Emerging Climate Technologies: Principles & Pitfalls

Factsheet - March 2023

Compiled by EarthJustice, EDF, NRDC, Sierra Club, SWEEP & Conservation Colorado

Hydrogen

Hydrogen is a fuel that has the potential to be a low-carbon replacement for a range of fossil fuel uses. It does not exist naturally and must be produced through energy-intensive processes. Even when hydrogen is created with clean energy, strong guardrails around production and use are critical to ensure hydrogen is a climate solution. Rigorous lifecycle emissions analysis and community engagement is critical, as hydrogen production or combustion can produce GHG and NOx emissions.

Principles and Pitfalls

- Production:
  - Hydrogen should be produced from renewable energy, otherwise inefficiencies and energy loss during production can increase overall emissions.
  - The renewable energy must be additional, from resources built to accommodate the hydrogen production energy load, otherwise we risk taking renewables from more efficient sectors.
  - The most advanced water efficiency should be prioritized, particularly with ongoing drought.
- Transportation and Storage:
  - Hydrogen is a small molecule which makes the risk of leakage high. Strong leak mitigation measures and monitoring are necessary.
  - Hydrogen should only be used in purpose-built pipelines, as it will leak from and embrittle existing natural gas infrastructure.
- Usage:
  - Hydrogen should only be used in hard to electrify sectors, like industry, *not* for passenger cars or for heating buildings or for baseload power generation.

Geothermal

Geothermal refers to using heat underground to either produce electricity or to heat and cool buildings. Hot fluids underground can be brought to the surface to produce steam and create electricity. Heating and cooling in buildings taps into temperatures underground which remain a constant 55 degrees. Buildings can be connected via an underground loop at a district level or community wide.

Principles and Pitfalls

- Cost:
  - The cost and benefits of each project and the entire system must be properly evaluated against other decarbonization options.
  - For heating and cooling, the number of buildings that could be connected to the network is key to preventing excessive costs, to split the cost among more users and increase efficiency.
- Materials:
  - There are outstanding technology questions about using existing pipes or what types of pipes will be best for geothermal heating and cooling.
- Ownership and operation:
  - Networked geothermal presents a potential new business plan for gas utilities, so we should understand the technology's potential impact on the utility business model and in what cases utility ownership may not be as beneficial for customers as 3rd-party or municipal ownership.

Carbon Capture - CCS & CCUS

"CCS" stands for carbon capture and storage and "CCUS" stands for carbon capture, *utilization*, and storage. These processes capture carbon from pollution sources and either store it underground (ie. in geologic formations), or use it (ie. in industrial products like concrete or to extract fossil fuels). CCS & CCUS are potential strategies to mitigate carbon emissions, especially in hard-to-abate industries, but guardrails are necessary to ensure that we do not prolong fossil fuel dependency or increase harm in communities already bearing unjust pollution burdens.

Principles and pitfalls:

- The role of CCS & CCUS in meeting our climate goals depends on having policies that ensure environmental integrity and justice throughout projects, from capture to transport to storage.
- Policies and investments must ensure that CCS & CCUS do not continue dependency on fossil fuels, delay aggressive near-term emission reductions, or crowd out opportunities to transition to clean energy.
- End uses:
  - CCS & CCUS should focus on sectors without viable pathways to electrify or decarbonize.
  - Captured carbon should *not* be used to ramp up fossil fuel extraction (ie. Enhanced Oil Recovery)
- Environmental Justice:
  - Communities are understandably concerned about CCS & CCUS and need to be involved in policy development and in evaluating project proposals. Colorado's Environmental Justice Advisory Board issued recommendations on CCUS that should be incorporated into state policies.
  - If CCS & CCUS are deployed, state policies must ensure that projects do not exacerbate local pollution. Capturing carbon doesn't necessarily reduce co-pollutants like toxics that harm communities. In some instances, carbon capture projects may bring co-benefits, ie. by capturing other pollutants like NOx.
- Safety:
  - For CCS & CCUS to be potential climate solutions, policies must address safety risks and ensure projects meet technical standards for pipeline safety and carbon storage. Policies that weaken liability laws for these technologies undermine their integrity and potential as a carbon mitigation tool.
  - Keeping carbon underground can create the risk of earthquakes that can harm people and property, and cause public alarm. This risk can be managed – but only if the state adopts rules that ensure projects are sited and operated in a manner that avoids these risks.

Direct Air Capture

Direct air capture (DAC) is a strategy that aims to remove CO_2 from the atmosphere by using chemical filters to extract CO_2 from the air. The captured CO_2 can be stored underground or put to use, such as in industrial processes. In particular, these strategies may help address "legacy" carbon pollution that was already emitted and can otherwise stay in the atmosphere for centuries.

Principles and pitfalls

- While some amount of carbon removal may be necessary to achieve net-zero emissions by mid-century and address legacy carbon pollution, these strategies are not a substitute for reducing emissions directly from the pollution source. To realize the potential climate benefits of DAC, the technology must be deployed and governed in a way that does not delay or distract from aggressive emission reductions.
- For DAC to have climate benefits, the captured CO_2 must be kept out of the air. It is critical to have laws and rules in place that ensure secure, durable, and transparent CO_2 storage.
- Deployment of DAC at scale will likely be energy-intensive. Policies must ensure DAC does not compete for renewable or low-carbon energy needed for direct decarbonization. In addition, energy sources used to power DAC equipment must not create risks of additional co-pollution that worsens air and water quality.
- DAC is currently expensive and unproven at scale.