MuseLetter

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The last Museletter of this year contains two essays. The first essay, Can We Have Our Climate and Eat It Too?, was written during the Paris climate talks which have just finished to much fanfare. World leaders have agreed on an aspirational goal of keeping climate change below 1.5 degrees Celsius, unfortunately they have yet to agree on sufficient action to make it so. My essay searches for some clarity in this fog of wishful thinking. The second essay this month is a tribute to my friend Doug Tomkins who died last week. Doug was one of a kind in his dedication to protecting the beautiful world we live in.

Thanks for your support in 2015. I wish you a Happy Holiday and all the very best for 2016.
Richard

Can We Have Our Climate and Eat It Too?

As much as world leaders would like to focus attention on their economies, terrorism, or winning the next election, the heat is rising. Each new release of data on melting glaciers and extreme weather seems more dire than the last, and each governmental COP meeting organized to come up with an agreement on what to do about the climate crisis is freighted with more hopes and fears.

Because it is so urgent, climate change is leading to divisions within and among societies. There is of course a divide between those who take climate science seriously and those who don't (here in the United States, the latter are so politically powerful as to have effectively blocked, for now, the possibility of a legally binding global emissions pact). Then there is the division between wealthy nations, such as the US and UK (that are responsible for the bulk of historic carbon emissions, and that therefore should rightly reduce fossil fuel consumption more rapidly—though they don't want to) and poorer nations like India (that bear little responsibility for existing surplus atmospheric carbon, and that would like to be able to burn more coal for the time being so as to grow their economies).

Yet another rift is developing between the military and the rest of society: military emissions are not counted in official UN climate statistics due to lobbying by the United States, yet that country's military establishment is the single largest sub-national consumer of fossil fuels on the planet; further, it is difficult to imagine how the US government could afford to subsidize the transition to carbon-free

electricity, agriculture, manufacturing, and transportation without tapping into its trillion dollar-per-year military and intelligence budget.

Each of these divides is likely to deepen as global warming becomes less of a forecast and more of a harsh reality. But there is one more division of opinion and action that I propose to explore for the remainder of this essay; it turns on the question of whether we can maintain economic growth while stabilizing the climate.

In This Corner: Climate Technofix

On one side of this divide are those who wish to preserve (or who see the usefulness of promising to preserve) the economic status quo while reducing carbon emissions. They are driven by the belief that political realism requires minimal interference with industrial lifestyles and priorities—particularly economic growth. Business as usual can be maintained, it is said, through the deployment of one or more of a suite of technologies.

The first set of these technologies consists of wind and solar electric power generators. Renewable energy technologies comprise a disruptive, unstoppable juggernaut that out-performs fossil fuels and creates growth and jobs, according to their most boosterish advocates. An almost entirely wind-and-solar future is entirely affordable; indeed it will be cheaper than a status-quo fossil fueled future. The energy transition will thus entail only benefit and no sacrifice.

Other technofixers, who think solar and wind are incapable of fully replacing fossil fuels in the time we have for the transition (because they produce power intermittently), instead praise the potential for nuclear power. New versions of atomic reactors (modular mini-reactors, thorium reactors, fast breeder reactors) are now on the drawing boards and, if the promotional literature is to be believed, they will to be cheaper and safer than existing models.

Still others say fossil fuels are so central to our present economy that they cannot be abandoned altogether, or not quickly enough; the technofix in this case is Carbon Capture and Storage (CCS). We can continue burning coal while catching and burying the carbon released from its combustion before it can do any harm to the climate. The technology has been proven on a small scale; all that's required is sufficient investment. Other variations on this theme include burning biomass and burying the CO2 underground (BECCS), enhanced weathering (EW), and direct air capture (DAC).

If all else fails, say the technofixers, geoengineering can remove carbon from the atmosphere by seeding the oceans with iron, or it can make the planet's atmosphere more reflective so as to reduce heating.

Clearly, not all of the groups I have described here see eye to eye: for example, many renewables advocates are anti-nuclear, anti-CCS, and anti-geoengineering. And only some renewables advocates can be described as technofixers (though the lion's share of nuclear, CCS, and geoengineering boosters fairly can). More on that shortly.

In the Other Corner: Managed Powerdown

The other side of the divide argues that catastrophic climate change cannot be averted without a steep reduction in global energy use, and such a reduction will in turn inevitably mean economic contraction. Technology can assist in our adaptation to a new energy regime and a smaller economy, but it cannot realistically propel further industrial expansion of the kind seen during the 20th century.

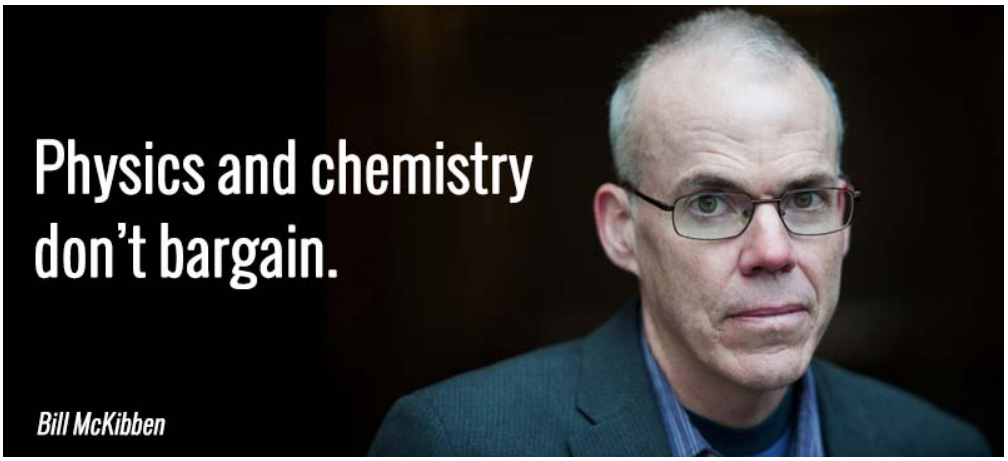
Many powerdown proponents see climate change as a symptom of the deeper problem described in the 1972 Limits to Growth scenario studies. As population and per capita consumption increase, a point will inevitably be reached when resource depletion and environmental pollution make further growth impossible. According to this view, climate change is an expression of the pollution dilemma inherent in the expansion of population and per capita resource consumption; low-carbon technologies might be able to slow the trend toward ecosystem collapse driven by unbridled economic growth, but they cannot by themselves prevent collapse; only efforts to reduce population and consumption undertaken sufficiently early in the trend could accomplish that. Ecological footprint and planetary boundaries analysis offer confirmation, showing that current human population and consumption levels are drawing down Earth's biocapacity and interfering with its natural support systems.

It is important to note that many renewable energy advocates are powerdowners who regard solar and wind power as insufficient by themselves to halt catastrophic climate change, absent fundamental economic change that would see per capita use of energy and materials decline significantly in industrial nations.

Others with a powerdown perspective say that while CCS and geoengineering are unworkable, carbon sequestration could indeed be accomplished via basic changes to agriculture that would enable farmers to build soil rather than destroying it (which is the net effect of current practices). Humanity has removed 136 Gt of carbon from soils through agriculture and other land use during the industrial era. There is the potential to reverse the trend by minimizing tillage, planting cover crops, encouraging biodiversity, employing crop rotation, expanding management intensive pasturing, and introducing properly made biochar to soils. But that would mean rapidly revolutionizing the entire global agricultural system—in effect, partially (and intelligently) de-industrializing it.

According to its advocates, although powerdown goes against the grain of near-universal preference for further industrial expansion, it is a strategy that has one significant advantage: it is a proven way to slow and reverse climate change, since historic economic recessions have correlated closely with slower growth in carbon emissions. If economic contraction were managed, its unwanted adverse human consequences could be minimized, while its environmental benefits could be maximized.

The fact that I wrote a book titled *Powerdown* may tell you on which side of this divide I personally fall.



Reality Chooses Sides

Were technofix and powerdown to be put to a vote today, there is little doubt which side would win. Most people in industrialized nations prefer to continue living essentially as they do now, while most in poorer countries aspire to join them by consuming more manufactured goods and becoming more mobile. But controversies are often decided ultimately not by the relative popularity of the ideas in play, but by the accuracy with which those ideas reflect physical reality. Just as the ongoing controversy over whether climate change is real and caused by humans is mooted by the very real impacts of increasing atmospheric carbon levels, the hope that new machines can protect cherished lifestyles in the face of climate chaos may be destined for a similar fate.

First, the speed and scale of emissions reduction that is actually required probably cannot be achieved while preserving the economic status quo. As climate scientist Kevin Anderson points out in a recent *Nature Geoscience* paper:

> According to the IPCC's Synthesis Report, no more than 1,000 billion tonnes (1,000 Gt) of CO2 can be emitted between 2011 and 2100 for a 66% chance (or better) of remaining below 2° C of warming (over preindustrial times). . . . However, between 2011 and 2014 CO2 emissions from energy production alone amounted to about 140 Gt of CO2. . . ." [Subtracting realistic emissions budgets for deforestation and cement production,] "the remaining budget for energy-only emissions over the period 2015–2100, for a 'likely' chance of staying below 2° C, is about 650 Gt of CO2.

Those 650 gigatons of carbon equate to just 19 years of continued business-as-usual emissions from global fossil energy use. The notion that the world could make a complete transition to alternative energy sources, using only a scant two-decade fossil energy budget, while avoiding significant economic disruption, can be characterized as optimistic to a degree that stretches credulity. In fact, it is becoming clear that the 2° Celsius target may now be politically unachievable (it looks as though commitments delivered to the COP 21 meetings in Paris will only be capable of hitting a target of around 2.7° C); the closer to 2° C that future negotiators are able to come in their

commitments, the more economic compromise will have to be accepted. If the target were to be revised down to 1.5° C—a goal that seems to be gaining traction at COP21 as I write—the challenge will be even greater.

Also, while solar and wind power are getting cheaper, their current rate of deployment is far too slow to replace coal, oil, and natural gas quickly enough to keep warming anywhere near the still-official goal of 2° C. That means far more investment is needed, which only a wartime level of government intervention in the economy is likely to organize. And these energy sources still pose technical challenges at high rates of penetration in the overall energy mix. While solar and wind energy production is greatly expandable, these sources yield energy variably and uncontrollably. It takes additional technology and capacity redundancy to adapt these sources to our 24/7 energy demand patterns. If societies could get by on baseload power from hydro, geothermal, biogas, and biomass, a transition to renewables would be much more affordable and systems would be easier to engineer. This is the case in countries like Uruguay, which has made headlines recently for generating 95% of its electricity from renewable energy. But that would mean using much less energy overall—which leads us back again to the powerdown argument.

Nuclear power capacity is expensive to build, and the nuclear waste problem is yet to be solved. Few nations are expanding their fleets of reactors, while the ongoing Fukushima crisis continues to highlight the risks and costs of existing nuclear technology. Tellingly, the nuclear industry seems incapable of delivering new plants on time and on budget. In order for the nuclear industry to grow sufficiently so as to replace a significant portion of energy now derived from fossil fuels, hundreds of new plants would be required, and soon. The enormous investment needed for such a build-out would probably preclude simultaneous large-scale government financial support for solar and wind generators. More realistically, given the expense and long lead-time entailed in plant construction, the nuclear industry may do well merely to build enough new plants to replace old ones that are nearing retirement and decommissioning. In short, it would simply be unrealistic to expect a nuclear renaissance as an alternative to a massive shift toward renewable energy in addressing the climate dilemma.

Carbon Capture and Storage technology (often advertised as "clean coal") is likewise proving too expensive and impractical. Despite a massive public relations offensive by the coal industry, the technology is currently used only where there is a robust market for carbon dioxide (notably in the oil and soft drinks industries). If carbon were priced sufficiently high to make CCS financially sensible, the resulting electricity price would far exceed that of wind and even solar PV power. Other forms of carbon capture are untested at scale or are likely to carry prohibitive costs.

Meanwhile geoengineering presents risks on a nearly unprecedented scale (the only obvious precedent being climate change itself). Every technology has unintended consequences; technologies designed to change the chemistry of the atmosphere or oceans could have unintended consequences as serious as the climate crisis they are intended to address.

Finally, technofixers nearly always appeal to the phenomenon of economic decoupling (wringing more and more economic growth from less and less energy and materials throughputs) as a way to achieve the logically impossible, citing evidence of modest past decoupling as proof that far more robust decoupling is possible in the future. However, that past evidence is challenged in a paper published earlier this year in *Proceedings of the National Academy of Sciences*, which attributes much of it to false accounting. Realistically, while efficiency may help at the margins, it can't enable us to continually grow the economy while using less energy and consuming less stuff.

The energy transition entails not just building boatloads of solar panels and wind turbines; we will need alternative transport infrastructure, much of which does not exist yet (when was the last time you saw a hydrogen-powered airliner?), and alternative farming practices and industrial processes as well. The cost of this new energy-using infrastructure is seldom counted in transition proposals, which tend to focus just on energy supply requirements. And some manufacturing (e.g., cement making) and transport (aviation) may only work on a much smaller scale than today in an all-renewable future. All of this taken together suggests that the energy transition will inevitably require not only time, investment, and the replacement of an extraordinary amount of infrastructure, but profound economic reorganization as well.

In the end, though the technofix view has many proponents, when examined closely it fails for lack of time, money, and simple physical feasibility.

In a recent New York Times opinion piece titled "Imagining a World Without Growth," Eduardo Porter summarized briefly the arguments of scientists who say we must leave economic growth behind. He then listed all of the social benefits that have flowed from growth in recent decades and concluded:

> Whatever the ethical merits of the case, the proposition of no growth has absolutely no chance to succeed. For all the many hundreds of years humanity survived without growth, modern civilization could not. The trade-offs that are the daily stuff of market-based economies simply could not work in a zero-sum world.

Porter gets this exactly wrong. For "zero-sum world" (which is a socio-political construct) substitute the words "finite planet" (which better describe our factual, physical context). If our market economy cannot work on a finite planet, it is the economy that will give way, though the planet will also suffer in the process. Porter is effectively telling us that the global economy is an airplane incapable of controlled descent, a car without brakes. While degrowth advocates do make an ethical argument, the core of their concern is pragmatic: nothing can grow forever in a limited space with limited resources, and we are seeing urgent signals (climate change, biodiversity loss, soil degradation, ecosystem failure) warning that we have already grown too much. In his article, Porter does not show how infinite economic growth is possible; he merely insists we must have more growth because . . . well, we must. If pressed, he would no doubt

cling to one or another of the technofixes we have already questioned. But that's just not a rational response to the logical and practical necessity of coming to terms with limits.

However difficult it may be, our primary task as a species this century will be to do (as much as we can) precisely what Porter says is impossible—to shrink the economy and rein in population while promoting human well being. We can do so as we minimize climate change by reducing energy consumption and by replacing fossil fuels with renewable resources, while also transforming agriculture and downsizing transportation and manufacturing. Otherwise we get climate chaos and an economy that collapses rather than adjusting.

Where's the evidence that controlled degrowth is possible? Admittedly, there are few historic examples, none of them closely paralleling our current situation (Cuba in the 1990s and the Edo period in Japan come to mind). Nevertheless, we know that people can live satisfactory lives with much less energy than folks in industrialized nations currently do, because everyone did so only a few decades ago and the entire population was not miserable. True, in those days many people suffered from hardships and diseases that we would not want to resurrect, but we have vastly more knowledge today than ever before about how to wring more social benefit (which is not the same as GDP) from less energy use. That knowledge has less to do with technology (though the appropriate technology movement of the 1970s still has a great deal to teach us) and more to do with economic equity, political accountability, public health, and the promotion of sharing and caring. Just compare the rankings of nations according to the Human Development Index, the Genuine Progress Indicator, or the Index of Sustainable Economic Welfare with their ranking by GDP: there are some surprising differences (the United States ranks first in terms of nominal GDP but below Costa Rica in the 2015 World Happiness Report, which is yet another alternative index of societal well being). It is in the exploration of those differences that our greatest opportunities may lie.

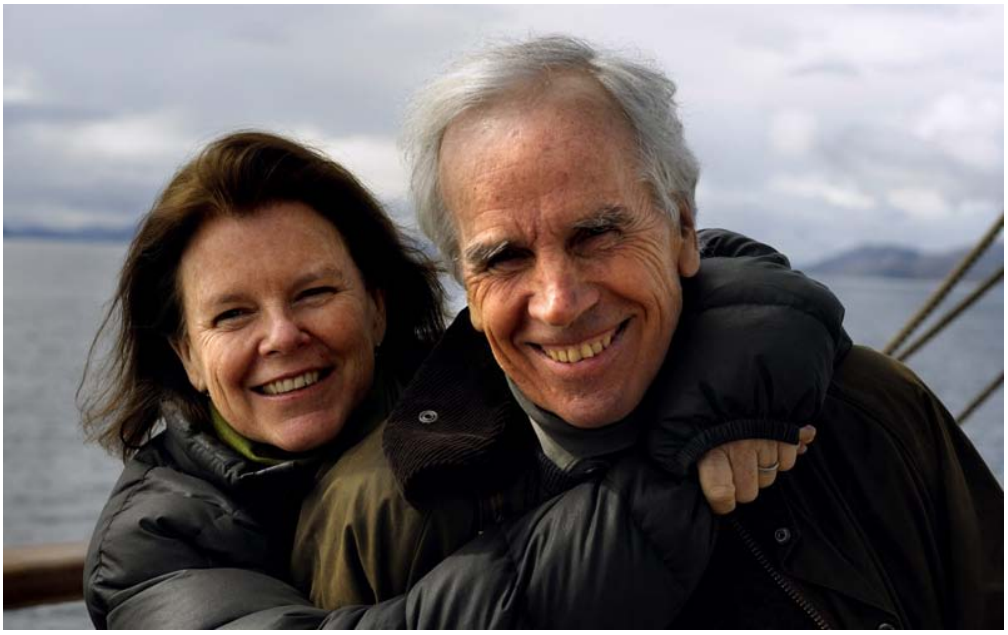
One final tactical point: it is my impression, gleaned from personal conversations, that many savvy renewable energy advocates are deliberately downplaying the technical hurdles and greatly overstating the potential of solar and wind technologies. They observe that the forty-three-year-old Limits to Growth discourse has failed to inspire reductions in global population and material throughput, instead provoking the sort of denialism epitomized in Eduardo Porter's article. Their gambit instead is to cheerlead renewable energy installation—getting as much of it as possible, in as short a time as possible—while avoiding discussion of deeper questions about planetary limits. Is this a wise tactic? Obviously, that's a matter of opinion. Renewables advocates face strong pushback from entrenched and powerful fossil fuel interests, so their resort to public relations messaging strategies is understandable. Nevertheless, my own view is that if solar and wind are oversold and their potential problems are glossed over, there will eventually be a backlash in policy and public opinion. A more transparent and honest approach could prevent that. Meanwhile the planetary limits discussion is more urgent than ever.

Climate change may divide us. But if we are to avert the worst of it,

we must unite behind strategies that will actually work in the real world to preserve the planet's life support systems as well as the best of what we enjoy as modern humans. But that's going to entail some material sacrifice for just about everyone—especially those who currently consume the most. Here's the thing: the sooner we accept reality, the smaller the sacrifice and the greater the benefit.

You may also be interested to read my related short report for policy makers Renewable Energy After COP21: Nine issues for climate leaders to think about on the journey home.

Remembering Doug Tompkins



From Richard Heinberg and entire staff & board of Post Carbon Institute

We at Post Carbon Institute heard today with profound sadness of the sudden passing of Doug Tompkins—one of the world's foremost conservationists and a great friend and supporter of our work and that of many other environmental organizations. Doug, who was 72, died following a kayaking accident in Patagonia. He had co-founded The North Face clothing company in 1964 and Esprit a few years later and was a skilled climber, kayaker, photographer, and bush pilot. He was renowned equally for being a pioneering outdoorsman, a highly successful businessman, and a fearless conservationist.

A couple of years ago Doug came to us with the proposal to collaborate on a big coffee-table book on energy; it was published as *ENERGY: OVERDEVELOPMENT AND THE DELUSION OF ENDLESS GROWTH*. He had worked with other environmental organizations to produce similar books on confined animal feeding operations, industrial agriculture, overpopulation, and mountaintop removal coal mining, among other topics.

Doug felt fiercely protective of Earth's vulnerable ecosystems, and used his fortune to purchase large, pristine tracts of land in South

America as permanent nature preserves, which he then donated to Chile and Argentina.

When discussions turned toward humanity's ecological dilemma (which they inevitably did when he was present), Doug didn't mince his words or seek security in politically palatable nostrums: in his view, there were simply too many of us, using too much, too fast.

Doug lived out his philosophy and dedicated his time and resources to making sure future generations have access to a natural world as abundant and majestic as the one he grew to love as a young backpacker in the early 1960s. His passing leaves a void within the environmental movement that no one can fill. His was a clear and uncompromisingly honest voice and we will miss him greatly.

Our thoughts are with his family and also with our friends at the Doug's own environmental organization, the Foundation for Deep Ecology. Perhaps the best way of all to remember Doug would be simply to get out into Nature at the first opportunity: experience it, love it, protect it.