

# Academics and clean energy experts urge Massachusetts officials to commit to 100 percent renewable energy.

September 19, 2017

Dear legislators,

As academics, researchers, industry leaders, and clean energy experts, we urge you to support *An Act transitioning Massachusetts to 100 percent renewable energy* (“The 100% Renewable Energy Act,” S.1849 and H.3395).

Our reliance on dirty sources of energy like oil and gas is harming our health and changing our climate in dangerous ways. While solar and wind energy are growing rapidly, we are still not doing enough to protect our communities from harmful pollution and ensure a safe, livable climate for future generations.

We need to accelerate our progress towards a future powered entirely by renewable energy. With President Trump and his officials denying the truth about climate change and working to increase our dependence on fossil fuels, Massachusetts must live up to its historic role as a clean energy leader. The Commonwealth should commit to achieve 100 percent renewable energy as quickly as possible.

The 100% Renewable Energy Act sets out a clear pathway towards 100 percent renewable energy, on a timeline that is achievable with support from state leaders and continued innovation in the private and public sectors. By enacting this legislation, Massachusetts can take the steps necessary to avoid the worst impacts of climate change, while building stronger, healthier, and more prosperous communities.

## **Why 100 percent renewable energy is a necessary goal**

### **Climate change**

For decades, we have known that emissions of carbon dioxide and other greenhouse gases from the burning of fossil fuels are a major driver of climate change. Many of the impacts that scientists predicted from greenhouse gas emissions are already happening. In Massachusetts, extreme storms have become 81 percent more frequent since the 1940s.<sup>1</sup>

Unless we move quickly to phase out the burning of fossil fuels, we will likely see these impacts become much worse. Sea levels could rise by more than 7 feet in the Boston area by the end of the century, and residents could experience up to 90 days each year with

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<sup>1</sup> *When it Rains, it Pours*, Travis Madsen and Nathan Wilcox, Frontier Group and Environment America Research & Policy Center, Summer 2012, <<http://www.environmentmassachusetts.org/reports/mae/when-it-rains-it-pours>>.

temperatures greater than 90 degrees Fahrenheit by 2070.<sup>2</sup> Droughts will last longer, while extreme storms will become more severe, leading to potentially catastrophic flooding.

To avoid the worst impacts of global warming, we must bring our carbon emissions down to zero by mid-century or sooner. Given that many countries and many regions of the United States are lagging in meeting these goals, Massachusetts and other leading states and municipalities must go above and beyond, bringing our emissions down sooner. Furthermore, given the risks of climate “tipping points” leading to warming even faster than currently anticipated, emissions must be reduced as fast as possible by those with the ability to lead.

## **Public health**

Renewable energy strategies that reduce emissions of greenhouse gases also reduce emissions of air pollutants that can affect local and regional public health. Pollution from fossil fuels is linked to a wide range of health problems, including asthma, cardiovascular disease, and premature death. Many of these impacts are felt disproportionately by low-income communities and people of color, as well as residents of neighborhoods that are located near highways, airports, and other polluting infrastructure.

Reducing air pollution generally leads to immediate improvements in public health, providing a near-term and local rationale for strategies that will also have long-term and global implications. A recent report showed that the growth in wind and solar from 2007-2015 in the United States had resulted in \$29.7–\$112.8 billion in health benefits and saved 3,000–12,700 lives.<sup>3</sup> These savings are related to reductions in particulate matter and ozone concentrations, with corresponding reductions in premature deaths, cardiovascular and respiratory hospitalizations, and heart attacks. This is a conservative estimate, as it omits other important health effects of air pollution, such as asthma attacks, lost days of school and work, and premature births.

## **Achieving 100 percent renewable energy in Massachusetts**

### **Recent progress**

Solar, wind, energy efficiency, and other clean energy technologies are growing rapidly in Massachusetts and across the country. Since 2007, the amount of solar energy capacity installed in Massachusetts has increased more than 300-fold.<sup>4</sup>

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<sup>2</sup> *Climate Ready Boston Final Report*, City of Boston, December 2016, <<https://www.boston.gov/departments/environment/climate-ready-boston>>.

<sup>3</sup> “The climate and air-quality benefits of wind and solar power in the United States,” Dev Milstein et al., *Nature Energy* 6, 14 August 2017, <<https://www.nature.com/articles/nenergy2017134>>.

<sup>4</sup> *Renewables on the Rise*, Gideon Weissman, Rob Sargent, and Bret Fanshaw, Frontier Group and Environment Massachusetts Research & Policy Center, July 2017, <<http://environmentmassachusetts.org/reports/mae/renewables-rise>>.

The economics of both solar and wind power are now so attractive that renewable energy has become the largest source of new electricity capacity added to the grid in the United States for four of the last five years, and was responsible for 60–70 percent of all new additions in 2015 and 2016.<sup>5</sup>

Wind energy has accounted for 30 percent of U.S. generation capacity installed since 2012. Solar power already produces lower cost power than natural gas peaking power plants, and provides that power when it is needed most — during high demand heat wave days. Bloomberg New Energy Finance “New Energy Outlook 2017” forecasts that the cost of onshore wind energy will be lower than the cost of coal power by 2018 and that solar will be cheaper than coal power by 2021.<sup>6</sup>

In recent years, we have also seen similar declines in the costs of energy storage, electric cars, heat pumps and LED light bulbs.

Electric vehicles (EV) are extraordinarily more energy efficient than internal combustion engine (ICE) vehicles, resulting in EV operating costs per mile that are 3 times lower than operating an ICE vehicle. And as battery prices decline, the upfront cost of EVs follows. A recent UBS report found that the cost of building a Chevy Bolt was \$4,600 less than expected, and projected 2018 as the year when EV total cost of ownership would cross over ICE total cost of ownership.<sup>7</sup>

Heat pumps are now delivering over 3 kilowatt-hours of heat for every kilowatt-hour of electricity they consume. Air source heat pumps have made significant improvements in energy efficiency over much wider range of operating temperatures, now working below -10° F. Air source heat pumps for new homes now cost less to install than a fossil fuel heating system.<sup>8</sup>

### **Getting to 100% renewable energy**

A recent review of seven studies conducted by researchers at universities, government institutions, and nonprofits shows that there are no insurmountable technological or economic barriers to achieving 100 percent renewable energy.<sup>9</sup>

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<sup>5</sup> “Renewable generation capacity expected to account for most 2016 capacity additions,” Cara Marcy, U.S. Energy Information Administration, 10 January 2017, <<https://www.eia.gov/todayinenergy/detail.php?id=29492>>.

<sup>6</sup> “Solar Power Will Kill Coal Faster Than You Think,” Jess Shankleman and Hayley Warren, Bloomberg.com, <<https://www.bloomberg.com/news/articles/2017-06-15/solar-power-will-kill-coal-sooner-than-you-think>>.

<sup>7</sup> *UBS Evidence Lab Electric Car Teardown – Disruption Ahead?*, Patrick Hummel et al., UBS, 18 May 2017, <[http://www.advantagelithium.com/\\_resources/pdf/UBS-Article.pdf](http://www.advantagelithium.com/_resources/pdf/UBS-Article.pdf)>.

<sup>8</sup> “The Future of Housing in America,” Kevin Ireton, *The Best of Fine Homebuilding* (ISSN: 1936-8135), Winter 2014.

<sup>9</sup> *We Have the Power: 100% Renewable Energy for a Clean, Thriving America*, Travis Madsen et al., Environment America Research & Policy Center and Frontier Group, Spring 2016, <<http://www.environmentmassachusettscenter.org/reports/mac/we-have-power-0>>.

In order to reach 100 percent renewable energy across all sectors of the Massachusetts economy, we must:

- Reduce our total energy consumption by taking advantage of every opportunity for energy efficiency;
- Replace fossil fuel power plants with clean, renewable generation like wind and solar;
- And electrify all energy used for transportation (with a few exceptions) and for buildings (e.g., space heating and hot water).

In order to convert all electricity generation to renewable resources by 2035, the renewable portfolio standard (RPS) will have to increase by an average of about 5 percent per year from the 2017 level of 12 percent. In order to achieve 100 percent renewable energy economy-wide by 2050, about 3.5 percent of fossil fuel now used for heating and vehicles will have to be converted every year to electricity. These rates of increase are not at all unrealistic if Massachusetts makes a commitment to 100 percent renewable energy.

All of these trends are now underway but need to be dramatically accelerated. See the Appendix for an analysis of what it will take to reach these goals in Massachusetts.

## **Massachusetts must lead the way**

### **Growing momentum for 100 percent renewable energy**

More than 40 municipalities in the United States have committed to a goal of 100 percent renewable electricity or 100 percent renewable energy economy-wide.<sup>10</sup>

Cities that own their utilities can mandate the amount of power they obtain from renewable energy. The City of Austin, for example, has required that Austin Energy obtain 65 percent of its power from renewable energy by 2025.

Other cities without municipal utilities are also taking big steps towards 100 percent renewable energy. San Diego is the largest city with a legally binding 100 percent renewable electricity goal and reveals the tensions that can rise with utilities over such a transition. The city hopes to use community choice aggregation, joining with other municipal governments to aggregate their electricity demand and choose their energy source. But San Diego Gas & Electric is mounting a public relations campaign against community choice aggregation. This suggests that state-level efforts to restructure utility profit models are essential to the success of cities going 100 percent renewable.

At least five cities and towns in Massachusetts — Salem, Cambridge, Leverett, Framingham, and Lowell — have committed to 100 percent renewable energy, with other municipalities weighing similar commitments.

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<sup>10</sup> “Is Your City #ReadyFor100?”, Sierra Club, <<http://www.sierraclub.org/ready-for-100/cities-ready-for-100>>.

Additionally, more than 100 leading global companies have pledged to switch to 100 percent renewable energy as part of the RE100 initiative.<sup>11</sup> These companies include IKEA, Anheuser-Busch InBev, Facebook, and General Motors. Google is on track to obtain 100 percent of its electricity from renewable sources this year.

Finally, the State of Hawaii has passed a law to achieve 100 percent renewable electricity by 2045. Hawaii's largest electric utility has developed a plan to achieve 100 percent renewable electricity by 2040, five years ahead of the state's requirement.

### **Massachusetts' legacy of leadership**

For decades, Massachusetts has been a national leader in efforts to reduce fossil fuel pollution and expand clean energy.

In 2001, Massachusetts adopted the nation's first binding limits on carbon pollution from power plants. Massachusetts was also among the first states to adopt stronger vehicle emissions standards in the 1990s.

More recently, the Commonwealth has emerged as one of the top states in the country for solar energy. Massachusetts is leading on solar not because we have more sunshine than other states, but because state officials have embraced pro-solar policies. As a result, Massachusetts is currently ranked sixth in the nation for total solar capacity, with nearly twice as much solar installed as Texas and more than three times as much as Florida.<sup>12</sup>

Clean energy policies adopted by state leaders can make a real difference in Massachusetts, while setting a bold example for other states to follow.

### **The national landscape demands strong action in the states**

Despite an ever-growing body of evidence linking global warming and climate change to human actions, and despite the growing frequency and severity of storms like Hurricanes Harvey and Irma, President Trump and his officials are turning their backs on climate action. The Trump administration is moving to roll back federal limits on carbon pollution from power plants and vehicles, while encouraging the expansion of fossil fuel extraction on public lands.

With the federal government moving in the wrong direction, it is up to states like Massachusetts to lead. Our climate and our health can't wait.

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<sup>11</sup> "Companies - RE100," RE100, <<http://there100.org/companies>>.

<sup>12</sup> *Lighting the Way 4: The Top States that Helped Drive America's Solar Energy Boom in 2015*, Gideon Weissman, Bret Fanshaw, and Rob Sargent, Frontier Group and Environment America Research & Policy Center, July 2016, <<http://www.environmentamerica.org/reports/ame/lighting-way-iv>>.

Please act expeditiously to pass the 100% Renewable Energy Act. With your leadership, we can take bold steps towards a future powered entirely by renewable energy, and help ensure that our children inherit a safe, healthy, and livable planet.

Sincerely,

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## Appendix: The pathway to 100 percent renewable energy

The way to get to 100 percent renewable energy for Massachusetts is to reduce energy needs by optimizing energy efficiency in all sectors, and to electrify or otherwise convert to renewable energy nearly all energy uses for transportation and buildings (e.g., space heating and hot water), and replace fossil fuel power plants with renewable generation from sources like wind and solar. All of these trends are now underway but need to be dramatically accelerated.

The main goals in the 100% Renewable Energy Act are for renewable energy to supply:

- 100 percent of electricity needs by 2035;
- 80 percent of all energy needs by 2040;
- and 100 percent of all energy needs by 2050.

In order to convert all electricity generation to renewable resources by 2035, the renewable portfolio standard (RPS) will have to increase by an average of about 5 percent per year from the 2017 level of 12 percent. Based on recent estimates, we would need to add approximately 2,100 MW of new solar and 2,500 MW of new wind capacity on average each year to serve Massachusetts.<sup>13</sup> To achieve this, state officials should increase the RPS as soon as possible by an average of 5 percent or more each year.<sup>14</sup> State leaders should also put in place other state policies to incentivize or require all utilities<sup>15</sup> and their customers to contract for more new renewable projects in New England, as well as increase the energy efficiency of their customers. In addition, more energy storage and real-time pricing will be needed to manage intermittency.<sup>16</sup>

To meet the goals for the remainder of our energy use, almost 50 percent of the following end-uses will also need to be electrified, converted to other forms of renewable energy, or saved through energy efficiency by 2030 and almost 60 percent by 2035:

- natural gas and fuel oil now used for heating buildings and related uses, and
- gasoline and diesel oil now used for transportation.<sup>17</sup>

To reach these levels, about 3.5 percent of these fossil fuel uses will have to be converted every year to electricity.<sup>18</sup> This will require a very rapid ramp-up of electric vehicles, heat

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<sup>13</sup> These estimates of new capacity are based on the estimates in the 2015 paper “100% clean and renewable wind, water, and sunlight (WWS) all-sector energy roadmaps for the 50 United States” by Jacobson et. al. (Energy Environ. Sci., 2015, 8, 2093), which are 46,214 and 38,218 MW of wind and solar, respectively, divided by the 18 years remaining through 2035. These estimates include the impact of electrification. Source: <http://web.stanford.edu/group/efmh/jacobson/Articles/I/USStates.xlsx>.

<sup>14</sup> This 5% average reaches the same 100% level by 2035 as the series of gradual step increases specified in S.1849.

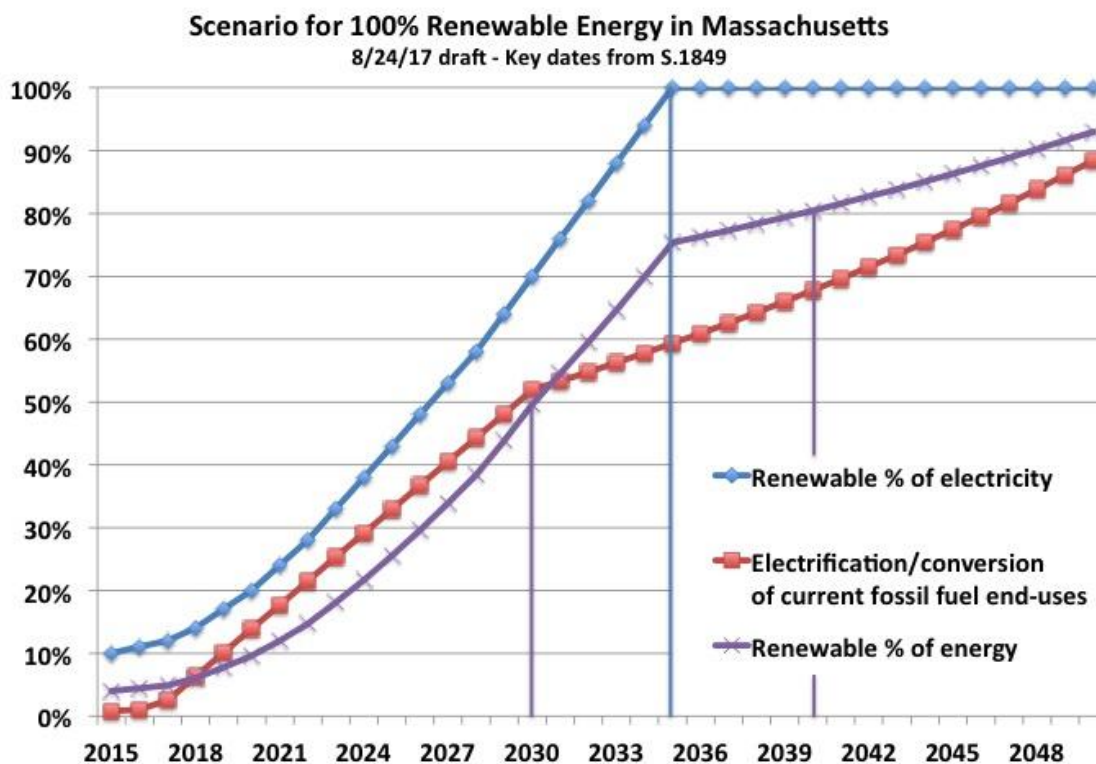
<sup>15</sup> Including utilities that are currently exempt from the RPS requirements.

<sup>16</sup> By the time we reach very high levels of renewable penetration (e.g., >75% after 2030), new storage and grid management technologies can be expected to have become feasible to support the remaining progress to 100% renewable electricity.

<sup>17</sup> Airline travel and some trucking and shipping, for which electrification may not be feasible, would convert to renewable biofuels.

pumps and other electric technologies for heating and cooling. New state, regional, and federal policies will be needed to achieve this electrification. These policies include carbon pricing, incentives and requirements to purchase these technologies, and tougher state limits on greenhouse gas emissions from other forms of transportation still using fossil fuels.

One scenario is shown in the following chart for the increases that will be required in renewable electricity (blue line with diamonds) and electrification (red line with squares).<sup>19</sup> The purple line with “x” marks shows the resulting percent of all state energy use supplied by renewable energy – reaching 50 percent in 2030, 75 percent in 2035, 80 percent in 2040 and 100 percent by 2050.



These rates of increase are not at all unrealistic if we start soon. From May 2016 to May 2017, the annual rates of increase in wind and solar capacity installed in New England were 65 percent and 39 percent, respectively.<sup>20</sup>

<sup>18</sup> This linear 3.5% electrification rate is assumed through 2030 because the starting point is near zero. Beginning in 2031, a 4% escalation rate is used for electrification in this scenario.

<sup>19</sup> This scenario is a simplified model, not a comprehensive program or a prediction.

<sup>20</sup> See [https://www.eia.gov/electricity/monthly/epm\\_table\\_grapher.php?t=epmt\\_1\\_17\\_a](https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_1_17_a). In May 2017, wind and solar contributed 3.2% and 3.8% to regional generation (for a total of 7%), based on <http://isonewswire.com/updates/2017/6/20/wholesale-electricity-prices-and-demand-in-new-england-may-2.html>.

At the same time, this pathway to 100 percent renewable energy will require a major mobilization of policies, planning, and public and private investment. Transformation will be needed in public attitudes and behavior as well as in technologies and policies. Finally, mobilization will be needed at the municipal and community levels as well as by the Legislature.