologies with parallel efforts to develop and already start deploying a wide set of new technologies. The faster and deeper the deployment of existing mitigation technology options in the next decade, the lower the dependence on new and more uncertain technologies in the longer term. However, technologies that are not currently commercially available play an important role to enable low-carbon transitions. Research, development, demonstration and deployment of a wide range of new technologies for the future transition is a key area for international cooperation.

4. Non-technology drivers of changes, such as infrastructure or behaviour, condition the feasibility of different technological options. For example, denser urbanisation patterns in cities enable the deployment of non-motorised and public transportation; potential for product substitution in the industrial systems depends on market organisation and government incentivisation; dietary shifts, reduced food wastage and efficient food production largely depend upon changes in the behaviour of both consumers and producers.

5. The system-level role and contribution of any given technology option depends on which broader strategy is pursued across sectors. For example, the perspective on renewable electricity depends on the dynamics of other sectors, in particular transport (electric vehicles and trains), industry (electrification, green hydrogen) and heating of buildings (heat pumps).

6. To achieve 1.5C compatible pathways, we would need to take carbon dioxide out of the atmosphere. But the number and scale of carbon dioxide removal (CDR) technologies varies greatly across different types of pathways; higher near-term emission reductions decrease the need for high scale of deployment for these options. The role and feasibility of a CDR technology in a given sector in the context of keeping global warming to 1.5°C depends on the capacity of other sectors to imagine solutions to decrease their carbon footprint sufficiently.

7. Local and national circumstances, including policies to limit trade-offs, determine whether the synergies with sustainable development can be realised, and therefore which portfolios of technologies will be implemented. Technological choices should be taken according to the specifics of the local context in terms, for example, of

resources availability (crucial for the feasibility of renewables), geographical characteristics (a country with lots of remote areas may favour a decentralised electricity system to provide electricity to all people), synergies with other sustainable priorities (improved cook stoves make fuel endowments last longer and hence reduce deforestation, support equal opportunity by reducing school absences due to asthma among children and empower rural and indigenous women).

8. Investments in technology deployment and R&D must be made with a long-term and systemic perspective that takes into account the consequences of short-term action for the achievement of long-term climate and sustainable development objectives and the interplays between decisions taken on different components of the transformation. This means accounting for the financial risk posed by the adoption of high-carbon options now in the context of a global low-carbon transition, notably given the risk of lock-ins and stranded assets. Current markets do not necessarily capture these effects nor provide the right incentives so that mixes of policy instruments in combination with behaviour change, technological innovation, building of institutional capacity and multi-level governance would be needed to correct these market imperfections.

These insights provide guidance on feasible actions to be implemented to achieve the required transition to a decarbonised future achieving simultaneously climate and sustainable development objectives. They also inform choices among different technology options and mitigation strategies given the possible trade-offs with socio-economic and development priorities as defined in each local context.

