FAQ: Carbon in an electrified future: Technologies, trade offs and pathways

1. **Biomass has been criticized as a risky and unsustainable energy source, threatening food security and ecosystems across the world. Do the pathways presented in the report exacerbate this by promoting biomass?**

The report recognises that there are challenges and limitations that arise with biomass as an energy source and so maintains that biomass can be a source of sustainable carbon only if managed responsibly and in the context of robust governance in order to avoid land-use change, biodiversity loss and carbon stock depletion. In this way, biomass can become a cornerstone of the 2050 carbon mix without breaching ecological limits.

2. **Are the electrification scenarios presented in the Report too ambitious? Infrastructure, technology and costs remain major barriers.**

The electrification scenarios presented in the Report build on an international consensus surrounding the importance of electricity in all major net zero scenarios. The IEA posits, in its 1.5°C-aligned pathway, that electricity's share of the final energy demand would reach 54%, while IRENA argues for a 59% final share. In the ETC's *Fossil Fuels in Transition Report*, it found that even higher levels could be possible, depending on progress made. In its Accessible but Feasible (ACF) scenario, a 62% final share was posited, while the more ambitious Possible but Stretching (PBS) scenario shows a possible 71% share for electricity. The Unconstrained scenario in this report is intended to push the maximum share of electricity (77%) and what technologies and sectors could drive this, if they were not constrained by clean power supply.

The report is clear that unlocking this full potential of electrification depends on the rapid deployment of renewable generation, investment in grids and storage, and policies that accelerate clean power buildout.

3. **Should we not aim for zero carbon use by 2050, rather than "managed carbon"? Would allowing for any carbon in the system not undercut climate goals?**

The report fully supports the goal of net zero emissions by 2050, but net zero does not mean zero carbon molecules. It means achieving a balance where all remaining carbon emissions are neutralized by permanent removals or offset through sustainable use.

Some uses of carbon cannot be easily substituted, such as producing chemicals and plastics and providing energy for aviation where dense, energy rich fuels are essential. Given this reality, the report focuses on what must be done to achieve net-zero goals, namely ensuring that the remaining carbon is sustainably sourced, fully accounted for and managed, so that the system as a whole reaches zero emissions.

4. **Will large-scale capture and storage not lock in fossil fuel use or slow the shift to renewable energy?**

The report is clear that linear end-of-life solutions, such as CCS, represent a pragmatic and timely solution where circularity solutions are challenged, but that these should not be scaled to give license to inefficient sourcing and use of carbon. These technologies are not ideal outcomes, but pragmatic ones in a context where not all carbon can be reused or recycled.

5. **Does the report rely too heavily on unproven technologies, such as direct air capture or advanced storage?**

The report assesses a wide range of technologies with a focus on earlier stage maturity levels, highlighting how near or far these various options are to their levels of maturity, as well as abatement costs, and considers this in its analysis. While some electrification technologies, such as MOE/electrowinning, shockwave heating, as well as geological hydrogen are at early stages, a large range of biotech and bioconversion technologies, as well as carbon utilization technologies, such as electrochemical reduction and biocatalysis, are much more advanced.

By including a spectrum from mature to emerging solutions, the report provides a realistic and actionable roadmap with various scenarios, accounting for uncertainty and allowing for flexibility as innovation advances. In this vein, the report is clear as to where policy and R&D support will be needed to bring newer technologies responsibly to scale.

6. **Does the report now overlook major regional differences in technology readiness, infrastructure, resource availability, etc.?**

The report acknowledges that the path to sustainable carbon management will necessarily look very different across regions. For example, the rate of electrification will depend on energy price variation and technology learning rates across regions. Circularity and storage are also dependent on technology, approaches and regulatory certainty, which shifts regionally. Concerning biomass, the report is clear that in regions with higher risk of food insecurity, shifting areas from food to energy production should be avoided, regardless of efficiency gains.

While the report analyses different technological solutions to electrification, as well as sourcing, use and storage of carbon, it is clear that the optimal technology mix will vary by region.

7. **Are chemical recycling and thermo-conversion technologies genuinely circular, or do they risk prolonging fossil-style waste systems?**

The report distinguishes between chemical recycling (material-to-material or closed-loop recycling) technologies and thermo-conversion (waste-to-fuels or chemical intermediaries). While chemical recycling can support circularity by converting waste plastics back into monomers or polymers, there is concern that in practice these technologies could prioritise energy recovery over true circularity.

The report acknowledges this criticism of thermo-conversion from waste, and in estimations of plastic waste circularity, only chemical-to-chemical pathways are included in scenarios.

8. **Isn't carbon capture and utilisation (CCU) just a way to keep using carbon — does it really support net zero?**

The report recognises CCU as a smaller but potentially useful part of the carbon system, capable of converting captured carbon into fuels, chemicals or materials. The actual emissions outcome of using these technologies depends on the carbon source (biogenic, fossil or atmospheric) and the end-use (fuel or material). Fuels produced using captured fossil carbon will be re-emitted when used and would therefore need to be offset by permanent removals to achieve net-zero balance.

Because CCU pathways are energy- and hydrogen-intensive, their contribution depends on access to low-carbon energy and rigorous lifecycle accounting. When applied in this way, CCU can help reuse existing carbon and reduce the need for new fossil feedstocks, particularly where circular material options are limited — but it cannot substitute for reducing carbon use overall.