Environmental Updates

November 2017

Designed for use with the Global Development And Environment Institute's *Environmental and Natural Resource Economics* textbook

Decarbonizing the Global Economy

The 2015 Paris Agreement on Climate Change embodies the goal of preventing planetary warming from exceeding 2°C compared to pre-industrial levels, with a more ambitious target of limiting warming to no more than 1.5°C. Governments agreed to "Nationally Determined Commitments" (NDCs) for reduction in carbon emissions. But the commitments currently "cover only approximately one third of the emissions reductions needed to be on a least-cost pathway for the goal of staying well below 2°C."[1]

In June 2017, an article in the journal *Nature* proposed that the world had only three years to safeguard the climate,[2] reiterating the conclusion of a scientific report published in April 2017, "2020: The Climate Turning Point", warning that should greenhouse gases emissions continue to rise after 2020, or even remain level, then the 2°C temperature goal would become almost unattainable. [3]

Global temperature rise depends on cumulative global CO_2 emissions. The Paris temperature range (1.5 to 2°C at most) can be translated into a budget of CO_2 emissions that is still permissible. Scientists have estimated that the safe carbon budget that we should consider is 600 gigatons of CO_2.[4] At the current level of emissions, which is 39 gigatons of CO_2 per year (i.e. 10.6 Gt of Carbon)[5], the global carbon budget of 600 Gt of CO_2 is equivalent to only 15 years of emissions. As a result, CO_2 emissions need to peak by 2020 to achieve the 2°C target, then rapidly decline towards zero.

Global emissions held relatively steady during the period 2014-2016, but are set to increase again by 2% in 2017 according to recent reports.[6] If CO_2 emissions peaked in 2020, then reducing emissions to zero would need to be achieved in a period of 20 years, between 2020 and 2040. But if global CO_2 emissions only peak in 2025, then staying on course with the 2°C target would require a transition to zero carbon in only 10 years, which would be virtually impossible.

Is even a 20-year zero-carbon transition possible? A team of scientists have undertaken to outline "what these carbon budgets actually mean in terms of concrete action."[7] According to their analysis, the decarbonization of the world economy is challenging but achievable, requiring both rapid reduction in emissions and increased carbon absorption:

On the emissions side:
Cut global CO_2 emissions from energy and industry in half in the 2020s decade, then in half again in the 2030s decade, and then in half again in the 2040s decade.

On the "carbon capture and storage" side:
Absorption of carbon dioxide from the atmosphere must be

massively increased, for an extra storage capacity of about 5 Gt of carbon per year out of the atmosphere by 2050 (18.3 Gt of CO_2) — nearly double what all the world's trees and soils now absorb.

Technologies to capture and store carbon are still speculative. A more natural way to store carbon in ecosystems can be achieved at a low cost by mobilizing and harnessing the carbon sink potential of forests and soils. Net emissions from land use, including agriculture and deforestation, needs to fall steadily to zero by 2050, and reforestation and soil regeneration practices need to be implemented on a broad scale to allow for the storage of an additional 5.6Gt of carbon per year, in addition to the 3Gt currently absorbed by global soils and ecosystems.[8]

According to the authors of the article in *Science*, "The Roadmap to Rapid Decarbonization," reaching these goals will require "Herculean" efforts on both sides of the climate equation.[9] They describe the path of decarbonization as follows:

2017-2020:

All countries prepare for the task ahead by laying vital policy groundwork: Scrapping the $500 billion per year in global fossil fuel subsidies; zeroing out investments in any new coal plants; committing to going carbon-neutral by 2050; putting into place policies such as carbon pricing or renewable electricity portfolio standards to achieve that goal.

2020-2030:

In this decade, carbon pricing expands to cover most aspects of the global economy, averaging around $50 per ton of CO_2 (far higher than seen almost anywhere today), rising to $400 a ton by mid-century. Aggressive energy efficiency programs ramp up. Coal power is phased out in rich countries by the end of the decade and is declining sharply elsewhere. Leading cities like Copenhagen go totally fossil fuel free. Wealthy countries no longer sell new combustion engine cars by 2030, and transportation gets widely electrified, with many short-haul flights replaced by rail. Meanwhile, efforts to start increasing carbon dioxide absorption start this decade, including reforesting degraded land and deploying technologies such as direct-air capture or bioenergy with Carbon Capture and Storage (CCS) to pull CO_2 out of the atmosphere.

2030-2040:

Leading countries like Denmark and Sweden should have completely carbon-free electrical grids and have electrified virtually all of their transport, heating, and industry. Cars with internal combustion engines "will have become rare on roads worldwide." Aircraft will be almost entirely powered by carbon-neutral fuels such as biofuels or hydrogen.[10] New building construction will be largely carbon-neutral, using emissions-free methods for steel and concrete or through other techniques. And "radical new energy generation solutions will enter the market." Meanwhile, an extra 1 to 2 gigatons of carbon must be withdrawn from the atmosphere annually, with a heavy R&D effort on expanding that further.

2040-2050:

By the early 2040s, major European countries are close to carbon-neutral, and the rest of the world is moving toward that goal by the end of the decade. Electricity grids are nearly entirely carbon-free. "Natural gas still provides some back up energy, but CCS ensures its carbon footprint is limited. Modular nuclear reactors may contribute to the energy mix in some places." Lower-income countries are still using some fossil fuels, and the world is still emitting a small amount of CO_2 in 2050 (about one-eighth of current emissions), but work continues on eventually phasing that out."[11]

The "roadmap" article indicates that achievement of carbon neutrality is technically possible. But how will policymakers react to the sheer scope of this challenge? The role of civil society is likely to be crucial in pressuring policy makers to set ambitious climate agendas, and if they fail to do so, to take independent action, as illustrated by the U.S. Climate Alliance launched by 15 U.S. States, along with a coalition of cities, business-

es, and NGOs, which have pledged to achieve the US climate commitments made in 2015 despite the decision to withdraw from the Paris Agreement by the Trump Administration.[12]

From an economic point of view, the striking thing about the "roadmap" is that despite its ambitious goals it may not involve high economic costs, at least in the initial stages. The rapidly declining cost of renewable energy means that in many cases it is becoming the most cost-effective option for new power development:

> Renewable energy sources are set to represent almost three quarters of the $10.2 trillion the world will invest in new power generating technology until 2040, thanks to rapidly falling costs for solar and wind power, and a growing role for batteries, including electric vehicle batteries, in balancing supply and demand.[13]

There are also significant "co-benefits" to a low-carbon path, such as reduction in ground-level pollution from limiting fossil fuel use (a critical issue in India and China), increased food productivity associated with carbon-storing agricultural techniques, and benefits from forest preservation such as flood prevention. Many energy efficiency measures are economically profitable even without considering carbon reduction. As the more demanding targets are approached, costs are likely to rise, but much can be achieved at low or even negative cost.

The United Nations climate conference meeting in Bonn, Germany in November 2017 (known as COP-23) set in motion a process for "ramping up" the climate commitments of participant nations, with a first evaluation in 2018. The successful continuation of this process will be essential to translating demanding technical goals into practical policies.

Endnotes:

1 United Nations Environmental Programme, *Emissions Gap Report 2017*.
2 Christiana Figueres et al. "Three Years to Safeguard our Climate", *Nature,* Vol. 546, Issue 7660, 28 June 2017.
3 2020 the Climate Turning Point http://www.mission2020.global/2020%20The%20Climate%20Turning%20Point.pdf
4 Ibid.
5 Note: 1 Gigaton of Carbon corresponds to 3.67 Gt of CO_2 as the ratio of molecular weight of CO_2 (44) to molecular weight of Carbon (12) is 44/12 = 3.67.
6 Alister Doyle, "World Carbon Emissions on the Rise Again – Study," *Reuters,* November 13, 2017. https://reut.rs/2jlB21y
7 J. Rockström et al. "The Roadmap to Rapid Decarbonization," *Science* 24 Mar 2017: Vol. 355, Issue 6331, pp. 1269-1271 http://science.sciencemag.org/content/355/6331/1269
8 See GDAE's Climate Policy Brief #4, April 2017 "Hope below our feet: soil as a climate solution" http://www.ase.tufts.edu/gdae/Pubs/climate/ClimatePolicyBrief4.pdf
9 Rockström et al., 2017.
10 The feasibility of biofuels for this purpose is subject to question, since many current biofuels are environmentally destructive, require extensive land use, and are not carbon neutral. Some biofuels such as those derived from wastes are more benign, but availability in the necessary amounts is unlikely and would require significant technological progress on "next-generation" biofuels.
11 Brad Plumer "Scientists made a detailed "roadmap" for meeting the Paris Climate Goals. It's eye-opening," *Vox,* March 24, 2017. https://www.vox.com/energy-and-environment/2017/3/23/15028480/roadmap-paris-climate-goals
12 https://www.usclimatealliance.org/
13 Bloomberg New Energy Finance, *New Energy Outlook 2017`*