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Net Zero 2050: Rhetoric and Realities

Canada's interests are ill-served by wishful politics

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In November 2020, the federal government signaled its intention to move Canada's economy to net zero greenhouse gas (GHG) emissions by 2050, tabling the Canadian Net-Zero Emissions Accountability Act in the House of Commons. A daunting challenge, as Canada is not on track to meet even its softer, non-binding Paris Climate Accord target of a 30 per cent reduction in GHG emissions from 2005 levels by 2030.

Assuming that setting a goal will therefore make it inevitable, involves considerable wishful thinking. In practice, achieving Net Zero 2050 requires changing both structure and modus operandi of our societies, forcing systemic electrification and eliminating hydrocarbons. Absent from the political rhetoric is whether existing energy alternatives to hydrocarbons allow us to rationally undertake such a transition. Broad, compelling evidence suggests not.

Historically, the world has successfully navigated several energy transitions, but only when doing so was demand-driven and socio-economically advantageous. In contrast, top down, policy-push, political programs rapidly face hard-edged socio-economic and physical obstacles. This paper explores the "green" energy technologies promoted by governments as Net Zero solutions, to identify the limits of what they can deliver. Applying a ground rule from venture capital, we identify issues that ceteris paribus cause the case to fail, and use those observations to outline consequences and outcomes.

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Net Zero is confronted with the reality that hydrocarbons are nature's most efficient embodiment of primary energy: the combination of high energy density, abundance, stability, safety, portability and affordability is unmatched by any other source of energy. In contrast, electricity, hydrogen and batteries are energy carriers, not primary energy sources, a fundamental distinction routinely downplayed by proponents. Worth noting is that the Paris Climate Accord, differentially focused on expanding wind, solar and batteries, is essentially silent on nuclear energy, the only alternative that matches key hydrocarbon efficiencies.

The Net Zero sentinel technology is the electric vehicle (EV), imposed through regulations as a virtuous, revolutionizing trendsetter, which in reality combines several potent, negative externalities in a sleek shell. With a lifecycle environmental footprint worse than conventional vehicles, the EV is the very embodiment of the "build it and renewable electricity will follow" magical thinking that has been fuelling a $30 trillion, "green" investment bubble.[1]

Renewables. Inconvenient realities.

Hydrocarbons today represent some 80 per cent of global primary energy, the same proportion as 30 years ago. After decades of preferential policies and trillions of dollars in subsidy-driven investment, wind and solar remain single digit contributors, and despite rapid growth, global battery capacity amounts to a rounding error. It is well worth asking why this is so.

First, there is the wishful thinking that wind, solar, battery and hydrogen technologies are somehow going to repeat Moore's Law, with its revolutionizing billion-fold increase in energy efficiencies and transformative costs savings across an array of technologies. The prospect of that is nil.

- The bulk of wind and solar power improvements have been realized, leaving 30 per cent theoretical improvements.[2]
- Global battery storage capacity, rapid expansion notwithstanding, represents mere minutes of North American electricity consumption.
- Hydrogen has fundamental limitations. Prohibitive costs aside, compounding energy inefficiencies across the input/storage/output cascade are irremediable, while direct fuel applications face intrinsic issues.

In reality, "green" technologies are polar opposites of Moore's Law: they compound two fatal flaws—high materials density and high energy input requirements—into a third one: unreliable, high-cost, low energy-density output. One 850MW/h, 1million panel solar farm, covering 36km^2 on average produces 35 per cent or 300MW/h. One 180m high, 2MW/h wind turbine with a 10,000m^2 operational footprint, 40 ton rotor, 70 ton nacelle and a 220 ton steel tower anchored in a 2,000 ton concrete base, on average produces 35 per cent or 700KW/h. In contrast, one 10 ton industrial diesel engine with a 5x3x3 meter footprint routinely produces 2,600HP/2MW at 24/7/365. Crucially, whereas the diesel engine is designed and built to be recycled, solar panels, key wind turbine components and lithium-ion batteries are not recyclable, continuously compounding the new resources conundrum.

The International Energy Agency (IEA) estimates that this materials density issue alone, will precipitate 700-4,200 per cent increases in demand for critical minerals such as lithium, cobalt, graphite, nickel and rare earths, amplifying geopolitical risks and environmental, economic and human rights impacts. Tesla's 2030, 20 million vehicle/year target, alone requires 90 per cent of today's graphite and 50 per cent of global cobalt production plus the combined output of the world's leading nickel producers. With governments forcing European and North American car manufacturers into the EV market, the 55 million vehicles projected globally by 2026[3], will irremediably bring supply chain risks to a head.

Second, all "green" energy technologies engender rapidly growing negative environmental externalities by causing incontrovertible, large scale ecological disruption:

a. Neither turbine blades nor solar panels nor lithium-ion batteries are physically or economically recyclable. They are instead, at an alarming rate ending up in landfills leaching toxic chemicals—an estimated 10 million tons/year of batteries by 2030 alone. The International Renewable Energy Agency (IRENA) forecasts that by 2050 unrecyclable solar panels will equal 2x all forms of plastic waste globally and the Energy Information Agency (EIA) estimates in excess of 3 million tons/year of unrecyclable resin composite turbine blades by 2050.

b. Comprehensive empirical evidence underscores the negative impacts of wind and solar farms on marine and terrestrial ecosystems: tellingly, multi-decade, multi-continent data shows that by mixing air layers that would otherwise remain separate, giant wind turbines change downstream atmospheric conditions, increasing night time minimums and evaporation, causing micro-spatial and regional climate change.[4]

Third, wind turbines, solar panels and lithium-ion batteries, from the raw materials to the concrete, steel, silicon, glass and composites that go into them, require orders of magnitude higher energy input than conventional energy equipment, and hydrocarbons provide the near totality of this energy. As with the insolvable materials equation, the EV is a prime example of the embodied energy issue: to produce from zero, a single 500kg, 100KW/h lithium-ion battery requires processing 250,000kg of materials and 100x or 10MW of energy—14x the average hourly output of the wind turbine above.[5a] Scale up global grid storage requirements to gigawatt or terawatt levels, and the notion of batteries as part of the solution becomes risible.

To understand the terminal implications of this invisible, embodied energy reality, it is critical to consider a key fact. Because the input energy required to manufacture "renewables" from zero by a considerable margin exceeds their lifetime output, it is impossible for the electricity derived from any combination of wind turbines, solar panels and batteries to ever suffice to duplicate them from zero. The logic is implacable.[5b]

Bridging the Net Zero energy gap

Some short form math illustrates what replacing hydrocarbon energy with alternative electricity entails.

By 2050, projected global energy demand is the electricity equivalent of 240PWh/year (10^{15}W), 75-80 per cent or upwards of 190PWhr/year from hydrocarbons. That translates into a requirement to bring online 22TW (10^{12}W) of alternative generating capacity, a number doubled by industry code specifying that new electrical infrastructure be built for peak loads. Since there are approximately 10,500 days until 2050, this means bringing online approximately 4GW (10^{9}W) every day until then.

Under different mix-and-match scenarios, it presents mind-boggling options. It means integrating into the grid every day until 2050, either two 2GW nuclear plants or 6,000 2MW wind turbines with 3GW of nuclear backup or a 500 km^2 solar farm with 3GW of nuclear backup—at a 35 per cent load factor with nuclear backup compensating for intermittency and absence of credible storage capacity.

These numbers do not include the gigawatts of embodied energy necessary to mine, refine and transport raw materials and build reactors, turbines, panels and grid infrastructure. They also do not include the gigawatts for decommissioning and replacing the millions of turbines and solar panels that successively reach their 15-20 year operational lifespan during the 2050 build out.[6] Numbers scale proportionally to country level, and even if demand were reduced by say100x, overarching, physical, socio-economic, environmental and supply chain issues make this transition impossible.

Discussion

So where do we go from here? To answer that question, we need to look at historical context. It is necessary to understand that the Paris Accord, Net Zero, the E in ESG (Environmental, Social, Governance) guidelines, the "renewables" realities and absurdities described here are all outcomes of 30 years of institutionalized political overreach. They are largely divorced from scientific, technological and socio-economic fundamentals, and ideologically blind to realistic alternatives.

It is in particular, necessary to ponder why the Net Zero political agenda—with its messianic promises orders of magnitude greater than "green" energy technologies can ever deliver, and the Malthusian delusion that we must fundamentally transform our societies to stop an otherwise unavoidable climate catastrophe—has since its inception at the 1992, Rio de Janeiro Climate Conference, been strictly confined to the advanced economies of Europe, North America, Australia and New Zealand. Against that background, it's worth noting that a number of key commentators are now publicly echoing Google's RE<C Project engineers 2014, conclusion: "Incremental improvements to existing energy technologies aren't enough; we need something truly disruptive; we don't have the answers."[7] Recently, US Climate Envoy John Kerry acknowledged that indispensible Net Zero technologies have yet to be perfected or invented.[8]

This is important, because perpetuating the perilous myth that today's "renewables" are capable of replacing hydrocarbons—taxing CO2 while diverting billions of dollars into dead-end technologies through subsidized, "green washed" investments—to convince ourselves that we are acting appropriately towards achieving a salvational energy transition, is demonstrably precipitating ever more serious, unsustainable socio-economic and environmental damage. Sweden is now realizing that wind and hydro cannot replace nuclear.[9] California, the UK, Germany and South Australia, where "renewables" are major contributors, are experiencing blackouts leaving millions and industry without power. Across the advanced economies, "green" energy equals steeply escalating electricity prices with attendant class-based energy poverty and excess winter deaths.[10] Official commentary about the need for energy rationing has surfaced in California, Germany and the Netherlands[11], while on the ground Net Zero policies are resulting in both organized political pushback and at times violent confrontations such as the "gilets jaunes" in France, and spreading NIMBY anti-wind and solar farm protests across the Netherlands, Germany and the United States ironically, increasingly organized by environmentalists.[12]

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An imperative requirement towards an answer, is dispassionately taking stock of the climate issue, especially the Goodhart's Law-driven[13a], pseudo-scientific hyperbole that frames Net Zero politics. A growing choir of eminently qualified voices[13b] most recently former president Obama's top energy science advisor, Steven Koonin[14] has for years been drawing attention to the widening discrepancies between what computer model-based, consensus climate science and the mainstream media tell us is a climate crisis, and the steadily accumulating body of quality, observational, empirical evidence and peer reviewed research that refutes the alarmist narratives. NASA and NOAA in 2019, stated that global temperatures have increased by 1.OC since 1900; 90 years of radio sond and 40 years of satellite data show a continued slow increase but crucially, no acceleration[15], and observational studies put temperature sensitivity to a doubling of CO2 at around 1.5OC on the1.5-4.5OC IPCC range.[16] The Science section of the 2001, Third IPCC Report stressed: "we should recognize that we are dealing with a coupled, nonlinear, chaotic system, and that therefore, the prediction of future climate states is not possible." Yet, the projections used to justify Net Zero policies and the Paris Accord, are based on fundamentally flawed computer climate models that overstate warming by some 200 per cent.[17a] Importantly, observational, empirical evidence remains agnostic as to what, with requisite confidence levels, is attributable to anthropogenic influences vs. natural variability.[17b]

Above all, answering where we go from here, involves keeping our eyes wide open to the energy realities evolving around the world, outside the advanced economies' bubble of wishful politics. The IEA is forecasting that even if all Paris Accord signatories actually fulfill their commitments, from the 80 per cent that hydrocarbons represent today, will still account for 60 per cent of primary energy by 2040.[18] Unrelenting, accelerating energy demand throughout the Indo Pacific region and the African continent—together 80 per cent of the world's population—anchors hydrocarbons as the indispensable, dominant energy source for decades, quite conceivably well beyond 2050. Next generation, cleaner and more efficient energy technologies are steadily coming online, and while a growing number of countries are adopting LNG, the reality is that globally 600 million tons/year of new coal mines are under construction[19], and 1,600+ next generation coal power plants are planned or coming on line[20a]. It is worth noting that, assuming a realistic re-assessment of its energy policies in lieu of wishful grandstanding, Canada could make significant, real world contributions towards mitigating GHGs, articulating its diverse energy and energy management resources to supply LNG and even oil as an alternative to coal, and uranium for an anticipated nuclear build-out.[20b] With the onset of the realization that wind, solar, hydrogen and batteries are incapable of insuring adequate, reliable and affordable energy, we see acknowledgement that electrification of key economic sectors can only occur through the introduction of next-generation nuclear power. This is driving a broad international effort by national and regional governments and industry, backed by philanthropists and key environmentalists, to bring online sub-300MW small modular reactors (SMRs) as early as 2030—Russia already has two SMRs in the Arctic. For perspective, one150MW molten sodium SMR with the footprint of a football field combines the average output of some 220, 2MW wind turbines with the storage capacity of 1million Tesla S batteries.[21]

The key answer however, is that no matter the degree to which we succeed in rationally diversifying our energy sources, the overarching reason why hydrocarbons will remain the sine qua non variable in the equation, is the matrix of interlocking hydrocarbon-based technologies that we have indispensably built into the core of our societies, at global scale. That is the ultimate reality check against wishful Net Zero politics.

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References

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