



# Underneath It All

Ensuring Canada's electricity grid can power our net-zero and economic ambitions is no small undertaking—and a big opportunity.



# Contents

- 1 A generational undertaking
- 3 The four reasons to go big on clean electricity
- 12 Powering a net-zero economy
- 20 A clean electricity action plan
- 22 Endnotes

## Underneath It All

December 2021 | © 2021 Clean Energy Canada

ISBN: 978-1-989692-05-9

All rights reserved. Permission is granted to reproduce all or part of this publication for non-commercial purposes, as long as the source is cited as “Clean Energy Canada.” Clean Energy Canada is a program at the Morris J. Wosk Centre for Dialogue at Simon Fraser University.



MORRIS J. WOSK  
CENTRE FOR DIALOGUE

# A generational undertaking



Canada is an electricity heavyweight. In addition to being the world's sixth-largest electricity producer and third-largest electricity exporter, **Canada can boast an electricity grid that is now 83% emission-free**, not to mention residential electricity rates that are the cheapest in the G7.<sup>1-3</sup>

On the face of it, our electricity system appears poised for success. **With an abundance of sunshine and blustery plains, Alberta and Saskatchewan have wind and solar power potential that rivals the best on the continent.**<sup>4</sup> Meanwhile, British Columbia, Manitoba, Quebec, and Newfoundland and Labrador have long excelled at generating low-cost hydro power. It's only natural to assume that Canada, with a solid head start and generous geography, is already positioned to provide enough abundant, affordable clean electricity to power our net-zero and economic ambitions.

But the reality is that Canada, like most nations, is not yet prepared for a world increasingly committed to carbon neutrality.

The federal government's forthcoming Clean Electricity Standard, a policy promised by the governing Liberals last election, would require all electricity in the country to be net zero by 2035. While an encouraging start, it's by no means the end. **Electrification—that is, hooking up our vehicles, heating systems, and industry to a clean electricity grid—will require Canada to produce roughly twice as much non-emitting electricity as it does today in just under three decades.**<sup>5-7</sup>

That is no small undertaking.

**This massive ramp up in clean electricity will require significant investment from governments and utilities, along with their cooperation** on measures and projects such as interprovincial power lines. It will require energy storage solutions, smart grids to balance supply and demand, and energy efficient buildings and appliances to cut energy waste.

While Canada has mostly relied on large hydro and nuclear power in the past, newer sources of electricity such as solar, wind, geothermal, and biomass with carbon capture and storage will in many cases be the superior option going forward—thanks to rapidly falling technology costs and shorter construction times. And yet **Canada added less solar and wind generation in the last five years than almost any other G20 country** (save for Indonesia, Russia, and Saudi Arabia).<sup>8</sup> That will need to change, quickly.

In addition, Canada's Constitution places electricity policy under provincial jurisdiction, meaning electricity systems across Canada have independently evolved to use different energy sources, regulatory models, and approaches to trade and collaboration. While this model has worked to date given our low consumer rates and high power reliability, collaborative action and a cohesive vision will necessarily underpin not just a 100% clean grid by 2035—but a net-zero-enabling one by 2050.

## WHAT NEEDS TO HAPPEN?

Detailed recommendations can be found at the end of this report but are summarized as follows:

- ✓ The federal government must use its governing power to put Canada on track to 100% clean electricity by 2035 by both **limiting the use of fossil fuels to produce electricity and increasing the uptake of clean electricity sources.**
- ✓ Federal and provincial governments must **support the development, scale-up, and installation of new generation, storage, transmission, and efficiency technologies** to meet the requirements in the forthcoming Canadian Electricity Standard and of a net-zero 2050.
- ✓ Getting to a clean grid by 2035 and net zero by 2050 cannot be accomplished in isolation. **Governments, utilities, industries, clean energy companies, and Indigenous nations will need to collaborate, innovate, and invest together.**

---

Canada needs bold measures that show the world our country is ready for the net-zero economy.

Lastly, the time it currently takes to move a clean power project from proposal to operation is far too long if Canada is to attain a clean grid by 2035 and a net-zero-enabling one by 2050. This means that federal, provincial, territorial, and Indigenous governments must work with rural communities and industry stakeholders to accelerate the approvals, financing, and construction of clean energy projects and provide investor certainty.<sup>8,9</sup>

In doing so, **Canada can set a course to carbon neutrality while driving job creation and economic competitiveness.** Our closest trading partners and many of the world's largest companies and investors are demanding cleaner goods. A clean grid underpins clean production, just as it underpins our climate goals.

The International Energy Agency estimates that for the world to reach net zero by 2050, electricity generation worldwide must increase by over 2.5 times between today and 2050.<sup>10</sup> Countries are already plotting their energy pathways, and there is much to learn from each other.

**Consider South Australia. The state currently gets 62% of its electricity from wind and solar and, combined with grid-scale battery storage, has not lost a single hour of electricity in the past five years.**<sup>11</sup> South Australia expects 100% of its electricity to come from renewable sources before 2030. An added bonus given today's high energy prices: annual household electricity costs have declined A\$303 since 2018.<sup>12</sup>

The transition to clean energy is not about sacrificing our way of life—it's about improving it. But we'll need the power to make it happen.



**Merran Smith**, Executive Director

# The **FOUR REASONS** to go big on clean electricity

**1**

To ensure Canada can effectively combat climate change

PAGE  
**4**

**2**

To diversify and strengthen Canada's economy

PAGE  
**8**

**3**

To further expand Indigenous clean energy ownership

PAGE  
**14**

**4**

To improve energy security and affordability

PAGE  
**16**



**1**

To ensure Canada can effectively combat climate change



Despite having a strong and credible federal climate plan, **Canada also has a lot of work to do. Canadians rank seventh globally in CO<sub>2</sub> emissions per capita, higher than Saudi Arabia and the U.S.**<sup>18</sup>

In fact, among G7 nations, only Canadian and U.S. emissions have risen since the Paris climate agreement was signed in 2015.<sup>19</sup> Since this report is about electricity, it should be pointed out that Canada remains the country with the highest electricity demand per capita among the G20, highlighting the importance of decarbonizing this sector.<sup>8</sup> So while Canada's electricity grid is relatively clean, it still accounts for 8.4% of national emissions, or about the same as B.C.'s total emissions.<sup>3</sup>

What's more, a growing clean grid is essential for electrifying and decarbonizing Canada's transportation sector (responsible for 25% of national emissions), some heavy industry (11%), and buildings (12%), which often rely on natural gas heating.<sup>3</sup> For example, 79% of households in Alberta use natural gas for heating, as do 72% in Saskatchewan, 67% in Ontario, 58% in British Columbia, and 51% in Manitoba.<sup>20</sup>

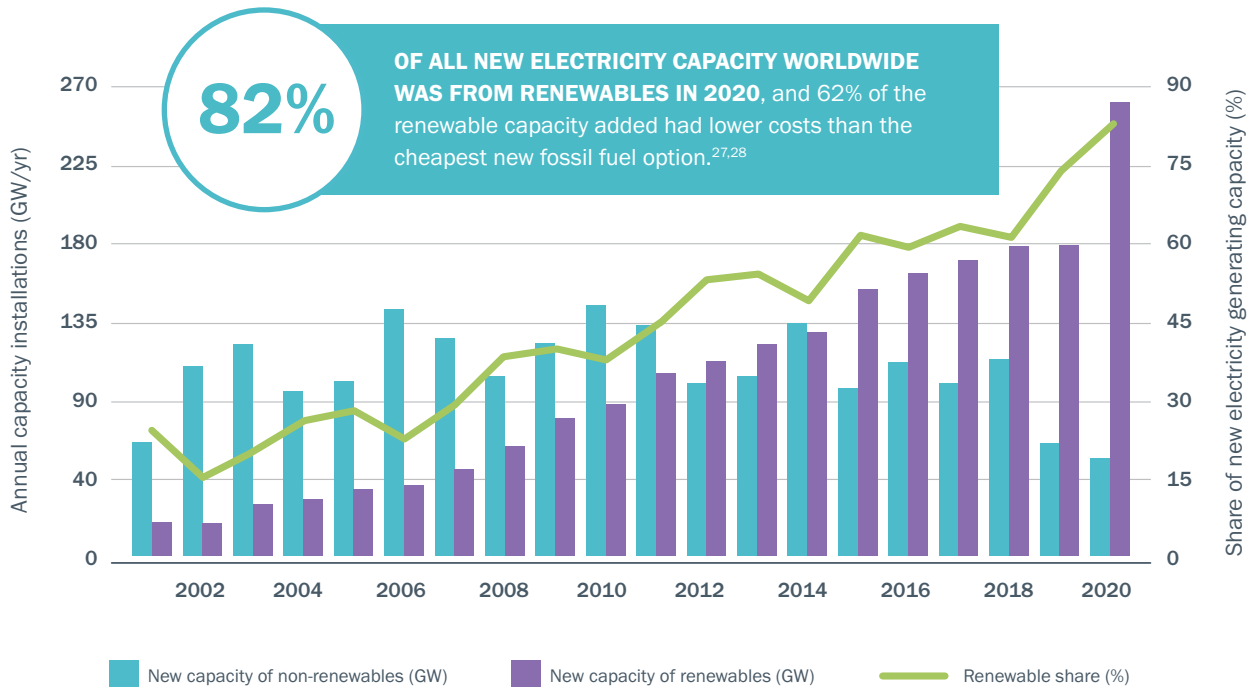
Accordingly, **the International Energy Agency says that moving to a 100% clean electricity grid is the single most important climate action that countries can take.**<sup>21</sup> Many nations have significantly cleaned up their electricity grids, switching from fossil fuel sources like coal to clean energy options like wind and solar. In each year since 2015, more renewable power was added to grids around the world than fossil fuels and nuclear combined.<sup>22</sup>



## WHAT IS A CLEAN ELECTRICITY STANDARD?

While electricity generation is a provincial responsibility, the federal government (under the *Canadian Environmental Protection Act*) has the authority to set emission performance standards, which it has already used to force the closure of coal-fired power plants without carbon capture and storage technology by 2030. **Under a Clean Electricity Standard, the carbon intensity threshold for electricity production would fall to zero CO<sub>2</sub>/kWh by 2035**, or perhaps earlier for those provinces whose grids are already dominated by hydro, nuclear, and wind power.<sup>17</sup>

## GLOBAL GROWTH IN RENEWABLE ELECTRICITY CAPACITY



Source: International Renewable Energy Agency (2021).<sup>22</sup>

In fact, the World Economic Forum concludes that replacing fossil fuels with mainly wind and solar power is entirely possible worldwide by 2030.<sup>23</sup> **Currently, 10 nations have emission-free electricity grids, with another eight countries having grids that are nearly so.**<sup>24</sup> Other nations, such as Denmark, have made great strides to move away from coal power. The country's emissions from electricity production are 85% lower than they were in 1990, and Denmark expects to produce 100% renewable power by 2027.<sup>25,26</sup>

With a strong starting position and many inherent advantages, Canada can follow a similar path. The federal government realizes this, and its commitment to a Clean Electricity Standard, requiring a 100% clean electricity grid by 2035, is a promising start. The new federal standard must be enacted quickly, however. If Canada is to close the gaps to 2035 and 2050, it must address the fact that certainty for investors is one of the biggest barriers to success.<sup>9</sup>

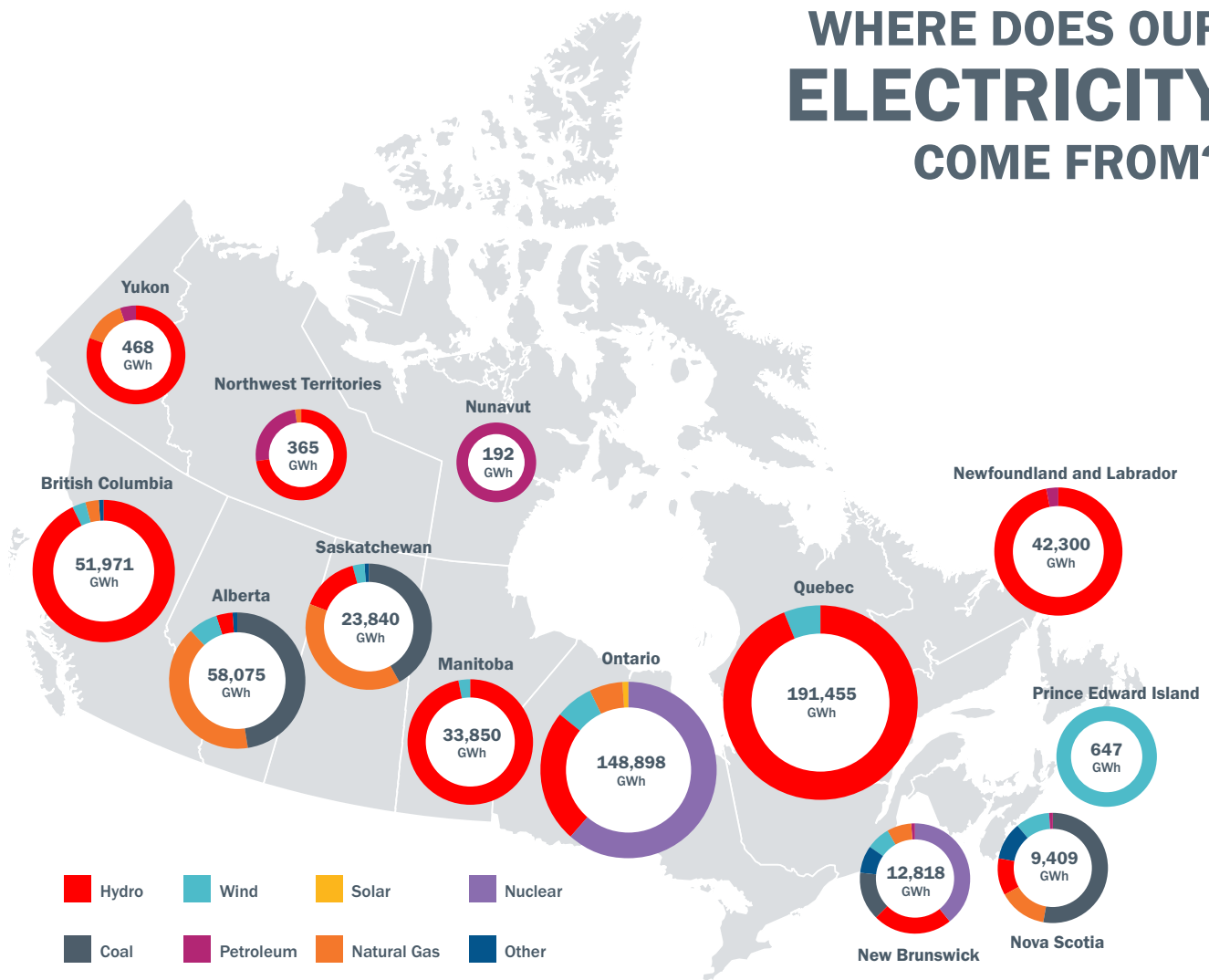


### CANADA RANKED SECOND

out of 42 countries assessed for their ability to meet electricity needs from renewable solar and wind sources.<sup>29</sup>



# WHERE DOES OUR ELECTRICITY COME FROM?



Notes: Data relates to 2019. "Other" includes refined petroleum products, biomass, solar, and tidal. Data source: Statistics Canada (2020).<sup>14,15</sup>

## NUCLEAR TO THE RESCUE?

**Nuclear energy generated in Ontario and New Brunswick currently supplies 17% of Canada's electricity.** Whether Canada must scale up nuclear generation to meet net-zero demand is still unclear. Canada's next generation of small modular reactors are not expected to be operational until close to 2030. The eventual costs, safety, and public acceptance of small modular reactor technology also remain unknown. While nuclear has the benefit of being a constant source of power (as opposed to variable sources like wind and solar), it faces stiff cost competition from grid-scale renewable electricity storage (which stores wind and solar power for later use), clean hydrogen (an energy carrier), and other storage technologies.





**2**

To diversify and strengthen  
Canada's economy

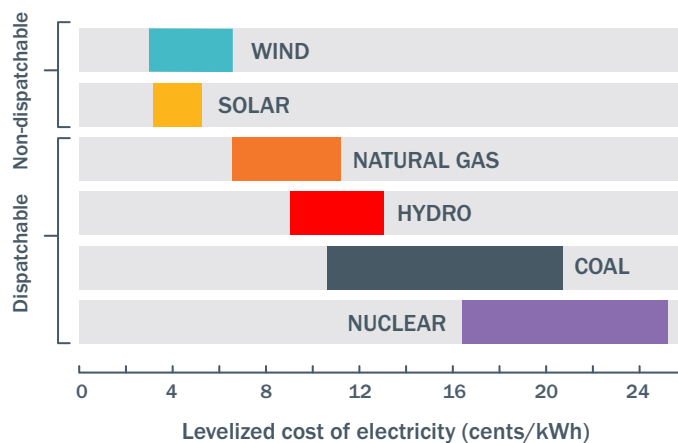
**Net zero is not just a climate opportunity but also an economic one.** Canada’s ability to produce affordable, clean electricity is a competitive advantage in several ways:

### Export potential

Scaling up clean power generation is an export opportunity in itself. **Canada currently exports eight percent of its electricity to the U.S. for a total value of \$2.6 billion.**<sup>1,30</sup> As our largest trading partner considers a Clean Energy Standard, America will need affordable, reliable sources of zero-emission electricity very quickly—and a lot of it. Indeed, while Canada’s grid is 83% non-emitting today, America’s is just 37% clean, with the same target as Canada: to get that to 100% by 2035.<sup>3,31,32</sup>

Crude oil is currently Canada’s largest export, but that won’t be the case for long.<sup>33</sup> The International Energy Agency’s *World Energy Outlook* shows that, even in its most conservative scenario, oil demand declines in the mid-2030s. If nations follow through on their net-zero pledges, global oil demand peaks around 2025.<sup>21</sup> Canada needs to diversify its exports; luckily, our southern neighbour has made it very clear—as evidenced by the cancellation of the Keystone XL pipeline—what kind of energy it wants more of going forward. Additionally, renewable power can also be used to produce green hydrogen and hydrogen-based fuels that can be shipped around the world—no power lines required. **Canada is among the best-positioned nations to produce low-cost green hydrogen, and a number of such facilities are now under construction.**<sup>34,35</sup>

**Average costs of electricity in Canada by source**



Notes: Includes illustrative carbon price range of US\$20-40/tCO<sub>2</sub> (\$25-50/tCO<sub>2</sub>). High end of coal incorporates 90% carbon capture and storage, but not the cost of transportation and storage. Solar refers to utility scale. Conversion from USD to CAD based on the average exchange rate of the first 10 months of 2021 provided by the Bank of Canada. While the levelized cost of electricity offers a useful indicator to help inform investment decisions, direct comparisons between electricity sources must also account for issues such as dispatch characteristics that are not reflected in the levelized cost of electricity. Data sources: Lazard (2021),<sup>36</sup> hydro data from Canadian Energy Research Institute (2018).<sup>37</sup>

## A competitive edge for industry

Many of Canada's exports are already lower carbon than their global competitors, and transitioning to a cleaner and expanded electricity grid while broadening electrification efforts will further leverage this advantage.

**A number of Canadian steel mills, while still using emissions-intensive technology, are the cleanest globally thanks to a clean electricity grid.**<sup>38</sup> Canada similarly produces the world's cleanest aluminum, while the emissions intensity of Canada's pulp and paper sector is now among the lowest as well.<sup>39</sup>

Currently, Canada's heavy industries—including cement, chemicals, fertilizers, forest products, mining, and steel—employ more workers than the oil and gas sector.<sup>40</sup> These industries, along with agriculture, manufacturing, and others, must further decarbonize for emissions reasons, but getting ahead of the curve

will also create opportunities to access markets looking for low-carbon products today.

The European Commission recently announced draft rules to enact a carbon border adjustment mechanism starting in 2023.<sup>41</sup> This mechanism would apply import charges to goods from nations without or with weak carbon pricing. Our low-carbon industries stand to benefit from such a system if they can keep up with shifting standards. The U.S. and U.K. are considering similar policies.<sup>42,43</sup> Some jurisdictions, like Kazakhstan, are already responding by increasing their decarbonization efforts to retain access to markets with such policies.<sup>44</sup> The U.K.'s *Ten Point Plan for a Green Industrial Revolution*, meanwhile, lays out plans for a competitive net-zero economy powered by clean electricity.<sup>45</sup>

## Companies in the market for low-carbon goods



Apple is committed to having a **100%-carbon-neutral supply chain by 2030.**<sup>46</sup>



BMW intends to reduce its manufacturing emissions by **40% by 2030.**<sup>47</sup>



FedEx is investing **US\$2 billion to electrify its fleet of 180,000 vehicles** in an effort to be carbon neutral by 2040.<sup>48</sup>

## CANADIAN COMPANIES POWERING THE FUTURE



**Brookfield Renewable Energy Partners**, headquartered in Toronto, has over 20,000 megawatts of clean energy capacity and just shy of 6,000 solar, wind, and hydroelectric facilities in North America, Europe, Asia, and South America, making it the world's largest producer of renewable energy.<sup>52</sup>

**Hydrostor** in Ontario uses surplus renewable energy from wind and solar power generated during the day to compress and store large volumes of air. This compressed air can then be run through a turbine to produce electricity when required, thus replacing natural gas use during peak demand periods.<sup>50</sup> The company has projects underway in six countries, including two in California that will provide 1,000 megawatts over eight to twelve hours, equivalent to the output of B.C.'s forthcoming Site C hydro dam.<sup>51</sup>

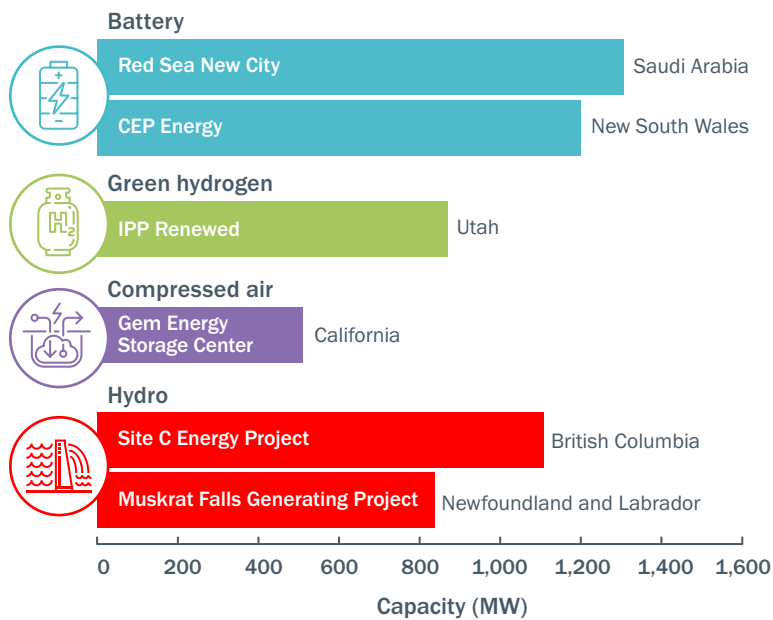


## A job creator

In its net-zero scenario, the International Energy Agency identifies an annual global market opportunity of more than US\$1 trillion by 2050 for manufacturers of clean technology, such as wind turbines, solar panels, lithium-ion batteries, electrolyzers, and fuel cells. This is comparable in size to the current global oil market. In the agency's scenario, **13 million additional workers are employed in clean energy and related sectors by 2030 if nations meet their current climate pledges**, a figure that doubles in the same timeframe if climate action brings the world on a pathway to net-zero emissions by mid-century. In fact, employment growth in clean energy more than offsets the decline in fossil fuel sectors.<sup>21</sup>

This finding is shared by Clean Energy Canada's recent report on jobs in the Canadian clean energy sector, *The New Reality*, which projects an increase of 208,700 additional clean energy jobs by 2030, far exceeding the 125,800 lost in fossil fuels over that timeframe. **That impressive growth would bring total employment in Canada's already sizable clean energy sector to 639,200**, of which 141,000 are in electricity generation and grid infrastructure. As Alberta updates its fossil-fuel-heavy electricity grid, the province is on track to see an annual 22% increase in wind power jobs alone.<sup>49</sup>

### Selected renewable energy storage projects by capacity compared to the Site C and Muskrat Falls hydro projects\*



## ENERGY STORAGE: A SIZABLE SOLUTION

Renewable electricity generated from solar or wind facilities is what's referred to as variable power, meaning electricity is only produced when the wind blows or the sun shines. For this kind of renewable energy to become the backbone of a clean electricity grid, it must either be stored or part of a large grid where electricity supply and demand can be balanced. Grid-scale renewable storage is quickly becoming a reality, with BloombergNEF projecting energy storage capacity around the world to boom more than 20-fold by 2030 compared to 2020 levels.<sup>56</sup>

\*Notes: All projects are planned or under construction. The IPP Renewed project is planned to run on a mixture of 30% hydrogen and 70% gas before systematically increasing to 100% renewable hydrogen by 2045. Sources: Site C Clean Energy Project (2017),<sup>57</sup> China Daily (2021),<sup>58</sup> Hydrostor (n.d.),<sup>59</sup> Intermountain Power Agency (n.d.),<sup>60</sup> Nalcor Energy (n.d.),<sup>61</sup> The Guardian (2021).<sup>62</sup>



**General Fusion**, established in 2002 in B.C., is transforming the way the world is energized with the most practical path to commercial fusion energy. The Fusion Demonstration Plant represents a major milestone on the company's path to commercialization. The Fusion Demonstration Plant will verify that General Fusion's Magnetized Target Fusion technology can create fusion conditions in a practical and cost-effective manner at power plant relevant scales, as well as refine the economics of fusion energy production, leading to the subsequent design of a commercial fusion pilot plant. Construction is anticipated to begin in 2022, with operations beginning approximately three years later.<sup>53</sup>

**Saint John Energy's** advanced smart grid enables customers to participate in powering our net-zero future through interconnected smart water heaters, thermostats, and heat pumps that, along with renewable power and storage, help balance electricity loads.<sup>54</sup> In 2021, the International Smart Grid Action Network declared the New Brunswick company's smart grid its top project, earning Saint John Energy an award of excellence.<sup>55</sup>



Credit: General Fusion | PI3 - Superheated plasma is key to achieving fusion energy. General Fusion's PI3 plasma injector is the largest, most powerful fusion plasma injector in the world.



# Powering a net-zero Canada

## 100% Clean Electricity



Wind



Geothermal



Solar



Bioenergy with carbon capture and storage



Hydro



Nuclear (non-emitting electricity)



Tidal

## Electrolysis



A process that produces clean hydrogen from renewable electricity and water.

## H<sub>2</sub> 100% Clean Hydrogen



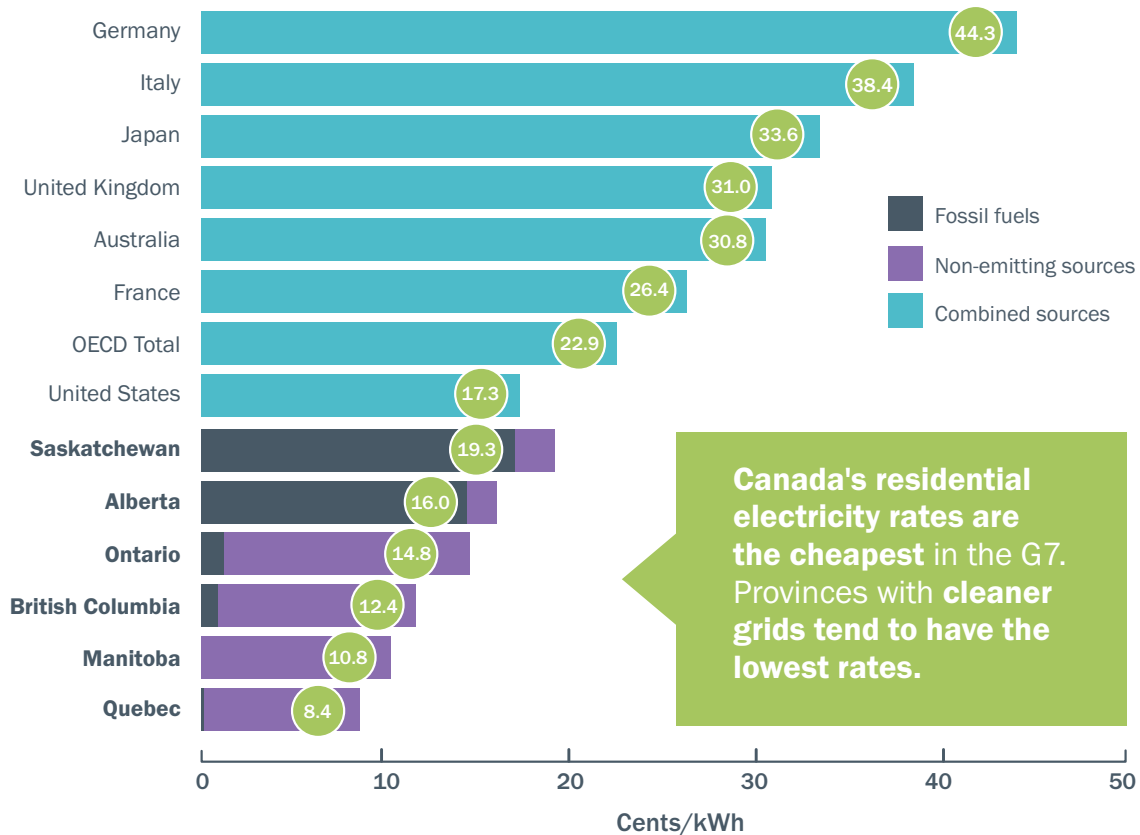
Hydrogen, an energy carrier like electricity, may have advantages in sectors such as steelmaking and long-distance transport (trucking, rail, aviation, and marine).

### Other forms of energy in 2050

While electricity and, to a lesser degree, hydrogen are expected to dominate as energy carriers in 2050, biofuel may play a role in difficult-to-decarbonize sectors like aviation. Carbon capture, utilization and storage (where carbon is captured and either permanently stored or utilized, for example to produce synthetic fuel) may also be used to tackle industry and transportation emissions. The above infographic is illustrative and not intended to be comprehensive.

# HOUSEHOLD ELECTRICITY PRICES BY SELECTED COUNTRIES AND PROVINCES

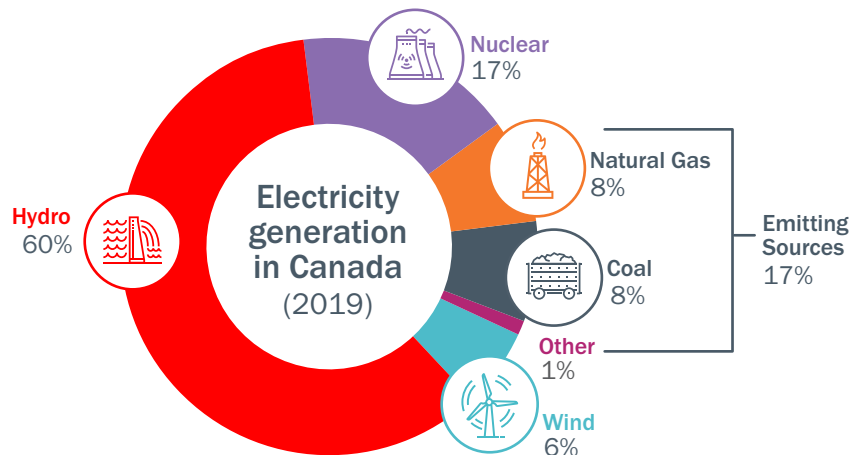
(2019)



Notes: Provincial data based on major cities and for a monthly consumption of 1,000 kWh. Data for territories not available. Prices include taxes. Exchange rate from Bank of Canada. Data sources: International Energy Agency (2020),<sup>2</sup> Hydro-Québec (2019),<sup>13</sup> Statistics Canada (2020),<sup>14</sup>

## CAPACITY VS. GENERATION

Electricity supply is often discussed in terms of capacity and generation. Capacity is the maximum electric output a facility can produce, while generation refers to the amount of power actually produced.<sup>16</sup>



Note: "Other" includes refined petroleum products, biomass, solar, and tidal. Data source: Statistics Canada (2020).<sup>14,15</sup>



3

## To further expand Indigenous clean energy ownership

### Indigenous Clean Energy identifies four opportunity areas for Indigenous leadership

- 1 Renewable energy projects
- 2 Energy efficiency and conservation
- 3 Advanced energy systems
- 4 Green energy infrastructure

---

The 300 MW Henvey Inlet Wind Project.  
Credit: Henvey Inlet Wind Project, Henvey Inlet First Nation





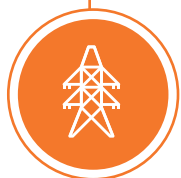
The creation of new clean electricity projects, as well as sustaining or scaling up existing ones, can provide economic and environmental benefits to Indigenous peoples when these projects are undertaken with consent and participation.

A 2020 assessment by Indigenous Clean Energy Social Enterprise identified between 2,107 and 2,507 existing Indigenous clean energy projects encompassing power generation, electricity transmission, heat production, and energy efficiency in Canada; 197 of these involve generation of over one megawatt, and many include partnerships between Indigenous communities and energy companies, utilities, and developers. These **medium-to-large Indigenous renewable projects experienced a 30% growth rate across Canada between 2017 and 2020.**<sup>63</sup>

Indigenous Clean Energy's report concludes that the scale of Indigenous clean energy leadership and ownership will continue to grow significantly over the short- and longer-term, and will increase employment and economic development for First Nation, Métis, and Inuit communities.<sup>63</sup>

This growth can be seen across Canada. **Wataynikaneyap Power, a utility majority-owned by 24 First Nations, is currently building a 1,800-kilometre transmission line to connect 17 First Nation communities to the Ontario power grid.** Operational in 2023, the project is expected to prevent over six megatonnes of emissions by replacing roughly 25-million litres of diesel fuel a year.<sup>64</sup>

In the Arctic, a 10-megawatt hydroelectric project is under construction in the diesel-reliant community of Inukjuak, Quebec, through a partnership between the Inuit Pituvik Landholding Corporation and Innergex Renewable Energy, one of Canada's largest clean energy companies. The project will eliminate almost a megatonne of emissions through its 40-year power purchase agreement with Hydro-Québec.<sup>63</sup>



Indigenous communities and enterprises are the **largest single owner of clean energy assets in Canada** after Crown and private utilities.<sup>63</sup>

In B.C., First Nations are involved in **79 grid-tied renewable energy projects**, which together deliver **13% of the province's electricity supply.**<sup>65</sup>



4

To improve energy security and affordability



Europe's recent spike in electricity prices lays bare another disadvantage of fossil fuel power, whose price is set on the global market, often sourced from unfriendly nations.

In contrast, countries with electricity grids that generate most of their power domestically from multiple sources with robust transmission systems fare better.<sup>66,67</sup> In addition, studies have shown that connected grids lower electricity costs for households and industry.<sup>68-71</sup>

Fortunately, Canada, while both importing from and exporting to the U.S., is a net exporter, making us effectively electricity independent. At the same time, Canada's current reliance on natural gas and oil to produce 8% of our electricity does expose those provinces and territories to rate fluctuations based on global and regional fossil fuel prices.<sup>15</sup> This exposure is in addition to the fact that these regions pay higher rates than those that rely on renewable electricity.<sup>13</sup>

Evidence is piling up globally that the path to abundant and affordable electricity is clean. **In 2020, 62% of total renewable capacity added around the world had lower costs than the cheapest new fossil fuel option.**<sup>28</sup> Unlike fossil fuels, renewables are less affected by the vagaries of global energy prices, as is currently being witnessed in many European countries.<sup>72</sup>

For Canada, success means building on an already strong foundation. Canada has the lowest electricity rates in the G7.<sup>2</sup> Canada's energy security is underpinned by its hydropower and, to a lesser extent, nuclear. Given that Alberta and Saskatchewan, in particular, have wind and solar power potential that rivals the best on the continent, it should also be underpinned by modern renewable sources and energy storage.<sup>4</sup>

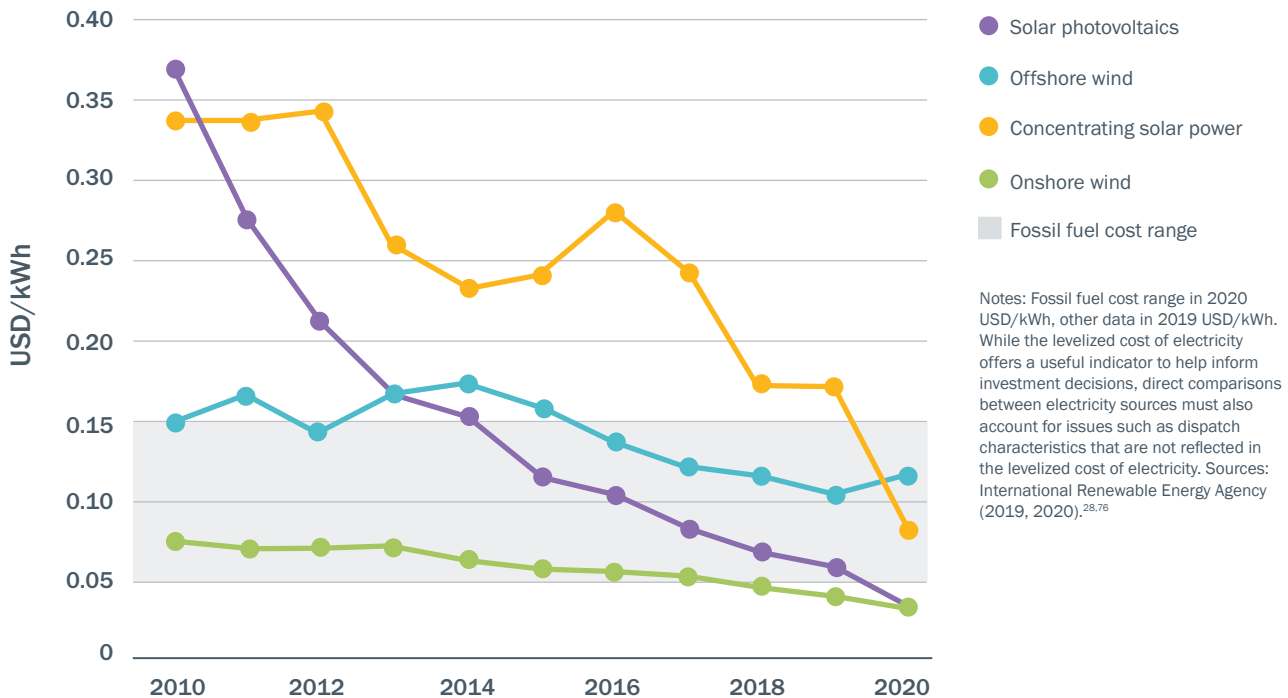


**Alberta's Renewable Electricity Program ran from 2017 to 2019** and successfully delivered 1,363 megawatts of wind generation at a weighted average bid price of \$38.62/MWh—**setting a new record in Canada for the lowest renewable electricity price ever seen.**<sup>73</sup>

More recently, a number of energy companies have established grid-scale batteries to store Albertan wind-generated electricity for when it's needed.<sup>74</sup> Southern Alberta's Travers Solar facility, slated for completion in 2022, represents Canada's largest solar panel project and is estimated to create over 1,000 jobs during peak construction.<sup>75</sup>

# COST DECLINES IN VARIOUS RENEWABLE ENERGY SOURCES

(between 2010 and 2020)



## THREE WAYS CLEAN, EFFICIENT ELECTRICITY BENEFITS YOUR BANK ACCOUNT

1



A net-zero-enabling grid is necessary to ensure we have enough clean power for all Canadian drivers to go electric. Today, a **Canadian electric vehicle driver will save \$800 to \$2,000 a year** in “fuel” costs compared to a gas car driver, depending on which provincial grid they plug into. They can also expect to save a few hundred dollars per year on maintenance, since EVs have far fewer parts and need less frequent repair.<sup>77</sup>

2



Until recently, electric heat pumps (that both heat and cool buildings) were, on average, more expensive to operate than natural gas furnaces. However, a combination of recent spikes in natural gas prices, increases in the federal carbon price, and government incentives have narrowed the gap to where **heat pumps in many parts of North America are becoming cost competitive with natural gas furnaces.**<sup>78-80</sup>

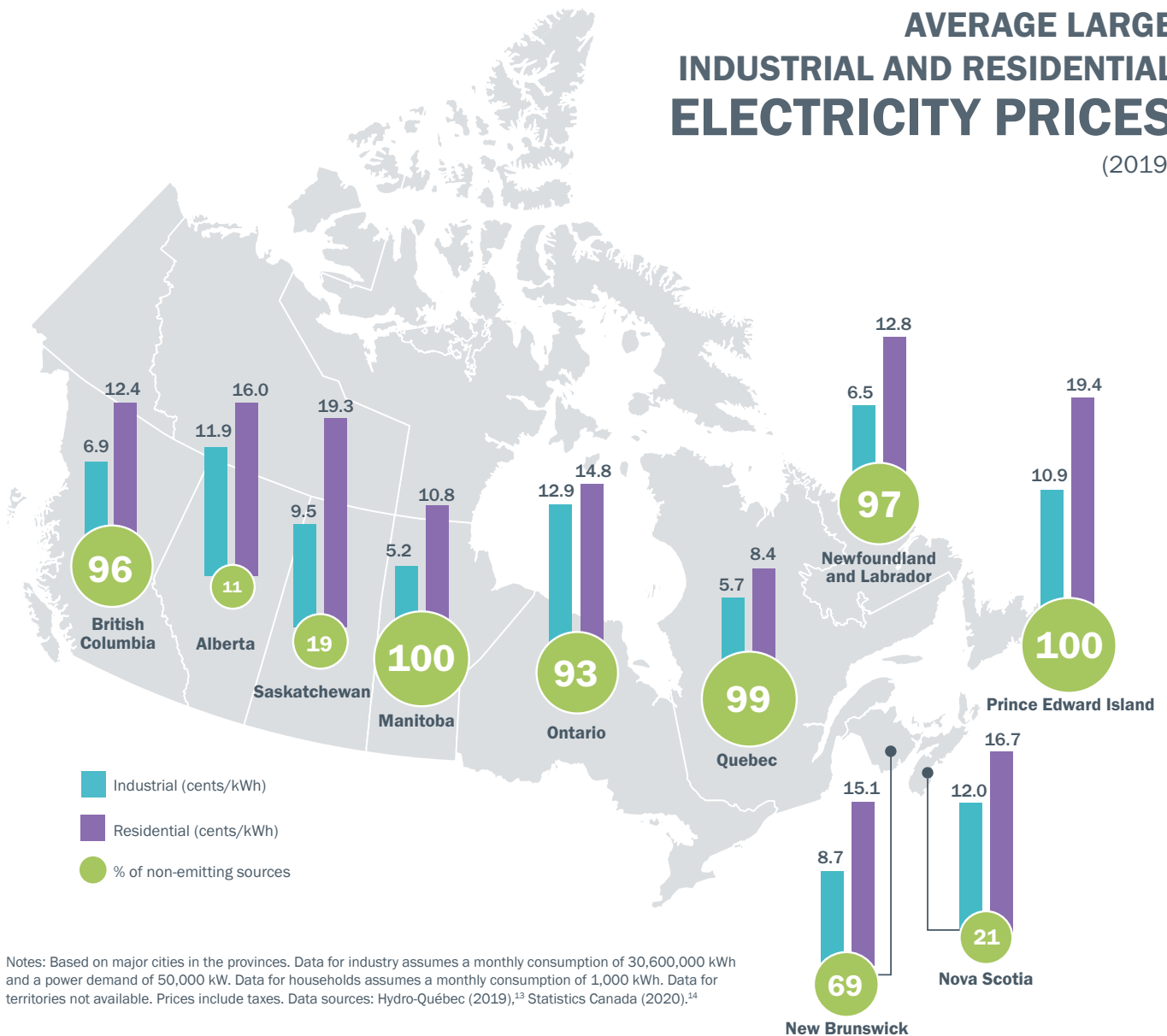
3



**Canadian families would save \$151 annually per household on average with best-in-class energy efficiency policies in place**, according to 2018 modelling conducted by Dunsky Energy Consulting on behalf of Clean Energy Canada and Efficiency Canada. **For families that retrofit their homes, savings would be far higher.** Across the Canadian economy, such measures would lead to \$1.8 billion in net residential savings and \$4.9 billion in net commercial and industrial savings.<sup>79</sup>

# AVERAGE LARGE INDUSTRIAL AND RESIDENTIAL ELECTRICITY PRICES

(2019)



Notes: Based on major cities in the provinces. Data for industry assumes a monthly consumption of 30,600,000 kWh and a power demand of 50,000 kW. Data for households assumes a monthly consumption of 1,000 kWh. Data for territories not available. Prices include taxes. Data sources: Hydro-Québec (2019),<sup>13</sup> Statistics Canada (2020).<sup>14</sup>

## SOUTH AUSTRALIA SHINES A LIGHT

While Europe is struggling with high electricity prices that some incorrectly blame squarely on the variability of solar and wind generation, South Australia has experienced the opposite. The state currently gets 62% of its electricity from wind and solar, and combined with grid-scale battery storage, has not lost a single hour of electricity in the past five years.<sup>11</sup> The state expects 100% of its electricity to come from renewable sources before 2030. This improvement in both reliability and emissions intensity has also resulted in a A\$303 reduction in annual household electricity costs since 2018.<sup>12</sup>



# A clean electricity **ACTION PLAN**



Connecting Canada to a 100% clean electricity grid and scaling up capacity to meet our national net-zero commitment is a generational opportunity.

**Affordable, abundant clean electricity is Canada's advantage in the modern global economy.**

Done right, investing in clean electricity will clean up industry, grow exports, keep power affordable for Canadian families, provide economic opportunities for Indigenous and rural communities, and ensure Canada has what it takes to become carbon neutral by 2050.

Much needs to be done, however, for Canada to seize this opportunity. Specifically, Canada must:

## REGULATE NOW

The federal government must use its governing power to put Canada on track to 100% clean electricity by 2035, both by limiting the use of fossil fuels to produce electricity and by increasing the uptake of clean electricity sources. To do this, the federal government must immediately:

- ✓ Prioritize establishing the recently announced Clean Electricity Standard with the goal of implementation beginning no later than 2023.
- ✓ Use the *Canadian Environmental Protection Act* to prevent the construction of additional fossil fuel power plants while the Clean Electricity Standard is being developed.

## INVEST NOW

Federal and provincial governments must support the development, scale-up, and installation of new generation, storage, transmission, and efficiency technologies to meet the requirements in the forthcoming Canadian Electricity Standard and make Canada ready for net zero. The federal government should:

- ✓ Provide direction to innovation and infrastructure funding agencies, including the Canada Infrastructure Bank and Infrastructure Canada, to direct investments toward a national clean electricity system.
- ✓ Include additional investment tax credits, as promised in the Liberal election platform, in Budget 2022 to support renewable energy and storage solutions to accelerate the deployment of clean energy toward a clean electricity grid by 2035.



## PARTNER NOW

Getting to a clean grid by 2035 and net zero by 2050 cannot be accomplished in isolation. Governments, utilities, industries, clean energy companies, and Indigenous nations will need to collaborate, innovate, and invest together. Specifically, they must:

- ✔ Use the proposed Pan Canadian Grid Council to bring together provinces, territories, Indigenous nations, local governments, utilities, industry, and the clean energy sector to define regional clean electricity pathways to 2035 and 2050; pathways should reduce emissions while maximizing reliability and affordability.
- ✔ Seek out Indigenous nations that are interested in the co-ownership of new generation, transmission, and storage projects that operate with Indigenous partnership.

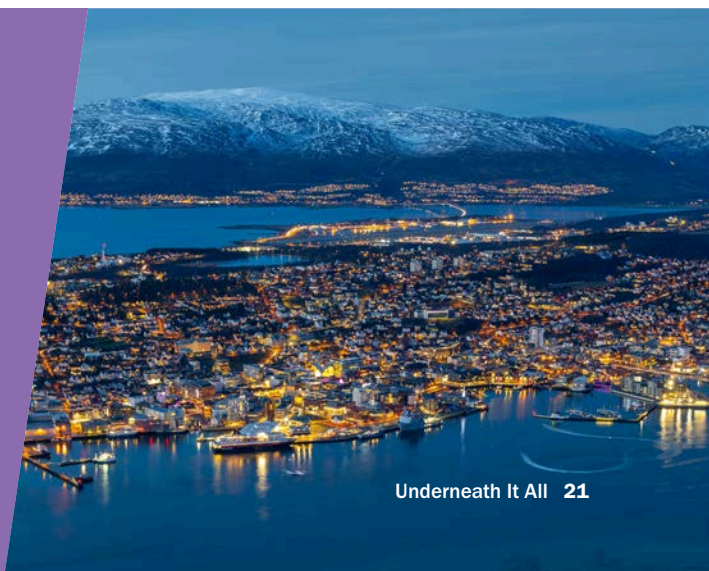
## PIVOT NOW

Finally, Canada needs bold measures that show the world our country is ready for the net-zero economy. Specifically, federal and provincial governments must:

- ✔ Streamline regulatory processes for clean energy projects with Indigenous consent and partnerships.
- ✔ Prioritize federal funding (such as through the Net Zero Accelerator) toward projects that support the switch from fossil fuels to clean electricity or hydrogen, rather than projects that perpetuate fossil fuel use and development.

## NORDIC NATIONS LEADING BY EXAMPLE

For 25 years, Denmark, Finland, Iceland, Norway, and Sweden have been cooperating on a common electricity market using hydro, nuclear, and wind as their primary energy sources.<sup>81</sup> Collectively, their electricity grid is now **87% emission-free with 63% of electricity coming from renewables.**<sup>82</sup>



# Endnotes

---

1. Electricity facts. *Natural Resources Canada*. <https://www.nrcan.gc.ca/science-and-data/data-and-analysis/energy-data-and-analysis/energy-facts/electricity-facts/20068> (2020).
2. International Energy Agency. *Energy prices and taxes for OECD countries*. <https://doi.org/10.1787/7b080c52-en> (2020).
3. Environment and Climate Change Canada. *National inventory report 1990-2019: Greenhouse gas sources and sinks in Canada*. <https://publications.gc.ca/site/eng/9.506002/publication.html> (2021).
4. Wind and solar energy potential in Canada and the world. *Kuby Renewable Energy*. <https://kubyenergy.ca/blog/wind-and-solar-energy-potential-in-canada-and-the-world>.
5. Environment and Climate Change Canada. *A healthy environment and a healthy economy*. <https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/climate-plan-overview/healthy-environment-healthy-economy.html> (2020).
6. Institut de l'énergie Trottier & e3c Hub. *Canadian energy outlook 2021 - Horizon 2060: Executive summary*. [https://iet.polymtl.ca/wp-content/uploads/delightful-downloads/CEO2021\\_ExecutiveSummary\\_20211006.pdf](https://iet.polymtl.ca/wp-content/uploads/delightful-downloads/CEO2021_ExecutiveSummary_20211006.pdf) (2021).
7. Canadian Institute for Climate Choices. *Canada's net zero future: Finding our way in the global transition*. [https://climatechoices.ca/wp-content/uploads/2021/02/Canadas-Net-Zero-Future\\_FINAL-2.pdf](https://climatechoices.ca/wp-content/uploads/2021/02/Canadas-Net-Zero-Future_FINAL-2.pdf) (2021).
8. Ember. *Canada: Coal generation falling at half the rate of the US and EU*. <https://ember-climate.org/global-electricity-review-2021/g20-profiles/canada/> (2021).
9. RBC Economics and Thought Leadership. *The \$2 trillion transition: Canada's road to net zero*. <https://thoughtleadership.rbc.com/the-2-trillion-transition/> (2021).
10. International Energy Agency. *Net zero by 2050*. <https://www.iea.org/reports/net-zero-by-2050> (2021).
11. Hanley, S. South Australia hasn't lost one hour of electricity in 5 years thanks to renewables & batteries. *CleanTechnica*. <https://cleantechnica.com/2021/09/29/south-australia-hasnt-lost-one-hour-of-electricity-in-5-years-thanks-to-renewables-batteries/> (2021).
12. Bang on target with \$303 in electricity savings. *Premier of South Australia*. [https://www.premier.sa.gov.au/news/media-releases/news/bang-on-target-with-\\$303-in-electricity-savings](https://www.premier.sa.gov.au/news/media-releases/news/bang-on-target-with-$303-in-electricity-savings) (2021).
13. Hydro-Québec. *Comparison of electricity prices in major North American cities 2019*. <https://www.hydroquebec.com/data/documents-donnees/pdf/comparison-electricity-prices-2019.pdf> (2019).
14. Electric power, annual generation by class of producer. *Statistics Canada*. <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2510002001> (2021).
15. Electricity from fuels, annual generation by electric utility thermal plants. *Statistics Canada*. <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2510001901> (2021).
16. Fact sheet - Canada's energy future 2017: Energy supply and demand projections to 2040 - Electricity. *Canada Energy Regulator*. <https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2017/fact-sheet-canadas-energy-future-2017-energy-supply-demand-projections-2040-electricity.html> (2020).
17. Jaccard, M. & Griffin, B. *A zero-emission Canadian electricity system by 2035*. <https://davidsuzuki.org/science-learning-centre-article/a-zero-emission-canadian-electricity-system-by-2035/> (2021).
18. CO<sub>2</sub> emissions (metric tons per capita). *The World Bank Group*. [https://data.worldbank.org/indicator/EN.ATM.CO2E.PC?most\\_recent\\_value\\_desc=true](https://data.worldbank.org/indicator/EN.ATM.CO2E.PC?most_recent_value_desc=true) (2021).
19. National inventory submissions 2021. *United Nations Framework Convention on Climate Change*. <https://unfccc.int/ghg-inventories-annex-i-parties/2021> (2021).
20. What is in a Canadian residential natural gas bill? *Canada Energy Regulator*. <https://www.cer-rec.gc.ca/en/data-analysis/energy-commodities/natural-gas/report/canadian-residential-natural-gasbill/index.html> (2021).
21. International Energy Agency. *World energy outlook 2021*. <https://www.iea.org/reports/world-energy-outlook-2021> (2021).
22. International Renewable Energy Agency. *World energy transitions outlook: 1.5 °C pathway*. <https://www.irena.org/publications/2021/Jun/World-Energy-Transitions-Outlook> (2021).
23. Wood, J. Renewable energy could power the world by 2050. Here's what that future might look like. *World Economic Forum*. <https://www.weforum.org/agenda/2020/02/renewable-energy-future-carbon-emissions/> (2020).
24. Ritchie, H. & Roser, M. Electricity mix. *Our World in Data*. <https://ourworldindata.org/electricity-mix> (2020).



25. Denmark still has far to go to meet tough 2030 emissions goal - energy agency. *Reuters*. <https://www.reuters.com/article/denmark-climatechange-idINL8N2DV11W> (2020).
26. New green record for Danish electricity: Lowest CO<sub>2</sub> emissions ever. *State of Green*. <https://stateofgreen.com/en/partners/state-of-green/news/new-green-record-for-danish-electricity-lowest-co2-emissions-ever/> (2020).
27. International Renewable Energy Agency. *Renewable capacity statistics 2021*. <https://www.irena.org/publications/2021/March/Renewable-Capacity-Statistics-2021> (2021).
28. International Renewable Energy Agency. *Renewable power generation costs in 2020*. <https://www.irena.org/publications/2021/Jun/Renewable-Power-Costs-in-2020> (2021).
29. Tong, D. et al. Geophysical constraints on the reliability of solar and wind power worldwide. *Nature Communications*. <https://doi.org/10.1038/s41467-021-26355-z> (2021).
30. Electricity annual trade summary – 2020. *Canada Energy Regulator*. <https://www.cer-rec.gc.ca/en/data-analysis/energy-commodities/electricity/statistics/electricity-summary/electricity-annual-trade-summary.html> (2021).
31. Total energy. *U.S. Energy Information Administration*. <https://www.eia.gov/totalenergy/data/browser/?tbl=T07.02A#/?f=A&start=2019&end=2020&chart-ed=1-2-3-5-8-14>.
32. Fact sheet: President Biden sets 2030 greenhouse gas pollution reduction target aimed at creating good-paying union jobs and securing U.S. leadership on clean energy technologies. *The White House*. <https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/>(2021).
33. Global Affairs Canada. *Canada's state of trade 2020*. <https://www.international.gc.ca/gac-amc/publications/economist-economiste/state-of-trade-commerce-international-2020.aspx?lang=eng> (2020).
34. Pflugmann, F. & De Blasio, N. The geopolitics of renewable hydrogen in low-carbon energy markets. *Geopolitics, History, and International Relations*. <https://doi.org/10.22381/GHIR12120201> (2020).
35. Frangoul, A. Canada is set to have one of the world's biggest green hydrogen plants. *CNBC*. <https://www.cnbc.com/2021/01/19/canada-is-set-to-have-one-the-worlds-biggest-green-hydrogen-plants.html> (2021).
36. Lazard. *Lazard's levelized cost of energy analysis - Version 15.0*. <https://www.lazard.com/media/451881/lazards-levelized-cost-of-energy-version-150-vf.pdf> (2021).
37. Canadian Energy Research Institute. *A comprehensive guide to electricity generation options in Canada*. <https://ceri.ca/studies/a-comprehensive-guide-to-electricity-generation-options-in-canada> (2018).
38. Hasanbeigi, A. & Springe, C. *How clean is the U.S. steel industry? An international benchmarking of energy and CO<sub>2</sub> intensities*. <https://www.globalefficiencyintel.com/us-steel-industry-benchmarking-energy-co2-intensities> (2019).
39. MNP LLP. *Low carbon industrial strategy: GHG benchmarking and competitiveness assessment of BC industrial sectors*. <https://bcbc.com/dist/assets/images/photo-gallery/lowcarbonadvantage/MNP-LCIS-Sector-Results.pdf> (2019).
40. Clean Energy Canada. *The Next Frontier*. <https://cleanenergycanada.org/report/the-next-frontier/> (2021).
41. Carbon border adjustment mechanism. *European Commission*. [https://ec.europa.eu/taxation\\_customs/green-taxation-0/carbon-border-adjustment-mechanism\\_en](https://ec.europa.eu/taxation_customs/green-taxation-0/carbon-border-adjustment-mechanism_en) (2021).
42. Volcovici, V. Democrats float border tariff for carbon intensive imports. *Reuters*. <https://www.reuters.com/world/us/democrats-float-border-tariff-carbon-intensive-imports-2021-07-19/> (2021).
43. Morison, R. & Edwards, A. U.K. considers carbon border tax to protect domestic industry. *Bloomberg*. <https://www.bloomberg.com/news/articles/2021-05-28/u-k-considers-carbon-border-tax-to-protect-domestic-industry?sref=52ZW06YM> (2021).
44. Kazakhstan considers domestic carbon tax to dodge EU border tax. *Reuters*. <https://www.reuters.com/article/kazakhstan-carbon-idUSL1N2QH0MM> (2021).
45. Government of the United Kingdom. *The ten point plan for a green industrial revolution*. <https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution> (2020).
46. Apple commits to be 100 percent carbon neutral for its supply chain and products by 2030. *Apple*. <https://www.apple.com/ca/newsroom/2020/07/apple-commits-to-be-100-percent-carbon-neutral-for-its-supply-chain-and-products-by-2030/> (2020).
47. BMW to reduce carbon emissions in car life cycle 40% by 2030. *Reuters*. <https://www.reuters.com/business/sustainable-business/bmw-reduce-carbon-emissions-car-life-cycle-40-by-2030-2021-09-02/> (2021).
48. Butler, D. & Mufson, S. Can the market save the planet? FedEx is the latest brand-name firm to say it's trying. *The Washington Post*. <https://www.washingtonpost.com/climate-environment/2021/03/05/more-than-50-companies-have-vowed-be-carbon-neutral-by-2040/> (2021).

49. Clean Energy Canada. *The New Reality*. <https://cleanenergycanada.org/report/the-new-reality/> (2021).
50. Hydrostor. <https://www.hydrostor.ca/>.
51. Sylvia, T. California to host 1 GW of compressed air storage. *PV Magazine*. <https://www.pv-magazine.com/2021/04/30/california-to-host-1-gw-of-compressed-air-storage/> (2021).
52. Brookfield Renewable Partners. *Brookfield*. <https://bep.brookfield.com/bep>.
53. General Fusion to build its fusion demonstration plant in the UK, at the UKAEA Culham campus. *General Fusion*. <https://generalfusion.com/2021/06/general-fusion-to-build-its-fusion-demonstration-plant-in-the-uk-at-the-ukaea-culham-campus/> (2021).
54. Saint John Energy. <https://www.sjenergy.com/>.
55. Announcing the honorees of the 7th ISGAN Award of Excellence in 'Future-Proofing the Grid Operation via Advanced Digitalisation & IoT'. *International Smart Grid Action Network*. <https://www.iea-isgan.org/award2021/award2021-1/> (2021).
56. Global energy storage market set to hit one terawatt-hour by 2030. *BloombergNEF*. <https://about.bnef.com/blog/global-energy-storage-market-set-to-hit-one-terawatt-hour-by-2030/> (2021).
57. Project overview. *Site C Clean Energy Project*. <https://www.sitecproject.com/about-site-c/project-overview> (2017).
58. Shijia, Ouyang. Huawei signs world's largest energy storage project. *China Daily*. <https://global.chinadaily.com.cn/a/202110/19/WS616e5a0aa310cdd39bc6fd68.html>.
59. Gem Energy Storage Center. *Hydrostor*. <https://www.hydrostor.ca/gem-energy-storage-center/>.
60. IPP Renewed. *Intermountain Power Agency*. <https://www.ipautah.com/ipp-renewed/>.
61. Muskrat Falls Generating Project. *Nalcor Energy*. <https://muskratfalls.nalcorenergy.com/project-overview/muskrat-falls-hydroelectric-generation-facility/>.
62. Morton, A. World's biggest battery with 1,200MW capacity set to be built in NSW Hunter Valley. *The Guardian*. <http://www.theguardian.com/australia-news/2021/feb/05/worlds-biggest-battery-with-1200mw-capacity-set-to-be-built-in-nsw-hunter-valley-australia> (2021).
63. Indigenous Clean Energy. *Accelerating transition: Economic impacts of Indigenous leadership in catalyzing the transition to a clean energy future across Canada*. <https://icenet.work/attachment?file=HGQf2DFTWWHllc6jcRtUCg%3D%3D> (2020).
64. Stueck, W. Inside the Indigenous-led power line deal that put 17 First Nations on the grid. *The Globe and Mail*. <https://www.theglobeandmail.com/business/article-deal-for-line-that-brings-light-was-more-than-a-decade-in-the-making/> (2021).
65. The Pembina Institute. *First Nation leadership in British Columbia's renewable energy future*. <https://www.pembina.org/pub/first-nation-leadership-british-columbias-renewable-energy-future> (2021).
66. Quality of electricity supply. *The World Bank Group*. <https://govdata360.worldbank.org/indicators/heb130a3c> (2021).
67. What makes a country's electricity system stable? *Drax*. <https://www.drax.com/power-generation/what-makes-a-countrys-electricity-system-stable/> (2019).
68. Dolter, B. & Rivers, N. The cost of decarbonizing the Canadian electricity system. *Energy Policy*. <http://dx.doi.org/10.1016/j.enpol.2017.10.040> (2018).
69. Brown, P. R. & Botterud, A. The value of inter-regional coordination and transmission in decarbonizing the US electricity system. *Joule*. <http://dx.doi.org/10.1016/j.joule.2020.11.013> (2021).
70. Americans for a Clean Energy Grid. *Consumer, employment, and environmental benefits of electricity transmission expansion in the eastern U.S.* <https://www.vibrantcleanenergy.com/wp-content/uploads/2020/10/EIC-Transmission-Decarb.pdf> (2020).
71. MacDonald, A. E. et al. Future cost-competitive electricity systems and their impact on US CO<sub>2</sub> emissions. *Nature Climate Change*. <http://dx.doi.org/10.1038/nclimate2921> (2016).
72. What is behind rocketing natural-gas prices? *The Economist*. <https://www.economist.com/graphic-detail/2021/09/20/what-is-behind-rocketing-natural-gas-prices> (2021).
73. Barretto, J. How Alberta achieved Canada's lowest renewable-electricity prices. *The Globe and Mail*. <https://www.theglobeandmail.com/report-on-business/rob-commentary/how-alberta-achieved-canadas-lowest-renewable-electricity-prices/article37465821/> (2017).
74. Bakx, K. A wave of electricity storage projects is coming to Alberta and could be the linchpin for more renewables. *CBC News*. <https://www.cbc.ca/news/business/bakx-windcharger-1.5987252> (2021).
75. Jackson, H. Canada's largest solar panel project to create more than 1,000 jobs in oil country. *CTV News*. <https://www.ctvnews.ca/climate-and-environment/canada-s-largest-solar-panel-project-to-create-more-than-1-000-jobs-in-oil-country-1.5666324> (2021).

76. International Renewable Energy Agency. *Renewable power generation costs in 2019*. <https://www.irena.org/publications/2020/Jun/Renewable-Power-Costs-in-2019> (2020).
77. Clean Energy Canada. *Taking the Wheel*. <https://cleanenergycanada.org/report/taking-the-wheel/> (2020).
78. Heating and cooling with a heat pump. *Natural Resources Canada*. <https://www.nrcan.gc.ca/energy-efficiency/energy-star-canada/about/energy-star-announcements/publications/heating-and-cooling-heat-pump/6817> (2021).
79. Clean Energy Canada & Efficiency Canada. *Less is More*. <https://cleanenergycanada.org/report/less-is-more/> (2018).
80. Heat pump savings calculator: How much could you save? *Efficiency Nova Scotia*. <https://www.energycns.ca/tools-resources/tool/heat-pump-calculator/> (2021).
81. Sánchez Nicolás, E. Commission: Pioneering Nordics' energy mix 'example' to EU. *EUobserver*. <https://euobserver.com/environment/151098> (2021).
82. Nordic Energy Research. *Tracking Nordic clean energy progress 2020*. <https://www.nordicenergy.org/project/tncep/> (2020).

# CLEAN ENERGY CANADA

Clean Energy Canada  
Simon Fraser University, Morris J. Wosk Centre for Dialogue  
Harbour Centre 3300 - 515 West Hastings Street  
Vancouver, B.C., V6B 5K3

