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Clean Energy Investment in the United States: The View to 2030

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The United States has attracted capital in clean energy markets for more than a decade. Renewable energy, or RE, investment in U.S. wind, solar, hydro, and geothermal power has increased nearly 250 percent since 2004, reaching 36.7 billion in 2013.[1] These numbers only represent part of clean energy's full investment potential as new regulations on carbon emissions and advances in technology will significantly increase demand for low-carbon fuels.

Public and private analyses of future energy use both foresee a surge in natural gas and RE. Relative to 2011 levels, the U.S. Energy Information Administration, or EIA, projects that natural gas consumption will grow 12.2 percent by 2030, even as low prices, debate about exports, and future carbon constraints create an uncertain trajectory for future natural gas development. EIA also predicts that 50.2 percent of new electricity consumption will come from natural gas and 46.6 percent from renewables by 2030.[2]

However, this prediction may be overly conservative. A Deutsche Bank analysis predicts that total coal-based electricity generation will fall from 45 percent in 2010 to 20 percent by 2030[3] and that natural gas will largely replace coal as the majority share of total electricity generation.[4] Deutsche Bank also forecasts a 0.7 percent compound annual growth rate for electricity demand. This is consistent with the past 20-year rate of energy use, despite increased population and urbanization, due to anticipated improvements in efficiency over the next 20 years. As new and existing power plants turn from fossil fuels, energy efficiency will become a greater part of the U.S. energy portfolio.

At the same time, wind and solar energy—which generated only 3 percent of U.S. electricity in 2010—are projected to experience significant growth and provide 17 percent of electricity by 2030.[5] Base load hydropower and geothermal energy are predicted to maintain their current levels of 7 percent of power generation. Altogether, Deutsche Bank predicts that renewable electricity will account for one-quarter of all U.S. electricity generation by 2030.[6]

These findings may show only a slice of clean energy's investment potential for three reasons. First, both states and the federal governments are moving to limit carbon pollution. Second, technological advances in clean energy offer a cost-effective, certain investment opportunity. Finally, financial tools and foreign investment can inject additional capital into the clean energy market. Clean energy is at an apex of viability and affordability as financial institutions and governments seek to secure a lower-carbon future.

Government actions to reduce greenhouse gas emissions

Federal actions

Federal efforts to cut harmful carbon pollution have created an environment ripe for clean energy investment. President Barack Obama's Climate Action Plan outlines a federal plan to lower carbon pollution and prepare the United States for the effects of a warmer climate, including more extreme and frequent storms, sea-level rise, drought, and changes in precipitation.

The Climate Action Plan relies heavily on the Environmental Protection Agency, or EPA, as the main regulatory agency coordinating the administration's effort to lower carbon pollution. The EPA is legally obligated to regulate pollutants that are harmful to public health under the Clean Air Act. Former EPA Administrator Lisa Jackson issued an endangerment finding in 2009 that indicates that greenhouse gases, or GHG—including carbon dioxide, methane, nitrous oxide, and hydro fluorocarbons—are harmful to public health and welfare for current and future generations.[7] The EPA findings align with those of the Intergovernmental Panel on Climate Change, which concluded that human-produced greenhouse gas emissions are already affecting fresh water availability, migration patterns, crop yields, human health, and extreme weather around the globe.[8] The endangerment finding legally obligates the EPA to reduce greenhouse gas emissions. As part of that obligation, the EPA is currently in the process of setting pollution standards for both the transportation sector and power plants. (see Tables 1 and 2 for details and timelines)

TABLE 1

Transportation standards

Date	Standard	Current stage	Details
July 2011	Fuel-economy standards for new cars and light trucks for model years 2017–2025	Finalized standard requires performance equivalent to 54.5 miles per gallon, or mpg, by 2025	• $1.7 trillion in fuel savings • Save 12 billion barrels of oil • Eliminate 6 billion metric tons of carbon-dioxide pollution
September 2011	First round of standards for medium- and heavy-duty vehicles for model years 2014–2018	Finalized standard set through 2018	• $50 billion in fuel savings • Save 530 million barrels of oil • Reduce GHG emissions by 270 million metric tons
February 2014	Second round of standards for medium- and heavy-duty vehicles for model years post-2018 announced	Standards to be finalized by March 2016	• Greater reductions in GHG emissions and fuel savings

Sources: The White House, *Climate Change and President Obama's Action Plan* (2014), available at http://www.whitehouse.gov/share/climate-action-plan; The White House, "Fact Sheet: Opportunity For All: Improving the Fuel Efficiency of American Tricks," Press release, February 18, 2014, available at http://www.whitehouse.gov/the-press-office/2014/02/18/fact-sheet-opportunity-all-improving-fuel-efficiency-american-trucks-bol; U.S. Environmental Protection Agency, *EPA and NHTSA Adopt First-Ever Program to Reduce Greenhouse Gas Emissions and Improve Fuel Efficiency of Medium- and Heavy- Duty Vehicles* (2011), available at http://www.epa.gov/otaq/climate/documents/420f11031.pdf.

TABLE 2

Carbon-pollution standards for power plants

Date	Standard	Current stage	Details
September 2013	Carbon-pollution standard for new power plants	Proposed rule; in comment period	Sets separate standards for natural-gas-fired turbines and coal-fired units
June 2014	Carbon-pollution standard for existing power plants	Proposed rule expected on June 2	States will be responsible for their own state implementation plans to meet the standard

Source: U.S. Environmental Protection Agency, "Carbon Pollution Standards: Regulatory Actions," available at http://www2.epa.gov/carbon-pollution-standards/regulatory-actions (last accessed May 2014).

Both of these types of standards provide opportunities for technological innovation. In particular, the companies that make pollution-reducing and energy-efficient technology will be able to increase supply and energy-efficiency capacity to meet the increased demand for efficiency created by these pollution-limiting regulations.

EPA carbon-pollution standards will require states to meet the federal emissions standards through either submitting their own implementation plans to the EPA or complying with a federal plan imposed on the state. Therefore, states have an incentive to create a plan that fits their unique energy portfolio. Investments in renewable energy, energy efficiency, and demand response—the incentives for consumers to reduce energy use during times of high demand—will be the most effective methods to reduce emissions while creating economic opportunity.

The federal government is also examining how clean energy investment may counteract the effects of extreme weather. The U.S. Department of Energy released a report in 2013 that outlined how extreme weather, droughts, heat waves, and wildfires will affect American energy infrastructure.[9] Hurricane Sandy in 2012 demonstrated consumers' vulnerability when almost 8 million people lost their power across the affected region.[10] Energy producers are also at risk, as storms and sea-level rise could potentially disrupt oil and gas production, as well as electricity generation and distribution. Decreased water availability and higher temperatures could lead to full or partial shutdowns at thermoelectric power plants—those powered by coal, natural gas, and nuclear energy—that need water for cooling. Drought and declining snowpack could cause hydropower shortages. Higher temperatures will also likely lead to the increased use of air conditioning with a higher risk of blackouts and brownouts in some regions during peak electricity consumption.

Resilient grid infrastructure, including micro-grid development, can help alleviate these concerns by producing more reliable energy while mitigating climate change. However, energy infrastructure will need to incorporate new technologies to ensure the resilience and reliability of electricity provision. The U.S. Department of Energy sees opportunities for improved energy efficiency, technologies to reduce water use, and "hardening" existing facilities to endure wildfires, storms, floods, and sea-level rise.[11]

As the federal government limits carbon pollution in power plants and develops higher fuel-economy standards, investors can help the manufacturing, auto, and energy industries meet those requirements.

State actions

State and local leaders have been using a suite of policy tools to limit greenhouse gas emissions, fight climate change, increase demand for clean energy, and drive economic growth. Governors and state legislators, together with key stakeholders, have begun enacting policies to create markets for clean energy. Three major state policies are outlined below.

Renewable portfolio standards

Twenty-nine states and the District of Columbia have implemented renewable portfolio standards, or RPS, laws requiring utilities to generate a certain amount of electricity from renewable energy sources. State RPS reduce the country's dependence on polluting fossil fuels to generate electricity by creating reliable markets for renewable energy development and investment. Over the past two years, public- and private-sector investment in the U.S. clean energy market has reached $77 billion.[12]

The majority of renewable portfolio standards were created after 2003, yet many have been revised and strengthened in recent years. For example, California originally established its RPS in 2003, and Maryland followed suit in 2004. Since the establishment of both laws, state leaders have increased their state's respective standard and updated the law to allow certain renewable energy technologies to count toward the mandate.[13] Maryland's RPS target is now 20 percent renewable energy sources by 2022 with a mandate for solar energy to contribute 2 percent,[14] while California's RPS target is 33 percent by 2020.[15]

In addition to California's renewable energy mandate, the state also requires that the three major power companies—Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric—have electricity storage capacity that can output 1,325 megawatts by 2020.[16] This battery storage mandate, the first in the United States, is an important strategy that will not only help manage and balance the inherent variability of renewable electricity generation but will also significantly accelerate investment in storage technologies.

Today, renewable energy technologies, such as wind, solar, and geothermal, are supplying affordable, reliable, and clean power to the equivalent of 16 million American homes—a result of state RPS policies that create a market for investment.[17] State RPS policies are tools to affordably create significant levels of renewable energy development, and as a result, the deployment of renewable energy attracts investments from manufacturers, creates jobs, and produces revenue for state and local economies.

Net metering

Net metering is a policy that allows customers who supply their own electricity from rooftop solar systems or other technologies to receive a credit on their utility bill for any excess electricity they produce beyond what they use onsite. Net metering policies have been implemented in 43 states and the District of Columbia.[18]

Net metering standards vary from state to state. Utilities in Vermont, for example, must allow net metered systems on a first-come, first-served basis to all customers until the cumulative generating capacity of all the net metering systems on its lines equals 15 percent of the company's peak demand.[19] In Minnesota, there is no limit on statewide capacity, but customers can net meter if their system is less than 40 kilowatts, or kW, in capacity.[20] Also, depending on the state, customers can choose to pay the utility for net consumption monthly or settle the account every 12 months.

RPS and net metering policies can drive greater investment in renewable energy projects when combined with the federal production tax credit or the investment tax credit, both of which help make renewable energy technologies more affordable and viable. Solar panel costs dropped 80 percent between 2008 and 2012, while the cost of wind energy declined 43 percent.[21] Equally significant, American-made products now account for 70 percent of the value of wind turbines installed in the United States, and a new solar project is being installed in the United States every four minutes.[22] If this growth continues at the current pace, the American solar industry could be installing a solar system every minute and twenty seconds by 2016.[23]

States are developing net metering policies, with or without federal assistance, to promote carbon-free energy. At the same time, the decreasing costs of wind and solar technology make these policies more attractive to homeowners. Economic incentives such as net metering lead to consumer benefits of decreased energy costs, which spur further investment in solar and wind.

State cap-and-trade programs

In addition to clean energy targets and incentives, some states have also created carbon markets to spur clean energy demand. The Regional Greenhouse Gas Initiative, or RGGI, was the first market-based regulatory cap-and-trade program to reduce greenhouse gas emissions from power plants in the United States. RGGI was launched in 2008 when 10 states—Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey,[24] New York, Rhode Island, and Vermont—joined together to create a market whereby the proceeds of emissions-allowance auctions are invested in energy efficiency, renewable energy, and other programs that benefit consumers.[25] This program provides millions of dollars in investments to companies that have energy-efficient practices or offer power plant technology that increases efficiency or reduces emissions.

Some have discounted RGGI's ability to generate income or decrease emissions, but changes to the program have yielded significant results. The cost of the permits in RGGI's auctions flat-lined at less than $2 per ton in 2010.[26] At such a low price, the incentive to cut emissions was low to nonexistent—a sign that RGGI's carbon cap was so high that it was not reducing carbon emissions beyond pre-existing business practices. In March 2014, RGGI completed its 23rd auction of CO2 allowances. It was the first auction since a new, much lower cap on emissions from the region's power plants was established in January, and the results were encouraging.[27] RGGI auctioned more than 23.491 million CO2 allowances at a clearing price of $4 per allowance. The March auction generated $93.96 million in proceeds that will now be available to RGGI states for reinvestment.[28] Cumulatively, RGGI auctions have yielded more than $1.6 billion for reinvestment.[29]

Perhaps most significantly, California also launched a cap-and-trade program for greenhouse gas pollution, which began in January 2013.[30] The first year of auctions in California generated more than $525 million in revenue for the state, and the state anticipates that annual auction revenue will rise over time.[31] Gov. Jerry Brown (D) signed two bills into law in September 2012 establishing guidelines on how this annual revenue will be disbursed. The laws do not identify specific programs that will benefit from the revenue but instead provide a framework for how the state will invest cap-and-trade revenue into local projects. The first law requires that the revenue from allowance auctions be spent for environmental purposes with an emphasis on improving air quality.[32] The second law requires that at least 25 percent of the revenue is spent on programs that benefit disadvantaged communities, which tend to suffer disproportionately from air pollution.[33]

Notably, there are also nascent efforts at both intra- and international linking of these sub-national markets. As of January 2014, Quebec formally linked its program with California's cap-and-trade market,[34] and Oregon, Washington state, British Columbia, and China signed memorandums of understanding with California to guide collaboration in addressing climate change.[35]

The impressive growth of renewable energy over the past few years is a signal that state policies—specifically renewable portfolio standards, net metering laws, and cap-and-trade programs—have successfully driven private-sector investment. However, more expansion of all proven forms of renewable energy must be promoted. More investment is needed in order to continue diversifying America's energy sector and create a low-carbon future.

Clean energy technology: Reduced costs, increased efficiency

Global clean energy investments reached $254 billion in 2013, with U.S. investment at $36.7 billion, or 14 percent of the global total.[36] Investment in this sector has been on a downward trend for the past two years, partially reflecting the declining costs of clean energy technologies since less money is now required to buy the same amount of clean energy.[37] Despite lower costs for clean energy systems and upgrades, investment in the first quarter of 2014 rose 9 percent over the same period last year.[38] And new research suggests that annual renewable energy investment will increase 230 percent to $630 billion per year by 2030.[39]

Clean energy technology has become more cost effective and mainstream across the country. In the past five years, wind and solar power use combined have more than doubled and currently make up 4.4 percent of the U.S. electricity generation mix.[40] More and more residents, businesses, and utilities are adopting clean energy technologies, due in large part to lower equipment costs, reduced energy prices, and energy savings potential.

For utilities seeking to add energy capacity, energy efficiency offers a cost-effective alternative to fossil-fuel energy sources. In two recent studies, the American Council for an Energy-Efficient Economy, or ACEEE, and the Lawrence Berkeley National Laboratory, or LBNL, found that energy efficiency is the lowest-cost energy resource.[41] The ACEEE study concluded that utility energy-efficiency programs cost two to three times less than supplying electricity from fossil-fuel resources.[42]

In addition to energy efficiency, renewable energy resources are also competing with and, in some cases, beating out fossil-fuel energy sources on cost. In Colorado, Xcel Energy chose utility-scale solar and wind projects last year over other energy sources based on price alone.[43] MidAmerican Energy Company placed the world's largest onshore wind-turbine order with manufacturer Siemens Energy in December 2013, citing the positive effect the additional wind farms would have on Iowa's economy.[44] In January, a Minnesota administrative judge ruled that utility-scale solar generation was the most cost-effective energy resource to meet 150 megawatts of energy capacity needed by Xcel Energy in the state by 2017.[45]

Advances in renewable energy technology mean declining costs and offer opportunities for large-scale growth. Wind power, geothermal power, and hydropower will continue to play an important part in the future of energy, but solar energy's decreasing cost and accessibility to the general public uniquely suit it for abundant expansion among governments, investors, corporations, and homeowners.

As previously noted, solar panel costs dropped 80 percent between 2008 and 2012, while the cost of wind energy declined 43 percent.[46] As a testament to the growing popularity and affordability of clean energy, solar panels are now being sold in big-box retail stores, including Best Buy, Home Depot, and Lowe's.[47] Last year, IKEA announced that it would begin selling solar panels in its U.K. stores.[48]

Additionally, several major corporations have installed solar arrays on many of their stores, including Wal-Mart, Costco, and Kohl's.[49] Google recently signed a contract for up to 407 megawatts of wind energy to power its Iowa data center.[50] Apple has also been switching to renewable energy, with 94 percent of the electricity for its corporate campuses and data centers now coming from renewable sources.[51] These major retailers recognize that investing in renewable energy can reduce their energy costs and allow them to allocate resources to other business operations.

New home construction is also incorporating clean energy technologies. Homebuilder Shea Homes partnered with solar firm SolarCity in 2012 and has since built and sold more than 1,000 energy-efficient, solar-powered residences in Arizona, California, Florida, Nevada, and Washington state.[52] In Texas, new houses within two communities in the Dallas-Fort Worth area will come with pre-installed solar panels.[53] Solar panel arrays have become standard features for many homebuilders, especially as demand for solar-generated power continues to rise.[54]

Although solar-powered homes and solar panels are not as attainable for low-income households, a recent Center for American Progress study suggests that solar technology is reaching middle-class homeowners in Arizona, California, and New Jersey.[55] In fact, the majority of solar installations are occurring in zip codes with median incomes ranging from $40,000 to $90,000.[56] Solar leasing programs are a major reason why solar technology has spread beyond wealthy homeowners. These programs allow residents to lease solar energy systems owned by third parties, such as Sunrun or SolarCity, rather than purchasing them outright. Solar leasing is available in 14 states and accounts for more than 70 percent of all residential solar installations in California, Arizona, and Colorado.[57] Solar loans, which provide a financing option to property owners that lead to direct ownership of rooftop solar systems, have recently emerged as another viable option that could increase solar adoption.[58] The residential sector is a fast-growing market for solar power, adding 792 megawatts in 2013—a 60 percent increase from the previous year.[59]

As renewable energy becomes even more cost and energy efficient, the demand from residential, industrial, and commercial sectors will only increase. This primes the United States for greater manufacturing, installation, and maintenance employment in the solar and wind industries.

Financial tools for clean energy

Financial tools are contributing to the growth of clean energy investment by driving down the costs associated with raising capital. Large-scale financing for clean energy projects is currently expensive, with capital costs comparable to credit card lending rates and high upfront transactional costs.[60] Financial instruments that are relatively new to the clean energy sector lower the cost of capital by bundling assets or debt. These instruments include securitization; investment yield vehicles, called "yield cos;" and real estate investment trusts, or REITs. By aggregating income-producing assets, these tools can transform non-liquid financial assets into tradable commodities, reduce exposure to financial risk, and provide sources of financing that come with lower transactional costs than can be obtained through traditional bank loans, debt, or equity financing. These instruments appeal to investors because they generally offer attractive returns and the opportunity to diversify investment portfolios.

Through securitization, businesses pool debt, such as solar leases or power purchase agreements, in order to issue tradable securities to investors. In November 2013, solar leasing company SolarCity sold $54 million in bundled cash payments by pooling together more than 5,000 residential and commercial solar contracts in the solar industry's first securitization.[61] SolarCity can now take the proceeds from this sale and invest them in other assets, highlighting securitization's effectiveness in raising capital. A recent study from the Michigan Technological University showed that securitization could lower the cost of capital for solar photovoltaic projects by 5 percent to 13 percent.[62]

Yield cos are corporate structures that are traded on stock exchanges and generate revenue by bundling existing power plants and projects that have fixed, long-term power purchase agreements with utilities. These financial structures are currently gaining popularity within the clean energy industry because of their ability to cheaply raise equity. NRG Energy launched NRG Yield in 2013 with a 1.3-gigawatt portfolio of energy generation assets, becoming the first yield co to include solar and wind resources.[63] SunEdison recently launched the first pure-play solar yield co in the United States, securing $250 million from Goldman Sachs Bank USA during its initial capitalization.[64] By spinning off a portfolio of projects to its newly formed yield co, SunEdison can offer stable, reliable cash flows to individual and institutional investors at lower costs and higher returns for the company.

Similar to yield cos, REITs pool together income-producing assets and issue shares to investors, but they have generally only been used in the real estate and fossil-fuel industries to date. REITs are not subject to corporate taxes, which helps reduce the cost of raising capital. Unfortunately, most clean energy systems do not specifically qualify as "real property" eligible to benefit from REIT designation. Instead, the Internal Revenue Service, or IRS, determines whether clean energy REITs are allowable on a case-by-case basis. Currently, the only clean energy REIT in operation was created by clean energy financier Hannon Armstrong Sustainable Infrastructure Capital Inc., after securing a private letter ruling from the IRS in 2013.[65] Newly proposed regulations released by the IRS in May 2014 offer more clarity about REIT qualifying assets but are not expected to significantly increase the number of clean energy facilities that can qualify for REIT status. This is because the ruling restricts REIT assets to immobile components of photovoltaic systems, likely disqualifying utility scale solar projects.[66]

Another way that clean energy investment is expanding is through energy savings performance contracts, or ESPCs. ESPCs are partnerships between public entities and energy service companies, or ESCOs, that allow government agencies to pay for energy-efficiency upgrades through achieved savings, thereby realizing energy savings without upfront costs. ESPCs are not new to clean energy, but their use has recently increased, especially within the federal government. In 2011, President Barack Obama challenged federal agencies to enter into $2 billion in ESPCs by the end of 2013. As a result, federal agencies identified $2.3 billion worth of projects, highlighting the energy savings opportunities within federal buildings.[67] President Obama extended the federal building energy-efficiency initiative through 2016 in December 2013.[68]

Financial tools that are emerging within the clean energy sector are lowering capital costs, reducing risk, and offering solid returns to investors. As these tools become more fully utilized, financing costs will continue to decrease, leading to more affordable clean energy technologies and greater investment in the sector.

Conclusion

Realizing the full potential of clean energy in the United States entails three things: strong government policies to help increase demand; energy and energy-related industry support to continue its trajectory of affordability and accessibility; and capital investments to help meet the increased demand for low-carbon energy. Working together, government, corporations, and investors will be able to form a healthier climate and stronger economy.

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