The Short List of Climate Actions That Will Work

There is more consensus on what solutions are effective than there appears to be

Sept. 29th, 2019 **Michael Barnard**, CleanTechnica and Editor of The Future is Electric

I spend a lot of time critiquing solutions for low-carbon transformation, and that leads, inevitably, to people asking me: *what works? What should we be doing?* Most recently, that came in the form of a question on *Quora* that was well enough formed to trigger me to write down the solution set: ***"What exactly is the current scientific consensus on steps to combat climate change?"***

Consensus is an interesting word. I tend to prefer consilience, where multiple lines of investigation lead to the same conclusions. That said, the following are the solutions or approaches that I see from my investigations and discussions as gaining consensus and consilience. It's not the how, but the what. There are many paths that lead to these realities. One way to read the following is to consider that it describes the world in 2050.

This list doesn't necessarily map easily to the Project Drawdown recommendations because its approach is a cost benefit analysis of CO2e reductions for dollars, while ***this is a more aggressive transformational vision***.

Electrify everything

Convert all energy services to work directly from electricity instead of fossil fuels. Transportation, industry, and agriculture. All of it. All gas appliances must go. All road transport must be electric. Most trains and a lot of planes must shift to electric. Electricity creating biofuels or hydrogen for the subset of transportation that can't be electrified. All heat from electricity. The US throws away two thirds of all primary energy, mostly in the form of waste heat from fossil fuels used in inherently inefficient combustion processes. We only have to replace a third of the actual primary energy we use today to maintain our lifestyle and economy.

Overbuild renewable generation

All other forms of generation with the exception of nuclear were overbuilt, so we'll do the same with wind and solar, and they are really cheap, so that is not that expensive. Also a bit of geothermal and some biomass. After all, about $3 trillion would provide all primary energy for everything the US does today.

Build continent-scale electrical grids and markets

And improve existing ones. HVDC became much more viable with high-speed hybrid circuit breakers in 2011, and is an essential technology for long-distance, low-loss electrical transmission. It can replace some AC transmission and be buried along existing right-of-ways.

Build a fair amount of hydro storage

And some other storage too. While storage of electricity is an overstated concern given overbuilt renewables and continent-scale grids, some is still required. Pumped hydro resource potential is far greater than the need, is efficient, and uses very stable, known technologies. Shifting existing hydro-electric dams to be passive, on-demand storage as opposed to baseload is also key. Fast response grid storage can be provided by existing lithium-ion technologies, as Tesla has proven in California and Australia. By 2050, we'll have roughly 20TWh of batteries on wheels in US cars alone, available both for demand management to reduce peak demand, soak up excess generation, and to provide vehicle-to-grid electricity as needed.

Plant a lot of trees

We have cut down about 50% of the six trillion trees that used to grow on earth. Planting a trillion trees would buy us a lot of time as they sucked about a ton of CO2 from the atmosphere per tree over 40 years.

Change agricultural practices

High-tillage agriculture is a process that keeps releasing carbon captured by the soil back into the atmosphere. Switching to low-tillage farming would buy us a lot of time as the CO2 captured by farmland would stay in the soil a lot longer, and some of it would be permanently sequestered.

Fix concrete

8% of global CO2 emissions come from making Portland cement. It's absolutely critical to urban densification and industry, so we won't stop making it. But it's a huge source of CO2, about half from the energy and half from CO2 that bakes off limestone as it is turned into quicklime. Electrifying that energy flow helps a lot, but capturing that CO2 is one of the few places where mechanical carbon capture makes sense.

Price carbon aggressively

The simplest way to get a lot of people and industries to shift away from emitting lots of CO2 is to make it expensive. That's what carbon taxes do.

Shut down coal and gas generation aggressively

Getting rid of coal is already happening, but it's by far the biggest single source of CO2 emissions. Aggressive actions to eliminate burning coal are needed. For gas, the question is how few gas plants can we build, how many of them can we run on biologically sourced methane and how fast can we shut them down.

Stop financing and subsidies for fossil fuel

Exploration, extraction, and use, just cut it out. The US alone spends tens of billions of dollars annually on subsidies of various kinds for the fossil fuel industry, and hasn't done a thing about it since committing to eliminate them in 2009. The G7 and G20 have committed to eliminating subsidies, but progress has been very slow. The World Bank continues to finance coal, oil, and gas projects, despite commitments to end them.

Eliminate HFCs in refrigeration

The *Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer* targets the unforeseen side effects of displacing ozone-depleting CFCs with high-greenhouse gas HFCs. Project Drawdown puts this at #1 on its ranked list of solutions by cost vs benefit. The US has not ratified this Amendment, although 65 other countries have.

There are some mildly controversial things left out of this list:

Nuclear power is too slow to build and too expensive

That's empirical reality, not an advocacy statement. The conditions for rapid build that existed in a couple of places and times in the past don't exist today. And we need a lot of clean electricity very quickly. Nuclear need not apply. Keep existing nuclear going, don't stop new nuclear buildout in China, pretty much the only place building new generation capacity, but don't expect it to be more than a rounding error in a few decades. New nuclear technologies are decades from commercial deployment at any scale, and we have technologies that are reliable, predictable, cheap, and fast to build, so there will be nothing for them to do once they actually make it out of R&D.

Mechanical carbon capture and sequestration is a mostly dead end

This is an overhyped fig leaf for the fossil fuel industry. Virtually every CCS site is actually an enhanced oil recovery site which recovers oil that couldn't be pumped out before, typically enough that 2–3 times more CO2 is generated from the oil than was put underground. Exceptions are natural gas wells with too high a concentration of CO2, leading to 25 times the emissions once the natural gas is burned. Expensive, unscalable, and wasteful. As stated, it might be useful for concrete.

Air-to-fuel technologies are dead ends

Solutions such as Carbon Engineering's direct-air-capture with hydrogen electrolysis to create synthetic fuels is a broken model. It's vastly more expensive and higher CO_2 emitting than electrification or biological pathway fuel synthesis. Any money spent on this would have vastly better results if spent on renewables instead. It's not an either-or, but in this case policy makers should ignore this and governments shouldn't fund.

The military is a hard problem

The military requires vast amounts of high energy fuel in places with no electrical supply chain, often for months at a time. The US military is considered by many to be the single largest CO_2 emitting organization in the world. However, eliminating global fossil fuel strategic military actions — which describes virtually everything done in the Middle East for the last 100 years — will diminish the need for the US military substantially. A great deal of its current emissions, which hopefully will start coming to light once the US signs the Paris Accord either in 2021 or 2025 once Trump is gone, are related to the ongoing Middle Eastern deployments. There's only so much we can do for biofuels, but to be clear, the world has been in a period of diminishing military conflict since the end of WWII. Globalization may have downsides, but the ties of trade and treaties which bind countries together have been highly effective in allowing diplomacy pathways to work, and making the military option increasingly difficult to consider.

Where approaches or recommendations from people or groups diverge from the above, question what lobbying groups are involved, where revenue will be lost or gained and in general what the motivations of the people or organizations involved are. This is all empirically grounded analysis. It's not rocket science.

We have the solutions. We just need the will to execute, which is being sapped by the losers in this necessary transformation, predominantly the fossil fuel industry.