

A Pivotal Time for Clean Energy



 CLEAN ENERGY CANADA

JUNE 2016

A Pivotal Time for Clean Energy
Tracking the Energy Revolution—Canada 2016

June 2016

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About Clean Energy Canada

Clean Energy Canada works to accelerate Canada's transition to a clean and renewable energy system. We collaborate with civil society, governments and the private sector to build awareness support for solutions that address climate disruption and foster an energy efficient, environmentally responsible and prosperous economy.



Clean Energy Canada is an initiative of the Centre for Dialogue at Simon Fraser University.

Photo (cover): Canadian leaders gather at the COP21 climate talks in Paris.

Credit: Justin Trudeau, Flickr.

Photo (opposite, right): Wind turbine being assembled.

Credit: Norm Betts, Bloomberg via Getty Images.

Photo (opposite, left): A technician installs a solar panel array.

Credit: Courtesy of NAIT via Green Energy Futures, Flickr.

SOURCE DATA AND METHODOLOGY

Clean Energy Canada's findings in this report draw on a variety of sources, including: Bloomberg New Energy Finance, annual reports for electricity utilities, the Canadian Wind Energy Association, the Canadian Solar Industries Association, the Canadian Hydropower Association and provincial major project inventories. All sources, calculations and assumptions are identified in the methodology summary available at: <http://cleanenergycanada.org/work/tracking-canada-2016/>

HOW WE ESTIMATE SPENDING

In this report, spending and investment figures reflect the amount of money spent (primarily by private and crown corporations) to build and commission clean energy projects.

All values are reported in Canadian dollars unless otherwise stated, and we do not report on the anticipated cost of projects announced or deals struck in the year. To ensure our analysis provides the most accurate look at spending possible, we aggregate provincial and project-specific data from a variety of official sources (including government and industry) and verify those data with third-party reviewers. We also include large hydro projects (greater than 50 MW) in our estimates, which are often not included in other publicly available estimates. Finally, adding individual values may not equal total values cited in the report due to rounding. Complete data sets are available in the methodology report for cross-reference.



What is Clean Energy?

Clean energy policies, technologies or services accelerate the shift to an economy based on renewable energy.

The clean energy transition involves:

Increasing the supply of renewable energy.

Reducing consumer and industrial energy demand.

Improving the infrastructure and systems that transmit, store and use energy.

Enabling market penetration of clean energy solutions.

TRACK THE ENERGY REVOLUTION

Each Monday we publish the Clean Energy Review, a free weekly digest of must-read climate and clean energy stories from across Canada and around the world.



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A photograph of Jim Carr, a man with white hair and glasses, wearing a dark suit, white shirt, and a red patterned tie. He is speaking at a podium, gesturing with his right hand raised. The podium has a blue banner with white text. The background is dark.

“We are at
a **crossroads**
between
reliance on
fossil fuels
of the past
and the
renewable
energy future
ahead.”

—Jim Carr, Federal Minister of Natural Resources,
April 2016

Political Resolve Opens a New Door

“We are at a crossroads between reliance on fossil fuels of the past and the renewable energy future ahead.”

A year ago, if you heard those words you would probably guess the speaker was an environmentalist, or maybe an executive at a start-up renewable energy company. But in 2016, that statement came from Canada’s Minister of Natural Resources in New York City, at the prestigious Future of Energy Summit hosted by Bloomberg New Energy Finance.

It wasn’t just new leadership in Ottawa that signalled change on the horizon. In Alberta, the newly elected government wasted no time in rolling out an ambitious climate change plan that promises to spark significant growth in renewable energy. Next door, the Saskatchewan government announced that renewable power would play a growing role in the province’s energy mix. Just as Ontario, Quebec, B.C. and the Maritime provinces triggered the first wave of significant climate action and clean energy spending in Canada by adopting strong, innovative policies, the next wave of spending will flow from the policy decisions being made today—in the prairies, the national capital, and beyond.

Even though 2015 was a groundbreaking year politically for Canada’s clean energy sector, clean


energy development slowed. After a big surge in 2014, spending dropped to \$10 billion from nearly \$12 billion¹. And rather than welcoming new provinces to the party, 2015 saw the “usual suspects” of clean energy development maintaining their lead.

We see the results for 2015 as unique: the product of a set of specific circumstances, rather than the start of a trend. But ensuring that clean energy growth picks back up—as it’s doing in so many of our peer countries—will require real leadership, from coast to coast to coast.

From Ottawa to Edmonton to Saskatoon, governments are saying all the right things about climate leadership and the clean energy transition. That newfound resolve has opened the door to the prospect of significant growth in the years ahead.

But to walk through that door, Canada’s policy makers and leaders will need to back up their promises with strong policies—and results. Fortunately, they have the opportunity to learn what works—and what doesn’t—from jurisdictions that broke early ground, and apply those lessons to developing a thriving clean energy sector backed by public support.

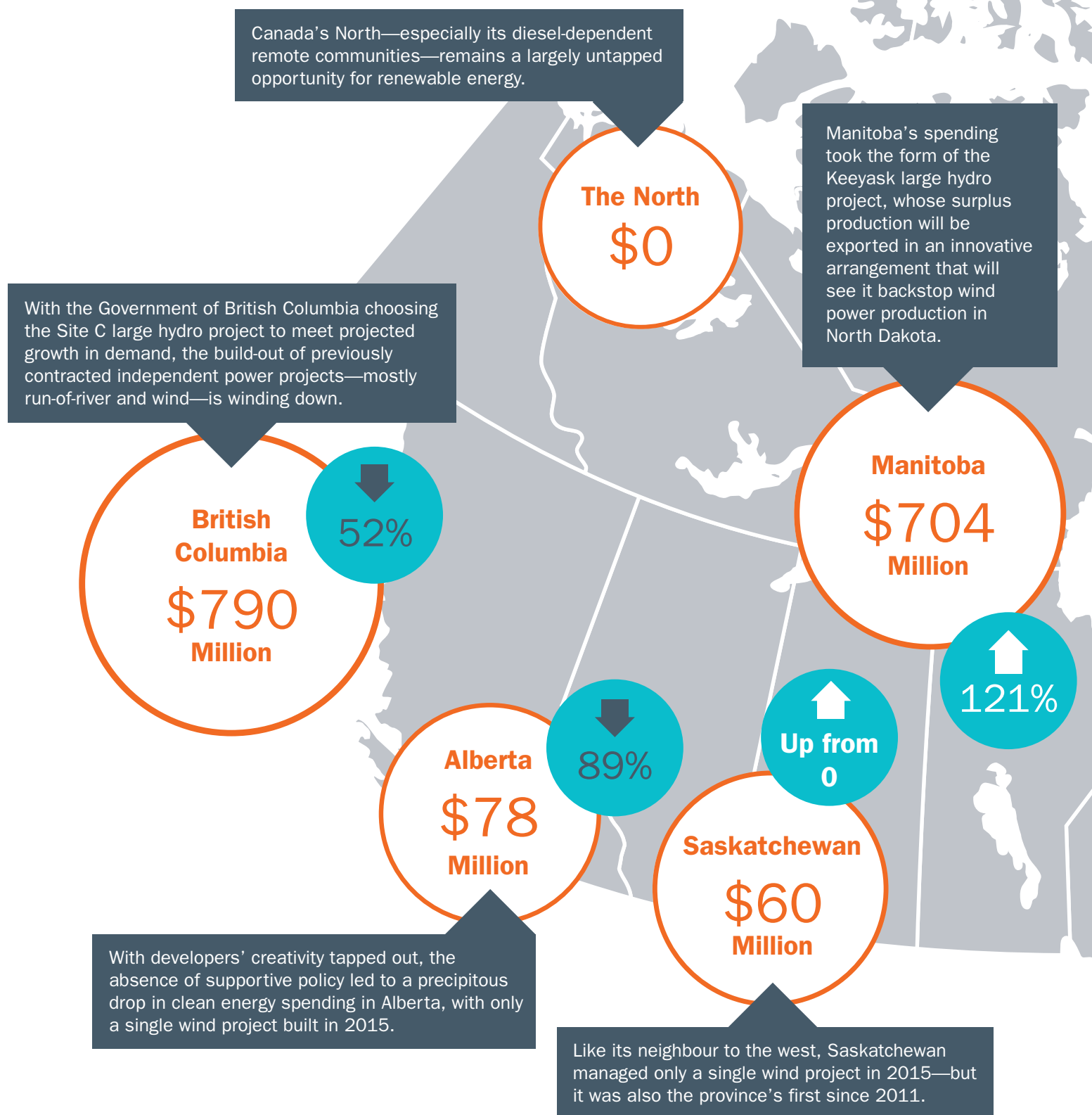
If the promises made in 2015 translate into strong policy, they will drive the next steps forward in Canada’s clean energy transition.



Merran Smith
Executive Director
Clean Energy Canada



¹ All values appear in Canadian dollars unless otherwise stated. For further details on spending estimates, please see the methodology section at the start of this report and the accompanying methodology document.



FOLLOWING THE MONEY

Clean Energy Spending Across Canada In 2015

/ CLEAN ENERGY SPENDING IN 2015

/ % CHANGE (2014-15)

↑
58%

Atlantic Canada

\$1.2
Billion

Newfoundland & Labrador's Muskrat Falls large hydro project dominated activity in Atlantic Canada, in Nova Scotia is keeping the province on track for its 40% renewable power target for 2020.

↓
15%

Ontario

\$5.3
Billion

Ontario was way out front, landing more than half of total clean energy spending. Despite relatively small year-on-year fluctuations, the build-out of renewable power projects to hit Ontario's target of 20 GW of renewable power capacity by 2025 continued apace.

↓
9%

Quebec

\$1.9
Billion

While most people equate electricity in Quebec with large hydro, wind power was the major player in 2015, accounting for nearly two-thirds of that year's spending.

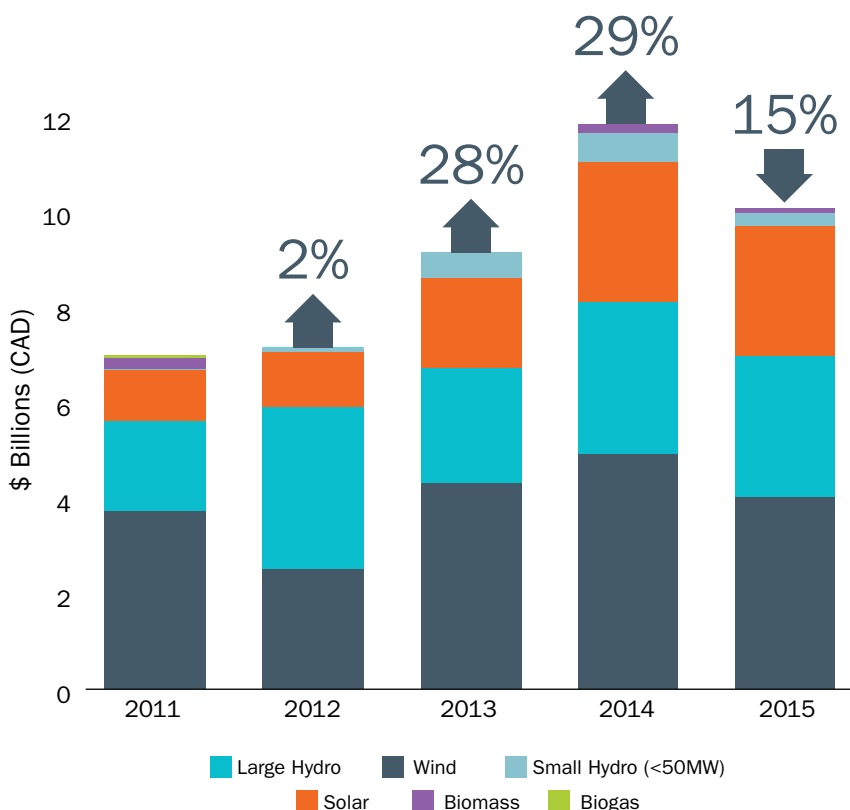
Spending Drops... To Second-Best Year Ever

Clean energy spending dropped slightly in 2015—to just over \$10 billion across Canada—on the heels of a banner year in 2014. But it was still Canada’s second-best year on record for clean energy spending, and renewable generation capacity grew by four per cent.

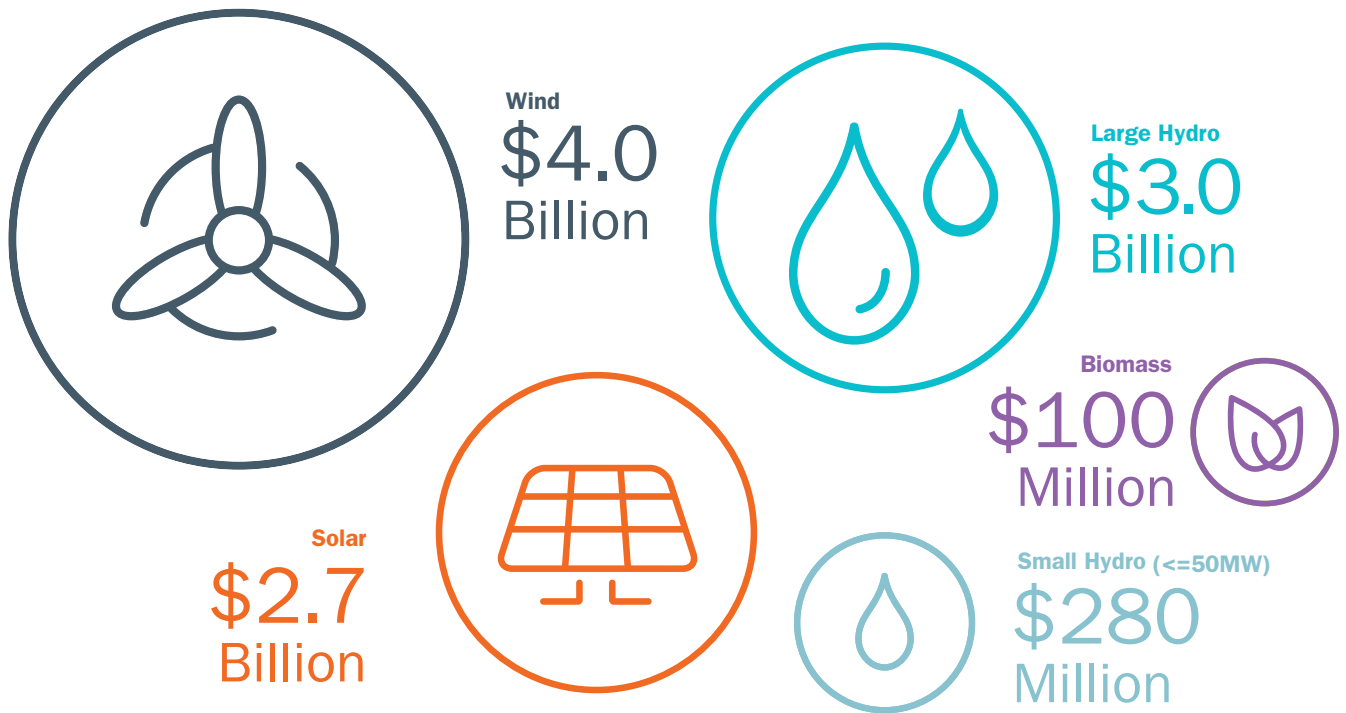
Over the past five years, more than \$45 billion has been spent to build new renewable energy projects across Canada. Most of those dollars have gone into wind (\$19.4 billion), large hydro (\$13.8 billion) and utility-scale solar projects (\$8.4 billion).

The mix of investors is diverse; it includes provincial crown corporations, Canadian businesses and multinational companies. Some of the biggest Canadian players have their roots in fossil fuels—oil and gas, pipelines and coal-fired power—but are branching out into renewable energy.

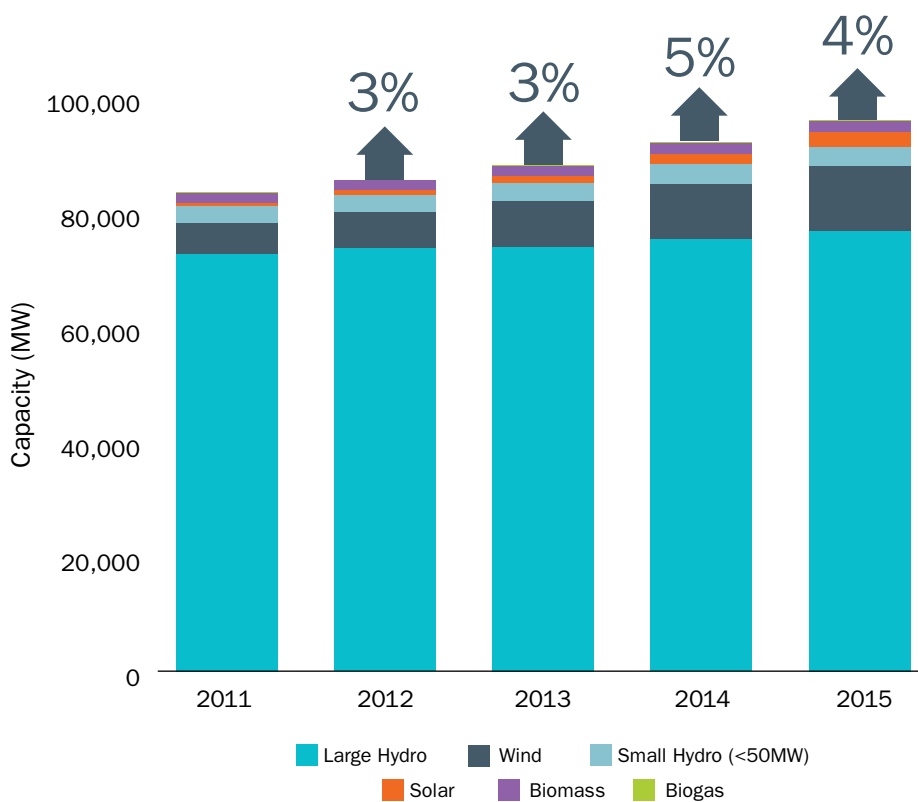
CHANGE IN TOTAL ANNUAL CLEAN ENERGY SPENDING IN CANADA



2015 SPENDING ON RENEWABLE ENERGY BY TECHNOLOGY



GROWTH IN TOTAL CLEAN ENERGY CAPACITY IN CANADA



Want to Attract Clean Energy Capital? Policy Matters.

If there's one lesson to be learned looking back over the past decade of growth in renewable energy—whether in Canada or abroad—it's that policy matters.

Our electricity systems were born in a fundamentally different era compared to the energy, environmental and economic context we know today. To transition those electricity systems to deliver reliable and affordable clean energy will require policy leadership from governments, innovation and creativity from the business sector and an informed and supportive public. That transition will affect Canada's markets, transmission and distribution systems, and regulations—not to mention public expectations. It's no small task.

Our political, business and civil society leaders are now well aware of the challenge they face. Fortunately, the examples of policies and business models we can build on is growing—with success stories to replicate and challenges to learn from.

Canada's provinces have taken different approaches to transitioning their electricity systems, but some of the lessons they've learned apply across the board.

TARGETS FOCUS THE MIND.

One approach that is consistent among nations, states, provinces and cities that are leading the global transition to clean energy is that they have all adopted renewable energy targets. Think China, the European Union, India, California, Texas, Ontario and Vancouver. Target-setting done well can inform sound public policy, provide certainty to business and rally public enthusiasm.

FOCUS ON DEVELOPING NEW TECHNOLOGIES OR DEPLOYING THE TECHNOLOGIES WE HAVE?

Trick question! The answer is both. We have increasingly competitive clean energy technologies available—whose deployment can be rapidly scaled—delivering near-term environmental and economic benefits. But there's no doubt that with further R&D, they can be even cheaper and better.

FRIENDLY COMPETITION CAN WORK WONDERS.

As the renewable electricity sector has matured, the number of players, technologies and approaches has grown. Harnessing competitive forces can help ensure the most cost-effective projects proceed.

SOCIAL LICENSE IS KEY.

As is the case with oil and gas, forestry, mining and pipeline projects, the development of renewable electricity and its associated transmission requires early and active engagement with stakeholders, along with innovative approaches to secure their support.



“Responding to climate change is about **doing what’s right** for future generations of Albertans—protecting our jobs, health and the environment.”

—Rachel Notley, Premier of Alberta, November 2015

WITH NEW POLICY ON THE HORIZON, THESE PROVINCES ARE WORTH WATCHING

As 2015 was drawing to a close—and the Paris climate change negotiations were approaching—Alberta and Saskatchewan independently rolled out new targets for renewable power that look set to drive the next significant wave of development in Canada.

ALBERTA



Alberta's Climate Leadership Plan included two key planks that promise to significantly change electricity generation in the province. In light of the high carbon intensity of coal-fired power—and its health risks—the province's plan committed to phasing out coal-fired power generation by 2030, a much faster phase-out than we would have seen under the leisurely timelines set in Canada's federal regulations.

Given coal-fired power generated 55 per cent of Alberta's electricity in 2014, this phase-out leaves a supply gap. And that's where the second big plank comes in: Alberta committed to generate as much as one-third of its electricity from renewable sources by 2030, which is about triple today's levels. Alberta's Electricity System Operator—tasked with developing a plan for achieving this objective—is working towards a first competition for procurement, targeted for the fourth quarter of 2016, to select renewable energy projects that can start delivering electrons by 2019. Ultimately, the province will need to drum up approximately 4200 MW of renewable power generation by 2030, enough to power 1.2 million homes.

SASKATCHEWAN





Just next door in Saskatchewan, the government announced that SaskPower—a crown-owned utility—would aim to generate 50 per cent of its electricity capacity from renewable sources by 2030, double the capacity of Saskatchewan's current renewable electricity portfolio. SaskPower anticipates that delivering on this commitment will require a significant expansion of wind power, coupled with growth in solar, biomass, geothermal and hydro. Later in 2016, SaskPower will move forward with procuring 100 MW of new wind generation, as well as 60 MW of utility-scale solar. Between 2019 and 2030, the utility estimates that it will develop up to 1600 MW of new wind generation—enough to power 42,000 homes.


PLAYERS ON THE CANADIAN CLEAN ENERGY FIELD

 = Canadian company

TOP 5 CORPORATE RENEWABLE ELECTRICITY DEVELOPERS IN CANADA (2015)

Developer	Total Capacity (MW) of Projects Developed in 2015	Project, Location and Capacity ²
Samsung C&T Corp. (South Korea)	339	Grand Renewable PV Plant, Ontario (130 MW) K2 Wind Farm, Ontario (322 MW) Armow Wind Farm, Ontario (204 MW)
Électricité de France SA (France)	191	Rivière-du-Moulin Wind Farm, Quebec (200 MW) EDF Mont-Rothery Wind Farm, Quebec (76 MW)
Suncor Energy Inc. (Canada) 	136	Cedar Point Wind Farm, Ontario (106 MW) Adelaide Wind Farm, Ontario (40 MW)
NextEra Energy Inc. (United States)	123	Goshen Wind Farm, Ontario (101 MW) East Durham Wind Farm, Ontario (22 MW)
Capital Power Corp. (Canada) 	107	K2 Wind Farm, Ontario (322 MW)





TOP 5 CROWN RENEWABLE ELECTRICITY OPERATORS IN CANADA

Company ³ 	Total Capacity (MW)
Hydro Québec	36,100
BC Hydro	11,826
Ontario Power Generation	6426
Nalcor (Newfoundland & Labrador)	6367
Manitoba Hydro	5243

² Capacity of projects developed includes the portion of the project owned by the company, which may be smaller than the total capacity of the project.

³ This list is limited to owned-and-operated projects. Many crown corporations also have contract agreements that go beyond what is listed here.

TOP 5 CORPORATE RENEWABLE ELECTRICITY OPERATORS IN CANADA (2015)

Company	Projects	Total Capacity (MW)	Project Details
TransAlta Renewables (Canada) 	31	1219	TransAlta Renewables owns 18 wind projects with a total capacity of 1200 MW, 12 small hydro projects with a total capacity of 89 MW and a biomass facility with a 25 MW capacity. TransAlta's share of these projects is 1219 MW.
Brookfield Asset Management (Canada) 	30	1145	Brookfield owns 24 run-of-river facilities with a capacity of 690 MW and 6 wind projects with a capacity of 456 MW. Brookfield is the sole owner of these projects.
Enbridge Inc. (Canada) 	15	1023	Enbridge owns 11 wind projects with a total capacity of 1296 MW and 4 solar projects with a total capacity of 114 MW. Enbridge's share of these projects is 1023 MW.
Fiera Axiom Infrastructure Inc. (Canada) 	43	862	Axiom owns 21 wind projects with a total capacity of 904 MW and 22 solar projects with a total capacity of 277.8 MW. It's ownership share is 862 MW.
Électricité de France (EDF) SA (France)	9	619	EDF owns 8 wind projects with a capacity of 1224 MW and one solar project with a capacity of 23 MW. Its ownership share is 619 MW.

“Canada has a chance to add a **new dimension** to its energy economy—one that is clean, profitable and globally groundbreaking.”

—Annette Verschuren, CEO of NRStor, October 2015



Ontario Emerges as Canada's Energy Storage Pioneer

For all the hardships pioneers face, being first also has its advantages. Companies that manage to solve the energy-storage conundrum—finding affordable and efficient ways to store electricity—will have technology and expertise to sell to the world. And demand for storage is set to surge, as countries start finding ways to meet the ambitious commitments they made at the UN climate negotiations in Paris last year.

What's the big deal with energy storage? Simple. As we all know, variable renewable sources of energy—like wind and solar—aren't always "on," and they aren't always producing power when it's needed. Where it exists, conventional hydro power can act as big batteries, backing up other renewables. But in other circumstances, we'll also need new energy storage technologies to ensure we have a consistent, reliable flow of power to the grid.

Ontario is rapidly emerging as a hub of energy storage innovation. According to the province's Independent Electricity System Operator, Ontario has invested in a mix of energy storage systems, with the aim of making the entire energy system more nimble, so that supply is tailored to better match demand in real time. The technologies—which include hydrogen conversion, thermal storage, flywheel, compressed air, and flow or solid-state batteries—are being developed by

10 companies and are scheduled to collectively produce 50 megawatts of storage capacity.

If the technologies being tested and developed in Ontario prove effective, the province will be in a better position to provide responsive, reliable and affordable energy to consumers—and the companies developing those solutions will be able to ride their pioneering vision straight to the bank.

TESLA ENERGY LAUNCHES THE POWERWALL, GETTING HOMEOWNERS INTO THE ENERGY STORAGE GAME

It's not just provincial utilities and technology developers that stand to benefit as energy storage becomes more reliable and affordable. In 2015, Tesla Energy announced it was developing a wall-mounted battery—the Powerwall—that homeowners could use to modulate their own energy supply and demand, keep appliances running during power outages and (for homes equipped with their own panels) capture solar power produced on-site.

The battery systems will come in two models, ranging in price from \$3000 to \$3500 US plus installation, and can be paired up for more electrical oomph. Canadian buyers should be able to get their hands on the systems this year; media reports indicate the Powerwall will be exclusively distributed by NRStor, a privately held Toronto-based energy storage project developer and owner, founded by Annette Verschuren.

THERE’S A NEW FRONTIER IN ENERGY RESEARCH, AND CANADIAN COMPANIES ARE AMONG THOSE BREAKING TRAIL.

These 10 companies are developing and testing energy storage systems as part of Ontario’s procurement process.

Energy Storage Technology	Company & Storage Capacity
Batteries Lithium-ion (solid-state) batteries and liquid electrolyte “Flow Batteries” store excess electricity from the grid and release that supply back into the grid.	Hecate Energy (14.8 MW) Canadian Solar Solutions Inc. (4 MW) Ameresco Canada Inc. (2 x 2 MW) SunEdison Canada Origination LP. (2 x 2 MW & 1 MW) NextEra Canada Development & Acquisitions, Inc. (2 x 2 MW) Baseload Power Corp. (2 MW)
Flywheels Like batteries, flywheels store and then quickly release energy as needed. Flywheels use a rotor placed within in a vacuum to store and then discharge kinetic energy.	Convergent Energy and Power LLC (12 MW)
Compressed Air Compressed air uses off-peak energy to pump air into a containment area where it is held until needed. It is then released through a combustion turbine.	NRStor Inc. (1.75 MW)
Thermal Thermal energy storage technologies reserve energy in the form of heat or cold. In this way, thermal storage can take excess generation and immediately put it to use, reducing the need to draw electricity at a later time.	Dimplex North America LTD (0.74 MW)
Hydrogen Power-to-gas is a hybrid solution that converts electricity to hydrogen through an electrolyser and injects the hydrogen into a storage tank. A hydrogen fuel cell power module can then be used to create electricity.	Hydrogenics Corp. (2 MW)



Photo: Hybrid flywheel system.
Credit: Simon Dawson, Bloomberg,
Getty Images.

The Vancouver Declaration

“Building on commitments and actions already taken by provinces and territories and the momentum from COP21 in Paris, we are moving toward a pan-Canadian framework for clean growth and climate change that will meet or exceed Canada’s international emissions targets, and will transition our country to a stronger, more resilient, low-carbon economy—while also improving our quality of life.”

—The Vancouver Declaration, March 2016

In March 2016, Prime Minister Trudeau and provincial and territorial leaders gathered in Vancouver for a First Ministers’ meeting on climate change. The outcome of the meeting was the Vancouver Declaration, a work plan for federal and provincial collaboration over the next six months. The analysis and negotiations are intended to produce a national climate and clean growth plan, which will emerge from a First Ministers’ meeting this fall for implementation in early 2017.

The Declaration identifies several commitments relevant to clean energy, including:

- **Transition** to a low-carbon economy by adopting a broad range of domestic measures, including carbon pricing mechanisms.
- **Foster** investments in clean technologies to reduce the carbon pollution associated with the production of energy, including renewable energy.
- **Encourage** the sharing of information, expertise and best practices in order to foster a favourable business environment for investments in innovative clean technologies.
- **Strengthen** pan-Canadian intergovernmental cooperation and coordination on clean growth and climate change, in collaboration with Indigenous peoples.

A New Era of Collaboration

In Canada, electricity systems are largely the domain of individual provinces. Cooperation between the provinces on power production and transmission has proven tricky political terrain to navigate.

The result? Rather than having electricity systems that offer the best value—economically and environmentally—to each region, we have a patchwork of systems.

But 2015 and the early part of 2016 may mark a turning point in collaboration between governments and with

businesses on energy more broadly, and on electricity specifically. With luck, these milestones will mark Canada's progress toward a new era of clean energy and climate coordination.

2015

May 2015

The **Canadian Council on Renewable Electricity** was launched in Ottawa with a focus on educating and engaging Canadians about the opportunity to expand the production and use of renewable electricity across the country. The founding members of the Council are the Canadian Hydropower Association, Canadian Solar Industries Association, Canadian Wind Energy Association, and Marine Renewables Canada.

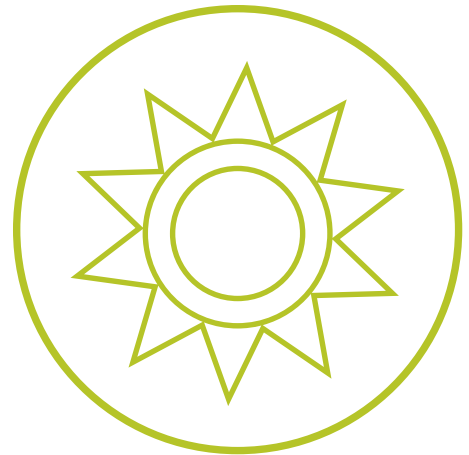
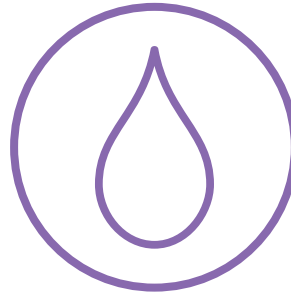
July 2015

The Council of the Federation—comprised of the premiers of Canada's provinces and territories—released their **Canadian Energy Strategy**. Although it's not a detailed blueprint, the strategy includes a focus on facilitating the development of renewable energy and developing transmission networks for domestic and export/import sources of energy.

Ontario and Newfoundland and Labrador announced a commitment to explore opportunities for importing clean and reliable electricity from Newfoundland and Labrador into Ontario. The discussions will be informed by the provinces' shared goals of reducing costs, fighting climate change, improving system reliability, and supporting a dynamic economy.

September 2015

Ontario and Quebec signed a Memorandum of Understanding (MOU) on energy collaboration, which includes a promise to discuss and explore opportunities for greater electricity trade from Quebec to Ontario. The agreement notes that this trade could reduce greenhouse gas emissions by decreasing the amount of natural gas-fired generation during Ontario's nuclear refurbishment period.



2016


January 2016

Alberta and Manitoba signed a **MOU** promising further co-operation on their shared goals of greenhouse-gas emission reductions, innovation, energy efficiency and renewable energy development, including hydroelectricity. It emphasized the importance of improving integration of electrical grids in western Canada to continue the transition to a lower-carbon economy.

March 2016

Prime Minister Justin Trudeau and provincial and territorial leaders—Canada's First Ministers—signed the **Vancouver Declaration** on clean growth and climate change (see Page 15).

The **federal budget** allocated \$2.5 million to Natural Resources Canada over the next two years to study regional clean energy cooperation. The funding aims to identify “the most promising electricity infrastructure projects with the potential to achieve significant greenhouse gas reductions.”

A photograph of Prime Minister Justin Trudeau speaking at a podium. He is wearing a dark suit, a white shirt, and a red patterned tie. The podium has a clear acrylic front and a microphone. In the background, the United Nations logo is visible on the left. The text is overlaid on the left side of the image.

“Last year, nearly a third of a trillion dollars was invested globally in renewable power, nearly fifty per cent more than was invested in power from fossil fuels.

That’s a trend that will continue to grow, and it’s one that represents a **tremendous opportunity** for Canada, and for the world—one we cannot, and will not, ignore.”

—Prime Minister Justin Trudeau, April 2016

A Pivotal Moment in Canada's Clean Energy Transition

Speaking at the World Economic Forum earlier this year, Prime Minister Trudeau stated: “My predecessor wanted you to know Canada for its resources. I want you to know Canadians for our resourcefulness.”

That's no small thing. Seizing the opportunity of transitioning our energy system to clean energy will require—and reward—the resourcefulness of both our business and political leaders. Or, as the Prime Minister put it in that same speech, “Our global push toward a low-carbon economy will produce new companies, new growth, and new prosperity.”

Countries leading the way on clean energy and climate action—developing new technologies and services, deploying them at home and exporting them abroad—stand to benefit economically and environmentally, and will emerge as the energy leaders and economic winners of the 21st century. If we are truly going to realize a pan-Canadian framework on clean growth and climate change, as promised by the Vancouver Declaration, we're going to need an unprecedented level of collaborative and coordinated government policy.

The opportunities and challenges for Canada are different than those our

neighbours and peers face. Already, Canada's electricity system is over 80 per cent non-emitting.

Unlike the United States, which has plenty of room to cut carbon pollution from burning fossil fuels for electricity, the big gains for Canada lie in electrifying everything we can—and making sure our electricity comes from clean and renewable sources.

Provinces will require stronger policies, incentives and programs to transition their energy systems off coal and natural gas and onto a higher proportion of renewables. These measures will be critical to attract clean energy investment in the years ahead. Meantime, the dollars

we invest in clean energy innovation today could pay dividends as new markets open up in Asia, Africa and the Americas. The skills and expertise Canadians are developing will be in demand around the world.

Several years ago, Silicon Valley guru Tim O'Reilly quipped: “Policy should protect the future from the past, not the past from the future.” While this thinking can be applied to just about any topic, it's particularly relevant for those tasked with crafting the policies that will guide the evolution of Canada's energy system and clean energy breakthroughs.

After a decade of federal indifference to climate and clean energy, we have some catching up to do. And now Canada's governments have set themselves an aggressive deadline to deliver a national framework for clean growth and climate change.

If they succeed, it will prove a pivotal moment in Canada's energy transition.



Photo: Solar array in Edmonton, Alberta.

Credit: David Dodge, Green Energy Futures, Flickr.