GETTING TO 100

A Status Report on Rising Commitments Among Corporations and Governments to Reach 100% Renewables

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CLEAN EDGE

commissioned by:
SolarCity

THE RISE IN COMMITMENTS

The goal of powering one's company, utility, city, state, or nation with 50%, 75%, or even 100% renewable electricity would have seemed preposterous not long ago. But increasingly, a growing number of companies and governments are aiming to achieve such targets. And nobody is laughing.

Reaching high penetrations of renewables, as we outline in this report, requires an all-of-the-above clean-energy approach. It includes the full portfolio of clean-energy sources including solar, wind, geothermal, biogas, and both existing large-scale and new small-scale hydro. It leverages both distributed and utility-scale generation, as well as offsite solutions such as renewable energy credits (RECs) and utility green power. And it requires a holistic systems approach including not only deployment of renewables, but deep efficiency (LEDs, net zero buildings, etc.), demand-side management, and energy storage.

While reaching 100% renewables may seem like an audacious goal, it's already starting to happen. Apple, for example, went from relying primarily on fossil fuels just a few years ago to powering all of its operations in the U.S. (corporate offices, retail stores, and data centers) with 100% renewables. Other companies to reach 100% renewables for their U.S. operations include Kohl's, Intel, Microsoft, and Unilever. Google, which has already committed more than $2 billion in funding for solar and wind projects, is now setting up data centers powered entirely by renewables.

Many of these companies have relied heavily on RECs to meet their ambitious goals. But while much has been accomplished through RECs, the trend is turning towards onsite and contracted projects for solar, wind, efficiency, and other clean-energy assets, due in large part to falling costs and increasingly available offerings. Unilever USA, for instance, is working to replace all of its REC usage with onsite and offsite renewable generation by 2020. And Walmart, the Environmental Protection Agency Green Power Program's #1 onsite renewable producer, has hundreds of onsite solar projects in the U.S, with hundreds more coming online.

The country of Costa Rica recently achieved a national first – receiving all electricity from renewables generation during the first 100 days of 2015, primarily from a mix of hydro (which typically supplies about 68% of Costa Rica's electricity but which received a huge boost from heavy rains early in the year) and geothermal (about 15%). At least 74 regions in Germany have reached 100% renewable electricity, with more working towards that goal. Several small islands have reached 100% renewables (or very close to it), such as Kodiak Island in Alaska and El Hierro in the Canary Islands. Three U.S. cities are now powered entirely by renewable electricity: Aspen, Colorado; Burlington, Vermont; and Greensburg, Kansas. Notable state-level commitments include Hawaii's recently passed mandate to get to 100% renewable electricity by 2045, Vermont's plan to get 75% of its electricity from renewables by 2032, and California's renewable electricity goal of 50% by 2030.

Timeline of 100% RE Events
(Select Milestones)

1982

Iceland gets greater than **99% of its electricity from hydro and geothermal**

2006

Whole Foods purchases enough **RECs to cover 100% of its electricity** use in stores and other facilities in the U.S. and Canada

2008

The North Face purchases enough **RECs to cover 100% of electricity** usage in North American facilities

2010

Greensburg, KS, powered by **100% wind power** after a 2007 tornado nearly destroyed the town

Kohls purchases enough **RECs to cover 100% of its U.S. electricity use**

2012

All Apple data centers powered by **100% RE**; all U.S. operations reach **100% RE in 2014**

2013

Intel uses **REC purchases and onsite solar** to reach **100% U.S. RE**

Microsoft reaches **global 100% RE usage** through **PPAs, RECs, and some onsite production in FY 2014**

2014

WWF, WRI, and 12 signatories launch the **Corporate Renewable Energy Buyer's Principles**

German state of Schleswig-Holstein (population 2.8M) uses **wind, solar, and biomass** to go **100% renewable**

The **RE100,** led by **The Climate Group in partnership with CDP**, launches with **12 companies** committing to source **100% of their electricity from renewable sources**

Spanish island of El Hierro uses **wind and pumped hydro** to reach **100% RE**

Burlington, VT, becomes the first sizable U.S. city to reach **100% RE**

2015

Costa Rica goes **100 days** using **only hydro, geothermal, and some wind and solar**

Hawaii **(100% by 2045)**, Vermont **(75% by 2032)**, and California **(50% by 2030)** raise the bar for U.S. state renewable commitments

The Rocky Mountain Institute launches the **Business Renewables Center (BRC)**, a collaborative platform aimed at accelerating corporate renewable energy procurement

Nike, Johnson & Johnson, Goldman Sachs, and other Fortune 500s **join the RE100**, bringing the total to **36 companies**

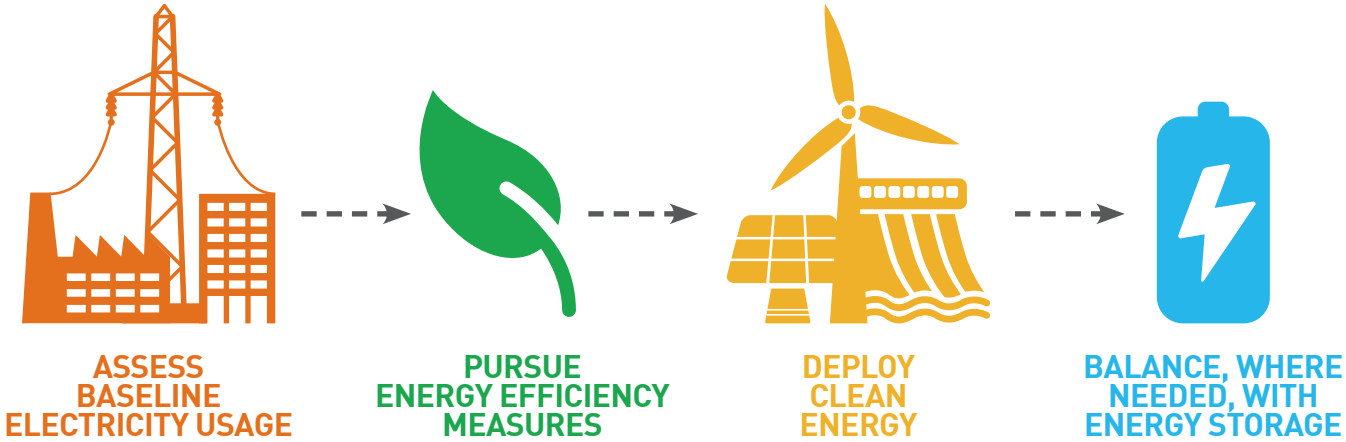
Kodiak Island, AK, reaches **99.7% RE** with **wind and hydro** power backed by storage

Source: Clean Edge research; Note: Clean Edge makes no claim to the logos in the above timeline. All trademarks are the property of the respective companies.

A number of critical developments – a perfect storm of social, technological and financial innovation – are changing the energy ecosystem and enabling this massive and unprecedented shift to a low- and zero-carbon future:

- **Competitive, low-cost renewables** are increasingly becoming the norm for new generation capacity in many regions and geographies, achieving the goal of grid parity with traditional fossil-fuel energy sources, and providing a hedge against volatility in conventional energy markets
- As renewables technology and its financing options expand, a growing number of **companies and governments are demanding that 50%, 70% or even 100%** of their electricity comes from renewables
- The **advent and availability of competitive energy storage systems**, for commercial/industrial, utility, and eventually residential scale, is addressing the intermittency issue for renewables and is poised to dramatically shift the energy equation
- Significant **breakthroughs in energy efficiency technologies and approaches** (a great partner to renewables), including advanced lighting and net zero buildings, are providing deep energy savings across the value chain
- Finally, the drive by governments and companies to **ensure climate resiliency** is reshaping the energy landscape by making progress toward a two-way, intelligent, distributed grid.

Getting to 100% for many businesses and governments won't be easy, and may take many years to implement. Major challenges and roadblocks remain. Companies and governments both have a growing toolkit to pull from as they set goals and deploy strategies. As we highlight in the 100% Renewables Toolkit section below, these include the following four steps:



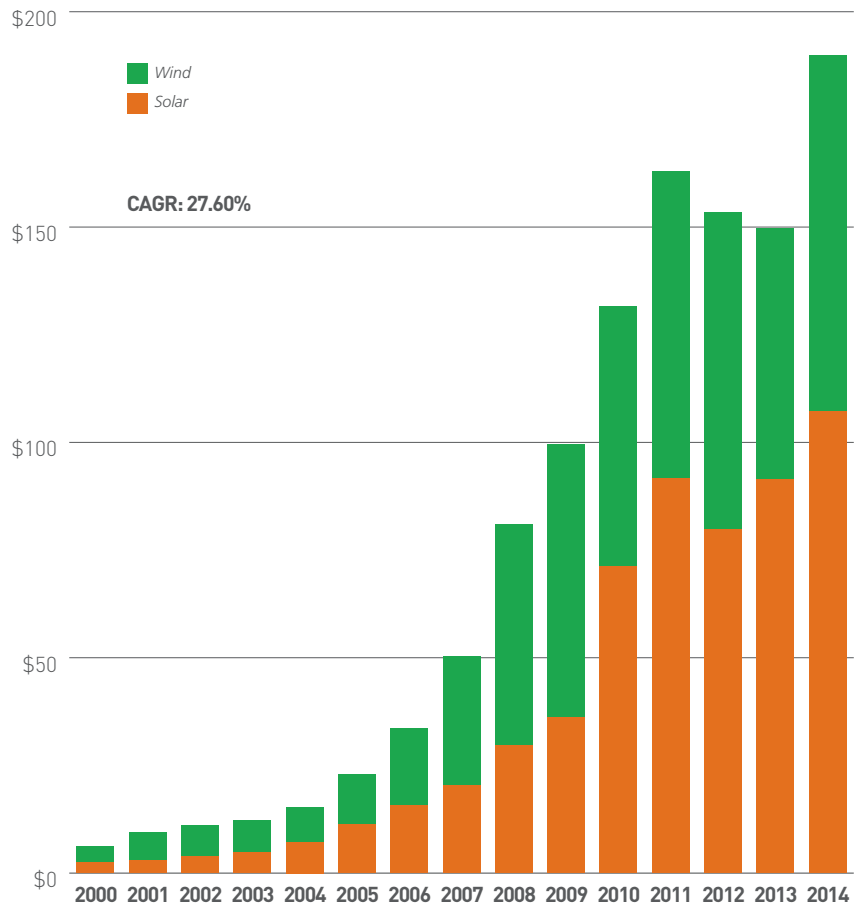
Source: Clean Edge research

THE GROWTH OF RENEWABLES

The growth of renewable energy since the start of the 21st century shows why reaching high penetrations of renewable electricity is no longer a pipe dream for many corporations and governments. In 2000, the size of the global solar PV and wind market was just $6.3 billion. By 2014, the solar and wind markets had expanded into a $190 billion global industry, representing a 14-year compound annual growth rate (CAGR) of 27.6%. In terms of total GW of capacity installed, solar PV has experienced a 14-year CAGR of 42.8%, with wind checking in with a 20.6% CAGR. Such growth rates over a prolonged period of time are rare, generally experienced in rapidly innovating high-tech sectors, not the usually staid energy industry. Sales of personal computers, for instance, saw a 27% CAGR from 1980 to 2000.

The billions of dollars invested in renewable energy over the years are reaping significant deployment levels around the world. According to research organization REN21's 2015 Global Status Report, renewables now outpace coal and natural gas combined for new generation capacity additions. Renewables represented approximately 59% of net additions to global power capacity in 2014, with wind, solar PV, and hydropower dominating the market. Globally, renewables comprised an estimated 27.7% of the world's power generating capacity last year, equaling approximately 22.8% of total global electricity generation.

CHART 1: SOLAR PV AND WIND MARKET SIZE, 2000-2014 ($ BILLIONS)



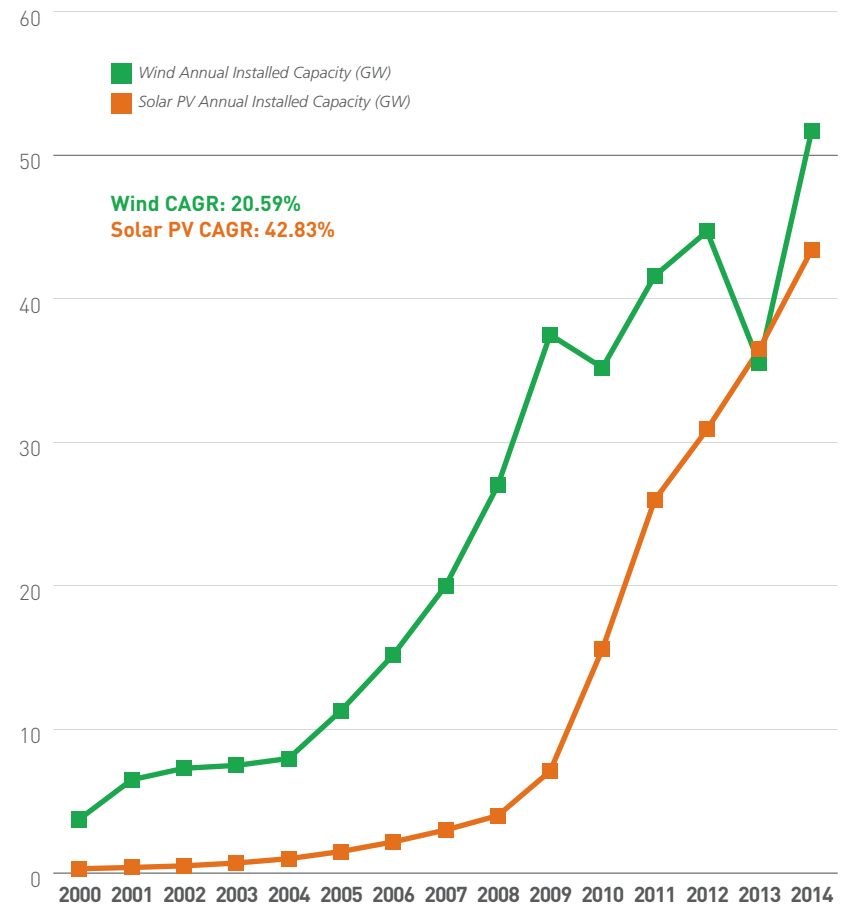
Source: Clean Edge research

Renewable energy's growth in the United States has been equally dramatic. According to Clean Edge's 2015 U.S. Clean Tech Leadership Index, which has tracked clean-energy deployment in the states since 2010, a dozen states have roughly doubled the percentage of electricity they receive from utility-scale renewable sources over the past six years. And 11 states now receive more than 10% of their in-state electricity generation from renewables. Three states – Iowa, South Dakota, and Kansas – now receive more than 20% of their electricity from wind power alone. California broke the 5% milestone for utility-scale solar PV generation in 2014, a first for any state.

While many factors have played a role in this growth, the declining cost of renewable energy has arguably been the most critical. In 2007, the global average cost of a solar PV system spanning residential through utility-scale systems (in dollars per watt) was $7.20. By 2014, that figure had fallen to $2.47 per watt according to Clean Edge estimates, a decline of more than 65 percent in just seven years. Likewise, in August 2015, the U.S. Department of Energy reported that power purchase agreements (PPAs) for power produced in the wind-swept middle sections of the country had fallen to as low as 2.24 cents per kilowatt-hour (kWh), down from 7 cents/kWh in 2009.

In a growing number of places, both wind and solar power are already cost-competitive with fossil fuel-fired power plants, both in the U.S. and internationally – the all-important tipping point known as grid parity. Numerous organizations including the U.S. Energy Information Administration (EIA), the Intergovernmental Panel on Climate Change (IPCC), and the financial advisory company Lazard, have published recent figures showing a MWh of onshore wind power can be produced at least

CHART 2: ANNUAL SOLAR AND WIND INSTALLATIONS, 2000-2014



Source: Clean Edge research

as cheaply as coal or natural gas-fired power. Some of these estimates show it to be even cheaper. For instance, in September 2014, Lazard estimated the levelized cost of electricity (LCOE) in the U.S. for a MWh of wind power ranged from $37 to $81, while a MWh of coal cost between $66 and $151. Meanwhile, the IPCC found global median prices for both coal and onshore wind to be around $80/MWh.

Solar power is also reaching grid parity in an increasing number of areas across the world.

A February 2015 report from Deutsche Bank found at least 39 countries where solar had reached grid parity in part of the country, and projected that it will reach grid parity throughout 80% of all global markets by the end of 2017 at the retail level. Further, it found that 41 U.S. states (including Washington, D.C.) could reach grid parity by 2017. Solar electricity per kWh in these states is expected to range from $0.09 to $0.14, while the average cost of retail electricity could be ten cents higher (or, in Hawaii, a whopping 32 cents greater).

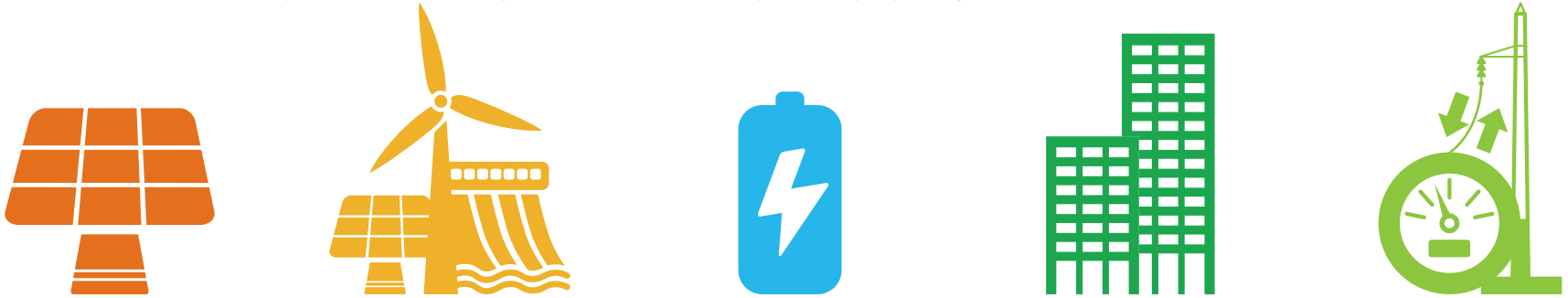
So where has all of this renewable energy development over the last 15 years gotten us? There are an emerging number of examples of geographic locations and businesses that have already reached the 100% RE promised land. Take Greensburg, Kansas, as an example. Nearly destroyed by a massive tornado in 2007, this tiny town in southwest Kansas decided to rebuild in a manner that reflected the town's name. It invested in energy efficient LEED-certified buildings, then built a new 12.5 MW wind farm to power the entire town's electricity needs.

Need a bigger example? How about the many states and sub-state regions across Germany that utilize all solar and wind? Or Reykjavik, Iceland, which gets all of its electricity and heat from geothermal energy? Entire (albeit small) islands, such as El Hierro in the Canary Islands or the South Pacific territory of Tokelau, New Zealand, have used wind and solar to meet 100% of their energy needs.

Businesses have gotten in on the act, as well. Apple gets 100% of the energy for its U.S. operations and data centers from renewable sources, and is working on the same goal for its remaining operations. Once Apple makes it, the world's most valuable corporation will join Microsoft (the fifth most valuable), which gets 100% of all its energy from solar, wind, and purchased renewable energy certificates (RECs). In 2012, Microsoft also took the unique step of instituting an internal price on carbon, serving to increase the value of renewables.

If this is what has been accomplished in the past 15 years, what can be done in the next 15? How can both governments and businesses lead the charge and lead by example? In the following sections of this report, we'll look at what's driving this transition and delve more deeply into the successes and challenges of both governments and companies in targeting, and/or achieving, 100% RE goals. Finally, we'll highlight the key components of a 100% Renewables Toolkit to reach high penetrations of renewable energy generation.

FIVE MAJOR DEVELOPMENTS ENABLING THE SHIFT TO 100%



1 **DISTRIBUTED SOLAR BECOMES COST-EFFECTIVE ACROSS GEOGRAPHIES**

2 **UTILITY-SCALE RENEWABLES GROW UP**

3 **ENERGY STORAGE COMPLETES THE PUZZLE**

4 **NET ZERO BUILDINGS AND SMART CONNECTED DEVICES DRIVE EFFICIENCY RENAISSANCE**

5 **AN EMBOLDENED, RESILIENT GRID TAKES SHAPE**

Source: Clean Edge research

1 DISTRIBUTED SOLAR BECOMES COST-EFFECTIVE ACROSS GEOGRAPHIES

Without question, the proliferation of ever-cheaper distributed solar generation – residential, commercial, and community – is a key driver toward the 100% RE goal. Rooftop or onsite, ground-mounted solar PV arrays are a growing part of the toolkit to expand clean-energy use by individuals, large and small businesses, governments, and increasingly, even utilities themselves.

The cost curves are undeniable. The plummeting prices of solar panels have been well documented, but the industry has recently been attacking balance-of-system costs and so-called soft costs (such as marketing, customer acquisition, permitting, and installation) as well. Bottom line: installed costs of solar PV systems around $3 per watt in the U.S. today will plunge some 40% to less than $2/watt by the end of 2017, according to Deutsche Bank projections.

Innovations in finance have played an equally important role in making solar cost-competitive and affordable. Leasing and third-party financing of PV systems, pioneered by companies like SunEdison and SolarCity, have been huge game changers; 80% of the residential PV installations in California, for example, are owned and financed by third parties. More recent innovations such as YieldCos and green/solar bonds continue to drive billions of dollars in new investment in solar as an asset class. And the use of long-term PPAs (long the exclusive domain of utility energy buyers) by corporate and institutional players has also surged, providing customers with price stability and a hedge against fossil fuel volatility. Corporate buyers now account for some 40% of all wind and solar PPAs in the U.S., according to Bloomberg New Energy Finance.

2 UTILITY-SCALE RENEWABLES GROW UP

While distributed generation is transforming our energy systems, the 100% RE goal is not attainable without significant megawatts from large utility-scale plants tapping wind, solar, and hydropower resources. Fortunately, wind and solar farms have soared in both capacity and generation output over the past decade, and are now viewed by dozens of utilities as key components of the energy mix, as hydro has been for decades. Along with natural gas, they are the fastest-growing segments of utility-scale generation.

In the U.S., for example, utility-scale wind and solar accounted for 47% of all new generation capacity that came online in 2014, and for nearly 70% of new capacity in the first half of 2015. The U.S. is now the world leader in utility-scale solar with 10.5 GW capacity from 604 plants by mid-year 2015, according to the Wiki-Solar database of large projects. China is right on America's heels with 10 GW, from a much smaller number of larger plants (344). Other fast-growing markets for utility-scale solar are the U.K. (#3 in the world), Japan, France, and Canada. Wiki-Solar tracks all plants larger than 4 MW, but many new plants are orders of magnitude larger. First Solar operates two different 550 MW plants in southern California, and after opening they were quickly surpassed as the world's largest by the 579 MW Solar Star plant. Solar Star, owned by Warren Buffett's BHE Energy and operated by SunPower, came online in June 2015.

Large wind farms have operated at utility scale for decades, cranking out many more MW than all but the largest solar plants. The U.S. has more than a dozen wind farms with capacities exceeding 500 MW, and a new 3 GW farm, proposed by Colorado billionaire Philip Anschutz to be the largest ever, has cleared the first regulatory hurdles to start construction in (of all places) Carbon County, Wyoming. As noted in Table 2 on page 14, most companies leading the charge toward 100% RE are procuring at least some utility-scale wind, such as Facebook data centers in Altoona, Iowa (operating) and Fort Worth, Texas (under construction).

But this isn't exclusively a space for large electric utilities. As evidenced by SunPower's involvement in the Solar Star plant, there are plenty of opportunities for utilities and renewables developers to collaborate. Community solar installations – which are generally smaller than utility-scale plants (with some notable exceptions) and allow renters and others who can't install their own panels to access solar power – represent another way that utilities and solar companies can partner. SolarCity is doing just that in Minnesota: it is partnering with local developer Sunrise Energy Ventures and Xcel Energy, the local utility, to build several community solar projects in the Twin Cities area.

At the national and state level, it's currently very hard to reach 100% RE without large-scale hydropower. Although the much more mature hydro industry is not growing like wind and solar, long-established hydro projects in places like Belize, Costa Rica, and Scotland (see Table 4 on page 16) are making significant contributions to those nations' ambitious renewable-energy goals. With the added advantage of providing baseload, dispatchable power – and still providing the world's leading source of energy storage – hydro will be a significant portion of many 100% RE portfolios for many years to come. A growing number of businesses are choosing access to hydropower resources to locate energy-intensive facilities, such as Google's data center in The Dalles, Oregon, and SolarCity's upcoming solar panel plant in Buffalo, New York.

100% RE IN THE NEWS: RECENT HEADLINES

How One Alaskan Island Went 100% Renewable

NV Energy Buys Utility-Scale Solar at Record Low Price Under 4 Cents/kWh

IKEA: Going 100% Renewable Makes "Good Business Sense"

Amazon Takes a Massive Leap Toward 100% Renewable Energy

Wind Power Generates 140% of Denmark's Power Demand

Top Indian Companies Show How They're Going 100% Renewable

City of Austin Gets 1.2GW of Solar Bids at Less than 4c/kWh

Facebook Doubles Renewable-Energy Target to 50% by End of 2018

Vermont and Hawaii Set High Renewable Portfolio Standard Targets

Zero to 100: Companies Double-Down on Climate Action

Nike, Johnson & Johnson, Starbucks, and Others Join Pledge for 100% Renewable Electricity

3 ENERGY STORAGE COMPLETES THE PUZZLE

Renewables may have grown significantly in recent years, but the inability to cost-effectively store energy has been seen as holding back the renewable industry. But that is changing. Now the energy storage industry has begun to boom, thanks largely to technological innovations in batteries and economies of scale that have dropped storage's price to the point where businesses, utilities, governments, and even some individuals can afford it.

Any way you slice it, storage has really begun to take off. Although about 80% of U.S. energy storage is still the traditional pumped hydro storage method, newer technologies, mostly batteries, are where the growth is. GTM Research claims that the U.S. installed 40.7 MW of storage in Q2 2015 alone, which was nine times more than was installed in the same quarter the previous year.

Players big and small have entered the storage arena. Electric car giant Tesla made big waves in April 2015 by announcing stationary storage products for home, business, and utility use. Startups like Advanced Microgrid Solutions reached an agreement in June 2015 to create a fleet of "hybrid electric buildings" using 500 MW worth of Tesla batteries. Other fast-growing companies like Stem are creating the software to control today's advanced batteries. GTM Research projects that new storage deployments in the U.S. will grow from less than 100 MW in 2014 to nearly 900 MW in 2019.

There are a number of reasons for this rapid expansion:

- Storage's costs have fallen dramatically over the last several years, chiefly as a result of improved battery technology and manufacturing processes. According to GTM, battery system prices fell from $3,400/kWh in 2010 to $1,600 in 2014, with further rapid cost declines projected.

- Utilities and commercial customers in particular are taking advantage of these falling costs. Commercial customers benefit from storage's ability to reduce their peak demand charges, which can constitute a significant portion of a large facility's electricity bill.
- Batteries are being used to solve some of renewable energy's intermittency challenges. They can be used to store solar power generated during the day, to be released during the late afternoon and evening hours when factories and buildings are still operating.
- Finally, the role of public policy in storage's rapid ascension can't be overlooked. States from Hawaii to California to Vermont are stepping up their renewable portfolio standard goals, opening the door for more storage to be used to integrate renewables. California, a renewable energy leader that is by far the biggest U.S. single-state market for non-pumped hydro storage, in 2013 instituted a mandate for the state's three major investor-owned utilities (IOUs) to procure 1.3 GW of energy storage by 2020. Storage is also eligible to receive financial incentives through the state's Self-Generation Incentive Program (SGIP).

By most indications, the trends that have led to this storage boom are going to continue. More states are exploring incentives and other ways to incorporate storage into their electricity grids. Prominent among them are New York, Massachusetts, and New Jersey, with states like Texas and Arizona also seen as up-and-coming markets. Their efforts will be driven by continually falling costs. Citi, for instance, released a report in September 2014 that predicted costs as low as "$230/kWh by early next decade." Such prices would open doors for many new customers.

Key questions remain, though. Chief among them is how to open new revenue streams for storage. Energy storage can serve many functions, including peak demand shaving, emergency backup, and frequency regulation. How to both regulate and monetize the value streams offered by these services is still being hammered out. For example, how to fairly compensate frequency regulation services was an issue until October 2011, when the Federal Energy Regulatory Commission (FERC) issued Order 755, requiring grid operators to fairly compensate "fast-ramping" frequency regulation services (such as storage). The Mid-Atlantic states grid operator PJM has been particularly aggressive in implementing this order, and as a result, has installed nearly 70 MW of storage since 2013, easily the most in the U.S. Once issues like this are decided, customers and project developers will be able to garner more revenue from storage, which will increase deployment.

4 NET ZERO BUILDINGS AND SMART CONNECTED DEVICES DRIVE EFFICIENCY RENAISSANCE

Clean generation and energy storage are the key components on the supply side of the 100% RE equation, but "radical efficiency" on the demand side is also critical to achieving the 100% goal. Since the built environment accounts for 32% of global energy demand (and 41% in the U.S., by EIA estimates), any organization or government aiming for 100% RE needs to make its facilities as energy-efficient as possible. And the leading edge of the green building movement is the rapidly growing phenomenon of net zero energy (NZE) buildings – structures that generate the same (or more) energy than they consume.

An NZE building fully powered by renewables is 100% RE by definition, and most leading NZE projects are indeed powered by onsite clean energy resources. In recent years, NZE buildings have grown from a handful of small academic locations, or environmental group offices of less than 15,000 square feet, to large-scale commercial facilities. Although measurements vary, the trusted New Buildings Institute lists two NZE-certified facilities larger than 200,000 square feet – NREL's research support facility in Golden, Colorado, and the Vacaville Transportation Center in

Vacaville, California. Among large facilities nearing NZE but not quite there yet are a Frito-Lay factory in Arizona, a courthouse in Massachusetts, and a 369,000 square-foot McCormick spice warehouse in Maryland.

NZEs may still be a nascent part of the building sector, but that will change in coming years as major new building mandates take effect in the U.S. and overseas. The European Union has mandated that all new public buildings must achieve "nearly zero" energy status by the end of 2018, and that all other new buildings achieve the same goals by the end of 2020. In California, the sweeping new building code mandates known as Title 24 took effect in 2014; they require net zero status for all new residential construction in the state by 2020 and for all new commercial buildings by 2030.

In addition to technologies like LED lighting and electrochromic glass, a wide range of "smart," web-connected technologies that power devices or control systems up or down are helping bring NZE buildings to reality (and spurring efficiency gains in many other sectors as well). The number of homes with smart thermostats roughly doubled in both North America (to 2.5 million) and Europe (to 700,000) in 2014, according to Berg Insight, a Swedish research firm. Overall, the global smart home market – encompassing smart refrigerators, entertainment systems, and many other appliances in the so-called Internet of things – is projected to reach $71 billion in 2018 from $33 billion in 2013, says UK-based research firm Juniper Research. Technologies such as smart thermostats, water heaters, lighting control systems, and sensor networks continue to open new frontiers in both residential and commercial building efficiency. Energy-efficient design and construction is increasingly just a starting point. It's ultra-efficiency in building operations, enabled by smart appliances and the software and networks that control them, that creates a "smart building" achieving NZE or near-NZE goals.

5 AN EMBOLDENED, RESILIENT GRID TAKES SHAPE

An intelligent, two-way electric grid is what ties all of these developments together. Increasing penetration of renewables, distributed renewables, storage devices, electric vehicles (EVs), and devices both "smart" and "dumb" all require an electric grid that is decentralized, more responsive, provides more information, and allows for two-way flows of energy that our current grid does not provide. Fortunately, investments in smart grid technology and deployment are on the increase.

At the heart of the smart grid is the smart meter, which enables two-way communication between electricity providers and end users. It's this technology that helps customers see near-real-time data on electricity prices and consumption, allowing them to make better decisions regarding their energy usage. According to research by Clean Edge, based on EIA data, more than 37% of all electric meters in the U.S. are now smart meters.

Microgrids – localized, distributed electric grids that can disconnect from the larger electric grid – are also enabled by smart grid technology. Microgrid deployment has been growing: Navigant Research estimates that microgrid capacity will grow to more than 4 GW by 2020, from just 685 MW in 2013.

In states such as New York, California, and Minnesota, regulators, utilities, and consumer advocates are grappling with redefining the relationship between utility and customer, while at the same time trying to upgrade the grid. Smart grid technology plays a role in these conversations. It facilitates two-way flows of electricity, provides better information and pricing signals for customers, and could allow utilities to utilize smart devices to provide grid services.

CORPORATE INITIATIVES DRIVING THE 100% RENEWABLES TREND

A growing number of large global corporations, both in the United States and abroad, have made commitments for all or portions of their operations to be powered by 100% renewable energy. And the trend is accelerating.

There are a number of reasons that a company may choose to go 100% renewable. Customer satisfaction, for one. As the public increasingly demands environmentally friendly goods and services, businesses are making public commitments to "green" their operations – sourcing renewable energy, meeting recycling goals, conserving virgin forestland. A second reason for using renewable energy is to help reach mandated RE goals. As more jurisdictions set binding RE targets, it makes sense that companies doing business in those places would change their operations in response.

But perhaps the biggest reason for sourcing renewable energy is that it is simply good business. Early efforts toward 100% RE, such as those of Whole Foods and The North Face in the previous decade, were largely driven by corporate social responsibility goals – with targets often met by the purchase of RECs. Now, firms are finding that rapid cost declines are making direct deployment and procurement of renewables an increasingly attractive financial proposition.

Traditional and virtual power purchase agreements (PPAs) for wind power – and increasingly, large-scale solar as well – can allow companies to lock in low electricity prices for decades at a time, with little to no up-front investment. This creates

TABLE 1: SELECT COMPANIES THAT HAVE ACHIEVED 100% RENEWABLE ELECTRICITY (FOR SELECT GEOGRAPHIES/OPERATIONS)

COMPANY	GEOGRAPHIES COVERED	DATE ACHIEVED
	U.S., all data centers worldwide	2012 for data centers, 2014 for U.S. operations
	U.S.	2013
	U.S.	2010
	All global energy use	FY 2014
	All U.S. stores, headquarters and distribution center, and business travel for North American employees	2008
	Global	2014
	U.S., Canada, and Europe	2013
	U.S.	2007
	U.S., Canada	2006

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cost certainty, which businesses love. And they have a myriad of ways to procure renewable power, including PPAs and onsite renewables such as rooftop solar arrays, in addition to RECs. The movement away from unbundled RECs (which allow a company to receive the benefits of renewable energy without actually receiving the energy itself) is in part due to concerns over additionality: unbundled RECs by themselves do not provide much impetus for further growth in renewables. By using onsite renewables or PPA-purchased off-site generation (and retaining the RECs generated by this power), businesses can also take direct credit for the environmental benefits that renewable energy offers. These and other sourcing strategies – and the challenges that accompany them – will be examined in greater detail in the 100% Renewables Toolkit section on page 17.

While it is admittedly still early days for the 100% RE movement, the list of firms that have pledged to get 100% of their energy from renewable sources is growing. Data centers, for instance, require massive amounts of energy, so it makes sense that many of the world's largest and most prominent technology companies, like Apple, Facebook, Google, Intel, and Salesforce, have all targeted (or even partially achieved) the 100% RE goal (and made huge investments in renewable energy). But it isn't just tech firms: The list of companies with 100% RE commitments includes Whole Foods, Nestle, Walmart, Kohl's, IKEA, and Starbucks, among many others. Many of these firms are members of an increasing number of non-governmental organizations that have sprung up to help them achieve their goals, such as the Rocky Mountain Institute's Business Renewables Center; the Corporate Renewable Energy Buyer's Principles, founded by WWF and World Resources Institute (WRI); and RE100, which is led by The Climate Group and CDP. The business community is starting to get the message: 100% RE is not just the right thing to do, but it's becoming the profitable thing to do as well.

TABLE 2: SELECT COMPANIES SEEKING 100% RENEWABLE ELECTRICITY

COMPANY	GEOGRAPHIES COVERED	TARGET DATE	INTERIM DATE	MOST RECENT REPORTED %
facebook	Global	Long-term; Not Specified	50% by end of 2018	21% (2014)
Goldman Sachs	Global	2020	N/A	N/A
Google	Global	Long-term; Not specified.	N/A	37% (2014)
IKEA	Global	2020	N/A	59% (2014)
MARS	Global	2040	Reduce fossil fuel energy use by 25% by 2015	N/A
	Global	2025	N/A	N/A
salesforce	All data centers	Long-term; Not Specified	N/A	43% (2015)
STARBUCKS COFFEE	Global	Long-term; Not Specified	N/A	N/A
Walmart	Global	Long-term; Not Specified	Produce or procure 7 billion kWh of renewable electricity globally by 2020	26% (2014)

Source: Clean Edge research. Note: Clean Edge makes no claim to the logos in the above table. All trademarks are the property of the respective companies.

A GROWING ROSTER OF GOVERNMENTS TAKE CHARGE

On the public sector side, forward-thinking cities, U.S. states, other sub-national governments, and entire nations have set 100% RE goals (or other very aggressive targets) and enacted other policies to promote the growth of renewables.

Cities like to say that they are on the front lines of climate change, and many have been working hard for many years to de-carbonize their energy systems. In the U.S., the Mayors' Climate Protection Agreement, established a decade ago, committed signatories to meet the greenhouse gas reduction goals set out in the Kyoto Protocol and now has more than 1,000 cities on board. Groups such as C40 and ICLEI Local Governments for Sustainability have been building networks of cities fighting climate change through renewable energy and other means. More recently, many cities across the world – from Sydney to Copenhagen to San Francisco – have committed to getting 100% renewable energy in the near future.

There is even more activity at the state or sub-national level, where regional leaders can band together and create greater change. In the U.S., 28 states and the District of Columbia have some form of Renewable Portfolio Standard in place for their investor-owned utilities. Although a great many RPS goals are fairly modest (or downright weak), some leading states have recently stepped up their game. In June of this year, Hawaii Governor David Ige signed the nation's first 100% RPS mandate, committing the Aloha State to become fully powered by renewable energy by 2045. California, with a population nearly 30 times greater than Hawaii's, passed in September 2015 an arguably even more ambitious mandate of 50% renewables 15 years sooner, by 2030. And three days after Hawaii's action, Vermont Governor Peter Shumlin signed into law a 75% RPS mandate by 2032.

TABLE 3: SELECT GOVERNMENTS THAT HAVE ACHIEVED 100% RENEWABLE ELECTRICITY

GOVERNMENT	POPULATION	DATE ACHIEVED
Aspen, Colorado, U.S.	6,700	2015
Carinthia, Austria	550,000	2013
El Hierro, Canary Islands, Spain	10,700	2014
Greensburg, Kansas, U.S.	777	2010
Iceland	317,351	1982
Kodiak Island, Alaska, U.S.	15,000	2015
Schleswig-Holstein, Germany	2,800,000	2014
Tokelau, New Zealand	1,337	2012

Source: Clean Edge research

Not surprisingly, only a handful of jurisdictions have achieved 100% RE so far, and most of those are tiny islands or very small cities. One notable exception is the nation of Iceland, with abundant hydroelectric resources supplemented by geothermal. With less than 330,000 people, however, Iceland is less populous than the smallest U.S. state. A more impressive example is Schleswig-Holstein, Germany's northernmost state along the Danish border. With a population of 2.8

million (comparable to Nevada), the state reached 100% RE in 2014 with mostly offshore and onshore wind power, along with some solar and biomass.

Germany is an interesting case study that illustrates how national and local policies combine to promote renewable energy expansion. German renewable energy policy turned a corner in the late 1990s when the newly elected Social Democrats began establishing progressively ambitious goals for RE deployment, putting feed-in tariffs and other policies in place to meet those goals. The result has been a staggering increase in renewable electricity, from 3.1% in 1990 to more than 25% today. Key to the RE boom was the emphasis that policy makers placed on sharing the benefits: more than half of the RE capacity installed in Germany is owned by farmers and other citizens, with substantial economic benefits to cities and regions. As of April 2013, 136 regions in Germany had set a goal to reach 100% RE. The emphasis on local participation and control is similar to the approach used in Denmark, a pioneer in wind energy development. Denmark has committed to receiving 100% of its electricity from renewable sources by 2035, and all energy by 2050.

Working hand-in-hand with aggressive renewable energy increases, are CO2 emissions reduction mandates. Nine Northeastern states banded together to create the Regional Greenhouse Gas Initiative (RGGI) cap-and-trade system and began trading in 2008. California, home of the only single-state carbon trading law in the U.S., linked its carbon trading market with that of the Canadian province of Quebec in 2014. Canada's most populous province, Ontario, signed a carbon trading deal with Quebec in April and could potentially join with California's as well. And in 2013 and 2014, China created carbon emissions trading systems (ETS) in five cities and two provinces. In September 2015, China announced it would create a national ETS, covering several key industrial sectors, by 2017.

TABLE 4: SELECT GOVERNMENTS MANDATING HIGH RENEWABLE ELECTRICITY GOALS

GOVERNMENT	POPULATION	GOAL	TARGET DATE
Belize	324,000	89%	2033
California, U.S.	38,800,000	50%	2030
Costa Rica	4,600,000	100%	2021
Denmark	5,700,000	100%	2035 (electricity and heat)/2050 (all other energy)
Germany	80,600,000	80%	2050
Hawaii, U.S.	1,400,000	100%	2045
Munich, Germany	1,500,000	100%	2025
San Francisco, CA, U.S.	852,000	100%	2020
Scotland	5,300,000	100%	2020
Sydney, Australia	4,600,000	100% (including heating and cooling)	2030
Vermont, U.S.	626,000	75%	2032

Source: Clean Edge research

Finally, at the cross-border level, numerous agreements have served to promote RE development. The countries of the European Union (EU) have a goal of obtaining 20% of their total energy from renewable sources by 2020 and 27% by 2030 (it is currently around 15%). These goals, coupled with mechanisms like an ETS, aim to help the continent achieve its goal of 80% reduction in greenhouse gas emissions by 2050. More recently, in November 2014, the U.S. and China agreed to a landmark GHG reduction deal that could also help boost the global push for 100% renewable energy.

THE 100% RENEWABLES TOOLKIT

There are a range of steps that governments and corporations can take to transition to a significant percentage of renewables – including the goal of getting to 100%. The flow chart below highlights the decision-making process and available actions in each of the main buckets.

As mentioned earlier, getting to 100% renewables is not a trivial task and depending on a range of factors, can take years or decades for organizations and regions to achieve. It requires a whole systems approach; one that encompasses a range of decision points and actions.

ASSESS BASELINE ELECTRICITY USAGE

PURSUE ENERGY EFFICIENCY MEASURES

Building Retrofits

- LEDs
- HVAC/Heat Pumps
- Energy Management Systems
- Insulation
- Double-/Triple-Pane Windows
- Efficient Machinery

Demand Response/ Smart Appliances

- Smart Thermostats
- Smart Meters and Connected Devices

Net Zero Buildings (New Construction)

DEPLOY CLEAN ENERGY

Onsite Renewables (Lease or Own)

Utility Scale Renewables (PPA)

Community Solar

Renewable Energy Certificates (RECs)

Utility Green Power Programs & Green Energy Tariffs

Third-Party Clean Energy Offerings (IPP)

Energy Mix of Regional Operations

BALANCE, WHERE NEEDED, WITH ENERGY STORAGE

Distributed Storage

Large-Scale Storage

Source: Clean Edge research

DEPLOY CLEAN ENERGY TOOLKIT OPTIONS

On the following two pages you will find descriptions of the key toolkit resources in deploying clean energy.

Onsite Renewables (Lease or Own)

Solar PV systems dominate here, including rooftop systems, carports, and ground-mounted systems located adjacent to a facility. Onsite generation is one of the most visible and impactful ways for organizations to deploy renewables so that internal and external stakeholders see their commitment to clean energy. Outright ownership of assets is not the only option for enabling projects. Falling prices and prevalent financing options, which often make clean electricity costs lower than conventional offerings, are making it easier to deploy onsite systems and are removing barriers. Not all buildings or locations, however, are well suited to onsite renewables (older roofs in need of replacement, shaded areas, etc.). Small-scale wind power, geothermal, waste-to-resource and micro-hydro are options as well.

Utility-Scale Renewables (PPA)

Solar PV and wind are increasingly at cost parity with grid energy and fossil-based sources, making utility-scale renewables an attractive choice. And large deployments can offer additional economies of scale. Acquiring utility-scale projects requires a skilled, dedicated team of experts and/or partnerships with experienced developers, both of which require moderate to significant amounts of resources. Electricity is most typically acquired under long-term power purchase agreements (PPAs). Some utilities and states have set up roadblocks for companies and governments trying to procure utility-scale renewables, as well as develop onsite distributed systems mentioned above.

A virtual power purchase agreement (VPPA) is an innovative financing structure that can help in some instances. Through this arrangement, a company purchases renewable power and RECs at a fixed price from a renewable energy developer. However, the developer sells that power into the grid, then pays the company a portion of the difference between the PPA price and the price it receives from the grid operator. If the market price is higher than the PPA price, the company ends up making money on the deal. In this way, the developer receives cash to pay for the project, while the company receives a hedge against electricity cost increases. Other utility-scale options include geothermal, hydropower, and waste-to-energy.

Community Solar

In recent years, the availability of community solar has opened up renewables to a larger group of stakeholders. Projects are developed by a utility or third-party provider, with portions or shares of the project sold directly to organizations and individuals. The various parties who pay into the project may acquire the energy credit (say from a specified number of solar panels) via virtual net metering and/or may receive direct payments for the benefits of the project. This is a good option for organizations that otherwise have a challenge installing onsite resources. The ability for developers to pick prime locations can optimize energy resource performance.

Renewable Energy Certificates (RECs)

The solution with perhaps the lowest barrier to entry, RECs enable companies to buy the "environmental and clean-energy" attributes of existing and new renewable deployments. While RECs have had their place in the marketplace for many years, some argue that RECs are a poor substitute to company-sited or direct utility-scale offerings, as they do not guarantee that new cleanly generated electrons are being brought online (a concept known as additionality). Many companies that relied on RECs initially to meet their renewables targets are now moving towards other options where their direct involvement and ownership is apparent.

Utility Green Power Programs & Green Energy Tariffs

Utilities in many parts of the country offer voluntary programs for customers to support clean energy. These offerings are typically sold at a premium (in other words, they are more expensive than the prevailing grid utility mix rates). A few programs have proven successful (usually in communities well-aligned with clean-energy goals or in places where utilities have offered to lock in renewables pricing over a period of time). Most programs, as currently structured (additional cost and little or no passed-on value), have limited participation, however.

A few states and utilities have recently begun offering green energy tariffs aimed at large customers (while at the same time, in some cases, blocking others from participating in the renewables market). These programs promise to help customers procure all or a portion of their energy use from locally installed clean-energy resources. For this offering, the utility develops a portfolio of clean-energy projects (or acquires them from 3rd party sources) and customers are offered a specific rate to pay for accessing a portion of that resource. As regulatory models develop and pricing for renewables continues to decline, this solution may see more availability.

Third-Party Clean Energy Offerings (IPP)

In deregulated markets like Texas and parts of California and the Northeast, energy users can go directly to third-party providers outside of their designated utility. In this scenario, the clean-energy provider (independent power producer, or IPP) builds and operates wind, solar, and other clean-energy assets, and sells access to the power directly to customers. However, since many markets are not deregulated, this option is not available to all market participants.

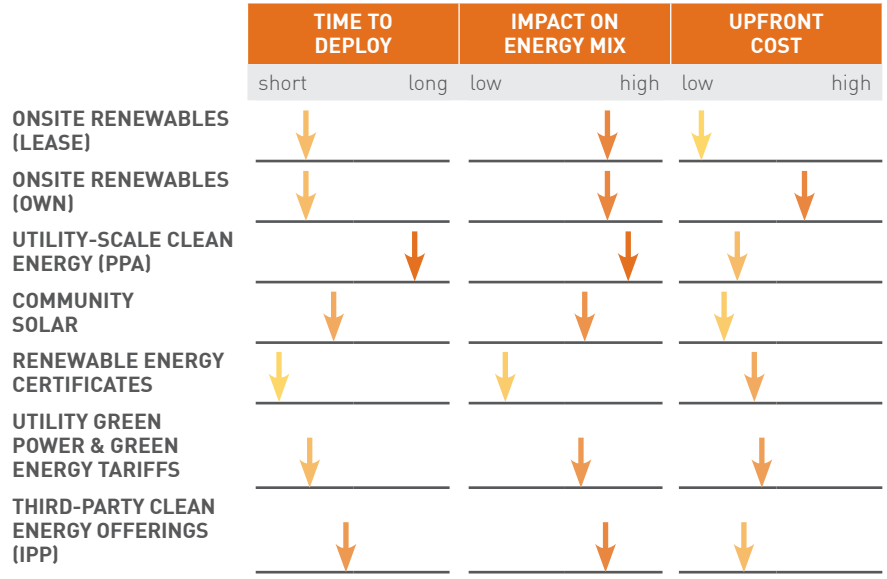
Energy Mix of Regional Operations

The regional mix of energy can have a great impact on how much additional clean energy a government or company needs to procure to meet its renewables goals. For companies expanding their operations, this can have a significant impact on site location efforts. For example, if a company is looking to procure 100% of its electricity from renewables for, say, a new data center, it might choose to locate in a region that already has a high percentage of renewables as part of its existing electricity mix.

But it's important to note that not all pathways are created equal. For example, organizations that want to procure energy generated close to their energy consumption/use would not likely be as interested in RECs, which are generally produced at locations hundreds or even thousands of miles from one's operations and do not necessarily ensure the development and deployment of new clean-energy generating facilities. Similarly, an organization looking to acquire renewables with little or no upfront costs would be more interested in a PPA, loan, or lease arrangement, than buying a system or systems outright. So, an organization's needs, and a host of other factors, will determine which options make the most sense.

TABLE 5: CLEAN ENERGY TOOLKIT COMPARISONS

Below is an assessment, by Clean Edge, on how the various clean-energy toolkit options map against "time to deploy," "impact on direct energy usage," and "upfront costs" for customers. No assessment of this kind is perfect. However, we believe the following illustration helps map out the key issues, and enables stakeholders to better understand the various toolkit options and their potential impacts.



Source: Clean Edge research

CONCLUSION: WHERE WE ARE AND THE ROAD AHEAD

A decade and a half into the 21st century, the mission to reach 100% renewable energy is an increasingly realistic goal (and in a few cases, already a reality) for businesses and governments around the world. Getting there certainly presents daunting challenges, but a growing number of organizations are stepping up to meet them and help attain this aggressive resource optimization, climate, and economic goal.

As Clean Edge has mapped out in this report, the pathways to 100% renewables are varied and multi-dimensional. Even for companies or governments of comparable sizes, there is no one-size-fits-all approach. Options such as onsite renewables, PPAs for utility-scale solar and wind farms, RECs, community solar, and green energy tariffs all have a role to play, depending on geography, costs, budgets, utility regulations, and a host of other factors unique to each entity aiming for such targets.

Yet some strategies are common to virtually every business or government starting down the 100% RE path. Both the demand and supply sides of energy use must be thoroughly scoped out, starting with a comprehensive assessment of current baseline energy consumption and resulting GHG emissions. Maximizing the energy efficiency of existing buildings and operations, as well as new construction, is a critical first step, and dramatically increased deployment of clean-energy resources, in whatever form that takes, will clearly be a strategy employed by most. And increasingly cost-effective energy storage technologies, both distributed and large-scale, are likely to be near-ubiquitous components of the 100% RE toolkit as well.

It's an exciting time, and many trends enabling the 100% RE goal are pointing in the right direction: the declining costs and ever-increasing scale of solar and wind power; varied and innovative financing options; increasing public support; and in many areas, progressive government energy policies and utility regulatory reform.

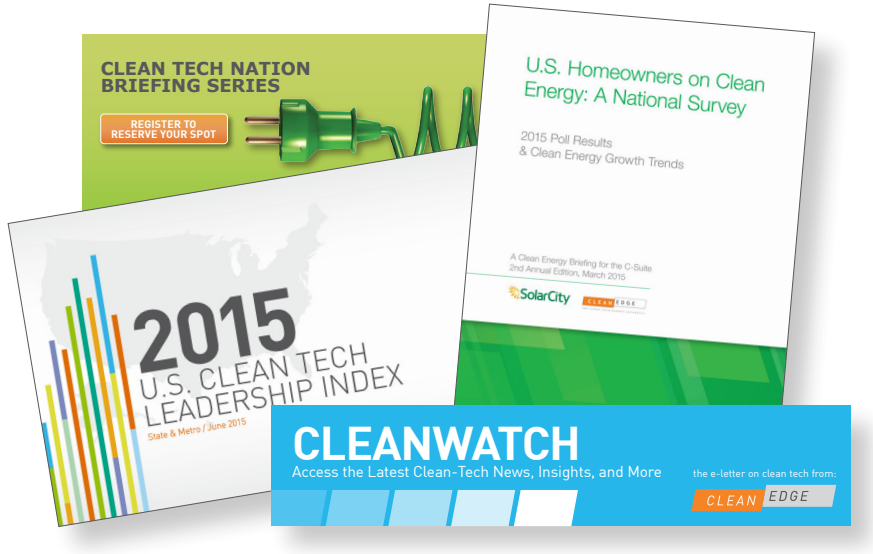
But huge challenges remain. Entrenched business and political interests continue to maintain market and regulatory barriers (and in some areas, erect new ones) toward available and affordable clean-energy options. While some regions are pursuing ever more aggressive efforts, clean-energy supportive regulations and policies are coming under attack in other regions. And utilities and regulators will need to find new ways to work with clean-energy companies – and find ways to value and deploy renewables – to further the transition to low-carbon energy sources. This means that, for the foreseeable future, some regions and nations will be well ahead of others on the road to 100% RE.

For many entities the 100% RE goal is a long-term one. But the rise in commitments to such a future is picking up more adherents. As that momentum grows, it will build an increasing body of resources, best practices, and shared knowledge of the advancements and pitfalls on the road to 100% renewables. In many ways, we are just at the very beginning of this game-changing new phase of the clean-energy revolution: the shift to 100% renewables. It will be a marathon, not a sprint, for sure, but the pace shows no signs of slowing down.

ABOUT & DISCLAIMER

CLEAN EDGE

Clean Edge, Inc., founded in 2000, is the world's first advisory firm devoted to the clean-tech sector, providing stakeholders with timely research, trending analysis, and actionable insights. The firm delivers an unparalleled suite of clean-energy benchmarking services including stock indexes, utility and consumer surveys, and regional leadership tracking, serving companies, investors, NGOs, and governments. Managing director Ron Pernick and senior editor Clint Wilder are coauthors of the widely acclaimed business books *The Clean Tech Revolution* (HarperCollins, 2007) and *Clean Tech Nation* (HarperCollins, 2012). To keep abreast of the latest clean-tech trends, or for more information on the company, visit www.cleanedge.com.



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SolarCity at a Glance

Key Corporate & Government Activities & Milestones

This report was commissioned by SolarCity. SolarCity® (NASDAQ: SCTY) provides clean energy. The company has disrupted the century-old energy industry by providing renewable electricity directly to homeowners, businesses, and government organizations for less than they spend on utility bills. SolarCity gives customers control of their energy costs to protect them from rising rates. The company makes clean energy easy by taking care of everything from design and permitting to monitoring and maintenance. The following timeline showcases the company's key corporate and government activities and milestones.

DECEMBER 2008 — SolarCity announces **SolarLease, a $0-down financing option for California**

JULY 2009 — SolarCity announces new **Power Purchase Agreement (PPA) offering for businesses, schools, and churches**

APRIL 2010 — SolarCity and **City of Lancaster, CA**, announce partnership

JULY 2010 — First SolarCity **Walmart installation** comes online in **Stockton, CA**

2011 — SolarCity launches **Homebuilder Program**, which works with builders nationwide to offer **solar to new home builders for no extra charge**

OCTOBER 2012 — SolarCity, **Los Angeles Unified School District** partner to install **7.4 MW of solar** on 26 schools

DECEMBER 2013 — SolarCity announces **DemandLogic Energy Storage System** for business

NOVEMBER 2014 — SolarCity and **Burton School District** in Porterville, CA announce **solar energy storage project for eight schools**

MARCH 2015 — **Microgrid Service GridLogic** launched worldwide

APRIL 2015 — **DemandLogic, GridLogic** begin incorporating new **Tesla battery** into their offerings

JULY 2015 — SolarCity announces **solar leases for small and medium-sized businesses using California pace financing**

+

SolarCity's **Walmart solar PV system installations exceed 200 projects**

SEPTEMBER 2015 — SolarCity creates new fund to finance **$400 million in solar projects**; firm has raised funds to finance more than **$9 billion in U.S. solar projects**

+

Kauai Island Utility Cooperative announces it will work with SolarCity to install a **solar+storage system with 52MWH of storage**

JUNE 2015 — SolarCity announces its **first community solar initiative in Minnesota**

Source: Clean Edge research

APPENDIX A: COMPANY & GOVERNMENT TABLES WITH ADDITIONAL DETAILS

TABLE 1: SELECT COMPANIES THAT HAVE ACHIEVED 100% RENEWABLE ELECTRICITY (FOR SELECT GEOGRAPHIES/OPERATIONS)

COMPANY	GEOGRAPHIES COVERED	DATE ACHIEVED	HOW ACHIEVED
Apple	U.S., all data centers worldwide	2012 for data centers, 2014 for U.S. operations	Data centers -- powered by a mixture of onsite and offsite (purchased) wind, solar (including concentrated solar), biogas fuel cells, geothermal, and micro-hydro production. Purchased RECs from local sources where these options are not available. Stores and other facilities -- primarily purchased renewable electricity generated locally, or RECs where local RE not available.
Intel	U.S.	2013	Purchased 3.1 billion kWh of RECs in 2014. 20 onsite solar arrays that produce about 12 million kWh.
Kohl's	U.S.	2010	Primarily RECs with significant onsite solar and some wind. 161 U.S. stores have rooftop solar arrays with about 50 MW capacity. Company purchased 1.5 billion kWh of RECs in 2013.
Microsoft	All global energy use	FY 2014	Purchased more than 3 billion kWh via PPAs and RECs in FY14. Also has small amounts of onsite rooftop PV. Investments facilitated by internal price on carbon which has saved the company $10 million and eliminated 7.5 million metric tons of CO2. The company expects to charge business units $20 million for emissions in 2015.
The North Face	All U.S. stores, headquarters and distribution center, and business travel for North American employees	2008	RECs and carbon offsets with small amounts (about 2 MW) of rooftop solar
Steelcase	Global	2014	Achieved through purchase of wind and hydro RECs.
Unilever	U.S., Canada, and Europe	2013	All factories in North America and Europe powered by 100% RE through purchased RECs. In 2014, partnered with NRG in U.S. to procure all electricity through onsite and offsite (purchased) renewables by 2020. Globally, significant investments in biomass, wood waste, and fuel crops.
Voya Financial	U.S.	2007	RECs generated from wind power
Whole Foods	U.S., Canada	2006	Mostly wind power through purchased RECs. Several stores also have rooftop solar PV installations.

Source: Clean Edge research

TABLE 2: SELECT COMPANIES SEEKING 100% RENEWABLE ELECTRICITY

COMPANY	GEOGRAPHIES COVERED	TARGET DATE	INTERIM DATE	MOST RECENT REPORTED %	DETAILS/SPECIFIC PLANS TO ACHIEVE GOAL
Facebook	Global	Long-term; Not Specified	50% by end of 2018	21% (2014)	Most recent data center in Iowa uses 100% wind power purchased from nearby wind farm. New data center under construction near Dallas will also utilize 100% local wind power.
Goldman Sachs	Global	2020	N/A	N/A	Joined RE100 in September 2015 to demonstrate commitment to being carbon zero. Plan to achieve this goal globally through long-term renewable power purchases; where those are not feasible, will use RECs.
Google	Global	Long-term; Not specified.	N/A	37% (2014)	Currently has nine PPAs in place worldwide to access more than 1,100 MW of wind power. Some facilities have rooftop solar totaling about 1.9 MW. Has also invested over $2 billion in wind and solar projects worldwide.
Ikea	Global	2020	N/A	59% (2014)	Goal is to produce as much renewable energy as company consumes by 2020. By end of 2015, will have invested 1.5 billion Euros in renewable energy, particularly offsite wind and onsite rooftop solar PV. Also receives a significant amount of energy from onsite biomass boilers.
Mars	Global	2040	Reduce fossil fuel energy use by 25% by 2015	N/A	Utilizing onsite solar PV panels, wind power, geothermal, hydro, and biomass. Purchase of power from Mesquite Farms wind farm in 2015 achieves 100% RE goal for U.S. operations.
Nike	Global	2025	N/A	N/A	Joined RE100 in September 2015 and formally announced a commitment to 100% RE for owned or operated facilities by 2025.
Salesforce	All data centers	Long-term; Not Specified	N/A	43% (2015)	Currently at 34% RE, all through purchased renewable power (17%) and purchased RECs (26%). Company is working to "steadily increase" amount of renewable power over time, but has no specific commitments.
Starbucks	Global	Long-term; Not Specified	N/A	N/A	As of end of 2015, will have purchased enough RECs to cover 100% of electricity from U.S. and Canada-owned stores. Joined RE100 in September 2015 to "explore ways to further increase its use of renewable electricity as part of its global energy mix."
Walmart	Global	Long-term; Not Specified	Produce or procure 7 billion kWh of renewable electricity globally by 2020	26% (2014)	Currently has 380 renewable projects worldwide. Onsite rooftop solar is a primary resource. Also procures RE through PPAs. Investing in energy storage, as well.

Source: Clean Edge research

TABLE 3: SELECT GOVERNMENTS THAT HAVE ACHIEVED 100% RENEWABLE ELECTRICITY

GOVERNMENT	POPULATION	DATE ACHIEVED	HOW ACHIEVED
Aspen, Colorado, U.S.	6,700	2015	Approximately 50% hydro, with wind and some solar and geothermal making up the rest. In September 2015, the city signed a contract with a wholesale provider in Nebraska to replace the last of its fossil fuel-fired electricity with wind power.
Carinthia, Austria	550,000	2013	Primarily hydro, including pumped hydro storage in this Austrian state. Some rooftop solar and small utility-scale solar PV installations. Some wind and biomass as well.
El Hierro, Canary Islands, Spain	10,700	2014	11.5 MW wind farm backed by pumped hydro on island in the Canaries. Also some solar thermal and rooftop PV.
Greensburg, Kansas, U.S.	777	2010	12.5 MW wind farm, supplemented by small rooftop solar installations, built after town was nearly destroyed by 2007 tornado. Town also built new public buildings and businesses to LEED certification.
Iceland	317,351	1982	Mostly hydro supplemented with geothermal. These sources supply nearly 100% of electricity and more than 80% of heating and hot water demand (a pair of islands off Iceland's coasts still use some diesel generated power, supplying just .01% of the country's electricity). Currently working to convert transportation sector to electricity.
Kodiak Island, Alaska, U.S.	15,000	2015	30 MW hydropower and 9 MW wind power, backed by 3 MW of battery storage
Schleswig-Holstein, Germany	2,800,000	2014	State currently receives 100% electricity from wind (primarily onshore with some offshore), solar, and biomass. By 2025, state expects to have 10.5 GW onshore wind, 2.5 GW offshore wind, and 2.5-2.9 GW solar.
Tokelau, New Zealand	1,337	2012	1 MW solar array backed by batteries and coconut oil-fired generators on New Zealand island territory

Source: Clean Edge research

TABLE 4: SELECT GOVERNMENTS MANDATING HIGH RENEWABLE EALECTRICITY GOALS

GOVERNMENT	POPULATION	GOAL	TARGET DATE	DETAILS/SPECIFIC PLANS TO ACHIEVE GOAL
Belize	324,000	89%	2033	Currently about 60% of electricity comes from hydro and biomass. Wind power expected to expand under current RE commitment.
California	38,800,000	50%	2030	In January 2015, Gov. Jerry Brown called for increasing the state's Renewable Portfolio Standard to 50% by 2030, along with a doubling of energy efficiency in the state's buildings. The bill was passed in September 2015 and signed by the governor.
Costa Rica	4,600,000	100%	2021	Currently gets about 68% from hydro and 15% from geothermal, with small amounts of wind and very little solar. Currently expanding hydro and geothermal resources, and may look into energy storage.
Denmark	5,700,000	100%	2035 (electricity and heat)/2050 (all other energy)	Expand onshore and offshore wind generation, which already accounts for about 39% of electricity. Supplement with biomass (including use in CHP systems) and solar. Policies in place to encourage electrification of transportation and all other sectors.
Germany	80,600,000	80%	2050	Currently at around 29% of electricity through biomass, wind (onshore and offshore), solar (distributed and utility-scale), and hydro. Numerous policies in place to expand renewables, especially wind and solar. Also promoting cogeneration and renewable heating methods. Solar+storage growing in importance.
Hawaii, U.S.	1,400,000	100%	2045	Currently about 21% of electricity, primarily from wind, biomass, and geothermal, with some solar and hydro. Wind and solar will make up much of new renewable capacity, backed by energy storage.
Munich, Germany	1,500,000	100%	2025	Currently supplied by mixture of 13 hydro plants, 20 solar plants, 2 biomass plants, plus wind and geothermal, all within the Munich region. Municipal utility is planning expansion of solar, hydro, and particularly wind power. Whatever RE can't be generated near Munich is purchased from elsewhere in Germany and Europe in the form of onshore and offshore wind, solar PV and solar thermal.
San Francisco, CA, U.S.	852,000	100%	2020	As of 2011, about 30% hydro and 16% non-hydro renewables. Plan to reach 100% largely involves expanding opportunities for all residents to purchase renewable electricity, such as through green leases and community choice aggregation. Policies also in place to support expanded rooftop solar. Municipal government operations already at 100% RE.
Scotland	5,300,000	100%	2020	As of 2011, had about 3.4 GW of onshore wind and 1.4 GW of hydro, with some biomass and tidal power. Primary expansion sectors will be onshore and offshore wind. Geothermal, fuel cells, storage, and solar PV will also play a role.
Sydney, Australia	4,600,000	100% (including heating and cooling)	2030	City's energy plan calls for obtaining 30% of electricity from renewable electricity (primarily solar and wind), and replacing natural gas with waste gases to make up 100% renewable energy.
Vermont, U.S.	626,000	75%	2032	Currently more than 27% of electricity from renewable sources, especially hydro, biomass, and wind. 2011 Energy Plan currently being updated to reflect new goals going into effect as of June 2015.

Source: Clean Edge research

APPENDIX B: RESOURCES

Groups working toward 100% RE

BUSINESS FOR INNOVATIVE CLIMATE & ENERGY POLICY

HTTP://WWW.CERES.ORG/BICEP Ceres and the members of the Business for Innovative Climate & Energy Policy (BICEP) work with businesses and lawmakers to pass "meaningful energy and climate change legislation"

BUSINESS FOR SOCIAL RESPONSIBILITY

HTTP://WWW.BSR.ORG/EN/ Business for Social Responsibility (BSR) works with businesses, governments, and NGOs "to create a just and sustainable world"

BUSINESS RENEWABLES CENTER

HTTP://WWW.RMI.ORG/BUSINESS_RENEWABLES_CENTER Rocky Mountain Institute and its corporate members have created a "collaborative platform aimed at accelerating corporate renewable energy procurement"

CORPORATE RENEWABLE ENERGY BUYER'S PRINCIPLES

HTTP://WWW.WRI.ORG/PUBLICATION/CORPORATE-RENEWABLE-ENERGY-BUYERS-PRINCIPLES Led by WWF and WRI, the Principles were developed to "spur progress on resolving the challenges [faced] when buying renewable energy." To date, 43 companies are signatories.

GLOBAL 100%RE

HTTP://GO100RE.NET Global 100%RE aims to establish a global network of 100% RE regions

GO 100%

HTTP://GO100PERCENT.ORG/CMS/ The Renewables 100 Policy Institute created the Go 100% Renewable Energy website to showcase the global movement to 100% RE

RE100

HTTP://THERE100.ORG Led by the Climate Group in partnership with CDP, RE100 hopes to get 100 of the world's most influential businesses to commit to going 100% renewable

THE TEN ISLAND CHALLENGE

HTTP://CARBONWARROOM.COM/CONTENT/SMART-ISLAND-ECONOMIES Sponsored by the Carbon War Room and Rocky Mountain Institute, the Ten Island Challenge aims to accelerate Caribbean economies' transition to renewable fuels

WE MEAN BUSINESS COALITION

HTTP://WWW.WEMEANBUSINESSCOALITION.ORG We Mean Business brings together several leading business and climate organizations to help lead the transition to a low-carbon economy

Reports & Roadmaps to Achieve 100% Renewables

CALIFORNIA ENERGY COMMISSION/CALIFORNIA PUBLIC UTILITIES COMMISSION, "NEW RESIDENTIAL ZERO NET ENERGY ACTION PLAN 2015-2020"
HTTP://WWW.CPUC.CA.GOV/NR/RDONLYRES/92F3497D-DC5C-4CCA-B4CB-05C58870E8B1/0/ZNERESACTIONPLAN_FINAL_060815.PDF California's June 2015 plan to meet its goal of having all new homes be zero net energy by 2020

CDP/THE CLIMATE GROUP, "UNLOCKING AMBITION: TOP CORPORATE AND SUB-NATIONAL CLIMATE COMMITMENTS, SEPTEMBER 2015 UPDATE"
HTTP://WWW.THECLIMATEGROUP.ORG/_ASSETS/FILES/UNLOCKING-AMBITION.PDF The most recent update to a large listing of businesses and governments that are seeking or have reached 100% renewable and/or 100% greenhouse gas emission reduction goals

DEUTSCHE BANK SECURITIES, INC., "F.I.T.T. FOR INVESTORS: CROSSING THE CHASM"
HTTPS://WWW.DB.COM/CR/EN/DOCS/SOLAR_REPORT_FULL_LENGTH.PDF A February 2015 analysis that looks at solar costs in the near- to mid-term future and shows how solar has reached grid parity in many parts of the world

GREENPEACE, "CLICKING CLEAN: A GUIDE TO BUILDING THE GREEN INTERNET"
HTTP://WWW.GREENPEACE.ORG/USA/WP-CONTENT/UPLOADS/LEGACY/GLOBAL/USA/PLANET3/PDFS/2015CLICKINGCLEAN.PDF Greenpeace's May 2015 "Clicking Clean" report grades major Internet companies on their commitments and movement towards 100% RE

GREENPEACE INTERNATIONAL/GLOBAL WIND ENERGY COUNCIL/ SOLARPOWEREUROPE, "ENERGY [R]EVOLUTION: A SUSTAINABLE WORLD ENERGY OUTLOOK 2015"
HTTP://WWW.GREENPEACE.ORG/INTERNATIONAL/GLOBAL/INTERNATIONAL/PUBLICATIONS/CLIMATE/2015/ENERGY-REVOLUTION-2015-FULL.PDF A September 2015 update to a set of scenarios detailing how the world can get to 100% renewable energy by 2050.

PRICEWATERHOUSECOOPERS/POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH /INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS/ EUROPEAN CLIMATE FORUM, "100% RENEWABLE ELECTRICITY: A ROADMAP TO 2050 FOR EUROPE AND NORTH AFRICA"
HTTP://WWW.PWC.CO.UK/ASSETS/PDF/100-PERCENT-RENEWABLE-ELECTRICITY.PDF A 2010 roadmap from a major investment bank offering opportunities and consequences for 100% in Europe and North Africa

RENEWABLE ENERGY POLICY NETWORK FOR THE 21ST CENTURY (REN21), "RENEWABLES 2015: GLOBAL STATUS REPORT"
HTTP://WWW.REN21.NET/WP-CONTENT/UPLOADS/2015/07/REN12-GSR2015_ONLINE-BOOK_LOW1.PDF The 2015 version of this annual report provides statistics on worldwide deployment and investment of renewable energy

THE SOLUTIONS PROJECT
HTTP://THESOLUTIONSPROJECT.ORG AND HTTP://WEB.STANFORD.EDU/GROUP/EFMH/JACOBSON/ARTICLES/I/USSTATESWWS.PDF The Solutions Project in May 2015 released a series of roadmaps that show how each state (and several nations) can reach 100% RE using only water, wind, and solar

U.S. DEPARTMENT OF ENERGY, "2014 WIND TECHNOLOGIES MARKET REPORT"
HTTP://WWW.ENERGY.GOV/SITES/PROD/FILES/2015/08/F25/2014-WIND-TECHNOLOGIES-MARKET-REPORT-8.7.PDF A yearly report that highlights developments in the wind power sector, including cost trends

WORLD FUTURE COUNCIL/GLOBAL 100%RE, "HOW TO ACHIEVE 100% RENEWABLE ENERGY"
HTTP://WORLDFUTURECOUNCIL.ORG/FILEADMIN/USER_UPLOAD/CLIMATE_AND_ENERGY/CITIES/POLICY_HANDBOOK_ONLINE_VERSION.PDF A policy handbook from 2014 that highlights eight case studies and offers policy recommendations for governments looking to go 100% renewable

WORLD FUTURE COUNCIL/NORDIC FOLKECENTER/CLIMATE SERVICES CENTER, "FROM VISION TO ACTION: A WORKSHOP REPORT ON 100% RENEWABLE ENERGIES IN EUROPEAN REGIONS"
HTTP://MITIGATIONPARTNERSHIP.NET/SITES/DEFAULT/FILES/FROM_VISION_TO_ACTION_POLICY_RECOMMENDATIONS_FOR_100__RE_IN_EUROPEAN_REGIONS.PDF A report from a 2012 workshop providing an overview of renewable energy policies in Europe, and a roadmap for 100% RE

WWF/CERES/CALVERT INVESTMENTS/DAVID GARDINER AND ASSOCIATES, "POWER FORWARD 2.0: HOW AMERICAN COMPANIES ARE SETTING CLEAN ENERGY TARGETS AND CAPTURING GREATER BUSINESS VALUE"
HTTPS://WWW.CERES.ORG/RESOURCES/REPORTS/POWER-FORWARD-2.0-HOW-AMERICAN-COMPANIES-ARE-SETTING-CLEAN-ENERGY-TARGETS-AND-CAPTURING-GREATER-BUSINESS-VALUE/VIEW A 2014 report from WWF, Ceres, and others detailing business practices in moving towards clean energy while totaling the savings they realize from their efforts

WWF/ECOFYS/OMA, "THE ENERGY REPORT: 100% RENEWABLE ENERGY BY 2050"
HTTP://WWF.PANDA.ORG/WHAT_WE_DO/FOOTPRINT/CLIMATE_CARBON_ENERGY/ENERGY_SOLUTIONS22/RENEWABLE_ENERGY/SUSTAINABLE_ENERGY_REPORT/ In 2011, WWF and others spelled out the main challenges to 100% RE, then laid out a scenario through which it can be reached