Financial Bailout Spending Would Have Almost Paid for Thirty Years of Global Green New Deal Climate: Triage, Regeneration, and Mitigation

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1. Introduction

Human induced climate crisis is destroying the capacity of our planet to support our species and other life at an unprecedented rate (Woodward, 2019). In addition to climate *mitigation* and *adaptation*, climate triage, or climate *restoration* of already passed or about to pass tipping points is now essential to avoid disaster (Fiekowsky, et. al. 2019). Tipping points include: a) Amazon rain forest frequent droughts, b) Atlantic circulation slow-down since 1950s, c) Arctic sea-ice area reduction, d) Boreal forest fires and pests changing, e) Coral reef die-off, f) Greenland ice-loss, f) Permafrost thawing and methane release, g) J. Wilkes Basin East Antarctic ice-loss, i) West Antarctic ice-loss (Pearce, 2019).

The most urgent of these is Arctic warming and sea-ice loss that is causing a wavering and slowing Jet stream, and permafrost methane release, so that the arctic for the first time may be a net carbon emitter rather than absorber, *triggering a long-feared feedback loop of warming causing accelerated warming* (Freedman, 2019). Arctic summer sea-ice will disappear within the next two or three decades if current trends continue (Stroeve, 2019). This increases already extreme polar warming due to open ocean heat absorption causing more Greenland ice sheet melting and a shifting jet stream and increased severe weather events (Harvey, 2016). As noted above, accelerated arctic warming could lead to runaway catastrophic global warming due to the permafrost methane release.

In this paper I will argue that a global "Global Green New Deal" (GGND) will require at least three phases and three funding sources. The three overlapping phases are: a) short-run climate restoration or triage, b) medium-term soil carbon sponge and water cycle regeneration or adaptation, and c) long-run "Green House Gas" (GHG) drawdown or mitigation. The three funding sources are: a) utilizing the sovereign power of the U.S. government and Federal Reserve to create dollars as Modern Monetary Theory (MMT) theorists have painstakingly pointed out, b) taxing GHG emissions and c) taxing wealthy and high-income individuals with a particular focus on rentiers. With the caveats that receipts from b) should be partially or wholly redistributed to low income and low wealth households and countries to offset the burden of these taxes on them, and that receipts from b) and c) do not, at least initially, need to cover GGND expenditures due to a). We need to deploy all available options in confronting this looming existential crisis before it is too late.

2. Funding

A quick synopsis of the MMT rationale for monetization is as follows[1]:

In principle it is nonsensical to talk about the federal government needing to tax or sell bonds to "pay" for federal programs. The moment a government takes over the task of creating money (as the Bank of England first did in 1694) the government is already "borrowing" from everyone who holds the currency. The government redeems its "borrowing" by accepting its own currency as payment for taxes - at which point these IOUs from the Government to holders of the currency are expunged. Trust in the value of the currency (in the mostly "secondary" market where it's used) represents trust that others will value it. For a longtime this trust was based on, at least the perception of, a promise by the Central Bank, or Fed, that these IOUs from the government could be redeemed for gold (that everyone trusted for historical reasons), but since the era of fiat money, trust in the currency is based on trust that everyone else will trust it, and that the government will accept it as "Legal Tender" for paying taxes.

In practice when the government spends, the Fed debits the Treasury's reserve account and credits the reserve accounts of the banks where the spending ends up (or elsewhere if spent outside the Fed system). As Kelton (formerly Bell) describes in great detail in her now classic paper, there is almost always a mismatch between what's in the Treasury Reserve account and what the government is spending that is smoothed through various institutional means by the Fed to maintain a stable Federal Funds rate target (Bell, 2000). The key point though is that if there are insufficient funds in the Treasury's reserve account from taxes or bond sales, the only obstacles to the Treasury selling Bonds directly to the Fed to raise the necessary funds are self-imposed institutional constraints that can and have been lifted numerous times.[2] Direct purchase is currently not authorized but in principle there is no reason why this constraint could not be lifted again, especially after the Fed has recently created trillions of dollars ex-nihilo on "Quantitative Easing" (QE) "open market" purchases of Treasuries, and Freddie, Fannie, and Ginnie mortgage backed securities.

In fact, M2 money supply has expanded more than three times as fast in the last 9 years from the end of the financial crash in June 2009 to June 2019 (roughly $6.3 T) as it had in the 27 years Nov. 1980 to Nov. 2007 prior to the crash (roughly $ 5.8 T).[3]

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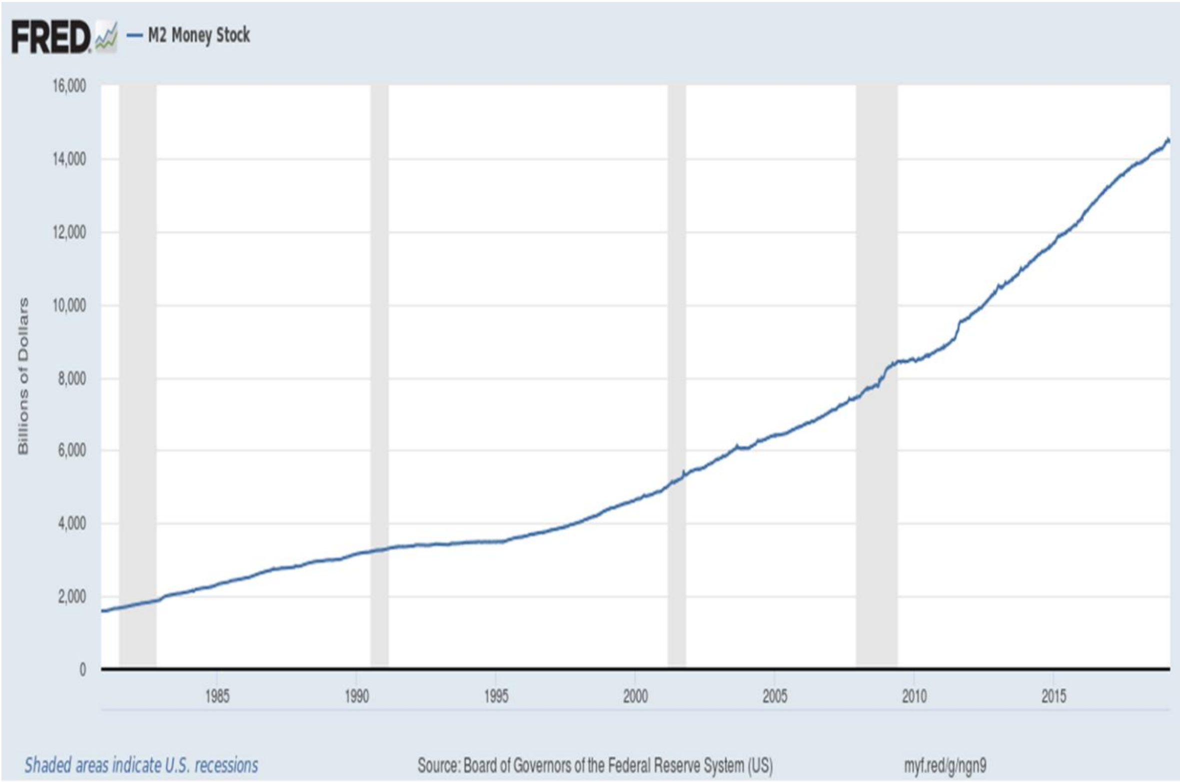
[1] Here I am strictly referring to monetization, not other policies that are often included as part of MMT like guaranteed employment (that I agree with) and free trade (that I don't agree with). For the record I would consider myself a "Neo-Rentierist" MMTer in the broad sense – see below.

[2] Note for non-economists: Technically when the Federal Reserve buys Treasury Bills directly from the Treasury, the Treasury is "borrowing" money from the Fed. However, since all of the interest on T-Bills held by the Fed, minus a negligible amount for Fed overhead, goes back to the Treasury, this "debt" to the Fed never has to be paid back. It is therefore not really "debt" but simply money creation for the Treasury by the Fed, or direct "monetization" of government spending.

[3] FRED, M2 Money Stock, downloaded 12/17: https://fred.stlouisfed.org/series/M2 .

Figure 1: Fed Purchases of Treasuries 2008-2019 Explosion



Roughly $ 2.8 T ($ 1.7 T Treasuries and $ 1.3 T Fannie, Freddie, and Ginnie securities) or 44% of this $ 6.3 T expansion has been directly created by the Fed via the financial bailout and QE over this period (FRED.

Figure 2: Fed Purchases of Treasuries 2008-2019 Explosion

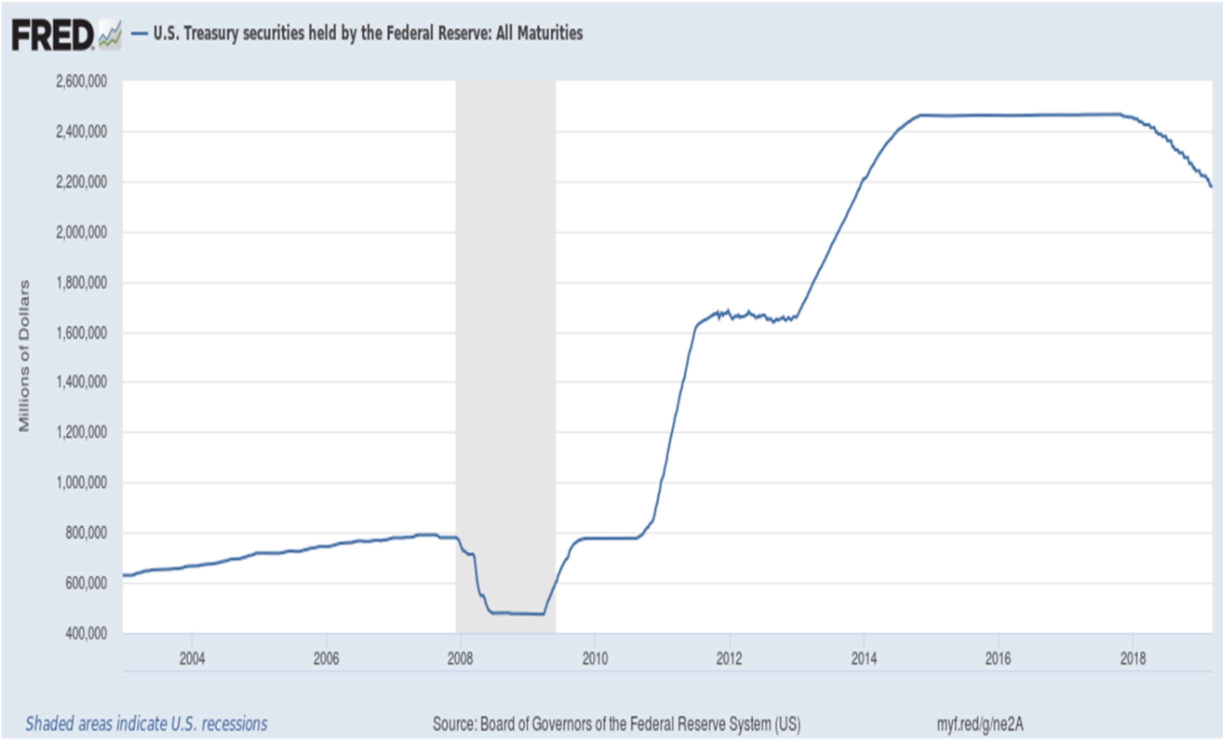
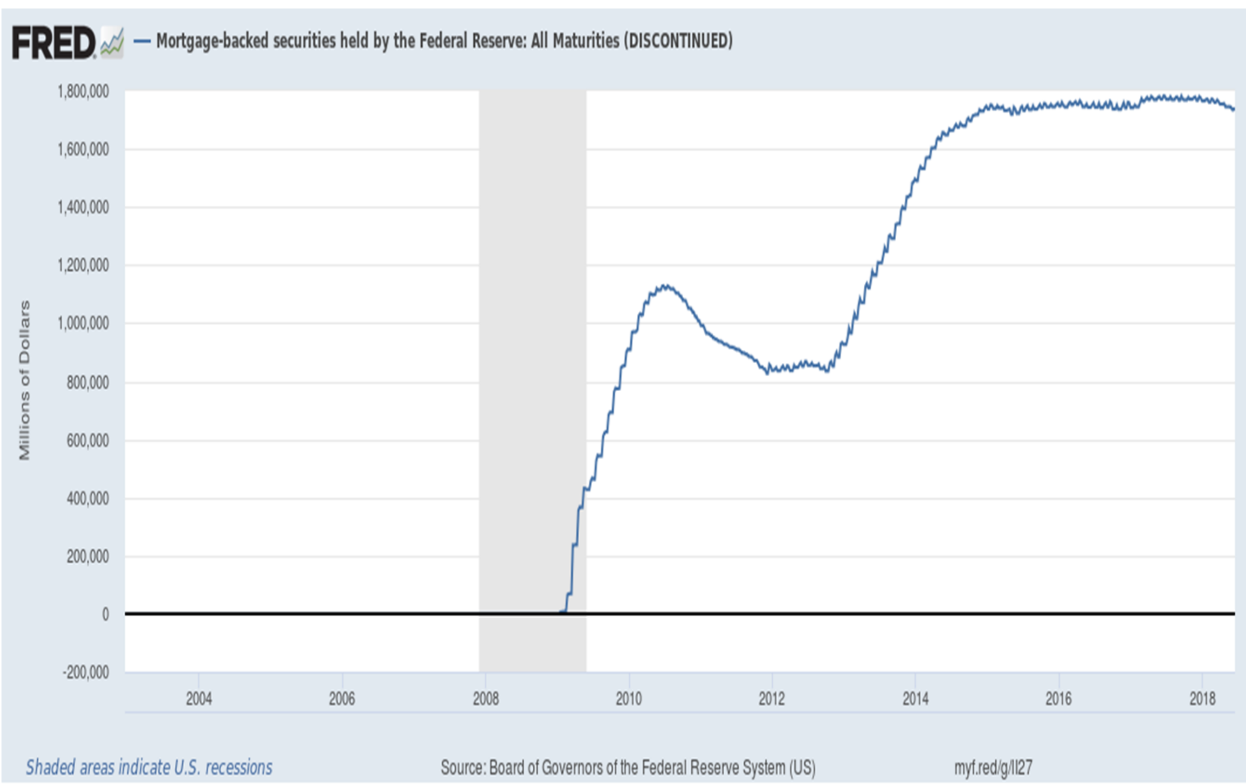


Figure 3: Fed Purchases of Fannie, Freddie, and Ginnie Securities



This has caused real estate (up 22%)[4] and financial asset prices (x2.5)[5] to rise along with non-financial private debt (up 46%).[6] But real economic growth for this expansion has been slower than prior periods of positive annual GDP growth: 2010 - 2018 average annual 2.3%, 1992-2007 3.3%, 1983-1990 4.1%, and inflation, or prices for produced goods and services (as opposed to existing assets), has been very low: with annual CPI average increases of 1.5%, versus 2.5% and 3.9%, for these same periods.

The fact that MMT monetization of government spending is not particularly novel or original misses the important political effect of highlighting this possibility that has always existed and often been used, in WWII for example (Garbade, 2014). This is critical as it shifts the discussion of financing a Green New Deal and Marshall Plan (GGND), for example, to the *really important* issues of *real economic resource use* instead of the irrelevant "how do we pay it?" question. Thinking about the problem this way directs planning toward how to create enough *real slack* in the economy to accommodate the enormous amount of new government spending on investment and employment that such a program would require. As in WWII, such an expansion of real economic resource use will require offsetting reductions in consumer and other investment spending and production and probably direct rationing and price controls (as in WWII) to prevent unforeseen bottlenecks from leading to inflation instead of real resource reallocation. This means for example that simply taxing *extreme* income, wealth, and luxury production will not be adequate as it will be necessary to tax *a sizable enough share of upper income households and luxury goods* so as to achieve sufficient real reductions in production and use of these kinds of goods and services to accommodate public GNDMP spending and investment.

MMT critics frequently point out, the power to monetize government spending is not unlimited. This includes left critics who are in full agreement with the goal of expanding public provision and spending (Paley 2018) (Wolff 2019) (Henwood 2019) (Sawicky 2019). However, as documented above, the ship of monetized public spending to prop up Finance, Insurance, and Real Estate (FIRE) and maintain tepid GDP growth has sailed in the US and elsewhere since the crash, and probably will keep sailing during the next recession (Buiter, 2019).[7] It is true that history is replete with examples of monetized public spending leading to runaway inflation and MMT critics have rightly expressed skepticism that governments can be trusted to use this power responsibly over the long term. However, there is no doubt that in the run-up to the crash private finance did not use its power to create money responsibility either (Keen, 2017), and that this has been a regular feature of capitalism throughout its history (Minsky, 1986). Central banks also are incapable or unwilling to use their power to create money responsibly when the Fed other Central Banks monetized private debt to bail out FIRE instead of homeowners and the real economy. In this respect the main difference between these agents has been what this power is used *for*. I see no reason why, when we are faced with an existential crisis that is unquestionably greater than any crisis humanity has never before faced in its history, we should not use the

[4] Real residential property prices in US (FRED).

[5] Dow Jones.

[6] BIS credit to private non-financial sector from all sectors at market value long series 2009-2018.

[7] Op. cit.

public power of fiat money creation, and especially the unique global monetary power of the U.S. dollar, to address it. If this eventually causes inflation so be it. As in war time we need to act.

However, as monetization even for a currency as strong as the U.S. dollar involves trust, it is probably best to monetize but not advertise it, as the U.S. has now been doing for over a decade via the Federal Reserve.[8] In this sense I think the most important MMT take home point is not that public spending can be monetized but rather that when emergency public spending is urgently required for real needs (for example species survival), the real constraint should be the real economy (no pun intended) and not public *financial* resources.

Therefore, raising public revenue through taxing is important and not just in order to prevent inflation, or reduce concentrated economic power and social inequity, but to signal to the world that the government is not on an unrestrained course of currency debasement. On this issue I find the "Neo-rentierists" Michael Hudson and Steve Keen (who both view themselves as being broadly in the MMT camp) most persuasive (Hudson, 2012, 2015) (Keen, 2017) (Baiman, 2020). Both highlight the debilitating macroeconomic and income extraction role of money creation through ever increasing private debt in the absence of periodic debt cancellation or "Jubilee" as practiced in ancient civilizations. Judicious public money creation can be a used to offset this burden of private debt without generating similarly burdensome public debt obligations.

In addition to raising revenue and preventing inflation, the key objective for taxing rentiers would be to reduce the parasitic burden that they place on especially lower income and wealth households and real production, in order to eliminate or at least reduce the sacrifices in access to goods and services that these households and production may have to make in a GGND transition toward a more equitable and democratic economy and society. Broad improvements in distributional equity and production efficiency will for obvious reasons make a GNDMP transition less painful, more feasible, and more equitable. Taxing high income and wealth individuals would also mitigate their disproportionate GHG emissions from consumption.[9] Similarly, the purpose of taxing GHG emissions would obviously be to reduce them. This can be done with rebates to low wealth and low-income, households and countries, to avoid unfair burdens and perverse incentives (Rajan, 2019).

3. Short-Run Climate Restoration or Triage

As pointed above, we have already, or will shortly, pass a number of critical climate change thresholds. A tipping point like Arctic sea ice loss is likely to have a dramatic impact on other tipping points like Atlantic circulation and Jet stream slowing and location shifting, and accelerated Greenland ice-sheet shifting and melting, and possibly catastrophic permafrost methane release. The likely shifting of the Atlantic circulation and Jet stream if Greenland

[8] Op. cit. There is also some recent evidence that the dollar as world currency is beginning to be dethroned

[9] https://www.theguardian.com/environment/2015/dec/02/worlds-richest-10-produce-half-of-global-carbon-emissions-says-oxfam

replaces the Arctic as the central pole of low temperature (until the Greenland ice-sheet melts) would have severe impacts on regional climates throughout the globe, possibly transforming Spain and areas in northern Mexico and the southwest US into unlivable desserts, as is already occurring in parts of Africa and Asia where a combination of extreme heat and humidity is making human respiration and cooling, and thus outdoor non-air conditioned habitation impossible.[10] We are in an emergency situation that calls for emergency responses.

One of the more intriguing possibilities would mimic the way in which large scale volcanic eruptions temporarily cool the planet by suffer into the atmosphere. Solar-Geoengineering would mimic this by similarly releasing solar (or some other agent) into the upper atmosphere to cool the planet, and especially the polar regions, until more lasting solutions like soil and plant regeneration and carbon drawdown are put in place.

Prominent among these proposals has been that of David Keith, a professor of applied physics at Harvard, who has developed a detailed plan of action that, based on multiple state of the art climate models, would achieve an about 1.5-degree Celsius average cooling across the planet relative to scenarios with 2xCO2 (that would increase average temperature by about 2.5 degrees Celsius in these models) with no average change in precipitation, and reduced variation, and maximum, global temperatures and precipitation levels. In particular models have indicated that this proposal would reduce: 1) variations in water availability, 2) extreme precipitation, 3) tropical cyclones, and 4) extreme temperatures. Keith's idea is to inject 1.5 million tons of sulfur per year into the stratosphere (the eruption of Mt. Pinatubo released 8 million tons in 1991) at an estimated cost of only $ 5 billion to build 100 customized aircraft that would make about 120,000 flights per year to do this (commercial flights per year are about 40 million) (Keith, 2013, 2019).

Though Keith is very modest and cautious in emphasizing that much more research is needed before such a scheme should be tried, it appears that the current urgency of avoiding greater and probably irreversible climate catastrophe weighs in on the side of immediately moving forward with pilot projects and full-scale implementation.[11] Another compound that has been suggested is calcium carbonate (also released by volcanos) as sulfur may impact the Ozone layer (FCR, 2019, p. 22).[12] As with MMT, I think it would politically probably be most efficacious to label this as "volcanic simulation" or some similar, more familiar, label, rather than "solar geo-engineering" that conjures up disastrous technological overreach and extreme risk, like conventional nuclear power.

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[10] See for example this 12/13/2019 summary of "Our DIRE Climate Emergency" at COP25 in Madrid Spain by Dr. Peter Wadhams, Dr, Peter Carter, Paul Beckwith, and Regina Valdez https://youtu.be/Bje8JMuaDp4

[11] In communications with David Keith I pointed out that the Nordhaus based DICE projections, used in his presentation, were based on utterly unrealistic and unjustifiable methodology and empirical assumptions (Keen, 2019). Though Keith appeared to be aware of some of these problems, Nordhaus' influence in dampening urgency over climate change may be a significant barrier to moving climate triage forward (Keith, 2019) (Keen, 2019).

[12] Though Keith does believe the sulfuric ozone impact would be a significant danger, he is experimenting with other compounds like calcium carbonate (Keith, 2019).

A whole range of other potentially promising triage technologies that could make a real immediate difference in reducing the impact of global warming have been summarized in a recent white paper by "The Foundation for Climate Restoration" (FCR) (Fiekowsky et. al., 2019).[13] As the objective of the FCR is to promote private investment in these technologies, the focus in the white paper is on whether possible CO2 sequestration methods could potentially be *profitable*, as well as *scalable* and *permanent.* The three top "solutions" so identified are: 1) carbon-negative cement production to replace standard cement production, 2) ocean iron fertilization to stimulate ocean fertility and GHG sequestering, and similarly 3) marine permaculture growing of kelp and seaweed forests. Of these, carbon-negative cement using synthetic limestone produced from captured atmospheric CO2 has already successfully used in the San Francisco airport and appears to be commercially competitive with cement currently made from quarried limestone. FCR estimates that it would cost $250 billion per year to build 5,000 plants per year that each capture and sequester a million tons of carbon and produce 2 million tons of limestone, so that 5,000 plants would sequester 5 GT/CO2Eq per year.

Of the other techniques, Marine Permaculture based on mimicking Kelp forest growth near natural ocean upwelling, as proposed and demonstrated by Brian Von Herzen of The Climate Foundation (another prominent climate triage, applied physicist, engineer, and entrepreneur) may be able to absorb and permanently sequester significant amounts of CO2 from the ocean, as well as cool the ocean and help preserve coral reefs if placed near them, when rolled out to scale (Project Drawdown, 2017, pp. 179-80). Herzen has also worked on reversing coral bleaching using wave pumps and cool water from the deep ocean.[14] Though there is some controversy about whether Ocean Fertilization results in permanent sequestering, if it can, it may be another low-cost method for CO2 withdrawal ((Fiekowsky et. al., p. 16-17) (Jehne, 2019, p. 19).

See Table's 1 and 2 below for environmental and economic summaries of these and other triage techniques investigated in the FCR white paper. Note that the FCR white paper discusses "solar radiation management" (SRM) but does not recommend it immediately stating that "…it is premature to focus on SRM other than for research and avoiding emission from permafrost, until we commit to restoring safe levels of CO2." (FCR, 2019, Box 5, p. 22). As this white paper was written in Sep. 2019, before the recent evidence of accelerated permafrost melting and arctic methane release and possible beginning of a catastrophic global warming feedback loop (Freedman, 2019), the FCR position on SRM may have already changed.

The FCR white paper does discuss "iron salt aerosol" and "stratospheric aerosol injection" that works by adding "miniscule amounts of iron to ship or power plant fuel" that could eliminate atmospheric methane by catalyzing it into CO2 and water, increase cloud brightness, and increase ocean and land photosynthesis (FCR, 2019, p. 21). The later is specifically being

[14] http://www.climatefoundation.org/reversing-coral-bleaching.html

explored as method of reducing arctic sea-ice melt through standard commercial ship voyages in the arctic region.[15]

Table 1: Potential Climate Triage Methods

CO_2 SEQUESTRATION METHOD	SCALABILITY (>25 GT CO_2/YR)	FINANCEABILITY (FUNDING AVAILABLE NOW)	PERMANENCE (100 YRS +)	OTHER BENEFITS
SYNTHETIC LIMESTONE (Blue Planet, 2019)[1]	Yes, can scale to >25 GT CO_2/yr.	Yes, can be paid for by the construction industry buying product they would buy anyway.	Yes, CO_2 is sequestered for >100 yrs.	Resulting limestone is well suited to construction needs. Reduces the need for quarries.
OCEAN IRON FERTILIZATION (Martin, 1988)[3]	Yes, can scale to >25 GT CO_2/yr.	Yes, can be paid for through sales of commercial fishing licenses and taxes as fisheries rebound.	Yes, CO_2 is sequestered for >100 yrs.	Can revitalize marine ecosystems, providing food and livelihoods for struggling coastal communities.
MARINE PERMACULTURE/ RESTORING PRIMARY PRODUCTIVITY OF OCEANS (The Drawdown Agenda, 2018)[4]	Yes, can scale to >25 GT CO_2/yr.	Yes, can be paid for through sales of kelp and commercial fishing licenses.	Yes, CO_2 is sequestered for >100 yrs.	Provides important food source for marine life, improving ecosystem health.
DIRECT AIR CAPTURE (DAC) WITH CO_2 PUMPED UNDERGROUND (Doukas, 2017)[5]	Yes, can scale to >25 GT CO_2/yr.	No, would require government or donor funding, currently unbudgeted (Temple, 2019).[6]	Yes, CO_2 is sequestered for >100 yrs	N/A
OCEAN ALKALINIZATION (Ilyina et al, 2013)	Yes, can scale to >25 GT CO_2/yr.	No, would require government or donor funding, currently unbudgeted (Wang, 2012).[7]	Yes, CO_2 is sequestered for >100 yrs.	Reduces ocean acidity.
BIOENERGY WITH CARBON CAPTURE AND STORAGE (BECCS) (IPCC, 2018)[8]	No, can scale to 0-8 GT CO_2/yr.	No, cost of biofuel exceeds the market price for renewables, and growing biofuel competes with acreage for food crops and forests.	Yes, CO_2 is sequestered for >100 yrs.	Provides clean energy.
AGRICULTURE, FORESTRY, AND IMPROVED LAND USE (AFOLU); (IPCC, 2018).[9]	No, can scale to 1-11 GT CO_2/yr.	No, could be financed through coordinated public-private partnerships, but these are not currently in place.	Varies depending on intervention type and environmental conditions.	Improves soil health and productivity, increasing global food supply and livelihood for farmers.
OCEAN DOWNWELLING (Preuss, 2001), (de Figueiredo, n.d.).[10]	Could be >25 GT CO_2/ year, but net CO_2 removal is unproven.	No, could be financed through coordinated public-private partnerships, but these are not currently in place.	May be 100 yrs+, but unproven. More research needed.	NA

[15] https://youtu.be/1hhzrormtP4 "Geoengineering may be the answer to climate change", Vice News, 12/14/2019

Source: Fiekowsky et. al., 2019, Table 1, p. 11.

The economics of these CFR climate triage methods are summarized in Table 2 below.

Table 2: Potentially Effective Climate Triage Methods with Cost Estimates

SOLUTION, SCALED UP TO 50 GT CO_2/YR	NATURAL PROCESS IT MIMICS	PUBLIC FINANCING REQUIRED	INVESTMENT PER YEAR (FOR 10 YEARS) AND IRR*	ESTIMATE BASIS	NOTES
CARBON-NEGATIVE BUILDING MATERIALS	Shellfish build shells from CO_2 and Calcium	N/A	$250 B/yr to build up capacity by 5 billion tons/ year IRR = 15%	Blue Planet Ltd—business plan	$50/ton/ year at capacity; Quarried stone costs $30–200/ ton
OCEAN FERTILIZATION	Volcanic dust fertilizes the ocean	$20 M/yr for monitoring, public oversight	$300 M/yr for 10 years; IRR = 20%	Pasture Partners - business plan	300 pastures per year Removes ⅓ GT of CO_2 /yr/ pasture
PERMACULTURE ARRAYS WITH UPWELLING	Kelp forests near natural upwelling sites	$10 M/ yr for monitoring, public oversight	$100 B/yr for 10 years; IRR = 15%	Climate Foundation-business plan	To build arrays to cover 1 million km^2 per year, for 10 years.
TOTAL		$30 million a year for 30 years			

*IRR = internal rate of return, or annualized rate of earnings on an investment

Source: Fiekowsky et. al., 2019, Table 2, p. 24.

4. Medium-Term Soil and Water Cycle Climate Regeneration or Adaptation

There is no question that we need to rebalance our climate by reducing global warming and that increased GHG emission has been, since at least the late 20th century, a key driver of the increased net planetary heat absorption that is causing our climate crisis. Less well known, is that until the early 20th century human agriculture was the largest emitter of CO2 (Skuce, 2015).

We have to stop increasing and start drawing down GHG emissions. However, even getting to net zero will not stop existing calamitous climate change trends, it will just prevent them from getting even more catastrophic. Reversing the enormous damage to our environment that we have already caused through GHG drawdown alone could take centuries or even Millenia. Are there other things, in conjunction with GHG reduction and drawdown, that we can do to more immediately cool and stabilize our climate, by regenerating our soil and hydrology, and at the same time drawdown carbon emissions?

Walter Jehne, former CSIRO Climate Scientist and Microbiologist, founder of "Healthy Soils Australia" (HSA), is a leading advocate of this approach (Jehne, 2017). In an HSA white paper, Jehne points out that hydrology is responsible for 95% of planetary cooling and that "high input" agriculture including: "…excessive use of fire, cultivation, fertilizers, bio-cides, irrigation and fallowing all of which oxidize carbon." has led to declining levels of carbon in most agricultural soils over the past 100 years from about 5% to less than 1% in many places (Jehne, 2017, p. 2).

Jehne concludes (2017, p. 3):

"After over 50 years of warnings and 30 years of global policy denial and delay, it is now too late for reductions in future CO_2 emissions to adequately slow down its rise or its greenhouse effects. It is now too late even for the drawdown of carbon to zero or negative net emissions, by itself, to prevent accelerating the dangerous hydrological feedbacks and climate extremes."

Instead, we must face the reality that we have seriously disturbed the Earth's climatic balances which will continue to accelerate dangerous climate extremes and impacts unless we immediately take the following steps:

1. **Safely and naturally cool regional and the global climate** by three watts per square meter to offset and buffer the greenhouse warming we have induced to date.
2. **Secure the essential water (and thus food) needs** of the more than 5 billion people (over half the projected population) expected live in urban concentrations by mid-century, so as to sustain their stability.
3. **Regenerate and extend the resilience of the Earth's residual bio-systems** so they buffer these climate extremes and secure our water, food, and life essentials."

The HSA white paper offers an extensive plan for doing this and drawing down 20 btC (or roughly 74 GT CO2 Eq)[16] per year by 2030 on a global scale, see Table 3 below.

Table 3: Soil and Water Cycle Climate Regeneration Methods[17]

	Current accounts			Regenerated targets by 2030 via the project			
Activity	**Area bha**	**Rate tC/ha/an**	**Emissions btC**	**Area bha**	**Rate tC/ha/an**	**Emissions btC**	**Potential savings btC/an**
a. Our global carbon emissions per an.			**130**			**unknown**	
a.1 Forest fires	0.4	30	12	0.2	20	4	-8
a.2 Grass fire	2	3	6	0.5	2	1	-5
a.3 Coral acidific.	2	2	4	2	1	2	-2
a.4 Cement manuf.			4			3	-1

[16] Op. cit., see footnote 14

[17] Source: (Walter Jehne, 2019, Table 1, p. 3)

a.5 Fossil fuel oxid.			10			7	-3
a.6 Soil C oxidation	6	3	18	8	-1	-8	-26
a.7 Landfill wastes			3			2	-1
Net potential change			**56**			**11**	**-45**
a.8 Respiration			74			unknown	
b. Our global carbon draw down per an			**120**			**144**	
b.1 Forest regeneration	3.5	10	35	3.5	15	52	+17
b.2 Grassland regeneration	4	4	16	4	5	20	+4
b.3 Cropland regeneration	1.5	5	7.5	1.5	5	7.5	0
b.4 Current deserts & wasteland activities	5	0.5	2.5	3.0	0.5	1.5	-1
b.5 Regenerating degraded wasteland				2.0	2.0	4	+4
b.6 Ocean regeneration	34	1.7	59	34	1.8	61	+2
Net potential change							**+26**
Potential change to carbon budgets.							71 btC/an

These methods are focused on restoring top soil and the "soil carbon sponge" that absorbs and filters water for long durations and incubates the fundamental microbial processes through which plants access nutrients, fix carbon, and create soil. So, for example method "a.1 Reduce forest wildfires," is focused on stimulating natural fungi that can convert forest fuels into stable soil to reduce forest risk and intensity, and method "a.4 Cement manuf." is based on using less cement to foster more "urban forest canopies and water absorbent soil sponges" in our built environment.

Jehne claims that there is now a roughly 10 btc per year mismatch between total current global emissions 130 btc, and drawdown 120 btc,[18] and develops a plan to cover this gap and drawdown

[18] Jehne is using a more comprehensive accounting of the global carbon cycle than that used by the IPCC that for example includes emissions from forest fires and respiration (personal communication 12/12/2019). He is also measuring carbon rather than CO2 equivalent GHG, based on the conversion he used in (Jehne, 2019, p. 9) cited above approximately: 1 btc = 3.7 btCO2 Eq. GHG. In this context it's important to note that there are other more short-term but often extremely potent GHG emission others than CO2 like: methane, tropospheric ozone, and

an additional 10 btc by 2030, by achieving 28% of the 71 btc (-45 btc emissions reduction plus 26 btc drawdown) goals outlined in Table 3.

Most noticeably, Jehne assumes a goal of only a 30% reduction in carbon emission from fossil fuel use over the next 10 years. He notes that, though based on the accounting above, humanity emits some 10 billion tons of carbon (37 btCO2) annually from burning fossil fuels, this is only 7-8% of the 130 btC/an emitted from all sources, and opines that:

"More problematic is that many of the 7.5 billion people now on Earth rely on the energy form fossil fuels to sustain their essential needs, industrial ecology and social stability. Any major cut in its use may lead to global economic and social instability and more ecological exploitation and damage.

Given that it is an imbalance that that we need to fix, there may be ways to do this other than by ceasing all use of a socially critical component and instead altering other components to restore the balance."

Is this a cop-out all realism? I'm inclined toward the later given our current track record. The fact that dominant share of oil production is state owned, and that when countries such as Ecuador offered to not exploit new oil reserves if the international community would refund an equivalent sum to do this, there were no takers (Bremmer, 2010) (Goldman, 2017). In line with GGND goals it would make sense to first stop private investor driven fossil fuel production and use by forcing losses on wealthy private investors and financial institutions while offering retraining and alternative comparable jobs to fossil fuel workers and communities, but slowing down this transition for developing countries that depend on, often largely nationalized, fossil fuel production for development and growth.

Jehne has worked up a five-year plan with cost estimates for implementing these methods, see Table 4 below. Remarkably he estimates total global costs for this five-year 2020-2025 soil and water cycle climate regeneration plan at only $ 100 million. Though this appears like an exceedingly low estimate, note again that Jehne's methods rely on natural, and often microbiol processes, and assume extensive grass roots community mobilization.

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hydrofluerocarbon refrigerants (Zaelke and Bledsoe, 2019). As noted below, curbing hydrofluerocarbon refrigerants are the number #1 Project Drawdown GHG reduction method.

Table 4: Soil and Water Cycle Climate Regeneration Methods with Cost Estimates[19]

No	Activity	Saving of btC	Year 1 2020	Year 2 2021	Year 3 2022	Year 4 2023	Year 5 2024	Total $ m	% of budget
1.	Project Management								
1.1	Proj. coordination		2	1	1	0.5	0.5	**5**	5
1.2	Communication		2	1	0.5	0.5	1	**5**	5
1.3	Implementation		1	2	1	0.5	0.5	**5**	5
1.4	Project evaluation		0.5	3	2.5	2	2	**10**	10
1.5	Project overheads		0.5	1.5	1.2	1	0.8	**5**	5
	Sub total 1		6	8.5	6.2	4.5	4.8	**30**	30
2	Regeneration implementation								
2a	Emission reduction								
2a.1	Forest wildfires	**8**	1	3	1	1	0	**6**	6
2a.2	Grassland fires	**5**	0.5	2	1	0	0	**3.5**	3.5
2a.3	Coral acidification	**2**	0	0	0	1	0.5	**1.5**	1.5
2a.4	Cement use	**1**	0	0	0	0	1	**1**	1
2a.5	Fossil fuel use	**3**	0	0	0	0	1	**1**	1
2a.6	Soil oxidation	**26***	1	4	2	2	1	**10**	10
2a.7	Landfills	**1**	0	0	0	0.5	0	**0.5**	0.5
2a.8	Land respiration	**?**	0	0	0	0	0	**0**	0
2b	Carbon draw down								
2b.1	Forest regener.	**17**	0.5	2	2	2	0	**6.5**	6.5
2b.2	Grass regener.	**4**	0.5	1.5	1	0.5	0	**3.5**	3.5
2b.3	Cropland regener.	**0**	0	0	2	1	0	**3**	3
2b.4	Desert regener.	**-1**	0	0	0.5	0	0	**0.5**	0.5
2b.5	Arid zone regener.	**4**	0	3	2	2	0.5	**7.5**	7.5
2b.6	Ocean blue carbon	**2**	0	0	0	1	0.5	**1.5**	1.5
2b.7	Upland wetlands	***2a.6**	0	1	1	0.5	0	**2.5**	2.5
2b.8	City to Soil	***2a.6**	0.5	1	1	0.5	0	**3**	3
2b.9	Urban agriculture	***2a.6**	0	2	2	3	2	**9**	9
2b.10	The urban sponge	***2a.6**	0	0	0	0.5	0	**0.5**	0.5
2b.11	Bio-fertilizers	***2a.6**	0	0	0.5	1	0.5	**2**	2
2b.12	Innovation aids	**?**	0	0	1.8	3.0	2.2	**7**	7
	Sub total 2		4	19.5	17.8	19.5	9.2	**70**	70
	Total 1 and 2		**10**	**28**	**24**	**24**	**14**	**100**	**100**

[19] Source: (Walter Jehne, 2019, Table 2, p. 4)

5. Long-Term GHG Drawdown or Mitigation

Finally, Table 5 below summarizes 56 methods offered by Project Drawdown for reducing GHG over the next thirty years 2020-2050 for which cost estimates have been derived (Project Drawdown, 2017). Project Drawdown uses the conventional framing that the most effective way to avoid climate catastrophe is through GHG reduction and eventual drawdown, and there is no doubt that we must do this. Though, as noted above though the climate mitigation effects of this may take centuries or millennia to be realized, if we don't do this we will face increasingly catastrophic climate events no matter how much triage and regeneration we do.

As can be seen in Table 5, these 56 Project Drawdown methods are estimated to achieve a 555.56 mtCO2 Eq. GHG drawdown. cost $28.9 trillion, and save $ 68.1 trillion, over the next 30 years from 2020-2050.

Table 5: Project Drawdown GHG Drawdown Climate Mitigation Methods with Cost Estimates

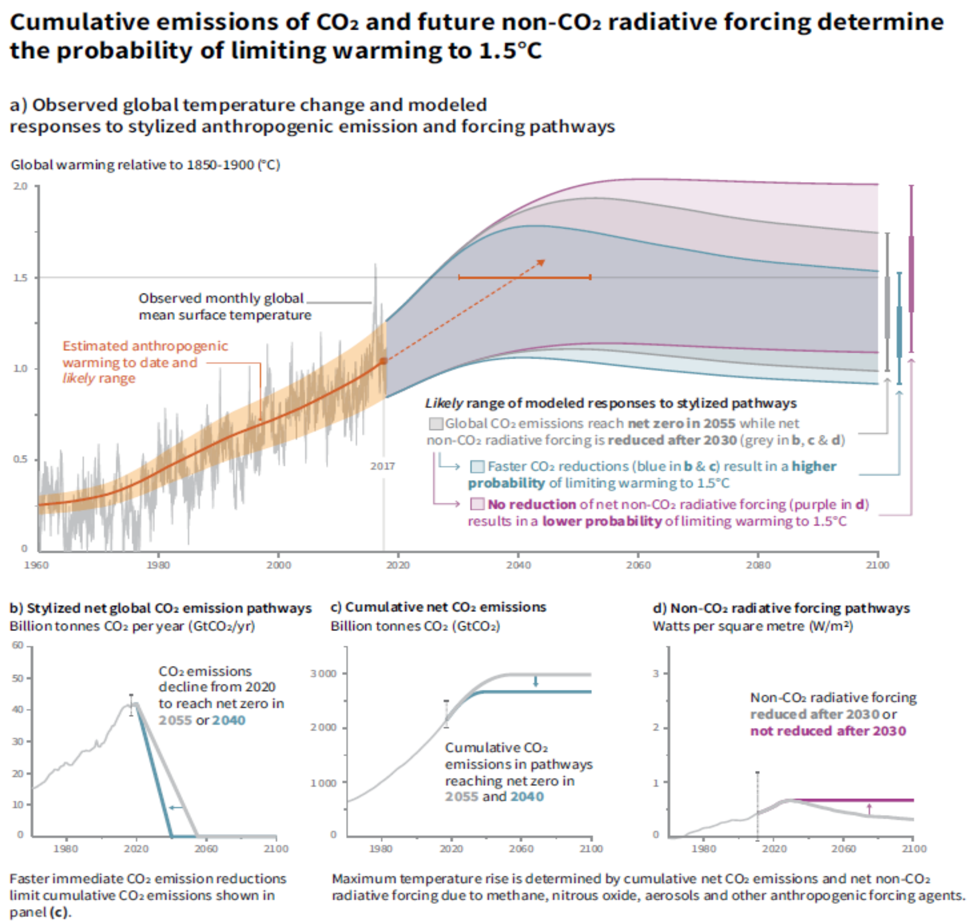
		Economic or Social Sector Impacted	Total Atmospheric CO2 eq Reduction (GT)	Net Costs (Billions U. $)	Savings (Billions U.S. $)	Methods Included in Co2 eq Reduction and Cost Totals	Cumulative CO2 eq Reduction for Methods with Cost Estimates (GT)	Cumulative Net Costs for Methods with Cost Estimates (Billions US $)	Cumulative Savings for Methods with Savings Estimates (Billons US $)
1	**Regrigerant Management**		89.74	N/A	($902.77)				
2	**Wind Turbines (Onshore)**	Electricity Generation	84.6	$1,225.37	$7,425.00	1	84.6	$1,225.37	$7,425.00
3	**Reduced Food Waste**	Food	70.53	N/A	N/A				
4	**Plant-Rich Diet**	Food	66.11	N/A	N/A				
5	**Tropical Forests**	Land Use	61.23	N/A	N/A				
6	**Educating Girls**	Women and Girls	51.48	N/A	N/A				
7	**Family Planning**	Women and Girls	51.48	N/A	N/A				
8	**Solar Farms**	Electricity Generation	36.9	($80.60)	$5,023.84	2	121.5	$1,144.77	$12,448.84
9	**Silvopasture**	Food	31.19	$41.59	$699.37	3	152.69	$1,186.36	$13,148.21
10	**Rooftop Solar**	Electricity Generation	24.6	$453.14	$3,457.63	4	177.29	$1,639.50	$16,605.84
11	**Regenerative Agriculture**	Food	23.15	$57.22	$1,928.10	5	200.44	$1,696.72	$18,533.94
12	**Temperate Forests**	Land Use	22.61	N/A	N/A				
13	**Peatlands**	Land Use	21.57	N/A	N/A				
14	**Tropical Staple Trees**	Food	20.19	$120.07	$626.97	6	220.63	$1,816.79	$19,160.91
15	**Afforestation**	Land Use	18.06	$29.44	$392.33	7	238.69	$1,846.23	$19,553.24
16	**Conservation Agriculture**	Food	17.35	$37.53	$2,119.07	8	256.04	$1,883.76	$21,672.31
17	**Tree Intercropping**	Food	17.2	$146.99	$22.10	9	273.24	$2,030.75	$21,694.41
18	**Geothermal**	Electricity Generation	16.6	($155.48)	$1,024.34	10	289.84	$1,875.27	$22,718.75
19	**Managed Grazing**	Food	16.34	$50.48	$735.27	11	306.18	$1,925.75	$23,454.02
20	**Nuclear**	Electricity Generation	16.09	$0.88	$1,713.40	12	322.27	$1,926.63	$25,167.42
21	**Clean Cookstoves**	Food	15.81	$72.16	$166.28	13	338.08	$1,998.79	$25,333.70
22	**Wind Turbines (Offshore)**	Electricity Generation	14.1	$545.30	$762.50	14	352.18	$2,544.09	$26,096.20
23	**Farmland Restoration**	Food	14.08	$72.24	$1,342.47	15	366.26	$2,616.33	$27,438.67
24	**Improved Rice Cultivation**	Food	11.34	N/A	$519.06				
25	**Concentrated Solar**	Electricity Generation	10.9	$1,319.70	$413.85	16	377.16	$3,936.03	$27,852.52
26	**Electric Vehicles**	Transport	10.8	$14,148.00	$9,726.40	17	387.96	$18,084.03	$37,578.92
27	**District Heating**	Buildings and Cities	9.38	$457.10	$3,543.50	18	397.34	$18,541.13	$41,122.42
28	**Multistrata Agroforestry**	Food	9.28	$26.76	$709.75	19	406.62	$18,567.89	$41,832.17
29	**Wave and Tidal**	Electricity Generation	9.2	$411.84	($1,004.70)	20	415.82	$18,979.73	$40,827.47
30	**Methane Digesters (Large)**	Electricity Generation	8.4	$201.41	$148.83	21	424.22	$19,181.14	$40,976.30
31	**Insulation**	Buildings and Cities	8.27	$3,655.92	$2,513.33	22	432.49	$22,837.06	$43,489.63
32	**Ships**	Transport	7.87	$915.93	$424.38	23	440.36	$23,752.99	$43,914.01
33	**LED Lighting (Household)**	Buildings and Cities	7.81	$323.52	$1,729.54	24	448.17	$24,076.51	$45,643.55
34	**Biomass**	Electricity Generation	7.5	$402.31	$519.35	25	455.67	$24,478.82	$46,162.90
35	**Bamboo**	Land Use	7.22	$23.79	$264.80	26	462.89	$24,502.61	$46,427.70
36	**Alternative Cement**	Materials	6.69	($273.90)	N/A	27	469.58	$24,228.71	
37	**Mass Transit**	Transport	6.57	N/A	$2,379.73				
38	**Forest Protection**	Land Use	6.2	N/A	N/A				
39	**Indigenous Peoples' Land Manag**	Land Use	6.19	N/A	N/A				
40	**Trucks**	Transport	6.18	$543.54	$2,781.63	28	475.76	$24,772.25	$49,209.33
41	**Solar Water**	Electricity Generation	6.08	$2.99	$773.65	29	481.84	$24,775.24	$49,982.98
42	**Heat Pumps**	Buildings and Cities	5.2	$118.71	$1,546.66	30	487.04	$24,893.95	$51,529.64
43	**Airplanes**	Transport	5.05	$662.42	$3,187.80	31	492.09	$25,556.37	$54,717.44
44	**LED Lighting (Commercial)**	Buildings and Cities	5.04	($205.05)	$1,089.63	32	497.13	$25,351.32	$55,807.07
45	**Building Automation**	Buildings and Cities	4.62	$68.12	$880.55	33	501.75	$25,419.44	$56,687.62
46	**Water Saving - Home**	Materials	4.61	$72.44	$1,800.12	34	506.36	$25,491.88	$58,487.74
47	**Bioplastic**	Materials	4.3	$19.15	N/A	35	510.66	$25,511.03	
48	**In-Stream Hydro**	Electricity Generation	4	$202.53	$568.36	35	514.66	$25,713.56	$59,056.10
49	**Cars**	Transport	4	($598.69)	$1,761.72	36	518.66	$25,114.87	$60,817.82
50	**Cogeneration**	Electricity Generation	3.97	$279.25	$566.93	37	522.63	$25,394.12	$61,384.75
51	**Perennial Biomass**	Land Use	3.33	$77.94	$541.89	38	525.96	$25,472.06	$61,926.64
52	**Coastal Wetlands**	Land Use	3.19	N/A	N/A				
53	**System of Rice Intensification**	Food	3.13	N/A	$677.83				
54	**Walkable Cities**	Buildings and Cities	2.92	N/A	$3,278.24				
55	**Household Recycling**	Materials	2.77	$366.92	$71.13	39	528.73	$25,838.98	$61,997.77
56	**Industrial Recycling**	Materials	2.77	$366.92	$71.13	40	531.5	$26,205.90	$62,068.90
57	Smart Thermostats	Buildings and Cities	2.62	$74.16	$640.10	41	534.12	$26,280.06	$62,709.00
58	Landfill Methane	Buildings and Cities	2.5	($1.82)	$67.57	42	536.62	$26,278.24	$62,776.57
59	Bike Infrastructure	Buildings and Cities	2.31	($2,026.97)	$400.47	43	538.93	$24,251.27	$63,177.04
60	Composting	Food	2.28	($63.72)	($60.82)	44	541.21	$24,187.55	$63,116.22
61	Smart Glass	Buildings and Cities	2.19	$932.30	$325.10	45	543.4	$25,119.85	$63,441.32
62	Women Smallholders	Women and Girls	2.06	N/A	$87.60				
63	Telepresence	Transport	1.99	$127.72	$1,310.59	46	545.39	$25,247.57	$64,751.91
64	Methane Digesters (Small)	Electricity Generation	1.9	$15.50	$13.90	47	547.29	$25,263.07	$64,765.81
65	Nutrient Management	Food	1.81	N/A	$102.32				$64,868.13
66	High-speed Rail	Transport	1.52	$1,038.42	$368.10	48	548.81	$26,301.49	$65,236.23
67	Farmland Irrigation	Food	1.33	$216.16	$429.67	49	550.14	$26,517.65	$65,665.90
68	Waste-to-Energy	Electricity Generation	1.1	$36.00	$19.82	50	551.24	$26,337.49	$65,685.72
69	Electric Bikes	Transport	0.96	$106.75	$226.07	51	552.2	$26,624.40	$65,911.79
70	Recycled Paper	Materials	0.9	$573.48	N/A	52	553.1	$26,910.97	
71	Water Distribution	Buildings and Cities	0.87	$137.37	$903.11	53	553.97	$27,048.34	$66,814.90
72	Biochar	Food	0.81	N/A	N/A				
73	Green Roofs	Buildings and Cities	0.77	$1,393.29	$988.46	54	554.74	$28,036.80	$67,803.36
74	Trains	Transport	0.52	$808.64	$313.86	55	555.26	$28,845.44	$68,117.22
75	Ridesharing	Transport	0.32	N/A	$185.56				
76	Micro Wind	Electricity Generation	0.2	$36.12	$19.90	56	555.46	$28,881.56	$68,137.12
77	Energy Storage (Distributed)	Electricity Generation	N/A	N/A	N/A				
77	Energy Storage (Utilities)	Electricity Generation	N/A	N/A	N/A				
77	Grid Flexibility	Electricity Generation	N/A	N/A	N/A				
78	Microgrids	Electricity Generation	N/A	N/A	N/A				
79	Net Zero Buildings	Buildings and Cities	N/A	N/A	N/A				
80	Retrofitting	Buildings and Cities	N/A	N/A	N/A				

6. **Financial Bailout Spending Would Have Almost Paid for Thirty Years of Global Green New Deal Climate: Triage, Regeneration, and Mitigation**

The 2018 SR15 IPCC carbon budget estimate for a 66% chance for earth to stay below 1.5 Celsius above pre-industrial world average temperature has been estimated by the IPCC to be 420 btCO2 or roughly 10 years of current GHG CO2 Eq. emissions (42 btCO2).[20]

As shown in Table 5, GHG drawdown over 30 years for the 56 Project Drawdown methods for which there are cost estimates is about 556 mtCO2. From Figure 4 below, drawn from p. 6 of the SR15, it appears that 30 years of reducing GHG's by 42x30/2= 630 btCO2 Eq. would surpass our ten-year carbon budget but give us a chance of staying below 1.5 C. The 556 btCO2 Eq. reduction from implementing the 56 Project Drawdown methods above would thus achieve 556/630=0.88 or 88% of this necessary drawdown.

Figure 4: GHG Reduction Needed to Stay Below 1.5 Celsius Global Warming[21]



The last row of the last three columns of Table 5 show cumulative: CO2 eq reduction 555.46 (GT), Total Cost $28,881.56 billion, and Total Net Savings $68,137.12 billion. The methods by which these costs and net savings estimates have been calculated could presumably serve as a

[20] Op. cit. Footnote 17.

[21] https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf

basis for a GGND spending plan for 2020-2050. As this would occur over a thirty-year period the "spending" would be cumulative but revolving and include return payments and rollovers of loans, credits, and guarantees, and new loans, credits and guarantees, that would be issued over this period of time to support the GGND.

The most comprehensive estimate of the total amount of monetary "commitments", including revolving cumulative lending, guarantees, and spending made by the Fed over 2008-2011 to bail-out global finance is $ 29 T or roughly the same as the $ 28.9 T estimate above for the total amount of "cash" needed to pay to reduce GHG emissions by 555.46 CO2 eq. GT or 88% of the 630 CO2 eq. GT needed keep average global temperatures from rising by more than 1.5 degrees Celsius over the 2020-2050 period.

Note that this GGND spending estimate also results in a $68.1 T net savings estimate and a much longer 30 year "roll-over" period for the spending than the roughly three-year 2008-2011 period for the $ 29 T global financial bail-out estimate.[22]

Furthermore, even if we add the costs of potentially effective triage and regeneration methods for the periods indicated in the plans outlined in Sections 3-5, this would only add $ 1.3 trillion so that overall cost for these (with extensive overlap and double counting between the methods of Tables 3-5) would be $ 30.2 T, so that the $ 29 T financial bailout would have covered 96% of this cost, see Table 6 below.

Table 6: Additional Cost of Triage and Regeneration Methods

	Cost/an $ b	Years	Cummulative $ b
Solar Geoengineering		5	$ 5.00
Carbon Negative Cement	$ 250.00	5	$ 1,250.00
Permaculture Arrays with Upwelling	$ 0.32	10	$ 3.20
Soil and Water Cycle Climate Regeneration	$ 0.10	5	$ 0.50
Total			$ 1,258.70

As in the case of the global financial bailout accounting below, return payments are *not* deducted from the cost estimates. In the Project Drawdown estimates they would presumably come out of the estimated "Net Savings". Moreover, as discussed in Section 2, for direct equity and efficiency reasons, and in order to most effectively reduce demand driven GHG emissions, U.S. demands for pay-backs if these were funding through "Marshall Plan" style loans and credits, should be tilted (like Marshall Plan Policies stipulating land reform and break-up of industrial monopolies) in a progressive direction toward taxing high income, wealth, and generally unproductive monopolistic rentier sectors like private fossil fuel production and the "Finance, Insurance, and Real Estate" (FIRE) sector.

Also, per the discussion in Section 2, spending alone will not produce a GGND. The increase (or decrease, if net financial savings resulted in job and income losses) in investment, employment, income, and consumption, particularly in developing countries, from GGND spending would

[22] There is abundant evidence that the Fed's largesse was not just used to bail-out nominally U.S. (with global exposure) financial institutions, but also directly and indirectly through "counter-party" bailouts, "foreign" financial institutions (Hudson, *Killing the Host* (2015, Dresden: ISLET-Verlag).

need to be offset by taxing the wealthy (to create slack or more jobs) for global equity and so that this spending will result in reallocation and creation of *real* economic capacity to reduce net GHG emissions and not just bottlenecks and unsustainable inflation. The 56 Project Drawdown projects summed up in Table 5 not only exclude highly ranked methods for which cost and savings estimates are not available, but also family planning and other population growth reduction measures and most importantly other critically important GHG *demand side* reductions from income and wealth *redistribution*.

Moreover, about half of global GHG emissions come from the consumption of the upper 10% of income earners.[23] So that the effectiveness of the GGND will also depend on the extent to which it redistributes most of the benefits of green economic transition toward lower income and wealth households and productive sectors, and places most of the burdens of the transition on the wealthy and rentier sectors. In this sense the GGND would be a complete reversal of the Neoliberal International Monetary, World Bank, and Federal Reserve policies of the last few decades.

The question before us may thus be framed in a nutshell. Are modern civilization and species survival more important than the Neoliberal order, and global finance and Neo-rentierism?

[23] Op. cit., footnote 6.

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