A CAUTIONARY TALE FOR GOVERNMENTS AROUND THE WORLD

The City of Ottawa's Climate Change Master Plan:

Infeasible and Damaging to Ottawans, the Environment and Human Rights

January 27, 2022

The City of Ottawa's plan is hopelessly naïve and, ultimately, impossible to successfully enable. Nevertheless, it will cause great financial pain to residents and the businesses of Ottawa for no environmental benefit. Indeed, enabling the plan would contribute to an ecological and humanitarian disaster.

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1.0 Executive Summary

Canada's capital city, Ottawa, is on the verge of a self-induced crisis. This predicament is being brought on by an obsession with "stopping climate change," prioritizing it over real world environmental, health, economic and energy supply concerns. The forecast cost of achieving the City's net-zero greenhouse gas emissions by 2050 target is astonishing: ***$57.4 billion*** to be spent over the three decades between 2020 and 2050, with a present value of ***$31.8 billion***. And this is just the estimated direct cost. The actual cost, including spinoffs, to the Ottawa economy and residents will be significantly higher. And one cannot ever begin to place a dollar value on eliminating people's choices about how they wish to live.

The magnitude of the "renewable" energy projects that the City says it will engage in to meet its net-zero target are equally astonishing: 36 square kilometres of rooftop solar will be required, a ***161,485%*** increase over today's levels, ***710 industrial wind turbines***, each taller than the Peace Tower, and ***122 large shipping containers of lithium batteries*** for power storage.

The genesis of the City's climate change plans was local flooding in the spring of 2019 and a series of moderate tornadoes that struck the region in late summer of 2018. Despite the floods being shown to have been caused by poor management of the annual run-off of melting snow that year and the fact that no tornadoes have been reported in the area since the 2018 event, local politicians saw fit—under extreme pressure from local activists—to declare a "climate emergency" and direct city staff to develop a plan in response. The result is the City of Ottawa's Climate Change Master Plan.

Due to the interest other municipal governments are showing in following Ottawa's example—for instance, the City of Calgary declared a climate emergency on November 15, 2021 joining Edmonton, Vancouver, Toronto, Ottawa and Montreal who already had their own—ICSC-Canada undertook a comprehensive review of Ottawa's Climate Change Master Plan, along with its associated climate and energy strategies. What follows can best be described as a cautionary tale of what *can and will inevitably happen* when fiscal policy and hard-nosed science and engineering are subordinated to ideology and special interest, pressure politics.

ICSC-Canada found Ottawa's Climate Change Master Plan to be generally infeasible, dangerous to the well-being of residents and destructive of the local environment. In addition, if the City's

climate mitigation (efforts to slow climate change) plans were to be implemented, they would support the worst human rights and environmental abuses across the world.

The three most important considerations when deciding on an energy infrastructure are affordability, reliability and environmental performance. The City of Ottawa seems preoccupied with only one aspect of the three with its overwhelming focus on greenhouse gas emission management. Consequently, in contrast to the City's overarching vision, as defined in its Climate Change Master Plan, to transition "Ottawa to a clean, renewable and resilient city by 2050," its current plans would transform Ottawa into a polluted, fragile and bankrupt city suffering from regular dangerous blackouts and business failures. Few people would voluntarily choose to live there.

In this report, we demonstrate that, even if the science being trusted by the City of Ottawa were correct, the City's approach to policy determination is still unsound. There is no chance that the developing world, now the world's largest emitters, will follow Canada's lead, let alone that of a single city, on climate change mitigation.

"Decarbonizing" an entire economy would mean virtually eliminating the use of all fossil fuels used to provide energy services like heat, light, motive power and all the thousands of uses of electricity. Consequently, achieving net-zero for the City of Ottawa would face insuperable technical and cost barriers, and demand unacceptable political changes for a democratic society, placing us back to standards of living of at least 150 years ago. The only sensible climate-related actions for the City of Ottawa, and indeed, cities and other jurisdictions around the world, is to:

Corner of Rideau Street and Sussex Drive in the City of Ottawa, about 150 years ago. (Library and Archives Canada)

- prepare for future climate change with sensible, cost-effective adaptation strategies;
- promote economic prosperity so as to provide the wealth we need to ensure resiliency;
- ensure a reliable, affordable energy supply to safeguard our citizens and maintain our standard of living.

The City of Ottawa has included, as a secondary objective in its Climate Change Master Plan, adaptation to climate change. However, it focussed only on the threat of dangerous warming and its associated impacts. Included in the Climate Change Master Plan 2021 Status Update was reference to the following now being included in the City's Official Plan:

> "Reduce the urban heat island effect and help protect the vulnerable from extreme heat."

Despite asserting that "Ottawa must be an energy conscious city where people can live, work and play in all future climate conditions," cooling adaptation requirements were entirely ignored. This, despite the fact that cooling is a far more threatening for a high latitude city like Ottawa and so should be the primary focus of any adaptation planning. City of Ottawa staff apparently do not know that cold weather kills 20 times as many people across the world as hot weather, according to an international study analyzing over 74 million deaths in 384 locations across 13 countries. The findings were published in the peer-reviewed general medical journal *The Lancet*.

Also missing from the City of Ottawa's Climate Plan is a realistic statement of the benefits of emissions reduction. While the costs of implementing the plan would be over $57 billion, the complete elimination of all carbon dioxide emissions from the City (both community and corporate), about 6.4 million tonnes in 2019, would reduce present annual global emissions by only 0.014%. In the context of a world in which emissions are constantly rising due to economic activity in Asia, the emissions benefits of Ottawa's enormous economic sacrifice would be too small to measure. Implementing such a plan constitutes dangerously foolish and futile environmentalist symbolism.

2.0 Introduction

In April 2019, a resolution to declare a climate emergency was introduced by Councillor Shawn Menard to the City of Ottawa town council. Activist pressure in support of the resolution was intense, with a protest outside Ottawa City Hall on April 16th calling on councillors to declare the emergency. Not surprisingly, on April 24th the motion was passed, having received support from Mayor Jim Watson and all the city councillors except Councillors Allan Hubley and George Darouze who voted against the resolution. Ottawa thereby joined 514 cities across Canada and 1,997 across the world to have declared a climate emergency. Regarding the declaration, Councillor Jenna Sudds said:

> "It's the young people who are inheriting the problems that we're all responsible for creating."

Still from the 2019 Canadian documentary "Global Warning" - used with permission from the director

This action had consequences, however. As a result of the declaration, climate campaigners now had a lever to push the City into actually creating and enabling a plan to address the supposed crisis. Again, activist pressure was intense and this eventually led to the creation of two documents:

1. "**The Climate Change Master Plan**," the City's master plan, first published in January 2020 and amended in Dec 2020, to reach net-zero GHG gas emissions by 2050 and adapt to warming and related phenomena. *The mayor and all councillors supported the plan*. The major elements of the plan included:

- The City Council's adoption of the following GHG reduction targets based on 2012 levels:
  - Reduce emissions from the community by:
    - 43 per cent by 2025
    - 68 per cent by 2030
    - 96 per cent by 2040
    - 100 per cent by 2050
  - Reduce emissions from City operations by:
    - 30 per cent by 2025
    - 50 per cent by 2030
    - 100 per cent by 2040
- The Climate Change Master Plan identifies eight priority actions for the period 2020 – 2025:
  1. Implement "Energy Evolution" (see below);
  2. Undertake a climate vulnerability assessment and develop a Climate Resiliency Strategy;
  3. Apply a climate lens to the new Official Plan and its supporting documents;
  4. Apply a climate lens to asset management and capital projects;
  5. Explore the feasibility of setting corporate carbon budgets, including piloting them in a small portion of the organization;
  6. Explore options for carbon sequestration methods and the role of green infrastructure;
  7. Encourage private action through education, direct and indirect incentives, municipal support and advocacy for support of individuals and private organizations by senior levels of government;
  8. Develop a governance framework to build corporate and community capacity, align priorities and share accountability in tackling climate change.

2. "**Energy Evolution**," prepared by the City's consultant, Sustainable Solutions, for attaining the goal of "net-zero" carbon dioxide (CO_2) emissions by 2050. The forecast estimated direct cost of achieving this target is $57.4 billion to be spent over the three decades between 2020 and 2050, with a present value of $31.8 billion. The actual cost, including spinoffs, to the Ottawa economy and residents will undoubtedly be significantly higher.

   Energy Evolution was published in October 2020 and it forms one of the foundations for the City of Ottawa Climate Change Master Plan—*the mayor and all councillors supported Energy Evolution*. The major elements of Energy Evolution are:

- Significantly reduce demand for energy, phase out fossil fuels and increase use of renewable resources;

- To reduce emissions by 100%. This would mean that:
    - Almost all fossil fuels will have to be phased out;
    - Heating and transportation systems will have to be electrified;
    - Waste heat utilization and renewable natural gas production will be required;
    - Enough renewable electricity (primarily wind and solar) generation and electricity storage will be required to meet demand and offset emissions on the provincial power grid. In particular, the model relied upon the City indicates that the following will be needed:

        • Solar photovoltaic (PV) reaches 1,060 MW by 2050 (approximately 36 km^2 of solar PV47 mostly on rooftops)
        • Wind generation reaches 3,218 MW by 2050 (approximately 710 large scale turbines, each taller than the Peace Tower)
        • 310 MW of local energy storage by 2030 and 612 MW by 2050 (122 large shipping containers of lithium batteries)

- A total of 39 actions to reduce greenhouse gas (GHG) emissions were detailed in Energy Evolution. They state that the five actions which will have the most significant impact are to:
    - Electrify personal vehicles;
    - Retrofit existing residential buildings;
    - Divert organic waste from landfill and create renewable natural gas;
    - Retrofit existing commercial buildings;
    - Transition to zero emission commercial fleets.

The Climate Change Master Plan states that "Ottawa is experiencing warmer, wetter and more unpredictable weather. On average, summers are getting hotter and winters less cold."

There is no analysis of the costs per ton of CO_2 emissions avoided. So, there is no way to know whether the proposed expenditures are cost effective compared to other options, or make sense in terms of the alleged value of the emission reductions.

The plan includes suggestions for additional taxes and fees that could be imposed on City residents, the largest of which are road tolls ($1.6 billion), congestion charges ($388 million), development charges ($234 million), road user fees ($188 million) and land transfer tax increase ($130 million).

Ottawa City Hall

The City of Ottawa will also spend $986 million to roll out 450 new 40-foot battery-powered buses over 5 years (by 2027) and, according to the October 2021 Climate Change Master Plan 2021 Status Update, transition to a "fully zero emission bus fleet by 2036 (based on funding availability and operational needs)." The Status Update pledged, "The first four battery-electric buses will be operational by the end of 2021, with the acquisition of an additional 74 battery-electric buses included in OC Transpo's 2022 capital budget." On November 26, 2021, the City's plans were amended to the first four buses being "ready to enter service in early 2022" and that OC Transpo "will seek to add an additional 74 battery-electric buses to its fleet in 2023." On December 3, 2021, the City of Ottawa's Auditor General committed to conducting an audit of the electric bus plans to be reported on in 2022. Section 3.2 addresses problems with the City's plans.

Covered under this cost is the bus purchase, charging equipment, electrical upgrades at the St. Laurent garage and a backup generator powered by natural gas. It's hard to estimate what the cost will be to power the buses. The staff report to the transit commission points out that electricity prices could increase and diesel prices could drop, impacting the City's ability to pay back the loan taken in establishing the buses.

As expected, media, environmental group and politician response was highly supportive:

- The Ottawa Citizen reported: "Some of the 13 public delegates who addressed the committee, like Ella Mar, ratcheted up the urgency for council to set targets on reducing emissions. Mar told councillors that approving a climate change plan might be the most important action they take in their lives."

- Ecology Ottawa stated that "A city like Ottawa – relatively wealthy and highly educated, with no major industry emissions – has an obligation and an opportunity to lead the way."

- Daniel Buckles of "The People's Official Plan" stated that "Humanity is facing a climate emergency, and cities are at the centre of the solution—which makes Ottawa's new Official Plan a once-in-a-generation opportunity to point the City toward a carbon-free, climate-safe future."

- Councillor Scott Moffatt, Chair of the City of Ottawa's Standing Committee on Environmental Protection, Water and Waste Management, said "The actions we

need to take to protect the environment are good for municipal taxpayers because they will help us save money through energy efficiency and climate resiliency. The proposed projects are tangible ways to achieve Council's aggressive targets to reduce greenhouse gas emissions. We can't, however, address climate change alone. We need support and funding from our partners and other levels of government to achieve these targets."

- Mayor Jim Watson indicated that flooding and tornadoes in Ottawa are caused by climate change. He stated that "There is a connection, and I think when you look at almost every scientific journal and every report that's come out on climate change, these are not coincidences. They're actually serious challenges to the planet's well-being."

3.0 Lack of Feasibility of Most of the Official Plan's Measures

3.1 Introduction

Professor Vaclav Smil of the University of Manitoba is the world's foremost authority on energy transitions. In his book *Energy Transitions: History, Requirements, Prospects*, he provides a number of examples of very significant barriers to rapid decarbonisation. He concludes that decarbonisation is extremely challenging and describes the idea that it can be achieved in a few decades as a "grand delusion."

Professor Smil did not address another major barrier, which is the effect of decarbonisation policies on the distribution of economic benefits and burdens in society. Promoting wind and solar energy, for example, may increase incomes for the companies that produce these technologies (mostly in China), but policies that undercut the viability of oil, natural gas and coal production and fossil-fuel-based power generation impose large losses on the regions and communities where that production occurs.

Outside of the centrally planned economies, no government has attempted to prescribe the timelines for commercialisation of new technologies or the dates by which a large share of society's needs must be met by a new technology. Governments that try to decide which energy sources we will produce and consume in the future will not have perfect knowledge or perfect information. Among other things, they will seek to judge future energy market conditions and prices in a rapidly evolving and highly competitive world, and they may very well be wrong. For example, in the past, governments around the world spent billions of dollars based on the perception that the world was running out of low-cost oil, so that new non-oil alternatives temporarily had a large competitive advantage. But those who forecast the "end of oil" have been proven wrong again and again as new exploration and development technologies have increased supply even faster than the rapidly growing global oil demand. By 2019, the world's oil consumption surpassed 100 million barrels per day, yet there was so much supply available that prices were depressed.

"Picking winners" may be an increasingly popular aspect of government industrial policy (despite its history of failures), but prudent politicians should be hesitant about committing billions of taxpayers' dollars to technologies that are not ready and cannot compete without permanent subsidies.

ICSC-Canada provides the following analysis of feasibility of the City of Ottawa's approach to climate change.

The Climate Change Master Plan approved by Ottawa City Council, based on the recommendations of its consultant, Sustainable Solutions, includes 39 "actions" that the consultant identified as needed to meet the target of net-zero GHG emissions by 2050. Neither the consultant's proposed strategy, entitled "Energy Evolution," nor the documents approved

by Council offered any detailed assessment of the costs and feasibility of the actions. A full evaluation would require a very long discussion. Here, we propose to identify and comment briefly on the elements in the plan that raise the most serious questions of feasibility, whether on technical, economic, institutional or political grounds.

3.2 Complete Electrification of the Private and Public Vehicles, Including Transit

Electric vehicles represent 1% of the vehicle stock in Ottawa today. The main barriers to increased use remain their higher cost, their limited range (especially in cold weather) and the limited availability of recharging stations; these problems cannot be wished away. If businesses were required to purchase electric trucks to continue operations in the City, many, if not most of them, would move their operations elsewhere. Similarly, if all personal vehicles were required to be electric, much of the population would likely move to other jurisdictions.

Electric buses, which cost twice as much as diesel-powered buses, have a record of higher breakdowns and reduced range in winter weather. Therefore, the City would have to establish recharging depots throughout Ottawa, at great cost.

The issue of cold weather performance of electric buses deserves further discussion:

Most electric buses are powered by a lithium-ion battery. In addition to the large production and transport costs for the batteries is a sensitivity to temperature that makes using electric buses in cold weather challenging. Indeed, battery manufacturers have already told us that low temperatures impact performance. A study has shown that, as temperature drop, electric bus range drops too. For example, a change from about 10 degrees Celsius to about minus 6 degrees Celsius *decreases electric bus range up to 38%.* During this past winter, in Berlin, Germany, 23 electric buses broke down in the cold due to the batteries giving out. They had to be quickly replaced with other buses, often internal combustion engine-driven buses. At –10 degrees Celsius, Berlin's electric buses were supposed to have a 130 km range, but *the batteries ran out halfway through their journeys*.

Moreover, bus batteries take two and a half to six hours to fully charge, with each charge only taking the bus about 200 km under optimal conditions. Steep hills, heavy loads and rough surfaces make them even more inefficient.

Furthermore, it's difficult to estimate what the cost will be to power the buses. The staff report to the transit commission points out that electricity prices could increase and diesel

prices could drop, impacting the City's ability to pay back the loan taken in establishing the buses. This planned transition to electric buses will have a huge impact on Ottawa's transportation system, jeopardizing reliability and sapping tax-payer dollars into a supposedly "green energy" scheme that will strand commuters in our coldest weather. And, as discussed in section 4.2.2.3 of this report, it will also cause serious environmental damage when the batteries are manufactured.

Until more comprehensive testing and temperature improvements can be made, it would be irresponsible, even dangerous, to transition our transportation systems from reliable internal combustion-powered buses to electric buses.

> ***Note:*** *Nathalie Gougeon, the City of Ottawa's Auditor General, is currently conducting audits (reports due out later in 2022) on the City's electric bus plans as follows (concerning the below, Ms. Gougeon explains: "An audit sprint represents an iterative cycle of audits performed on a continual basis with a focus on areas of greatest risk to the City"):*
>
> - *Zero-Emission Bus Audit – Sprint 1: "The objective of this audit sprint1 is to provide reasonable assurance that the City has assessed and considered the technology risks and operational requirements of the City as it selected the type of technology/vendor for the pilot project and in developing its plan to evaluate bus performance as part of the pilot project."*
> - *Zero-Emission Bus Audit – Sprints 2-5: "The objective of these agile audits is to provide reasonable assurance on the significant/high-risk elements of the ZEB [Zero Emission Bus] program. Each audit sprint will be focused on a separate topic, including the pilot project and other elements of the transformation."*

It is crucially important that Ms. Gougeon and her team consider the points we raise in this section. ICSC-Canada would be happy to assist in the audit.

The Climate Change Master Plan is focused on implementing Energy Evolution, which also includes the goal of complete electrification of personal vehicles in the City. ICSC-Canada board member New Zealand-based consulting engineer Bryan Leyland explained on the Leighton Smith Podcast Episode 116 - June 23rd 2021 why this is impractical:

> "Electric cars are a very expensive way of reducing carbon dioxide. And as far as the average car user is concerned, they're less convenient and less useful. When the Model T came out, it was a dramatic improvement on the horse and cart. The electric car is a step backwards into the equivalence of an ordinary car with a tiny petrol tank that takes half an hour to fill. It offers nothing in convenience or extra facilities."

Concerning installing electric car charging stations in a city like London, England, Leyland said,

> "I can't see how they would be practical because they take up so much space. If you've got cars coming into a petrol station, they would stay for an average of five minutes. If you've got cars coming into an electric charging station, they would be at least 30 minutes, possibly an hour, but let's say its 30 minutes. So that's six times the surface area to park the cars

while they're being charged. So, multiply every petrol station in London by six. Where are you going to find the place to put them?"

The City of Ottawa would certainly face similar challenges.

There are numerous other problems with electric cars—high price, **poor low temperature performance** and safety (see Section 4.1.5 Electric Vehicle Fires). The Canadian Department of Industry internal briefing note "*Fleet Management Renewal Strategy: Information For The Deputy Minister's Office,"* was quoted from by Truth North on December 2, 2021:

Electric cars are a dangerous choice for Canadian winter driving

> "'While an accelerated plan to shift entirely to green energy net-zero emissions is appealing, it is not realistic at this time … for the following reasons: Advancement in the automotive technology is not readily available for all operational requirements; restrictive range capabilities and lack of access to public charging infrastructure in most of Canada remains a challenge; and lack of access to repair networks. Operational requirements, for example size of vehicles, restrictive range capabilities and safety features, are not entirely met by net-zero emission vehicles," staff said. 'Green technology is not readily available.'"

True North also reported:

> "Another April 13, 2021 report by the Commons environment committee found that replacing gas vehicles with electric cars would be too expensive for most Canadians. The report, titled The Road Ahead: Encouraging The Production And Purchase Of Zero Emission Vehicles In Canada, concluded that "higher battery costs were the main cause of the higher price" for consumers."

Finally, concerns are being raised around the world that widespread use of EVs will result in serious electricity shortages in the rest of society. Put simply, the grid and infrastructure simply aren't there to support the electrification of the private car fleet. For example, Toyota president Akio Toyoda warned on December 16th that Japan would run out of electricity in the summer if all cars were running on electric power. Robert Wimmer, Toyota's head of energy and environmental research testified before the U.S. Senate in March 2021 and said, "If we are to make dramatic progress in electrification, it will require overcoming tremendous challenges, including refueling infrastructure, battery availability, consumer acceptance, and affordability."

3.3 Public Reaction to Fees and Congestion Charges

The proposal to introduce almost $2.5 billion in road user fees, congestion charges, added parking charges and other vehicle penalties would be so strongly resisted by the residents of Ottawa that the political opposition would be irresistible.

3.4 Establishment of Car-Free Zones in the Byward Market and the Core of Ottawa

The elimination of parking, reduction in vehicle lanes and other restrictions on personal vehicle access to much of central Ottawa would sharply reduce demand for services offered by the businesses there. The business owners would mount a concerted opposition and, if that failed, simply move their businesses to other parts of the City, so killing the Byward Market as a gathering place and tourist attraction would yield no emissions reduction.

3.5 The "Active Transportation" Plan Cannot Work

The plan calls for the share of people who walk or cycle to work to rise from 9.6% today to 20% by 2030. Victoria, B.C. has the highest active transportation share in Canada at 16%, even though it has ideal weather for it. Achieving 20% in Ottawa's winter weather is virtually impossible.

3.6 The Cost of Retrofitting Existing Buildings would be Astronomical

Studies of the costs of retrofitting residences to meet net-zero requirements in the United Kingdom show that the costs can average over $150,000 per unit. Many homeowners cannot afford such an expense, so forcing it by regulation would provoke a strong opposition, and paying for it with taxpayers' dollars would be prohibitively expensive.

3.7 Having Ottawa Hydro Go All-Renewables is Neither Feasible nor Desirable

3.7.1 Overview

If Ottawa Hydro were to go all-renewables, it would effectively make Ottawa a separate jurisdiction from the provincially owned and regulated generation and transmission utilities; it is not clear that this is legal. Regardless, it would sharply increase electricity costs, perhaps doubling them every decade, and forcing much business out of Ottawa. In addition, it would significantly reduce the security and reliability of electricity supply to consumers, increasing the probability, severity and duration of brownouts and blackouts.

Ottawa would also face the problem of disposing thousands of massive wind turbine blades at the end of their useful lives. Wind turbine blades are made of fiberglass and currently cannot be recycled or repurposed, so they pile up in landfills. Recent trends have indicated that wind turbine blades have increased in size, reaching 60 – 80 m in length. To make matters worse, most wind turbines last only about 15 years, half that of their promised 30-year lifetime.

Concerning recycling the millions of photovoltaic solar panels that would cover 36 square km of Ottawa roofs, the area required to meet the City's 100% renewable electricity target, it is important to note the following from The Ontario Society of Professional Engineers:

> "Canada's regulations do not currently make the recycling of solar panels mandatory, nor do they provide guidelines for the reuse or disposal of panels that have reached the end of their lifespan. With the number of Canadian solar farms on this rise, we must bear in mind that there is still a real need for thoughtful approaches to their eventual decommissioning."

That is an understatement. Here is how solar panel waste has grown and is expected to grow in Canada:

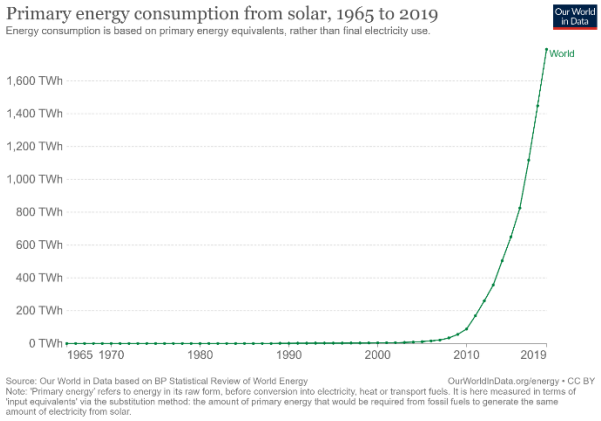
- in 2016: 350 tonnes, which, even in 2022, we have no capacity to recycle
- in 2020: 700 tonnes
- in 2030: 13,000 tonnes
- in 2040: 150,000 tonnes
- in 2050: 650,000 tonnes

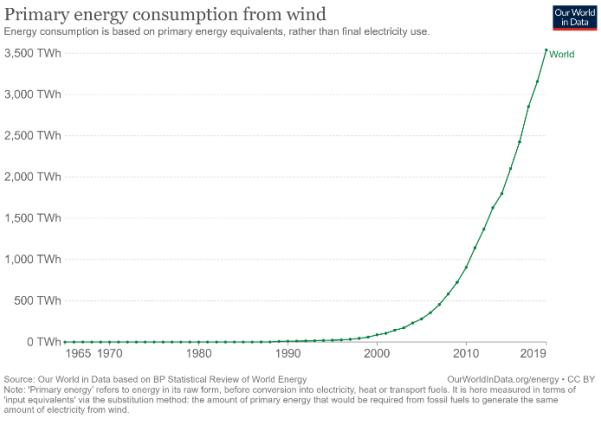
For more on this topic, see section **4.1.4 Solar Power Impacts on Health."**

3.7.2 Powering the City Primarily with Wind and Solar Power is Infeasible

To get a sense of how unworkable it would be to power Ottawa mainly by wind and solar power, some perspective is needed.

We are often told by wind and solar power advocates that both energy sources are expanding rapidly and that they will soon be able to take over from conventional power sources. We are shown graphs of world primary energy consumption from these sources like the following in support of this optimistic forecast:

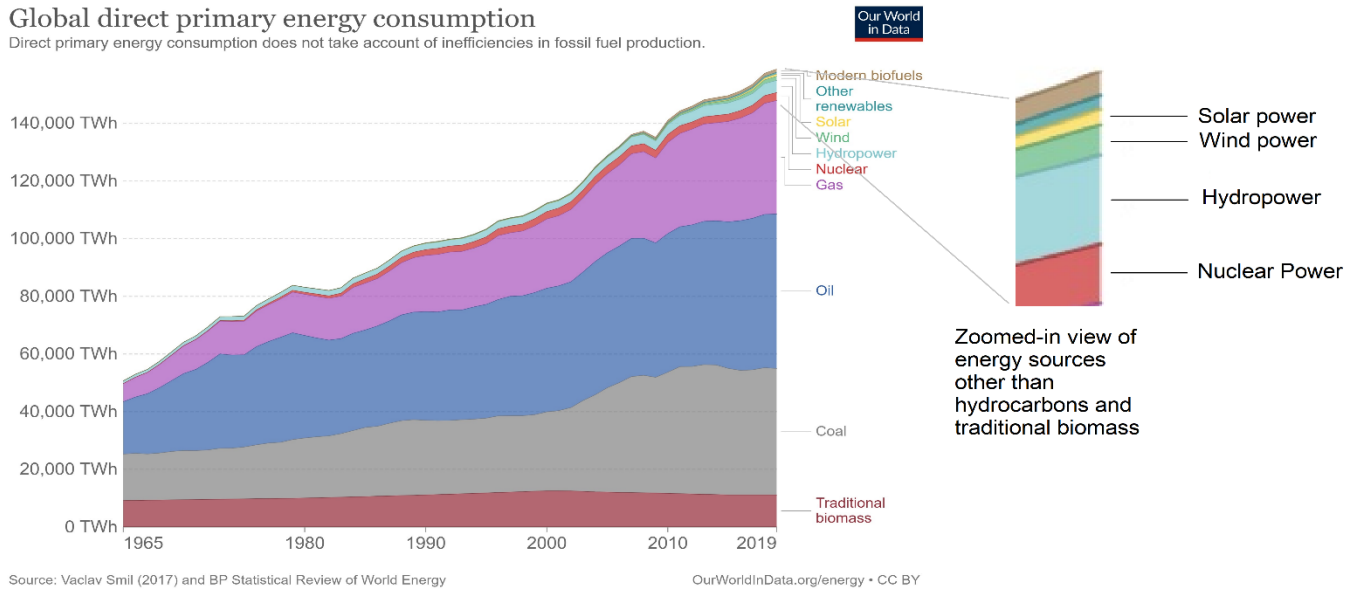




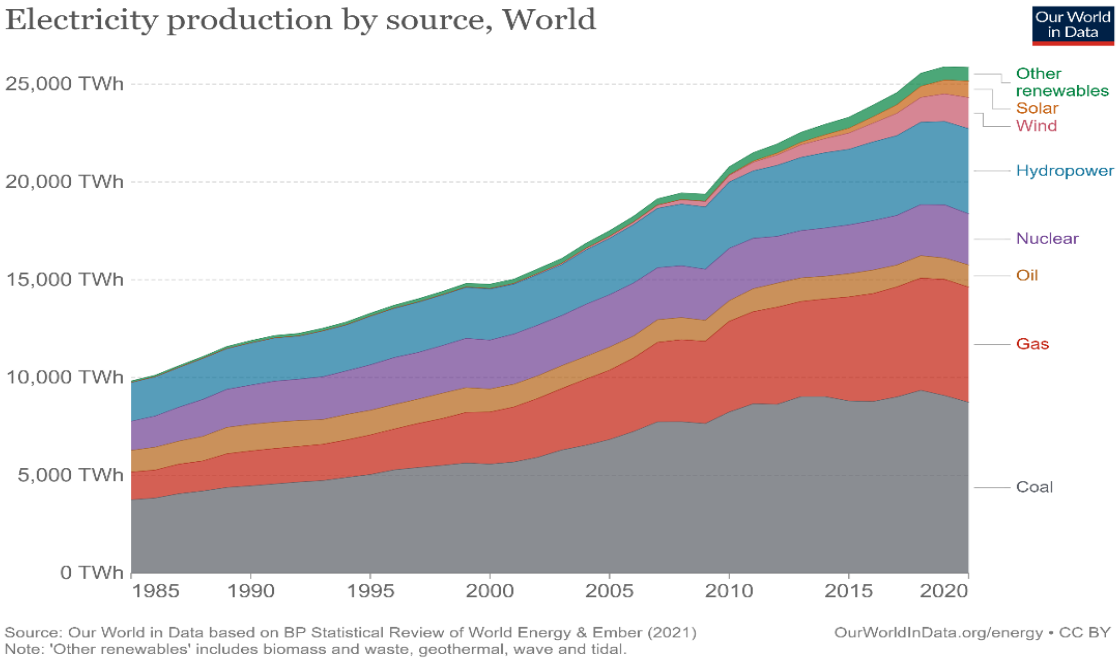
Similar graphs are available for Canada alone, but with the energy quantities on the vertical axis much less, of course.

While it is true that both wind and solar have been expanding rapidly, the following figure demonstrates that they are, in reality, *trivial* power sources in comparison with conventional energy sources. See the "Zoomed-in view of energy sources other than hydrocarbons and

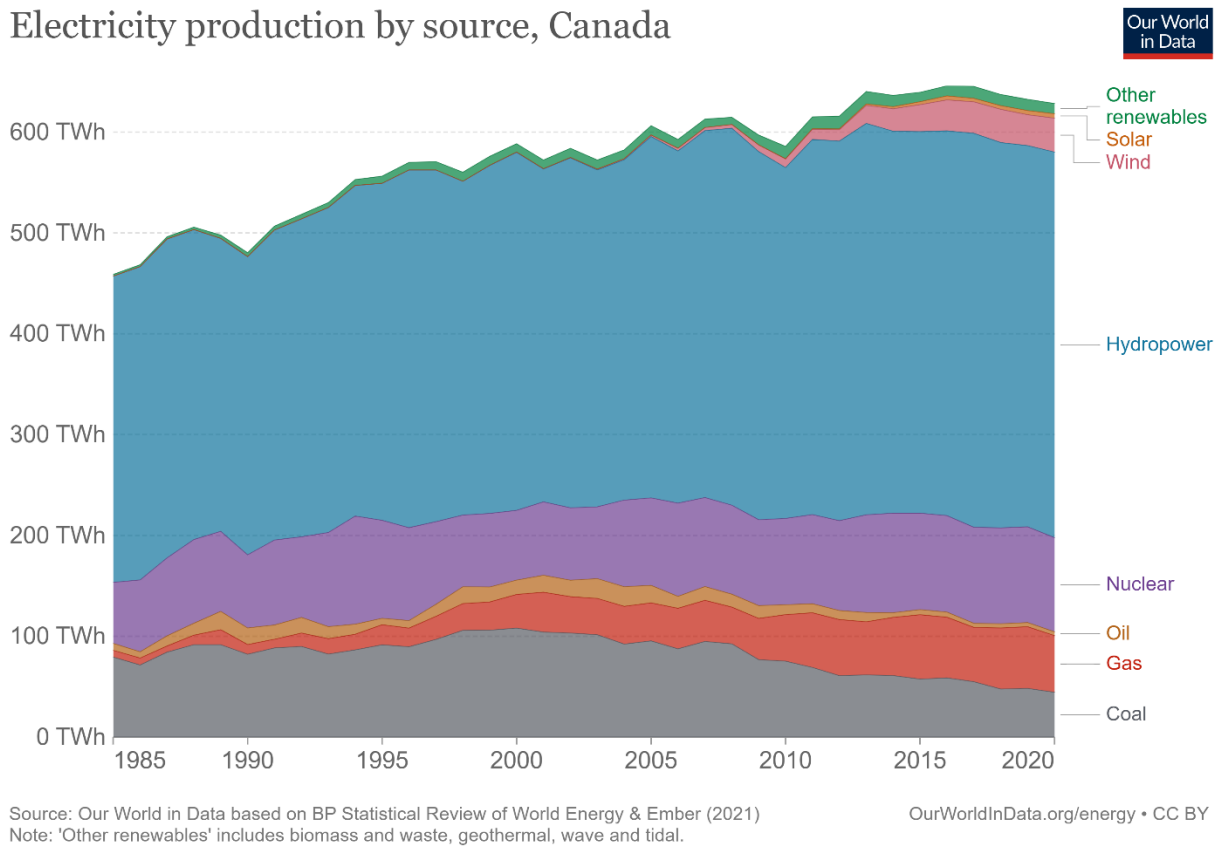
traditional biomass" to the right of the below graph to properly appreciate the relative magnitudes of wind and solar power.



The situation is only slightly better if one just considers electricity production:



Here is Canada's circumstance (next page):



Despite the massive support given wind and solar power in the past three decades and despite the many UN reports and agreements that favour these energy sources (see Climate Policy Myth #1 for more details), they still constitute only a tiny fraction of worldwide energy consumption. To think that the experience of Ottawa, or any other jurisdiction, will somehow be radically different to the experience of the world as a whole, and that we can suddenly make a massive switch to wind and solar power without widespread blackouts, defies common sense.

As described in Climate Policy Myth #1, there are very good reasons why powering a modern industrial society 100% on wind and solar power is not possible with today's technology, or any reasonably foreseeable future technology. The major problem is the intermittency of these supposedly "green" energy sources. In order to assure uninterrupted supplies (to avoid brownouts and blackouts), utilities must either have backup generation that is "dispatchable," such as natural gas-fired plants, or electricity storage, ready to go on line the instant the wind slows or the Sun goes behind a cloud (or at night). Consumers end up paying twice and the GHG emissions produced by the inefficient operation of backup powerplants (they must regularly ramp up and down to compensate for variable wind and solar power) largely negates any emissions "benefit" the renewable sources supposedly provide.

Focusing on adaptation to inevitable climate change, in particular cooling and associated impacts, is the only sensible climate change plan. Regardless, if City councillors still insist on

divesting from fossil fuels, the only alternative that would safely and economically provide sufficient dependable power in the near future would be nuclear power, certainly not wind or solar. Over the next decade it is expected that a new type of fission reactor will start to come on line: Small Modular Reactors, or SMRs, that generate 300 Megawatts of electricity (MWe) or less, in contrast to today's large reactors which typically generate 1,000 MWe. Six SMRs would be adequate to generate all of Ottawa's current electrical demand of 1,800 MWe.

Readers who would like to learn more about SMRs can read "Canada's Small Modular Reactor Action Plan" on the Natural Resources Canada website here. To learn about the safety of SMRs, visit the Canadian Nuclear Safety Commission webpage on this topic here.

3.7.3 Battery Storage Back-up is Infeasible

As described earlier, it is also very expensive to provide bulk electricity storage using batteries. Regardless, bulk electricity battery storage is hopelessly insufficient, no matter the cost. David Wojick, a Virginia-based Ph.D. in the logic and philosophy of science, explains this well in his article "California secretly struggles with renewables" (January 19, 2021). Here is an excerpt:

> "California has hooked up a grid battery system that is almost ten times bigger than the previous world record holder, but when it comes to making renewables reliable it is so small it might as well not exist. The new battery array is rated at a storage capacity of 1,200 megawatt hours (MWh); easily eclipsing the record holding 129 MWh Australian system built by Tesla a few years ago. However, California peaks at a whopping 42,000 MW. If that happened on a hot, low wind night this supposedly big battery would keep the lights on for just 1.7 minutes (that's 103 seconds). This is truly a trivial amount of storage…Barely time to find the flashlight, right?
>
> "This one reportedly utilizes more than 4,500 stacked battery racks, each of which contains 22 individual battery modules. That is 99,000 separate modules that have to be made to work well together. Imagine hooking up 99,000 electric cars and you begin to get the picture.
>
> "The U.S. Energy Information Administration reports that grid scale battery systems have averaged around $1.5 million a MWh over the last few years. At that price this trivial piece of storage cost just under TWO BILLION DOLLARS. At 103 seconds of peak storage that is about $18,000,000 a second. Money for nothing."

The City of Ottawa should pay attention to the comments of Professor Jacques Treiner, Associate researcher at *LIED* (Université Paris-Diderot)**:**

> "Today when it comes to using renewable energies on a large scale, we don't know how to store energy. If we knew how to do it, on the days of high production, we would stock it and we would use it during moments of low production. But we do not know how to do that on a massive scale. And so, we cannot, at the moment, envisage an electrical mix that is 100% renewable energy."

See section 4.4.5.2.2 of this report, "Wind and solar power require large scale back-up," for more on this topic.

Fritz Vahrenholt, CEO of the German Wildlife Foundation and the former CEO of a wind turbine company said in the documentary "Global Warning," (see right) in response to the idea that we can power an industrial society 100% on renewables,

> "30 percent is good, 20 percent is better, 50 percent is very costly, very expensive. And beyond 50 percent, the system will break down. I have built thousands of wind turbines. I know the volatility that we have in winter times, high winds and produce two thirds of the wind energy and in summer there is nothing. And on the other hand, photovoltaics, you know, we have from maybe until September a lot of sun, but in winter nothing…"

3.7.4 Insufficient minerals and metals for cities around the world to "go green"

The City of Ottawa council apparently do not understand another crucial fact about wind and solar power: there are not enough "green" exotic minerals and metals for cities around the world to achieve their net-zero ambitions even if it *was* worth trying to do so.

City staff should review the paper by Cambridge University Emeritus Professor of Technology Michael Kelly, which shows that replacing just the United Kingdom's 32 million light-duty vehicles (of the 1.42 billion cars in operation worldwide) with next-generation EVs would require incredibly vast quantities of materials such as lithium, cobalt, copper and neodymium. And, as described in section 4.3 of this report:

> "The minerals and metals for a 'green' society are mostly limited to environmentally-negligent human rights abusers such as China, Russia, the Congo and the lithium triangle in South America."

Mark P. Mills, a senior fellow at the Manhattan Institute and a faculty fellow at Northwestern University's McCormick School of Engineering and Applied Science explains the scale of the mining increases required:

> "With current plans, the world will need an incredible 200 to 2,000 percent increase in mining for elements such as cobalt, lithium and dysprosium. That requires massive new mining operations in countries all over the globe, which would require the use of a significant amount of conventional energy.
>
> "Australia's Institute for a Sustainable Future cautions that a global 'gold rush' for energy materials will take miners into 'remote wilderness areas [that] have maintained high biodiversity because they haven't yet been disturbed.'"

As a consequence, if the City of Ottawa actually were to carry out its Climate Change Master Plan, it would be encouraging many of the worse environmental and human rights abuses in the world. For more on this topic, see section 4.3 of this report.

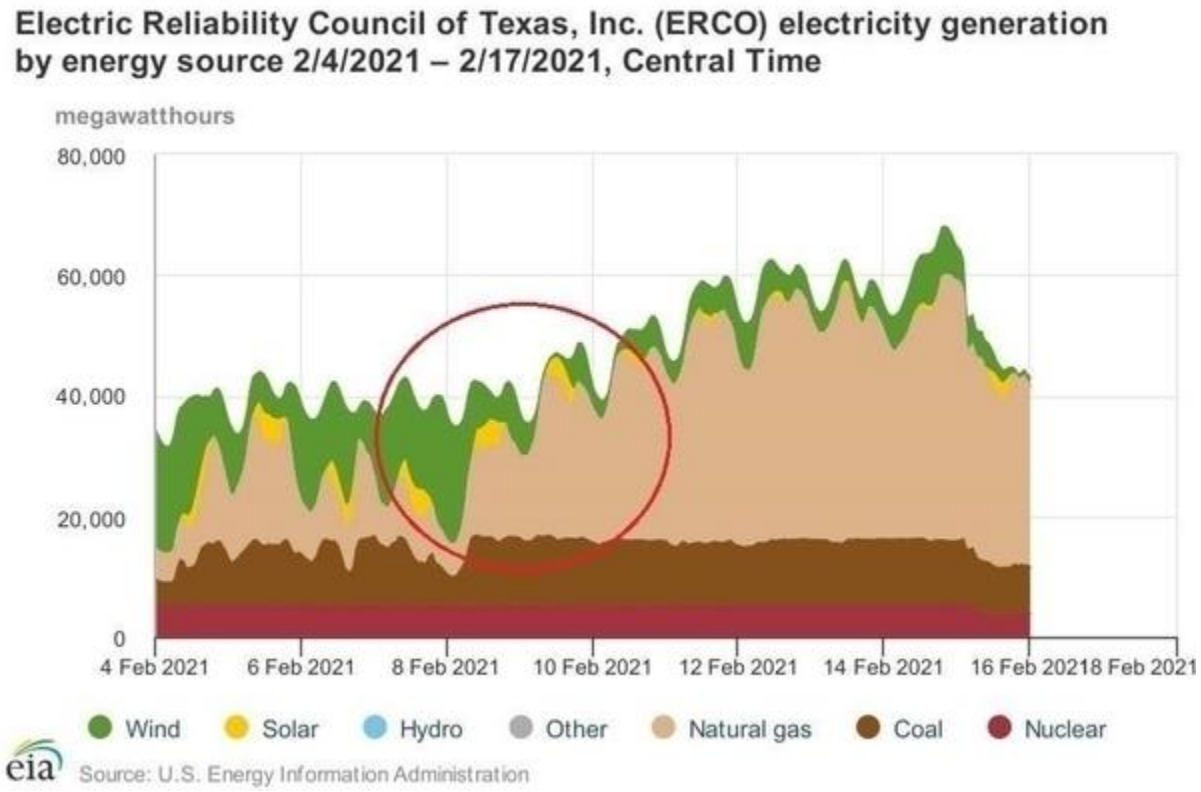
4.0 Adverse Impact of Attempting to Enable the City's Plan

4.1 Health and Safety Impacts on Ottawa residents

4.1.1 Blackouts and Brownouts

The most dangerous impact of the City's climate plans, if they ever came even close to being enabled, is widespread backouts and *complete failure of our electricity supply*. We had a relatively mild preview of what is in store for Ottawa in February 2021 when severe cold hit Texas, the state with the most wind power in America. Reporting from Houston, Dr. H. Sterling Burnett, senior fellow on environmental policy for the Heartland Institute, explained:

> "Data from the Electric Reliability Council of Texas shows four days before the first snowflake fell, wind and solar were providing 58 percent of the electric power used in Texas. Fortuitously, the sun had been shining and the wind blowing. These conditions ended, and within a matter of hours more than 13,000 megawatts of wind and solar power went offline. The wind died off and the turbines began to freeze, and winter storm clouds blocked the sun.



> "As always, natural gas, coal and nuclear facilities ramped up production when wind and solar failed. Then the storm hit. Even as the wind picked up, ice had formed on the turbines, keeping them offline, and snow and ice coated solar panels, preventing them from generating power. More wind and solar failed, and the cold had a cascading effect on coal, natural gas and nuclear. Some gas lines froze, other gas, due to contracts, was being shipped out of state, some equipment failed, and some powerlines snapped and transformers broke. More coal, natural gas and nuclear failed during the storm than wind and solar, *but only because wind and solar had failed even before the storm hit*. What power remained during the crisis was delivered almost entirely by natural gas, coal and nuclear. Wind and solar power remained almost wholly offline for the duration.

> "The result: more than eight million Texans (including me), in more than four million homes, lost lights, power and heat.[1] Temperatures in my house fell into the 40s, and within the first night I went through all the heating oil in the old-fashioned lamps I keep for outages caused by periodic tornados. For some (not me, fortunately), the problems were even worse. Water-treatment plants lost power, meaning thousands of people lost access to clean water even if their pipes did not freeze. Widespread 'boil water' orders were issued, but of course you can't boil water during a power outage if your stove is electric."

The final tally, The Wall Street Journal reported, was approximately $200 billion in damage and about *700 people dead* from hypothermia, carbon monoxide poisoning and other causes. And, it could have been much worse—the state came within a few minutes of a total grid failure that could have lasted weeks and killed thousands of people.

Dr. Burnett continues:

> "To sum up, political interference in energy markets, driven by climate alarmism, resulted in a huge increase in volatile, intermittent wind and solar power being forced and incentivized into Texas' power system, undermining the reliability of the state's electric grid. When that went offline, even before cold temperatures reached their peak, gas, what little coal remains and nuclear, which faced their own problems, couldn't cover renewable power's ongoing shortfall throughout the entire period of extreme winter weather. Had winter demand not peaked, most people would have remained blissfully unaware of the limited power wind and solar are often able to provide to Texas homes and businesses, but

[1] U.S. Government Accountability Office: "in February 2021, extreme cold weather that spread from the Canadian border as far south as Texas caused record winter demand for electricity and left about 4.5 million customers in Texas, along with about 376,000 customers in Louisiana and Oklahoma, without power."

> weather, like wind and solar power, is fickle. Because of that, *no large-scale power system should ever rely on wind and solar power for a substantial part of its electric power supply.* As Texas showed this past week, and California demonstrates every summer, to do so is to court catastrophic, potentially deadly, failure.
>
> "Imagine how much worse Texas' situation would have been if everyone relied on electric vehicles and the state prevented people from hooking natural gas up to their homes for cooking, heating and water heating—policies climate activists commonly advocate. Mandating more reliance on electric power for transportation and basic necessities, as some localities, states and the federal government are doing or considering doing, even as they further increase the amounts of unreliable wind and solar power on the grid, is a guaranteed recipe for large-scale power disasters to become common."

While Texas, at 1,603 blackouts, ranks second in the U.S. in blackouts in the period between 2008 and 2017, California has more than twice as many, 4,297. California's trouble is explained by officials who now openly admit to an over-reliance on wind and solar power. The governor said there was not enough wind during summer 2020 (when the state suffered its first rolling blackouts in 20 years) to keep the turbines going with cloud cover and nightfall restricting solar power. The Los Angeles Times reported on October 6, 2020:

> "gas-burning power plants that can fire up when the sun isn't shining or the wind isn't blowing have been shutting down in recent years, and California has largely failed to replace them with cleaner alternatives such as lithium-ion batteries."

Consequently, the state has fallen thousands of megawatts behind its needs. Governor Gavin Newsom said, "we failed to predict and plan for these shortages" and took responsibility for the rolling blackouts in the summer of 2020.

If a prolonged power failure like that which occurred in Texas happened in Ottawa in the depths of a -30^{o} C cold spell, it would make Texas' experience seem mild by comparison. We would likely see huge numbers of casualties and bankrupt businesses while local air pollution would soar as citizens increasingly resorted to fossil fuel-powered home generators. Trying to electrify everything, and making wind and solar power our main power source, would especially hard on low-income Ottawans who are more likely to suffer and die during winter blackouts, as they cannot afford generators or backup battery systems, which are very expensive.

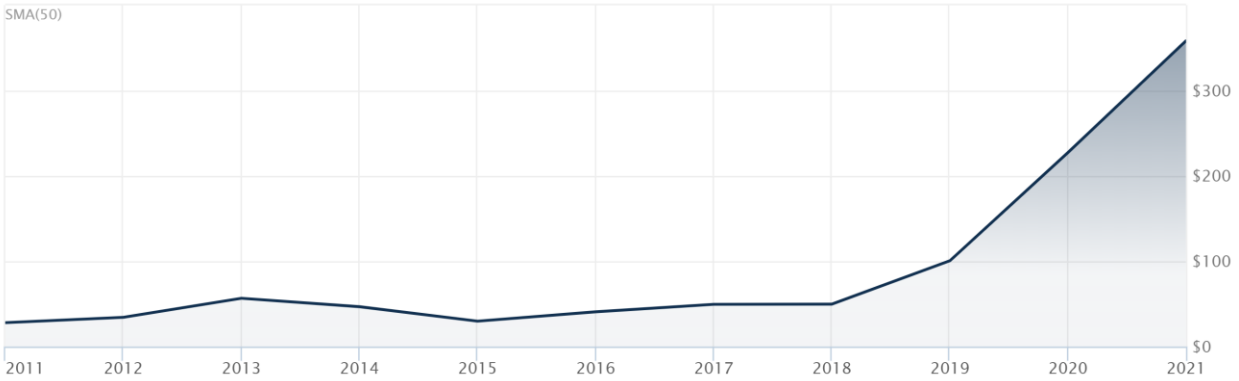
This scenario, more than any other, should frighten City of Ottawa councillors intent on following Texas' lead into a green energy nightmare. A secure and prosperous city is impossible with a weak electrical grid, and Ottawa's grid would be the weakest imaginable if the City of Ottawa's Climate Change Master Plan is ever fully enabled. Electricity-powered systems have been found to fail far more often than those powered by natural gas or any other energy source. Greater electrification means lower reliability. And when they fail, the results can be catastrophic. Think of Hurricane Ida: New Orleans lost power. It didn't lose natural gas flow. The city was running natural gas-fired temporary generators to meet its needs, which

were limited so people evacuated. What if they couldn't evacuate because their means of evacuation—their electric cars—couldn't be charged?

Dr. Burnett summed up the situation well:

> "As any engineer would have said openly before the politics of climate alarm and cancel culture raised their ugly heads, wind and solar power are particularly unsuited for a large power grid because they work only when the weather conditions are just right."

About the only entities that would benefit from Ottawa being powered by all electric solar and wind powered systems, besides wind and solar power manufacturers and their suppliers, would be the manufacturers of home standby emergency power generators. Indeed, Generac Power Systems, which manufactures about 75% of the home generators sold in the U.S., announced in July 2021 second quarter record sales of $920 million, a 68% jump over last year. Here is The Wall Street Journal record of Generac Holding's Inc.'s yearly average stock prices on the New York Stock Exchange in the past 10 years:



Writing in the Journal on September 7, 2021, energy expert Robert Bryce reported ("Get ready for the Blackouts – Mismanagement and the push for renewables are degrading the reliability of the U.S. electrical grid"):

> "Generac's soaring sales are evidence that the U.S. electric grid is becoming less reliable...Consumers are spending billions of dollars on generators to have on hand when the power goes out…Generac says in a recent investor presentation that power outage severity is 'increasing significantly.' Between 2000 and 2020, the number of what the Energy Department calls 'major electric disturbances and unusual occurrences' jumped 13-fold."

Beside mismanagement of electrical systems, Mr. Bryce lists the causes of this unreliability:

- "the rush to add renewable energy sources such as wind and solar, which depend on amenable weather to function.
- "over the past few years, numerous coal and nuclear plants that provide baseload power and help keep the grid stable have closed.

> "North American Electric Reliability Corporation, a nonprofit trade group, said in a report last month that 'changing resource mix' is the most urgent challenge for reliability. The

group says America's electric generation capacity 'is increasingly characterized as one that is sensitive to extreme, widespread, and long duration temperatures as well as wind and solar droughts.'"

In section 4.4.5.2.3, "Wind and solar power drive electricity prices very high," we discuss what has happened in Europe as a result of their disastrous attempts to transition to greater reliance on wind power.

Why would the City of Ottawa want to replicate this in our even colder climate?

4.1.2 Wind Turbine Operational Impacts on Health

Wind turbine noise can cause many negative health effects for those living nearby. Sleep deprivation is caused by the sub-audible sound waves sent out as blades spin and create vibrations in our homes and body cavities such as our ears, ocular orbs, skull, lungs or bellies.

The Australian anti-wind power group, Stop These Things, writes: "Unless you're living with it, you'll have no idea what it's like to suffer incessant wind turbine generated low-frequency noise and infrasound. A trail of abandoned homes wherever these things operate is testament to the fact that the noise is insufferable."

The organs of the inner ear control our sense of motion, position and balance similarly to many other species with backbones. One function is to respond to sounds and vibrations that we don't consciously hear but feel, called infrasound, which can arise from wind turbines. Infrasound increases pressure in the inner ear and distorts balance and hearing. This has led to a host of adverse symptoms in people living close to the turbines.

People around the world who live close to wind turbines have reported symptoms such as headaches, fluctuating pressure and ringing in the ears, increased blood pressure, anxiety, nausea, panic attacks and depression. We have seen that as people distance themselves from wind turbines, their symptoms abate or disappear. And upon returning to areas close to wind turbines, these symptoms return. This is called the *Wind Turbine Syndrome*. It most often affects the young, old and those especially sensitive to stimuli. ICSC wrote about this in "An Ill-wind in Ontario."

Due to these effects, a two-kilometre setback from residences is recommended and this setback has been chosen for other jurisdictions which also have lower noise limits than Ontario has right now. A two-kilometre setback is likely impossible if 710 large scale turbines, each 160 metres in height, are installed within Ottawa city limits. Currently the Ontario setback regulation for wind turbines is only 550 metres—that is unchanged from 2009, when turbines were smaller and less powerful.

4.1.3 Wind Turbine Safety Concerns

4.1.3.1 Structural Collapse

As large-scale industrial wind turbines (IWTs) spread across Canada, we are seeing increasing examples of catastrophic failures. For example, in the fall of 2021, a 100-metre-tall 3 MW turbine collapsed at the Kent Hills wind farm about 55 kilometres southwest of Moncton, New Brunswick. The cause was determined to be cracks in the foundation as a result of a design flaw that has is leading TransAlta Renewables Inc., the Alberta-based company that owns and operates the turbines, to take down and repair 49 other 3 MW IWTs in the facility. The company estimates that the cost of the repair work will be $75,000,000 to $100,000,000 and take two years to complete.

The photograph/video below shows the aftermath of another failure of an IWT that occurred about the same time at the Bow Lake wind power facility near Sault Ste. Marie, Ontario. Sault Online reported on September 1, 2021:

> "[engineer William] Palmer [an expert in wind power] stated, 'this incident is the 10th wind turbine failure in Ontario that has put the blades (and in this case all three of the 50-metre-long blades for the failed turbine) onto the ground… this is the second collapse of a very similar GE wind turbine and the 6th case in Ontario in which GE turbines have put blades on the ground.'"

Collapse of Bow Lake wind power facility near Sault Ste. Marie. Click on image to see video.

Palmer, an author of numerous published academic papers on the topic and presenter at international conferences on wind turbines and health and safety, explained that he has seen debris from turbine failures flung more than 500 metres. Yet the Ontario regulation for setback between a wind turbine and a right of way or roadway is currently just a blade length plus ten metres. In the case of the Nation Rise power project south of Ottawa, for example, which Palmer acted as a witness against in a citizen appeal, that would be 79 metres or just 259 feet.

Sault Online reported:

> "Just two months ago, a turbine failed in Southgate, just west of Toronto. The roadway nearby was closed for a week."

ICSC-Canada Director Dr. Jay Lehr said:

> "Blades flying off turbines have killed more than 100 people around the world in the past decade. In addition, nearly 1,500 wind towers have collapsed for unexplained reasons. As a result, Finland, Bavaria and Scotland have limited wind turbines closer than 1.2 miles from homes."

4.1.3.2 Fire

After blade failure (19% of all accidents), the most common accident in wind turbines is fire (15%). Firetrace International asserts that wind turbine fires may account for up to 30% of all catastrophic wind turbine accidents. Power Engineering International reported (October 29, 2020) that "the wind industry has underestimated fire risk for decades." They explain that wind turbines catch fire primarily due to faults in electrical or mechanical systems resulting in ignition which spreads to the surrounding plastics and fibreglass nacelle.

Firetrace reports:

> "Based on research conducted by CWIF [Caithness Windfarm Information Forum], since 2000 there have been 385 documented wind turbine fires. A number of these fires [were] not only a total loss of the turbine but had devastating consequences. In June 2012, the View Fire, which burned 367 acres in Riverside County, California, was caused by a wind turbine fire. Nearby residences were evacuated, and over 100 firefighters fought the wildfire to get it contained.
>
> "In October 2013, two young mechanics became trapped on top of a burning wind turbine [image on next page and video here] and died as a result at the Piet de Wit Wind Farm in the Netherlands.

> "More recently, in the U.S., two wildfires were sparked from wind turbine fires. In July 2019, melted debris falling from a turbine fire caught the surrounding grass and brush on fire to cause the Juniper Fire wildfire, which put 39 structures in danger. It took almost 200 fire crew members to contain the 250-acre fire over three days. A turbine fire on August 26, 2019 is blamed for the Rhodes Ranch 3 Fire outside of Abilene, Texas."

Most wind turbine fires completely destroy the turbine. This is because of the time it takes firefighters to travel to the remote locations where most turbines are located and the fact that the fire is typically difficult to access (the average turbine hub is over 80 meters above the ground). Various sources show that about one turbine in every 2,000 will typically burn down in any given year. So, the City of Ottawa can expect that, of the 710 planned turbines, one will burn down every three years.

Jane Wilson, president of Wind Concerns Ontario summed up the situation ("Recent wind turbine failures are cause for concern," September 2, 2021):

> "People who have never seen an actual modern wind turbine and who are familiar only with images from the wind power developers' lobby group may not understand that these are industrial structures. We are calling for an update to Ontario's regulations for these power generators, for both safety and health. The current regulations are unchanged from 2009

> and the McGuinty government, despite the fact turbines are growing more massive every year. Government needs to act, now."

4.1.4 Solar Power Impacts on Health

Photovoltaic cells contain chemicals and other substances toxic to humans and other animals. For example, lead can leach out as solar cells break down in landfills. According to cancer biologist Dr. David H. Nguyen, these chemicals include cadmium telluride, copper indium selenide, cadmium gallium (di)selenide, copper indium gallium (di)selenide, hexafluoroethane, lead and polyvinyl fluoride.

A 2018 report from the German Stuttgart Institute for Photovoltaics and the Institute for Sanitary Engineering, Water Quality and Waste Management concluded:

> "From the installed power and the power-related weight, we can estimate that by 2016 photovoltaics had distributed around 11,000 tons of lead and around 800 tons of Cd (cadmium) [worldwide]."

A hazard summary of cadmium compounds from the U.S. Environmental Protection Agency points out that exposure to cadmium can lead to serious lung irritation and long-lasting impairment of pulmonary functions. These pollutants can be almost completely washed out of disposed solar modules over a period of several months by rainwater. Damages due to natural events such as hail storms, tornadoes and earthquakes, can pose great concerns with exposure to toxic chemicals, especially since solar panels are delicate and break easily, quickly becoming hazardous.

The pro-solar website EnergySage writes:

> "One of the most toxic chemicals created as a by product of this process [i.e., preparing silicon and making wafers for monocrystalline and polycrystalline panels] is silicon tetrachloride. This chemical, if not handled and disposed of properly, can lead to burns on your skin, harmful air pollutants that increase lung disease and, if exposed to water can release hydrochloric acid, which is a corrosive substance bad for human and environmental health."

Consequently, it is critically important that solar panels be properly recycled, not merely dumped in landfills. But solar panel recycling is challenging. It is difficult to separate raw materials such as glass, aluminum and the rare and valuable materials (including tellurium, iridium and gallium) used to construct the modules. And today's recycling costs more than the economic value of the materials recovered. In fact, a Chinese expert told *The South China Morning Post* that "If a recycling plant carries out every step by the book, their products can end up being more expensive than new raw materials."

It is therefore not surprising that, according to a 2015 United Nations Environment Program (UNEP) report, between 60% and 90% of electronic waste is illegally traded and dumped in poor nations. And, of course, those nations lack the resources and funds to recycle and sequester toxic waste, leading to a severe public health hazard if the chemicals from solar panels leach into the groundwater supply. Other sources also estimate that only about 10% of solar panels around the world are recycled.

The situation in Canada is even worse—there are *no* dedicated solar panel recycling facilities in our country nor any plans underway to establish one. In Canada, solar panels are not included in any provincial or territorial extended producer responsibility regulations to keep electronic waste out of landfills. Yet, it is estimated that by 2030, Canada's solar sector will produce 13,000 metric tons of waste from decommissioned solar panels and 650,000 tonnes by 2050. Canada's National Observer reported ("The glaring problem with Canada's solar sector and how to fix it," November 27, 2020) that Canada does not currently have the capacity to recycle even the relatively modest 350 tons produced in 2016 alone and so our only solar panel recycling options are outside of Canada—panels must be shipped to the U.S. or Malaysia for recycling.

4.1.5 Electric Vehicle Fires

The Bolt, an electric vehicle sold in North America by General Motors, has been tied to at least nine fires since early 2020, and Hyundai's electric vehicles have been tied to about 15 fires. We are also starting to occasionally see Teslas burst into flames, one as recent as November 2021 when the fire spread to the nearby garage of the owner's home.

In August of 2021, General Motors recalled 73,000 2021 Chevrolet Bolt electric vehicles in addition to the 70,000 Bolts that were manufactured between 2017 and 2019. Replacing the batteries of all 143,000 recalled Bolts could cost about $1.8 billion.

The cause of the electric vehicle fires is their lithium-ion batteries. These batteries burn fiercely, and in addition to the fire and heat danger, is extreme toxic fluoride gas emissions. These fumes are especially dangerous in confined environments.

Since lithium-ion fires are a chemical reaction, they can only be cooled rather than extinguished and can end up burning for several days. Motor Biscuit reported on December 26, 2021:

> "Business Insider reports that a Tesla fire in Austin, Texas used 40 times more water to put out than a gasoline-powered vehicle. They believe this is because Teslas use lithium car batteries.
>
> "The emergency responders who put the fire out reported that the lithium battery cells could lead to fire several hours after a crash. According to the Austin Fire Department Division Chief Thayer Smith, a typical gasoline fire takes 200 to 1,000 gallons of water to put out. When it comes to an EV fire, this total can increase to 30,000 to 40,000 gallons of water."

After severe damage to a parking structure in Germany, all lithium-ion and nickel-metal hydride battery based electric vehicles have been banned from parking underground. For more on this problem, see here and here.

Battery fires are only one of many problems and inefficiencies of electric vehicles. It is nonsensical to attempt to change our automotive industry to electric, as it will not provide us with the reliable transportation we need nor will it benefit the environment. In California, there is a growing percentage of electric vehicle users that are switching back to gasoline cars, and at only about 2% of the U.S. new car market, this does not bode well for the electric vehicle industry.

4.2 Ecological Damage

For a good overview of how so-called green energy is anything but green, City of Ottawa staff should review this August 10, 2020 five-minute video, "Do we have to Destroy the Earth to Save it?" by well-know environmentalist Michael Shellenberger, author of *Apocalypse Never: Why Environmental Alarmism Hurts Us All* (2020).

4.2.1 Operation of Wind Turbines

We often hear that hundreds of thousands of birds and bats are killed by wind turbines every year in the United States and tens of thousands in Canada. But this seriously understates the problem. Sherri Lange, VP Canada for *Save the Eagles International* and CEO of *North American Platform Against Wind Power*, explained:

> "The **real numbers** of bird and bat deaths from industrial wind turbines are unknown: it is an accounting routinely and grossly underestimated by ornithological societies everywhere. A bench mark for fairly honest accounting came from the Spanish Ornithological Society which reached conclusions [in 2012] that Spain's 18,000 wind turbines are killing 6 - 18 million birds and bats every year.

> "From that study, Save the Eagles and others computed that in the U.S. alone, between 13 and 39 million birds and bats were killed per year. What are the real-world level numbers?
>
> "The numbers and sizes of turbines have increased now, and even those numbers now need to be recalculated. However, we will not know real numbers because scavengers make off with injured or dead birds, the counts are done by developers, are scant in time and scope, and the coverup is enormous.

> "Another 'feature' of ornithological horror, is the vast numbers of insects, butterflies, etc., that are attracted to turbine lights, thereby creating a lunch bar for bats and other flying creatures. You might as well say these are eco traps.
>
> "We often forget about the mysteries of migration: Monarch Butterflies for example, have a route that is some 3,400 miles (5,500 km) from Mexico to the US and Canada, yearly. The path across the Great Lakes, (Erie), is about 40 km. The project proposed at Cleveland, six massive turbines about 8 miles out, will certainly impact that fly path. A German study from 2021 indicates that about 1,200 TONS of insects [per year at the German wind park] are destroyed by industrial wind turbines (about one TON per turbine). [Study: "A loss of 1,200 tons of flying insect biomass destroyed every year (model case c) is equivalent to an order of magnitude of 2.4 billion moths of the species N. pronuba with a weight around 500 milligram each or 2.4 trillion aphids with around 0.5 milligram lost every year since over a decade."]

Apart from birds and bats colliding with fast moving wind turbine blades, there is a drop in nearby air pressure that can burst blood vessels in their lungs and kill them if they fly too close. Bats are especially sensitive to this pressure drop which explains why twice as many bats are killed by turbines as are birds. Ms. Lange says that bats,

> "are a guardian species, alleviating many tons of pesticide use, as each animal consumes about 1000 insects per hour…Bats' lungs are fragile and about the width of a sheet of paper, and they explode at the tips of the turbine blades. It does not matter the size of the turbine, but what does matter, exponentially we could say, is that the larger the 'sweep,' the larger the area for lung explosions, and dismemberment."

This results in billions of extra mosquitoes since bats are essential in keeping mosquito and crop-damaging insect populations in check.

The presence of wind turbines can also cause behavioural changes in animals. For instance, if a wind farm is built along their regular migration path, they will have to find a new route, which may lead them across roads or other unsafe areas. Overall, the fatalities to birds and bats caused by wind turbines far exceeds those caused by collisions with communication towers, power lines, windows and cats. Ms. Lange concluded:

> "Why does this matter? Biodiversity is in a crunch, landscapes and habitat are being chewed up with solar and wind factories; the chain of life is broken again and again. Species are going extinct because of industrial wind turbines. This is a known fact."

This mass slaughter is immoral, and is not justified by the unreliable, expensive and relatively small amounts of electricity we derive from industrial wind turbines.

Concerning the industrial wind turbine collapse described in section 4.1.3 ("Safety") above**,** Sault Online reported that engineer William Palmer, an expert in wind power:

> "noted citizens were right to be concerned about environmental issues. 'Your comments about the environmental hazard of oil leaking into the watercourse from turbines (either

> lubricating or hydraulic oil of which there are several drums worth of oil in most turbines today) is another issue. Again, the setbacks to watercourses [are] similar to [those] for human protection—sadly inadequate.'
>
> "According to Power Engineering, there can be a significant amount of lubricants used on the metal behemoths which dot the landscape.
>
> "'In a typical wind turbine, a large supply of lubricating oil is placed into the gearbox. The lubrication system contains filters for the oil and, depending on the turbine design, lubricant is either pumped through the system or is gravity fed,' according to Power Engineering. 'Gearboxes on the generally smaller-sized turbines installed in the mid-1980s hold about 10 gallons of oil or less. Newer, larger machines might hold as much as 60 gallons.'"

To make matters even worse, despite decades of operation across the world, there is no scientific proof that wind energy saves on carbon dioxide (CO_2) emissions in real world operation. North Carolina physicist and energy expert John Droz explains:

> "There is good evidence that wind energy can produce more CO_2 than gas does. This non-intuitive reality is based on the fact that there is no such thing on the Grid as Wind energy by itself. What actually typically exists is a Wind + Gas package…Most of the time, Wind is paired with Single-Cycle Gas [turbines]. Analyses done by independent experts have concluded that: Wind + Gas can produce **more CO_2** than Gas (Combined-Cycle)!"

To learn more about this problem, how wind turbines affect local meteorology and view the many references in support of his conclusions, see Droz's paper, *Taking the Wind Out of Climate Change* (April 19, 2021).

4.2.2 Environmental Impacts of "Green Energy" Manufacturing and Construction

The City of Ottawa has an overarching "vision to transform Ottawa into a thriving city powered by clean, renewable energy." Even ignoring the mass slaughter of local wildlife by erecting 710 bird and bat-killing large-scale turbines, it turns out that wind and solar power are anything but clean and renewable. This 2-minute clip from Michael Moore's 2020 documentary film, *Planet of the Humans*, demonstrates that, when you consider how these machines are made, and the huge volume of toxic waste that is released when they are manufactured, wind and solar power may very well be *the dirtiest and most environmentally destructive energy sources on the planet*. No one could rationally accuse Moore of being right wing or a promoter of fossil fuels.

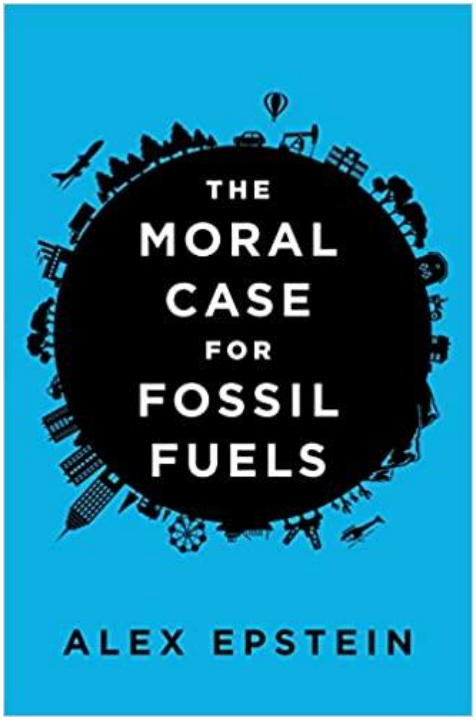
Mark Mathis, of the Clear Energy Alliance explained:

> "Producing solar panels and windmills requires a lot of mining for resources, especially for rare earth minerals. China owns 95% of the rare earth market and the Chinese government isn't all that protective of the environment. Their mining projects are creating giant toxic and radioactive lakes. It's a serious problem they will be dealing with for decades."

An outstanding overview of many of the reasons that industrial-scale wind power is neither clean nor green is "Before committing billions to industrial wind turbines - A column about nature and technology" by Katie Singer, published in Wall Street International Magazine on April 19, 2021. Like Moore, Singer does not come across as right of centre or in any way contesting the climate alarm, yet her article clearly demonstrates that City of Ottawa councillors have had the wool pulled over the eyes on the supposed environmental and other benefits wind power. Let's consider these issues one by one.

4.2.2.1 Manufacturing Impacts of Industrial Wind Turbines

Wind turbines require enormous amounts of steel and iron. A windmill will need about a hundred times more steel, iron and other materials to generate the same electrical capacity as a gas-fired fossil fuel plant. This is a huge expense and has devastating environmental impacts. Even after wind turbines are installed, they require a backup fossil fuel plant that continues burning 90% of the time, making the wind turbine largely unnecessary and, in essence, mostly just "virtue signalling."



Alex Epstein's book *The Moral Case for Fossil Fuels*, shows that, compared to gas-fired power plants, windmills need one hundred times more mining of ores and coal; one hundred times more power for smelting, forging and casting; one hundred times more cement and excavations and destruction of forests and hills; and one hundred times more transportation and installation costs.

The torque being applied by wind forces on the blades of large industrial wind turbines is typically equivalent to a fully loaded school bus sitting at the end of a lever arm the length of a football field. These huge twisting forces necessitate massive concrete bases of hundreds of tons of cement to anchor the turbines, and, of course, the production of cement is a major contributor to overall CO_2 emissions.

Mark Mills (senior fellow at the Manhattan Institute and a faculty fellow at Northwestern University's McCormick School of Engineering and Applied Science) gives a good example:

> "Building a single 100-megawatt wind farm, which can power 75,000 homes requires some 30,000 tons of iron ore and 50,000 tons of concrete, as well as 900 tons of non-recyclable plastics for the huge blades. To construct a solar plant that could produce the same amount of energy would require 150% more cement, steel and glass."

And this doesn't even count "balsa fever," the massive deforestation that is now happening across the Amazon basin's forests, often called the lungs of the Earth, to provide the millions of tons of balsa wood that form the backbones for wind turbine blades around the world. Besides the breakdown of ecosystems by illegal deforestation, balsa fever has had devastating consequences for Ecuador's Indigenous Amazonian communities.

Dr. Ramon Gonzalez-Drigo, Department of Strength of Materials and Structural Engineering at Barcelona East School of Engineering (EEBE), Universitat Politècnica de Catalunya, explained in the documentary film "A Green Paradox: Balsa wood exploitation in the Amazon for wind energy | openDemocracy":

> "Using balsa wood is to plunder a natural resource in an unsustainable way. Currently, the wood is being extracted without any consideration towards replenishment and, also, with social consequences for the peoples that are contracted."

All this is a far cry from the environmentally friendly image that wind turbine manufacturers and climate activists present to the public.

4.2.2.2 Land Use Requirements of Industrial Wind Turbines

Another drawback of relying on wind power is the immense amount of land required. Turbines must be placed far enough apart that they don't interfere with each other since each turbine slows wind speed as it extracts kinetic energy from the wind, creating an unavoidable "wind shadow." This means that farms with significant numbers of turbines require huge tracts of land.

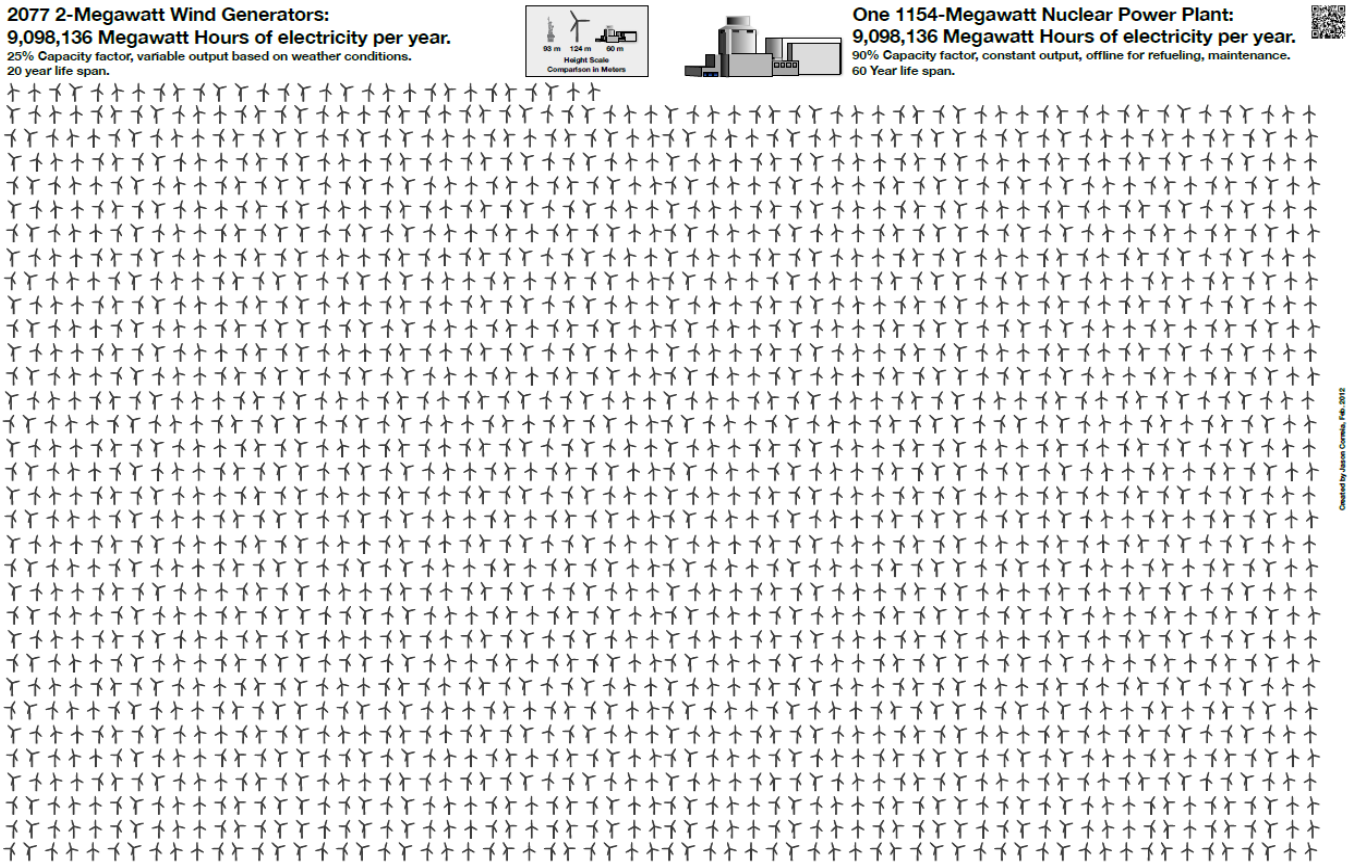
ICSC-Canada Director Dr. Jay Lehr said:

> "To give a sense of scale, to replace the energy from one average natural gas power plant sitting on 4 acres of land would require 2500 acres of large wind turbines."

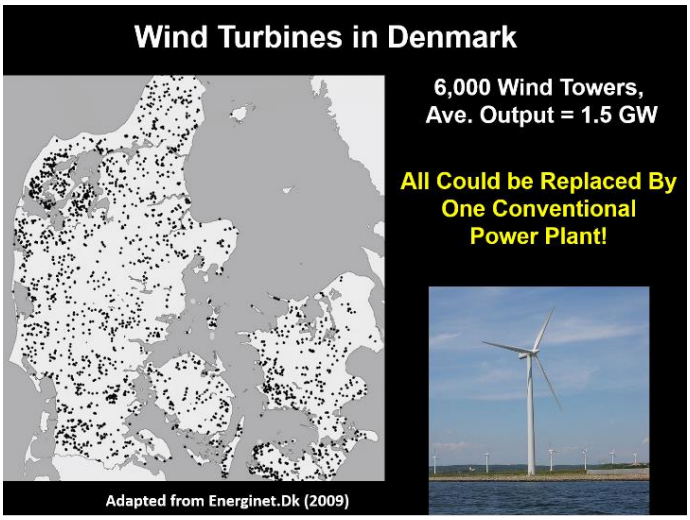
The American Nuclear Association (ANS) demonstrates how many wind turbines it would take to replace a typical nuclear power plant in the graphic on the next page. This is what would be required to match the nuclear power plant output if this array of turbines could hypothetically run continuously at 25 percent of its rated capacity (this is typical for wind power).

The ANS explain:

> "Simply adding more turbines will not necessarily result in a greater amount of electric power or level it out to a continuous flow. Sometimes the wind is slow, non-existent, or even too fast for the turbines to use safely. Thus, this graphic [above] shows a representation of how average wind-power performance could achieve the same amount of power as a nuclear power plant. Unlike a nuclear power plant, however, the output of wind is too variable to power a city."



Denmark invested heavily in wind turbines and it is now possible to walk from one side of the country to the other and never lose sight of an industrial wind turbine. Many people consider them a blight on the landscape.



Another factor usually ignored is that vast forested areas often must be cleared to make way for the turbines and associated infrastructure. For example, in February 2020, Forestry and Land Scotland revealed that 13.9 million trees have been cut down to make way for 21 wind farm projects since 2000. Scotland's *The Herald* reported:

> "Lyndsey Ward, a Highlands wind farm activist, said: 'Not only are millions of CO_2 absorbing trees being felled for turbines, hundreds of thousands of acres of ancient carbon-holding peat are being dug up too.

> "'These figures are astronomical enough, but if you add in the infrastructure requirements and grid connections, many more trees will have been sacrificed and peat lost as remote wind factories are connected to a grid that cannot cope with them.'"

4.2.2.3 Batteries

According to Ottawa's Energy Evolution report, to meet it's target of reducing emissions by 100% by 2050, the City will need 310 MW of local energy storage by 2030 and 612 MW by 2050. This would consist of approximately ***122 large shipping containers of lithium batteries***.

Most electric vehicle batteries are lithium based and rely on a mix of rare earth metals and cobalt, manganese, nickel and graphite. Such materials require massive amounts of energy to mine, transport, process and refine, far greater than the extraction and transport of oil and natural gas. Mining and mineral processing also require large volumes of water, and can pose contamination risks from mine drainage and wastewater discharge.

When mining rare earth metals, about 90% of what is pulled up from the ground contains uranium, thorium and other radioactive nuclides. This radioactive waste can pose serious risks if it is not properly disposed of. In China, for example, champion of rare metals, in Heilongjiang province, a carpet of toxic dust covers agricultural regions.

Batteries are often portrayed as generating no greenhouse gases. Yet, even the Canadian Broadcasting Corporation (CBC) has pointed out that:

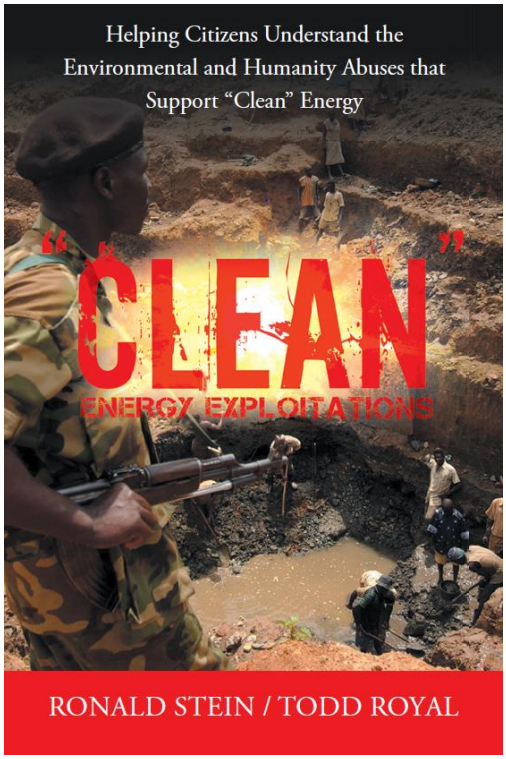
> "Mining and processing the minerals, plus the battery manufacturing process, involve substantial emissions of carbon."

The CBC cites Jennifer Dunn at Northwestern University's Center for Engineering Sustainability and Resilience who explained:

> "The material that helps power the battery is produced from a number of different metals, things like nickel and cobalt and lithium."

And, of course, China controls most of the lithium and cobalt, which are often produced with child labor and near-slave labor, with practically no health, safety or environmental safeguards.

For example, CBC reports that "there have been mass fish kills related to lithium mining in Tibet."



To understand what has happened and how so many good-hearted people across the world have been deceived by the clean, renewable energy myth of wind and solar power, readers should look up the newly released book, ***Clean Energy Exploitations*** *– Helping citizens understand the environmental and humanity abuses that support 'clean' energy* (right), by engineer and energy consultant Ronald Stein and Todd Royal, an independent public policy consultant focusing on the geopolitical implications of energy.

4.2.2.4 Warming Caused by Wind and Solar Power

Industrial wind turbines generate electricity by extracting kinetic energy from the wind. Dr. Howard Hayden, professor of physics emeritus of the University of Connecticut, explained that this reduces the wind speed and so lessens forced convective heat transfer between the atmosphere and the surface. For Ottawa, this would be advantageous in the winter as there would be less wind chill in the vicinity of turbines. However, it would be detrimental in the summer as there would be less beneficial cooling by the wind near the turbines. If Ottawa did erect 710 industrial wind turbines in the City, the area over which these effects are felt could be pronounced.

Besides changing direct wind chill, reducing wind speed alters the exchange of moisture, heat and momentum between the atmosphere and the surface in other ways. In two papers published on October 4, 2018, "Climatic Impacts of Wind Power," in the journal *Joule,* and "Observation-based solar and wind power capacity factors and power densities," in *Environmental Research Letters*, Harvard University researchers Dr. David Keith and Dr. Lee Miller explained some unexpected discoveries. They showed that wind turbines cause significant *increases in local surface temperatures* in the regions where they are located. Keith and Miller found that wind turbines of between 100 and 150 meters in height, the likely size of the proposed City of Ottawa machines, when operating at night, can pull warmer air from as high as 500 meters or more down to the previously cooler and stable air near the surface, warming the ground and so affecting people, plants and animals living near the turbines.

Keith and Miller found that, if the United States obtain all of its electricity (0.5 terawatts), from wind turbines, the mixing of warmer and cooler air would cause a temperature rise of 0.54°C in the areas close to the wind turbines. The overall temperature of the continental U.S. would rise 0.24°C, with the night time temperatures rising by as much as 1.5°C. More than 10 other studies that observed warming near operational U.S. wind farms are supported by this research.

The warming effect by generating all U.S. electricity with wind power is about the same as that which would be achieved by "decarbonizing" the entire global electricity generation.

The impact of solar power, primarily caused by changing the albedo (reflectivity) of the land, would be about one-tenth as much.

Keith and Miller also found that the transition to wind or solar power in the U.S. would require *five to twenty times more land than previously thought*.

Author Dr. David Keith said:

> "If your perspective is the next 10 years, wind power actually has—in some respects—more climate impact than coal or gas."

4.3 The City of Ottawa's plans support the world's worse human rights abuses

The development of so-called clean energy by western nations is exploiting the most vulnerable people in the world and destroying their environments. As Dr. Jay Lehr put it,

> "When you look at industrial wind turbines, you do not see the slave labor used by the Chinese to mine the rare earth metals required for these machines."

Stein and Royal explain that many African, Asian and South American children are being enslaved and dying in mines and factories to extract and process the rare-earths and exotic minerals required for solar panels, wind turbines, electric vehicles (such as the planned City of Ottawa buses) and utility-scale storage systems to work. **These are unquestionably blood minerals**.

The most important components of electric vehicles, for example, are lithium-ion rechargeable batteries. The principal materials used in lithium-ion batteries are cobalt, lithium, manganese and graphite. ICSC-Canada Economics/Policy Advisor Robert Lyman explained:

> "A recent United Nations report warned that the raw materials used in EV batteries are highly concentrated in a small number of countries where environmental, labor and safety regulations are weak or non-existent. 'Artisanal' cobalt production [cobalt is crucially important for solar panels, wind turbines and batteries] in the Democratic Republic of the Congo now supplies two-thirds of the global output of the mineral. Many of the mines employ child labor in extremely dangerous tasks. Up to 40,000 children [some as young as 4-years old] are estimated to be working in extremely dangerous conditions, with inadequate safety equipment, for very little money in the mines in Southern Katanga. The children are exposed to multiple physical risks and psychological violations and abuse, only to earn a meager income to support their families."

Stein and Royal expand on this:

> "Cave-in's, constant exposure to toxic, radioactive water, dust and dangerous air loaded with cobalt, lead and uranium with other heavy metals breathed into lungs day-after-day so western citizens can feel good about their Tesla or wind turbine. Cobalt ore is sent to China since one of the larger mines in the Congo is Chinese-owned Congo Dongfang International Mining Company."

Lyman continues:

> "Lithium mining also presents social and environmental risks. Again, to quote the UNCTAD report:
>
> > 'For example, indigenous communities that have lived in the Andean region of Chile, Bolivia and Argentina for centuries must contend with miners for access to communal land and water. The mining industry depends on a large amount of groundwater in one of the driest desert regions in the world to pump out brines from drilled wells. Some estimates show that approximately 1.9 million liters of water are needed to produce a tonne of lithium. In Chile's Salar de Atacama, lithium and other mining activities consumed 65 percent of the region's water. That is having a big impact on local farmers—who grow quinoa and herd llamas—in an area where some communities already must get water driven in from elsewhere.'"

This is just a sample of the injustices to meet *current* raw material requirements for wind and solar power. Imagine the raw material demands, Third World mining and child labor conditions and ecological destruction, under the huge demands of the planned "green" energy expansion.

Stein and Royal's book also shows something we should be very glad to see: there is a worldwide abundance of fossil fuels in virtually every country. However, such is not the case with the minerals and metals for a "green" society which are mostly limited to environmentally negligent human rights abusers such as China, Russia, the Congo and the lithium triangle in South America.

In "Exposed: Child labour behind smart phone and electric car batteries," Amnesty International summed up the reality of much of the "green energy" supply chain:

> "'The glamourous shop displays and marketing of state-of-the-art technologies are a stark contrast to the children carrying bags of rocks, and miners in narrow manmade tunnels risking permanent lung damage,' said Mark Dummett, Business & Human Rights Researcher at Amnesty International."

To understand how their plans will support the world's worse human rights abuses, City of Ottawa staff need to listen to "**Blood Minerals Behind Wind and Solar Power**," the radio interview with Stein and Royal on *The Other Side of the Story*, broadcast on July 12, 2021 on the America Out Loud Network here.

4.4 Financial Consequences

4.4.1 Introduction

The Council's approval of the Climate Change Master Plan does not mean that it has approved a budget. In fact, the document submitted to Council states explicitly that "all information presented represents high level estimates that are currently uncommitted and unfunded capital and operational needs."

4.4.2 The Estimates

Nonetheless, the financial analysis in the plan offers an order of magnitude estimate of what implementing it would cost the City and its residents over the period from 2020 to 2050. The analysis projects that the cumulative community-wide expenditure from 2020 to 2050 will total $57.4 billion, with a present value of $31.8 billion. All of these costs are above and beyond the expenditures that are currently underway or planned. The actual cost, including spinoffs, to the Ottawa economy and residents will undoubtedly be significantly higher. And one cannot ever begin to place a dollar value on eliminating people's choices about how they wish to live.

There is no analysis of the costs per tonne of carbon dioxide emission avoided. In other words, there is no way, based on the consultant's analysis, to know whether the proposed expenditures are cost effective compared to other options or make sense in terms of the alleged value of the emission reductions.

The plan foresees annual community-wide expenditures of approximately $1.6 billion per year net present value for the decade 2020 - 2030. Of this, $581 million per year net present value would be spent on transit and "active transportation" (bicycle and walking paths) infrastructure and an additional $41 million per year net present value for municipal building retrofits, the zero-emission non-transit municipal vehicle fleet and methane production from landfill and other sources.

4.4.3 Sources of Funds

The consultant acknowledges that the municipality will not be able to meet an expenditure of this size alone. It therefore assumes that a substantial (but unstated) amount of funding will come from the federal and provincial governments. This assumes, of course, that governments that support such high "climate emergency" expenditures will be in power for the next 28 years. Otherwise, the full funding obligations would have to be borne by City taxpayers.

The plan includes suggestions for several additional taxes and fees that could be imposed on City residents, the largest of which are road tolls ($1.6 billion), congestion charges ($388 million), development charges ($234 Million), road user fees ($188 million) and land transfer tax increase ($130 million). No doubt, the imposition of such charges will create some controversy.

4.4.4 Context

The City of Ottawa Budget for the 2021 fiscal year anticipated the spending of $4.3 billion. The proposed Climate Plan expenditures thus would increase that total by 37%. Even if the federal and provincial governments contributed half the Climate Plan funding, an extremely optimistic assumption, Ottawa taxpayers would be required to pay (one way or another) about $800 million per year, or 19% more than they now pay annually.

The magnitude of the spending anticipated over the 2020 - 2030 period is even more striking when compared to the City's present sources of funds and current spending allocations.

Ottawa's projected revenues from property taxes, the largest single source of funds, in 2021 was $1.85 billion. ***The Climate Plan expenditure of $1.6 billion per year would absorb 86% of that.***

The largest spending item in the 2021 municipal budget was $746 million to be spent on community and social services. ***The Climate Plan expenditure would be equal to more than twice that.***

The second largest spending item in the 2021 municipal budget was $647 million to be spent on transit. ***The Climate Plan expenditure would be equal to two and a half times that.***

> The main financial impact on an individual resident of Ottawa would be through a massive increase in the cost of owning and operating a vehicle; the plan marks an intensification of the City Council's longstanding war on cars and car owners. If one could portray it in terms of a property tax increase, for each of the next ten years the owner of a house with an assessed value of $400,000 would see his or her ***property tax rise from $4,035 per year to $4,780 per year assuming senior government aid or to $5,528 per year without senior government aid.***

If the costs of taxes and fees rise high enough, people will not be able to afford to live in Ottawa and they will simply move elsewhere, even if it means moving to communities just beyond the City's boundaries. Driving people out of Ottawa would, of course, help to reduce emissions.

One of the factors that will make living in Ottawa unaffordable for many people will be the inevitable increase in electricity rates due to mass conversion to wind and solar power.

4.4.5 Ottawa's electricity

4.4.5.1 The city's proposals

The City proposes to take several measures to change the way electricity is generated in Ottawa. It also plans greatly to expand the role, responsibility and budget of Ottawa Hydro, the local electricity distribution utility, essentially taking over many functions now performed by the provincial electrical utilities. For example, it will:

- Increase Ottawa's residential use of solar photovoltaic equipment from 72 kW (see p. 18 *Technical Paper 2020*) today to 174 MW by 2030, ***a 241,567% increase,*** and to 320 MW by 2050, ***a 444,344% increase.*** The City documents do not explain how this is to be achieved; i.e., by passing regulations, by subsidies or by taxes that make the alternatives far too expensive.

- Increase the commercial solar power equipment installations from 584 kW today to 400 MW by 2030, ***a 68,393% increase,*** and to 740 MW by 2050, ***a 126,612% increase***.

- Add 310 MW of bulk electricity storage by 2030 and 612 MW by 2050. The capital cost of bulk-power storage using lithium-ion batteries ranges from U.S. $600 to U.S. $3,800 per kWh. The cost of bulk electricity storage in the United States was $625 per kWh in 2018. Using the latter cost yields a price tag of **$382,500,000 for 612 MW storage**.

- Increase Ottawa's wind-generated electricity production capacity to 1,609 MW by 2030, and 3,218 MW by 2050. The current cost of installing a wind turbine is conservatively estimated to be about $2,500 per kW. ***So, the capital cost of 1,609 MW would be over $4 billion and the cost of adding 3,218 MW would be over $8 billion.***

The issue of the cost of electricity is important enough to look at more closely.

4.4.5.2 Wind and solar power are too variable and too costly to significantly support our economic needs

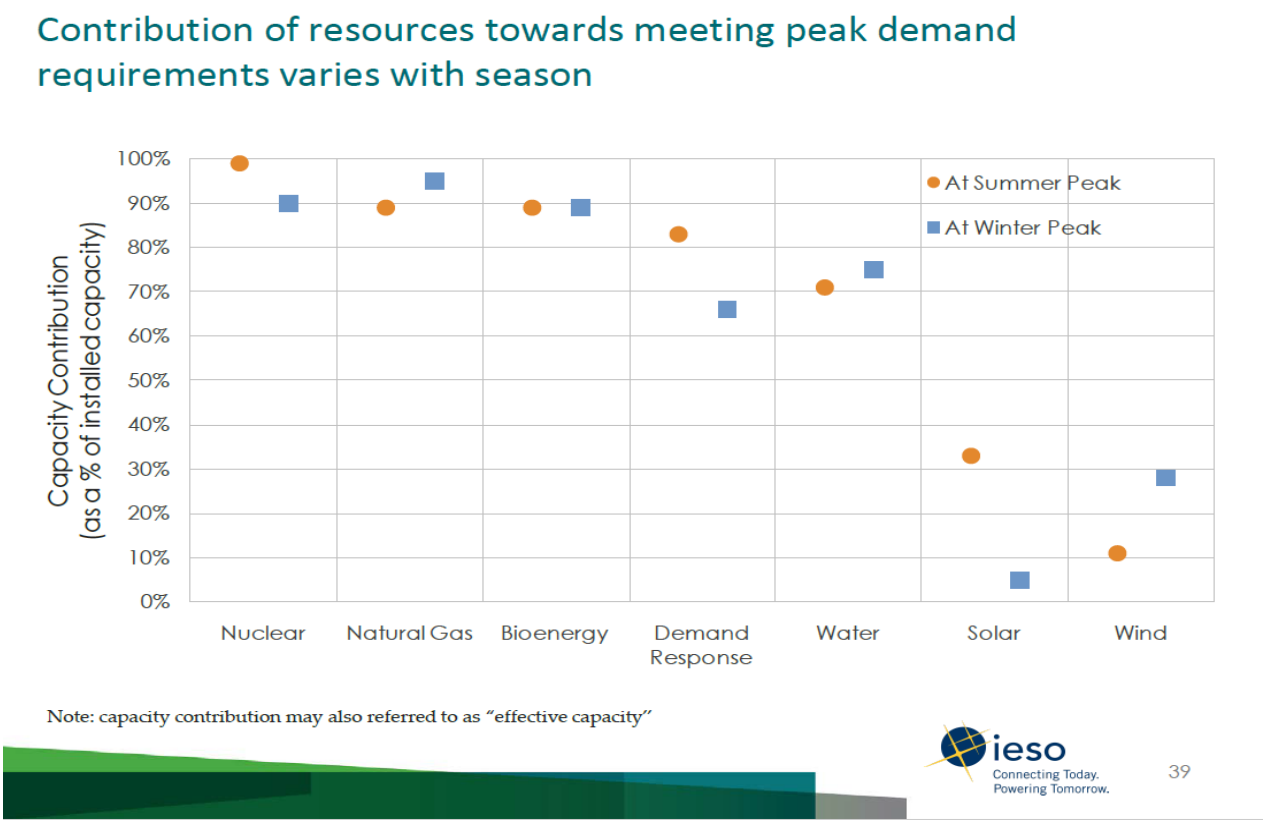
4.4.5.2.1 Wind and solar power highly variable

Proponents of wind and solar power often tell us that these energy sources are now cost competitive with conventional sources such as natural gas, nuclear and coal. But this ignores the fact that electrical energy produced by solar and wind is highly variable, intermittent and unreliable.

Professor Jacques Treiner, Associate researcher at *LIED* (Université Paris-Diderot) puts it well:

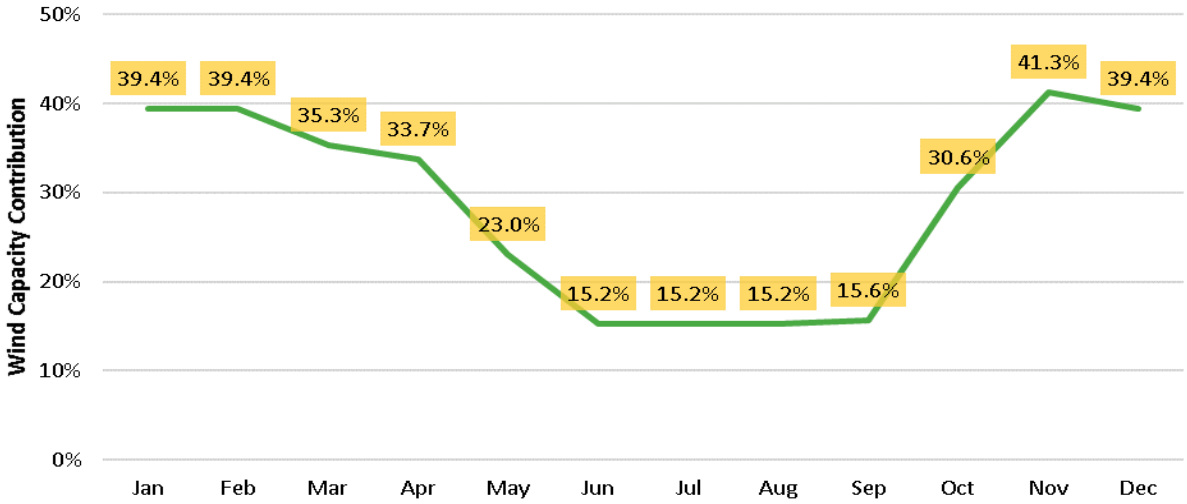
> "There is no knob that you can turn that makes the thermonuclear reactions in the Sun more intense or less intense when we need more or less electricity. For the wind, it is the same. These energies are inexhaustible. But we don't control the flow."

In contrast to conventional electricity sources which can be relied upon to give the power they are rated for most of the time, solar and wind produce energy according to the season, weather and time of day, not necessarily when they are needed, as seen in the following graph from Ontario's Independent Electricity System Operator (IESO) (2016).
[6]



It should also be noted that large scale industrial wind turbines are highly inefficient, with a typical production of a mere 2.5 megawatts of power per turbine. And this only occurs when wind speed is between 8 and 25 miles per hour. The wind does not, however, blow within this speed range most of the time even in the best locations. Moreover, when the wind isn't blowing, fossil fuels are needed to back up wind turbines when they cannot produce electricity. The following graph shows the average monthly capacity contribution of wind power during the weekday peak hour as a percent of installed capacity forecast by IESO for the period July 2021 to December 2022 (reference):

Monthly Wind Capacity Contribution Values



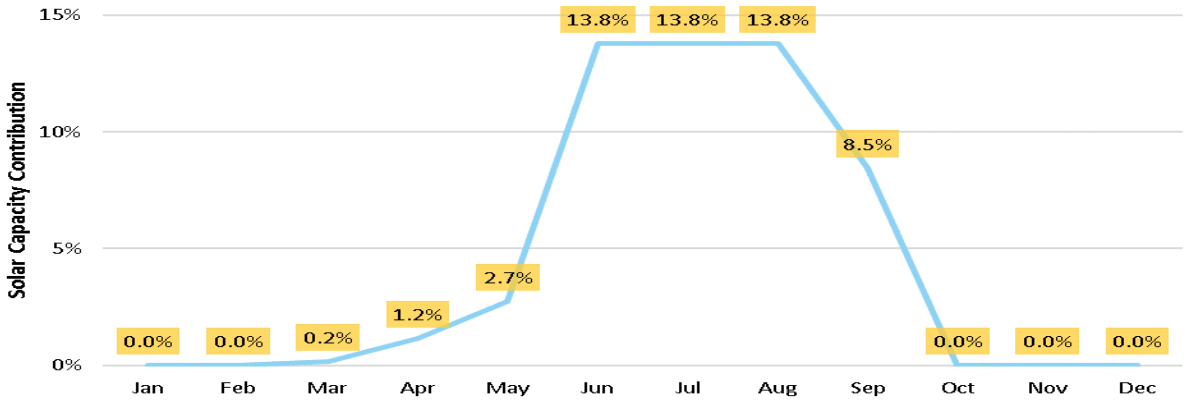
This means that, over this 18-month period, the actual amount of wind-powered electricity available in Ontario at the time of day when we most need it the most in, say, February, a generally windy month, is expected to be 39.4% of the total installed capacity of wind power in the province. For the summer months, when the wind is generally more quiescent, it is forecast to be only 15.2%. Projections for Ottawa alone would be similar.

ICSC-Canada Director Dr. Jay Lehr said:

> "The wind industry projects the annual output of their turbines to be 30 to 40% of rated capacity. However, experience for the past decade indicates that annual outputs are more commonly between 15 and 30%. For example, when 137 U.S. wind projects self-reported to the U.S. Energy Agency in 2003, their average capacity was 26.9%. Nine years later it rose to 30.4%. However, 27 European Union countries reported their efficiency in 2007 to be only 13%. The saddest reality is that wind turbines produce no power 70% of the time."

The following graph shows the average monthly capacity contribution of solar power during the weekday peak hour as a percent of installed capacity forecast by Ontario's Independent Electricity System Operator (IESO) for the period July 2021 to December 2022 (reference):

Monthly Solar Capacity Contribution Values



This means that, over this 18-month period, the actual amount of solar-powered electricity available at the time of day when we most need it the most in the summer is expected to be 13.8% of the total installed capacity of solar power in the province. For the winter months, when most of the panels would be covered with snow, it is forecast to be 0%. According to the International Energy Outlook 2016, solar generators in Canada have a five-year average capacity factor of 6% (reference). Projections for Ottawa would be similar.

Solar panels covered with snow.

4.4.5.2.2 Wind and solar power require large scale back-up

The low-capacity contributions for wind and solar power mean that large quantities of back-up power are require if we are to avoid daily blackouts. With today's technology, significant bulk battery storage of electricity is impractical and extremely expensive. Currently, the use of bulk energy storage by batteries increases the cost of delivered electricity by 10 times the cost of the renewable generation itself.[2] Consequently, backup power plants are typically used. These must run at 90% of their capacity at all times in order to be immediately ready to provide uninterrupted electricity to consumers when the wind does not blow or the Sun does not shine.

Moreover, wind and solar also need long distance, costly transmission lines. Thus, in order to assure uninterrupted supplies to avoid blackouts, utilities must either have backup generation such as natural gas-fired plants or electricity storage.

"Thirty Gigawatts of wind maybe requires twenty-five GW of backup."

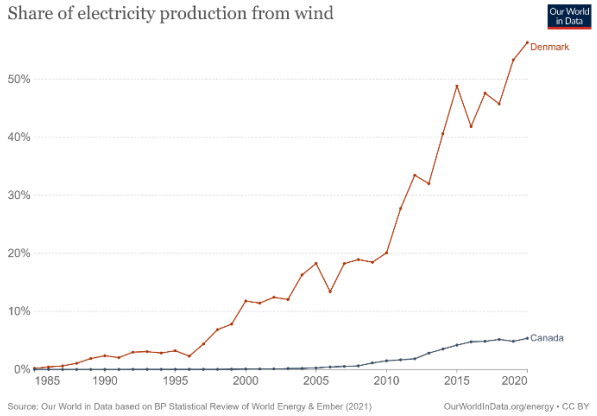
- Mr. Rupert Steele, former Director of Regulations of Scottish Power

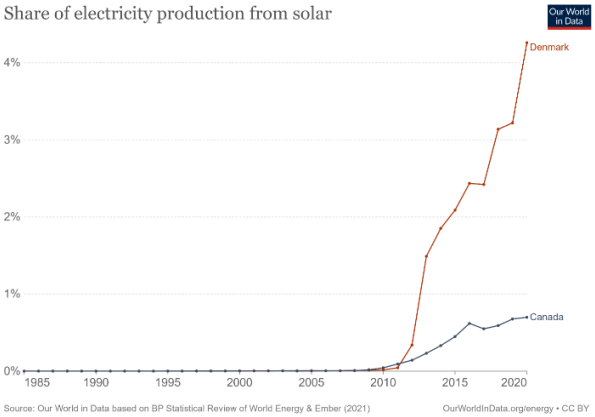
[2] *U.S. Battery Storage Market Trends*, Energy Information Administration, May 21, 2018

4.4.5.2.3 Wind and solar power drive electricity prices very high

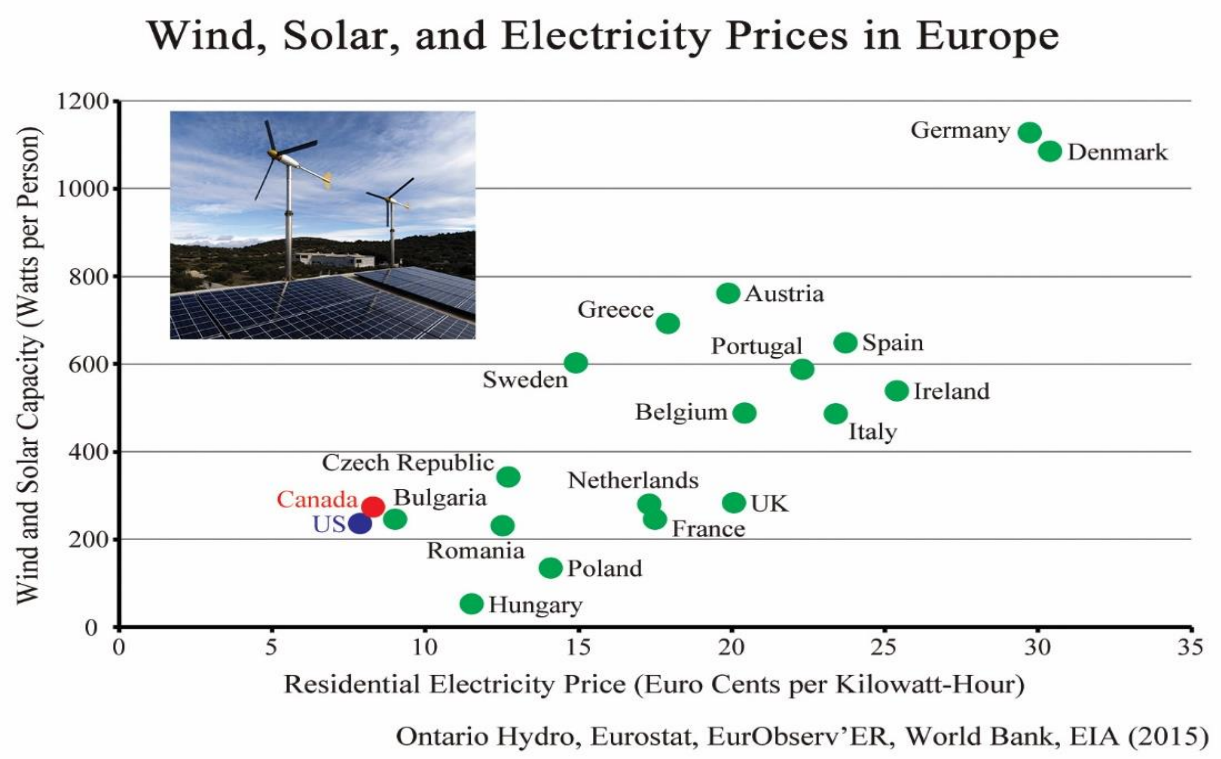
Countries with high percentages of wind and solar generation in Europe (Denmark, Germany and Spain) also have the highest electricity prices in the European Union. Danish and German electricity rates are on average three times those in Canada. The figures from Denmark are especially instructive since that country is already well along the same path that the City of Ottawa council wants Ottawa to go.

First, consider the relative fractions of power currently provided by wind and solar power in Canada and Denmark:

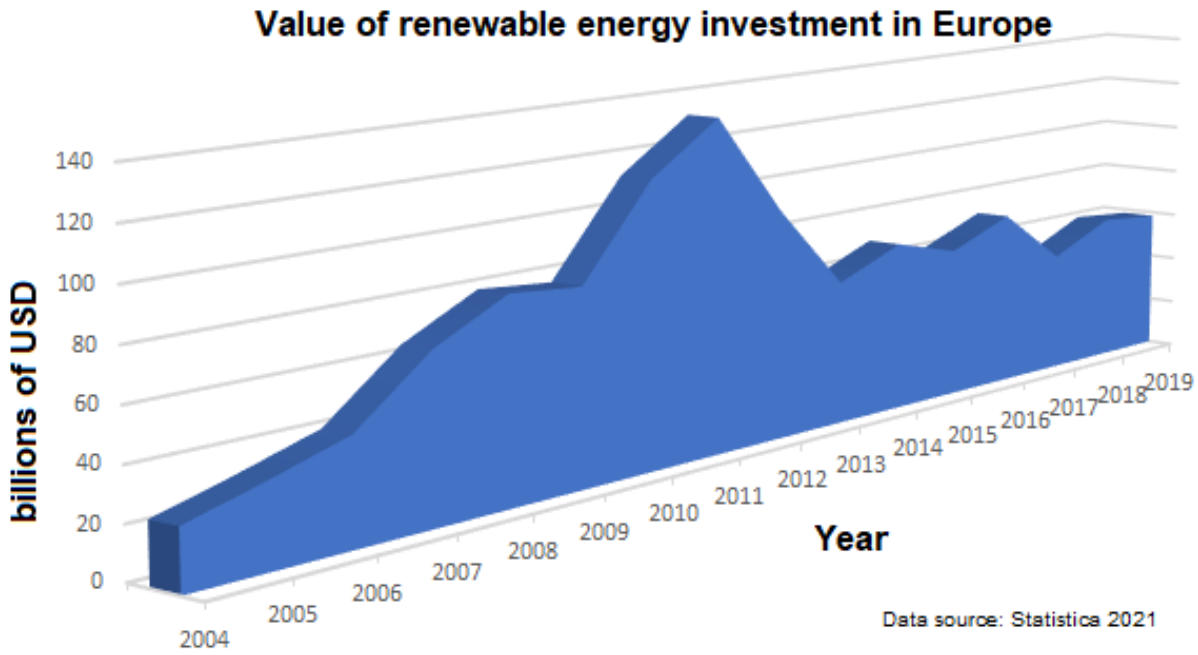




Across the world, as the fraction of power generated by wind and solar increase, so does the price of electricity. Note the different positions of Canada and Denmark on the following graph.



Given the high power prices in Europe, largely brought about because of their increasing reliance on renewable energy, it is not surprising to see investments in these energy sources shrinking in Europe:



JunkScience.com summarizes the problems in Europe in "Unsung Zeroes: The Top 10 Under-Reported Climate Flops of 2021," published on December 28, 2021:

> "**European wind failure causes disastrous global energy crisis.** As Europe has closed its coal plants in a rush to embrace wind turbines over the past 20 years, 2021 witnessed a decrease in wind and the ensuing failure of European wind turbines. With fewer coal plants to fall back on, Europe has been forced to rely on natural gas plants, causing natural gas prices to skyrocket and a global energy crisis. Some of the outcomes: energy company failures, manufacturing and fertilizer plant shutdowns, projected increase from 50 million to 80 million in the number of Europeans living in energy poverty and a greater reliance on Vladimir Putin's goodwill for supplies of natural gas. Plus, emissions have increased. The media has been largely silent on the ongoing energy crisis and emissions backfire, especially with respect to its origins in green policies."

Economist Robert Lyman, a co-author of this report, estimates that if we were to "electrify" Canada, which is converting the Canadian economy to use electricity as fuel, it would cost somewhere between 3.6 and 5.9 trillion dollars. This would approximately double the cost of electricity to Canadian consumers. A similar analysis would show the same for Ottawa.

An illustration of the true costs of new wind and solar power can be seen in the following graph from the Institute for Energy Research (U.S.). The graph represents the LCOE (Levelized Cost (in USD) of Electricity from Existing Generation Resources). They have included all costs except for

transmission costs, which would bring the wind and solar costs even higher as they are typically built at a great distance from population centres.

To make matters worse still, most wind turbines last only about 15 years, half that of their promised 30-year lifetime. A study done by Utah State University showed that, when you include all the costs of wind turbines, *wind-generated electricity costs seven times more than natural gas-generated electricity*. This is not something our society can afford, and so putting large subsidies into wind farms is ineffective and dangerous to our nation's energy security.

Speaking at the 13th International Conference on Climate Change in Washington D.C. in July 2019, engineer Douglas Pollock from the University of Chile explained what has been happening in Chile as a cautionary tale about what can happen in other countries if we follow their disastrous devotion to green energy. Showing the chart on the next page of energy costs, Mr. Pollock said that the wind and solar sources Chile has brought online recently "have meant an average cost at least nine times higher than those of traditional sources."

Power Plant Type	Generator name	Investment [MMUS$]	Rated Power [MW]	Capacity Factor	Output [MW]	Unit Cost [MMUS$/MW]	Times more expensive
PV	El Pelícano	250	100.8	19.0%	19.2	13.1	7.9
Wind	San Juan de Aceituno	430	184.8	30.0%	55.4	7.8	4.7
Thermosolar/PV	Cerro Dominador	1,400	210.0	19.0%	39.9	35.1	21.2
Total Renewable		**2,080.0**	**495.6**	**23.1%**	**114.5**	**18.2**	**11.0**
Coal Power Plant (canceled 2010)	Barrancones	1,100	540.0	95.0%	513.0	2.1	—
Hydroelectric - Reservoir	Angostura	715	316.0	58.0%	183.3	3.9	—
Hydroelectric - Run-of river (canceled 2016)	HidroAysén	3,200	2,750.0	85.0%	2,337.5	1.4	—
Total Conventional		**5,015.0**	**3,606.0**	**84.1%**	**3,033.8**	**1.7**	**1.0**

But we don't have to look abroad for convincing evidence for extreme costs due to a massive conversion to wind and solar power. The results of providing large subsidies to the wind and solar industries were amply illustrated in the province of Ontario, which provided above-market tariffs, effectively subsidies, for these generation sources under long-term fully guaranteed contracts. According to then-Ontario Auditor General Bonny Lysyk's 2015 report, from 2006 to 2014, the electricity portion of the hydro bills of residential and small-business consumers increased by 70%, primarily due to forcing electricity suppliers to preferentially use expensive wind and solar power whenever it was available. In particular, the Global Adjustment fees, covering the excess payments to generators over the market price (to cover the cost of renewables) cost consumers $37 billion during that period and were projected to cost another $133 billion from 2015 to 2032.

The Fraser Institute performed an econometric analysis of the consequences of Ontario's Green Energy Act that provided major rate-based subsidies to wind and solar energy in Ontario. It found that the policies had serious adverse effects on the manufacturing sector, likely producing the loss of 75,000 permanent jobs.[3]

> ***"Electricity systems are complex, and too often policymakers pursue renewable energy sources such as wind and solar without understanding their true costs."***
>
> - Dr. Pierre Desrochers, associate professor U of Toronto Mississauga, co-author of June 2019 Fraser Institute study "Generating Electricity in Canada from Wind and Sunlight"

[3] R. McKitrick. *Understanding Changes in Ontario's Electricity Markets and Their Effects*, Fraser Institute, April, 2018

On top of all this is a loss of energy security and reliability, increased vulnerability of the energy system to disasters and cyber-attacks, and increased subsidies to wind and solar power stations. These costs are not factored in to government cost estimates, giving energy consumers a skewed perception of the impact of transitioning to so-called renewable energy.

Clearly, attempting the energy transition planned by the City of Ottawa in a few decades is unfeasible and would cripple Ottawa's economy, driving many people out of the City.

5.0 Climate Policy Myths

Like in many jurisdictions across the world, the City of Ottawa's *Declaration of Climate Emergency*, its *Energy Evolution* document and its *Climate Change Master Plan* are all based on popular, though unjustified, climate policy myths. Fully correcting these beliefs is beyond the scope of this report, but ICSC-Canada makes the following comments after a sample of the City's implied or directly-stated policy assumptions.

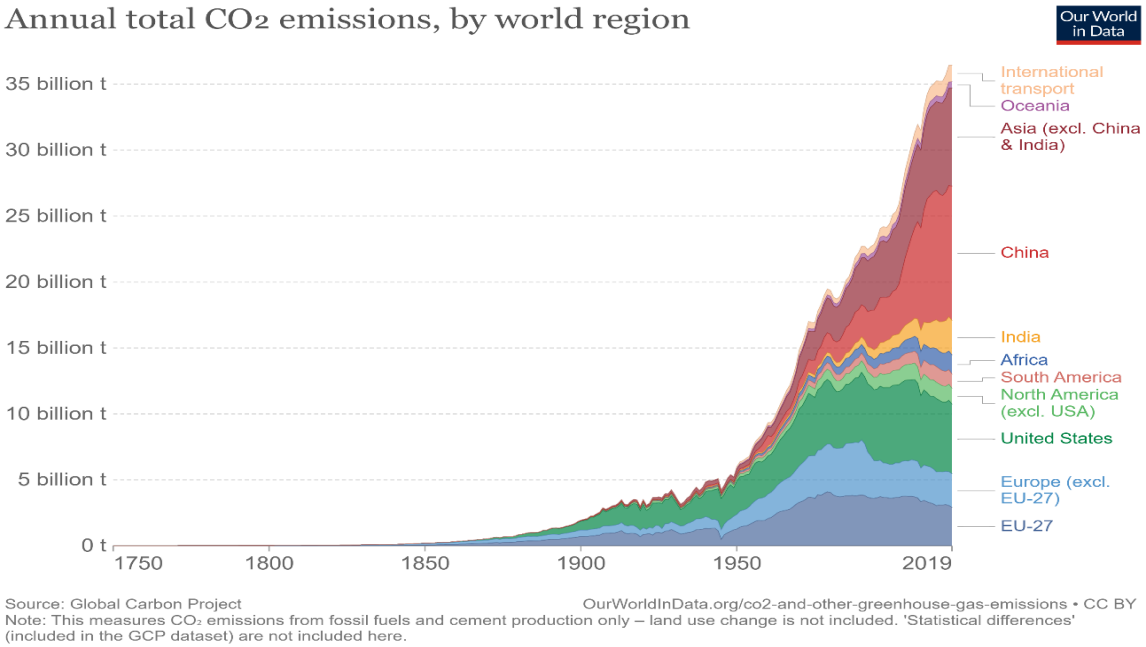
5.1 Climate Policy Myth #1: The City of Ottawa plans are part of a Canada-wide, indeed worldwide, trend of significantly reducing human greenhouse gas emissions, primarily as a result of lessening our dependence on coal, oil and natural gas.

The facts: None of this is true. Consider the following.

5.1.1 Greenhouse gas emissions are not reducing, either nationally or internationally

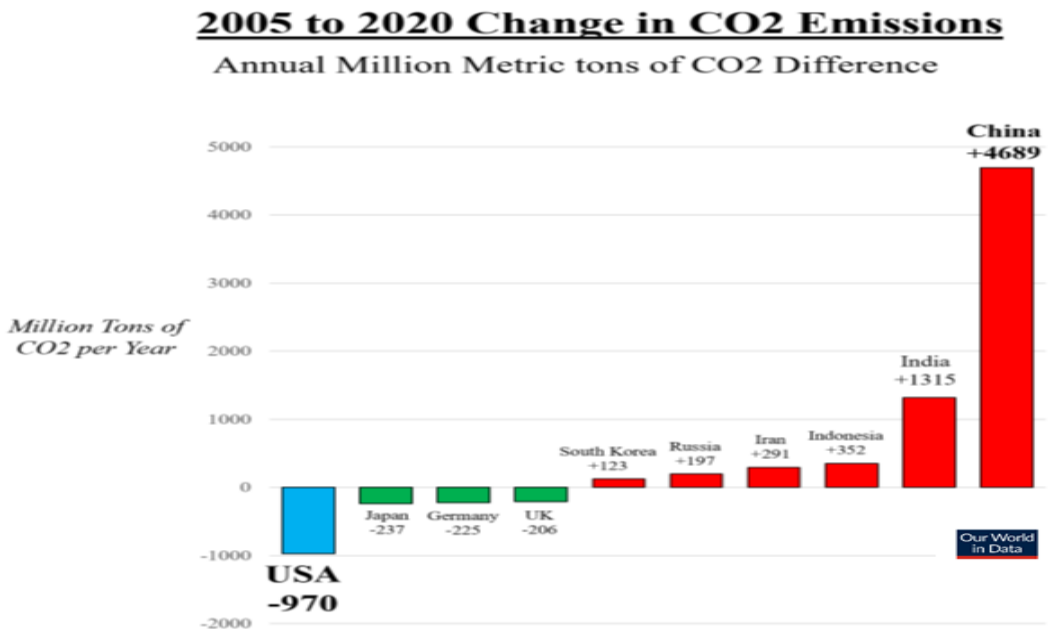
The countries of the world have been setting targets for greenhouse gas (GHG) emissions reductions since 1992. In 2015, at the 21st Conference of the Parties to the Framework Convention on Climate Change (COP21) in Paris, countries agreed to submit voluntary plans every five years as to how they would reduce emissions in the future. Several countries, including Canada, submitted plans indicating their voluntary objectives for emissions reductions by 2030.

Yet, global GHG emissions *rose* by 59% from 1990 to 2019.[4] With the exception of a few countries in Europe, no country has *ever* met its emission reduction target. As shown in the following figure, despite 25 previous UN COP meetings, CO_2 emissions, the principle GHG emitted by human activity (aside from water vapour), have continued upward unabated.

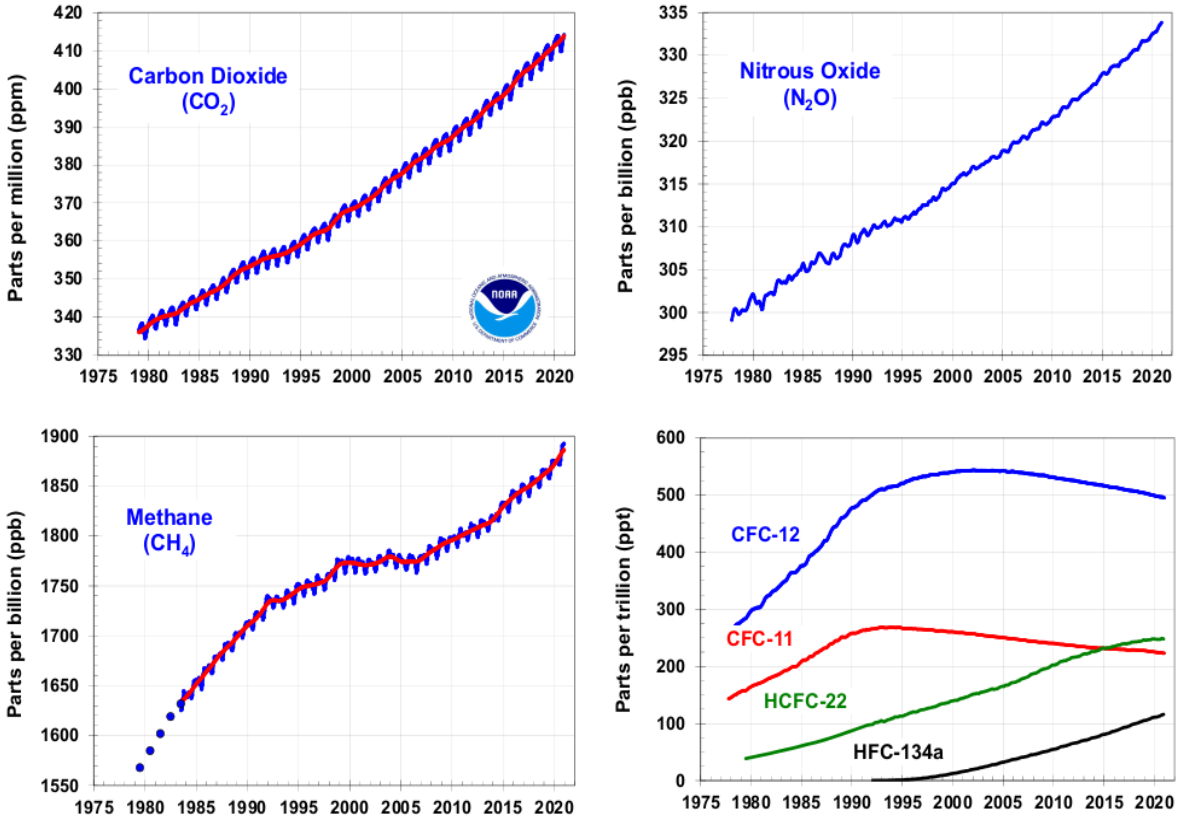


[4] BP Statistical Review of World Energy 2019

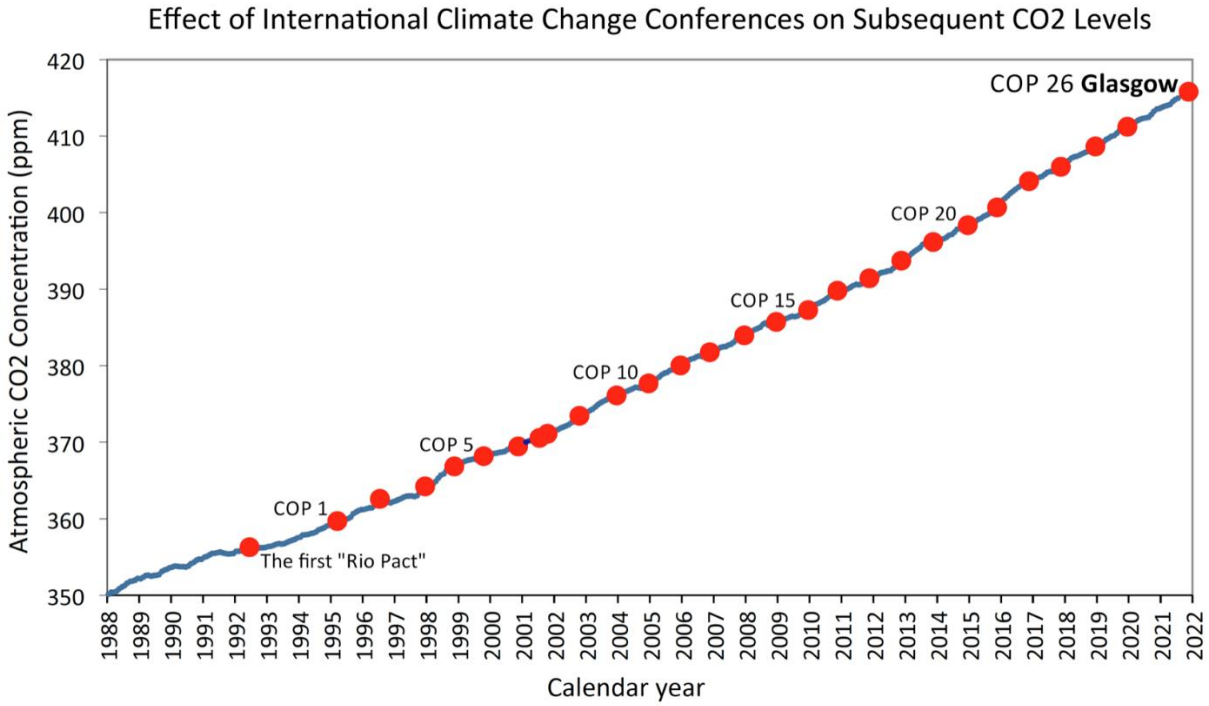
The trend since 2005 is especially worth noting (Canada's CO_2 emissions dropped by an amount too small to see on the scale of this graph):



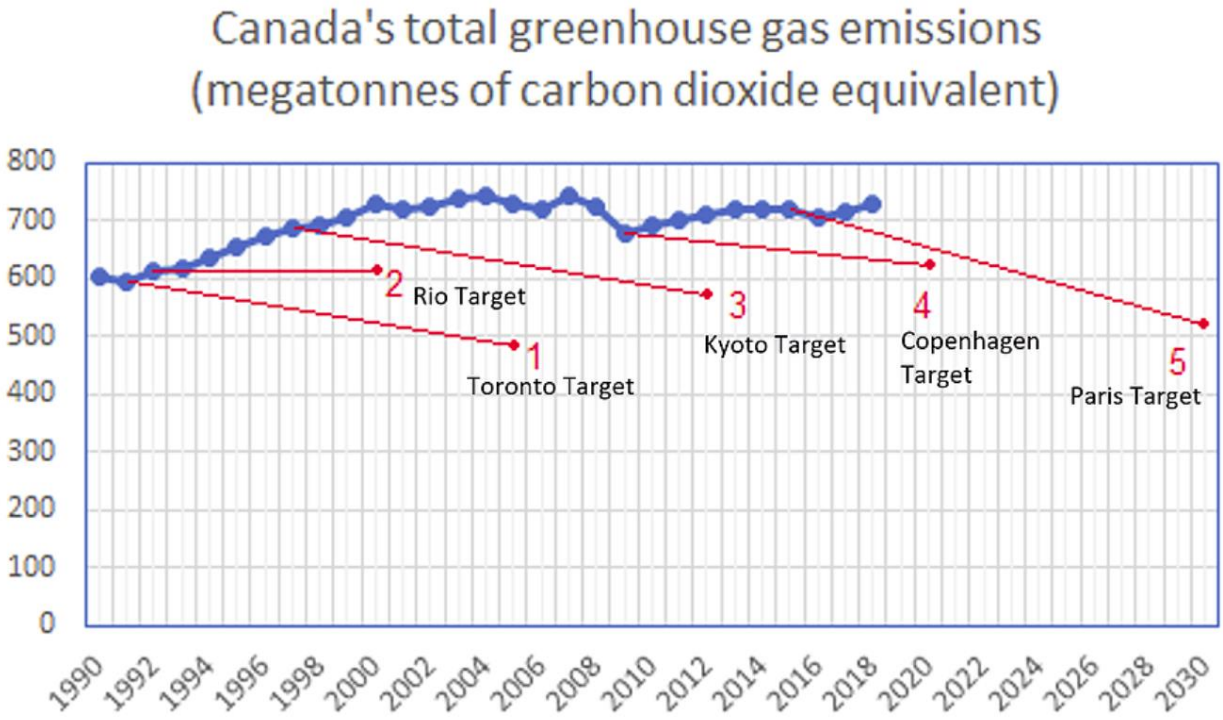
Not surprisingly, atmospheric levels of the principle anthropogenic greenhouse gases continue to rise accordingly, as seen below.



The lack of impact of the UN climate change conferences on the levels of CO_2 in the atmosphere is especially pronounced:



We can see from the following graph and the bullet points following it (ref: Canadians for Sensible Climate Policy) that Canada has been especially poor at meeting its targets, regardless of whether Liberals or Conservatives are in power:



- **"Between 1984 and 1993**: Prime Ministers Trudeau, Turner, Mulroney, Campbell and Chretien committed to reduce emissions to 20% below 1988 levels (588 Mt CO_2 equivalent (CO_2e*)) by 2005. Indeed, this was the target Canada agreed to at the 1988 Toronto Conference on the Changing Atmosphere. Instead, our emissions rose about 24% between 1988 and 2005.

- **"1992**: Canada targets year 2000 as having the same GHG emissions as in 1990. This was Canada's target under the 1992 Rio de Janeiro Earth Summit. Instead, emissions rose about 21% above 1990 levels by 2000.

- **"Between 1993 to 2006**: Prime Ministers Chretien, Martin and Harper pledged to reduce to an average of 6% below 1990 levels between 2008 and 2012. Eddie Goldenberg, Chretien's top political aide admitted in 2007 that the Liberals knew they had no way of implementing the target when Chretien signed the Kyoto Protocol which included those targets. Instead, in 2012 emissions were 18% above 1990 levels.

- **"2009**: Harper pledged to reduce GHG to 17% below 2005 levels by 2020. This was Canada's target under the Copenhagen climate agreement. University of Alberta School of Business Prof. Andrew Leach said at the time that would require the government to shut down the equivalent of Canada's transportation sector within a decade. Instead, emissions were about the same in 2018 as they were in 2005.

- **"2015**: Harper pledged to reduce GHG emissions to 30% below 2005 levels by 2030. This was Canada's target under the Paris Agreement and was the initial target of the government of Justin Trudeau. In July 2021, Canada submitted its updated nationally determined contribution (NDC), where it strengthened its emission reduction target to at least 40 - 45% below 2005 levels by 2030.

It seems unlikely we will meet this latest target. A July 2021 Pembina Institute report found that Canada was on track to reduce emissions by only 36 per cent by 2030. Another study released in October 2021 by the Trottier Energy Institute at Polytechnique Montréal found that emissions would fall only 16% by 2030 if they only accounted for well-understood federal government policies. The CBC reported on November 4, 2021, however, "at least one study, released by the Toronto-based think-tank Clean Prosperity this past week, showed Canada has a reasonable chance of meeting the target if it fully implements the federal government's plan and oil and gas prices fall."

For more on this topic see the Climate Action Tracker's webpage for Canada where they conclude, "there is a very large 'domestic action gap' between where Canada's emissions in 2030 will be under current policies and where they need to be to be 1.5°C compatible."

** Note: While CO_2 is the most important GHG, aside from water vapour, gases such as methane and nitrous oxide are also hypothetical drivers of global warming. Carbon dioxide-equivalents (CO_2e) attempt to sum up all of the supposed warming impacts of the different GHGs in order to give a single measure of total GHG emissions.*

5.1.2 Why are international emissions continuing to rise?

Over the period 2010 to 2019, the country members of the Organization for Economic Cooperation and Development (OECD) reduced their GHG emissions from 13 billion tonnes per year to 12 billion tonnes per year, or 8%. However, what is often overlooked is the fact that, during the same period, the non-OECD countries *increased* their emissions from 18.1 billion tonnes per year to 22.2 billion tonnes per year, or 23%. Non-OECD emissions thus rose four times as fast as OECD emissions fell during this period.[5] Given that the non-OECD countries constitute two-thirds of global GHG emissions, a share that is constantly rising, it is not surprising that global GHG emissions have continued to grow despite the actions of OECD countries.

5.1.3 Why have Canadian GHG gas emissions not been reducing?

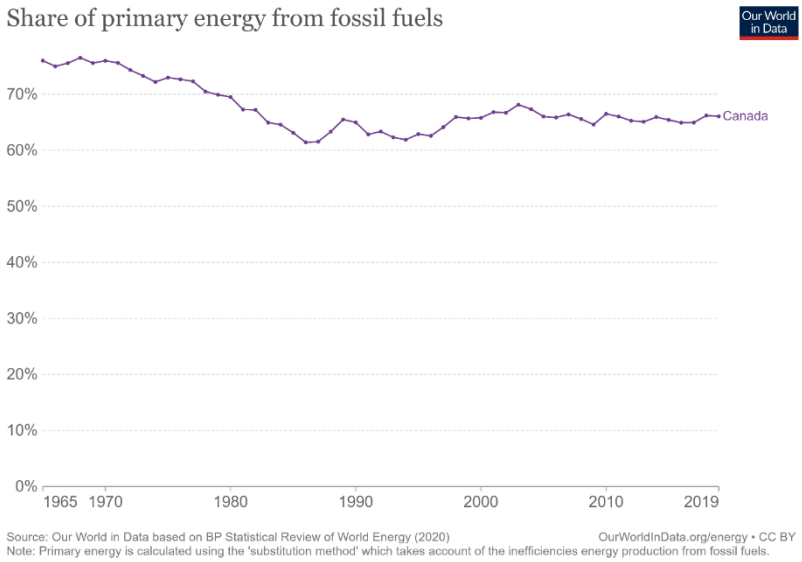
Canada is one of the coldest countries on Earth. It is also one of the largest countries, with more than 7,000 km separating St. John's, Newfoundland from Victoria, British Columbia. There are long distances between our major urban centres and between our areas of high population density and the remote communities of the North. Canada is a country rich in resources of all kinds, including the resources needed to produce energy like oil, natural gas, coal, uranium and hydro-electric resources. Partly because of this, Canada is a relatively wealthy, industrialized country; it has been able to use its comparative advantages in low cost, plentiful and secure energy to build a modern economy with plenty of high-income jobs.

It has been like this for a long time. For well over a century, Canadians have developed their economy, settlement patterns and infrastructure based on plentiful and cheap energy. Our roads, railways, electricity generation and transmission facilities, mines, pipelines, city structures, industrial plants, commercial facilities, vehicles and homes have all been designed and built based on a heritage of plenty of energy.

Much of that infrastructure has a long life. It cannot be replaced in a few decades. Energy transitions historically have occurred because new sets of technologies arose that were superior in terms of performance, reliability and cost to the ones then available, so consumers voluntarily opted for change. And, as explained in more detail in the introduction to section 3 of this report, such changes, even when they satisfy these conditions, take many decades to carry out. They do not occur because governments set arbitrary political targets, especially in support of technologies that have poor performance, are unreliable and expensive, as is presently occurring in Canada and many western nations.

For these reasons, Canada is just as reliant on inexpensive, reliable fossil fuels today as it was 30 years ago, as demonstrated by the figure below.

[5] Ibid



There are huge benefits to Canada from the continuation of our fossil fuel resources development:

• In 2019, oil and gas exports totaled over $122 billion, even during a period of depressed oil prices. They contributed 5.3% of Canada's GDP, in comparison to 1.7% by electricity generation and 0.2% by other sources of energy production, including renewables.

- Government revenues from the oil and gas industry averaged $14 billion per year over the 2015 to 2019 period.
- Capital expenditures, heavily influenced by the available cash flow, declined by 40% from a peak in 2014, but still totaled $33.3 billion in 2019. By comparison, renewable energy investments fell from over $3 billion in 2015 to about $1.3 billion in 2019.
- The present gross market value of Canada's reserves of oil, natural gas and coal is in the neighbourhood of $12 - 13 trillion.

This, however, is just the beginning of the story. Energy-intensive industries that rely on fossil fuels—mining, manufacturing, petrochemicals, plastics, steel, cement, metal fabrication and pulp and paper industries, for example, and all the companies that provide goods and services to those industries—play a huge role across the Canadian economy.

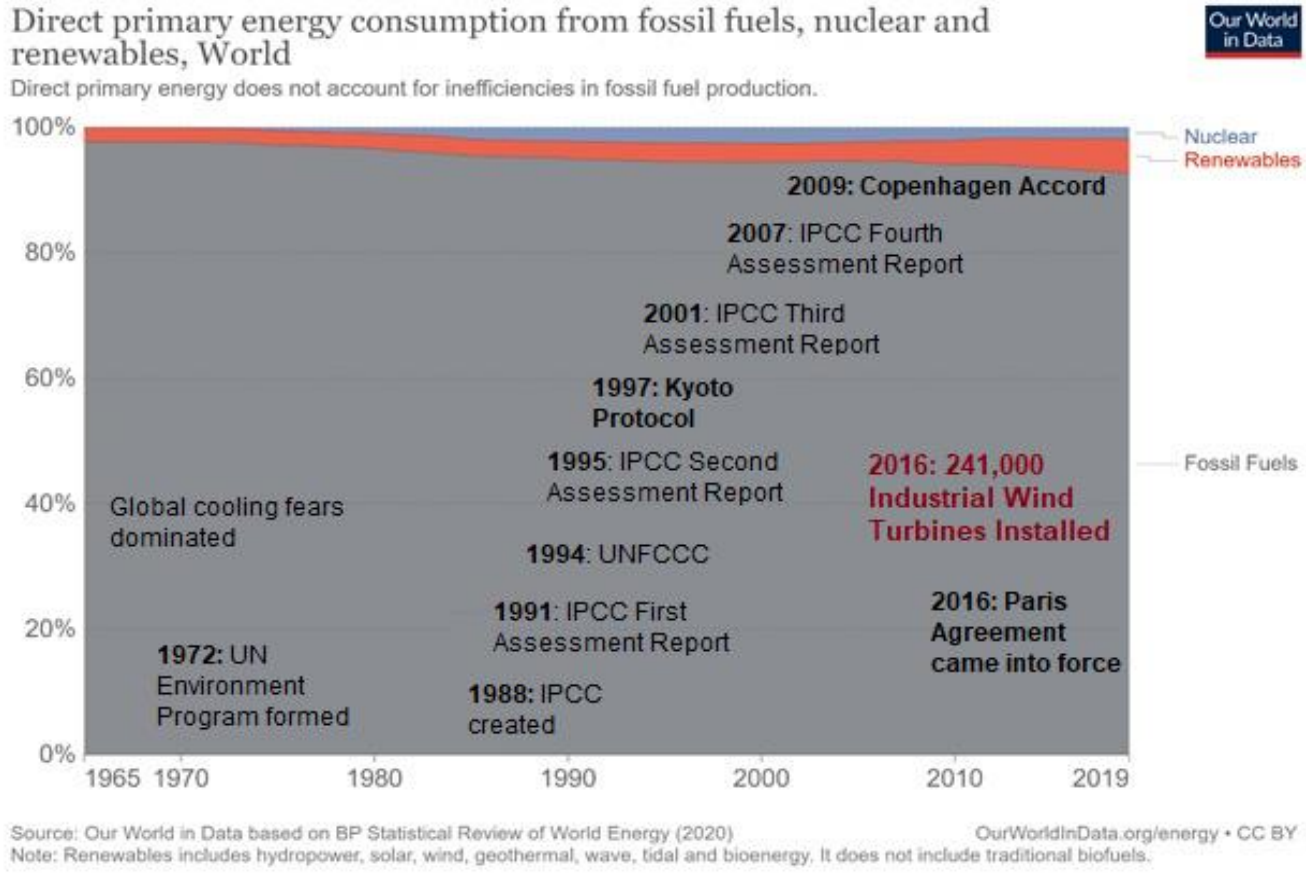
In short, the economic contribution of oil and gas, directly and indirectly, to Canada's economy, and so our social support networks, health care, first responders, education, indeed everything that has made Canada the peaceful, prosperous country we hope it will continue to be for future generations, dwarfs that of renewables. Sensible governments recognize this and so are loath to forego the economic benefits of fossil fuel development.

5.1.4 Despite huge investments in renewable energy and countless climate change agreements, fossil fuels remain the world's dominant energy source

By 2019, $3.7 trillion had been spent globally on climate measures over the previous decade, including untold hundreds of billions in support of wind and solar power. Besides huge subsidies to these energy sources, governments have also given them massive grants and tax breaks and forced utilities to use wind and solar power in ways they otherwise would not have. Our leaders have also agreed to numerous climate change policies that favour wind and solar.

Industrial wind turbine "farm" in Palm Springs, California

Consequently, at the end of 2016 there were more than 341,000 industrial wind turbines operating across the world, according to the Global Wind Energy Council, and approximately 707.5 gigawatts of installed solar photovoltaic capacity globally in 2020. Yet, as the following figure illustrates, despite all of these agreements, reports and funding, their share of direct primary energy consumption across the world is still very small (aside from traditional biomass, hydropower is the largest "renewable energy," so wind and solar power represent only a fraction of the red "Renewables" portion below). In 2019, fossil fuels (coal, oil and natural gas) supplied 84% of the world's primary energy consumption. Renewables supplied 5%; wind and solar energy supplied 2%, according to the BP Statistical Review of World Energy 2019.



5.1.5 This overall trend will not change in the foreseeable future

Developing countries made it clear several years ago that their efforts to reduce emissions to meet ambitious targets are contingent on the provision of over $100 billion per year in funding by the wealthier countries. To date, there is no agreement on the apportionment of the payment obligations or the recipients' rights. In July 2021, the developing countries updated their demands for additional funding to finance mitigation, adaptation and what they consider "compensation" for the past emissions of the developed countries. Included in their demands was an addition $4 billion per year in climate aid from Canada and $80 billion per year from the United States. The report from developing nations published in July increased their overall demand to at least *$750 billion USD per year* from developed countries in the post-2025 period. For these reasons alone, meaningful agreements on significant further climate cooperation seems unlikely.

But will things get better, from an emissions perspective, in the more distant future? Not likely. Consider the following:

According to United Nations data, the global population will grow by more than two billion people between 2018 and 2050, and almost all of this growth will be in Asia and Africa. Europe and North America, which had only 15% of the world's population in 2018, will see that share shrink to 11% by 2050.

A 2017 report by Price Waterhouse Cooper (PWC)[6] offered excellent analysis of the likely patterns of economic growth by region and country to 2050. Among other things, the report found that the world economy could more than double in size by 2050, far outstripping population growth, due to continued technology-driven productivity improvements. Further, emerging markets (E7) could grow around twice as fast as advanced economies on average. (The E7 countries are China, India, Brazil, Russia, Indonesia, Mexico and Turkey. The G7 countries are the United States, Germany, Japan, the United Kingdom, France, Italy and Canada.) As a result, six of the seven largest economies in the world are projected to be emerging economies in 2050 led by China, India and Indonesia. The United States could drop to third place in the GDP rankings, and the European Union share of world GDP could fall below 10% by 2050.

The United States Energy Information Administration, in its 2021 International Energy Outlook report, projected the trends in global energy supply, demand and emissions to 2050. Its economic projections broadly coincided with those of PWC. Overall, the 2021 EIA Outlook projected world energy consumption to rise about 50% between 2021 and 2050, due almost entirely to strong economic growth, increased access to marketed energy and rapid population growth in the non-OECD countries. World energy-related "CO_2 equivalent" (CO_2e) emissions (excludes emission changes from land use changes and forestry) are projected to grow in the OECD countries by about 5% and in the non-OECD countries by 35% between 2019 and 2050. In

[6] *The Long View: How will the global economic order change by 2050?* PWC, February, 2017

other words, the EIA projects global CO_2e emissions to grow from about 35 billion tonnes in 2022 to 43 billion tonnes in 2050.

This is a long way from the "net-zero emissions" targets that environmental groups promote and some western governments are imposing on their citizens. If such emissions reductions were feasible, and if all OECD countries attained them but emissions growth continued in the non-OECD as now projected, by 2050 global emissions would be about 29 billion tonnes per year, only 16% below the 34.2 billion tonnes of global emissions in 2019.

With its ever-declining shares of global population and income, "the west" will not be able to constrain the aspirations, the energy use or the emissions of the emerging economic and population giants. EnergyNow.ca reports:

> "As of January 2021 there were 201 coal plants under construction globally [70% of which are financed by China], including 92 in China, 30 in India and 24 in Indonesia, according to Global Energy Monitor. That's in addition to 345 coal-fired power plants in the pre-construction phase, including 135 in China."

Again, fossil fuels will continue to dominate and global emissions will continue to rise, no matter what the City of Ottawa does.

5.2 Climate Policy Myth #2: The City of Ottawa's actions will significantly affect global GHG emissions and so Earth's CO_2 levels and hence "global temperature."

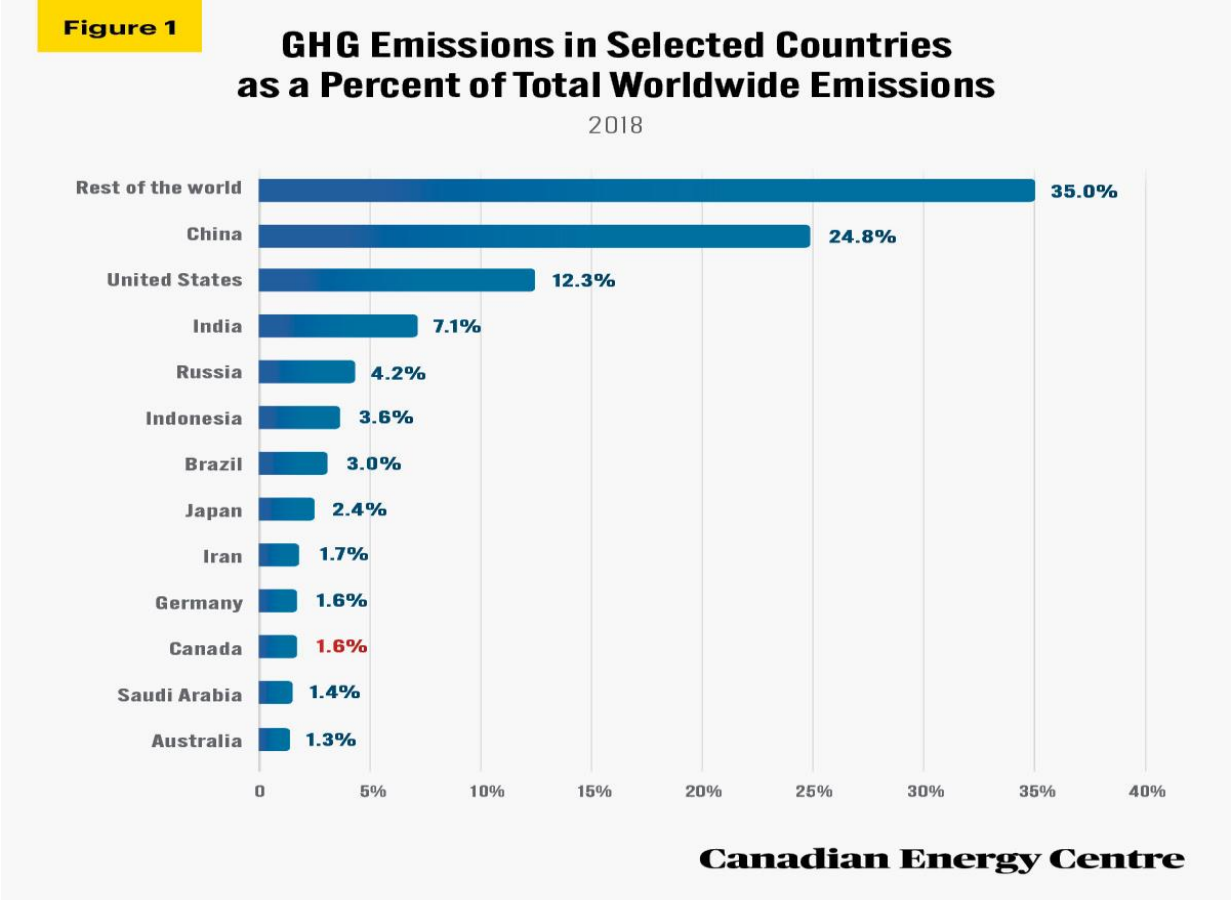
The facts: According to the November 2020 City of Ottawa report, "Results of the 2019 Community and Corporate Greenhouse Gas (GHG) Inventories":

- Ottawa's "community emissions" (emissions from buildings, transportation, waste and agriculture activities taking place within the geographic boundaries of the City) in 2019 was 6,140 kilotonnes (kt) of "carbon dioxide equivalent" (kt CO_2e).

- Corporate emissions (from activities under municipal operational control, namely facilities, fleet, solid waste and wastewater treatment) was 241.7 kt CO_2e.

So, the total emissions for the City of Ottawa in 2019 was 6,381.7 kt CO_2e or 6.381 million tonnes of CO_2e. This is 0.87% of Canada's total 2019 GHG emissions of 730 million tonnes which is 1.6% of world emissions. Thus, Ottawa's total emissions represent only about 0.014%, or *14-one-hundred-thousandths*, of world emissions, too small to even show up on the following graph (next page).

Figure 1



According to University of Guelph Professor Ross McKitrick (*A Practical Guide to the Economics of Carbon Pricing*, University of Calgary School of Public Policy, Volume 9, Issue 28, September 2016), completely stopping all of Canada's carbon dioxide emissions immediately would reduce the global concentration of CO_2 by about three parts per million (ppm) over the next 100 years. This means that immediately bringing Ottawa's CO_2 emissions to net-zero and extending it over the same time frame would reduce the global concentration of CO_2 by about 0.026 ppm, an amount too small to even measure. Ottawa's current net-zero by 2050 plan would actually result in an even smaller reduction in overall CO_2 concentration in the atmosphere since it is less severe than an immediate reduction to zero. This means that the real reduction that is forecast to result from the Ottawa plan *would be somewhat less than 0.026 ppm, a totally inconsequential quantity.*

In 2018 Dr. Patrick Michaels, past president of the American Association of State Climatologists and former Director of the Center for the Study of Science at The Cato Institute, explained that, using the model employed by the U.S. Environmental Protection Agency (EPA), a 90 million tonne per year GHG reduction (that envisioned to occur in 2022 as a result of Environment and Climate Change Canada's 2018 carbon pricing plan) will result in between 0.001 and 0.002 degrees Celsius less global warming by 2100 than would otherwise occur, depending on the assumed sensitivity of the atmosphere to changes in GHG. This means that the City of Ottawa's target of reducing emissions from its current level of 6.381 million tonnes of CO_2e GHG emissions per year to net-zero (the City's 2050 target) and keeping it there all the way to 2100

would result in between about *0.000057 – 0.00014 degrees Celsius less global warming by 2100 than would otherwise occur*.

> In other words, Ottawa's almost $60 billion climate plan, if it were extended a half century beyond its current target of 2050, would result in about ***one-ten-thousandths of a degree global temperature change***. This is smaller by at least two orders of magnitude that what can even be measured.

Clearly, even if you accept the UN's hypothesis that CO_2 emissions are damaging the climate and so should be curtailed, the direct impact on both atmospheric CO_2 levels and global temperature of Ottawa's plans are trivial.

But shouldn't we abide by our Paris Agreement targets anyway so as to set a positive example to encourage China and other large emitters to follow through on their commitments? This is the topic of Climate Policy Myth #3.

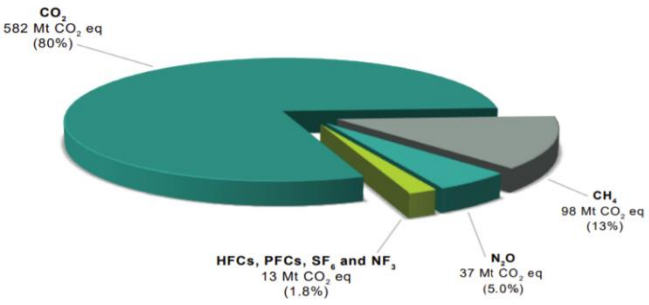
5.3 Climate Policy Myth #3: The Paris Agreement will compel countries around the world, including China, the world's largest emitter, and other developing countries to make meaningful reductions in GHG.

The facts: The plans submitted to the UN in fulfilment of countries' Paris Agreement commitments are entirely voluntary in nature. The Agreement contains no legal obligations to reduce emissions and no penalties for non-compliance. So, the Paris Agreement will not force any nations to make emissions reductions.

5.3.1 How likely is China, the world's largest emitter, to significantly reduce emissions?

The Paris Agreement gives significant advantages to China, still considered a developing country by the U.N., that do not apply to Canada, the U.S. and other developed nations. Compare the following nationally determined contributions (NDCs) that Canada, the U.S. and China have agreed to follow under the Paris Agreement (note: achievement of a country's NDC is not legally binding):

Figure ES–3 **Breakdown of Canada's Emissions by GHG (2019)**



The Government of Canada (GC) initially pledged to reduce GHG emissions (about 80% of which is CO_2 – see left) by approximately 30% below 2005 levels by 2030. In June 2021, Canada passed the *Canadian Net-Zero Emissions Accountability Act* which legislates a 2050 net-zero target. In July 2021, the GC updated the UNFCCC NDC that it intends to achieve: it is now **40 – 45% below 2005 levels by 2030**.

Under President Barack Obama, the U.S. initially agreed to reduce its GHG emissions (about 81% of which is CO_2) by between 26% and 28% below its 2005 levels by 2025. In line with President Joe Biden's unilateral decision to rejoin the Paris Agreement, on April 22, 2021, the U.S. submitted a revised NDC of reducing GHG emissions by **50% – 52% below 2005 levels by 2030**, including land-use, land-use change and forestry (LULUCF). In addition, in November 2021, the Biden administration officially committed the USA to net-zero emissions no later than 2050.

In its initial Paris Agreement NDC pledge (2016), China committed to stop *increasing* carbon dioxide (CO_2) emissions by "around 2030." In December 2020, Chinese President Xi Jinping announced a planned revision, namely that by 2030, "China will lower its carbon dioxide emissions per unit of GDP by over 65 percent from the 2005 level." Just before the UN Climate Change Conference (COP26) in Scotland last November, China officially submitted its new NDC pledge to "**peak carbon dioxide emissions before 2030** and achieve carbon neutrality (net-zero) before 2060" plus some renewable energy targets. Climate Action Tracker comments, "China's proposed NDC update is only a slight improvement from its first NDC."

It makes no sense for developed countries to agree that China, which emits double that of the U.S., is permitted to increase emissions to 2030 while immediately restricting Canada and the U.S. More industries will simply move to China and total global emissions will then likely rise even more quickly.

5.3.2 The Paris Agreement is actually far more asymmetric still

Under the Agreement, China and other developing nations need not *ever* cut back emissions. On page one of the Agreement, it states:

> "The Parties to this Agreement, Being Parties to the United Nations Framework Convention on Climate Change [i.e., the UNFCCC], hereinafter referred to as 'the Convention.' …In pursuit of the objective of the Convention, and being guided by its principles…"

The Convention is referenced no less than 51 times in the Paris Agreement. So, Paris is clearly based on the UNFCCC, and Article 4 in the Convention states:

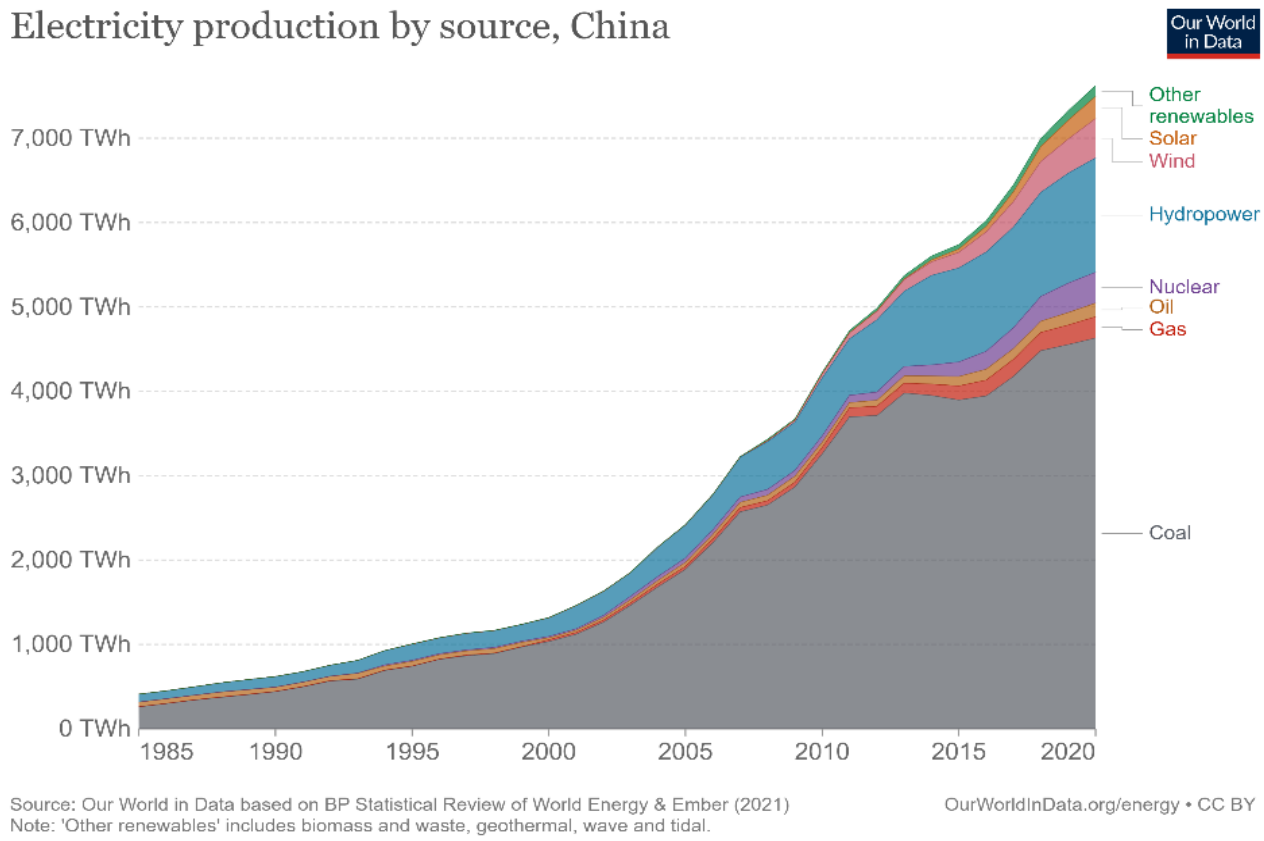
> "The extent to which developing country Parties will effectively implement their commitments under the Convention will depend on the effective implementation by developed country Parties of their commitments under the Convention related to financial resources and transfer of technology and will take fully into account that economic and social development and poverty eradication are the first and overriding priorities of the developing country Parties."

Expressed in plain English, under Paris and other treaties based on the UNFCCC, any emission reduction commitments made by developing nations are contingent on developed countries giving them enough technology and, more importantly, sufficient funds. Former EPA

Administrator Scott Pruitt illustrated the scale of this when he said in an October 17, 2017 Fox News interview that, “India conditioned all of the responsibilities on receiving $2.5 trillion of aid.”

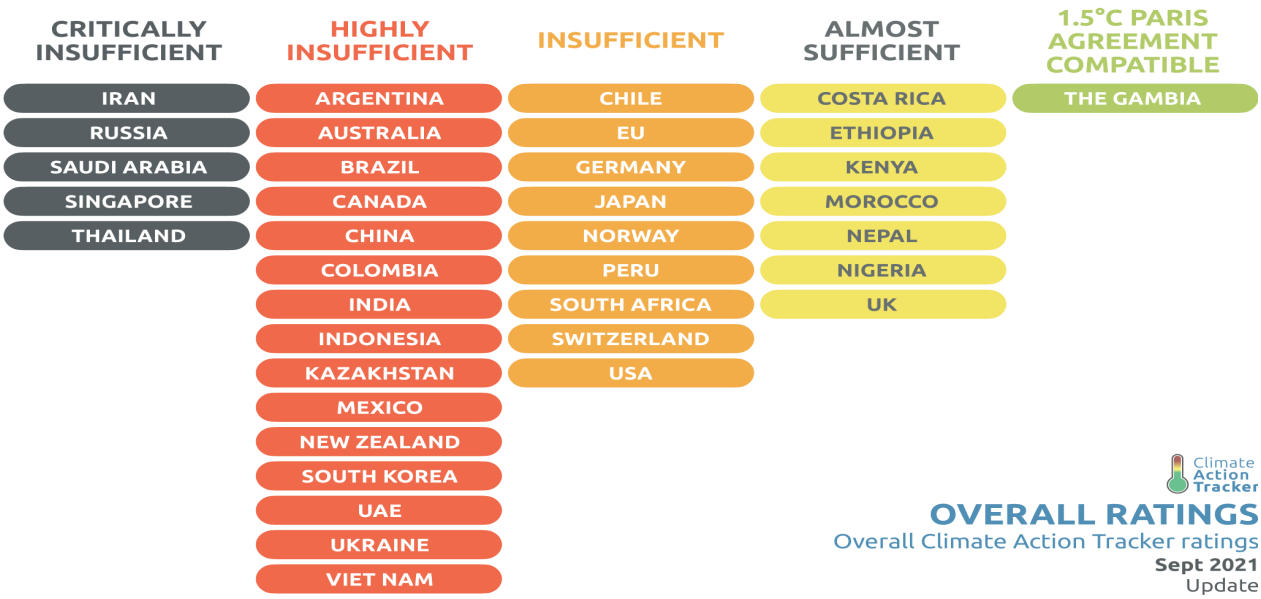
But even if developed countries give developing countries everything they have committed to, the UNFCCC indicates that developing countries may still ignore their emission reduction commitments if they interfere with their “first and overriding priorities” [of] “economic and social development and poverty eradication.” Developed nations are expected to keep their commitments no matter how it impacts their economies.

Restricting emissions of CO_2 in developing nations would very likely involve reducing their use of coal, the source of over half of China’s electricity, for example (see graph below). As coal is the least expensive power source across much of the world, restricting CO_2 emissions by limiting coal use would clearly interfere with development priorities. So, no matter what they promise, China and other developing countries are unlikely to abide by their commitments, presenting UNFCCC Article 4 as their justification.

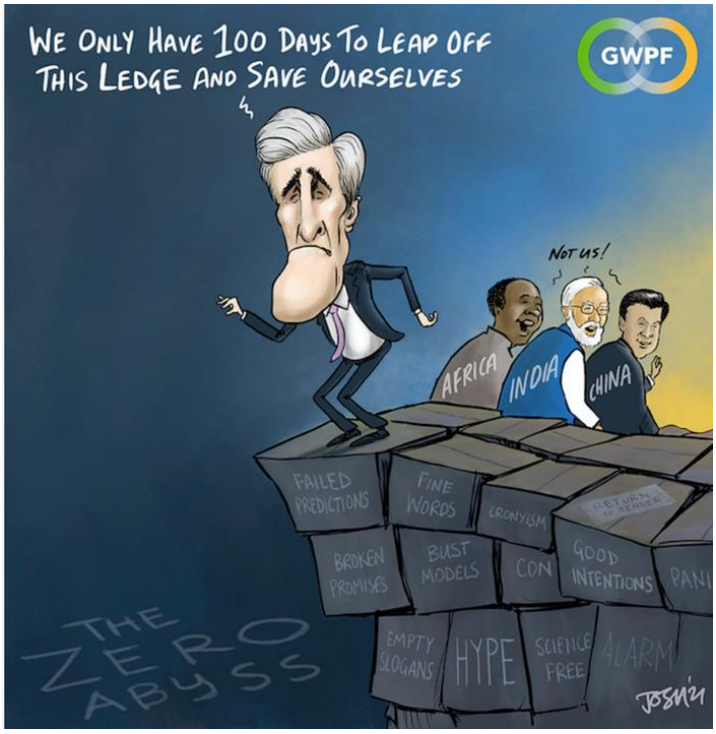


This is unlikely to change any time soon. Chinese negotiator Su Wei asserted at the UN’s Peru climate conference (2014) that the objective of the Paris Agreement is to “reinforce and enhance” the UNFCCC, not redraft it.

It is instructive to see how close countries' official plans come to those that would be required to meet the UN's 1.5°C target globally (counting their commitments to international climate finance). Climate Action Tracker provided the following figure just prior to COP26:



The only country in this chart that was on track to meet their 1.5°C target was The Gambia, the smallest country in Africa with a population less than Toronto, Canada. But The Gambia is anything but a positive role model for the world. The country is awash in widespread poverty, infectious disease and severe human rights abuses.



Writing for Regulation Economics (Australia), noted economist Dr. Alan Moran reported on October 1, 2021:

"China says that unless U.S. ceases its criticism, it will sabotage the Paris treaty – reportedly 'an oasis of cooperation' between the two countries. China told John Kerry that it won't follow U.S. self-harming energy policies and rejects measures said to be necessary to limit temperature increases to 1.5C.

"The UN reports, instead of the goal of net-zero greenhouse gas emissions, countries' Nationally Determined Contributions (NDCs) imply a 16 per cent increase to 2030 and, 'A sizeable

number of NDCs from developing countries contain conditional commitments to reduce emissions, which can only be implemented with access to enhanced financial resources and other support.'"

Scientific American explained on November 6, 2021 that, while India has yet to formally submit an updated NDC, Prime Minister Narendra Modi just announced that his country would reduce the carbon intensity of the nation's gross domestic product by 45 percent, compared with 2005 levels, by 2030, ultimately ***achieving net-zero emissions by 2070, a half century from now***.

At the UN's COP26 climate conference in Glasgow, developed countries wanted developing nations to agree to *phase out* "unabated" coal-fired power (coal power that does not use carbon dioxide capture and storage, which is exceptionally expensive). India, with approximately 300 million people in poverty and more than 600 million without access to uninterrupted electricity, backed by China and other coal-dependent developing nations, rejected this approach. The compromise finally agreed to was merely to ask countries to *phase down* their unabated coal use.

India's Minister for Environment and Climate Bhupender Yadav asked "How can anyone expect that developing countries can make promises about phasing out coal and fossil fuel subsidies when developing countries still have to deal with their development agendas and poverty eradication?" Chinese COP26 Delegate Li Zheng agreed, "To demonize fossil fuel will only hurt ourselves."

What this means, of course, is that the City of Ottawa, like any city in the developed world which was foolish enough to actually attempt to achieve net-zero GHG emissions any time in the near future, will find their sacrifices will be for absolutely nothing. The Global Warming Policy Foundation (GWPF) editorial cartoon above sums up the situation for all developed countries.

5.4 Climate Policy Myth #4: The sources of raw and processed materials and technology needed to carry out much of the City of Ottawa's climate change plans—wind and solar power and batteries—are secure and reliable

The facts: In contrast to fossil fuels, which are found throughout the world, especially in Canada, the raw materials, processing and manufacture of "green energy technologies" are largely concentrated in unstable and/or unfriendly countries.

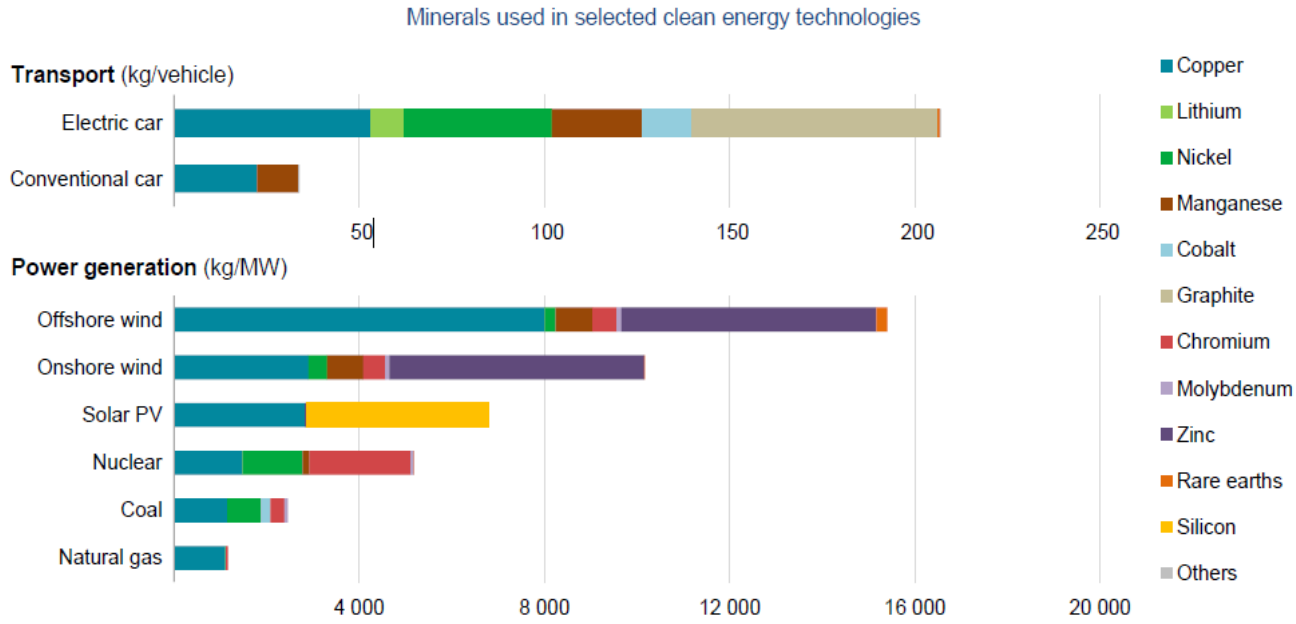
5.4.1 "Green" technologies require huge, and growing, quantities of rare or exotic minerals

While showing the bar chart below, the International Energy Agency (IEA), the world's pre-eminent source of energy information, explained ("*The Role of Critical Minerals in Clean Energy Transitions*," May 2021):

"Green-energy technologies" use far more critical minerals than conventional-energy technologies. A typical electric car requires six times the mineral inputs of a conventional car, and an onshore wind plant requires nine times more mineral resources than a gas-fired power plant. Since 2010, the average amount of minerals needed for a new unit of power generation capacity increased by 50 percent as the share of renewables has risen."

The Role of Critical Minerals in Clean Energy Transitions

The rapid deployment of these technologies as part of energy transitions implies a significant increase in demand for minerals



Notes: kg = kilogramme; MW = megawatt. The values for vehicles are for the entire vehicle including batteries, motors and glider. The intensities for an electric car are based on a 75 kWh NMC (nickel manganese cobalt) 622 cathode and graphite-based anode. The values for offshore wind and onshore wind are based on the direct-drive permanent magnet synchronous generator system (including array cables) and the doubly-fed induction generator system respectively. The values for coal and natural gas are based on ultra-supercritical plants and combined-cycle gas turbines. Actual consumption can vary by project depending on technology choice, project size and installation environment.

The most important components of electric vehicles, for example, are lithium-ion rechargeable batteries. The principal materials used in lithium-ion batteries are cobalt, lithium, manganese and graphite. Dr. Karine Samuel, Professor of Management, Grenoble University, France, explained in the documentary film, "The Dark Side of Green Energies":

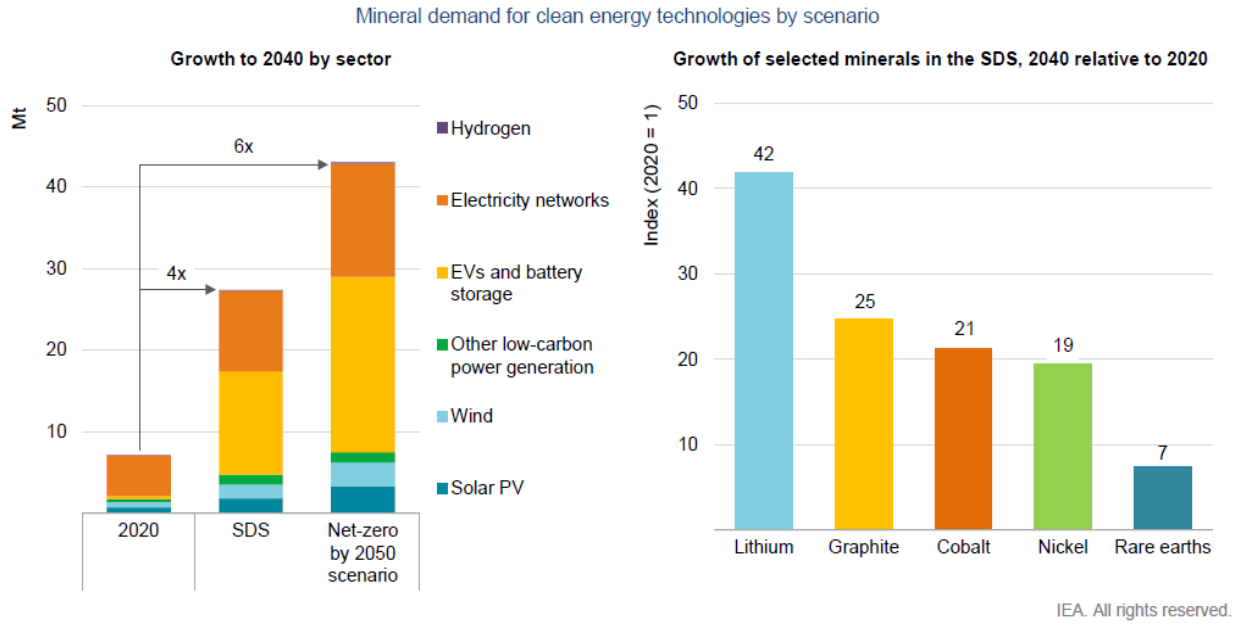
"Rare metals are not only in electric cars. We need magnets for wind turbine engines. Rare metals are also used to make cells for solar panels."

The IEA found that with an energy transition like the one envisioned by U.S. President Joe Biden, for example, demands for key minerals such as lithium, graphite, nickel and rare-earth metals would explode by 2040. The IEA reported, while showing the below bar chart:

> "Our bottom-up assessment suggests that a concerted effort to reach the goals of the Paris Agreement (climate stabilisation at 'well below 2°C global temperature rise,' as in the IEA Sustainable Development Scenario [SDS]) would mean a quadrupling of mineral requirements for clean energy technologies by 2040. An even faster transition, to hit net-zero *globally* by 2050, would require six times more mineral inputs in 2040 than today."

The Role of Critical Minerals in Clean Energy Transitions

Mineral demand for clean energy technologies would rise by at least four times by 2040 to meet climate goals, with particularly high growth for EV-related minerals



Notes: Mt = million tonnes. Includes all minerals in the scope of this report, but does not include steel and aluminium. See Annex for a full list of minerals.

Both the Biden and Trump administrations have expressed alarm concerning the supply problems of these essential resources.

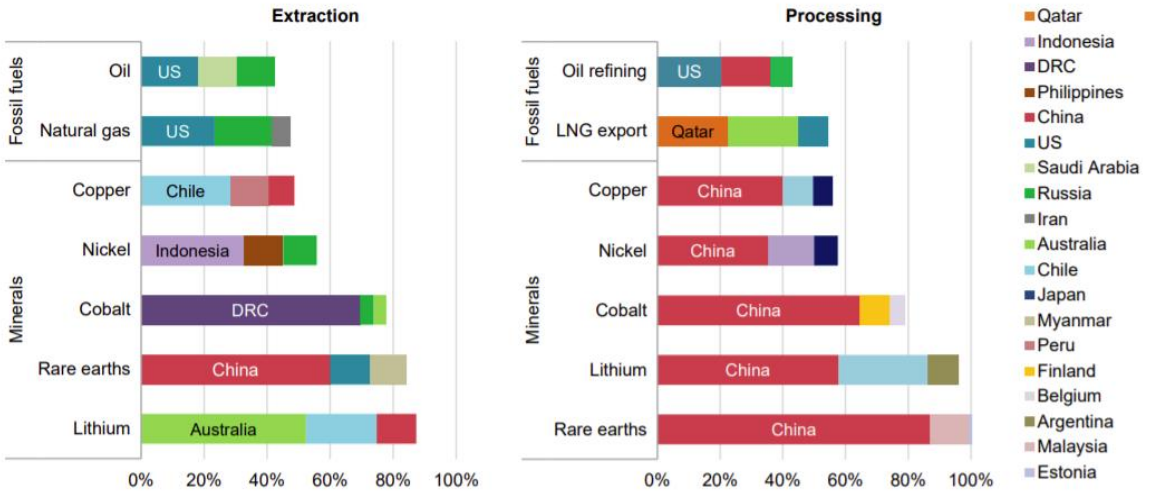
5.4.2 "Green" technologies largely rely on raw materials, processing and manufacturing in countries that are either unstable or unfriendly to Canada

The aforementioned IEA report shows clearly that, in contrast to fossil fuels, the vast majority of the minerals needed to achieve net-zero emissions come from, and are processed by, nations that are either unstable or unfriendly to Canada.

The Role of Critical Minerals in Clean Energy Transitions

Production of many energy transition minerals today is more geographically concentrated than that of oil or natural gas

Share of top three producing countries in production of selected minerals and fossil fuels, 2019



Notes: LNG = liquefied natural gas; US = United States. The values for copper processing are for refining operations.
Sources: IEA (2020a); USGS (2021), World Bureau of Metal Statistics (2020); Adamas Intelligence (2020).

The situation is only worsening. University of Houston Professor Larry Bell reports ("China Targets US Weakness for Afghan Rare Earths, Taiwan Chips," September 25):

> "China has amassed stunning control over 70% of the world's lithium supplies and 85% of rare earths supply chains to dominate global industries and jobs that depend on them."

Mineral resources lost to the west in Afghanistan are also problematic. Bell explains:

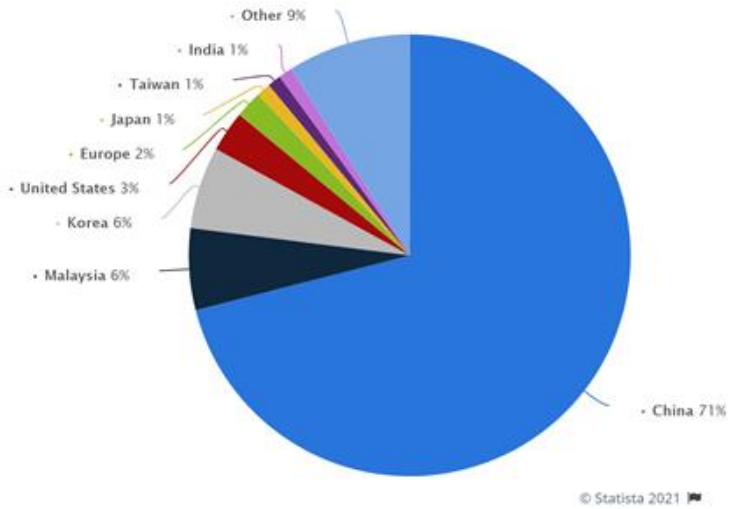
> "Among a long list of losses resulting from the Biden administration's unconditional surrender of Afghanistan to the Taliban and their Chinese partners are raw materials critical to the production of those so-called 'renewable' energy technologies, including more than $1 trillion in vast raw earth riches."

In a presentation he gave on September 29, 2021, James Taylor, President of the Heartland Institute, showed the following pie charts (reproduced on the next page with permission), clearly demonstrating that much of the wind turbines and solar panels to be invested in by the City of Ottawa will likely be controlled by, and therefore be money for, China as well. Bell continues:

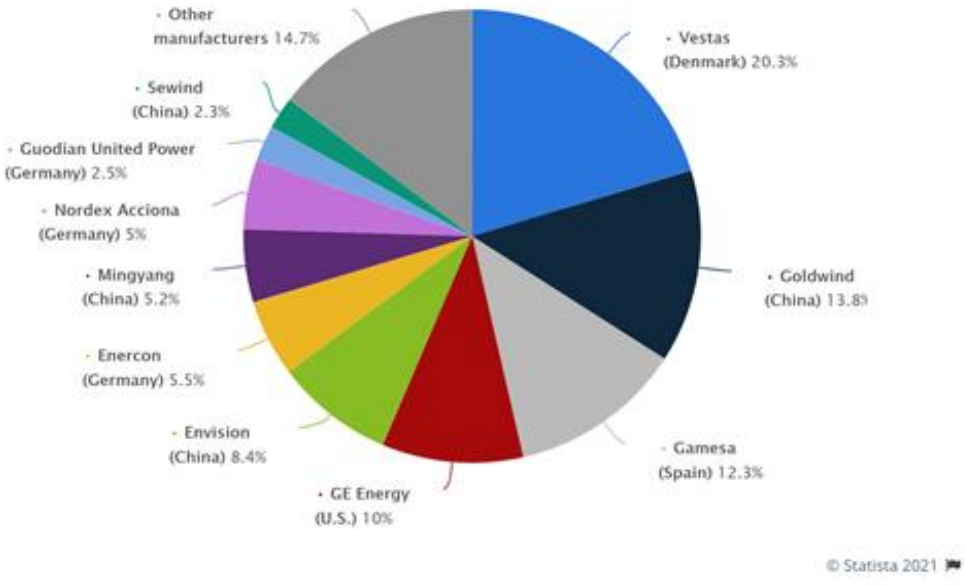
> "Applying forced labor and toxic environmental policies…[China] will soon be home to more than 100 lithium-ion battery mega factories, the technological heart of the EV revolution."

Energy & Environment › Energy

Distribution of solar photovoltaic module production worldwide in 2019, by country



Global market share of the world's leading wind turbine manufacturers in 2018, based on sales



6.0 Conclusion

The City of Ottawa's climate and energy plans are a cautionary tale for leaders in other jurisdictions who may also be considering complying with the demands of aggressive, uninformed activists. Fully enabled, the City's plans would endanger all Ottawans with regular blackouts and brownouts and vastly increase the cost of living for residents. Yet, contrary to the assertions of climate campaigners, the plans would cause significant environmental harms while contributing to human rights abuses around the world. Further, the impact on climate of Ottawa's ~$60 billion plan would be too small to even measure, let alone feel.

Some may think the sort of "virtue signaling" the City of Ottawa has engaged in with its climate mitigation plans are laudable. This could perhaps be a rational point of view, *if*

- there was any chance that we could prevent dangerous climate change without causing far greater harms to people and the environment, and
- other jurisdictions that emit far more than does Ottawa would follow and make emissions reductions comparable to those made by Ottawa.

But neither of these conditions are satisfied. Even *attempting* to carry out the plans put forward by the City would cause far more harm to Ottawans and their local environment than any foreseeable climate change. And China and other developing nations, by now the major GHG emitters, have made it abundantly clear that they have no intention of handicapping their economies by implementing significant emission reductions. Ottawa's climate mitigation plans therefore are "all pain and no gain."

Consequently, the only sensible actions for the City of Ottawa, and indeed, cities and other jurisdictions around the world, is to:

- prepare for future climate change with sensible, risk-weighted and cost-effective adaptation strategies. For a high latitude city like Ottawa, the major focus should be on preparing for possible cooling impacts as this would be by far our greatest threat. Societies that did not adequately prepare for climate change are no longer with us;
- promote economic prosperity so as to provide the wealth we need to ensure resiliency;
- ensure a reliable, affordable energy supply to safeguard our citizens and maintain our standard of living, without which we will not be able to afford effective environmental programs.

In Annex A to this report, we lay out a full description of what sensible adaptation programs look like and why, along with ensuring Ottawa's resilience and dependable power supply, they are the best way forward. All climate change mitigation plans should be cancelled.

It is important for City of Ottawa leaders to recognize that environmental activists will never be satisfied and simply move the goalposts when politicians comply with their demands. The

Mayor and Ottawa Counsellors will eventually have to stand up to climate campaigners or be voted out of office for destroying our way of life. Most Ottawans are not yet aware of the disaster that awaits if the City actually enables even a fraction of its most recent climate and energy plans. But, when they do, no politician who supported these destructive and costly policies will be safe.

There is still time for the City of Ottawa to step back from taking these enormously expensive and dangerous measures and do what's right for the City in the long run, not merely politically convenient in the short term. ICSC-Canada representatives stand willing and able to assist in any way we can to help make this a reality.

Annex A – The Benefits of an Adaptation-Focused Plan for the City of Ottawa

A.1 Key Take-away Message

Adaptation and building economic reliance in changing times are more prudent than attempting to mitigate uncertain future climate change, especially for jurisdictions that produce relatively negligible GHG gas emissions.

A.2 Background

Humans have been adapting to changes in climate for as long as we have existed. This adaptation has taken many forms, including:

- migrating from one area to another;
- changing habitation, clothing and eating habits;
- building structures that reduce the adverse effects of actual climate changes;
- building dikes, storm shelters and burying electrical and communications cables underground, where practical.

Our ability to adapt to climate change and extreme weather has improved as new technologies have developed and income levels have increased. Richer societies can adapt better and faster than poorer ones. They have more resources with which to adapt.

Adaptation to future climate changes, whether or not caused by human activities, will occur if and when the people affected determine that there is a need to change. This is what natural adaptation means.

In climate policy, however, adaptation relates to the actions that governments will take and/or require people to take soon in order to anticipate changes in the climate that have not yet occurred but are projected on the basis of mathematical models that have yet to make reliable forecasts. In other words, climate policy is largely concerned with adaptation to events based on high levels of uncertainty. Dr. Judith Curry, former Professor and Chair of the School of Earth and Atmospheric Sciences at the Georgia Institute of Technology, explained:

> "Outcomes of future climate change are associated with deep uncertainty, and plausible outcomes (especially on the high end) are weakly constrained. Experts inevitably disagree on what constitutes a plausible worst-case scenario when the knowledge base is uncertain."

Indeed, apart from uncertainties in emissions scenarios, there are substantial uncertainties in climate sensitivity to many factors, some of which include:

- increasing carbon dioxide concentration levels;
- future volcanic eruptions;
- solar variability;
- multi-decadal ocean oscillations;
- possible instabilities in ice sheets.

Over the period of 2011 to 2018, actions taken by governments around the world to respond to climate change cost almost U.S. $3.7 trillion. Of that total, only about U.S. $190 billion, or approximately 5%, was spent on adaptation. Almost all the rest was spent on mitigation. There are no publicly-available data concerning the total expenditures of federal and provincial governments in Canada on climate-related policies and measures, so there is no way to compare the share of expenditures in Canada on mitigation and adaptation to those on a global level.

The Global Commission on Adaptation, in its September 2019 report, portrayed accelerating climate adaptation as "a human, environmental and economic imperative." The Commission views adaptation as more economically justified than measures to mitigate potential climate changes through reducing GHG emissions. *Its report stated that one dollar invested in adaptation yields about four dollars in benefits. Danish economist Bjorn Lomborg, another advocate of adaptation, estimates that one dollar going to mitigation yields only 11 cents in benefits.*

A.3 Today's Situation

The Climate Intelligence Foundation (CLINTEL), a group of several hundred scientists largely based in Europe, examined the potential benefits of climate adaptation at a summit held in the Netherlands in January 2021. The scientists present concluded:

> "Adaptation has already amply proven its value, while mitigation turns out to be inefficient and expensive."

CLINTEL views adaptation options as being treated by governments as though they were a "last resort" to be deployed only if the Paris Agreement objectives of restraining the increase in global temperatures to no more than two degrees Celsius cannot be met. We did, however, see significant progress at COP26 with regards to adaptation. In "Cop26: EU helps deliver outcome to keep Paris Agreement targets alive," the European Union reported on November 13:

> "On climate finance, the agreed text commits developed countries to double the collective share of adaptation finance within the $100 billion annual target for 2021 - 2025."

At the November 9 high-level plenary session at COP26, EU Executive-Vice-President Frans Timmermans said:

> "The Adaptation Fund can play a key role and that is why I am pleased to announce for the first time that the European Commission is committing €100 million to the Fund, to support developing countries."

Yet others see adaptation as just as pointless as mitigation, given that they regard the causes of climate change as primarily natural and, they believe, unlikely to impose significant adverse effects on humans. They acknowledge, however, that, given the uncertainty that still clouds much of climate science, adaptation measures may have merit as an "insurance policy."

The San Francisco-based Climate Policy Initiative tracks "climate finance" across the world and reports it as being dedicated to either mitigation (efforts to slow climate change), adaptation or a combination of the two. Of the over $1 billion USD per day being spent on climate finance globally, only about 5% of it is being dedicated solely on adaptation. Most of the rest is spent directly on mitigation actions.

In Canada the situation is only slightly better: 13% of federal climate finance has been spent on adaptation. This is contrary to the recommendation of the United Nations that the mitigation/adaptation split be 50/50. A major reason for this imbalance is that, unlike most adaptation projects, mitigation actions—in particular, renewable energy projects—make large profits for multinational corporations and give governments greater control of their nations' energy infrastructures.

In "The Real Climate Crisis," our March 24th *Climate Change Minute*, ICSC-Canada researcher Mary-Jean Harris explained the ethical problem with dedicating so much more funding to mitigation than to adaptation (see here):

> "This is immoral, effectively valuing the lives of people suffering today due to natural climate change less than the lives of people yet to be born.
>
> "International Climate Science Coalition – Canada is focused on encouraging governments to concentrate on real problems in today's world instead of merely trying to appease activists."

ICSC has written about this issue often, an example being "Reconsidering climate change," published in the leading magazine World Commerce Review out of the UK (see here).

In its November 2, 2021 news release, the Government of Canada showed that they are starting to take adaptation more seriously (at least with regards to helping developing countries). It was announced that Canada will deliver up to $57.5 million "to building resilience in developing countries' communities that need it most."

A.4 Benefits to Ottawa and our political leaders of a climate policy focused on adaptation

A dollar invested in helping Ottawa adapt to climate changes here is more likely to have genuine benefits than a dollar spent on mitigating global climate changes over which Ottawa, with its insignificant share of emissions, cannot possibly hope to influence, let alone control. While adaptation is part of the City of Ottawa's current policy, it remains, for all intents and purposes, a fresh approach to climate change in the eyes of most of the public and the media. Policy pragmatists, aware of the enormous influence of the environmental lobby in Canada, view adaptation as a policy "half-way house" that is less expensive and intrusive than mitigation measures and may be useful to endorse if only to evade the condemnation of being called a "climate denier."

> When the ICSC-Canada consultant Ditchley Public Affairs conducted focus group testing of various possible government responses to climate change, they found that, when the topic of adaptation to climate change was introduced, it was well received by participants across the political spectrum.

Presented skillfully, adaptation as the primary response of any particular city to climate change is tough to argue against. While there will certainly be those who will be opposed to taking effective adaptive measures in response to climate change, that is a difficult position to defend, especially in the face of a *perceived* increase in the frequency and intensity of extreme weather events.

A.5 Cautionaries about an adaptation-focused climate policy

Adaptation policy faces the same challenge as mitigation policy—uncertainty about what the future holds, about when to act and how much to spend. Climate alarmists focus on the substantial challenges associated with long-lived decisions with high stakes and high sunk costs. These include major infrastructure, building developments and land use planning. Thus, some have proposed banning all development in certain areas and fundamentally altering building codes at great cost to future residential, commercial and industrial building owners.

Depending on how extreme these measures are, they might come to rival the immense costs of mitigation measures now planned by the City of Ottawa. The more intrusive adaptation measures are often premised on the assumption of the efficacy of government planning of the economy, based on probabilistic modeling of the future costs and benefits of different options.

A.6 A better way to engage in adaptation policy

An alternative is called "*Dynamic Adaptive Policy Pathways*" (DAPP). Flexibility and iterative planning are core elements of this approach. Its objective is to "develop an iterative, learning decision process that cost-effectively reduces risk today while avoiding foreclosing future options." Considering the full range of plausible scenarios, the DAPP approach provides clear information on the effectiveness and timing of options, enabling analysts to assess under which conditions and on which timescale a plan could fail.

DAPP incorporates flexibility into adaptation plans that can be changed over time as more is learned and conditions change. In other words, flexibility and iterative planning are core elements of the approach.

Thus, there is room for anticipatory adaptation, so long as it is flexible and dynamic.

A.7 Resilience

Another valuable approach involves borrowing a page from economics—the concept of resilience. Resilience is the ability of an economy to "bounce back" in the face of unexpected events and shocks to the system. The study of economic resilience is still in its infancy, but some aspects of it have been known and practiced for centuries and can help guide the City of Ottawa in preparing for future climate change.

Germany after the Second World War offers an example. A completely devastated country, Germany recovered its prosperity within a generation due to the dynamism of free markets and a cultural tradition that emphasized hard work, efficiency and pride in a job well done, valuing education, stable family relationships and respect for the rule of law. Equally important, the economic culture valued enterprise, risk taking and individual responsibility, as well as broadly cordial relationships between capital and labour groups and support for the modern welfare state. It was not accomplished by central planning, in which governments, in their often-clumsy ways, seek to decide who the winners and losers will be and what will be the pace of change. The same principles of resilience are applicable to dealing with any climate changes that may occur in future.

While it has the connotation of returning to the original state as soon as possible, because of changed circumstances it more often means "bouncing forward" to a new equilibrium in which the economic structures, practices and even the infrastructure are modified to cope better with future volatility.

A.8 Conclusion

Whether justified or not, politicians in the City of Ottawa and other municipalities across the western world, along with the media and a substantial share of the public, support a large climate policy response. *In these circumstances, adaptation measures cost far less and offer far*

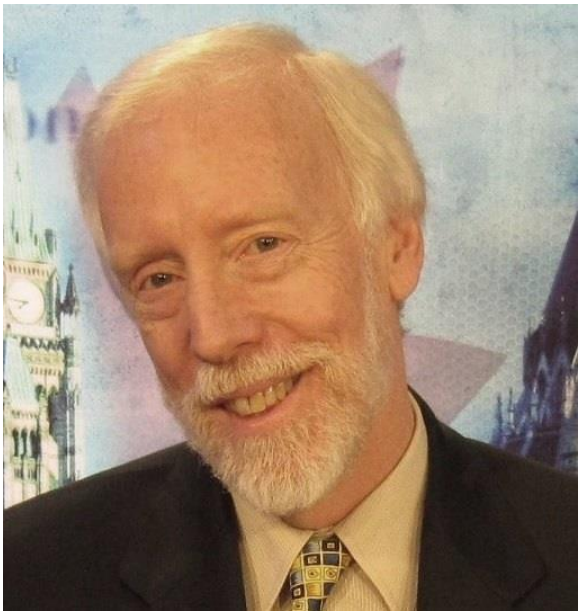
more certain municipal benefits than mitigation measures. It is also important that we promote a permanent form of economic resilience rather than an increased dependence on central planning.

Like mitigation, adaptation to natural or possible anthropogenic climate change can involve intrusive government planning and regulation of the economy, and it can be extremely expensive. Therefore, it is important that the approach to adaptation instead be based on flexible and iterative planning, with a shift away from probabilistic modelling.

If and when there is a clear expectation of specific and localized adverse climate effects, it may be possible to take effective land use planning approaches and other measures that are well targeted, moderate in cost and timely in effect. They involve a range of adaptation measures, depending on the local vulnerabilities, land use and nature of the assets at risk, a far superior strategy than attempts to mitigate climate change.

ANNEX B – ABOUT THE AUTHORS

B.1 ICSC-Canada Executive Director: Tom Harris, Ottawa, Ontario



Tom has Bachelor and Masters Degrees in Mechanical Engineering (thermo-fluids and energy focus). He has 43 years' experience working as a mechanical engineer and project manager, science and technology communications professional and media and S&T advisor to a former Opposition Senior Environment Critic in Canada's federal Parliament.

For the past 22 years Tom has been working with a team of scientists and engineers to promote a sensible approach to range of energy and environmental topics, climate change in particular. His main focus has been the controversial science underlying the dangerous human-caused climate change hypothesis and the problems with attempting to replace conventional power sources with unreliable and expensive alternative energy. Tom's December 2019 presentation in Madrid, Spain about the latter topic may be seen here. A TV interview he took part in in Madrid may be seen here.

Between 2006 and 2008, Tom was Executive Director of the Natural Resources Stewardship Project. Since 2008, he has been Executive Director of the International Climate Science Coalition (ICSC). Until 2011, he taught a total of 1,500 students at Carleton University in the second year Earth Sciences course, "Climate Change: an Earth Sciences Perspective." Tom describes his approach to the course here. An excerpt from a lecture may be viewed here.

Tom is regularly published in newspapers in Canada and the U.S. and occasionally in Australia, New Zealand, the U.K. and other countries. He is often interviewed on radio and occasionally television and hosts the podcast *Exploratory Journeys* and co-hosts the radio program *The Other Side of the Story* (with Dr. Jay Lehr) on the America Out Loud network.

Contact Mr. Harris by e-mail by clicking here or by calling 613-728-9200.

B.2 ICSC-Canada Economics/Policy Advisor and Director: Robert Lyman, Ottawa, Ontario

Robert Lyman has an Honours degree in International Relations (Economics, Political Science and History). He is a retired economist and public servant who spent over forty years analyzing and advising on energy, environment and transportation policy issues.

Robert spent the first ten years of his career as a foreign service officer with postings to Canadian embassies in Caracas, Venezuela and Washington, D.C. He then spent 37 years working in different federal government departments, almost always as an analyst, advisor and manager dealing with energy and environmental policy issues. Here are highlights:

- He worked as an economist in the Energy Policy Branch of Energy, Mines and Resources during negotiations over oil and gas policy before and after the National Energy Program.
- In the late 1980s, he was the Senior Director of Energy Policy when climate change issues first arose; Robert was heavily engaged in the implementation of Offshore Accords with Newfoundland and Nova Scotia and with the negotiation of the resource aspects of aboriginal land claims.
- He was first federal co-chair of the Federal-Provincial Committee on Climate Change.
- Robert was the Senior Director of Oil Policy from 1995 to 2002 when the fiscal regime governing oil sands development was being expanded. At that time, he led the first federal work assessing the public policy that should govern CO_2 capture and storage.
- Robert managed the group providing advice on the potential for emissions reduction in the oil industry during the Climate Change Table Process prior to the Kyoto Protocol.
- He retired in 2006 as Director General, Environmental Affairs at Transport Canada, where he managed a directorate responsible for providing policy advice and delivering programs that would reduce the environmental effects of the transportation industry.

After retiring from the public service, Robert spent ten years as a consultant performing policy-related studies for the federal and provincial governments. His recent writings have been published by the U.K. Global Warming Policy Forum and by Friends of Science. He is an occasional contributor to the Comment page of the Financial Post. Robert recently appeared as an expert witness before the House of Commons Committee on Industry, Science and Technology to discuss the role that “green energy” should play in Canada’s economic recovery.