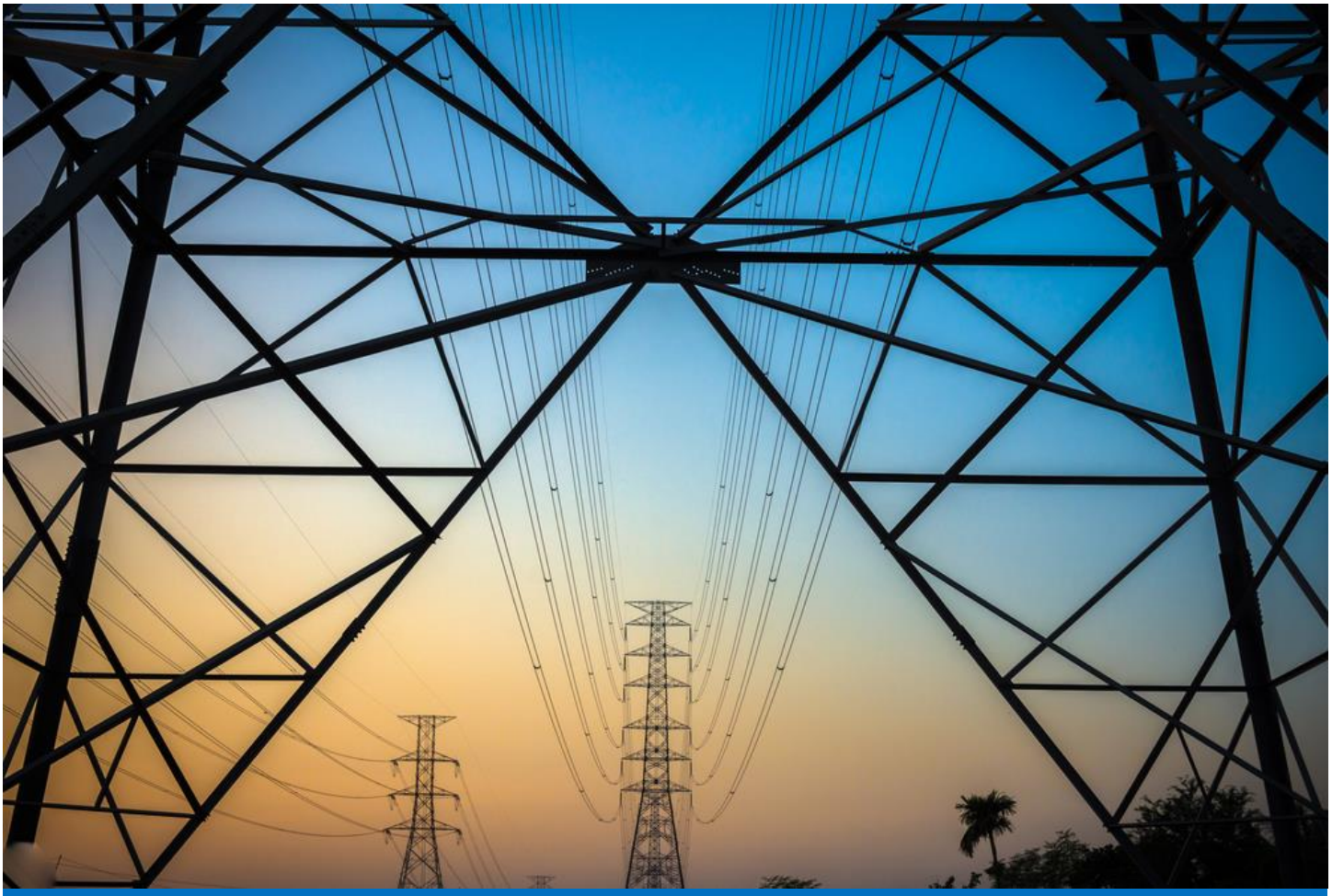


Shocking Reality: Electrification and Decarbonization

Net Zero – Pathway to Economic and Energy Catastrophe

June 19, 2019

Friends of Science Society

Contents

Cover image licensed from Shutterstock.

This is a plain language document.

Executive Summary

The David Suzuki Foundation's report *"Zeroing in on Emissions: Canada's clean power pathways – A Review"* presents a review of a set of theoretical possibilities for reducing emissions from fossil fuels based primarily on the notion that everything powered by fossil fuels today can be electrified using a connected power grid of hydro, wind, solar, tidal, batteries, and geothermal. It is concerning that much of the content of Canada's Expert Panel on Sustainable Finance echoes many of the unrealistic proposals of the Suzuki report. There is a deeply concerning disconnect between concept, cost-benefit analysis and implementation of proposed technologies. Practically speaking, the world runs on oil, natural gas and coal – all 'renewable' forms of energy require these to exist and to function on the power grid. There is no magic replacement.

The scenarios set out in the Suzuki paper are just that - imagined possibilities crafted by people who would like to see technological and economic developments that have not happened to date. The report offers a list of ten simple slogans of three to five words, wrapping up with 'bring everyone along' – claiming "*Together, these strategies are a litmus test for a credible climate plan."* The technologies promoted like wind and solar can complement a conventional power grid, but not replace it. They have long been dismissed as unable to address climate change, and in terms of energy return on energy invested, wind and solar are unable to support basic society. Due to their weather-dependent nature, wind and solar are especially unsuited to a cold, vast, snowy, often overcast country like Canada.

Furthermore, the energy generation options that do show promise, such as Small Modular Reactors, are not yet market ready. Based on historical trends in energy transition, their introduction will take decades. Innovation is certainly worth pursuing, but that is not a sound basis for public policy or a major shift in investment.

What is problematic is that all of the changes in Canada's energy supply and demand system that the Suzuki report envisages and advocates for depend not upon the free choices of producers and consumers but upon massive intervention, subsidization and regulation by governments. Government central planning never has worked as well as free, competitive markets, and there is no reason to believe that will happen soon.

Making dramatic changes to the electrical grid often has extremely dire, unexpected consequences. Germany and the UK have experienced a huge rise in heat-or-eat poverty and premature deaths due to the introduction of expensive wind and solar and related transmission line/natural gas back-up costs. The Suzuki *"Zeroing…"* report excludes mention of the additional physical infrastructure costs and socio-economic implications. Poverty is not a way to 'bring everyone along.'

This report, ***"Shocking Reality: Electrification and Decarbonization"*** shows that "Net Zero" is a pathway to economic and energy catastrophe. We provide some cautionary real-world examples to inform the public and policymakers. The greatest risk is that, based on an incomplete assessment, certain parties may begin some of these major transitions, only to then find ourselves 'stuck' as the costs of additional, unaccounted for infrastructure bloom while the economy staggers under the burden; that grid reliability may be put at risk – or that industry, faced by rising costs and regulation, may abandon Canada for greener, free market pastures.

"Do you guys on Wall Street have something in your desks that makes steel? Where is fertilizer, cement, plastic going to come from? Do planes fly through the sky because of some number you put in a spreadsheet?... The idea that we have the current tools and it's just because these utility people are evil people and if we could just beat on them and put (solar panels) on our rooftop—that is more of a block than climate denial," Gates said. "The 'climate is easy to solve' group is our biggest problem." – Bill Gates https://youtu.be/d1EB1zsxW0k (11:42)

Shocking Reality: Electrification and Decarbonization

Net Zero – Pathway to Economic and Energy Catastrophe

"I assert: decarbonizing by 80% by 2050 is impossible without mass deaths."
-Professor Michael J. Kelly, Cambridge University[1]

In May 2019, the David Suzuki Foundation released a report entitled *"Zeroing in on Emissions: Canada's clean power pathways – A review."*

The document is premised on the following notions, that Canada:

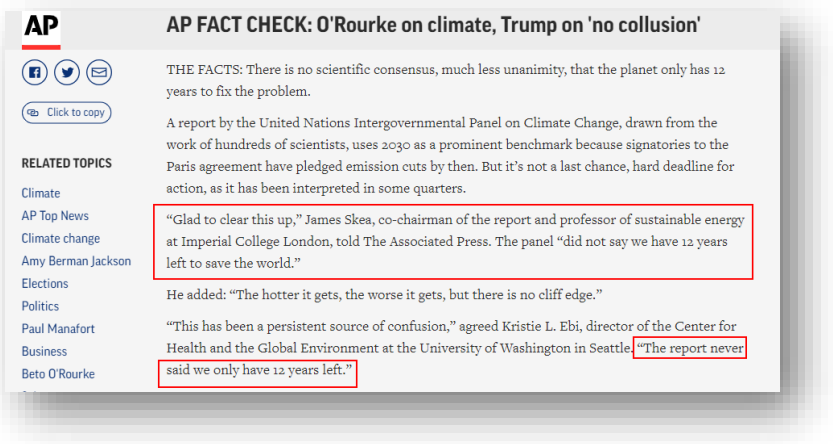
a) **Must** meet Paris Agreement greenhouse gas (GHG) reduction targets, even though it is a legally non-binding agreement
b) **Can** meet Paris Agreement GHG reduction targets through simply electrifying all manner of processes currently driven by fossil fuel power
c) **Must** accelerate all processes that would lead to net zero emissions or a climate breakdown awaits
d) **Can** achieve these goals with little relative cost to Canadians or economic impact to the Canadian economy, and perhaps with profitable new market opportunities.

"Shocking Reality: Electrification and Decarbonization" explores the lack of due diligence on the part of the Suzuki Foundation authors. The modelled (simulated) visions of *"Zeroing in on Emissions"* means that the public and policymakers are being misled by the simplistic 'litmus test' list of the 'test for a credible climate plan' by the David Suzuki Foundation. When a few simple examples, facts and operational costs from the real world are used to frame the proposals, as we do herein, most modelled options are shown to be in the realm of fantasy. By not including relevant real-world examples, Suzuki et al are leading Canadians and international institutional investors down a path to disaster – a catastrophe of chaotic economic and energy supply.

Accelerate clean power
Do more with less energy
Electrify just about everything
Free industry from emissions
Switch to renewable fuels
Mobilize money
Level the playing field
Reimagine our communities
Focus on what really matters
Bring everyone along
Together, these strategies are a litmus test for a credible climate plan. –
"Zeroing in on Emissions"

[1] https://www.rbkc.gov.uk/pdf/Prof%20Mike%20Kelly%20-%20FENand%20ER.pdf

Models vs Observations – Burden of Proof



AP

AP FACT CHECK: O'Rourke on climate, Trump on 'no collusion'

Click to copy

RELATED TOPICS

Climate
AP Top News
Climate change
Amy Berman Jackson
Elections
Politics
Paul Manafort
Business
Beto O'Rourke

THE FACTS: There is no scientific consensus, much less unanimity, that the planet only has 12 years to fix the problem.

A report by the United Nations Intergovernmental Panel on Climate Change, drawn from the work of hundreds of scientists, uses 2030 as a prominent benchmark because signatories to the Paris agreement have pledged emission cuts by then. But it's not a last chance, hard deadline for action, as it has been interpreted in some quarters.

"Glad to clear this up," James Skea, co-chairman of the report and professor of sustainable energy at Imperial College London, told The Associated Press. The panel "did not say we have 12 years left to save the world."

He added: "The hotter it gets, the worse it gets, but there is no cliff edge."

"This has been a persistent source of confusion," agreed Kristie L. Ebi, director of the Center for Health and the Global Environment at the University of Washington in Seattle. "The report never said we only have 12 years left."

"Zeroing in on Emissions" opens with the claim that *'human caused climate change is reaching a tipping point.'* This claim is disputed by the Intergovernmental Panel on Climate Change (IPCC) AR5 Working Group I (Physical Sciences) report of 2013, which showed that despite a large rise in carbon dioxide, global warming had flatlined. That evidence weakened the case for human-causation, as Dr. Judith Curry reported to the US Senate in 2014.[2] *"Zeroing…"* claims that Canada is warming at twice the global average rate, a claim that has been made about virtually every place on the planet,[3] rendering the comment moot, absurd and unscientific. As noted by scholars in the above news report, 'there is no cliff edge' and therefore no need for urgency and errors due to lack of sober second thought or lack of full cost-benefit analysis.

The catastrophic climate claims that abound in the media and the fantastic-sounding solutions presented by *"Zeroing…"* authors suffer from the same problem. They are based on computer simulations (models), not reality. As physicist Freeman Dyson has said, (referring to colleague and computer modeller Suki Manabe) "…And he always said from the beginning "The climate model is a very good tool for understanding climate, but a *very bad tool for predicting climate."* …But if you look at the real world there are hundreds of different things going on all the time. *The computer model can´t possibly give you a complete picture."*[4]

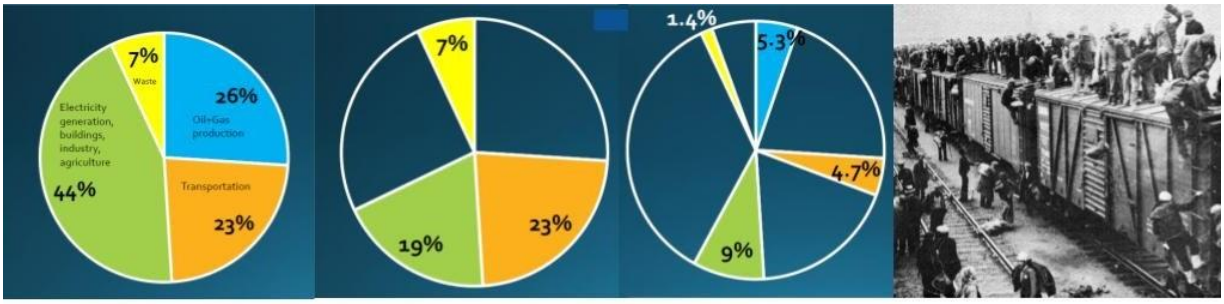
The "Burden of Proof" review of 100% renewable grid proposals found: "efforts to date seem to have ***substantially underestimated the challenge*** and delayed the identification and implementation of effective and comprehensive decarbonization pathways." [5]

According to a 2007 study by Armstrong and colleague Dr. Kesten Green of the University of South Australia, they "...concluded that their (IPCC model) methods violated 72 of the 89 relevant forecasting principles in the Principles of Forecasting handbook. Even a single violation could render a forecast useless." Armstrong states that the claim of a precautionary principle for 'immediate action' on climate change is political, and not scientific.[6]

---

[2] https://curryja.files.wordpress.com/2014/01/curry-senatetestimony-2014-final.pdf
[3] http://tomnelson.blogspot.com/2010/07/settled-science-can-everyplace-really.html
[4] https://www.marijnpoels.com/single-post/2019/03/05/We-don%E2%80%99t-understand-climate-its-very-complicated-and-were-only-at-the-beginning-to-understand-what-the-effects-may-be
[5] https://www.sciencedirect.com/science/article/pii/S1364032117304495
[6] https://repository.upenn.edu/marketing_papers/133/

Targets for Economic Disaster



2014 ratios of emissions and sources in Canada

Canadian gov't committed to attain a 50% reduction from 2005 level by 2050

Canadian gov't notionally committed to an 80% reduction in GHGs

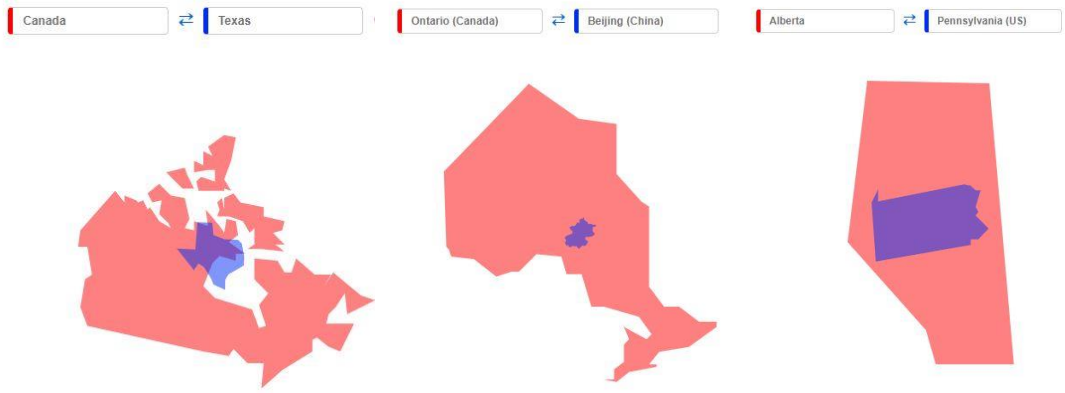
The result? The end of Canada as we know it today. Back to the Future 1930s.

Canada has made promises it can't keep on climate and GHG reduction targets. In his presentation of 2017 to Friends of Science Society's Annual Event, Robert Lyman asked the question: ***"Can Canada Survive Climate Change Policy?"***[7] The image above illustrates that it cannot. He wrote:

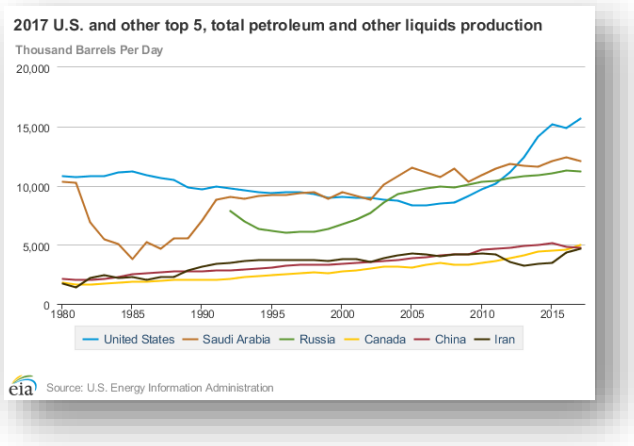
- *"In 2005, Canadian emissions were 738 megatonnes of carbon dioxide equivalent. In 2014, after six years of the worst recession since the Great Depression, Canadians emitted less, 722 megatonnes. Twenty-six per cent of those emissions were from oil and gas production, 23 per cent were from transportation, and roughly equal portions of around 10 per cent were from electricity generation, buildings, industry and agriculture, with waste and other sources making up a residual 7 per cent. Assuming that emissions do not grow one bit over the next 32 years as a result of increased economic activity or increased population, achieving a 50 per cent emissions reduction from 2005 levels would mean reducing emissions to 369 megatonnes CO2 equivalent. That is comparable to completely eliminating the current emissions from oil and gas production, electricity generation, and all emissions-intensive industries like mining, petrochemicals, auto and parts manufacturing, iron, steel and cement. Gone. Achieving the aspirational goal of 80 per cent reduction recommended by the IPCC would mean reducing emissions to 147 megatonnes CO2 equivalent.* ***That would be comparable to reducing Canada's per capita emissions and our energy economy to the current levels of Bolivia, Sudan or Iraq."***
  - The value for CO2 emissions (metric tons per capita) in Bolivia was 1.93 as of 2014.
  - The value for CO2 emissions (metric tons per capita) in Sudan was 0.309 as of 2013.
  - The value for CO2 emissions (metric tons per capita) in Iraq was 4.81 as of 2014.
  - The value for CO2 emissions (metric tons per capita) in Canada was **15.11** as of 2014.[8]

[7] http://blog.friendsofscience.org/2017/05/10/can-canada-survive-climate-change-policy/
[8] https://www.indexmundi.com/facts/canada/indicator/EN.ATM.CO2E.PC

How Does Canada Compare for Emissions?



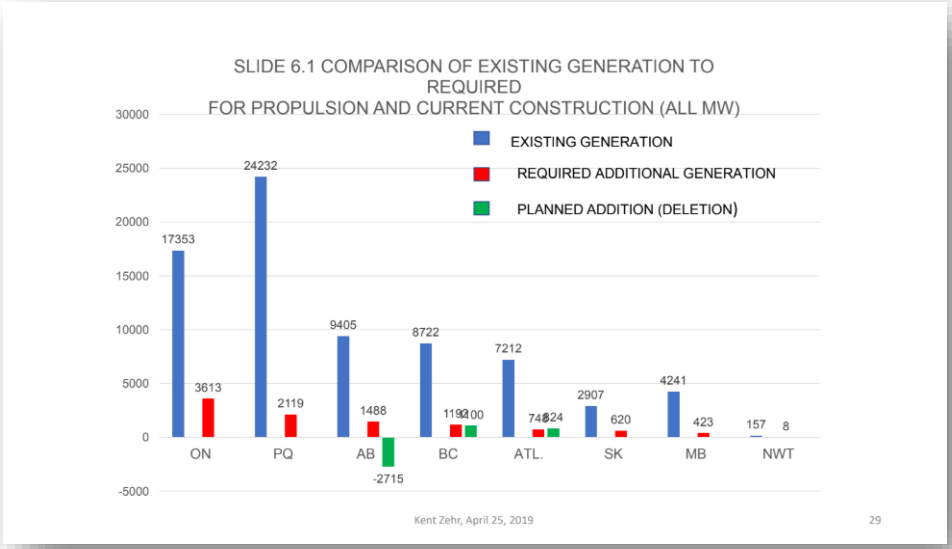
Canada's emissions are about the same as those of Texas; Ontario's about the same as those of the city of Beijing, China; and Alberta's emissions are about the same as those of the state of Pennsylvania, USA. Canada achieving net zero emissions will not make us a leader, but a loser. It will inflict economic catastrophe on this country and its citizens and ruin our international competitiveness, while the world will continue, business as usual.



Canada is one of the top six petroleum producing nations of the world. It is the only country of those six where the government and ENGOs are trying to reduce emissions to zero. Most of the impetus for this net-zero campaign comes from foreign funded environmental groups who appear to be: a) part of a trade war against Canada, cloaked in 'green'; b) fronting vested corporate and foundation and institutional investor interests in pushing global cap and trade, carbon pricing and renewables, part of the ClimateWorks plan,[9] of which, the Tar Sands Campaign appears to be an important segment of activity.

[9] https://web.northeastern.edu/matthewnisbet/2018/05/21/summary-of-strategic-philanthropy-in-the-post-cap-and-trade-years-reviewing-u-s-foundation-climate-and-energy-funding-at-wires-climate-change/

Electricity Comes from Power Plants - Even for EVs



Source: Electric Vehicle Considerations for Canada[10]

More than 10,000 megawatts of additional electrical generation capacity are required for Canada to be 100% electric passenger cars by 2040.

By converting the conventional Internal Combustion Engine (ICE) vehicle daily energy equivalent fuel consumption to electrical energy, this analysis finds that the electric vehicle (EV) policy in place by the federal government will leave Canadians in the dark, if implemented.

- The Canadian government under Justin Trudeau has stated by 2040 all vehicles sold in Canada will be zero emission vehicles generally meaning rechargeable electric vehicles.
- While projecting the usage and mileage of such vehicles is difficult and subject to interpretation and speculation, the amount of energy being expended by that sector of the economy today is measured and reported.
- Using the actual measured amount of energy expended in this area today allows some determination of what conditions must exist for all vehicles in Canada to be electric in 2040.
- At perfect efficiency, impossible, **more than 10,000 megawatts of additional electrical generation capacity are required for Canada to be 100% electric passenger cars by 2040.**
- At the present time, there are two large power projects being built in Canada, Site C in BC and Muskrat Falls in NL. Combined, they have a capacity of 1,924 megawatts, if they meet their design capacity.[11]

[10] https://blog.friendsofscience.org/2019/05/13/electric-vehicle-considerations-for-canada/

[11] Example of lead time and cost escalation: Site C dam in BC was first considered in hearings in 1980-81 and turned down. After the Clean Energy Act of 2010, it began to move forward; in 2012 it was mandated under CEAA; 2014 received environmental approval from federal and

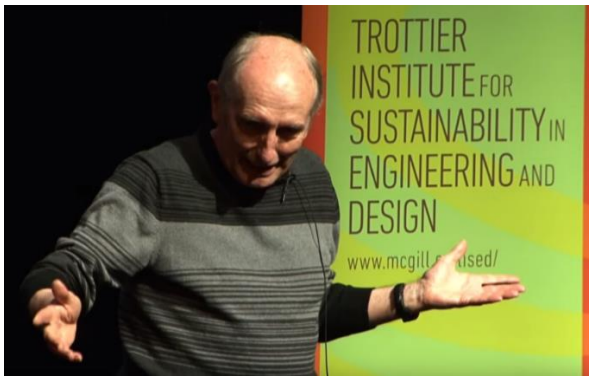
- The existing projects have taken or will take more than five (5) years to reach production.
- There are no other large power generation projects even being contemplated in Canada currently. To meet the 2040 stated objective **at least eight (8) more projects, of about the sizes being built, are required.**
- In addition to the power generation, large amounts of additional electrical infrastructure (transmission lines/chargers) will be needed to deliver the newly generated power to locations where it will be needed. None is planned now. *(Costs are in the hundreds of billions or trillions – the 500-kV transmission line from Calgary to Pincher Creek wind farms (~216km) cost $2.2 billion dollars. With additional load from more EVs, upgrades would be required for most distribution lines (within neighbourhoods) and transformers and the Information Technology (IT) infrastructure at the electric system operation. The IT costs alone may be in the 9 figures.)*
- Given how electrical vehicles will be used, most for commuting and shopping, recharging will be a nighttime load on the power system.[12] Weather may require day-time charging adding to base load demands. **This eliminates solar and wind power from contention as new supply.**
- Other technologies, fission and fusion, may be deployable in time to meet the projected demand. However, both of these technologies have long, long lead times and will be challenged to meet demand in even fifteen years.
- **The subsidies for buyers of electric cars should cease immediately. A national consensus needs to be developed supporting increased power generation and distribution ahead of the demand coming on from electrical vehicles.**

Clearly if there is not enough electrical power for Canada's vehicle fleet today, there will certainly not be enough for the vast electrification proposals of "Zeroing in on Emissions," nor is there sufficient time or money to build the necessary new power plants.

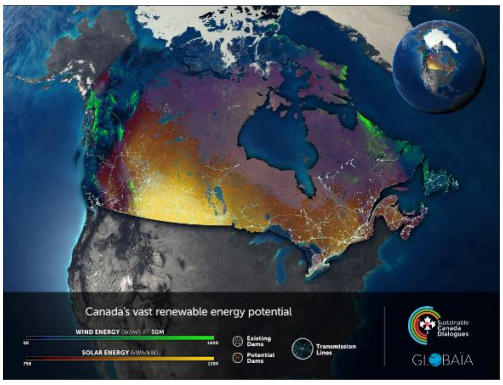
Furthermore, a transition to EVs will result in a loss of gasoline fuel tax revenues to government. Presently Canadians pay about $170/t carbon tax equivalent in fuel taxes. Where will the government get additional revenues for road maintenance and construction when EVs will not use fuel or pay such taxes?

provincial authorities. Site clearing began in 2016 – since then it has been stalled and started several times with court action from various environmental groups or First Nations. The original cost was estimated at $6.6 billion; estimates now predict $11 to $12 billion. This cost does not include transmission lines to hubs. *(Source: Wikipedia)*

[12] Blair King, A Chemist in Langley, provides his analysis of BC's proposed conversion to EVs. https://achemistinlangley.net/2016/12/16/electrifying-bcs-transportation-system-debunking-the-myths-part-i-that-bc-hydro-load-estimate/ and https://achemistinlangley.net/2016/12/16/electrifying-bcs-transportation-system-debunking-the-myths-part-ii-night-charging-of-vehicles/ His numbers differ from that of Kent Zehr, P. Eng., but both show that substantial additional power generation is necessary and King shows that consumer behavior with respect to EVs will be far outside the assumptions of some policy documents.



Vaclav Smil https://youtu.be/5guXaWwQpe4



Acting on Climate Change
http://www.sustainablecanadadialogues.ca/files/PDF_DOCS/Energy_map_en.pdf
http://www.sustainablecanadadialogues.ca/en/scd/endorsement

"Energy Revolution? More like a Crawl" - Dr. Vaclav Smil

Trottier Institute for Sustainability in Engineering and Design Sept 19, 2015.

"One of the most sophisticated machines in modern civilization is the machine that flew me here, right? And that's a gas turbine, right? And that's the machine that flew me here today. For those of you who don't know, we can take the exact same turbine that flew me here and put it on the ground to generate electricity (with some modifications). Extremely sophisticated machine with extremely low failure rate. But you know, there are only five companies in the world that can make it – the big ones. Suppose I have an infinite amount of natural gas, I cannot order 10 GW [of gas turbines] per week, because there are only five manufacturers of gas turbines in the world. ...so, when you get into sophisticated conversions (of energy) there are many limitations, and this is why it takes longer." – Vaclav Smil to McGill Engineering students

In Professor Emeritus Vaclav Smil's presentation to McGill engineering students in 2015, he explains that at this point, there are no new advances in the energy revolution. He also explains in his presentation and in his many books, that wind and solar are low density forms of kinetic capturing of energy, but they do not generate dispatchable (on demand) energy. Wind and solar are weather dependent, erratic and fickle. And they typically must be backed up by a natural gas power generation plant and equivalent dispatchable power. However, the groups *"Acting on Climate Change"* and *"LEAP Manifesto/Org"* have promoted a plan, referred to in *"Zeroing..."* to establish a national wind-hydro grid, which they claim is possible by 2035, less than 16 years away.

Friends of Science Society had professionals in the power generation industry assess this proposal in 2015 and found that it was technically infeasible, if attempted, would cost hundreds of billions/trillions of dollars and put Canada at risk of national blackout.[13] Canada's extreme weather conditions make it quite unsuitable for wind and solar, despite claims to the contrary, as explained in our report, "In the Dark on Renewables: Rebutting Deloitte Insights and Climate Reality."

"Zeroing in on Emissions" correctly claims that Canada has one of the 'cleanest' power grids in the world already due to massive hydro reserves in some provinces. Hydro works fairly well with wind, but wind

[13] http://blog.friendsofscience.org/2015/09/29/power-generation-information-on-difficulties-of-instituting-the-proposed-wind-hydro-national-grid-network-in-acting-on-climate-change/

is still typically backed-up by natural gas. In fact, that is one of the big attractions for investors in natural gas generation. The combination of natural gas and wind makes for erratic power generation, requiring the ramping up and down of natural gas 'peaking' plants, a more wasteful use of energy, but offering much higher 'peaking' market prices. Wind and solar also require multi-billion-dollar infrastructure behind the scenes. Wind is sold to the public on claims it is 'free' and to investors as a path to riches, and to pension funds with unfunded liabilities, as a path to 20-40 years of guaranteed interest from tax-subsidized payments via carbon taxes on poor citizens, and the generation of tradeable Renewable Energy Certificates.

> *"We need about 3,000 feet of altitude, we need flat land, we need 300 days of sunlight, and we need to be near a gas pipe. Because for all of these big utility-scale solar plants – whether it's wind or solar – everybody is looking at gas as the supplementary fuel. The plants that we're building, the wind plants and the solar plants, are gas plants."* [1]
>
> *– Robert F. Kennedy, Jr. Environmental activist, Member of the board of Bright Source, developers of the Ivanpah Solar Station, Nevada, a 392 MW (peak) concentrated solar plant*

Hoping to rely on hydro to back-up wind and solar can lead to serious regional or national energy problems. In the case of Tasmania, their plentiful hydro power was sold to Australia to capitalize on the carbon tax then in place in Australia. However, there is a back-up power supply line called "Basslink" from mainland Australia to Tasmania, which failed, leading Tasmania to draw heavily on their own hydro. Then a drought ensued, and water levels in dam reservoirs dropped to dangerous levels. (If hydro reservoirs drop below a 'dead pool' certain level, turbines may become fouled with air, dirt or rubble which can destroy these very expensive, 'one-of' pieces of special equipment.) Tasmania had to buy $44 million in diesel generators to fill in power generation, and then restart a Combined Cycle Gas Turbine (CCGT) plant that had been shuttered.[14]

A similar situation prevailed in Venezuela that precipitated much of the country's collapse. A four-day work week was instituted in a failed attempt to save electricity and the country's economy, in April of 2016, as Gretchen Bakke writes in the New Yorker.[15]

"The main reason for these machinations, apart from long-term political mismanagement, is drought. There has been little rain in Venezuela in the past three years, and a crippling deficit last year in particular—a predictable effect of El Niño, the global climate cycle that periodically warms parts of the Pacific Ocean, causing deluges in Texas and Florida, warm weather in eastern Canada, and desiccation in Indonesia and parts of Latin America. As a result, the water behind Venezuela's dams, which supply around two-thirds of the country's electricity, is at a historic low. At the Guri Dam, the nation's largest hydropower facility, the water is reportedly within five metres of dead pool. At this low level, the worry is that air will get into the dam's inner workings along with the water, producing vibrations in the metal turbine blades that can rattle the structure to death. If Venezuela's reservoirs run dry and its dams stop working, its grid will, too."

The 2015 drought in British Columbia, caused by the natural El Nino phenomenon, was a wake-up call for BC residents as they were forced to go to water rationing, despite their wealth of dams and reservoirs. Imagine what would happen with many times the load on the grid with EVs and electrified industry. Then a drought. *"Zeroing..."* claims that BC's Williston reservoir could theoretically supply 2,700 MW continuously for six months. But people need power all year long. And reservoirs need time to refill – which is why BC and Alberta have had many happy years of electrical power trading between Alberta coal-fired power plants, which are difficult to shut down when there is reduced night-time demand in Alberta, so that power was fed to the BC grid and allowed BC dams to replenish overnight.[16]

---

[14] http://euanmearns.com/the-tasmanian-energy-crisis/
[15] https://www.newyorker.com/tech/annals-of-technology/the-electricity-crisis-in-venezuela-a-cautionary-tale
[16] Energy insight offered by email by retired power generation expert P. Eng.

These are all cautionary tales for Canadians. If the net-zero 'all electric' plan was to be attempted, *Canezuela* awaits.

The Myth of Retrofit Energy Efficiency

The theory of 'do more with less' is tantalizing and in some cases has useful application. However, sweeping programs of regulation or incentivizing perceived 'large untapped opportunities' may reveal that the reason for being untapped, is related to unrealistic cost vs little benefit. In Canada, the Building Owners and Managers Association (BOMA) and LEED Standards have been integral to facility design, construction and upgrade for decades. The idea of energy efficiency is not new.

The following is an excerpt of a Robert Lyman post: *"Look before you leap on housing retrofits."*

One of the central parts of the energy proposals in "*Zeroing…"* is to retrofit assets. A recent article written by Michael Kelly, a professor at the University of Cambridge, describes a 2019 U.K. government report stating that *"the 29 million existing homes in the U.K. must be made low-carbon, low-energy and resilient to climate change".* [17]

In it, he described his experience in advising on a pilot program launched by the UK government in 2008. That program, called, *"Retrofit for the Future"* committed 150,000 pounds (Canadian $262,000 at today's exchange rates) to retrofit each of 100 houses in the housing association (i.e. social housing) sector. The target for the program was to reduce per house GHG emissions by 80%, largely by installing full wall insulation, underfloor insulation, the newest high-efficiency appliances, and other measures. The efficiency improvement goal was not attained (some units reached 60 per cent GHG emissions reduction), even at that elevated cost.

The City of Cambridge subsequently considered a proposal to retrofit the city's 49,000 homes and 5500 other buildings at a cost of 700,000 to one billion pounds (Canadian $1.2 billion to $1.7 billion) to halve the CO2 emissions. The City declined. If that proposal were to be extended to all 29 million existing homes in the U.K., the cost of retrofitting would be about 4.3 trillion pounds (Canadian $7.5 trillion).

If the typical U.K. household energy bill of 2,000 pounds per year (Canadian $3,500) were halved, the saving would be 29 billion pounds (Canadian $51 billion) per year, and the payback time would be 150 years.

Proponents of expensive emissions reduction measures often claim that, if they were ordered to be done in the entire economy, the resulting economies of scale would reduce costs to a more manageable level. However, in the U.K., private lenders would not agree to finance a home improvement unless the payback period were about 3-4 years, rising to perhaps 7-8 years on infrastructure investments in the home. There is no way that the payback period could be reduced to that level, especially in eleven years.

If private lenders would not touch such uneconomic investments, would governments? There are about 14 million housing units in Canada. **If the cost of major housing retrofit here (not to mention commercial buildings) were the same as in the U.K., the cost to halve GHG emissions would be $3.6 trillion.**[18] [19]

[17] https://www.thegwpf.com/decarbonisation-and-the-command-economy/#_ftn2

[18] https://blog.friendsofscience.org/2019/05/13/look-before-you-leap-housing-retrofits/

[19] How much is $3.6 trillion ($3,600,000,000,000)? If you were given a guaranteed annual income of $100,000 per year from such a fund, you would have to live 36,000 years to spend it, even if you received no interest. It costs about $6 million per kilometer to build a highway in Canada, and the distance from Halifax to Vancouver is just under 6,000 km. You could build a highway that crossed Canada 100,000 times for

Free Industry from Emissions=Reality $$$$$

Image licensed from Shutterstock.

"Zeroing…" suggests that we can *"Electrify Just About Everything; Free Industry from Emissions."* These blithe statements hide the multi-trillion-dollar implications for the Canadian economy, fraught with stormy clouds of risk due to lack of realistic cost-benefit assessment.

In *"Zeroing…"* on page 13, the computer screen shot is from the Alberta Electrical System Operator. Visible are references to the co-generated electrical power that exists today from the waste heat of oil sands and other industrial operations. In other words, **much of Canada's heavy industry is a renewable contributor of power generation back to the grid.** (See AESO screenshot below of Cogeneration July 17, 2019 at 10:10AM – "MC = Maximum Capacity; TNG=Total Net Generation; DCR=Dispatched [and accepted] Contingency Reserve. TNG is what is on the grid at the time of this screenshot.)

Cogeneration			
ASSET	MC	TNG	DCR
ATCO Scotford Upgrader (APS1)	195	142	0
Air Liquide Scotford #1 (ALS1)	96	73	6
AltaGas Harmattan (HMT1)	45	37	0
Base Plant (SCR1)	50	7	0
Bear Creek 1 (BCRK)	64	52	0
Bear Creek 2 (BCR2)	36	0	0
BuckLake (PW01)	5	2	0
CNRL Horizon (CNR5)*	203	176	0
Camrose (CRG1)*	10	0	0
Carseland Cogen (TC01)	95	68	0
Christina Lake (CL01)	100	83	0
Dow Hydrocarbon (DOWG)	326	178	7
Edson (TLM2)	13	9	0
Firebag (SCR6)	473	382	20
Fort Hills (FH1)	199	164	0
Foster Creek (EC04)	98	69	0
Joffre #1 (JOF1)	474	365	0
Kearl (IOR3)	84	45	0
Lindbergh (PEC1)*	16	3	0
MEG1 Christina Lake (MEG1)	202	146	0
MacKay River (MKRC)	207	172	0
Mahkeses (IOR1)	180	156	0
Mulligan (MUL1)*	5	2	0
Muskeg River (MKR1)	202	158	7
Nabiye (IOR2)*	195	155	0
Nexen Inc #2 (NX02)	220	0	0
Poplar Creek (SCR5)	376	207	0
Primrose #1 (PR1)	100	74	0
Rainbow Lake #1 (RL1)	47	0	0
Redwater Cogen (TC02)	92	72	0
Shell Caroline (SHCG)*	19	0	0
Syncrude #1 (SCL1)*	510	365	0
U of C Generator (UOC1)*	12	12	0
University of Alberta (UOA1)*	39	24	0

According to industry experts consulting with us, most of Canada's large industrial facilities are already 'electrified' – though certain processes still require fossil fuel energy or by-products. There is no easy 'fix' for that, no matter how much money is thrown at new technologies or processes.

However, as an exercise in contemplating the cost and evaluating the reality of "Zeroing…" proposals of "*Electrify Just*

$3.6 trillion. It costs about $2 billion to build a new hospital in Canada; you could build 1800 of them for $3.6 trillion. If you laid $3.6 trillion U.S. one-dollar bills on their edge in a row, they would stretch around the earth at the equator 10 times.

About Everything; Free Industry from Emissions", the following offers some rough mathematical calculations.

The National Energy Board publishes Canada-wide and provincial data (incidentally, another service that will end with the National Energy Board) in terms of petajoules (PJ)[20] of total primary energy by economic sector and by energy source.

Total Primary Consumption 2016 - 11,150 PJ
Industrial sector (including oil and gas, mining and other) - 52%, or 5,798 PJ
Transportation sector - 23%, or 2,565 PJ
Residential Sector - 13%, or 1,450 PJ
Commercial sector - 12%, or 1,338 PJ

Demand by Energy Source 2016
Refined Petroleum Products - 4,677 PJ
Natural Gas - 3,898 PJ
Electricity - 1,884 PJ
Biofuels - 549 PJ
Others - 142 PJ

Kent Zehr, P. Eng. has done a detailed evaluation of what appears to be a huge market of opportunity, but in fact suggests that of the 11,151 PJ of energy consumed in Canada in 2017, 5,993 PJ were already electrical or other locked in supplies, leaving a total of 5,158 PJ of gross opportunity which on further consideration reduced to a total of 1,966 PJ annually. This information is presented graphically on the next slide

- As noted in the footnote, a Petajoule,PJ, is a very large quantity of energy, equal to 277,778 MegaWattHours, MWH.

[20] The joule is the standard unit of energy in general scientific applications. One joule is the equivalent of one watt of power radiated or dissipated for one second. One petajoule is 10^{15} joules (1 million billion) or 278 gigawatt hours.

- Therefore, the identified net opportunity, as given in the Summary slide of 1,966 PJ equals 500,000,000 MWH.
- From StatsCan, recently Canada had a total annual electrical consumption of 650,000,000 MWH.

Therefore, the *electrical supply system built up all across Canada in the last 100 years must be increased in size by 84%, nearly doubled, in the next 20 years* to deliver the minimum net opportunity for greening.

The foregoing analysis, as reasonable as it sounds, is completely wrong.

The major mistake is the first step in the logic chain, assuming the amount of existing electrification to be 5,993 PJ. As reasonable as that sounds, it is entirely unreasonable since the total electricity supplied in Canada, 650,000,000 MWH equals only 2,339 PJ.

Even if only half of that 5,993-2,339 = 3,654 PJ shortfall is greened, the total possible to be greened is 3,793 PJ or about 240% of existing total Canadian consumption

A wise man once said; "Given time, money, and steel, nothing is impossible."

The existing Canadian electrical system required about 100 years to construct. To capture the greening opportunity in the next 20 years, or 30, or 40, requires us to construct more than twice as much capacity as we currently have. That means dispatchable (on-demand) base load capacity, not wind, not solar. On top of these challenges, the new generation facilities would require kilometers of high voltage transmission lines. This would cost in the trillions[21] and face worse public opposition than pipelines.

We have neither the time, the money, or the steel to meet this challenge. Therefore, 'greening the grid' as proposed is impossible

Alternative Energy/Storage Options – Transition to Reality

Small Modular Reactors (SMR)

The Canadian government and numerous industry partners made a heroic push in 2018 to develop a national roadmap[22] on Small Modular Reactors, an emerging nuclear technology where Canada appears to have a leading technical edge in terms of global development. While this is a promising area for power generation, using low nuclear radiation to generate power for fixed facilities as well as portable contexts, there will not be a demonstration model until 2026 with first commercial deployment by 2030.

If the demonstration and deployment are successful, there is no doubt that a potential global market could be tapped.

However, as Vaclav Smil notes about the transitional period of new energy options:

"Going from biomass to coal, it took us 35 years, globally. Going from 5% oil to 25% of oil took us 40 years. Going from 5% natural gas to 25% natural gas has taken us 55 years. …but the technique gets trickier. Everything you could do with wood, you could do with coal, only better. Energy density…ton of oil is 42 gigajoules compared to ton of coal which is about 24 Gj. You get almost twice as much energy in oil than in

[21] The 500-kV high voltage line from Calgary to wind farms in southern Alberta cost $2.2 billion for 213 km.
[22] https://smrroadmap.ca/wp-content/uploads/2018/11/SMRroadmap_EN_nov6_Web-1.pdf

coal. And on top of that, it is a portable fuel. So, you can run the planes, trains and cars with it. And it requires some sophistication of use."

If we rely on Smil's references, SMR might achieve 25% of market by perhaps 2085 (perhaps later, as it is a more sophisticated technology that will require new skills and special handling). According to the World Nuclear Association, other countries/competitors are at a more advanced stage of development.[23]

WORLD NUCLEAR ASSOCIATION

Small reactors for near-term deployment – development well advanced

Name	Capacity	Type	Developer
VBER-300	300 MWe	PWR	OKBM, Russia
NuScale	60 MWe	integral PWR	NuScale Power + Fluor, USA
SMR-160	160 MWe	PWR	Holtec, USA + SNC-Lavalin, Canada
ACP100	125 MWe	integral PWR	NPIC/CNPE/CNNC, China
SMART	100 MWe	integral PWR	KAERI, South Korea
BWRX-300	300 MWe	BWR	GE Hitachi, USA
PRISM	311 MWe	sodium FNR	GE Hitachi, USA
ARC-100	100 MWe	sodium FNR	ARC, USA
Integral MSR	192 MWe	MSR	Terrestrial Energy, Canada
BREST	300 MWe	lead FNR	RDIPE, Russia

WORLD NUCLEAR ASSOCIATION

Small reactor designs at earlier stages (or shelved)

Name	Capacity	Type	Developer
EM2	240 MWe	HTR, FNR	General Atomics (USA)
VK-300	300 MWe	BWR	NIKIET, Russia
AHWR-300 LEU	300 MWe	PHWR	BARC, India
CAP200	220 MWe	PWR	SNERDI, China
SNP350	350 MWe	PWR	SNERDI, China
ACPR100	140 MWe	integral PWR	CGN, China
IMR	350 MWe	integral PWR	Mitsubishi Heavy Ind, Japan
Westinghouse SMR	225 MWe	integral PWR	Westinghouse, USA*
mPower	195 MWe	integral PWR	BWXT, USA*
Rolls-Royce SMR	220+ MWe	PWR	Rolls-Royce, UK
PBMR	165 MWe	HTR	PBMR, South Africa*
HTMR-100	35 MWe	HTR	HTMR Ltd, South Africa
Xe-100	75 MWe	HTR	X-energy, USA
MCFR	large?	MSR/FNR	Southern Co, USA
SVBR-100	100 MWe	Lead-Bi FNR	AKME-Engineering, Russia
Westinghouse LFR	300 MWe	Lead FNR	Westinghouse, UK
TMSR-SF	100 MWt	MSR	SINAP, China
PB-FHR	100 MWe	MSR	UC Berkeley, USA
Integral MSR	192 MWe	MSR	Terrestrial Energy, Canada
Moltex SSR-U	150 MWe	MSR/FNR	Moltex, UK
Moltex SSR-W global	150 MWe	MSR	Moltex, UK
Thorcon MSR	250 MWe	MSR	Martingale, USA
Leadir-PS100	36 MWe	lead-cooled	Northern Nuclear, Canada

WORLD NUCLEAR ASSOCIATION

Very small reactor designs being developed (up to 25 MWe)

Name	Capacity	Type	Developer
U-battery	4 MWe	HTR	Urenco-led consortium, UK
Starcore	10-20 MWe	HTR	Starcore, Quebec
USNC MMR-5&10	5 MWe	HTR	UltraSafe Nuclear, USA
Gen4 module	25 MWe	Lead-bismuth FNR	Gen4 (Hyperion), USA
Sealer	3-10 MWe	Lead FNR	LeadCold, Sweden
eVinci	A few MWe	Heatpipe	Westinghouse, USA

However, it seems clear that the roadmap for SMR is heavily reliant on federal incentives and regulation over market impetus, from the 'roadmap':

[23] http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/small-nuclear-power-reactors.aspx

"The federal government should implement measures to share risk with private investors, incentivizing first-commercial deployment of SMRs in Canada, aimed at: • Reducing the cost of capital, for example with loan guarantees • Providing long-term price stability, for example through a Production Tax Credit • Reducing capital cost tax burden, for example through an Investment Tax Credit or extending Accelerated Cost of Capital Allowance provisions for renewable energy to nuclear energy projects"

Likewise, the roadmap references to Bill C-69 and the new Impact Assessment Act suggest these to be crucial to the development. Considering the several known and 'unknown' risks related to nuclear energy, particularly this smaller, more portable form, that would be a new entry, untested in the market, it is deeply disturbing to consider the possibility that the approval process and critical infrastructure legislation has been redesigned to provide a preferential fast track of such technology under a more subjective process that will be done by parties with no requirement for them to have industry-related expertise.

*"Through Generation Energy—a national dialogue on Canada's energy future - the federal government heard that a **pan Canadian approach to SMRs would reduce uncertainty and help guide decisions by investors and policymakers, and inform decisions by regulators**. Leveraging its convening power, the federal government, challenged all interested provinces, territories, and power utilities from across the country to co-create a Roadmap for SMRs."*

While there are opportunities for this Canadian SMR technology to develop and excel, it should not be at the expense of Canada's fossil fuel resource industries which have an existing skilled work force, infrastructure, leading edge technology and global market and for which the technologies to manage all aspects of use, transportation, clean-up and reclamation are well-known and well-provided for under Canadian law and technological development. Intentionally sidelining oil, gas, oil sands and coal development in Canada through 'climate' legislation while creating preferential treatment for one industry over another based on the whims or lobbying of certain sectors has made Canada 'hostile' to investment, according to PPHB Energy Investment Banker.[24]

*"For the federal government, its support of certain energy projects, while fighting others, has allowed itself to be positioned as both pro-energy and anti-energy. This split political personality is seen by the global energy industry as a sign **Canada has evolved into a hostile location to do business.** For an industry that operates with decades long planning and development timetables, this **hostile attitude** could cause long-term damage for Canada's economy, and especially its western provinces where the energy industry is centered. **Energy hostility** will also put the mining, timber and other extractive industries on notice that their growth may soon become challenged. For an industry that operates with decades-long planning and development timetables, **this hostile attitude could cause long-term damage for Canada's economy**."*

Hydrogen Power

An excerpt of Global Warming Policy Foundation's report: "Transition to Reality"[25]

Despite the investment of many billions of dollars in hydrogen power research, especially in the USA, the fundamental problems with hydrogen as an energy carrier remain. Consider, for example, the problems of transportation and distribution. Before hydrogen can be transported anywhere, it needs to be either liquified or compressed. To liquify it, it must be cooled to a temperature of −253 ◦ C. At this temperature, refrigerators are extremely inefficient; as a result, about 40% of the energy in the hydrogen must be spent to liquify it. In addition, because it is a cryogenic liquid, still more energy would be lost as the

[24] http://www.pphb.com/pdfs/musings/Musings041718.pdf
[25] https://www.thegwpf.org/content/uploads/2019/02/Lyman-2019.pdf

hydrogen boils away during transport and storage. As an alternative to liquifying it, one could use high pressure pumps to compress it. This would only waste about 20% of the energy in the hydrogen. However, safety-approved, steel tanks capable of storing hydrogen at 5000 psi weigh approximately 65 times as much as the hydrogen they can contain. Consequently, to transport 200 kilograms of compressed hydrogen, roughly equal in energy content to 200 gallons of gasoline, would require a truck capable of hauling a 13-ton load. In principle, a system of pipelines could, at enormous cost, be built for transporting gaseous hydrogen. But because hydrogen is so diffuse, with less than one third the energy content per unit volume of natural gas, these pipes would have to be very big, and large amounts of energy would be required to move the gas along the line. Another problem is that hydrogen can penetrate readily through the most minutely flawed seal, and can actually diffuse right through solid steel itself. This would create ample opportunities for much of the hydrogen to leak away during transport. As hydrogen diffuses into metals, it also embrittles them, causing deterioration of pipelines, valves, fittings, and storage tanks throughout the entire distribution system. Unless very carefully monitored, the pipeline system could become a continuous source of catastrophes. Given these technical difficulties, the implementation of an economically viable method of hydrogen distribution from largescale central production factories is essentially impossible.

Pumped Hydro

"Zeroing…" makes brief mention of other energy forms of storage. These are necessary to maximize the use of wind and solar. Pumped hydro is one possibility. It is important to appreciate that at this point, pumped hydro is typically used to smooth operations for 'load balancing' especially in conjunction with erratic renewables, but there is insufficient storage for any long-term demand. Likewise, pumped hydro often presents similar environmental consequences or faces public challenges as do hydro dams. The scale for long-term power supply from pumped storage is difficult for most people to imagine.[26]

The NEB material on pumped storage indicates that pumped storage is not energy-free; energy is required for pumping, in some cases **more** than the energy subsequently generated.[27]

"*Canada's only PSH facility is Ontario Power Generation's Sir Adam Beck Pump Generating Station. This 174-megawatt facility pumps water from the Niagara River into a 300-hectare reservoir for energy storage. This storage capacity is greater than what currently exists in all of Canada's newer, emerging storage technologies, such as batteries.*

The United States (U.S.) has over 30 PSH facilities with a combined capacity of 22 gigawatts. U.S. facilities generate around 23 000 gigawatt hours (GWh) per year, and consume 29 000 GWh to operate their pumps. Despite this net loss of energy, the grid reliability provided by PSH facilities and the ability to generate when demand is strong is highly beneficial and will become increasingly important as Canada and the U.S. integrate more renewable power into their grids."

Battery Storage

Energy author Euan Mearns refers to battery storage as "the Holy Grail." Though media stories give rapturous attention to every new advance, large scale battery storage cannot yet, and possibly never, meet the needs of modern society. The complexities of scale are difficult for average citizens to imagine. As of April 8, 2016, Roger Andrews calculation in "Energy Matters" stated that: *"…installed world battery + CAES + flywheel + thermal + other storage capacity amounts to only about 12 GWh, enough to fill global*

[26] http://euanmearns.com/the-loch-ness-monster-of-energy-storage/
[27] https://www.neb-one.gc.ca/nrg/ntgrtd/mrkt/snpsht/2016/10-03pmpdstrghdr-eng.html?=undefined&wbdisable=true

electricity demand for all of fifteen seconds. Total global storage capacity with pumped hydro added works out to only about 500 GWh, enough to fill global electricity demand for all of ten minutes."[28]

Celebrities and star investors often unwittingly mislead the public on what is possible and what is not, or what the cost would be. A good example is an interview with Jeff Skoll in Maclean's Magazine of July 21, 2017 wherein Jeff Skoll, Al Gore's movie producer, said:

*"Jeff Skoll: Obviously being entrepreneurial means taking risks, putting bets on lots of different things. Some of the things we put our bets on years ago were solar and wind; ten years ago, it cost $4 a watt to get solar installed, today it costs 38 cents a watt. It's going down to pennies in the next years. Burning coal and trying to capture its off gasses, y'know, probably wasn't the best idea, but we're trying [referring to Carbon Capture and Sequestration]. In the meantime, I think the biggest breakthrough that's upon us is the new generation of batteries which are super inexpensive, super powerful**; we can have a global grid with batteries, solar and wind within a decade if we put our minds to it.** The only thing that can slow us down are political obstacles, the economics are there. We're still making bets on technologies and we always will, but the ones that are advanced now have not only have proven their track record but they're about to demonstrate that even more so."*

By stark contrast, an industry power generation expert posted an article on LinkedIn entitled "Wind's Winter of Discontent" about what kind of battery power Alberta would need on one winter day.

"How much storage would we need to replace all our thermal generation? On Feb. 4, 2019, we would have needed to replace 225,000 MWh. Given that storage is only around 90% efficient, we would need to install 250,000 MWh. In addition, the system would need to be sized to cover the peak thermal production of 9,800 MW. According to Bloomberg, at current battery production rates, a system this size would require all the lithium ion batteries produced in the world for over a year. Not an easy feat. (For Now, at Least, the World Isn't Making Enough Batteries)

*How much would all this storage cost? Recent estimates for utility scale storage show battery costs of around C$650/kW for the system plus C$250/kWh for the actual batteries (this is about 70% of the current cost of a Tesla Powerwall; see link: Powerwall). **The cost to provide enough storage for <u>one cold winter day</u> in Alberta would be C$69 billion.** Unfortunately, this wouldn't be nearly enough. We would need weeks, if not months, of storage to maintain a reliable grid. The costs would be in the C$100's of billions if not trillions of dollars.*[29]*"*

Regarding Jeff Skoll's comment above industry experts have a completely different view of the real costs of wind and solar. Referring to the NDP Alberta government (2015-2019) plan to put 5,000 MW in renewables on the grid, one consultant put it this way:

*"What makes renewables expensive is integrating these technologies into the grid. Grids can handle small amounts of renewables, but the levels proposed by governments with environmental ambitions are overwhelming. These require massive expenditures in transmission, peaking power [natural gas plants], and possibly storage. **Even if wind and solar were free, the integration expenses could cost more than all other forms of generation once you pass a certain tipping point.** Another cost is market reform, but this would only apply in areas where there are competitive markets. In Alberta for example, the AESO has decided that renewable subsidies will make our once thriving energy market unsustainable. **This has led them to introduce a capacity market which will lead to $10's or maybe $100's of millions in transition expenses along with years of uncertainty.** Lastly, what gets lost in all this is the actual carbon reductions or lack thereof. The current state of storage technology is insufficient to back large*

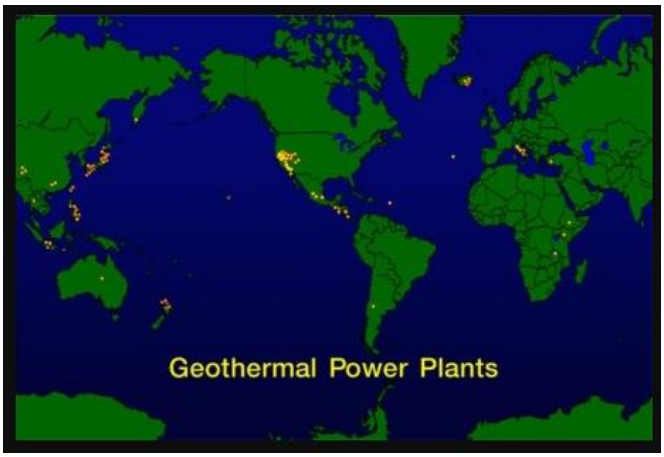
[28] http://euanmearns.com/is-large-scale-energy-storage-dead/
[29] https://www.linkedin.com/pulse/winds-winter-discontent-curtis-sheptycki/

quantities of renewables. This is leading to investments in relatively inefficient natural gas peaking facilities that negate the carbon benefits of renewables. ***Arguably, we may be better off from both a carbon and economic perspective by just investing in efficient base load natural gas and completely forgetting about renewables.*** *Existing infrastructure could be used, and market changes wouldn't be required. Regardless of the chosen path, we are a long, long way from a 100% renewable energy grid."*[30]

Geothermal

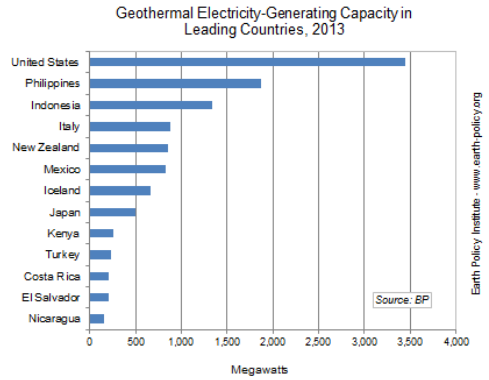
Geothermal captures the heat generated by earth itself, either through a series of near surface boreholes that can circulate retained heat (through the use of electrically powered pumps), or at a more industrial scale, by deep holes tapping into the earth's thermal power that comes from the core. Heat can be passively directed to the surface (i.e. to heat greenhouses or drying facilities), or in a more complex system to generate power, cold water can be pumped deep down to 'hot rocks', generating steam to drive turbines above ground. This makes geothermal rather dependent on geography.

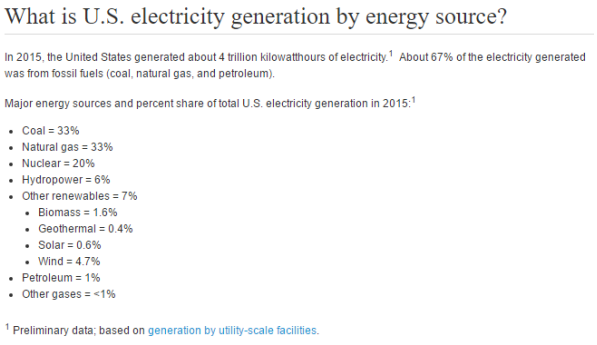
The best places in the world for geothermal tend to be on or near fault lines.



Source: Euan Mearns http://euanmearns.com/geothermal-energy-in-perspective/

The United States is the largest producer of geothermal power in the world, but even so, the contribution to the nation's power generation is very small.





[30] http://blog.friendsofscience.org/2017/12/14/alberta-rejoicing-over-renewables-auction-will-be-short-lived/

In a cold, vast country like Canada, with extreme temperature differentials, the cost of infrastructure, distance to market from source of geothermal generation, and lack of areas with suitable thermal gradient mean geothermal will not be a major or cost-efficient supplier of power generation or heat.[31]

One Container Ship Puts out the Pollution of 50 Million Cars

Image licensed from Shutterstock.

While Canada turns itself inside out to try and go net-zero, and the rest of the world continues pretty much business as usual, container ships continue to spew the equivalent pollution of millions of cars. This means your carbon tax is a ridiculous and humiliating waste of time – really just meant as a way to put a price on carbon so that renewables investors can make money from *"a substance whose value lies in its absence."*

They can then parlay that into carbon trading where they make money from *"the lack of delivery of an invisible substance to no one."*

If it is all sounds like a racket, it is known as "Conning the Climate."

[31] https://friendsofscience.org/assets/documents/Geothermal_Alberta_A_Cause_for_Caution.pdf

Anthropocene or Meghalayan

Source: https://www.hindustantimes.com/science/meghalayan-age-makes-the-state-a-part-of-geologic-history/story-bvbKrd33IXgMD1o6BaSjmM.html

Mawmluh Cave is found at an elevation of 1,290 metres in the northern state of Meghalaya in India. As one of the longest and deepest caves in India, its stalagmites recorded remarkable changes in earth's climate that occurred some 4,200 years ago. There was an abrupt cooling and drought, widespread in the world, that lead to the collapse of societies. This dramatic change and two others marked in the rock, have become defining periods of ages within the Holocene.

The International Union of Geological Sciences (IUGS), is one of the largest scientific societies in the world. It was founded in 1961 and "promotes and encourages the study of geological problems, especially those of world-wide significance, and supports and facilitates international and interdisciplinary cooperation in the earth sciences."[32]

The IUGS did not identify the Anthropocene – which many say is the recent 50-year period of humans affecting climate. In fact, on twitter the IUGS said that the name "Anthropocene" (human-caused) has not even been submitted for consideration and that it is more of a sociological term, not a scientific one.

Just to prove that the science is never settled, as soon as the IUGS decided on the subdivision of the Holocene epoch of 11,600 years into three ages: Greenlandian, Northgrippian and Meghalayan, scientists began to debate whether the Meghalayan was a global or regional phenomenon. But this gives you a sense of the time scales related to assessing climate change; not 50 years, but hundreds or thousands.

[32] http://iugs.org/index.php?page=what-is-iugs

The Sleep of Reason Produces Monsters

Yellow Vest/Gilets Jaunes protest in Paris – source unknown

Robert Lyman wrote this post about a recent GWPF publication.[33]

Remy Prud'homme, a celebrated French economist now teaching at the Massachusetts Institute of Technology, recently wrote a paper that described the "energy transition" that the government of France was seeking to achieve in order to "decarbonize" the French economy. It was published by the Global Warming Policy Foundation under the title, The Energy Transition – Useless, costly, unfair.

In a short 15 pages, Prud'homme dissects the reasoning behind the French policy and shows how flawed it is. His analysis offers many useful lessons for those concerned about climate-related policies in Canada.

The objective of the French government's policy is to reduce annual carbon dioxide equivalent emissions from the current level of 340 million tonnes (Mt) to 170 Mt by 2050 and subsequently to zero. Unlike historic energy transitions, which were driven by market demands and technological innovation, this transition is entirely politically motivated. It is based on acceptance of the theory of anthropogenic global warming, i.e. that greenhouse gases emitted as a result of human activities are the drivers of increases in the average global temperature. Prud'homme call this theory "more political than scientific". However, rather than challenging the theory on its scientific basis, he treats it as though it were scientifically validated, and shows how the policies based on it are pointless and damaging.

[33] https://blog.friendsofscience.org/2019/06/14/the-sleep-of-reason-produces-monsters/

Impact of Potential OECD Policies on Temperatures

To do this, he describes the differences between two scenarios. In the reference scenario, without energy transition policies, yearly global emissions stay at their 2017 level. He regards this as "realistic", given that over the last 33 years, global emissions have increased by 80 per cent, so assuming they would decrease in the 33 years from 2017 to 2050 seems unrealistic.

He compares this to a "policy scenario", in which between 2017 and 2050 OECD countries reduce their carbon dioxide emissions by 50 per cent and the rest of the world (i.e. the "developing countries") do not increase their yearly emissions.

As a parenthetical comment, Robert Lyman would argue that both scenarios are very "optimistic" in terms of the prospects for reducing emissions; the absolute levels of emissions, however, are less important for his case that the differences between the scenarios.

In the reference scenario, the average world temperature would increase, according to the Intergovernmental Panel on Climate Change (IPCC) analysis, by 0.53 degrees C. The strong measures adopted under the policy scenario would bring this temperature increase down to 0.48 degrees C. The difference between the scenarios is thus 0.05 degrees C., or 5/100ths of a degree. The difference is small and, in practice, negligible.

He then examined the impact of policies by France. France's emissions represent one per cent of global emissions, which themselves are just one per cent of the stock of carbon dioxide in the atmosphere. So, if by some miracle France were to instantly stop emitting carbon dioxide, the growth in the atmospheric stock would be reduced by 1/10,000, and the effect on global warming would be "entirely insignificant".

A great deal is being made in France of the importance of closing the four remaining coal-fired power plants (with a capacity of 3 GW, accounting for 1.8 Per cent of electricity output). This will be done over the next four or five years. In contrast, China will soon open about 560 thermal power plants with a capacity of 259 GW.

The Costs of the Policy

Electricity

France's carbon dioxide equivalent emissions by economic sector are quite different from those of Canada. Transportation produces 39 per cent, residential and services 24 per cent, manufacturing 21 per cent, energy 14 per cent, and other sources 3 per cent.

Strangely, French policy is to reduce nuclear power generation and replace it with wind and solar; that is, to replace one low emission source for another. Prud'homme shows how, considering the energy required to build wind and solar plants and the effects of having to build backup plants, the results of this will almost certainly be to increase emissions. EdF, the main electrical utility, is obligated to buy wind and solar under feed-in-tariffs that guarantee above-market rates for wind and solar suppliers for 15-year periods. The cost of this practice is about five billion euros (roughly $7.5 billion Canadian) per year and increasing regularly. The regulator has estimated that, with conservative assumptions, the cumulative cost will be 57 billion euros ($85.5 billion Canadian) over the period 2014-25. Moreover, the combined effect of the 20% value-added tax and the tax on electricity consumption adds another one billion euros per year to ratepayers' bills.

To this can be added many indirect costs, including:

- The destruction of rural landscapes
- The loss in value to neighbouring real estate, estimated at 20 billion euros ($30 billion Canadian) so far
- The deaths of thousands of birds and bats

- The significant cost of the electricity gathering and transmission systems, estimated to add one billion euros per year to transport costs
- The costs of back-up generation and of curtailment due to the frequent periods when the generation does not match demand and renewable energy is given "first-to-the-grid" rights.

Experience to date in Europe and elsewhere shows that, as the share of wind and solar energy in a country's electricity generation system rises, the rates for consumers rise. While France is not yet one of the European countries most heavily affected by this, the developments planned for the French "energy transition" imply a doubling of electricity rates.

Transportation

To reduce emissions caused by road transport, French governments have used several measures. Notably, they have heavily taxed vehicles and subsidized alternatives. Taxes on road transport that do not apply to other goods and services amounted to 45 billion euros ($67.5 billion Canadian) in 2017. After tobacco, road fuels (gasoline and diesel) are the most taxed goods in France. The government's plan to increase road taxes even more led to the Yellow Vests protest movement.

Prud'homme comments on the French use of carbon taxes, noting that in theory they could replace all other anti-carbon policies, but in fact are used as an addition, not a substitute. He argues that implementing a carbon tax in only one country or one group of countries (e.g. the OECD) rather than globally merely serves to displace economic activity from the taxing countries to the others, but he also notes that a single world carbon tax is "socially and politically unthinkable".

Non-automobile transport modes are subsidized as much or more than other European countries. SNCF, the French national rail monopoly, receives about 14 billion euros ($21 billion Canadian) per year in subsidies. Urban transit receives about 9 billion euros ($13.5 billion Canadian) per year, financed by a special tax levied on businesses. A purchaser of an electric vehicle receives a subsidy of 6,000 euros ($9,000 Canadian). If the government reaches its goal of one million EVs purchased in one year (very unlikely), the taxpayer's bill would be 6 billion euros ($9 billion Canadian) per year.

All these taxes and subsidies have had a limited effect on energy demand or emissions. The share of rail in freight transport has stagnated; it represents only 10 per cent of total freight and 2 per cent of freight shippers' expenditures. Cars represent 89 per cent of passenger transport expenditures. Bicycles, highly touted and subsidized, account for 0.5 per cent of passenger travel. In these circumstances, the main effect of road taxes is to increase general transport costs and to reduce mobility. Lower mobility reduces the effective size of labour markets, and hence their efficiency (workers cannot access the jobs they want, and enterprises cannot access the workers they need).

The French Road Safety Agency is reducing the speed limit on secondary roads from 90 km/h to 80 km/h, claiming that this would lower carbon dioxide emissions by 30 per cent. In fact, it will reduce average speeds by 2-5 km/h, fuel consumption by 1 or 2 per cent, and carbon dioxide emissions by a similar percentage.

Fairness

Regressive Effects in France

The share of energy expenditures in electricity, road transport, and housing is larger in poor households than in rich ones, so fuel taxes fall disproportionately on the poor.

There are also regressive subsidies. The very large subsidies to electric vehicles, for example, go for the purchase of cars costing far more than the average family can afford, and usually go for the purchase of a second or third car.

The National French Statistics Agency keeps track of "energy vulnerability", a condition that exists when a household spends more than 8 per cent of its income on home heating and/or more than 4.5 per cent on transport. T**wenty-two per cent of French households are in a position of energy vulnerability, and the number is rising, with the problem especially acute for senior citizens.**

The costs of energy differ by regions. To illustrate, in 2011, the household expenditures on electricity averaged 630 euros ($945 Canadian) in large cities and 850 euros ($1,275 Canadian) in rural areas. In the same year, household expenditures on car fuels averaged 1,083 euros ($1,632 Canadian) in large cities and 1769 euros ($2,654 Canadian) in rural areas.

Regressive Effects Internationally

The greatest "regressivity" is the impact of climate policies on developing countries. which simply cannot afford the cost of using wind and solar energy for electricity generation when cheaper coal is available. Through what Prud'homme refers to as "environmental imperialism", rich countries, their aid agencies and the development banks they control have decided not to finance coal-fired power plants, even through reimbursable loans. NGOs have successfully lobbied private banks to adopt the same policy. China, however, has stepped in and financed coal-fired plants (at interest rates higher than World Bank rates, and with fewer environmental constraints). This may have long-term strategic consequences.

At COP15 in Copenhagen in 2009, rich countries promised to pay poor countries a hundred billion dollars per year starting in 2020 if the poor countries agreed to commit to huge emissions reductions. Nine conferences later, no progress has been made. "*There is absolutely no agreement as to who exactly will pay what, to whom, according to what criteria, and with what controls.*"

> It seems doubtful that the revolt of people is diminishing when the state progressively and aggressively confiscates the means of their subsistence, and finally their dignity.

Drieu Godefridi, Belgian philosopher, jurist and author

https://blog.friendsofscience.org/2018/11/28/3-reasons-to-think-that-the-movement-of-yellow-vests-has-only-just-begun/

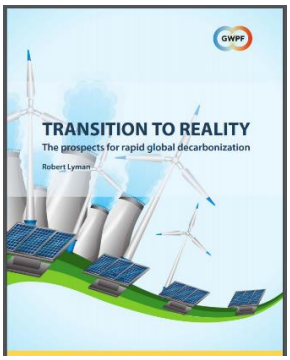
"Transition" vs Pollution

Prud'homme expresses his strong objection to real environmental degradation of air, land and water. He describes how in France the fight against carbon dioxide has pushed aside the fight against pollution. The former Ministry of the Environment has even been renamed "The Ministry of Ecological Transition and Solidarity".

Prud'homme concludes:

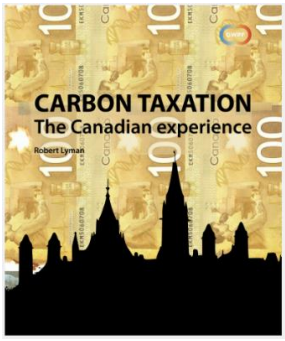
"*This transition is neither ecological, nor solidary, much less economic. The transition stands beyond the realm of rationality, in a world of fantasy. As Goya puts it in one of his etchings: 'the sleep of reason produces monsters'.*"

Additional Resources:



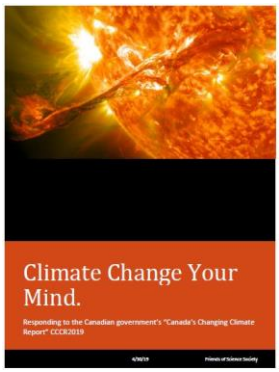
Overview: https://www.thegwpf.org/energy-policy-needs-to-transition-to-reality/

Report: https://www.thegwpf.org/content/uploads/2019/02/Lyman-2019.pdf



Overview: https://www.thegwpf.org/canadas-carbon-taxation-its-worse-than-thought/

Report: https://www.thegwpf.org/content/uploads/2019/06/Lyman-carbontax-1.pdf



Overview: https://blog.friendsofscience.org/2019/05/01/climate-change-your-mind-rebutting-canadian-governments-climate-report/

Report: https://blog.friendsofscience.org/wp-content/uploads/2019/05/Climate-Change-Your-Mind-FINAL-2.pdf

Overview: https://blog.friendsofscience.org/2019/05/05/futile-folly-canadas-climate-policy-goals-in-the-global-context/

Report: https://blog.friendsofscience.org/wp-content/uploads/2019/05/Futile-Folly-FINAL.pdf

Robert Lyman is an Ottawa energy policy consultant, former public servant and diplomat. Many of his insights have been incorporated into this report and those above. His complete biography can be read here.

About

Friends of Science Society is an independent group of earth, atmospheric and solar scientists, engineers, and citizens who are celebrating its 16th year of offering climate science insights. After a thorough review of a broad spectrum of literature on climate change, Friends of Science Society has concluded that the sun is the main driver of climate change, not carbon dioxide (CO2).

Friends of Science Society
P.O. Box 23167, Mission P.O.
Calgary, Alberta
Canada T2S 3B1
Toll-free Telephone: 1-888-789-9597
Web: friendsofscience.org
E-mail: contact(at)friendsofscience(dot)org
Web: climatechange101.ca