Many governments are transitioning to cleaner energy sources to decarbonize their electricity and energy systems – and studies show that high penetrations of renewable energy are possible while maintaining reliable and affordable energy. This report looks at real-life examples, across the United States and around the world.
Pathways to Minnesota’s Clean Energy Future:
National, State, and Local Policy Examples

“Pathways to Minnesota’s Clean Energy Future” was prepared in spring 2019 by the staff of the Energy Transition Lab at the University of Minnesota’s Institute on the Environment.

Research was conducted using publicly available information sources. Clean energy and carbon-neutrality activities are fast-moving targets, and every effort was made to include as up-to-date information and data as possible. Corrections, updates, and suggestions for future editions of this report may be sent to energyfuture@umn.edu. Energy Transition Lab acknowledges the generous support of the McKnight Foundation in making this work possible.

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Introduction

Aggressive clean energy and renewable energy targets are snowballing across the United States and around the world. Let’s take a closer look.

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Introduction

Aggressive clean and renewable energy targets are snowballing across the United States and the world. Fifty-three countries, 23 U.S. states, and 120 U.S. cities are pursuing 80, 90, or 100% renewable energy or 100% clean energy standards, some with great success. In addition, a growing number of utilities have committed to 100% carbon-free energy. A number of studies show that such high penetrations of renewable energy are possible while maintaining reliable and affordable energy.1,2,3,4,5,6 It will take real-life examples to test these modeling studies.

In the United States, where renewable energy makes up 17.6% of total U.S. electricity generation,7 the most significant activity is at the state level. States are embracing 100% renewable or 100% clean energy standards through legislation and executive orders. If all of the U.S. states considering these targets adopt them, almost half of U.S. citizens would be participating in this dramatic energy transition. In fact, nearly 20% of all U.S. residents already live in places committed to 100% clean energy. In the United States, states and cities are the main implementers of these policies, so their examples demonstrate what’s possible. This national momentum could lead to adoption of national goals, as the states are the "laboratories of democracy." The federal Smith-Lujan Clean Energy Standard bill8 is a prime example of a national approach that respects regional differences, avoids a one-size-fits-all approach, and would put the United States on a path to 100% clean energy.

Many governments are switching from fossil fuels to cleaner energy sources to decarbonize their electricity and energy systems. There are also additional reasons for adopting clean and renewable energy policies: consumer preference for cleaner energy sources, cleaner air, use of local resources, and producing new jobs. Renewable and clean energy policies are aided by falling costs and improved performance for renewable energy systems and technologies such as battery storage.

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1 Vibrant Clean Energy LLC, Minnesota’s Smarter Grid: Pathways toward a Clean, Reliable and Affordable Transportation and Energy System, McKnight.org
2 MN Solar Pathways Pathways, Solar Potential Analysis Report,
A renewable energy standard (RES) requires utility companies to source a certain amount or percentage of the energy they generate or sell from renewable sources such as wind and solar. They are sometimes also called renewable portfolio standards (RPS). A clean energy standard encompasses all of the renewable resources in an RPS or RES and adds zero-carbon resources to the mix. These policies, ramped up to high levels, will lead to decarbonization of the energy sector (i.e., removing carbon and carbon equivalents) and will reduce greenhouse gas emissions (GHG) contributing to climate change. Decarbonization policies are usually focused on the electric sector, but are increasingly encompassing the transportation and buildings sectors.

**KEY TERMS**

**Decarbonization**
Reducing or removing carbon dioxide and equivalents from energy sources

**Renewable Energy**
Energy from sources not depleted when used, such as wind or solar power, hydroelectric, geothermal, bioenergy, and hydrogen (produced from renewable energy sources)

**Clean Energy**
Everything in the renewable portfolio, plus nuclear, natural gas with carbon capture and storage (CCS), and large hydroelectric. Also known as: carbon-free electricity, zero-carbon electricity

**Greenhouse gas reduction targets**
Nearly 200 countries signed the Paris Climate Accords in 2015 in an effort to cap global warming at 1.5 degrees Celsius this century, and many countries such as the United Kingdom, France, and Germany have developed long-term low carbon strategies. Following the United States’ withdrawal from the Paris Climate agreement, 24 states including Minnesota have agreed to uphold the U.S. commitment of reducing emissions 26 to 28% below 2005 levels by 2025 by joining the United States Climate Alliance. Many states have implemented statewide greenhouse gas targets. States use a variety of baseline years, ranging from 1990 to 2006, and most states have a common target year of 2050. Many cities have also made greenhouse gas reduction targets.

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10 “2019 Fact Sheet”, US Climate Alliance, April 2019, https://static1.squarespace.com/static/5a4c9b2e18b27d4da21c9361/t/5cc5aa56e9a7f542fe4233c/1556830885910/USCA+Factsheet_April+2019.pdf
International Energy Targets

Renewable and clean energy policies occur predominantly in locations and countries with large capacities for renewable energy (namely those areas endowed with natural resources conducive to large amounts of hydroelectric, wind and solar). For this report, we highlight the renewable and clean energy activity of seven countries. In Europe, we focus on the clean energy activities of Denmark, Sweden, Scotland, and Germany. In Central America, we highlight the clean energy activities of Nicaragua and Costa Rica. We also include China’s clean energy activities (which doesn’t yet include 100% renewable or clean energy standards) because of the country’s scale, varied activities across sectors, and potential for overall global impact. The following table presents timeframe, targets, and fuel mix for each country.

COUNTRIES WITH 80-90-100% RENEWABLE OR CLEAN ENERGY STANDARDS

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>YEAR</th>
<th>GOAL</th>
<th>FUEL MIX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>2011</td>
<td>100% renewable energy in electricity, transportation, and heating/cooling by 2050</td>
<td>Denmark is phasing out coal generation: As of 2016, coal made up roughly 29% of electricity generation, down from more than 54% in 2003. In 2017, wind generation constituted 43.4% of domestic electricity generation.</td>
</tr>
<tr>
<td>Sweden</td>
<td>2010</td>
<td>100% renewable electricity by 2040, fossil free by 2050</td>
<td>Renewable energy sources including hydroelectric, solar, wind, and biofuels provided 64.9% of electricity generation in 2016. Nuclear power provides the bulk of electricity generation.</td>
</tr>
</tbody>
</table>

13 IEA Wind, Wind Energy in Denmark https://community.ieawind.org/about/member-activities/denmark
<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Target</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scotland</td>
<td>2017</td>
<td>100% renewable electricity by 2020, 50% renewable energy across electric, transportation, and heating and cooling sectors by 2030</td>
<td>In 2017, 68.1% of electricity came from renewable sources (predominantly wind, hydroelectric, solar, bioenergy, landfill gas, wave/tidal, and sewage gas), an increase of more than 14% since 2016. In 2015, nuclear provided generation 35% and fossil fuels 22% of electricity generation, but these shares continue to decline.</td>
</tr>
<tr>
<td>Germany</td>
<td>2017</td>
<td>80% renewable electricity by 2050, 10% renewable transport by 2020, 14% by 2030</td>
<td>Germany’s primary renewable energy source is wind, but the country’s solar capacity is growing (increasing 16% in 2018). In 2018, 40% of electricity was generated from renewable sources.</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>2017</td>
<td>90% renewable electricity by 2020. Voluntary targets of 55%, 64% and 73% of total installed capacity to be renewable energy, by 2018, 2023, and 2030, respectively.</td>
<td>Renewables make up almost 75% of the gross domestic energy supply, and more than 50% of the electricity supply. In 2016, oil accounted for 47.6% of electricity generation, with wind making up 15.9%, hydroelectric making up 9.3%, biofuels making up 11.6%, and geothermal making up 15.4%.</td>
</tr>
</tbody>
</table>

Continued on next page...
<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Goal</th>
<th>Progress/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costa Rica</td>
<td>2019</td>
<td>100% renewable electricity by 2030</td>
<td>As of October 2018, 98.5% of electricity was generated from renewable sources, largely due to hydropower, which accounted for 72% of electricity generation, while 16% was generated from wind and 8.9% from geothermal.</td>
</tr>
<tr>
<td>China</td>
<td>2018</td>
<td>35% renewable electricity by 2030 (RPS)</td>
<td>China plans to reach its energy goals largely through increased efficiency in energy transmission, and large amounts of solar capacity (53 GW of PV in 2017) and wind capacity being installed. In 2016, wind was 9% of installed power generation capacity, hydro was 2%, solar was 5%, and coal was 58%.</td>
</tr>
</tbody>
</table>

**Denmark**

Denmark is an instructive model for how such a transition can take place. In 2011, the country pledged to reach 100% renewable energy by 2050 – and became the first country to include transportation and heating in its 100% goal. Denmark has very little hydroelectric and no nuclear power. Coal electricity generation, which used to dominate in Denmark, has shifted to wind and bioenergy. Coal used for heating is also shifting to bioenergy, which makes up the lion’s share of renewable energy in Denmark. Agriculture provides manure and straw for bioenergy development, and fossil fuel power plants have switched to wood pellets and chips. Wind is an important component of Denmark’s renewable energy supply. The first wind turbine was built in Denmark in 1979, and wind energy development continues in both onshore and offshore (North Sea) locations. The figure (next page) illustrates the significant progress Denmark has made on its overall energy, electricity, transportation, and buildings goals.

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26 Ibid.


DENMARK’S PATH TO A RENEWABLE FUTURE BY SECTOR

Aiding the country’s transition to renewable energy is an emphasis on increased energy efficiency. Denmark has focused on using energy in cost-effective ways that reduce the nation’s energy demand. Since 1990, energy consumption has dropped by 8%, mostly due to a 28% decrease in fossil fuel consumption. These efficiency improvements are largest in the manufacturing and building sectors.

Source: 34, 35, 36

**Sweden**

In 2010, Sweden adopted a goal for 100% electricity from renewable energy sources by 2040, although that goal does not completely eliminate the use of nuclear energy. In 2016, Sweden abolished a tax levied on nuclear plants and allowed for permitting additional new ones. Sweden has been meeting their renewable standards due to its large amounts of existing hydroelectric resources and by installing large quantities of wind and solar power.

**Scotland**

Scotland plans to have 100% of gross annual electricity production from renewable sources by 2020, and 50% of consumption in the heating, transportation, and electricity sector sourced from renewable resources by 2030. The country plans to be fully decarbonized across all sectors by 2050. Major parts of energy policy are being devolved to the Scottish Government from the United Kingdom. Scotland now has the authority to oppose the construction of new nuclear plants and pursue an aggressive renewable energy policy. In October 2018, wind power in Scotland provided 98% of electricity demand for that month. Electricity generation from coal and nuclear resources have decreased over the last decade in Scotland.

**Costa Rica**

Costa Rica has a 100% renewable electricity by 2030 goal, although President Carlos Alvarado has stated the transition could occur by 2021. Additionally, Costa Rica intends to be free of fossil fuels across the transportation, industry, agriculture and land use, and waste sectors by 2050, according to its National Decarbonization Plan. Costa Rica is already very close to 100% renewable electricity, making news in 2017 by going 300 days of the year entirely on renewable energy. The country is currently moving towards the decarbonization

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of the transportation sector, including promoting electric vehicles and changing the structure of public transportation.\textsuperscript{47}

**Nicaragua**

Nicaragua’s Plan for Electric Generation Expansion (2017) establishes non-binding targets for the country, starting with a goal of 55% renewable electricity by 2018, 64% by 2023, and 73% by 2030. Notably, Nicaragua exceeded the 55% interim goal in 2017 with 56% renewable electricity generation. The country pledged an additional goal for 90% renewable electricity by 2020.\textsuperscript{48} Access to electricity in Nicaragua jumped—the electrification rate went from 47% in 2002 to 80% in 2014. This progress in renewable electricity development is notable given that Nicaragua is the poorest country in Central America and had the highest fossil fuel use for electricity (67%) in the region as recently as 2011.\textsuperscript{49}

**Germany**

Germany has been pursuing a long-term energy and climate strategy under the Renewable Energy Sources Act (2000), and continues to adapt it as technology and market forces advance. The law requires a minimum of 80% of electricity to be derived from renewable sources by 2050, with an intermediate goal of 35% electricity and 18% for gross energy consumption by 2020.\textsuperscript{50} Germany also has a renewable transportation target of 10% by 2020 and 14% by 2030.\textsuperscript{51,52} The country has a diverse renewable portfolio. Wind is the predominant source of domestic renewable energy production, but solar capacity has been increasing in recent years.\textsuperscript{53} Germany achieved 40% renewable electricity generation in 2018.\textsuperscript{54} The country started phasing out nuclear power plants in 2011 and will close its last plants in 2022. In 2019, Germany announced its intention to create legislation that will shut all its coal plants by 2038.\textsuperscript{55}

\textsuperscript{48} ClimateScope 2018, Nicaragua, BloombergNEF, http://global-climatescope.org/results/ni#power-market
\textsuperscript{49} InterAmerican Development Bank, Renewable Energy Experiences in Nicaragua to Generate Electricity, IDB July 2015.
China

In 2018, China increased its RPS to 35% for electricity consumption by 2030 (with fines for noncompliance), a notable improvement from the country’s previous policy of 20% of the country’s energy to come from non-fossil fuels by 2030.\(^{56}\) Much of the energy being generated towards this goal is anticipated to come from solar and wind. China added more than 53 GW of photovoltaic solar in 2017, 43 GW of solar in 2018, and plans 210 GW of wind by 2020.\(^{57,58}\) Overall, renewable energy resources made up 36.6% of installed capacity for electricity generation in 2017.\(^{59}\) A big driver for the increase in capacity comes from domestic manufacturing, as China is the leading manufacturer of renewable energy technology, especially for solar and wind energy.\(^{60}\) In May 2019, China announced 20.8 GW of clean energy projects that will be built without subsidies.\(^{61}\)

The country also plans to construct an ultra-high voltage transmission line to deliver clean energy by 2020, providing the equivalent of 18 million tons of coal in renewable electricity.\(^{62}\) The ultra HV transmission line is part of a larger plan to better integrate energy across the six regional grids, where there are bottlenecks between the northern and western areas of electricity production, and eastern areas where electricity consumption is high.\(^{63}\) Additionally, in 2009, China committed to the reduction of its 2005 carbon intensity level\(^{64}\) – that is, reducing carbon emissions per unit of GDP – by 40 to 45% by 2020.\(^{65}\)

\(^{64}\)Carbon intensity level is defined as the amount of carbon dioxide produced per unit of economic growth.
United States: Clean energy standard, Green New Deal

In a May 2019 bill, Senator Tina Smith (Minnesota) and Representative Ben Ray Lujan (New Mexico) call for a federal 80% clean energy standard by 2035, and nearly zero carbon electricity by 2050.66 In February 2019, Representative Alexandria Ocasio-Cortez (New York) and Senator Ed Markey (Massachusetts) released their “Green New Deal” resolution calling for 100% “clean, renewable and zero-emission energy sources” in the next decade.67 The Green New Deal resolution is not yet detailed in legislation but also includes provisions for jobs, health care, housing, economic security, clean air and water, healthy food, education, clean transportation, and manufacturing. In response, Representative Matt Gaetz (Florida) released a resolution dubbed the “Green Real Deal,” calling for innovation, competitive markets, and investment in zero carbon resources such as nuclear energy and carbon capture and storage.68

Presidential candidate Governor Jay Inslee (Washington) recently presented aggressive policy proposals for the United States, including the Evergreen Economy plan which includes $9 trillion for the clean energy transition and the creation of 8 million new jobs.69 The plan calls for carbon-neutral power by 2030 and emissions-free power by 2035. It also calls for cars, trucks, and buses to be emissions-free by 2030, and a “zero carbon building standard” by 2030. Other presidential candidates support zero-carbon emissions and Green New Deal decarbonization efforts. In May 2019, the Zero-Emission Vehicles Act of 2019 was re-introduced in Congress, calling for 100% zero-emissions vehicles by 2040, and was co-sponsored by three 2020 presidential candidates (Kamala Harris, Bernie Sanders, and Kirsten Gillibrand).70

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69 An Evergreen Economy for America, Inslee for America, https://jayinslee.com/issues/evergreen-economy
State Energy Targets

In the United States, the most aggressive renewable energy targets – in the form of 100% renewable energy or clean energy standards – are being implemented in Puerto Rico, Washington, D.C., and six states: Hawaii, California, Vermont (90% target), New Mexico, Nevada, and Washington. As a result, almost 20% of U.S. residents now live in places committed to 100% clean energy.

As mentioned earlier in this report, renewable energy standards (RES) and renewable portfolio standards (RPS) are used interchangeably. The table below presents the timeframe, policy target, and sources of renewable energy for these U.S. leaders:

### STATES WITH ADOPTED 90-100% RENEWABLE ENERGY OR 100% CLEAN ENERGY STANDARDS

<table>
<thead>
<tr>
<th>STATE</th>
<th>YEAR</th>
<th>GOAL</th>
<th>NOTES AND COMPLEMENTARY POLICIES</th>
<th>PROGRESS/ SOURCES OF RENEWABLE ENERGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hawaii</td>
<td>2015</td>
<td>30% by 2020, 40% by 2030, 70% by 2040, 100% by 2045</td>
<td>RPS for net electricity generation</td>
<td>In 2018, distributed solar generation accounted for 33% of Hawaii’s renewable electricity generation. Additionally, the 2018 RPS Legislative Report indicates that the goal will likely be met through solar energy capacity and electricity storage projects implemented by Hawaii’s main utility companies. In 2015, Hawaii’s fuel mix for electricity generation was 67.3% oil, 15.1% coal, and 17.8% from renewable resources.71</td>
</tr>
<tr>
<td>Vermont</td>
<td>2015</td>
<td>75% by 2032, 90% by 2050 (for total energy from renewable sources)</td>
<td>A RES across electric (67% goal), transportation (10% goal), and building (30% goal) sectors.</td>
<td>Electricity is nearly 100% renewable. In 2017, 60% from hydroelectric power, 20% biomass, 13% wind, and 11% utility- or customer-sited solar.72 Overall, half of Vermont’s power comes from hydroelectric plants in Canada.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>State</th>
<th>Year</th>
<th>Goal</th>
<th>Energy Standard/Goal Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>2018</td>
<td>60% by 2030, 100% by 2045</td>
<td>100% goal is a Clean Energy Standard (CES) for retail electricity sales, and the 60% goal is an intermediate RPS. The CES also includes zero carbon resources such as large hydroelectric and nuclear. In 2017, 44% of California’s electricity was supplied by hydroelectric and other renewable resources, 34% natural gas, 9% nuclear, 9% unspecified imports, and 4% coal.</td>
<td></td>
</tr>
<tr>
<td>Washington, D.C.</td>
<td>2018</td>
<td>100% renewable electricity by 2032</td>
<td>An electricity goal through the Clean Energy D.C. Omnibus Amendment Act of 2018</td>
<td>In December 2018, D.C.’s fuel mix was 37.5% natural gas and 62.5% non-hydroelectric renewables.</td>
</tr>
<tr>
<td>New Mexico</td>
<td>2019</td>
<td>100% by 2045</td>
<td>Carbon-free electricity goal through the Energy Transition Act (2019)</td>
<td>The current electric fuel mix is 35% coal, 40% natural gas, and 25% non-hydroelectric renewables.</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>2019</td>
<td>100% by 2050</td>
<td>RPS through the Puerto Rico Energy Policy Act in April 2019. The goal also includes a ban on coal plants starting in 2028.</td>
<td>The Act allows for automatic connection to the electric grid for small-scale solar installations (&lt;25kW). In the fiscal year ending June 30, 2017, 47% of Puerto Rico’s electricity came from petroleum, 34% from natural gas, 17% from coal, and 2% from renewable energy.</td>
</tr>
<tr>
<td>Nevada</td>
<td>2019</td>
<td>50% by 2030, 100% by 2050</td>
<td>50% total electricity goal and 100% non-binding zero carbon goal (electricity only) created when Governor Sisolak signed S.B. 358 in April 2019.</td>
<td>In 2017, 70% of electricity was generated with natural gas, and geothermal and solar resources provided an additional 19% of electricity in Nevada. Nevada has the greatest solar potential of any state.</td>
</tr>
<tr>
<td>Washington</td>
<td>2019</td>
<td>100% by 2030, 2045</td>
<td>100% carbon neutral electricity by 2030, 100% carbon free electricity by 2045, according to S.B. 5116 (which was signed into law May 7, 2019)</td>
<td>67% of Washington’s electricity comes from hydroelectric power, and 23% from coal and natural gas. Nuclear, wind, and biomass provide the remaining 10%.</td>
</tr>
</tbody>
</table>

Leaders in Renewable Energy and their Targets

Hawaii

Hawaii was the first U.S. state to pass such legislation on June 8, 2015, and has a renewable portfolio standard (RPS) that targets 100% of net electricity generation from renewable sources by 2045.\(^7\) Hawaii’s RPS includes wind, solar, hydroelectric, biogas, geothermal, ocean thermal, biomass, biofuel, and hydrogen produced from renewable energy sources in its 100% RPS. Hawaii’s RPS was pushed by a stakeholder group, the Hawaii Clean Energy Initiative, and a supportive governor, Linda Lingle, in 2009. They supported a 40% RPS and laid the groundwork for the 100% renewable energy legislation, signed by Governor David Ige, in 2015.\(^8\) In 2018, distributed solar generation accounted for 33% of Hawaii’s renewable electricity generation.\(^9\) The 2018 RPS Legislative Report indicates that the state will likely meet the 100% goal through solar energy capacity and electric storage projects that are being implemented by Hawaii’s main utility companies.\(^10\)

Hawaii has taken additional steps to improve its use of renewable energy resources by addressing the challenges facing the state’s electric grid and the effect of large intermittent loads from solar energy. Because large amounts of solar energy are being produced, at certain times of the day Hawaii sees the electric grid supply of electricity (load) exceeding the consumer demand.\(^11\) This caused significant problems for Hawaii’s net energy metering program, which was established in 2001 and shut down in 2015.\(^12\) Following the shutdown, Hawaii saw a large drop in the number of solar photovoltaic (PV) permits issued, and solar energy installers have been increasingly limited in the amount of renewable energy they can send back to the grid. The Hawaii State Energy Office is currently working on ways to improve the structure of the current electric grid to address the difference in peak load times, increase the state’s ability to store energy to be used during peak times,\(^13\) and improve electricity transmission across islands.\(^14\)

\(^9\) Ibid.
Vermont

Vermont, under former Democratic Governor Shumlin, established a Renewable Energy Standard (RES) in 2015. Vermont’s RES calls for 90% of total energy across the electric, transportation, and building sectors to come from renewable sources by 2050. The standard sets interim targets across the sectors, including an initial goal of 55% renewable electricity – met by the state – in 2017. Vermont’s current Governor, Republican Phil Scott, is supportive of the current RES goals and structure. Vermont defines renewable energy as energy from a “technology that relies on a resource that is being consumed at a harvest rate at or below its natural regeneration rate.” This excludes some energy sources – namely, natural gas, some solid waste treatments, and nuclear energy. Vermont permanently closed its last nuclear plant, the Vermont Yankee Nuclear Power Station, in 2014.

Washington, D.C.

Washington, D.C., including the White House, promises to run on electricity from 100% renewable energy by 2032 through Mayor Bowser’s signing of the Clean Energy D.C. Omnibus Amendment Act of 2018. Under this act, the eligible technologies include solar, wind, eligible biomass, biofuels, geothermal, tidal/oceanic sources, hydroelectric, and waste-to-energy resources. The act also calls for assistance with low-income weatherization, job training, and energy efficiency upgrades in affordable housing; new building emission standards; and in the transportation sector, a vehicle excise tax that is dependent on fuel efficiency.

Puerto Rico

In Puerto Rico, Governor Ricardo Rossello enacted the Puerto Rico Energy Public Policy Act in April 2019, following passage of the bill in the Legislative Assembly of Puerto Rico. The Act establishes a 100% renewable portfolio standard (RPS) for electricity by 2050 but also bans coal plants starting in 2028. The Act also provides for automatic interconnection to the grid of customer-sited solar energy systems below 25 kW.
Clean Energy Standards

California

California’s former Governor Jerry Brown spearheaded and signed into law on September 10, 2018, a Clean Energy Standard (CES) that states that 100% of retail electricity sales should be from renewable energy resources and zero-carbon resources by December 31, 2045, with an interim Renewable Portfolio Standard (RPS) of 60% by 2030. Renewable energy resources such as solar, wind, geothermal, biomass, small hydroelectric, renewable methane, ocean wave or thermal, or fuel cells using renewable fuels can be used to meet the 60% RPS. The 100% CES includes zero carbon resources such as large hydroelectric and nuclear. California’s last nuclear plant, Diablo Canyon, is retiring in 2025.

Carbon Free Electricity and Other Electric Goals

New Mexico

In March 2019, New Mexico’s Democratic governor Michelle Lujan Grisham signed the Energy Transition Act into law. The Energy Transition Act calls for 100% carbon free electricity by 2045 and includes funds “for the recovery of energy transition costs.” Specifically, the act provides $20 million for severance and retraining for employees of the soon to be shuttered coal-fired San Juan Generating Station. The new law was supported by the Democrat-led legislature, the Democratic governor, and the largest utility in the state, Public Service of New Mexico.

Nevada

Nevada Senate Bill 358 was signed by Democratic Governor Steve Sisolak in April 2019. The bill calls for 50% renewable electricity by 2030, and a non-binding goal of 100% zero carbon energy (for electricity) by 2050. Nevada Energy, which supplies 80% of Nevada’s electricity, supported the bill. SB 358 bumps the state’s RPS from 25% renewable energy by 2025 to 50% by 2030. Nevadans also voted in a referendum on the RPS: Question 6 was approved by voters on Nov 6, 2018, to increase the RPS to 50% by 2030, but requires a constitutional amendment. In Nevada, all constitutional amendments must go through two referenda. The second vote on Question 6 is scheduled for 2020, but looks to be unnecessary given SB 358. Nevada has the largest solar potential of any state in the United States.

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96 Ibid.
Washington State

In Washington State, Democratic Governor Jay Inslee presented a plan in December 2018 for 100% carbon neutral electricity by 2030 and 100% carbon-free electricity by 2045. The 100% targets were introduced in a package of bills before the legislature in January 2019. Governor Inslee signed the 100% clean electricity bill entitled “Supporting Washington’s clean energy economy and transitioning to a clean, affordable and reliable energy future” (SB 5116) into law on May 7, 2019. The law requires Washington utilities to divest from coal by 2025 and become carbon neutral by 2030. Power companies will be allowed to offset emissions from natural gas until 2045, when non-carbon-emitting resources must make up all the state’s retail electricity sales. A clean buildings bill is also awaiting the Governor’s signature. A clean fuel standard bill is currently being considered by the Washington State Legislature.

The Future: Executive Orders, Pending State Legislation, and Studies

In addition to the eight nationwide leaders profiled in the last section, 17 more U.S. states have combinations of supportive governors, bills, or executive orders calling for 100% renewable or 100% clean energy standard policies or studies. While most states active in 100% renewable or clean energy executive orders and legislation are Democrat-led, there is bipartisan support for these actions in some states. The state actions take differing approaches and timelines, with some proposing binding targets, and some proposing nonbinding goals, and others studying 100% renewable and clean energy policies.

The table on the following pages presents states currently considering 100% renewable or clean energy policies and/or proposing studies and states with supportive governors, along with the state’s current renewable targets and any progress made on renewable energy goals. If all the U.S. states considering or studying 100% renewable or clean energy standards adopted these standards, almost half of all Americans would be living in places that committed to 100% renewable and clean energy.\(^\text{100}\)

## States Considering 100% Renewable Legislation and/or States with Supportive Governors

<table>
<thead>
<tr>
<th>State</th>
<th>Current Goal</th>
<th>Proposed Goal and Policies</th>
<th>Progress Made on Renewable Energy Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnesota</td>
<td>25% by 2025 (RPS)</td>
<td>100% carbon free electricity, through the Clean Energy First Act (2019), moved into the omnibus energy and economic development bill (HF 2208) which passed the House May 2019.</td>
<td>In Minnesota, nuclear power accounted for 23%, coal for 37%, renewable sources for 25% (wind alone was 18%) of total electricity generation in 2018.(^{101})</td>
</tr>
<tr>
<td>New York</td>
<td>50% by 2030</td>
<td>100% carbon free energy by 2040 (part of Cuomo’s Green New Deal); Climate and Community Protection Act (Assembly Bill 3876) calls for 50% clean electricity by 2030, 100% carbon free energy across sectors by 2050.</td>
<td>In 2017, New York reached 27% renewable electric generation (mostly hydroelectric with wind, solar and biomass), with 40% of electricity generation coming from natural gas and 33% from nuclear power.(^{102})</td>
</tr>
<tr>
<td>Illinois</td>
<td>25% by 2025 (RPS) 1.5% by 2026 (PV)</td>
<td>Governor Pritzger pledged 100% “clean, renewable energy” for the state in 2019 and in his campaign. 40% RPS by 2030 bill introduced in Feb 2019 (HB 2966) 100% RES by 2050 bill introduced Feb. 2019 (HB 3624)</td>
<td>Forecasts indicate that Illinois will not meet its interim goal of 16% renewable electricity by 2020. Currently, 51% of Illinois electricity comes from nuclear plants, 34% from coal plants, 6% from natural gas, and 8% from renewable sources.(^{103})</td>
</tr>
<tr>
<td>New Jersey</td>
<td>100% by 2050 (Executive Order 28 signed May 2018)</td>
<td>RPS of 50% by 2030 signed by Governor Murphy in May 2018.</td>
<td>Executive Order 28 directs New Jersey to develop Energy Master Plan with pathway to 100% clean electricity by 2050. Part of the Governor’s plan to meet this goal comes in the form of offshore wind, with an ambitious 3,500 MW target. Currently, 90% of electricity generation came from natural gas and nuclear, with nuclear power currently providing 40% of electricity generation.(^{104}) Solar, biomass and wind currently provide 5% of New Jersey’s electricity generation.(^{105})</td>
</tr>
</tbody>
</table>

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\(^{105}\) Ibid.
<table>
<thead>
<tr>
<th>State</th>
<th>RPS Goal</th>
<th>Energy Standard by Year</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Florida</td>
<td>No RPS</td>
<td>100% Renewable Energy by 2050 (HB 1291) (electricity only)</td>
<td>Florida has a very high solar energy potential. In 2017, natural gas accounted for more than two-thirds of Florida’s electricity generation.106</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>18% by 2020-2021 Alternative Energy Portfolio Standard</td>
<td>100% Renewable Energy by 2050 (HB 1425) (electricity only)</td>
<td>In 2017, nuclear energy supplied 42% and renewable energy accounted for 4.5% of Pennsylvania's electricity generation.107</td>
</tr>
<tr>
<td>Maine</td>
<td>40% by 2017 (RPS)</td>
<td>100% Renewable Energy by 2050 (LR 2478), 100% Renewable Energy by 2030 (HP 0924) (electricity only)</td>
<td>In 2017, 76% of Maine’s electricity generation came from renewable energy resources, with 30% from hydroelectric, 26% from biomass (mainly wood products), and 20% from wind.108</td>
</tr>
<tr>
<td>Colorado</td>
<td>30% by 2020 (RPS goal for electricity)</td>
<td>100% by 2040 renewable energy supported by Governor Polis</td>
<td>About 50% of Colorado’s electricity comes from coal and 25% from renewable resources (79% from wind, 16% from hydroelectric and 5% from solar power).109</td>
</tr>
<tr>
<td>Connecticut</td>
<td>48% by 2030 (RPS)</td>
<td>Governor Lamont has expressed support for 100% clean energy standards</td>
<td>Nuclear power and natural gas together supply almost 95% of Connecticut’s net electricity generation.110</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>10% by 2015111</td>
<td>Governor Evers has expressed support for 100% clean energy standards</td>
<td>Coal provided 49%, natural gas 26% and renewable resources 9% of the state’s electricity generation in 2018.112</td>
</tr>
<tr>
<td>Oregon</td>
<td>50% by 2040</td>
<td>Governor Brown has expressed support for 100% Clean Energy Standards, following passage of a carbon cap and trade bill.</td>
<td>In 2017, 76% of Oregon’s electricity generation came from conventional hydroelectric power plants and other renewable energy resources.</td>
</tr>
</tbody>
</table>

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111 Wis. Stat. § 196.378 [http://docs.legis.wisconsin.gov/statutes/statutes/196/378](http://docs.legis.wisconsin.gov/statutes/statutes/196/378)
<table>
<thead>
<tr>
<th>State</th>
<th>Goal or Requirement</th>
<th>Details and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massachusetts</td>
<td>35% by 2030 (RPS)</td>
<td>100% clean energy bill introduced in Jan 2019 (HB 30-92), calls for 100% renewable electricity by 2035, and 100% renewable transportation and buildings by 2045. In 2017, Massachusetts generated 68% of its electricity from natural gas, 23% from nuclear, less than 4% from coal and 5% from renewables, primarily hydroelectric power.113</td>
</tr>
<tr>
<td>Maryland</td>
<td>25% by 2020 (RPS)</td>
<td>50% by 2030, study 100% renewable energy by 2040 (Clean Energy Jobs Act, passed in April 2019) (electricity only) In 2017, nuclear power accounted for 44% of the state’s electricity generation, and renewable energy including hydroelectric and utility-scale solar photovoltaic generation, accounted for 10% of Maryland’s electricity generation.114</td>
</tr>
<tr>
<td>Iowa</td>
<td>105 MW (RPS)</td>
<td>Bill (Senate File 312) introduced in 2019 to study 100% Renewable Energy (electricity only) In 2018, coal was responsible for 45% and wind 34% of Iowa’s electricity generation.115</td>
</tr>
<tr>
<td>Virginia</td>
<td>Renewable Energy Portfolio Goal 15% by 2025</td>
<td>HB 1635 introduced in 2019 called for clean energy (electricity only) by 2036 and a fossil fuel moratorium In 2018, Virginia’s electricity was generated with 33% nuclear and 50% natural gas generation. Coal and renewables provided the remaining generation.116</td>
</tr>
<tr>
<td>Texas</td>
<td>Renewable Generation Requirement 10,000 MW by 2025</td>
<td>HB 2148 introduced in 2019 to study the feasibility of a 100% renewable energy standard by 2050 In Texas, electricity was generated with almost 50% natural gas, 25% coal, 10% nuclear and 17% wind generation in 2018.117</td>
</tr>
<tr>
<td>Montana</td>
<td>Renewable Resource Standard 15% by 2015</td>
<td>HB 241 requiring that public utilities develop a plan for 100% renewable energy (electricity only) Montana’s electricity was generated from 49% coal, 39% hydroelectric, 8% wind and 2% natural gas and petroleum coke in 2018.118</td>
</tr>
</tbody>
</table>

114 U.S. Energy Information Administration, Maryland State Energy Profile, Last updated August 16, 2018. [https://www.eia.gov/state/?sid=MD](https://www.eia.gov/state/?sid=MD)
Minnesota

Minnesota has a supportive governor and a large utility supporting 100% clean energy activities. Minnesota’s current Renewable Portfolio Standard is 25% by 2025 and was set by the Next Generation Energy Act in 2007, which passed with nearly unanimous bipartisan support. New Democratic Governor Tim Walz announced in March 2019 that his administration is supporting 100% carbon free electricity by 2050. The Minnesota Legislature, whose House is Democrat and Senate is Republican, held hearings in the House on the governor’s plan, a bill entitled the Clean Energy First Act. The bill stalled in the Republican-led Senate. The Governor’s 100% carbon free electricity plan was moved into an omnibus energy and economic development bill, HF 2208, which passed in the House on April 24, 2019. The Senate version of the bill, SB 2611, did not include the 100% carbon free electricity plan. Additionally, 100% renewable energy legislation was introduced by Democratic Representative Jamie Long in February 2019.

**ECONOMIC BENEFITS OF CLEAN ENERGY**

**COST SAVINGS**

From 2017 to 2018, wind costs fell roughly 16% in Minnesota, making wind the cheapest new generation source. In that same period, solar costs fell 23%. Even without tax credits and other incentives, the cost of building new wind capacity in Minnesota is roughly the same as a new natural gas facility.

**CREATING NEW JOBS**

In Minnesota right now, there are more than 61,000 clean energy jobs. In 2018, the sector saw 4.7% job growth, more than 2.5 times faster than overall job growth. There are 4,400 jobs, or 7.3% job growth, projected for clean energy in 2020.

**RELIABLE**

Minnesota maintains a reliable regional electric grid during extreme weather due to geographically and resource diverse generation sources. During 2019’s three-day polar vortex, solar performed exceptionally well. Wind generation also played a critical role: While wind usually supplies 8% of annual energy in the region, it delivered nearly one-third (31%) of total generation during that period of extreme cold.

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123 Stephen Rakow (MN Department of Commerce). Citing MISO data via email. February 1, 2019


In December 2018, Xcel Energy, the largest utility in the state, pledged to be carbon free by 2050 across its eight-state service territory. In May 2019 the company announced it would close its coal plants by 2030, expand natural gas use, build 4 GW of solar by 2034, and seek to keep one of its two nuclear plants, Monticello, open 10 years after its scheduled retirement date of 2030. The second nuclear power plant, Prairie Island, will retire its two units in 2033 and 2034. These plants produced 23% of the net electricity produced in Minnesota in 2018.

**New York**

In January 2019, New York Democratic Governor Andrew Cuomo announced his support for 100% carbon free energy for New York by 2040 under Cuomo’s Green New Deal, five years earlier than Hawaii’s goal. This new target, part of Cuomo’s “Green New Deal,” requires approval from New York’s Democratic legislature, and no legislation with this target has emerged yet. The Climate and Community Protection Act (A3876) is currently under consideration in the New York Assembly and in the New York Senate with calls for 50% clean energy for electricity by 2030 and 100% clean energy from all sectors by 2050. Eligible technologies include biogas, biomass, fuel cells, hydroelectric, solar, tidal/ocean, and wind. The generation resources are broken into three tiers: Tier 1, for new renewables that came into operation after Jan 1, 2015; Tier 2, maintenance tier for existing renewable resources; and Tier 3, zero emissions credit (ZEC) requirement to support existing nuclear, needed to achieve 40% GHG reduction by 2030. Load serving entities must buy RECs, ZECs and offshore wind renewable energy credits (ORECs). A bill was introduced in January 2019 to maintain the viability of Tier 2 existing renewable resources by requiring electricity suppliers to buy renewable energy credits (RECs) from existing biomass, hydroelectric, and wind plants. In addition, a bill to study a 100% renewable grid in New York was introduced in 2019. In May 2019, New York adopted a final rule barring coal generation from electricity production by the end of 2020. New York’s current Clean Energy Standard was enacted in 2016 and includes 50% renewable energy standard by 2030, zero emission credits and an offshore wind standard (added in 2018, calls for 2,400 MW by 2030). In 2018, New York generated less than one

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130 New York State Senate, Relates to maintaining the continued viability of the state's existing large-scale, renewable energy resources, SB S23, introduced January 9, 2019, 2019-2020 Session, https://www.nysenate.gov/legislation/bills/2019/s23
131 New York State Senate, SB S2352 Directs the state energy planning board to conduct a study of the technical and economic feasibility of a one hundred percent renewable energy system, SB S2352A, introduced January 24, 2019, 2019-2020 Session, https://www.nysenate.gov/legislation/bills/2019/s2352
percent of its electricity consumption from non-hydroelectric renewables such as wind and solar (almost one quarter of New York’s electricity is generated from hydroelectric power). New York’s nuclear plants are scheduled to shut down in 2021. New York is currently seeking bids for 800 MW of offshore wind and 9 GW by 2035.

Is nuclear power needed to reach 100% clean energy goals?

Many experts believe the most efficient and feasible pathway to a low-carbon future includes nuclear energy. In Minnesota, two nuclear plants represent 23% of Xcel Energy’s low-carbon electricity portfolio. In December 2018, Xcel Energy was the first major utility to pledge 100% carbon free energy by 2050, and will reduce carbon emissions by 80% (from 2005) by 2030. The company plans to use nuclear power at least until 2040 to achieve its goal, but it is open to new technologies if affordability and reliability are maintained.

Some see nuclear energy as an expensive option dependent on subsidies, unable to compete with lower-cost forms of energy such as natural gas and renewable energy sources, and managing radioactive spent fuel. Many nuclear plants are aging and nearing the end of their planned lifetimes. Almost all the U.S. nuclear generating capacity was built between 1967 and 1990. 15 nuclear plants – almost 18% of total US nuclear capacity – have closed or have announced retirement between 2019 and 2025. Some experts worry that nuclear capacity slated for retirement will be replaced with natural gas, instead of renewable sources such as wind and solar, leading to net increased emissions.

In response to cost and competition concerns, some states, especially in the Northeast United States – where the wholesale electricity market is largely unregulated – are including carbon-free nuclear generation in their Clean Energy Standards and are providing market subsidies for nuclear plants. Zero emission credits – payments/subsidies to nuclear generation sources for not emitting GHGs – are being implemented in New York, New Jersey, Connecticut, and Illinois. In April 2019, the Supreme Court declined to hear challenges to zero emission credit policies in New York and Illinois. This action could lead to more ZEC activity in Ohio.

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135 Ibid.
Maryland and other states. In Pennsylvania, Exelon decided to close the Three Mile Island nuclear plant after legislation providing economic support failed. And New Hampshire is proposing a “baseload renewable generation credit” to support that state’s biomass plants, modeled on ZECs.

In Minnesota, regulated utilities can recover costs in rate cases. Nuclear plant upgrades for Xcel Energy’s two nuclear plants – Monticello and Prairie Island – were a major factor in Xcel’s last rate increase request.

**Illinois**

Illinois has both a supportive governor and significant legislative activity on renewable and clean energy standards. The new Democratic Governor of Illinois, J.B. Pritzger, pledged 100% "clean, renewable energy" for the state in January 2019 and in his campaign. Two bills introduced in 2019 focus on increasing renewable energy and job creation. A “Path to 100” bill (HB 2966) calling for a 40% RPS by 2030 was introduced in February 2019 to support the governor’s pledge and creates 21,000 clean energy jobs primarily in utility wind and solar projects. Another bill introduced in February 2019, the Clean Energy Jobs Act (HB 3624), calls for 100% renewable energy by 2050, and emphasizes job creation, especially in the solar industry, and equity. The Clean Energy Jobs Act also calls for aggressive electrification of the transportation sector.

Another related bill, the Clean Energy Progress Act (HB 2861) moves capacity procurement from PJM to the Illinois Commerce Commission and the Illinois Power Authority. There is concern in Illinois that PJM is proposing changes to the capacity market – the mechanism for buying power supply to meet expected demand – that will discourage renewables and zero carbon resources such as nuclear and that it would be better for the state to control its capacity market. In particular, PJM is waiting for a FERC ruling on two proposals, one involving a

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minimum price for subsidized generators to bid into the capacity market, and one removing subsidized renewable energy sources from the capacity market. Essentially, fossil fuel generators would receive capacity payments, while subsidized renewable and nuclear capacity will be available but unused in the capacity market.

It looks like these bills could be part of an omnibus energy bill before the Illinois General Assembly this spring or possibly fall. The state’s current RPS of 25% by 2025 was set by the 2016 Future Energy Jobs Bill, which also provided ZECs for nuclear plants and other financial support for nuclear power through 2026.148 Forecasts indicate that Illinois will not meet its interim goal of 16% renewable electricity by 2020.149

New Jersey

In New Jersey, Democratic Governor Phil Murphy signed Executive Order 28 in May 2018, which directs state agencies to develop an updated Energy Master Plan by June 2019 that provides a path to 100% clean energy by 2050.150 Also in May 2018, Governor Murphy signed bills increasing the RPS to 50% by 2030 and providing an energy storage target,151 and one providing for zero emission credits for nuclear plants.152 Part of the Governor’s plan to meet this goal comes in the form of offshore wind with an ambitious 3,500 MW target. A bill was introduced in the New Jersey Legislature May 13, 2019, that requires 100% zero carbon electricity by 2050.153 Nuclear power and natural gas currently provide 90% of electricity generation in New Jersey.154

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Policy matters

Most states pursuing 100% goals will do so by setting state policies, creating market certainty that reduces investor risk for the duration of the target period. Similarly, 29 states have passed some version of a renewable or clean energy standard that sets a specified percentage (typically between 10 and 40%) to come from renewable resources and a timeline, and eight states have set renewable energy goals. However, some states are pursuing renewable energy as an economic strategy, providing inexpensive energy and more jobs, without passing 100% renewable or clean energy legislation to do so.

Texas has the most installed wind capacity – 24,899 MW in 2018 – in the United States. Texas leads the nation in wind-powered generation and produced one quarter of all the U.S. wind-powered electricity in 2017. Texas Renewable Generation Requirement was established in 1999 and requires 10,000 MW (achieved) of renewable generation (500 MW non-wind) by 2025.

As noted above, a bill was introduced in the 2019 Texas legislature to study the feasibility of a 100% renewable energy standard for the state but the bill failed to advance.

Kansas scrapped its mandatory 20% RPS in 2015 and turned it into a voluntary goal, but the state has continued to build wind generation. In 2018, Kansas ranked among the top five states in total wind energy generation and had a larger share of electricity generated from wind energy (36%) than any other state.

In 2017, Oklahoma ranked second in the nation after Texas in electricity generation from wind, and Oklahoma’s electricity generation from wind was greater than coal for the first time in 2016. Oklahoma has a voluntary renewable energy goal of 15% by 2015, established in 2010.

North Carolina ranked second, after California, in the amount of installed solar power generating capacity with more than 4,400 megawatts. In 2007, North Carolina established a renewable portfolio standard of 12.5% by 2021 for investor owned utilities, 10% by 2018 for municipal and cooperative utilities.

158 DSIRE, Renewable Generation Requirement, last updated June 26, 2018, NC Clean Energy Technology Center at NC State University, http://programs.dsireusa.org/system/program/detail/182
160 DSIRE, Renewable Energy Goal, last updated June 22, 2018, NC Clean Energy Technology Center at NC State University, http://programs.dsireusa.org/system/program/detail/4178
161 DSIRE, Renewable Energy and Energy Efficiency Portfolio Standard, last updated July 9, 2018, NC Clean Energy Technology Center at NC State University, http://programs.dsireusa.org/system/program/detail/2660
Other States

Many other states are considering 100% renewable or clean energy legislation. In Florida, where solar energy potential is very large, a bill was introduced by Democratic Representative Anna Eskamani in February 2019 calling for 100% renewable energy by 2050. In Pennsylvania, a bill was reintroduced from the 2018 session in May 2019 for 100% renewable energy by 2050. Pennsylvania has supportive leadership in Democratic Governor Tom Wolf, who launched a climate action plan for the state in May 2019. One-hundred-percent clean energy by 2036 legislation was introduced in Virginia but failed because the bill contained a fossil fuel moratorium.

Democratic legislators in Texas and Montana introduced bills to study 100% renewable energy standards, but neither advanced in the Republican legislatures in those states. Legislation is anticipated in Michigan, North Carolina, and Arizona in the coming year.

Several other states have governors who are supportive of 100% renewable or clean energy standards. Maine’s Democratic Governor Janet Mills proposed a bill on April 30, 2019, that commits the state to 100% renewable energy by 2050, an 80% reduction in greenhouse gas emissions by 2050, and creates a climate council. Governor Mills also signed into law in April 2019 a bill eliminating gross metering for rooftop PV and restoring net metering in the state. In addition, a legislator recently introduced a Green New Deal plan that includes 100% renewable energy by 2030. Maine has a Democrat-led legislature.

In Colorado, Democratic Governor Jared Polis supports 100% renewable energy by 2040 but prefers “enabling markets” instead of mandates in executive orders or legislation.

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A bill, HB19-1313, supported by Xcel Energy, for a non-binding goal of zero carbon dioxide emissions from electric utilities by 2050 is currently under consideration in the Colorado General Assembly. Xcel Energy, the largest utility in the state (and in Minnesota), has pledged carbon free electricity by 2050. Another bill (HB19-1261), calling for a 90% reduction in statewide GHGs by 2050, was recently sent to Governor Polis to sign into law. Colorado has a Democratic governor and Democrat-led legislature.

Connecticut Governor Ned Lamont, Wisconsin Governor Tony Evers, and Oregon Governor Kate Brown — all Democrats — have expressed support for 100% clean energy standards. Connecticut and Oregon have Democrat-led legislatures, while Wisconsin has a Republican-led House and Senate. Wisconsin’s Governor Evers included a 100% carbon free electricity proposal by 2050 in his budget, and Oregon’s Governor Brown has indicated that 100% renewable energy actions will follow a carbon cap and trade bill currently being considered by the Oregon legislature.

In addition to Vermont, three states – Massachusetts, Maryland, and Iowa – have Republican governors who have expressed support for renewable or clean energy standards. In Massachusetts, Governor Charlie Baker signed in August 2018 An Act to Advance Clean Energy that increases the state’s RPS to 35% by 2030 and provides for both an energy storage target and a clean peak standard, and a Comprehensive Energy Plan in December 2018 that includes a 35% reduction in GHG by 2030. A bill for a 100% renewable energy standard was introduced in January 2019 in the Massachusetts General Court. The bill calls for 100% renewable electricity by 2035, and 100% renewable energy for transportation and buildings by 2045.

In Maryland, Republican Governor Larry Hogan has shown support for greenhouse gas reduction activities by enacting a law committing to reducing greenhouse gases by 40% by 2030, and by joining the U.S. Climate Alliance. In April 2019, the Maryland Legislature passed the Clean Energy Jobs Act and sent the bill to the Governor to sign into law. Governor Hogan announced in May 2019 that he will not sign the bill, but will allow it to move forward. The Governor also indicated that he will push 100% clean energy legislation by 2040 next year.

The Clean Energy Jobs Act increases Maryland’s RPS to 50% by 2030, adds 1,600 MW offshore wind and 14% solar by 2028, and calls for a study of 100% renewable energy by 2040 in Maryland.\textsuperscript{177} The bill also includes subsidies for trash incinerators (included in the “clean energy” definition).

Iowa Republican Governor Kim Reynolds is supportive of the large amounts of electricity being gleaned from wind (34% of Iowa’s 2018 electricity generation came from wind\textsuperscript{178}). Iowa’s MidAmerican Energy has pledged 100% renewable energy by 2020, and recently had a large 591 MW wind project approved by the Iowa Utility Board\textsuperscript{179}, but is also supporting a bill introduced in 2019 to add a fee for solar customers to “level the playing field.”\textsuperscript{180} There is some legislative activity directly related to 100% policies in Iowa: A bill was introduced in 2019 to study 100% renewable energy in the state by 2050.\textsuperscript{181} Iowa’s only nuclear plant – the 600 MW Duane Arnold Energy Center – is slated to close in 2020.

\textsuperscript{178} US Dept.of Energy EERE, WindExchange, Wind Energy in Iowa. \url{https://windexchange.energy.gov/states/ia}
\textsuperscript{181} Iowa Legislature, Senate File 312, introduced February 19, 2019, \url{https://www.legis.iowa.gov/legislation/BillBook?ga=%24selectedGa.generalAssemblyID&ba=SF312}
Utility Goals and Commitments

In addition, a number of utilities have committed to 100% renewable or 100% clean energy goals. The following table contains nationwide utilities with 100% goals, where they operate, and details of the goals.

<table>
<thead>
<tr>
<th>UTILITY</th>
<th>STATE(S)</th>
<th>GOAL</th>
<th>DETAILS</th>
</tr>
</thead>
</table>
| Idaho Power              | Idaho                                         | 100% clean energy by 2045                 | Clean Energy Goal. Idaho Power current provides 46.4% of its energy from hydroelectric, 10.7% from wind, and 3.6% from solar energy installations.  
| Xcel Energy183           | Colorado, Michigan, Minnesota, New Mexico, North Dakota, South Dakota, Texas, and Wisconsin | Carbon free by 2050                        | In December 2018, Xcel Energy, the largest utility in Minnesota and Colorado, pledged to be carbon free by 2050 across its 8-state service territory. In May 2019, Xcel Energy announced it would shut its two remaining coal plants by 2030, build 4 GW of solar and seek a 10 year license extension for one of its nuclear plants, Monticello, allowing it to operate until 2040. Xcel Energy also owns the Prairie Island nuclear power plant in Minnesota, whose licenses expire in 2033 and 2034.  
| MidAmerican184           | Iowa, Illinois, Nebraska and South Dakota     | 100% renewable                            | Plans to meet the goal through additional wind capacity generated from the Wind XII project.                                                                 184 MidAmerican Energy, Our Renewable Vision, https://www.midamericanenergy.com/our-renewable-energy-vision.aspx |
| Green Mountain Power185  | Vermont                                       | 100% carbon free by 2025, 100% renewable energy by 2030 | Builds on the previous 90% carbon free goal. Announced in 2019.                                                                                                                                   185 Green Mountain Power, Green Mountain Power launches vision to have 100 percent renewable energy by 2030, https://greenmountainpower.com/news/gmp-launches-vision-to-have-100-renewable-energy-by-2030/ |

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<table>
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<tr>
<th>Company</th>
<th>Region</th>
<th>Key Goals</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avista Utilities</td>
<td>Washington, Idaho, Oregon</td>
<td>100% Clean Electricity by 2024, Carbon neutral Electricity by 2027</td>
<td>Goal Announced April 2019.</td>
</tr>
<tr>
<td>Public Service New Mexico</td>
<td>New Mexico</td>
<td>70% carbon free energy by 2031.</td>
<td>Currently produces close to 50% carbon free energy. Also includes energy efficiency programs in their goal.</td>
</tr>
<tr>
<td>NV Energy</td>
<td>Nevada</td>
<td>Contracted more than 1000 MW of renewable energy in 2018</td>
<td>Supports the Nevada bill that would call for 100% carbon free emissions by 2050, and double the RPS to 50% by 2030.</td>
</tr>
<tr>
<td>Southern Company</td>
<td>Alabama, Georgia, Mississippi</td>
<td>Low or zero carbon by 2050</td>
<td></td>
</tr>
<tr>
<td>Madison Gas and Electric</td>
<td>Wisconsin</td>
<td>Carbon neutral electricity by 2050</td>
<td>MGE adding wind and solar to generation mix, 52% coal and 10.5% renewable energy in 2018</td>
</tr>
<tr>
<td>DTE Energy</td>
<td>Michigan</td>
<td>Reduce emissions by 50% by 2030, 80% by 2040</td>
<td>Plans to double renewable energy generation capacity, retire Belle River coal plant by 2030, retire Monroe Power Plant by 2040.</td>
</tr>
<tr>
<td>Consumers Energy</td>
<td>Michigan</td>
<td>Zero Coal by 2040</td>
<td>Consumer Energy plans on retiring Karn 1 and 2 coal-fired plants in 2023, Campbell 1 and 2 by 2030, and Campbell 3 (the youngest plant) by 2040. Additionally plans to add 550 MW of wind.</td>
</tr>
</tbody>
</table>

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189 Nevada Legislature, An Act relating to renewable energy, SB 358, introduced March 18, 2019 and signed into law April 22, 2019, 80th Session (2019).
Beyond the electric sector

In 2011, Denmark became the first country to include multiple sectors – electricity, transportation, and heating – in its 100% renewable energy by 2050 target. The 100% goal updates the following renewable energy targets assigned by the EU Renewable Directive in 2009: 52% for the electric sector, 10% for transportation, and 40% for the heating sector by 2020.

Scotland plans to be fully decarbonized across all sectors by 2050, with 50% of heating, transportation, and electricity sector consumption supplied by renewable resources by 2030. Norway and Sweden have pledged to have no fossil fuel vehicles by 2025 and 2030, respectively, and have made significant progress using renewable energy in the buildings sector.

In the European Union, all member countries adopted binding targets for the electricity, transportation, and building sectors in 2009. The 2009 Energy Directive (2009/28/EC) called for 20% of energy to be derived from renewable sources by 2020 for the EU as a whole. Individual countries had varied renewable targets, although all countries were required to have 10% of their transportation fuels come from renewable sources by 2020.

In 2018, the EU’s Renewable Energy Directive was revised (2018/2001/EU). Currently, the entire EU has a goal of 32% renewable energy for total energy consumption by 2030. The following table presents country specific and EU renewable policy directives for select countries and progress made towards their goals.

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198 Swedish Institute, Sweden Tackles Climate Change. [https://sweden.se/nature/sweden-tackles-climate-change/](https://sweden.se/nature/sweden-tackles-climate-change/)

199 Bioenergy is used for heating in Sweden, while electric heating is common in Norway.

### SELECT RENEWABLE ENERGY GOALS AND PROGRESS OF EUROPEAN UNION MEMBER STATES

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>COUNTRY GOAL</th>
<th>EU GOAL</th>
<th>RENEWABLE ENERGY GOAL</th>
<th>PROGRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU Renewable Energy Directive</td>
<td></td>
<td>All countries in the EU to reach 20% renewable energy by 2020, and 10% renewables in the transportation sector.</td>
<td>16% in 2015 (Total Energy) 6% in 2015 (Transportation)</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>100% renewable energy for all sectors by 2050</td>
<td>30% by 2020 (Total Energy) 10% by 2020 (Transportation)</td>
<td>35% by 2020, 100% by 2050 (Total Energy); 50% by 2020 (Electricity); 100% by 2050 (Transportation); 100% by 2035 (H&amp;C)</td>
<td>32.2% in 2016 (Total Energy) 53.7% in 2016 (Electric) 6.76% in 2016 (Transportation) 41.68% in 2016 (H&amp;C)</td>
</tr>
<tr>
<td>Sweden[^206]</td>
<td>100% renewable electricity by 2040, no fossil fuel vehicles by 2030</td>
<td>49% by 2020 (Total Energy) 10% by 2020 (Transportation)</td>
<td>50.2% by 2020 (Total Energy) 62.9% by 2020 (Electric); 13.8% by 2020 (Transportation) 62% by 2020 (H&amp;C)</td>
<td>53.8% in 2016 (Total Energy) 64.9% in 2016 (Electric) 30.3% in 2016 (Transportation) 68.6% in 2016 (H&amp;C)</td>
</tr>
<tr>
<td>Scotland</td>
<td>50% renewable energy for electricity, heating, transportation sectors by 2030; 100% carbon free by 2050[^207]</td>
<td>Not applicable. Part of U.K. Renewable Energy Directive.</td>
<td>68.1% renewable electricity in 2017, up from 54% in 2016; 3.1% biofuels in 2016; 4.8% renewable non-electric heating in 2016</td>
<td></td>
</tr>
</tbody>
</table>


[^202]: This 50% target to be generated by wind power.  
[https://www.transparency-partnership.net/sites/default/files/ws15223_denmark_gpa2015_en_long_03.pdf](https://www.transparency-partnership.net/sites/default/files/ws15223_denmark_gpa2015_en_long_03.pdf)

[^203]: Current requirement for 5.75% biofuels for ground transport.  
See IEA Bioenergy, Country Report 2018, October 2018,  


[^206]: NREAP 2020.
This number includes double counting. The accurate number is 18.8%.

[^207]: Scottish Government, Policy: Renewable and Low Carbon Energy, no date,  
China has also launched a series of building and construction policies that supplement its electricity goals. Starting in 2020, China calls for 50% of all new buildings to be certified green buildings, based on criteria established by the country’s Green Standards.\textsuperscript{210} China has also set efficiency targets in the cement, steel, and petrochemical industries.\textsuperscript{211} China has set mandatory EV targets for auto manufacturers: 10% in 2019 and 12% in 2020. Auto manufacturers can buy credits from over-performing competitors if they don’t meet the targets.\textsuperscript{212}

In the United States, a few states are considering targets in the transportation and building sectors, and one state has adopted sectoral targets. In Vermont, the state adopted renewable energy targets in 2016 for the electric, transportation, and heating sectors as part of its Renewable Energy Standard (RES). The table below contains sectoral targets as presented in the Vermont Public Service Commission’s Comprehensive Energy Plan 2016. Several other states also have zero or low carbon transportation and buildings goals.\textsuperscript{213}

\textsuperscript{208} Sweden includes double counting of produced renewable energy credits. 
https://www.bmwi.de/Redaktion/EN/Publikationen/monitoring-report-2016-summary.pdf?__blob=publicationFile&v=16

\textsuperscript{209} European Commission Progress Reports (4th, 2015-2016). 

\textsuperscript{210} CBRE, The New Era of Green Buildings in China, CBRE Research, June 2015,  


\textsuperscript{212} “China’s electric vehicle ambitions to take centre stage at Shanghai auto show.” South China Morning Post. April 14, 2019,  
https://www.scmp.com/business/companies/article/3006108/chinas-electric-vehicle-ambitions-take-centre-stage-shanghai

\textsuperscript{213} In September 2018, California’s Governor Brown signed an executive order mandating 5 million zero emission vehicles by 2025 plus $3.75 billion for charging infrastructure. In addition, California has a Low Carbon Fuel Standard whose purpose is to reduce GHGs from transportation by 10% by 2020 (from 2011 levels). Additionally, California launched an electric heat pump initiative in September 2018. Gov. Brown signed SB 1477 for low emissions buildings and sources of heat energy that provides incentives for innovative near-zero emission homes, encourages early-stage clean technologies, and provide support for low-income residents who pay a disproportionate share of their income for energy. Minnesota plans to electrify 20% of all cars,light duty trucks and SUVs by 2030 (MNDOT); in Oregon, target is in place to reduce GHGs from transportation by 10% (from 2015 levels) by 2025; in New York, in 2018, Gov Cuomo announced listening sessions on low carbon transportation options and is currently supporting clean fuels, expanding public transportation and increasing availability of clean fuel infrastructure in support of low and zero emission vehicles; and Colorado through Governor Polis’ Executive Order, is promoting transportation electrification by January 2019 with a goal of 940,000 EVs by 2040 and a $5,000 consumer tax credit. Colorado is also considering adopting California’s zero emission vehicle standard.
### VERMONT'S TARGETS BY SECTOR

<table>
<thead>
<tr>
<th>SECTOR</th>
<th>ESTABLISHED ENERGY GOAL</th>
<th>INTERMEDIATE STEPS TO REACHING GOAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Energy</strong> (Renewable Energy Standard)</td>
<td>25% by 2025</td>
<td>Adherence to the three sector goals (buildings, transportation, and electricity), improving infrastructure, and adding renewable energy capacity.</td>
</tr>
<tr>
<td></td>
<td>40% by 2035</td>
<td></td>
</tr>
<tr>
<td></td>
<td>90% by 2050</td>
<td></td>
</tr>
<tr>
<td><strong>Heat in Buildings and Industry</strong> (Regarding the energy used to heat Vermont’s buildings and to provide process heat in industrial applications)</td>
<td>30% by 2025</td>
<td>Increase use of eligible renewable energy (especially through wood, heat pumps and bioenergy) and increase efficiency to reduce energy costs.</td>
</tr>
<tr>
<td><strong>Transportation</strong> (The transportation sector is responsible for nearly half of GHG emissions in Vermont)</td>
<td>10% by 2025</td>
<td>The use of four strategies; reducing transportation energy demand with smart land use, shifting away from single-occupancy vehicles, increase the use of electrified vehicles, and increased efficiency of heavy duty vehicles.</td>
</tr>
<tr>
<td></td>
<td>80% by 2050</td>
<td></td>
</tr>
<tr>
<td><strong>Electricity</strong></td>
<td>55% by 2017</td>
<td>Converting the energy grid from a one-way grid to an integrated grid, managing electric load, and efficiently using renewable sources to meet the RES goals while lowering energy rates.</td>
</tr>
<tr>
<td></td>
<td>75% by 2032</td>
<td></td>
</tr>
<tr>
<td><strong>Greenhouse Gases (GHG)</strong> (regarding Vermont’s greenhouse gas emission reduction targets)</td>
<td>40% red. by 2030*</td>
<td>Vermont plans to meet this goal through the adherence of the RES standards, responsible land use and fostering local energy supply.</td>
</tr>
<tr>
<td></td>
<td>80-95% by 2050*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*reduction from 1990 emission levels</td>
<td></td>
</tr>
<tr>
<td><strong>Energy Consumption</strong> (A reduction in the total amount of energy being consumed, per capita)</td>
<td>15% by 2025</td>
<td></td>
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<tr>
<td></td>
<td>1/3 by 2050</td>
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</tbody>
</table>

Minnesota Cities with 70-80-90-100% Renewable Commitments and Carbon Neutrality

Many cities around the world, along with 120 cities in the United States, are adopting 70-80-90-100% renewable or clean energy standards. In 2018, 100 cities around the world were powered by at least 70% renewable electricity. Minnesota cities have been making considerable progress towards energy sustainability by adopting local policies designed to foster high levels of renewables. A large number of cities have committed to renewable energy commitments or carbon neutrality. The table below presents targets and goals for Minnesota cities.

<table>
<thead>
<tr>
<th>CITY (MN)</th>
<th>TARGET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cologne</td>
<td>100% renewable energy for city functions</td>
</tr>
<tr>
<td>Duluth</td>
<td>80% reduction in GHG by 2050 from municipal operations compared to 2008 levels</td>
</tr>
<tr>
<td>Minneapolis</td>
<td>100% renewable energy for municipal facilities and operations by 2022, and citywide electricity by 2030</td>
</tr>
<tr>
<td>Rochester</td>
<td>100% renewable energy citywide by 2031 across all sectors</td>
</tr>
<tr>
<td>Rosemount</td>
<td>75% renewable energy²¹⁶</td>
</tr>
<tr>
<td>Roseville</td>
<td>100% renewable electricity by 2040 at municipal facilities (non-binding goal)</td>
</tr>
<tr>
<td>St. Cloud</td>
<td>80% renewable electricity in municipal facilities²¹⁷</td>
</tr>
<tr>
<td>St. Louis Park</td>
<td>100% renewable electricity citywide by 2030, carbon neutrality by 2040</td>
</tr>
<tr>
<td>St. Paul</td>
<td>Carbon neutral municipal operations by 2030, carbon neutral citywide by 2050</td>
</tr>
<tr>
<td>Winona</td>
<td>Carbon neutral citywide by 2050</td>
</tr>
</tbody>
</table>

²¹⁶ Sierra Club, Ready for 100, [https://www.sierraclub.org/ready-for-100/commitments](https://www.sierraclub.org/ready-for-100/commitments)
Many of the more ambitious cities have 100% Renewable Energy Commitments in place for 2030; among these cities are St. Louis Park, Minneapolis, St. Paul, and Rochester (2031). St. Louis Park has committed to 100% renewable electricity by 2030 and carbon neutrality by 2040,\textsuperscript{218} while St. Cloud city operations were powered by 64% renewable energy in 2018 (its goal was 80%).\textsuperscript{219} Rosemount will be powered by 75% renewables, and Cologne will use 100% renewable electricity for city functions.\textsuperscript{220}

**Morris, Minnesota, and Saerbeck, Germany**

The small rural towns of Morris, Minnesota (pop. 5,286), and Saerbeck, Germany (pop. 7,128), are showing climate leadership in their respective communities. The towns are Climate Smart Municipality partners – through a University of Minnesota program that pairs select Minnesota cities with climate smart communities in Germany to accelerate progress on clean energy.

Saerbeck has a goal of carbon neutrality and is now producing 320% of its electricity needs with renewables. Saerbeck is known as a “climate town” thanks to a former ammunition depot that was transformed into an innovative bioenergy park, which supplies heating, electricity, and transportation fuels, and contains 70 solar arrays covering former bunkers, and seven wind turbines.

Morris hopes to be 100% renewable in the next decade. The UMN Morris campus already produces 70% of its electricity with renewable energy. The Morris Energy Experience Path highlights solar arrays, biomass gasification plant, wind turbines, and a “green dorm” on the UMN Morris campus and is similar to Saerbeck’s "energy experience trail," a walking path with examples and descriptions of renewable energy technologies. The city of Morris has installed LED lighting in municipal buildings, and is looking at adding solar to the city’s wastewater treatment plant.

\textsuperscript{218} Great Plains Institute, LHB, Inc, and Orange Environmental, St. Louis Park Climate Action Plan: Setting a course towards carbon neutrality. February 2018. https://www.stlouispark.org/home/showdocument?id=8214
\textsuperscript{219} St Cloud has achieved 64% power from non-hydroelectric renewable sources as of 2018. Hubbard, Rob, Minnesota municipalities share renewable energy success stories. Minnesota Legislature, 31 January, 2019. https://www.house.leg.state.mn.us/SessionDaily/Story/13531
Conclusions

Across the United States and the world, 80-90-100% clean energy and renewable energy targets are no longer the exception. Many small and large governments are moving forward to switch from fossil fuels to cleaner energy sources and to decarbonize their electricity and energy systems. Fifty-three countries, 23 U.S. states, and 120 U.S. cities are pursuing 80-90-100% renewable energy or 100% clean energy standards. If all of the U.S. states considering these targets adopt them, almost half of U.S. citizens will be participating in this dramatic energy transition. This is in addition to the almost 20% of U.S. residents currently living in the states and territories already committed to 100% clean energy. This kind of national momentum tends to lead ultimately to the adoption of national goals. Recently introduced clean energy standard legislation at the federal level is an example of a national approach that would put the United States on a path to 100% clean energy.

Many countries, states, and cities are getting close to 100% renewable or clean energy thanks to falling costs and improved reliability from renewable energy sources, but some will face challenges to meeting 100% goals and mandates. Experts point to electrifying significant portions of the transportation, heating, and industrial sectors as a necessary strategy. In some cases, the role of zero-carbon resources such as nuclear and carbon capture and storage (CCS) will need to be evaluated. More large and small scale renewable energy sources will need to be built, energy storage capacity added, and transmission expanded. These steps, combined with greater electric grid modernization for integrating renewables, will be necessary in order to stay on the pathway to our clean energy future.