

A Year for the Record Books



 CLEAN ENERGY CANADA

FEBRUARY 2016

A Year for the Record Books
Tracking the Energy Revolution—Global 2016 edition

February 2016

© 2016 Clean Energy Canada
ISBN: 978-0-9950609-0-6

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”.

Available digitally at www.cleanenergycanada.org.

Design: GOOD Company

Source Data

All data referenced are from Bloomberg New Energy Finance, unless otherwise indicated and accurate as of February 24, 2016. Financial estimates are based on 2015 US dollars, unless otherwise indicated.

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 and 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.

Cover photo: Workers assemble a large solar panel array at India’s Gujarat solar park. In 2015, India regained fifth place globally for clean energy investment, and has set aggressive targets to produce more clean energy in the years ahead.

Credit: Sam Panthaky, AFP, Getty Images.

Photo, opposite: Green Energy Project in Bhutan

An Asian Development Bank (ADB) green energy project that brings greater electrification to rural households in Bhutan and boosts access to green power in neighboring India.

Credit: Asian Development Bank, Flickr.

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.

 **SUBSCRIBE** | cleanenergycanada.org/review

 **FOLLOW** | [@cleanenergycan](https://twitter.com/cleanenergycan)

 **VISIT** | cleanenergycanada.org

CONTENTS

Foreword: While Fossils Crash, Clean Energy Soars	2
Renewable Investment Sets New Record	5
Spotlight on Canada	5
Following the Money	7
New Markets to Watch	7
Clean Technology Delivers More for Less	9
Growth at a Glance	9
Green is the New Black—and it’s Good Business	10
Cities Commit to 100% Clean	10
Canadian Businesses Competing Abroad	11
Bringing the Energy Revolution Home	13



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.

FOREWORD

While Fossils Crash, Clean Energy Soars

Energy headlines in 2015 were dominated by bad news. Plunging oil prices. Oil and gas companies scaling back investment. Coal companies going bankrupt. Job losses.

If it bleeds, it leads.

Turmoil in fossil fuel markets led many analysts to suggest clean energy investment would similarly stall out. How could renewable energy possibly compete with cheap oil, gas and coal?

But clean energy did compete, and it won. Once again, more money flowed into new renewable electricity than new power from fossil fuels.

A record US\$367 billion was invested in renewable power in 2015—a third of a trillion dollars. That's serious money. Clean energy has real momentum, and the commitments underpinning the Paris Agreement on climate change will keep that momentum going.

There's money to be made and money to be saved. For renewable power developers, declining technology and financing costs mean the profits are getting fatter.

For big power consumers, sourcing renewable power can lock in future savings from technologies whose fuel—wind, sun, water, biomass and the earth's heat—is free. Clean energy technology and service companies see market opportunities opening up on every continent. And a growing number of Canadian firms are putting skin in the game.

Other forces are also at play. In countries such as China and India, delivering more power without adding to the smog that already chokes big cities is paramount. In the United States, climate action is driving a shift from coal-fired power to clean energy. African countries, including South Africa, are delivering power to communities for the first time and want to avoid the expense of a centralized grid. Around the world, the growing cost-competitiveness of clean energy makes it an easier and easier choice.

Clean energy is going mainstream. Globally, 96 cities, states and even countries have set ambitious targets to achieve up to 100 per cent renewable energy. And it isn't just governments: some of the world's largest and most-recognized companies are committing to—and securing—100 per cent renewable power.

These global trends need to be on the radar of Canadian business and political leaders, because they paint a picture of great opportunity. We can lead or we can follow, but we cannot stand still.

There will continue to be markets for our fossil fuel resources for some time to come, but their future is increasingly uncertain. It's clear where the puck is going.

Canada has tremendous renewable energy resources, and we have been a leader in capitalizing on them. We have fostered renewable power developers, clean energy technology and service providers. The challenge now is to translate this domestic success into global success. And the clock is ticking.



Merran Smith
Executive Director
Clean Energy Canada



A photograph showing several workers in orange safety vests and yellow hard hats installing large blue solar panels on a metal frame. The workers are positioned around the panels, with one worker in the foreground reaching up to support a panel. The background shows a construction site with trees and a clear sky.

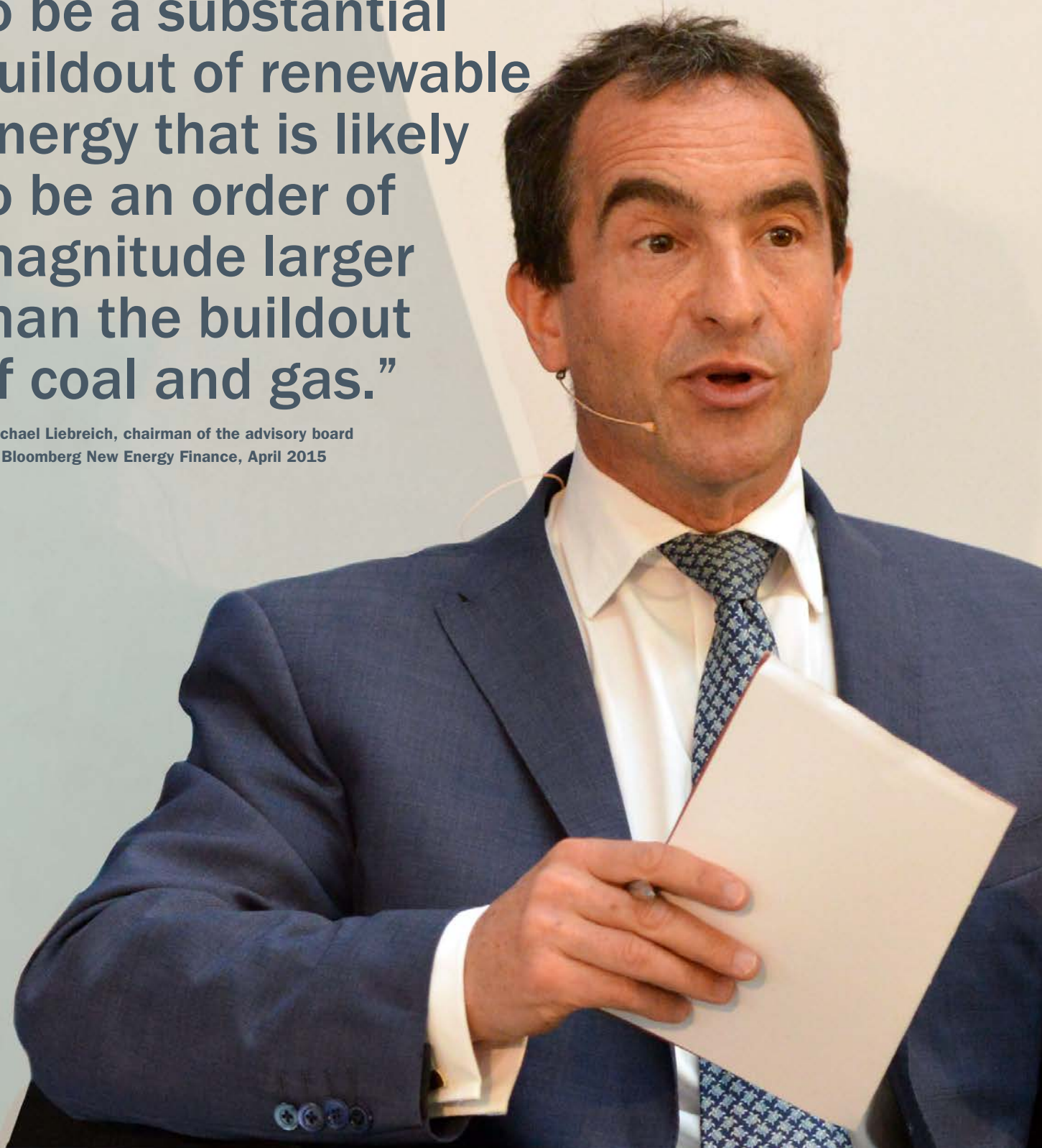
2015 marked the first
year in which more
money was invested
in clean energy in
developing countries
than in developed ones.

Photo: Indian workers construct part of the France-India Solar Direct Punjab Solar Park project in Muradwala, India.

Credit: Narinder Nanu, AFP, Getty Images.

“The electricity system is shifting to clean. Despite the change in oil and gas prices there is going to be a substantial buildout of renewable energy that is likely to be an order of magnitude larger than the buildout of coal and gas.”

—Michael Liebreich, chairman of the advisory board
at Bloomberg New Energy Finance, April 2015

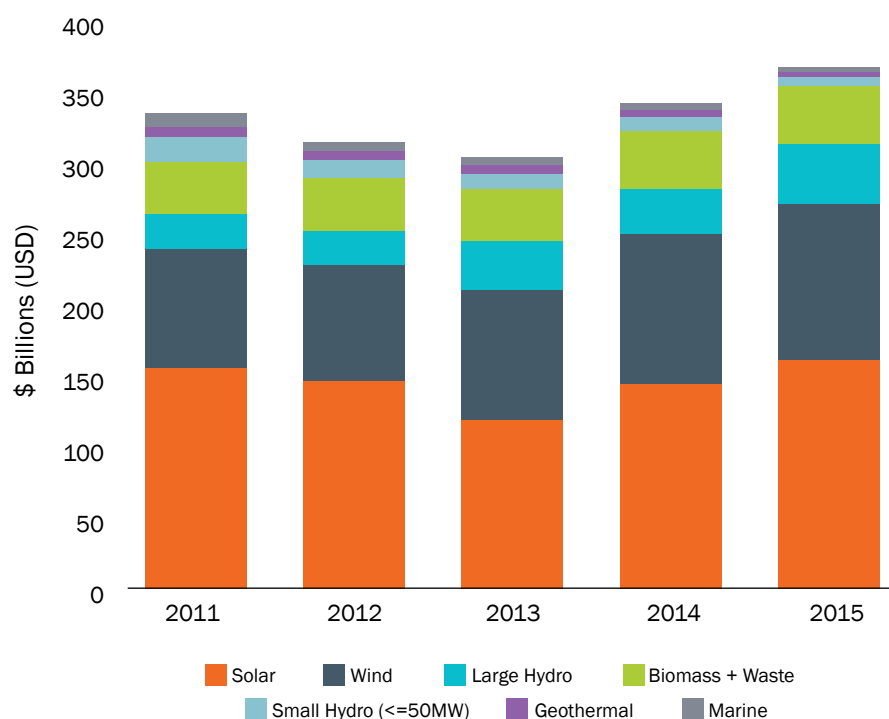


Investment in Renewables Sets New Record

Beating even bullish projections, global investment in clean energy hit a new record in 2015.

More than a third of a trillion dollars—US\$367 billion, to be precise—was invested around the world last year, a healthy seven per cent increase over 2014. Continuing recent trends, China, the United States and Japan were dominant, together making well over half of that investment.

TOTAL ANNUAL CLEAN ENERGY INVESTMENT



SPOTLIGHT ON CANADA



While Canada retained its eighth-place ranking for clean energy investment, 2015 totals were down 46 per cent from 2014, dropping to US\$4 billion. Why?

Canada has a patchwork of provincial renewable power policies varying from province to province, and these policies haven't provided long-term certainty. The country has also suffered from a lack of overarching federal policy support: pipelines trumped powerlines as a national priority. But there was good news late in 2015—Alberta and Saskatchewan both announced targets to increase their production of renewable power, and the newly elected federal government has indicated that getting more clean energy on the grid is a priority.

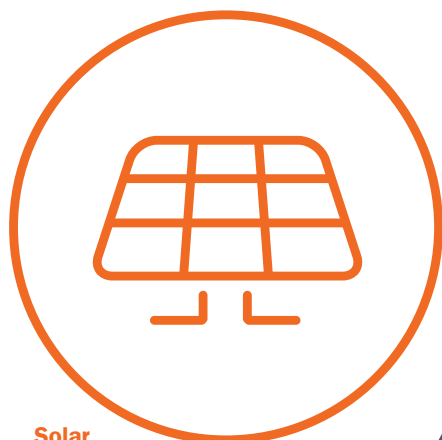
Photo, opposite: Michael Liebreich, June 2015.

Credit: Chatham House, Flickr.

Photo, sidebar: Alberta Premier Rachel Notley exits the front doors of the legislature in Edmonton.

Credit: Government of Alberta, Flickr.

2015 GLOBAL INVESTMENT (USD) IN RENEWABLE ENERGY BY TECHNOLOGY



Solar
\$161
Billion

Large Hydro
\$42
Billion



Geothermal
\$4
Billion



Wind
\$110
Billion



Biomass + Waste
\$41
Billion



Small Hydro
(≤50MW)
\$6
Billion



Marine
\$3
Billion

India regained fifth spot globally for investment in 2015, and appears poised to rise in the ranks as a clean energy investment destination. The government of Prime Minister Narendra Modi has set incredibly aggressive targets, aiming to deliver 175 GW of new renewable power to the grid by 2022—a five-fold increase.

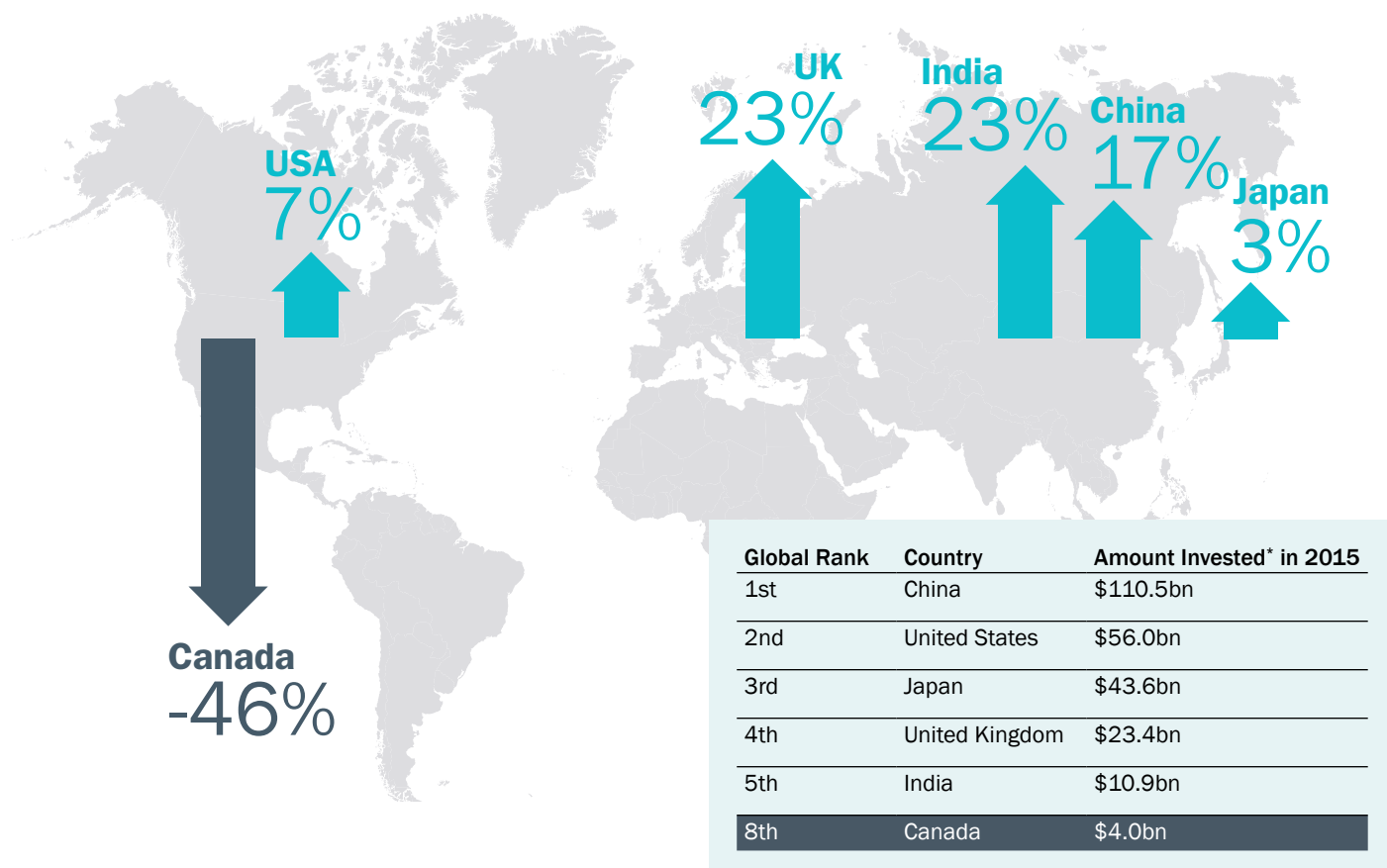


Photo: Meenakshi Dewan tends to maintenance work on the solar street lighting in her village of Tinginaput, India. Huge pylons run across these hills, supplying power to the big cities – but rural areas like this are not connected to the main grid.

Credit: DFID - UK Department for International Development, Flickr.

FOLLOWING THE MONEY

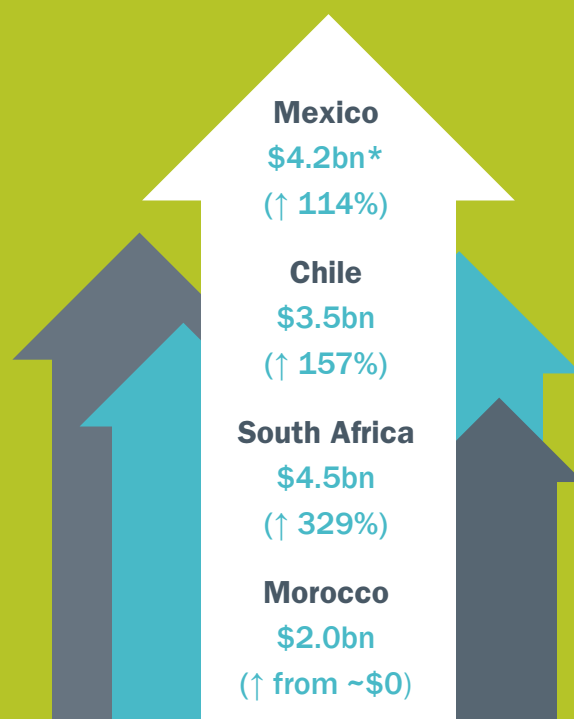
CHANGE IN CLEAN ENERGY INVESTMENT (2014–2015)



NEW MARKETS TO WATCH

2015 also brought a geographical broadening of clean energy as more developing countries got in on the action. In fact, 2015 marked the first year in which more money was invested in clean energy in developing countries than in developed ones.

The Middle East and Africa are two regions with significant clean energy potential. Both have growing populations, and an abundance of solar and wind resources. In the Middle East, 2015 was a breakout year for renewable energy—especially solar. Dubai closed out 2015 by launching a strategy to produce three-quarters of its energy from renewable sources by 2050. Egypt, Jordan and Morocco also moved forward with ambitious plans to harness the region's abundant renewable energy resources. In Africa, low rates of electricity access mean power systems are being developed from scratch—leading the *Economist* to suggest Africa could “leap ahead as one of the world's leading producers of clean energy.” In 2015, Africa and the Middle East had combined clean energy investment of \$13.4 billion, up 54 per cent over 2014.



*All figures in US\$

“We have this handy fusion reactor in the sky called the sun. You don’t have to do anything. It just works. It shows up every day and produces ridiculous amounts of power.”

—Elon Musk, CEO of Tesla Motors and Chairman of SolarCity,
May 2015



Clean Technology Delivers More for Less

In a year in which the world was reminded of the volatility of fossil fuel markets—the high highs, the low lows, and the speed of change between them—renewable energy technology costs continued to decline.

A fundamental benefit of clean energy technologies (like other technologies) is that they follow relatively predictable experience curves.

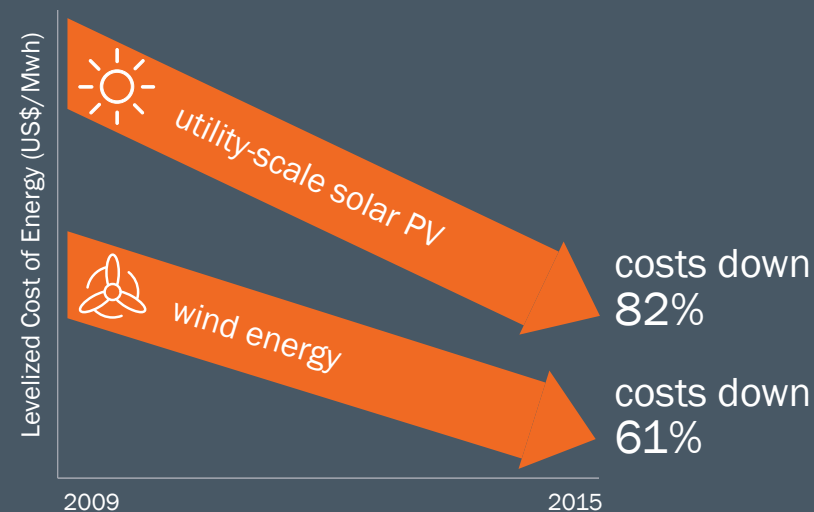
As production and experience scale up, costs come down.

When you couple those declining costs with free fuel from the wind, sun, water, biomass and the earth's heat, you have a formula for ever-

increasing competitiveness with fossil fuels.

In the U.S. over the last six years, wind and solar photovoltaic (PV) systems have become increasingly cost-competitive, without subsidies, thanks to improved efficiency and a material drop in the costs of components like panels, inverters and turbines. The unsubsidized cost of wind energy is down 61 per cent since 2009, and utility-scale solar PV is down 82 per cent.

DROP IN RENEWABLE ENERGY TECHNOLOGY COSTS



SOURCE: Lazard's Levelized Cost of Energy Analysis - Version 9.0 (2015)

GROWTH AT A GLANCE



Wind power deployment led the way: **up 31% in 2015** compared to the previous year, with nearly 64 gigawatts (GW) installed.

Solar deployment just keeps growing: **up 23% over 2014**, and up 96% since 2011—far and away the greatest growth rate in the sector.



Hydro continues to be **the world's dominant renewable power resource** (59%), followed by wind (22%) and solar (13%).

Photo, opposite: Elon Musk, serial entrepreneur, speaks at TED2013 in Long Beach, California.

Credit: James Duncan Davidson

Green is the New Black— and it's Good Business

Around the world, governments and businesses alike are making big commitments to clean energy. The private sector uses about half of the electricity produced globally, so when companies choose to switch to renewable power it can't help but accelerate the transition of global energy markets. Business initiatives like the RE100—a collection of big businesses committed to source 100 per cent of their power from renewables—are picking up steam.

To help companies deliver on these commitments in the United States, the Rocky Mountain Institute launched the Business Renewables Centre in 2015. Its mandate is to help streamline and accelerate corporate procurement of wind and solar power—helping the likes of HP, General Motors, FedEx, eBay, Yahoo and Sprint.

Launched in late 2014, RE100 is a collaborative, global initiative of influential businesses committed to 100 per cent renewable electricity. Their aim is simple: to massively increase corporate demand for renewable energy. These corporate clean energy leaders include:



CITIES COMMIT TO 100% CLEAN

Cities have also stepped up with plans to achieve 100 per cent renewable power—from Aspen to Oslo, Vancouver to Stockholm. More than half of the world's population live in cities. In Canada, that figure rises to more than 80 per cent. And the world's cities are growing fast.

Powering the needs of these cities poses a challenge, but it's also an opportunity to accelerate the transition to renewable energy. In 2015, Renewable Cities—a sister initiative at the Centre for Dialogue at Simon Fraser University—launched with a global learning forum in Vancouver, B.C. The forum brought together leaders from municipalities and government, the private sector and civil society to discuss solutions that would accelerate the adoption of 100 per cent renewable energy within cities globally.



www.renewablecities.ca



CANADIAN BUSINESSES COMPETING ABROAD

“Canada’s few major players in the solar industry are growing up and heading out into the world.”

—Ian Bickis, Canadian Press business reporter, October 2015

Canada’s domestic market for clean energy is only so big, and it hasn’t been growing as fast as elsewhere, so many Canadian companies are competing globally. Here’s a snapshot of some of those firms.

AMP SOLAR GROUP INC.

PORT CREDIT, ON FOUNDED: 2009

AMP Solar Group Inc. is an experienced rooftop solar project developer and a growing leader in utility-scale projects globally. AMP Solar’s portfolio includes one of the world’s largest rooftop solar projects (66 MW) with the Toronto District School Board, which involves installing solar panels on more than 523 individual schools. Other clients include IKEA, Canadian Tire, Lowes, TD Bank, Royal Bank of Canada and Menkes Developments.

In 2015...

AMP Solar signed agreements with 70 agricultural cooperatives in Thailand, energized three PV plants in the UK, and signed an MOU to develop 500 MW in India during Indian Prime Minister Narendra Modi’s visit to Canada.

ELECTROVAYA

MISSISSAUGA, ON FOUNDED: 1996

Electrovaya Inc. designs, develops and manufactures Lithium Ion SuperPolymer® batteries, battery systems and energy storage-related products for the clean electric transportation, portable energy, utility scale energy storage, smart grid power, consumer and healthcare markets.

In 2015...

In May 2015, Electrovaya purchased Europe’s largest lithium-ion battery ‘gigafactory’ (Evonik Litarion GmbH), which provides batteries for electric vehicles in Germany.

CANADIAN SOLAR

GUELPH, ON FOUNDED: 2001

Canadian Solar (NASDAQ: CSIQ) and its subsidiaries operate in 20 countries on six continents. A leading manufacturer of solar PV modules—with more than 30 million PV modules shipped—it also has a 9 GW pipeline of utility-scale power projects.

With R&D investments of over US\$600 million, Canadian Solar holds 217 global patents and strategic R&D partnerships with NREL, ECN and DuPont.

In 2015...

At US\$265 million, Canadian Solar’s acquisition of Recurrent Energy cracked the top-10 biggest clean energy deals of 2015.

Canadian Solar continued to climb the ranks of global PV module manufacturers, and closed 2015 as the second largest.

SKYPOWER GLOBAL

TORONTO, ON FOUNDED: 2003

SkyPower is one of the largest developers and owners of utility-scale solar energy projects in the world, with an extensive pipeline of over 25 GW worldwide. Projects totalling 9 GW of generation capacity—recently announced in bilateral agreements and other contract awards—are to be built in the Middle East, Africa and Southeast Asia over the next five years.

In 2015...

In 2015 SkyPower inked agreements to develop solar projects in India, Bangladesh, Egypt, Panama and Kenya.

In July 2015 SkyPower won the rights to develop 150 MW of solar power in the Indian state of Madhya Pradesh with a record low bid of 7.95¢/kWh.

TANTALUS

BURNABY, BC FOUNDED: 1989

Tantalus Utility Network – TUNet® – is Smart Grid technology that enables a utility to monitor, control and respond to events anywhere and at any time across its distribution network. It serves as the communications backbone that makes smart metering, power quality monitoring, outage reporting, load control, and distribution automation practical and cost-effective. The results include more efficient operations, more accurate billing, and the ability for a utility to deliver a high level of customer service.

In 2015...

Following back-to-back years of more than 50% revenue growth, Tantalus moved ahead with a 50% expansion of its Vancouver headquarters. Why?

To add room for state-of-the-art product testing facilities, customer technical training facilities and modernized engineering labs to support the company’s growth.

HYDROGENICS CORP.

MISSISSAUGA, ON FOUNDED: 2009

Hydrogenics is a developer and manufacturer of hydrogen generation and fuel cell products based on water electrolysis and proton exchange membrane technology.

In 2015...

In South Korea, Hydrogenics began commercial operations of its initial one megawatt fuel cell power system, owned and operated by the Kolon Hydrogenics joint venture.

In China, Hydrogenics signed separate supply agreements with several Chinese electric vehicle integrators to bring its fuel cell and fueling station technology to China.

**“The future markets,
the technologies,
the energy systems
will be low-carbon...
Whether you build
the next pipeline or
not... the economy
of Canada will not
be centred around
a fossil-fuel based
extractive economy.”**

—Achim Steiner, Executive Director
of the UN Environment Programme, January 2016



Bringing the Energy Revolution Home

The global clean energy market is growing—both in size and geography. Every year there are more countries and more companies choosing renewable energy. Using technology to harness energy from the wind, sun, water, biomass and the earth's heat is quickly becoming commonplace.

Renewable energy continues to exceed expectations, thanks in large part to growing recognition that it offers a wide range of benefits: Cleaner air. Less carbon pollution. Dropping technology costs. Free fuel.

The trends of 2015 illustrate how much global momentum there is behind clean energy—and that momentum will only keep increasing in light of the clean energy commitments that underpin the Paris Agreement on climate change.

There is money to be made and Canadian companies are setting their sights on clean energy markets around the world: in Asia, Africa and the Americas. Our largest trading partner—the United States—is the world's second biggest market for clean energy. And countries with whom we want to strengthen trade, like China and India, are destined to

remain high-priority, growing markets in the years and decades ahead.

Canada's performance in 2015 is unsettling, and markedly out of step with other nations: why the dramatic drop in clean energy investment, particularly when our peers and competitors are scaling up?

But there are signs that 2015 will prove anomalous, rather than the start of a new, downward trend. In the forthcoming Canada edition of our Tracking the Energy Revolution series, we'll unpack the details of where, why and how Canadian clean energy investment flowed in 2015.

The end of 2015 was marked by a flurry of changes in Canada's clean energy landscape: new commitments to renewable power in Alberta and Saskatchewan, the promise of carbon pricing in more provinces and even nationally, and a renewed federal commitment to climate leadership on the global stage in Paris.

While carbon-based fuels will remain an important part of the global energy system and Canada's economy for decades to come, their dominance and longevity are increasingly uncertain. What is more certain is that countries leading the way on clean energy—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 of the 21st century.



Photo: View from top of Enereem's Vestas V90
3MW turbine in Madeira, Portugal.

Credit: European Wind Energy Association,
Jason Bickley.