INCREASING USE OF CLEAN ENERGY GENERATION AND DISTRIBUTED ENERGY RESOURCES

Technologies and Key Policy Trends

TECHNOLOGY OVERVIEW.

Recent growth in the use of clean energy is fundamentally reshaping the U. S. electricity system. Some of the most pronounced changes involve the increased use of utility-scale renewables, which now account for over 75 percent of all renewables.[1] Generation from utility-scale wind and solar generation are now less expensive than coal fired generation in many parts of the nation.[2] Solar costs have dropped by more than 70 percent over the last decade with utility-scale prices ranging from 2.8 to 4.5 cents per kwh.[3] Similarly, the cost of on-shore utility-scale wind generation has fallen 69 percent since 2009, and 7 percent in 2018 alone, with utility-scale prices below 2 cents per kwh in some regions.[4] Even without soon-to-expire federal tax credits, renewable energy costs are lower than the marginal cost of conventional energy technologies under a variety of future scenarios.[5]

Meanwhile, nuclear power remained steady at 19 percent of the U.S. generation mix in 2018. Commercial scale use of carbon capture and storage (CCS) technology is still limited for power plants, with the Petra Nova plant being the only one in U.S operation, but technology development efforts continue alongside efforts to expand the carbon dioxide pipeline system.[6]

Technological innovations are occurring on the customer side of the meter as well. These "behind the meter" distributed energy resources include residential and commercial solar power, battery storage, fuel cells, electric vehicle charging, combined heat and power systems, microgrids, demand response technologies, and other energy management strategies. Electric vehicle charging and the opportunity for automotive batteries to serve as distributed storage is also a part of this transformation.

ECONOMICS.

Renewable energy (both utility scale and distributed) has emerged as an engine of economic growth. The solar industry employs 242,000 Americans, more than double the number in 2012, investing $17 billion in the U.S. in 2018.[7] Similarly, the wind industry employees 114,000 Americans, with over 500 factories in 42 states.[8] Five classes of distributed energy resources — distributed solar, small-scale combined heat and power, residential smart thermostats, electric vehicles and battery energy storage — contributed 46.4 GWs of impact on the U.S. summer peak in 2017, a figure that's expected to exceed 100 GWs by 2023.[9] The nuclear industry encompasses some 72,000 jobs in the U.S., across the utility, professional services and manufacturing sectors.[10]

KEY POLICY TRENDS

States' renewable energy ambitions soar. Twelve states and territories in recent years have raised their renewable energy standards to 50 percent or greater.[11] **California**, **Hawaii**, **Nevada**, **New Mexico**, **Puerto Rico**, and **Washington** have set a 100 percent clean energy goal.[12]

Governors leading efforts to address climate change. Twenty-five Governors have pledged that their state will reduce carbon emissions by at least 26 percent below 2005 levels by 2025.[13] Together, states making this non-binding commitment comprise over 55 percent of the U.S. population.[14]

Natural gas and renewables booming, coal generation continues to drop . The shale gas boom led natural gas power production to grow to 35 percent of the U.S. electricity mix in 2018, with renewables growing 5 percent to almost 18 percent.[15] At the same time, coal's percentage of the U.S. electricity generation mix fell to 27 percent, the lowest since World War II, with 13 GWs of coal capacity retiring in 2018.[16] In response to these changing economic circumstances, some states are increasingly considering incentives and other financial support to help coal communities.[17]

Incentives to continue nuclear generation expanding. While nuclear power remained steady at 19 percent of the U.S. generation mix in 2018, economic competition has forced many nuclear power plants to announce early retirements.[18] **New York**, **Connecticut**, **New Jersey** and **Illinois** have enacted incentives to

INCREASING USE OF CLEAN ENERGY GENERATION AND DISTRIBUTED ENERGY RESOURCES

support nuclear power, while **Ohio** and **Pennsylvania** are considering similar measures.[19]

Embrace of renewables by corporations and electric utilities growing. Corporate America's appetite for renewables has grown steadily in recent years, with over 175 major companies committed to purchasing 100 percent renewable power.[20] Changing economics and customer demand has led several major investor owned electric utilities to embrace renewables, including **Minnesota**-based Xcel Energy, which has pledged to be carbon-free in all eight states in which it operates by 2050,[21] Northern Indiana Public Service Company, which plans to retire all of its coal fleet in the next decade,[22] **Ohio**-based AEP, which pledged to cut its CO2 emissions 80 percent by 2050,[23] and **Michigan**-based Consumers Energy, which pledged zero coal use and a 90 percent reduction in carbon emissions by 2040.[24]

1 "More than 94 percent of net new electricity capacity in the USA from renewables in 2017 – emissions down 1 percent," J. Weaver, Electrek, Jan. 12, 2018. Retrieved from https://electrek.co/2018/01/12/94- percent-new-electricity-capacity-usa-from-renewables/

2 "Plunging Prices Mean Building New Renewable Energy Is Cheaper Than Running Existing Coal," M. Mahajan, Forbes, *Dec. 3, 2018.* Retrieved from https://www.forbes.com/sites/energyinnovation/2018/12/03/plunging-prices-mean-building-new-renewable-energy-is-cheaper-than-running-existing-coal

3 "Solar Industry Research Data," Solar Industry Energy Association. Retrieved from https://www.seia.org/solar-industry-research-data

4 "Levelized *Cost* of *Energy* and *Levelized Cost* of *Storage* 2018," Lazard Investments. Retrieved from https://www.lazard.com/perspective/levelized-cost-of-energy-and-levelized-cost-of-storage-2018/

5 Id.

6 "Recovery Act: W.A. Parish Post-Combustion CO2 Capture and Sequestration Project," NETL. Retrieved from https://www.netl.doe.gov/project-information?k=FE0003311

7 "Solar Industry Research Data," Solar Industry Energy Association. Retrieved from https://www.seia.org/solar-industry-research-data

8 "Wind Powers Job Growth," American Wind Energy Association, Retrieved from https://www.awea.org/wind-101/benefits-of-wind/powering-job-growth

9 "Distributed Energy Poised for 'Explosive Growth' on the US Grid," GreenTech Media, June 21, 2018. Retrieved from https://www.greentechmedia.com/articles/read/distributed-energy-poised-for-explosive-growth-on-the-us-grid

10 The 2019 U.S. Energy and Employment Report, National Association of State Energy Officials. Retrieved from https://www.usenergyjobs.org/

11 State Renewable Portfolio Standards and Goals, National Conference of State Legislators, Feb. 1, 2019. Retrieved from: http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx, adding Maryland, Nevada, and New Mexico based on the 2019 legislative sessions to date.

12 "Washington Commits to 100 percent Clean Energy and Other States May Follow Suit," Inside Climate News, P. McKenna, May 9, 2019. Retrieved from https://insideclimatenews.org/news/07052019/100- percent-clean-energy-map-inslee-washington-california-puerto-rico

13 United States Climate Alliance, Governor membership. Retrieved from https://www.usclimatealliance.org/governors-1

14 "Montana Governor Steve Bullock *Becomes* 25th *Governor* to *Join* U.S. Climate Alliance," July 1, 2019. Retrieved from https://www.usclimatealliance.org/publications/2019/7/1/montana-governor-steve-bullock-becomes-25th-governor-to-join-us-climate-alliance

15 "2019 Sustainable *Energy* in America *Factbook*," Bloomberg New Energy Finance and Business Council for Sustainable Energy, at 2-3. Retrieved from https://www.bcse.org/wp-content/uploads/2019-Sustainable-Energy-in-America-Factbook-Executive-Summary.pdf

16 Id.

17 "Ohio House Republicans overhaul 'clean-energy' bill to focus on nuclear, coal subsidies," May 22, 2019, Cleveland.com. Retrieved from https://www.cleveland.com/open/2019/05/ohio-house-republicans-overhaul-clean-energy-bill-to-focus-on-nuclear-coal-subsidies.html

18 "Nuclear power companies have spent millions lobbying for subsidies. Should Ohio, other states bail them out?," *Cincinatti* Enquirer, Apr. 30, 2019. Retrieved from https://www.cincinnati.com/story/news/2019/04/29/ohio-nuclear-plant-bailout/3519840002/

19 "Supreme Court won't hear nuke subsidy cases, clarifying state energy jurisdiction," Utility Dive, Apr. 15, 2019. Retrieved from https://www.utilitydive.com/news/supreme-court-wont-hear-nuke-subsidy-cases-clarifying-state-energy-jurisd/552768/

20 RE 100 Companies. Retrieved from http://there100.org/companies (as of May 24, 2019).

21 "For the first time, a major US utility has committed to 100 percent clean energy," Vox, Dec. 14, 2018. Retrieved from https://www.vox.com/energy-and-environment/2018/12/5/18126920/xcel-energy-100- percent-clean-carbon-free

22 "Northern Indiana utility ditching coal in favor of renewable energy in next 10 years," Indianapolis Star, Nov. 20, 2018. Retrieved from https://www.indystar.com/story/news/environment/2018/09/20/move-over-coal-indiana-utility-switching-solar-and-wind/1369539002/

23 "AEP's *Clean Energy Strategy* will *Achieve Significant Future Carbon Dioxide Reductions*," AEP, Feb. 6, 2018 [Press Release]. Retrieved from https://www.aep.com/news/releases/read/1503/AEPs-Clean-Energy-Strategy-Will-Achieve-Significant-Future-Carbon-Dioxide-Reductions-

24 Consumers Energy Clean Energy Plan. Retrieved from https://www.consumersenergy.com/community/sustainability/energy-mix/renewables/integrated-resource-plan?utm_campaign=sustainability&utm_medium=vanity-url&utm_source=cleanenergyplan&utm_content=cleanenergyplan

INCREASING USE OF CLEAN ENERGY GENERATION AND DISTRIBUTED ENERGY RESOURCES

Opportunities, Challenges and State Solutions

OPPORTUNITIES. The electricity system pioneered by Thomas Edison over 125 years ago is undergoing a fundamental transformation. Driven by technological innovations, growing consumer engagement, and heightened environmental awareness, the U.S. electricity system is evolving into a dynamic network with a decline in traditional generation sources and a rise in a more diverse array of utility-scale renewables and distributed energy resources.

Among the benefits attributed to utility-scale renewable technologies and distributed energy resources are energy cost savings, deferred infrastructure upgrades, enhanced system resilience and reliability, power quality benefits, and improved environmental performance.[1] Some states are also looking to continue the use of nuclear power as a reliable, emissions-free resource and interested in the opportunities for carbon capture and storage for coal generation.

CHALLENGES. Wind and solar technologies are variable resources since the wind does not always blow and the sun does not always shine. Integrating these variable resources onto the grid requires significant planning and the use of controllable generation, such as natural gas, hydropower and battery storage, that can ramp up or down quickly as supply and demand fluctuate.

Similar care must be taken to effectively integrate distributed energy resources onto the grid. Among the unique challenges posed by distributed energy resources are the need for more robust distribution system planning, privacy concerns related to third-party access to consumer energy data through mobile energy-conservation applications and cyber-security concerns.[2]

Existing nuclear generation faces economic challenges while the technologies associated with carbon capture and storage or utilization are cost prohibitive and call for additional infrastructure developments to achieve scale.

STATE SOLUTIONS. As discussed below, states have developed a wide array of policies to promote utility-scale renewables and distributed energy resources. Some are also developing incentives to support continued operation of nuclear plants. State solutions include:

- ***Establishing and/or Strengthening Renewable Portfolio Standards (RPS)*** – specifying that a certain percentage of the electricity provided by utilities come from renewable or clean energy resources which could include zero emission resources like nuclear power or carbon capture utilization and storage.
- ***Encouraging Distributed Solar Generation*** – updating state "net metering" policies and/or adopting alternative "value of solar" rates to accelerate residential and commercial solar projects without shifting the costs of maintaining the electricity grid to other customers.
- ***Encouraging Community Solar*** – promoting solar facilities shared by multiple community subscribers who receive credit on their electric bills for their share of the power produced.
- ***Accelerating Adoption of Battery Storage Technologies*** – establishing state storage targets, integrating storage with existing programs (such as RPS or clean peak standards), and incorporating storage into utility integrated resource planning and similar exercises.
- ***Promoting Off-Shore Wind Resources*** – establishing offshore wind procurement targets, RPS "carve outs," and/or favorable tax incentives.
- ***Addressing Transmission Constraints and Siting Requirements for Land-Based Wind Farms*** – expedite the often decade-long transmission permitting process while balancing environmental and procurement protections and adopt model state siting ordinances and/or reasonable setback requirements to ensure safety without hindering growth.
- ***Expanding Clean Energy Funding and Financing*** – innovative efforts to leverage public funds with private capital including Property Assessed Clean Energy (PACE) programs and green banks.

INCREASING USE OF CLEAN ENERGY GENERATION AND DISTRIBUTED ENERGY RESOURCES

- ***Adopting Greenhouse Gas Reduction Targets*** – setting greenhouse gas emission targets to address climate change.
- ***Expanding Corporate Access to Renewables*** – to meet growing corporate demand for renewables, many states are working to develop green power tariffs and reconsidering perceived barriers such as prohibitions on power purchase agreements, solar array size restrictions, onerous wind setback requirements, and prohibitions on companies obtaining electricity from the generator of their choice.
- ***Revisiting Hydropower –*** encouraging relicensing, upgrades at existing projects, and developing non-powered existing dams, new pumped storage projects, and conduit hydro projects.
- ***Supporting Continued Nuclear Generation*** – creating nuclear procurement targets and zero emissions credits (ZEC) Programs, using state mandated power purchase agreements (PPAs), including nuclear in state energy plans.

1 "Benefits of Distributed Generation," Distributed Generation Educational Modules, Consortium on Energy Restructuring, Virginia Tech, 2007. Retrieved from https://www.dg.history.vt.edu/ch1/benefits.html

2 "How leading utilities are planning for distributed energy resources," Utility Dive, Feb. 6, 2018. Retrieved from https://www.utilitydive.com/news/how-leading-utilities-are-planning-for-distributed-energy-resources/516260/

INCREASING USE OF CLEAN ENERGY GENERATION AND DISTRIBUTED ENERGY RESOURCES

State Solutions Spotlights

The U.S. electricity system is experiencing a fundamental transformation as a result of the rapid maturation of clean energy resources like wind and solar, advanced battery storage and other distributed energy technologies. These technologies are increasingly cost-competitive, are less susceptible to fuel price fluctuations, offer customers greater control of their energy choices, and typically involve lower or no emissions, including greenhouse gases, than most traditional sources.

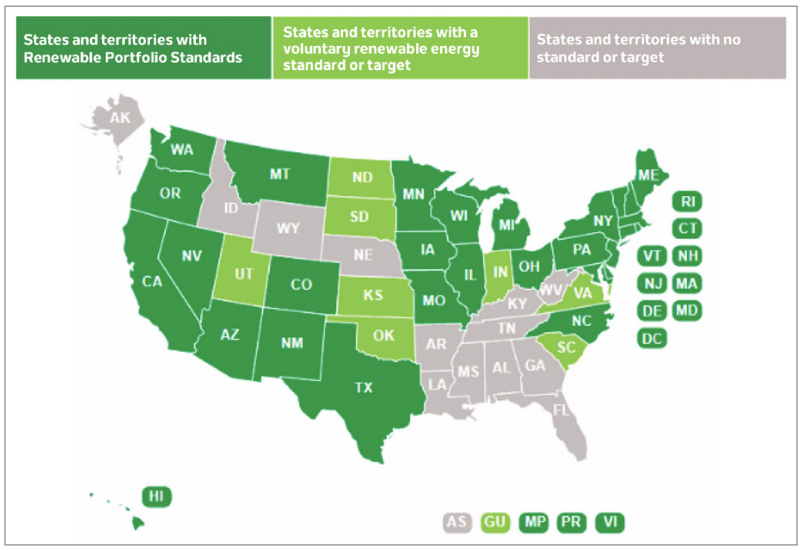

FIGURE 1: 2019 State RPSs and goals

Source: National Conference of State Legislatures. (2019, February 1). State renewable portfolio standards and goals. Retrieved from http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx

Governors have successfully pioneered a range of state policies to promote clean and distribute electricity technologies. State solutions include:

- Establishing and/or Strengthening Renewable Portfolio Standards (RPS)
- Encouraging Distributed Solar Generation
- Encouraging Community Solar
- Accelerating Adoption of Battery Storage Technologies
- Promoting Off-Shore Wind Resources
- Addressing Transmission Constraints and Siting Requirements for Land-Based Wind Farms Encouraging Distributed Solar Generation
- Expanding Clean Energy Funding and Financing
- Adopting Greenhouse Gas Reduction Targets
- Expanding Corporate Access to Renewables
- Revisiting Hydropower

ESTABLISHING AND/OR STRENGTHENING RENEWABLE PORTFOLIO STANDARDS (RPS). Twenty-nine states, D.C. and three territories have adopted Renewable Portfolio Standards (RPS), which require that a specified percentage of the electricity provided by utilities come from renewable or clean energy resources.[1] In some states, these resources may include zero carbon technologies such as carbon capture and storage, or nuclear energy. An additional eight states and one territory have set voluntary clean energy goals. First adopted by **Iowa** in 1983 under a voluntary approach, these requirements have proven effective in diversifying a state's electricity generation mix, encouraging domestic energy production and stimulating local job creation.

While most state targets are between 10 and 45 percent, twelve states and territories —**California, Hawaii, Massachusetts, Maryland, Nevada, New Mexico, New Jersey, New York, Oregon, Puerto Rico, Vermont,** and **Washington** state have requirements of 50 percent or greater.[2] Five of these states and territories - **California**, **Hawaii**, **Puerto Rico**, **Nevada**, and **New Mexico** have set 100 percent clean energy goals.[3]

State Spotlight: California. In September 2018, California enacted AB100, requiring that 100 percent of retail electricity sales come from zero-carbon technologies by 2045.[4] More specifically, 60 percent of

INCREASING USE OF CLEAN ENERGY GENERATION AND DISTRIBUTED ENERGY RESOURCES

sales must be from eligible clean resources by 2030, while the 2045 100 percent goal includes zero carbon resources as well.

State Spotlight: New Mexico. The New Mexico Energy Transition Act, adopted in March 2019, increases New Mexico's RPS to 50 percent renewables by 2030, 80 percent renewables by 2040 and 100 percent renewables by 2045.[5] The action follows an Executive Order issued by Governor Michelle Lujan Grisham earlier in the year.[6]

State Spotlight: New York. To complement their existing 50 percent RPS requirement, in 2016 New York added a "Clean Energy Standard" to compensate nuclear plants under a long-term contract that expires in 2029.[7] Illinois and New Jersey have subsequently adopted similar "Zero Emission Credit" approaches to support nuclear power. Governor Cuomo endorsed a 100 percent RPS requirement during his 2018 gubernatorial campaign.[8]

ADOPTING GREENHOUSE GAS REDUCTION TARGETS. Over the past decade, twenty-nine have adopted specific greenhouse gas reduction targets to address climate change.[9] More recently, over the past year, a bipartisan group of twenty-five Governors have pledged that their state will reduce carbon emissions by at least 45 percent below 2005 levels by 2030.[10] Together, states making this non-binding commitment make up 55 percent of the U.S. population.[11]

State Spotlight: Maryland. The Maryland Greenhouse Gas Reduction Act of 2009 requires the State to achieve a 25 percent reduction in Statewide greenhouse gas (GHG) emissions from 2006 levels by 2020.[12] In 2016, Maryland extended their goal to 40 percent reduction by 2030[13],[14]. Through 2016, Maryland had the largest percentage decrease in greenhouse gas emissions of any state, dropping 30 percent or 24 million metric tons.[15] Governor Hogan has since accelerated Maryland's greenhouse gas reductions efforts, joining the U.S. Climate Alliance – a bipartisan coalition of governors committed to achieving reductions as outlined in the 2015 Paris agreement – and outlining a strategy for Maryland to reach 100 percent clean electricity by 2040.[16]

State Spotlight: New Mexico. In 2019, New Mexico Governor Lujan Grisham issued an executive order to reduce greenhouse gas emissions in the state 45 percent by 2030 as compared to 2005 levels. The order also directed the Energy, Minerals and Natural Resources Department and the Environment Department to work to increase New Mexico's renewable portfolio standards and create a Climate Change Task Force to create a strategy to address climate change for all of New Mexico[17].

EXPANDING CLEAN ENERGY FUNDING AND FINANCING. To stimulate private investment in clean energy projects (both renewables and energy efficiency), numerous states have launched innovative efforts to leverage public funds with private capital. Popular efforts include Property Assessed Clean Energy (PACE) programs and green banks.

State Spotlight: Connecticut. The Connecticut Green Bank is a quasi-public organization created as the nation's first green bank in 2011. With funding from a system benefits charge and Regional Greenhouse Gas Initiative (RGGI) auction proceeds, the bank administers a statewide PACE program and offers an array of energy efficiency and clean energy financing options - including products for low-income households. Through 2018, the bank has mobilized over $1.5 billion of investment dollars, with every dollar of public ratepayer money bringing in $6 of private capital and helping to generate over $75 million in state tax revenue.[18]

State Spotlight: Missouri. Missouri's Property Assessed Clean Energy program, enacted in 2010, allows local governments to raise money to fund renewable or efficiency projects through a voluntary special assessment on a business or homeowner's property tax bill.[19] The projects funded to date include solar panels on a Scottish Rite Temple in Kansas City and Greenworks Lending for commercial transactions.[20] At least twenty states have created PACE programs, primarily in the commercial sector.[21]

State Spotlight: New York. New York's Green Bank, established in 2013, combines funds from ratepayers and RGGI to leverage private clean energy capital. With commitments now totaling over $522 million in support of up to $1.7 billion in clean energy

INCREASING USE OF CLEAN ENERGY GENERATION AND DISTRIBUTED ENERGY RESOURCES

investments, recent projects include loans to support community and residential solar.[22]

ENCOURAGING COMMUNITY SOLAR. Community solar has emerged as an affordable way for renters, homeowners and businesses to enjoy the benefits of solar power regardless of whether their building is conducive to hosting a solar array. Community solar typically refers to a solar facility shared by multiple community subscribers who receive credit on their electric bills for their share of the power produced.[23] Nineteen states have enacted policies and programs to promote community solar, with 43 states having at least one community solar project on-line.[24]

State Spotlight: Colorado. The Coyote Ridge Community Solar Farm is an initiative led by the Colorado Energy Office to demonstrate how low-income community solar can cut energy costs for utilities' highest need customers. The almost 2 MW Coyote Ridge Community Solar Farm will generate energy that will benefit low-income households, affordable housing providers and nonprofit organizations located within the service territory.[25]

State Spotlight: New Jersey. In January 2019, New Jersey's Board of Public Utilities approved at least 225 MW of community solar to be built over the next three years under a 2018 law, which will provide bill savings and power to approximately 20,000 to 30,000 homes and other customers. The program will also create local clean energy jobs and help the state meet its clean energy goals.[26]

ACCELERATING ADOPTION OF STORAGE TECHNOLOGIES. The need for continuous, real-time balancing of electricity supply with demand has defined the nature of the electricity grid to date. The emergence of cost-effective electricity storage is transforming the grid, helping to avoid excess grid infrastructure, integrating variable wind and solar resources, and enhancing grid reliability and resiliency.

The global energy storage market is growing exponentially.[27] In the U.S., energy storage revenue has grown from $58 million to $701 million over the last five years with technologies including flywheels, thermal energy storage, and advanced battery technologies.[28]

State policies that have proven successful in accelerating the adoption of storage technologies include establishing state storage targets, integrating storage into existing programs (such as RPS or clean peak standards), and incorporating storage into utility integrated resource planning and similar exercises.

State Spotlight: Arizona. Storage is emerging as an important component in Arizona's plans to modernize its grid. In February 2019, Arizona Public Service announced plans to deploy 850 MW of battery storage by 2025.[29] The utility plans to provide "solar after sunset" by coupling solar projects with battery storage, which beat new natural gas peakers in the competitive bidding process. This effort builds on the utility's 2017 success, when it installed two battery storage systems in rural Arizona to avoid rebuilding twenty miles of transmission and distribution lines.[30]

State Spotlight: California. In accordance with a 2010 California law,[31] investor-owned electric utilities in California were required to procure over 1.3 GW of energy storage by 2020. This procurement target helped establish the nation's largest commercial energy storage market. As of August 2018, the three largest utilities have already exceeded their targets based on the amount of energy storage procured or in the approval process.[32]

PROMOTING OFF-SHORE WIND RESOURCES. U.S. offshore wind has a technical resource potential of over 2,000 GWs,[33] which is one-sixth of the total existing capacity.[34] The combination of steady wind, absence of buildings or mountains, and relative proximity to the nation's largest cities, has made offshore wind an increasingly competitive clean energy resource. **Rhode Island** completed the nation's first offshore wind project in 2016. Today, there are 15 active projects off the east coast, with more under consideration in **California**, **Hawaii**, **New York** and **South Carolina.**[35]

State Spotlight: Maryland. Maryland created "offshore wind renewable energy credits" (O-RECS) as part of its 2013 Maryland Offshore Wind Act. Since then, 368 MW of offshore wind projects have been approved for development by the Maryland Public Service Commission. The projects are estimated to create 9,700 full time equivalent jobs and result in more

INCREASING USE OF CLEAN ENERGY GENERATION AND DISTRIBUTED ENERGY RESOURCES

than $2 billion of economic activity, including $120 million of investments in port infrastructure and steel fabrication facilities.[36]

State Spotlight: Massachusetts. Massachusetts enacted an offshore wind legislative target of up to 1,600 MW in 2016, which they subsequently doubled to 3,200 MWs in 2018.[37] In May 2018, the utilities selected the first 800 MWs at a levelized price of 6.5 cents per kwh.[38]

ADDRESSING TRANSMISSION CONSTRAINTS AND SITING REQUIREMENTS FOR LAND-BASED WIND. Utility scale wind energy was the number one source of new U.S. electricity generation in 2018, and is expected to keep the top spot with 10.9 GWs of new capacity scheduled to come online in 2019.[39] With 2018 industry growth at 8 percent, U.S. wind power supports 114,000 American jobs, over 500 domestic factories, and more than $1 billion a year in revenue for states and communities that host wind farms.[40] Three states — Texas, Iowa, and Illinois — will host more than half the planned wind additions.[41]

Many of the nation's best land-based wind resources are located in the nation's midwest and southwest, often far from large population centers.[42] Major new transmission lines are therefore needed if the nation is to harness this resource. Such projects typically cross multiple states and federal lands, which makes the process of obtaining the environmental permits, right of ways, easements and licenses particularly challenging. The Transwest Express from **Wyoming** to **Nevada** recently received its final permit approval from Wyoming, clearing the way for construction to begin as early as 2020 and to be in operation by 2023.[43] Other major transmission proposals currently under consideration include the SSO Green Renewable Rail from **Iowa** to **Illinois** and the Grain Belt Express from **Kansas** to **Indiana**. Expediting the often decade-long transmission permitting process can significantly accelerate land-based wind development.[44]

Many states are also grappling with siting concerns from nearby residents prompted by this rapid growth. Some states have designated siting authority to state agencies, while most "home rule" states rely on local governments to manage siting.[45] Nine states, **Maine, Massachusetts, Michigan, New York, Oregon, Pennsylvania, South Dakota, Utah** and **Wisconsin**, have adopted a model state wind siting ordinance, such as requiring property line setbacks of 110-120 percent of the turbine's height, to help local officials ensure safety without hindering the industry's continued growth.[46]

ENCOURAGING DISTRIBUTED SOLAR GENERATION. With the cost of installing solar dropping 70 percent over the last decade, the solar industry continues its rapid growth.[47] Today, the U.S. solar industry includes over 242,000 employees involved in the manufacture and installation of solar power, ranging from small rooftop systems to large utility-scale solar arrays.[48]

To encourage adoption of distributed solar generation, 38 states. and 4 territories offer "net metering," which allows residential and commercial customers to sell excess solar power back to the grid.[49] In recent years, many states have considered updating their net metering policies to avoid shifting the costs of maintaining the

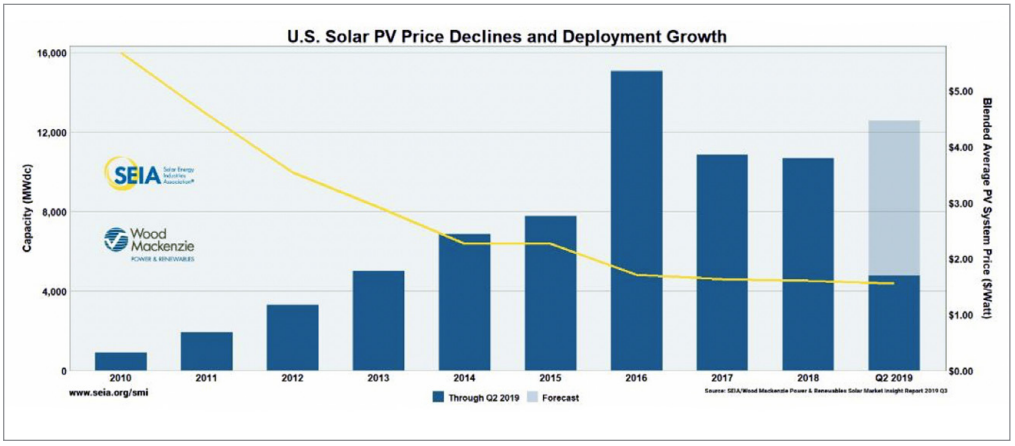

FIGURE 2: Retrieved September 18, 2019, from https://www.seia.org/solar-industry-research-data

INCREASING USE OF CLEAN ENERGY GENERATION AND DISTRIBUTED ENERGY RESOURCES

electricity grid to non-solar and other customers with distributed generation systems.[50] Some states have adopted alternative "value of solar" rates to compensate solar based on the variety of costs and benefits provided rather than paying a fixed retail rate.[51]

EXPANDING CORPORATE ACCESS TO RENEWABLES. Over 70 of the Fortune 100 corporations and almost 50 percent of Fortune 500 companies have set either clean energy or sustainability targets.[52] Yet these businesses have discovered a range of barriers that often prevent them from purchasing the type of electricity that they want. Common obstacles include prohibitions on the use of power purchase agreements, size restrictions on solar arrays, overly restrictive wind setback requirements, and, more fundamentally, a regulatory structure that requires the company to obtain its electricity from the local regulated monopoly.

To attract new business and economic development, governors are working with corporate leaders and utilities to develop creative solutions to hurdle these barriers. For example, in **Kentucky**, several utilities have proposed a "green tariff" to promote local clean energy projects and economic development.[53]

REVISITING HYDROPOWER. Hydropower remains the nation's largest generator of clean energy with 101 GWs currently operational.[54] As the nation incorporates more variable resources to the grid, emission-free hydropower can provide flexibility, given its ability to ramp up quickly and provide black start power when the grid is down.

Relicensing is a critical issue for the 325 hydropower plants whose licenses expire by 2032.[55] Although relicensing is a federal process, states should remain aware of the timeline for in-state assets. States interested in expanding hydropower can consider upgrades at existing projects, developing non-powered existing dams, new pumped storage projects and conduit hydro projects. To support existing hydropower, states could also consider including hydropower in their Renewable Portfolio Standards.

1 State Renewable Portfolio Standards and Goals, National Conference of State Legislators, Feb. 1, 2019. Retrieved from: http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx.

2 Id., adding Maryland, Nevada and New Mexico based on 2019 legislative sessions.

3 "Washington Commits to 100 percent Clean Energy and Other States May Follow Suit," Inside Climate News, P. McKenna, May 9, 2019. Retrieved from https://insideclimatenews.org/news/07052019/100- percent-clean-energy-map-inslee-washington-california-puerto-rico

4 SB 100 California Renewable Portfolio Standard Program: emissions of greenhouse gases. Retrieved from https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

5 New Mexico Senate Bill 489, 54th Legislature, 1st Session, March 2019. Retrieved from https://www.nmlegis.gov/Sessions/19 percent20Regular/bills/senate/SB0489.html

6 Executive Order 2019-003, "Executive Order on Preventing Climate Change and Energy Waste Prevention, Jan. 29, 2019. Retrieved from https://www.governor.state.nm.us/wp-content/uploads/2019/01/EO_2019-003.pdf

7 NY Clean Energy Standard, New York State Energy Research Development Authority (NYSERDA). Retrived from https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard

8 "NY Governor Wants Zero-Carbon Electricity by 2040," Greentech Media, Dec. 18, 2018. Retrieved from https://www.greentechmedia.com/articles/read/new-york-names-100-carbon-neutral-electricity-as-priority#gs.d6x1wg

9 "State Climate Policy Maps," Center for Climate and Energy Solutions (C2ES). Retrieved from https://www.c2es.org/content/state-climate-policy/

10 United States Climate Alliance, Governor membership. Retrieved from https://www.usclimatealliance.org/governors-1

11 "Pennsylvania Governor Tom Wolf *Joins* U.S. Climate Alliance," Apr. 29, 2019. Retrieved from https://www.usclimatealliance.org/publications/2019/4/29/pennsylvania-governor-tom-wolf-joins-us-climate-alliance

12 "Facts about the Greenhouse Gas Reduction Act of 2009," Maryland Department of the Environment. Retrieved from https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Publications/GGRAFactsAbout.pdf

13 "Climate Change Program." Maryland Department of the Environment, 2018, mde.maryland.gov/programs/Air/ClimateChange/Pages/index.aspx.

14 Maryland, Congress, Education, Health, and Environmental Affairs. General Assembly of Maryland, Oct. 2016. 2016 session, SB0323, mgaleg.maryland.gov/webmga/frmMain.aspx?pid=billpage&stab=01&id=sb0323&tab=subject3&ys=2016RS.

15 "Energy-Related Carbon Dioxide Emissions by State, 2005–2016," US Energy Information Agency, Feb. 27, 2019, at 2. Retrieved from https://www.eia.gov/environment/emissions/state/analysis/

16 Office of Governor Larry Hogan. Governor Hogan *Launches New Push* for *Clean* and *Renewable Energy.* August 14, 2019. https://governor.maryland.gov/2019/08/14/governor-hogan-launches-new-push-for-clean-and-renewable-energy/

17 "Gov. Lujan Grisham *Signs Executive Order Committing* New Mexico to *Essential Climate Change Action.*" Office of the Governor Michelle Lujan Grisham, 29 Jan. 2019, www.governor.state.nm.us/2019/01/29/gov-lujan-grisham-signs-executive-order-committing-new-mexico-to-essential-climate-change-action/.

18 "Green Banks *Impact Report, FY12-CY18," Connecticut Green Bank.* Retrieved from https://www.ctgreenbank.com/wp-content/uploads/2019/02/FY12-CY18-CGB-Impact-3-20-19.pdf

19 Missouri Department of Economic Development, Division of Energy, Property Assessed Clean Energy (PACE). Retrieved from https://energy.mo.gov/assistance-programs/pace.

20 Missouri Clean Energy District, Accessing Capital for Energy Projects, Success Stories. Retrieved from https://www.mced.mo.gov/success-stories/

21 "PACENation: Building the Clean Energy Economy," PACE Programs Near You. Retrieved from: https://pacenation.us/pace-programs/

22 "NY Green Bank *Announces Strong Second Quarter With Commitments Now Totaling Over* $522 *Million* in *Support* of *Up* to $1.7 *Billion* in *Clean Energy Investment Across* the *State,*" NY Green Bank: A Division of NYSERDA, Aug. 15, 2018 [Press Release]. Retrieved from https://greenbank.ny.gov/News-and-Media/In-The-News/2018-08-15-NY-Green-Bank-Announces-Strong-Second-Quarter.

23 "Community Solar," Solar Energy Industries Association. Retrieved from https://www.seia.org/initiatives/community-solar.

24 Ibid.

25 "Colorado develops largest low-income community solar project in US," PV Tech, *Aug. 11, 2017.* Retrieved from https://www.pv-tech.org/news/colorado-develops-largest-low-income-community-solar-project-in-us

26 "New Jersey BPU *Approves Community Solar Pilot Program,*" Jan. 17, 2019, [Press Release], Coalition for Community Solar Access. Retrieved from http://www.communitysolaraccess.org/new-jersey-bpu-approves-community-solar-pilot-program/

27 The global energy storage industry installed 6 GW in 2017 with over 40 GW expected by 2022, up from an initial base of only 0.34 GW installed in 2012 and 2013. "Facts and Figures," Energy Storage Association. Retrieved from http://energystorage.org/energy-storage/facts-figures

28 Advanced Energy Now, 2019 Market Report, Advanced Energy Economy, at 18. Retrieved from https://www.advancedenergynow.org/aen-2019-market-report

29 "APS Plans to Add Nearly 1GW of New Battery Storage and Solar Resources by 2025," GreenTech Media, Feb. 21, 2019. Retrieved at https://www.greentechmedia.com/articles/read/aps-battery-storage-solar-2025#gs.cut7i8

INCREASING USE OF CLEAN ENERGY GENERATION AND DISTRIBUTED ENERGY RESOURCES

30 "Energy storage saves Arizona utility from building 20 miles of transmission, distribution lines," Energy Storage News, *Aug. 10, 2017*. Retrieved from https://www.energy-storage.news/news/aps-to-install-4-mwh-energy-storage-systems-in-rural-arizona

31 AB-2514, Energy Storage Systems, approved by Governor on Sept. 29, 2010. Retrieved from https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200920100AB2514

32 Energy Storage Tracking Progress, California Energy Commission, Aug. 2018. Retrieved from https://www.energy.ca.gov/renewables/tracking_progress/documents/energy_storage.pdf

33 "Computing the Nation's Offshore Wind Energy Potential," U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Aug. 15, 2016. Retrieved at https://www.energy.gov/eere/articles/computing-america-s-offshore-wind-energy-potential

34 "America's *Electricity Generating Capacity*", American Public Power Association. Retrieved at https://www.publicpower.org/resource/americas-electricity-generating-capacity

35 "Offshore Wind Farms are Spinning Up in the U.S. - At Last," Wired, *Apr. 17, 2019*. Retrieved from https://www.wired.com/story/offshore-wind-farms-are-spinning-up-in-the-us-at-last/

36 "Offshore Wind in Maryland," Maryland Energy Administration. Retrieved from https://energy.maryland.gov/Pages/Info/renewable/offshorewind.aspx

37 H.4568, An Act to Promote Energy Diversity, Massachusetts Offshore Wind, Massachusetts.gov. Retrieved from https://www.mass.gov/service-details/offshore-wind; and H.4857, An Act to Advance Clean Energy, Retrieved from https://malegislature.gov/Bills/190/H4857

38 US Offshore Wind Industry Status Update, American Wind Energy Association. Retrieved from https://www.awea.org/Awea/media/Resources/Fact percent20Sheets/AWEA_Offshore-Wind-Industry-FINAL.pdf

39 U.S. Energy Information Administration. (2019, January 10). New electric generating capacity in 2019 will come from renewables and natural gas. Retrieved from https://www.eia.gov/todayinenergy/detail.php?id=37952

40 American Wind Energy Association. (2019, April 9). *US wind power grew 8 percent in 2018 amid record demand* [Press release]. Retrieved from https://www.awea.org/2018-market-report_us-wind-power-grew-8-percent-in-2018

41 U.S. Energy Information Administration. (2019, January 10). New electric generating capacity in 2019 will come from renewables and natural gas. Retrieved from https://www.eia.gov/todayinenergy/detail.php?id=37952

42 U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. (n.d.). Wind resource assessment and characterization. Retrieved from https://www.energy.gov/eere/wind/wind-resource-assessment-and-characterization

43 TransWest Express. (2019, April 19). *Wyoming Industrial Siting Council approves state permit for the TWE project* [Press release]. Retrieved from www.transwestexpress.net/news/alerts/2019/041919-wyoming-industrial-siting-council-approves-state-permit.shtml

44 St. John, J. (2019, April 23). $3 billion transmission project wins key permit in quest to bring wind power to the West Coast. *GreenTech Media*. Retrieved from https://www.greentechmedia.com/articles/read/transwest-wins-key-permit-for-transmission-to-bring-wyoming-wind-power-to-t#gs.dlsrql

45 Heibel, J., & Durkay, J. (2016, November 1). State legislative approaches to wind energy facility siting. Retrieved from http://www.ncsl.org/research/energy/state-wind-energy-siting.aspx

46 Heibel, J., & Durkay, J. (2016, November 1). State legislative approaches to wind energy facility siting. Retrieved from http://www.ncsl.org/research/energy/state-wind-energy-siting.aspx; see also Columbia Law School, Sabin Center for Climate Change Law. (n.d.). Model wind siting ordinance. Retrieved from http://columbiaclimatelaw.com/resources/model-laws-and-protocols/model-municipal-ordinances/model-wind-siting-ordinance and North Carolina and Pennsylvania Model Wind Ordinances, retrieved from https://www.energy.gov/savings/model-wind-ordinance.

47 Solar Energy Industries Association. (n.d.). Solar industry research data. Retrieved from https://www.seia.org/solar-industry-research-data

48 National Association of State Energy Officials & Energy Futures Initiative. (2019). *The 2019 U.S. energy & employment report*, p. 3. Retrieved from https://www.usenergyjobs.org/

49 Two additional states — Idaho and Texas — have voluntarily adopted net metering programs. Seven states — Arizona, Georgia, Hawaii, Indiana, Maine, Mississippi and Nevada — have statewide distributed generation compensation rules other than net metering. National Conference of State Legislatures. (2017, November 20). State net metering policies. Retrieved from http://www.ncsl.org/research/energy/net-metering-policy-overview-and-state-legislative-updates.aspx

50 Edison Electric Institute. (2016, January). *Solar energy and net metering*. Retrieved from http://www.eei.org/issuesandpolicy/generation/NetMetering/Documents/Straight percent20Talk percent20About percent20Net percent20Metering.pdf

51 Trabish, H. K. (2018, May 10). How two value-of-solar studies add up to no clear value of solar. *Utility Dive*. Retrieved from https://www.utilitydive.com/news/how-two-value-of-solar-studies-add-up-to-no-clear-value-of-solar/522892

52 Advanced Energy Economy. (2016). *Corporate advanced energy commitments, path for states to capture this growth*, p. 1. Retrieved from https://info.aee.net/growth-in-corporate-advanced-energy-demand-market-benefits-report

53 PPL. (2018, September 19). *LG&E and KU making system-wide enhancements to further improve safe, reliable service* [Press release]. Retrieved from pplweb.mediaroom.com/2018-09-19-LG-E-and-KU-making-system-wide-enhancements-to-further-improve-safe-reliable-service

54 U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. (2016, October). *Hydropower vision: A new chapter for America's first renewable energy resource*, p. 1. Retrieved from https://www.energy.gov/eere/water/articles/hydropower-vision-new-chapter-america-s-1st-renewable-electricity-source

55 National Hydropower Association & Chelan County Public Utility District. (2019, April). *Reinvigorating hydropower: A cornerstone of our clean, affordable, reliable electric future*. Retrieved from https://anf5l2g5jkf16p6te3ljwwpk-wpengine.netdna-ssl.com/wp-content/uploads/2019/04/Reinvigorating-Hydropower.pdf