

CLEAN ENERGY

by NextGen Climate



In order to address climate change, we must find common sense, economical solutions to reduce carbon pollution by building a clean energy economy.

INTRODUCTION

The United States is on the cusp of transformational change to the electricity sector. The power grid is shifting towards clean, low-cost, and sustainable energy sources that save consumers money and reduce carbon pollution.

Clean energy, once considered too expensive, is now competing headto-head on costs with fossil fuels and even beating them out in many locations around the country. The fundamentals of energy economics are changing and markets are responding accordingly, shown by the record clean energy installations across the United States in recent years.

The opportunity to build this new energy system will be a significant economic driver over the coming decades, especially because clean energy is a better job creator than fossil fuels. U.S. businesses are already leading the way with significant programs to purchase clean power for their operations. But the deck is stacked against clean energy, with the fossil fuel industry exerting inordinate amounts of political influence to prevent a level playing field.

In order to address climate change, we must find common sense, economical solutions to reduce carbon pollution from the electricity sector. The limiting factor for necessary upgrades and improvements to our power sector is not technology or cost, but is political and policy leadership (or lack thereof).

-01-

U.S. CLEAN ENERGY TRANSFORMATION OF THE POWER GRID

The U.S. power sector has driven incredible economic growth, sustained trillions of dollars of economic activity, powered our homes and businesses, employed millions of people, and has been the backbone of the world's best and strongest economy.

Yet the U.S. power grid today looks eerily similar to how our grid looked nearly a century ago.

That is about to change-quickly and for the better.

New clean energy technologies that are cheaper, more efficient, reliable, and sustainable are reaching cost levels lower than traditional fossil fuels and they are disrupting the traditional power market. Market and economic forces are changing the energy landscape for utilities, investors, and policy makers.

Based on the Energy Information Administration's Electricity Annual Viewer data for 2014, current U.S. power generation is *(see Figure 01)*:

- » 39% from coal
- » 4% from wind
- » 27% from natural gas
- » 0.4+% from solar
- » 20% from nuclear

» 6% from hydropower

» 2+% from other sources

About two-thirds of our current power supply comes from sources — like coal and natural gas — that dump carbon pollution in our atmosphere, making the power sector the single greatest U.S. contributor to climate change. Currently, the United States does not have a level playing field in the energy sector, as fossil fuels do not take the cost of cleaning up their pollution and the billions of dollars of subsidies they receive into their accounting.

The Intergovernmental Panel on Climate Change (IPCC) conservatively estimates that, without action, 1–5 percent of global mean Gross Domestic Product (GDP) is at risk every year due to climate change and the risks are even greater in certain localized areas.¹ Many experts, and the IPCC, itself recognize that these estimates represent the lower bound of likely impacts from climate change. From 2010–2014, the United States experienced nearly 50 climate-related disasters with costs in excess of \$1 billion each, and in 2013 alone the United States experienced \$125 billion in expenses from climate-related events.²

4

In order to address climate change, our country must find common sense and economical solutions to reduce carbon pollution from the electricity sector.

The solutions are at hand, and the limiting factor for upgrading and improving our power sector is political and policy leadership (or the lack thereof) not technology.

The fossil fuel industry and utility companies have a strong interest in maintaining the status quo. But while they want the American public to believe that their antiquated, polluting technologies are required to power our country, the shift to clean energy is already underway.

- » From 2009–2014 wind projects accounted for 31 percent of new generating capacity added in the United States. The American wind industry has attracted \$100 billion worth of investments in new projects since 2008.³
- » In 2014, solar accounted for 32 percent of new American generating capacity, and is the single largest source of new capacity through the first two quarters of 2015.⁴ The United States' installed solar capacity reached 20 GW in 2014, enough to power more than 4 million homes.

This growth is reflected in the energy stories of diverse states and regions, and is expected to accelerate.

California, the world's 7th largest economy and home to a carbon pollution cap-and-trade system, helps lead the way in solar energy with 3,549 MW installed in 2014 alone.⁵ In California, over 430,000 advanced energy workers are designing, installing, or building clean energy technologies.⁶

But this solar expansion has spread beyond the usual suspects, with states like North Carolina and Texas, Massachusetts, New Jersey, and New York included among the ten states with the most solar installations last year.⁷ Likewise, Midwestern states like Iowa and South Dakota are leading the nation in wind generation market share, getting over 25 percent of their in-state energy from wind.⁸ As renewables approach cost parity with fossil fuels, and in many cases become less expensive, electric utilities are learning how to integrate more and more clean sources into regular operations. For example, in 2015 Austin Energy recorded the lowest bids ever seen for a utility solar solicitation when it received 1200 MW of solar bids for less than 4 cents/kWh.⁹



[FIGURE 01] 2014 U.S. Power Generation

-02-

CLEAN ENERGY IS OUTCOMPETING FOSSIL FUELS ON COST

Clean energy sources are already competitive with fossil fuels in many cases throughout the United States and the world. Energy analysts use the levelized cost of energy (LCOE) for an apples-to-apples comparison of electricity system costs over their lifetimes, incorporating construction, financing, fuel, maintenance, taxes, and insurance costs. Levelized costs reported by Lazard Financial Advisory in 2014 demonstrated that, even when excluding subsidies, energy efficiency, wind, and utility scale solar are the cheapest forms of electricity generation for new installations.¹⁰

ALTERNATIVE ENERGY	Solar PV – Rooftop Residential						\$180		\$265	
	Solar PV—Rooftop C&I				\$126		\$177			
	Solar PV—Crystalline Utility Scale		\$60	<mark>\$72</mark> \$8	6					
	Solar PV—Thin Film Utility Scale		\$60	<mark>\$72</mark> \$8	6					
	Solar Thermal with Storage		\$118 \$130							
	Fuel Cell			\$11	5		\$176			
	Microturbine			\$102		\$135				
	Geothermal			\$89		\$142				
	Biomass Direct			\$87	\$116					
	Wind	\$37		\$81		\$162				
	Energy Efficiency	\$0	\$50							
	Battery Storage					\$168		\$	265	\$324
CONVENTIONAL	Diesel Generator								\$297	\$332
	Gas Peaking						\$179		\$230	
	IGCC			\$102	2	\$168	\$171			
	Nuclear			\$92	\$124 \$	132				
	Coal		\$66			\$151	I			
	Gas Combined Cycle		\$61	\$87	\$127					
	Levelized Cost (\$/MWh) \$0	\$50)	\$100	\$1	50	\$200	\$250	\$300	\$350

Trends in steeply declining renewable prices are projected to continue far into the 21st century, with zero fuel costs.

These low costs for renewable generation are translating to real savings for consumers. According to a recent analysis by DBL Investors, the average retail electricity price in leading renewables states is 5 percent lower than the price in the states that are furthest behind.¹¹

The Environmental Protection Agency estimates that states that transition to lower carbon energy

Summary of findings in Figure 02:

- » Energy efficiency, from demand management to infrastructure improvements, has the lowest lifetime costs per MWh.
- » Onshore wind is the cheapest energy generation technology available, with minimum and maximum costs lower than those same bounds for any other source on the market.
- » Utility scale solar has reached cost parity with coal and gas today in many regions and is projected to be cheaper than fossil sources throughout most of the United States by 2017.

sources will reduce consumers' electricity bills by about 8 percent by 2030.¹² Likewise, appliance and equipment efficiency standards for household items like refrigerators and clothes washers have proven that energy consumption and price declines can go hand in hand.¹³ In fact, by 2035 these standards will have netted U.S. consumer over \$1 trillion in savings thanks to reduced energy consumption.

Trends in steeply declining renewable energy prices are projected to continue far into the 21st century, with zero fuel costs. On the other hand, traditional energy technologies like coal, oil, and gas are not expected to decline in price because the vast majority of technology, operational, and financing innovations for these sources have already been made during the 100 years they have been on the market. While changes in the supply of fossil fuel resources — such as the recent U.S. shale gas boom — may result in temporary price dips, turbulence in fossil fuel markets reflects their inherent scarcity. Part of the built-in promise of renewable sources, on the other hand, is that they never run out and the cost of harnessing them is drastically driven down by innovation.

Already, energy efficiency is key to obtaining clean, reliable, and affordable electricity in the United



[FIGURE 03]

Technology capital cost* projections, 2010 – 2050

© ROCKY MOUNTAIN INSTITUTE 2011. USED WITH PERMISSION.

> States. At an average cost of just 4.6 cents per kWh saved, energy efficiency is widely considered to be the cheapest "source" of electricity, either clean or carbon-intense.¹⁴ Its importance can only be expected to increase as we transition to a low carbon electricity system.

Past performance and future projections of solar energy prices illustrate the imminent dominance of renewables in energy markets. The historical learning curve for photovoltaic solar has resulted in a decrease in cost of approximately 24 percent every time installed capacity doubles (*see Figure 04*).

Installed solar capacity in America is growing quickly, increasing by 34 percent between 2013 and 2014. The United States has installed over 20,000 MW of solar and that is expected to double in the next two years.¹⁵ This level of activity equates to the installation of a new solar project in the United States every 2.5 minutes.

While solar is the fastest growing renewable energy source right now, we can look to the pace of wind installations — and grid operators' success integrating this resource into the electricity system — as further evidence of the feasibility and inevitability of clean energies. By 2013, wind had already significantly outperformed even the most ambitious Department of Energy (DOE) installation projections from just five years prior.¹⁶ According to the DOE's Wind Vision Report, wind energy is viable in all 50 states.¹⁷

While technology costs are key, they are not the only indicator of value in a generating source. Renewables offer unique services to the electricity grid in terms of security, diversity, and time- and location-based value. Distributed generation secures the grid against impacts from extreme weather, terrorism, and other threats by making our power supply more robust. Likewise, investments to integrate renewable energy, such as installing smart grid technologies, storage, and improvements to transmission and distribution systems, will strengthen the grid as a whole.

The security benefits of a clean energy economy extend far beyond the electricity grid itself. Wind, solar, geothermal, and hydroelectric power are all intrinsically homegrown fuels. Moving our economy away from reliance on fuels sourced from other countries, friend or foe, frees leaders to make geopolitical decisions based on values rather than on concern for our energy security. Transitioning away from fossil fuels protects our economy from the inherent stresses and challenges of pursuing limited resources with increasing scarcity. Capturing the power of wind, solar, and other clean technologies in the United States creates jobs here at home whose economic impacts ripple through local economies across the nation.

The energy system of the 21st century will be driven by wind, solar, energy storage, and other renewable sources. What remains in question is the timing of this fundamental shift, and the answer is based as much on political leadership as on markets. If government leaders move as quickly as possible to create a level playing field for all energy sources, and if industry decision makers pursue investments with long-term profit models, the United States can achieve the economic, public health, and security benefits of clean energy and become the global energy leader of the 21st century. The state of technology is not the limiting factor in this energy equation — and neither are American businesses.

[FIGURE 04]

Module prices continue to decline based on a learning rate



If government leaders move as quickly as possible to create a level playing field for all energy sources, and if industry decision makers pursue investments with long-term profit models, the United States can [...] be the global energy leader of the 21st century.

-03-

U.S. BUSINESS AND CORPORATE LEADERS ARE TRANSITIONING TO CLEAN ENERGY

While political leadership is needed to accelerate these large magnitude changes, U.S. business leaders already recognize their own opportunities.

There is a growing trend among U.S. companies, even those whose primary focus is not energy, to supply more of their energy needs with clean sources. This is not just because they want clean energy, but also because it makes financial sense. According to Ceres and Calvert Investments, 60 percent of Fortune 100 and Global 100 firms have a renewable energy target, a greenhouse gas reduction target, or both.¹⁸ Here are just a few examples:

Apple is an international leader in renewable energy use, powering 100 percent of its U.S. data centers with renewables, and owning or operating several large solar installations in the United States and abroad. Earlier in 2015, Apple signed the largest commercial solar purchase in the United States, investing in a 280 MW California facility that will complete its goal of 100 percent renewable energy for all its facilities. **Google** is another renewable energy leader whose energy investments align with the company's mission to accelerate renewables. Google met 34 percent of its facilities' needs from renewables last year, and has its own commitment to reach 100 percent. In addition to its own energy needs, Google also invests heavily in renewable power projects in the United States and around the world — it has devoted more than \$2 billion so far to 19 projects.

Facebook has also committed to powering its data centers from 100 percent renewable energy, with an interim goal of 50 percent by the end of 2018. In a typical example, one of its recent data centers (in Altoona, Iowa) was co-developed with a 140 MW wind farm that Facebook sponsored nearby.





-04-

BUILDING A CLEAN ENERGY ECONOMY WILL STRENGTHEN OUR NATION'S ECONOMIC OUTLOOK

Transitioning to an economy based on clean energy will be a net benefit to businesses — which is why so many are already doing it — but also to consumers and the country as a whole. Common sense policies that allow markets to efficiently deploy clean energy will strengthen the nation's long-term economic prospects and create millions of jobs building a 21st century energy system.

Global net investment in renewable energy (excluding large hydropower) in 2014 was \$242 billion, up 17 percent from 2013. Meanwhile, fossil fuel power generation net investments amounted to only \$132 billion, marking the fifth straight year renewables have outpaced fossil fuels in terms of net investment in power capacity additions.¹⁹

Countries that incentivize and encourage early investment will reap the most benefits over time. Last year, China invested \$83.3 billion in renewables, a 39 percent increase over their investment in 2013.²⁰ U.S. renewable energy investment in 2014 was less than half of China's, at only \$35.8 billion. *(see Figure 05)*

By continuing to develop and deploy clean energy technologies, America can expand its role as the hub of innovation, partnerships, and talent. As the global clean energy market grows, America's early and active participation will put us in position to reap its rewards. America must win the global clean energy race. The International Energy Agency estimates the United States will need a \$2.1 trillion investment by 2035 to modernize the electricity grid and prepare for more renewable energy. This is equivalent to about \$105 billion in investments each year — triple our current level of clean energy investment.²¹ North America's power grid consists of millions of miles of utility lines, substations, switches, and hardware that will need to be upgraded to more efficient and smarter technology — even while it is already considered to be one of the largest and most complex machines humans have ever built.

By making these smart investments, the Department of Energy estimates that there is the potential to support over a million additional energy sector jobs for the transmission, storage, and distribution sector alone.²²

U.S. renewable energy investment in 2014 was less than half of China's, at only \$35.8 billion.

[FIGURE 05]

Global New Investment in Renewable Energy by Region, 2014 (\$ in billions)



-05-

CLEAN ENERGY CREATES MILLIONS OF JOBS AND IS A BIGGER EMPLOYMENT DRIVER THAN FOSSIL FUELS

Today, clean energy jobs are significantly outpacing fossil fuels jobs. In 2014, the number of people working in solar power surpassed the number of people employed as coal miners.²³ As the technology landscape continues to change, clean energy has the opportunity to be a significant driver of employment in every city, state, and region. These jobs include installing and operating clean energy, performing energy retrofits, designing and researching new technologies, and operating the clean energy businesses of tomorrow. Clean energy has the potential to create millions of jobs across all 50 states. In contrast, fossil fuel jobs are concentrated in relatively small geographic regions where these resources are found.

The solar industry has been a key driver of clean energy employment, and solar jobs are growing 20 times faster than the broader economy.²⁴ The following chart (*see Figure 06*) shows the growth of solar employment, which spans manufacturing, installation, sales, and operations. Over the long term, clean energy creates more jobs compared to fossil fuels such as: coal and natural gas. In fact, solar energy creates eight times more jobs in construction, installation, operations, and maintenance, than coal and natural gas do across full project lifetimes (*see Figure 07*).

[FIGURE 06] Solar Jobs are Growing Faster Than the National Average



[FIGURE 07]

U.S. Job Creation by Energy Source





The United States is already on the road to a clean energy economy. Technology and economics no longer limit our ability to realize this new energy system. With bold political leadership, we can accelerate America's transition to a clean energy economy, win this global clean energy race, strengthen our economy, and help mitigate potentially trillions of dollars of damages from climate change.

Endnotes

- Intergovernmental Panel on Climate Change, "Fourth Assessment Report: Climate Change 2007: 5.7 Costs, benefits and avoided climate impacts at global and regional levels," 2007.
- 2 NOAA, "Billion-Dollar Weather and Climate Related Disasters: Summary Stats," accessed 7/6/15.
- American Wind Energy Association, "Wind Energy Facts at a Glance," accessed 6/15/15.
- 4 Solar Energy Industry Association, "Solar Energy Facts: 2014 Year in Review," 12/17/14.
- 5 Solar Energy Industry Association, "Solar Energy Facts: 2014 Year in Review," 12/17/14.
- 6 Advanced Energy Economy, "California has Largest Advanced Energy Industry in U.S., with over 430,000 Workers, according to First-Ever State Employment Survey," 12/4/14.
- Solar Energy Industry
 Association, "Solar Energy
 Facts: 2014 Year in Review,"
 12/17/14.

- 8 American Wind Energy Association, "U.S. Wind Energy State Facts," accessed 6/19/15.
- 9 Greentech Media, "Cheapest Solar Ever: Austin Energy Gets
 1.2 Gigawatts of Solar Bids for Less Than 4 Cents," 6/20/15.
- 10 Lazard Financial Advisory, "Lazard's Levelized Cost Of Energy Analysis - Version 8.0," 9/2014.
- 11 Nancy Pfund and Anand Chhabra, DBL Investors,
 "Renewables Are Driving Up Electricity Prices Wait, What?" 03/2015.
- 12 Environmental Protection Agency, "Fact Sheet: Clean Power Plan Benefits," 5/11/15.
- 13 Natural Resources Defense Council (NRDC), "Strong U.S. Energy Efficiency Standards: Decades of Using Energy Smarter," 12/2014.
- 14 Lawrence Berkeley National Laboratory, "The total cost of saving electricity through utility customer-funded energy efficiency programs," April 2015.
- 15 Solar Energy Industry Association, "Solar Industry Data," accessed 07/02/15.

- 16 Wind Vision Report, "Appendix B: Summary of 20% Wind Energy by 2030," 3/12/<u>15.</u>
- 17 Wind Vision Report, "Appendix B: Summary of 20% Wind Energy by 2030," 3/12/15.
- 18 CERES, "A majority of world's largest companies are shifting to clean energy," 12/10/12.
- 19 Bloomberg New Energy Finance, "Global Trends in Renewable Energy Investment", 03/2015.
- 20 Bloomberg New Energy Finance, "Global Trends in Renewable Energy Investment", 03/2015.
- 21 Greentech Media, "US Power Sector Needs \$2.1 Trillion in Investments by 2035," 12/19/14.
- 22 Department of Energy Quadrennial Energy Review, "Chapter VIII Enhancing Employment and Workforce Training," 4/21/15.
- 23 Fortune, "In U.S. there are twice as many solar workers as coal miners," 1/16/15.
- 24 Greentech Media, "Solar Is Adding Jobs 20 times Faster Than the Broader Economy, but 'All Bets Are Off' in 2017," 01/15/15.