Union of Concerned Scientists

FACT SHEET

Massachusetts's Electricity Future

Reducing Reliance on Natural Gas through Renewable Energy

HIGHLIGHTS

Massachusetts has been reducing its dependence on coal and oil for electricity generation, but in the process has become heavily reliant on natural gas. The potential for natural gas overreliance poses numerous risks, including financial ones for consumers, who could face dramatic price swings and other impacts. The state has also made progress in cutting carbon dioxide emissions to help address climate change, but needs more reductions, and could be hampered by heavy dependence on natural gas.

New analysis from the Union of Concerned Scientists shows that implementing policies to tap into hydropower, land-based and offshore wind, and other renewable energy resources could allow Massachusetts to avoid natural gas overreliance, cut carbon dioxide emissions, and capture a range of additional consumer, health, and economic benefits at modest cost.

Massachusetts has long been highly dependent on imported fossil fuels to generate its electricity, but their mix has been changing. While coal- and oil-fired power plants are disappearing from the state—indeed, from the New England region—the role of natural gas looms ever larger.

The state's increasing reliance on this fuel, bordering on *over*reliance, has created greater risks—including for consumers: exposure to volatile natural gas prices, the costs of carbon pollution, and adverse economic impacts from over-investment in natural gas pipelines and power plants. In a 2015 Union of Concerned Scientists (UCS) assessment of the states on measures of overreliance risk, Massachusetts scored high, given that natural gas accounted for more than 50 percent of in-state electricity generation. And that number was slated to grow, as 70 percent of Massachusetts's projected near-term power plant additions would be natural gas–fueled (UCS 2015a).

Massachusetts also has a carbon emissions challenge, deriving in part from natural gas. Although the state has made appreciable progress in cutting its emissions of carbon dioxide (CO_2)—the heat-trapping gas mainly responsible for climate change—it needs to achieve a lot more to meet requirements, set forth in state

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Natural gas now accounts for half of New England's electricity generation mix, and more than 60 percent of Massachusetts's. This heavy reliance exposes consumers to risks such as volatile fuel prices and can hamper progress on cutting climate change–causing emissions. Shifting toward cleaner renewable energy resources such as wind, solar, and hydropower can greatly reduce these risks.

law and regional agreements, for 2020, 2030, and 2050.[1] And although natural gas earlier helped reduce the state's carbon emissions by replacing coal, it has now become a potential impediment to further progress. Gas burns more cleanly than coal or oil, but because it is still a fossil fuel it can impede the deployment of truly low-carbon renewable energy technologies such as wind and solar (Deyette et al. 2015). The potential deployment of new pipelines could make compliance with Massachusetts's carbon-reduction targets even more difficult (Shattuck, Howland, and Kumar 2015).

The state's prospects for solving these problems largely depend on the actions of its electric power industry, an ever more important player as other sectors (notably transportation and home heating) become increasingly electrified. In particular, what mix of electricity generation options should the state encourage to best serve it in the near and long terms?

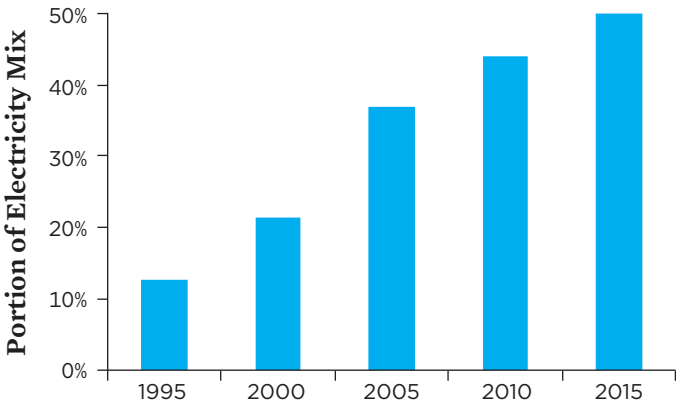
To help the people of Massachusetts and their leaders address the state's energy future, UCS analyzed electricity proposals now being debated in the legislature on the increased use of wind (both land-based and offshore) and hydroelectric power. We found that a combination of new clean energy policies to encourage large-scale increases in the use of hydropower and wind energy, for example, could substantially reduce natural gas usage, decrease the consumer risk of electric rate spikes, cut carbon emissions, and provide a host of other benefits at a very modest cost to consumers.

> ***Although natural gas earlier helped reduce Massachusetts's carbon emissions by replacing coal, it has now become a potential impediment to further progress.***

The Massachusetts Energy Scene

The mix of electricity sources in Massachusetts changed appreciably over the last 15 years as natural gas replaced much of the oil and coal. It increased from 30 percent of the state's generation in 2001 to 64 percent in 2015 (EIA n.d. a). For the New England regional electric grid on which Massachusetts also depends, natural gas now accounts for half of in-region generation (SNL 2016) (Figure 1).

FIGURE 1. Natural Gas's Rapid Rise in New England

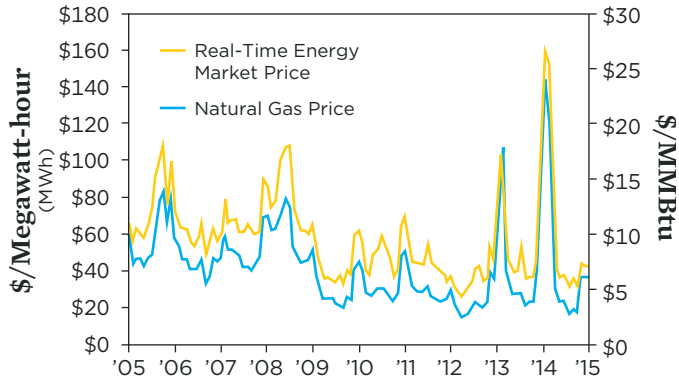


New England's reliance on natural gas for electricity generation has grown dramatically in recent decades. Natural gas now accounts for half of the region's mix.

DATA SOURCE: SNL 2016.

Prices for natural gas have generally been low in recent years, but New England's increased reliance on gas has led to appreciable price swings (Figure 2). The cold 2013–2014 winter led one Massachusetts utility, for example, to increase electricity rates the next winter (November to April) by 37 percent. These higher prices translated into a $40 rise in the average household's monthly electricity bill; bills dropped

FIGURE 2. Heavy Reliance on Natural Gas Puts Consumers at Risk for Price Swings



New England's heavy dependence on natural gas exposes customers to large variations in electricity prices based on natural gas's price volatility.

SOURCE: ISO-NE 2015.

Ad Meskens/Creative Commons (Wikimedia)

Offshore wind power in Europe, such as this wind farm off the coast of the Netherlands, employs some 75,000 people. Massachusetts also has world-class offshore wind power potential, and being a national leader in offshore wind development would allow the state to capture an appreciable early share of US jobs in that sector.

$38 the following spring (Kinney 2015; Kinney 2014).[2] In general, even commercial and industrial customers who have fixed their electricity prices and may be protected from price swings in the short term will likely feel the effects at contract renewal time (ISO-NE 2015).

While the low average price of natural gas in recent years has driven its expanding role, other changes in the power sector have also taken place. A range of clean energy and climate policies has promoted reliable, cost-effective, low-carbon power options. Along with the strongest energy efficiency policies in the country,[3] Massachusetts has a renewable portfolio standard (RPS) for local utilities and, with its northeastern and mid-Atlantic neighbors, is employing a marketplace mechanism for limiting power plant carbon emissions under the Regional Greenhouse Gas Initiative. Massachusetts has also been a leader in developing solar energy, ranking fourth among states for solar capacity installed during each of the last few years (GTM-SEIA 2016).

Prices for natural gas have generally been low in recent years, but New England's increased reliance on gas has led to appreciable price swings.

Energy Futures

The state has indeed made clean energy progress. But the retirement of several large coal-burning, oil-burning, and nuclear power plants in the state and region, together with the deployment of several natural gas pipelines now in the works—potentially funded by the state's electricity ratepayers—could put Massachusetts in a danger zone of overreliance on natural gas. The unprecedented funding arrangement[4] could increase economic risks to consumers even further if over the long term those pipeline investments,

potentially costing more than $1 billion for the electricity portion, turned out not to be needed (Hibbard and Aubuchon 2015; Serreze 2015).[5]

Reducing the state's potential overreliance on natural gas will likely require increased investment in some of the renewable energy technologies already in play, as well as in a broader set of technology options. Several options—for large-scale deployments that could reduce the state's natural gas and carbon risks while stabilizing power prices—are of particular interest:

- Driving the development of additional land-based renewable energy, including wind power within New England, and additional in-region electricity transmission infrastructure
- Making greater use of hydropower from out of state through investments in long-distance transmission lines
- Exploiting Massachusetts's world-class offshore wind power potential, which offers abundant resources close to Boston and other areas of high population density—and of strained electricity markets

The latter case could provide the state with a major economic opportunity, given the lack of offshore wind development in the United States to date.[6] Massachusetts could position itself as a leader in offshore wind and capture first-mover economic advantages, including in-state development of expertise in offshore wind manufacturing, project development, operations, and maintenance. Strong state policies to create the market certainty needed to launch such a new industry could allow Massachusetts to achieve economies of scale and gain the experience for bringing down costs considerably.

Shaping Our Energy Future

Several proposals now being considered by the Massachusetts legislature seek to shape the state's power sector through policies embracing a range of technologies. UCS analyzed a suite of such policies to assess their combined potential to reduce the state's reliance on natural gas, and we compared the costs and benefits of this scenario with those of a "business as usual" case based on current policies. The combination of new policies included:

- An accelerated ramp-up of the state's RPS, to almost 40 percent by 2030, which would increase the use of wind, solar, and other renewables
- A requirement that Massachusetts utilities enter into long-term contracts—the results of competitive bidding—to buy hydropower (which, for the most part, is not RPS-eligible) and RPS-eligible renewable energy in amounts totaling close to one-third of the state's electricity needs by 2030
- A requirement that the utilities contract for approximately 2,000 megawatts of RPS-eligible offshore wind power, enough to meet close to 15 percent of the state's electrical needs, by 2030

The combination reflects an amalgam of several competing proposals—H.2881 (Massachusetts House of Representatives 2015), S.1965 (Massachusetts Senate 2015a), and S.1757 (Massachusetts Senate 2015b), for example—each of which contains aspects that may be slated for inclusion in a forthcoming "omnibus" energy bill that will be the subject of legislative debate in spring 2016. These policies would result in roughly 2,000 megawatts each of hydropower, onshore wind and solar, and offshore wind.

The UCS analysis involved the compilation of data and assumptions on energy technology costs, performance, and financing, relying on publicly available data where possible. It also assessed regional renewable energy demand and eligible supply. Electricity modeling projected the composition and costs of New England electricity supply, and resulting emissions. The analysis estimated the monthly bill effects and changes in total emissions attributable to the suite of policies under assessment.[7] (For details, see the technical appendix at *www.ucsusa.org/MassachusettsElectricityFuture*.)

> ***UCS found that the suite of proposed clean energy policies is achievable and could reduce the region's reliance on natural gas.***

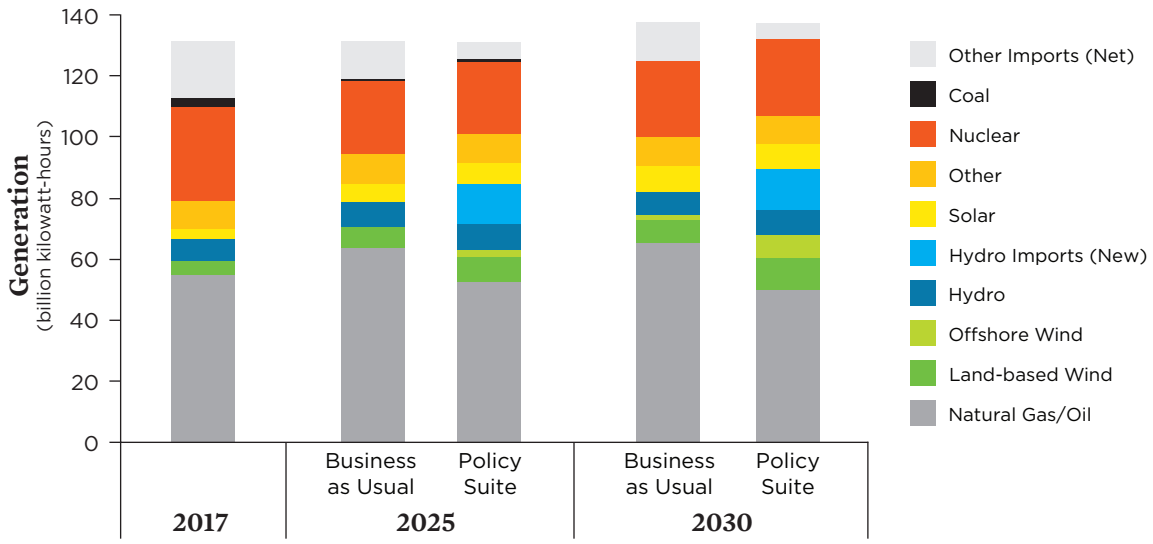
Findings

Our analysis found that this suite of policies is achievable and cost-effective, and would reduce the region's reliance on imported natural gas. We also found that these policies could produce a range of long-term economic and public health benefits that would greatly outweigh modest increases in direct electricity bills.

ENERGY MIX

Our projections show that these policies would together create a more balanced role for natural gas in New England's electricity

FIGURE 3. Massachusetts Policy Could Dramatically Change New England's Electricity Mix



Massachusetts policies to prevent natural gas overreliance could change the energy mix in New England appreciably. Natural gas could drop from 49 percent of the region's electricity generation to 42 percent, while wind power's share could grow from 4 percent to 15 percent.

Notes: Analysis does not include pumped hydro storage. The fuel category "Other" includes biomass, landfill gas, biogas, diesel, and fuel cells.

mix. Enough renewable energy resources exist to satisfy the requirements of the policy suite, thereby appreciably cutting the use of natural gas (Figure 3). Under the business-as-usual scenario, natural gas for power generation is projected to increase from 49 percent of New England electricity generation in 2017 to 52 percent in 2030. By contrast, under the mix of renewable energy policies, natural gas would fall to 42 percent of the region's generation by 2030, dropping 9 percent from 2017 levels and 23 percent below business as usual (Figure 4, p. 6).

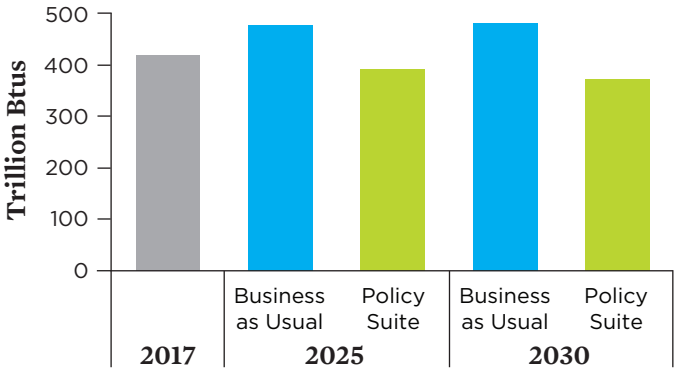
Massachusetts itself could benefit even more than the region as a whole, given its long-term contracts for hydro, offshore wind, and other renewable energy resources, which together could meet more than half of the state's electricity needs by 2030.

COSTS AND BENEFITS

Our analysis shows that the suite of policies to cut Massachusetts's reliance on natural gas offers a wealth of benefits to the state, the region, and beyond, over both the short and long terms:

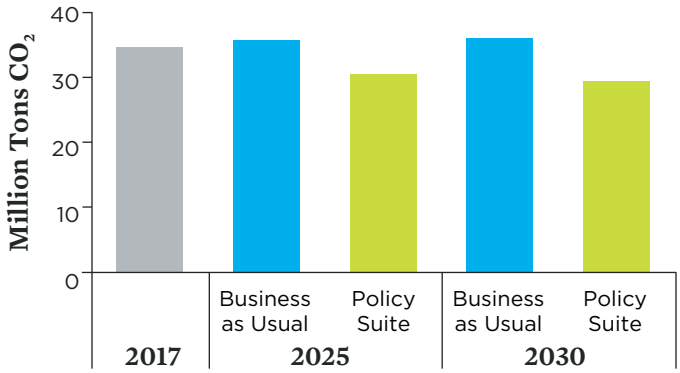
- **Reduced exposure to natural gas risks.** Using less natural gas for power generation would reduce the vulnerability of Massachusetts electricity customers to natural gas price swings, to the costs of carbon pollution, and to overinvestment in natural gas infrastructure, which could saddle customers with costs for underused, idled, or abandoned pipelines and power plants (UCS 2015a). Reduced demand for natural gas because of the suite of policies could also lower the fuel's price across the Massachusetts economy, bringing cost savings to homes or businesses using natural gas for heating or other applications.
- **Lower CO_2 emissions.** By investing in low-carbon electricity options, our analysis indicates, Massachusetts would contribute substantially to decreasing future CO_2 emissions (Figure 5, p. 6). Total emissions in the power sector could drop 5.2 million tons from 2017 to 2030 under the mix of policies, with the state's emissions in 2030 amounting to 6.6 million tons below business as usual. If Massachusetts were to set a 2030 carbon emissions reduction target of 40 percent (the middle of the range of the state's existing 2030 commitment) below 1990 levels, achieving it would require reductions of 14 million tons beyond the state's 2020 target. A 5.2-million-ton drop in emissions due to the policy mix would be an important first step for that phase, accounting for more than a third of the carbon reductions needed between 2020 and 2030.
- **Reduced pollution.** Cutting CO_2 emissions could lower the state's contributions to global warming, with its range

FIGURE 4. Renewable Energy Helps Reduce New England's Demand for Natural Gas for Power



Under business as usual, natural gas use for power generation in New England would increase. The suite of policies, on the other hand, could reduce natural gas use in the New England power sector by more than 100 trillion Btus—equivalent to almost one-quarter of 2030 demand under business as usual, and almost one-quarter of Massachusetts's natural gas use across all sectors in 2013 (EIA n.d. c).

FIGURE 5. Renewable Energy Reduces the New England Power Sector's Carbon Footprint



Under business as usual, CO_2 emissions from the New England power sector are expected to increase by 2030. Under the suite of renewable energy policies we analyzed, emissions in 2030 would be more than 5 million tons lower than in 2017, and almost 7 million tons lower than the 2030 business-as-usual case. These reductions would be equivalent to taking 1 milion to 1.3 million cars off the road (EPA 2016).

of climate impacts that harm human health and damage the economy, among other effects. A move toward greater use of renewable energy would also reduce emissions of fossil fuel pollutants such as sulfur dioxide and nitrogen oxides, which can exacerbate asthma, other lung diseases, and heart diseases among the region's residents. Taking just those three pollutants into account, the modeled combination of policies could bring health and economic benefits (regionally and globally) of more than $350 million in 2030 (in 2016 dollars).[8]

- **Clean-energy jobs.** A key result of replacing an out-of-region energy source (natural gas) with in-region sources (such as land-based wind, offshore wind, and solar) would be the creation of jobs. Already, almost 100,000 people work in the clean energy sector in Massachusetts today (MassCEC 2015). And by taking the lead in the United States on large-scale development of offshore wind, the state would be well positioned to capture an appreciable early share of US jobs in that sector, which in Europe now employs some 75,000 people (IRENA 2015).

The increased investments in renewable energy to reduce natural gas risks could raise average household electricity bills above business as usual by about $3.00 per month in 2030—with an average increase from 2017 to 2030 of $3.20 (see table). Those amounts are equal to less than 2.5 percent of the average residential bill in Massachusetts in 2015 (EIA n.d. d). For commercial and industrial customers, average cost increases in 2030 would be $32 per month (3.4 percent of average bills) and $333 per month (4 percent of average bills), respectively.[9]

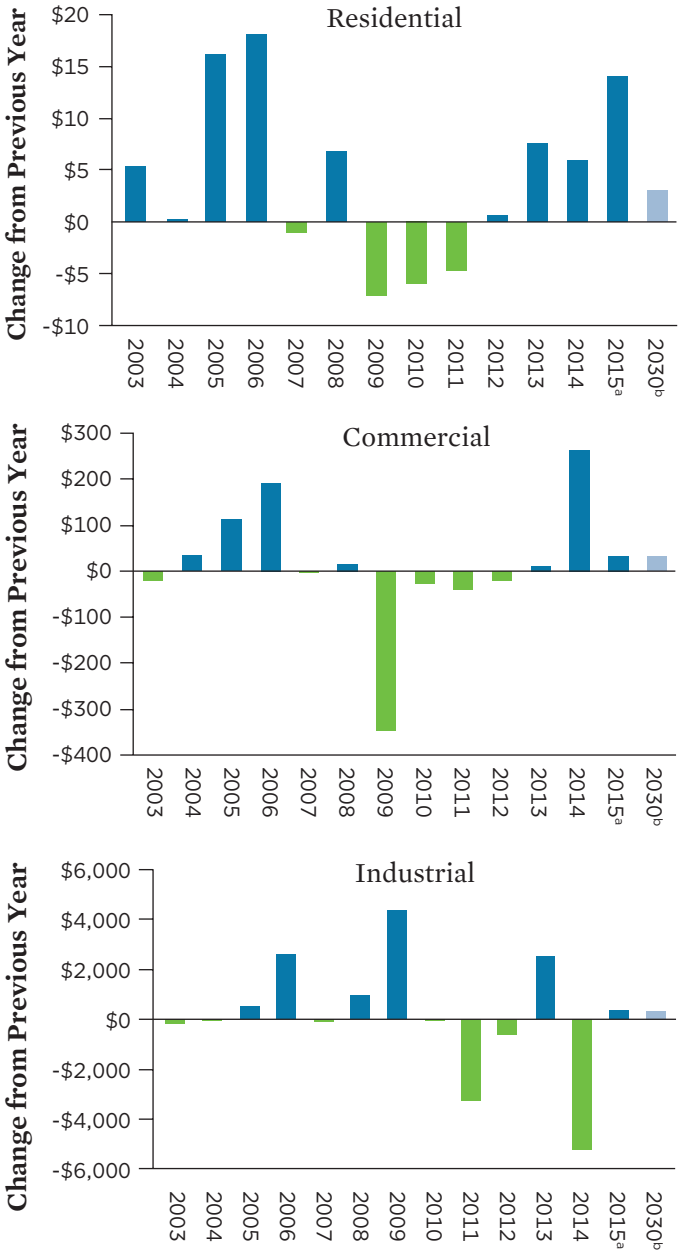
These projected increases, which may actually overstate the cost impact of the combination of policies,[10] would be much smaller than the year-on-year swings in average monthly electricity bills that Massachusetts households now regularly experience (Figure 6).[11] Such swings have been as high as $18 in recent years for households, and hundreds or thousands of dollars for commercial and industrial customers.

Projected Change in Monthly Electricity Bills (2016$)

	Residential	Commercial	Industrial
2017	$1.55	$14.55	$149.10
2020	$3.28	$31.04	$318.31
2025	$4.01	$42.76	$443.57
2030	$3.00	$32.05	$332.55
Average, 2017–2030	**$3.20**	**$32.98**	**$341.00**

The suite of policies to increase renewable energy and reduce natural gas reliance would lead to modest increases in electricity bills for customers in all rate classes, compared with business as usual.

FIGURE 6. Average Changes to Monthly Electricity Bills, 2003–2015 and 2030



Reducing natural gas risks by deploying offshore wind, hydro, and other renewables would raise average monthly household electricity bills only modestly above business as usual by about $3.00 in 2030 and by an average of $3.20 over 14 years. Average commercial and industrial customers could experience similarly modest monthly bill increases in 2030 of about $32 and $333, respectively. The added costs would actually be much smaller than the annual fluctuations in bills that Massachusetts electricity consumers now typically face.

Notes: a. Estimated change based on available monthly data. b. Projected change resulting from suite of proposed policies, compared with business as usual.

SOURCES: UCS ANALYSIS, EIA N.D. B.

A small premium for the suite of policies would seem to be a reasonable investment in reducing exposure to much larger rate increases due to over-reliance on one fuel source.

Recommendations

Having analyzed the above-noted suite of policies for reducing Massachusetts's exposure to natural gas risks, UCS offers several suggestions for decision makers and the public at large:

- **Be inclusive.** Our analysis suggests that combining different energy technologies could bring benefits beyond those of a more limited approach, and appreciably beyond what business as usual would bring. While offshore wind, for example, would likely raise consumer costs marginally at first, that increase would be offset by the benefits of launching this new Massachusetts industry—a potentially better option than sending those energy dollars out of state. Further, European experience indicates that as the US offshore wind market matures, it will exponentially grow more attractive—and serve as a good complement to hydropower.
- **Avoid incentives for fossil fuel infrastructure.** To reduce the risks of natural gas overreliance, we should not require electricity ratepayers to bear the long-term financial risks of additional investments in fossil fuels. Indeed, recent studies suggest that other approaches, such as greater use of liquefied natural gas, gas storage, and upgrades to existing natural gas pipelines, would avoid the need for major new pipelines in Massachusetts for electricity (Hibbard and Aubuchon 2015; Lander 2015).
- **Invest at scale.** To maximize the benefits of offshore wind, Massachusetts should invest at a scale commensurate with the state's power and carbon reduction needs and the major opportunity that this new technology represents. A 2,000 megawatt requirement, complemented by additional investments in offshore wind by other states in the region, could be enough to launch the US offshore wind industry while also reducing the cost of energy from this source by 55 percent over a decade (Kempton, McClellan, and Ozkan 2016).
- **Use other tools in the energy toolbox, too.** Added energy efficiency could offset some or all of the modeled policies' price increases as well as enhance the carbon-reduction benefits. Widened deployment of solar could also reduce energy prices while bolstering a proven job-creating sector in Massachusetts.

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Increased investment in renewable sources of electricity could raise the average household's electricity bill by about $3.00 per month in 2030, compared with business as usual. This increase is much smaller than the year-to-year swings in average monthly electricity bills that Massachusetts households now regularly experience. Consumers will also benefit from the reduction of public health and environmental impacts—and their associated costs—that comes from a cleaner energy system.

- **Maintain the lead.** Massachusetts has long been a leader in climate and energy issues, as reflected by its own policies that require deeper reductions than what has been mandated for the state under the federal Clean Power Plan (UCS 2015b). That leadership must continue. If, for example, Massachusetts waited for other states to invest in offshore wind first—presumably rendering it a less costly option in the United States later on—Massachusetts would forfeit many of the economic advantages, such as job creation, of launching a cutting-edge industry. Leading on offshore wind would also avoid delaying the large-scale carbon reductions that this technology can offer.

By embracing a wide range of clean energy technologies, and offering incentives to build them at scale, Massachusetts would lower the risk of large natural gas price fluctuations, significantly cut its global warming CO_2 emissions, and generate significant net benefits for public health and the state's economy.

***John Rogers** is a senior analyst in the UCS Climate and Energy Program. Paula Garcia is an analyst in the program.*

ENDNOTES

1 *The state's 2008 Global Warming Solutions Act requires reductions of 25 percent by 2020 and 80 percent by 2050 from 1990 emission levels (EEA 2016). Its commitment to the New England Governors/Eastern Canadian Premiers 2015 climate agreement calls for reductions by 2030 of 35 to 45 percent (CONEG 2015). In December 2015, Governor Charlie Baker also committed Massachusetts to the "Under 2 MOU"—a memorandum of understanding, promoted by states and other subnational jurisdictions in the wake of the Paris climate accord, to limit global warming to less than 2°C (Baker 2015).*

2 *Based on 600 kilowatt-hours of electricity use per month.*

3 *Massachusetts homeowners pay less, on average, for their monthly electricity than do their counterparts in 30 other states (EIA n.d. b).*

4 *Utility proposals awaiting approval by the state's Department of Public Utilities (DPU) would, for the first time, charge Massachusetts electricity ratepayers for investments in natural gas pipelines. The DPU's 2015 decision that opened this door is the subject of a case pending at the state's Supreme Judicial Court (CLF 2015).*

5 *In their analysis of pipeline needs for the Massachusetts Office of the Attorney General, Hibbard and Aubuchon (2015) examine a scenario involving the addition of pipeline capacity for electricity generation, at a cost of approximately $1.3 billion.*

6 *Completion of the first US offshore wind farm, off Block Island in Rhode Island, is scheduled for late 2016.*

7 *The modeling efforts were carried out by Sustainable Energy Advantage* (www.seadvantage.com) *and Daymark Energy Advisors* (www.daymarkea.com).

8 *The health benefits are calculated from the benefit-per-ton-of-reduction values reported in OAQPS 2015.*

9 *All cost figures in this paragraph and the next are in 2016 dollars.*

10 *The modeling assumption that long-term contracts for RPS-eligible resources will be fulfilled by New England supply alone may be conservative, and thus it might produce higher cost figures than would otherwise be the case. In reality, projects in neighboring areas—New York, Quebec, New Brunswick, and the Canadian Maritimes—could compete for the New England market, although additional transmission, at additional expense, could be required to access these resources.*

11 *The figures are also much smaller than the $10 more per month that a majority of Massachusetts residents indicated they would be willing to pay to significantly reduce carbon emissions (WBUR 2015).*

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NATIONAL HEADQUARTERS
Two Brattle Square
Cambridge, MA 02138-3780
Phone: (617) 547-5552
Fax: (617) 864-9405

WASHINGTON, DC, OFFICE
1825 K St. NW, Suite 800
Washington, DC 20006-1232
Phone: (202) 223-6133
Fax: (202) 223-6162

WEST COAST OFFICE
500 12th St., Suite 340
Oakland, CA 94607-4087
Phone: (510) 843-1872
Fax: (510) 843-3785

MIDWEST OFFICE
One N. LaSalle St., Suite 1904
Chicago, IL 60602-4064
Phone: (312) 578-1750
Fax: (312) 578-1751

WEB: www.ucsusa.org