



Carbon-Cutting Success Stories

**How the Regional Greenhouse Gas Initiative
Is Reducing Pollution and Investing in People**

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Executive Summary

Increasingly, leaders in the United States and around the world are taking action to protect our climate from global warming. With 2016 likely to be the hottest year in human history, the need for further action is only growing more apparent, and more urgent.

Fortunately, leading states continue to prove that curbing dangerous carbon pollution can reduce the risk of global warming and benefit local communities at the same time. The Northeast and Mid-Atlantic states have dramatically reduced dangerous power plant pollution, using tools including the Regional Greenhouse Gas Initiative, a policy that limits pollution over time and makes polluters pay for the privilege of using the sky for waste disposal. Much of the revenue is then invested in clean energy programs, which have boosted the regional economy by nearly \$3 billion.

Numbers, however, cannot tell the full story of the success of the Regional Greenhouse Gas Initiative. The case studies highlighted in this report show how this policy is working to help homeowners, farmers, non-profit organizations, clean energy entrepreneurs, governments and businesses save energy, save money, and do their part to preserve a livable climate for ourselves and for future generations.

The success of the Regional Greenhouse Gas Initiative over the last decade shows that we can do more. To speed our progress toward a clean energy future, participating states should double its pollution reduction goal through 2030.

The Regional Greenhouse Gas Initiative helps

residents, businesses and institutions throughout the Northeast to invest in clean energy and save money, even as they protect our climate.

- **Hunt Country Vineyards** in New York installed more than 300 solar panels, with financing assistance in part from the Regional Greenhouse Gas Initiative. The panels avert as much pollution as almost 3,000 cars emit annually – and save the winery thousands of dollars per month on electricity.
- **Solar City** is responding to demand for more clean energy – created in part by limits on carbon pollution like the Regional Greenhouse Gas Initiative – by building a “GigaFactory” in Buffalo to manufacture solar panels. When operational in 2017, this factory will be the largest solar panel factory in the Western Hemisphere. The company expects to create 3,000 new jobs in Buffalo. In 2015, solar energy in New York reduced carbon pollution equivalent to the emissions from 70,000 vehicles – and the state has barely scratched the surface of its clean energy potential.
- **Children’s Medical Center** in Hartford, Connecticut, retrofitted its lighting and cooling systems with support from Regional Greenhouse Gas Initiative funds. The project saved the hospital more than \$23,000 per year on electricity – enabling the hospital to keep its energy costs down as it expands its core mission of keeping kids healthy. At the same time, the project is protecting the climate by preventing as much carbon pollution as 30 passenger cars emit annually. Vast additional potential for efficiency projects like this exists across the state.

- The towns of **Swampscott** and **Wehnam** in Massachusetts installed energy-efficient street lighting with the support of revenue from the Regional Greenhouse Gas Initiative, reducing the towns' electricity costs by more than \$100,000 per year. At the same time, the projects are cutting as much carbon pollution per year as is contained in more than 33,000 of gasoline.
- In Maryland, the **Community Action Council of Howard County** has provided energy efficiency upgrades to hundreds of families using funds from the Regional Greenhouse Gas Initiative, including residents of the Shalom Square senior living complex in Columbia. Projects undertaken in 2014 now save beneficiaries a total of \$70,000 per year on electricity bills and prevent as much carbon pollution as emitted annually by 70 passenger cars.
- The **Matthias Agriculture Program** has also helped Maryland poultry farms upgrade their energy efficiency, supported by Regional Greenhouse Gas Initiative funding. Work at five poultry farms in 2014 saves an estimated annual 208,821 kWh of electricity and 16,000 gallons of propane, while reducing carbon pollution by an estimated 237 metric tons per year, equivalent to taking more than 50 passenger vehicles off the road.
- **Smuttynose Brewery** built a new highly-efficient brewery operation in Hampton, New Hampshire. The company was able to include more efficient brewing equipment with the help of New Hampshire Saves, a program that has been funded in part by Regional Greenhouse Gas Initiative revenues. Over the lifetime of the equipment installed through the program, Smuttynose will save more than \$1 million in energy costs – while helping to preserve the climate necessary for farmers to grow the raw ingredients for beer by preventing carbon pollution equivalent to driving a typical car for almost 13 million miles.
- **Oxford Networks**, an information technology company, added advanced efficiency technology to its data center in Brunswick, Maine, partially cooling the center with Maine's brisk outdoor air. The project was made possible by the state's energy efficiency utility, Efficiency Maine, with partial funding from the Regional Greenhouse Gas Initiative. The project reduced Oxford Networks' energy costs by as much as \$5,000 per year. Efficiency Maine's cumulative FY15 work saved as much energy as is contained in 26 million gallons of oil.

The Regional Greenhouse Gas Initiative works by limiting power plant pollution while generating revenue for clean energy and consumer benefit programs. To accelerate progress in protecting our climate, while also ensuring that health and economic benefits continue to flow to local communities, **state leaders should double the strength of the program.** Specifically, states should:

- Set the cap on power plant pollution to decline by 5 percent per year, instead of the current rate of 2.5 percent. This would lower dangerous carbon emissions to less than 40 million tons annually by 2030. States need to double the strength of the cap in order to reach their economy-wide climate goals.
- Continue to capture the revenue generated through allowance sales and invest it in efficiency and renewable energy projects that bring real rewards for local communities.
- Urge states outside of the nine-state Regional Greenhouse Gas Initiative region to take equally significant action to reduce pollution.

Introduction

The clean energy revolution is happening faster than anyone could have imagined a decade ago.

In 2005, the Northeast and Mid-Atlantic states generated more than a third of their electricity from extremely dirty fuels like coal and fuel oil.¹ Wind and solar power made up a negligible fraction of the power supply and inefficient uses of electricity – like incandescent lightbulbs – were common. As a result, the region’s power plants were producing more than 160 million tons of dangerous carbon pollution per year – causing as much global warming as annually burning more than 16 million gallons of gasoline or more than 150 billion tons of coal.²

Today, things look very different.

Thanks to strong energy efficiency programs, the region is using 5 percent less electricity today than it did in 2005, even as the economy and population have continued to grow.³ Electricity generation from dirty fuel oil and coal is down by more than 70 percent and continuing to decline.⁴ In just the last four years, the region has quadrupled its capacity for generating energy from the sun.⁵ And the door to a brand new industry – offshore wind power – is now open. In the summer of 2016, Deepwater Wind finished construction on the nation’s first offshore wind energy facility, the Block Island Wind Farm in Rhode Island.⁶ As a result of all of this clean energy deployment, overall levels of dangerous carbon pollution from power plants are down by almost half since 2005.⁷

There are many reasons why the clean energy revolution is happening so fast – but one critical policy driv-

ing progress and serving as a critical backstop is the Regional Greenhouse Gas Initiative. This policy sets a declining limit on emissions from power plants, sending a powerful market signal for power providers to invest in clean energy rather than dirty fuels. It also requires polluters to pay for the privilege of using our atmosphere for waste disposal, generating important revenues that states are using to fund important clean energy programs.

Our experience with the Regional Greenhouse Gas Initiative over the last decade shows that we can continue to cut carbon pollution and build a bigger, better clean energy economy. As the stories in this report demonstrate, limiting carbon pollution and funding clean energy programs delivers important benefits to local communities across the region, and opens doors for everyone to participate in building a better future for our communities and our children.

The success of the initiative could not have come at a more important time, since we must build on that experience to reach our goals when it comes to preventing the worst impacts of global warming. All of the states in the Northeast and Mid-Atlantic region are aiming to significantly cut carbon pollution across their entire economies. Guided by what scientists have determined that we must do, states are aiming to cut pollution by roughly 40 percent below 1990 levels by 2030, and then at least 80 percent by mid-century.

All of the states in our region – and indeed the entire nation – must meet these emissions targets in order to deliver on the promise we made when signing onto the Paris Climate Agreement, a commitment made by the United States and 194 other countries to

protect our planet from dangerous warming. Meeting this challenge will take a sustained commitment and ongoing leadership from the Northeast and Mid-Atlantic states.

One of the most impactful things that our states could do would be to strengthen the Regional Greenhouse Gas Initiative, tightening the limit on carbon pollution and further accelerating our transition to clean energy. In order for the states to deliver on their climate goals, analysis indicates that the program's cap on carbon pollution from power plants should be halved from 2020 to 2030, coupled with additional policies to limit pollution from other parts of the economy.⁸

We should move forward with confidence. In addition to our decade of experience with the benefits of the Regional Greenhouse Gas Initiative, we have vast additional clean energy resources to develop. Through increased efficiency, we can keep our demand for electricity stable even as our economy continues to expand. Offshore wind alone could produce five times as much electricity as East Coast states use every year – with no pollution.⁹ Every one of America's 50 states has the technical potential to generate more electricity from the sun than it uses.¹⁰ And clean energy technologies are only getting bet-

ter and cheaper: Between 2009 and 2014, the cost of solar electricity in the United States fell by 78 percent and the cost of wind energy fell by 58 percent – with no signs of stopping.¹¹ These facts are a major reason why many of the RGGI states are increasing their commitments to clean energy – including New York, which recently committed to get fully half of its electricity from renewable sources by 2030.

Finally, the vast majority of voters in our region support limiting carbon pollution through the Regional Greenhouse Gas Initiative, and want their elected officials to act. In fact, almost 8 in every 10 voters across the region – including a majority of Democrats, Republicans and Independents, support making the program twice as strong by 2030.¹²

In short, we have the experience, the resources, the technology, the know-how, and the political will to achieve our climate goals. Now is the time for our leaders to take another important step forward to cut dangerous carbon pollution by doubling the strength of the Regional Greenhouse Gas Initiative. The stories in this report demonstrate that doing so is not only good for the climate, but for communities throughout the Northeast and Mid-Atlantic regions.

Climate Action through the Regional Greenhouse Gas Initiative Benefits Local Businesses, Communities, and Families

By limiting power plant pollution, the Regional Greenhouse Gas Initiative (RGGI) is sending a clear directive to power producers to transition our electricity system away from dangerous fuels that harm our climate and our health. Since 2009, RGGI has been reducing dangerous global warming pollution from power plants in the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont.

By limiting pollution, RGGI is creating new opportunities for clean energy businesses – like Deepwater Wind, which recently erected the first offshore wind turbines in the United States along the coast of Rhode Island.

At the same time, RGGI is generating funding to drive energy efficiency and clean energy projects by making traditional power plant owners pay for permission to pollute. That funding helps to enable all of us to participate in and benefit from the transition to clean energy.

RGGI is a proven, successful approach to tackling global warming – reducing pollution and creating local benefits for people across the Northeast and Mid-Atlantic states.

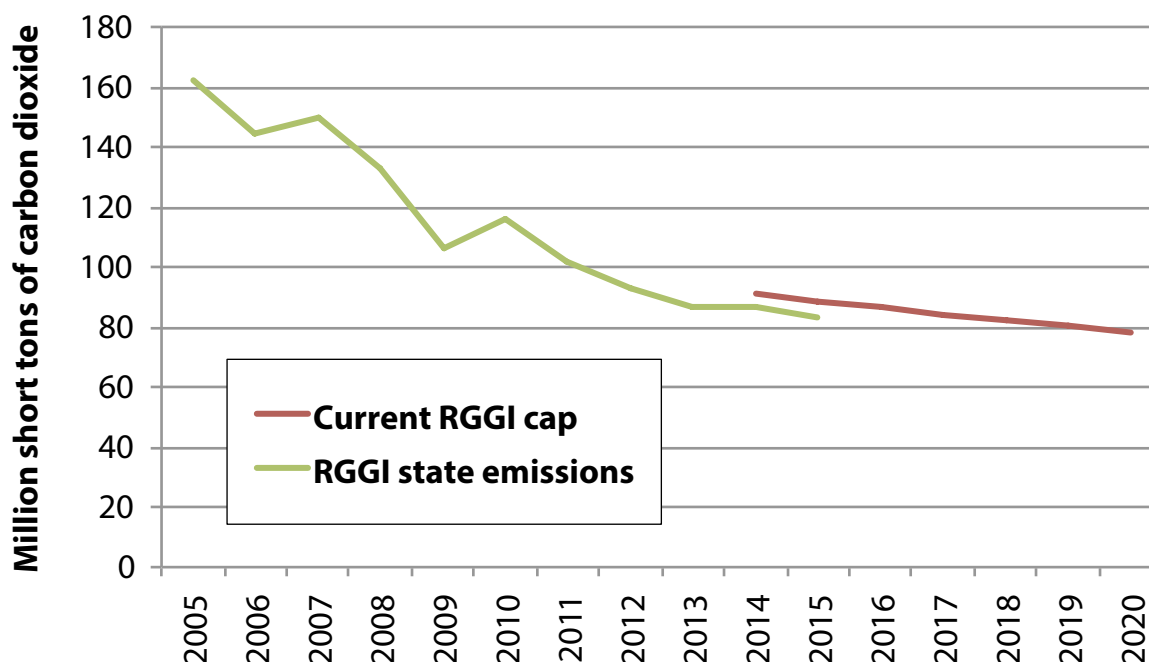
A Climate Program that Works: RGGI Cuts Pollution and Promotes Clean Energy

The nine Northeastern and Mid-Atlantic states participating in RGGI have dramatically reduced dangerous carbon pollution from power plants over the last decade. Overall, emissions are down by about half since 2005, when RGGI was first designed.¹³

Since 2005, power plant carbon pollution has fallen by about 5 percent per year – much faster than was generally believed to be possible.¹⁴ In 2013, as a result of the first official review of the program, the states decided to lock in that impressive progress by significantly lowering the cap on emissions in future years.¹⁵

RGGI has helped to cause some major shifts in the shape of our electricity system over the past decade. The most polluting power plants – those fueled by oil and coal – have mostly been shut down, or will be soon, in part due to pressure stemming from pollution concerns.¹⁷ When the Brayton Point coal plant shuts down in 2017, it will be the end of coal-powered electricity generation in Massachusetts.¹⁸ At the same time, clean energy sources are increasingly playing on a more even playing field, and are rapidly becoming a more significant part of our energy mix; New

Fig 1. Since 2005, RGGI States Have Reduced Power Plant Emissions by an Average of 5 Percent Per Year¹⁶



York State now has enough solar energy capacity to power more than 120,000 homes.¹⁹

RGGI has also generated revenue that states are investing in clean energy and energy efficiency programs. As of April 2016, auctions of pollution allowances through RGGI have generated more than \$2.4 billion across the RGGI states.²⁰ The states have all agreed that “at least 25% of the allocations will go to a consumer benefit or strategic energy purpose.” Through 2013, more than half (56 percent) of all auction proceeds had been allocated to programs encouraging energy efficiency, clean renewable energy, or other strategies to reduce greenhouse gas emissions, as estimated by RGGI, Inc.²¹

RGGI Helps Everyone Participate in and Benefit from the Transition to Clean Energy

RGGI helps enable all of us to participate in and benefit from the transition to clean energy. Consider:

1. In addition to reducing global warming emissions, RGGI has helped to reduce health-threatening pollution like soot and smog, making our communities safer. Acadia Center estimates that RGGI – in concert with policies limiting air pollutants harmful to human health – has helped to deliver more than \$10 billion in health benefits across the region.²²

2. RGGI has helped save money and benefited our economy. RGGI investments made through 2013 were projected to return nearly \$3 billion in energy bill savings to nearly 4 million households and nearly 18,000 businesses, including \$2.3 billion in energy savings from efficiency measures, and \$240 million from clean energy installations.²³
3. At the same time, investing RGGI funds in clean energy programs stimulates state economies and creates jobs. Research by the Analysis Group found that, from 2009 to 2014, RGGI generated nearly \$3 billion (net present value) in positive economic value for the region.²⁴

In the section below, we review some of the ways that businesses, homeowners and institutions have participated in the work of cutting dangerous carbon pollution, accelerating our transition to clean energy and protecting our climate. These stories showcase how people, businesses and communities can participate in and benefit from work to protect our climate – and provide a glimpse of the future benefits the Northeast region could see under a sustained commitment to cutting dangerous carbon pollution.

New York

Finger Lakes Vineyards go solar with the help of the New York Green Bank

Name	Hunt Country Vineyards, Dr. Frank Vinifera Wine Cellars, O-Neh-Da and Eagle Crest Vineyards, and Wagner Vineyards
Program	New York Green Bank
Project	~500kw of solar installations
Result	At Hunt Country Vineyards, 70 percent of electricity needs now met through the sun
Benefits	Carbon dioxide emissions reduced by 460 tons per year, the equivalent of taking 2,900 vehicles off the road

New York has set an ambitious goal, consistent with the Paris Climate Agreement, of reducing global warming pollution by 40 percent below 1990 levels by 2030.²⁵



With help from the New York Green Bank, Hunt Country Vineyards installed 348 rooftop solar panels. Credit: Joyce Hunt

Institutions across New York are eager to help achieve that goal, while also taking greater control over their own energy supplies and saving money on electricity. However, barriers to investing in clean energy projects remain – such as finding local lenders familiar with financing for clean energy projects.

New York took advantage of RGGI funds to create a program designed to help businesses overcome those barriers and participate in achieving the state's climate and clean energy goals. Founded in 2013, the New York Green Bank (NYGB) facilitates private participation in the clean energy marketplace, stimulating growth by addressing financing gaps and market barriers.²⁶

An early NYGB success was helping to advise several Finger Lakes region vineyards on financing solar energy to power their existing facilities.²⁷ Five vineyards – Hunt Country Vineyards, Dr. Frank Vinifera Wine Cellars, O-Neh-Da and Eagle Crest Vineyards, and Wagner Vineyards – worked together in 2015 to install large-scale solar power systems with a collective capacity of nearly 500 kilowatts, or about 100 times the capacity of a typical home solar installation.²⁸

Wineries have intensive power needs at certain points in their harvest and production cycle, from pressing the grapes, to chilling and heating wine, to pumping and filtering operations. Art Hunt, owner of Hunt Country Vineyards in Branchport, a farm and winery that's been in his family for seven generations, said his electric bill used to run \$3,000 to \$4,000 per month. Now, the 348 rooftop solar panels on the vineyard's wine production building, visitor center and farm shop are covering about 70 percent of the winery's electricity needs (even more panels would have been installed if not for system size limits under New York's net metering law), and should pay for themselves within six or seven years.²⁹

Hunt had known for some time that solar panels could help lower his energy costs. With panel purchase prices having fallen to an affordable level in

recent years, Hunt Country Vineyards was ready to make the move – but local banks were not quite ready to help.

"Our local bank had never loaned money for commercial-size solar installations," Art Hunt said. "Because we've been in business for many years, we have good credit, but they didn't know how to analyze the risks."

Hunt Green LLC, a sustainability and renewable energy advising firm headed by Art Hunt's daughter, Suzanne Hunt, introduced bankers in the Finger Lakes region to NY Green Bank. Discussions with NYGB, including a NYGB-led briefing for a consortium of local lenders, vineyard owners and solar power developers, helped provide assurance that solar projects are feasible transactions and that renewables could be a growth area for the banks' future lending efforts.

Art Hunt was present at the NYGB briefing. "With the Green Bank, we sat down and had a long discussion here in our town library meeting room," he said. "Albert Griffin [NYGB President] understood what the Green Bank should be doing. Not financing solar installations, but enabling with bridge loans, interim financing, or loan guarantees." With the assistance of the NYGB, four local banks in the Finger Lakes region were able to provide financing for the solar projects. Those banks are now positioned to more readily finance future clean energy projects in the area.

The collaborative effort by the vineyards resulted in a Solar Champion Award for the Finger Lakes Wine Region in 2015 from the Solar Energy Industries Association (SEIA). According to SEIA, solar installations in the Finger Lakes Wine Region will avoid approximately 460 metric tons of harmful carbon dioxide emissions each year, the equivalent of taking 2,900 vehicles off the road.³⁰

What's more, the Finger Lakes wine region is just getting started. "Four wineries got solar panels last year, and now another 15 or so will do so this year," Art Hunt said. "We're trying to show that it's very

SolarCity plant in Buffalo will help New York meet its RGGI emissions goals



A commemorative steel beam is lowered into the SolarCity GigaFactory in Buffalo, which will become biggest solar panel factory in the Western Hemisphere when it opens in 2017. Photo: New York State Office of the Governor/ Flickr

In order to reduce emissions to within the RGGI cap – and achieve the reductions in carbon pollution scientists say will be needed to prevent the worst impacts of global warming – the Northeast and Mid-Atlantic will need to replace fossil fuel-fired power plants with clean energy, especially renewable energy power from the wind and the sun.

Leading companies are swinging into action to meet the growing demand for renewable energy and many of them are setting up shop in the region. In New York, the new SolarCity GigaFactory in Buffalo will become the biggest solar panel factory in the Western Hemisphere when it opens in 2017.³⁴ The GigaFactory will be able to manufacture solar panels totaling more than 1 gigawatt of capacity each year, enough to meet about one-seventh of the U.S. demand for solar panels in 2015.³⁵ To put that in perspective, the entire U.S. solar industry installed a total of 7.3 GW of solar capacity in 2015.³⁶

SolarCity's Buffalo plant will add to a global manufacturing base that is making better, more efficient solar panels available at lower prices each year. Improvements in solar energy have already helped New York to reduce carbon pollution. In 2015, solar energy in New York's reduced carbon dioxide emissions by approximately 330,000 metric tons, equivalent to taking 70,000 vehicles off the road.³⁷

New York also sees the GigaFactory as part of its strategy for growing a 21st century clean energy economy. The state is investing approximately \$750 million in the new factory, which is projected to create 3,000 new jobs in Buffalo, and 2,000 additional jobs elsewhere in the state.³⁸

As the future home of one of the world's biggest solar panel factories, New York should be well positioned to continue its dramatic solar growth, and to continue to meet its emissions goals under RGGI.

cost effective, very dependable.” With 1,631 family vineyards and more than 400 wineries statewide, the growing grape, grape juice and wine industry generates more than \$4.8 billion in economic benefits annually for New York State, according to the New York Wine and Grape Foundation, and \$408 million in state and local taxes.³¹ The Finger Lakes is the largest of the state’s five main wine-producing regions, with some 150 wineries.

“Agriculture isn’t necessarily what people think of when they think clean and green,” said Suzanne Hunt.³² “But agriculture can play a leading role in transitioning to more sustainable production and power systems. In the Finger Lakes, the wine industry is a core part of the economy and helps drive the whole tourism industry. People are very proud of New York State wines.”

NYGB’s portfolio continues to grow. Recent NYGB portfolio additions include support for “Pay-As-You-Save” energy upgrades for 400 homeowners by New York City-based energy software company Sealed, Inc. and a partnership with Poughkeepsie-based BQ Energy to standardize solar project construction and post-construction financing, beginning with a solar energy development on a landfill.³³

Through NYGB’s work across the state, more and more New York businesses are able to participate in the clean energy transition. Expanding the use of solar power on commercial businesses across the region will be a key element of cleaning up our electricity system, reducing power plant pollution, and achieving the promise of the Paris Climate Agreement to protect the climate for generations to come.

Connecticut

The Connecticut Children’s Medical Center reduces energy use with the help of the Connecticut Energy Efficiency Fund

Name	Connecticut Children’s Medical Center
Program	Connecticut Energy Efficiency Fund
Project	Energy efficiency upgrade
Result	Energy savings of 287,700 kilowatt-hours per year, equivalent to annual energy use of 26 average American homes.
Benefits	Savings of more than \$23,000 per year on electricity. Annual carbon dioxide emission reduction is approximately 141 metric tons, equivalent to taking 30 passenger vehicles off the road. ³⁹

In 2008, Connecticut passed the Global Warming Solutions Act, committing the state to reducing greenhouse gas emissions to 80 percent below 2001 levels by 2050. The following year, RGGI was implemented, providing new opportunities for Connecticut homeowners and businesses to take part in achieving Connecticut’s longer term climate goals – including through energy efficiency improvements.

One Connecticut institution that has taken part in helping achieve statewide climate goals is the Connecticut Children’s Medical Center (CCMC), based in downtown Hartford. CCMC is a 187-bed hospital that has specialized in pediatric care since its inception more than 100 years ago. Today, it also serves as the primary teaching hospital for the University of Connecticut School of Medicine Department of Pediatrics, and has 20 locations in Connecticut and Massachusetts.

In 2013, the Connecticut Children’s Medical Center (CCMC) decided it wanted to reduce its energy use.

Hospitals are large consumers of energy. They are open year-round, 24 hours a day; they have thousands of employees; they require advanced cooling and heating; and many of their operations are energy-intensive, including lab work, refrigeration, and more. As a result, large hospitals in the United States use more than 4 percent of all energy consumed by the commercial sector, despite accounting for less than 1 percent of all commercial buildings.⁴⁰

CCMC wanted to make upgrades without diverting money from its core mission of providing pediatric care. So in 2013, CCMC reached out to the Connecticut Energy Efficiency Fund (CEEF) and Connecticut Light & Power (now Eversource) for assistance. Since its inception in 1998, CEEF has advanced the efficient use of energy; reduced air pollution and negative environmental impacts; and promoted economic development and energy security. In 2015, CEEF’s funding included more than \$15 million in RGGI auction revenue, alongside funding from ratepayers through charges on their electric and natural gas bills.⁴¹

With the help of CEEF, CCMC installed a variety of efficiency upgrades, including a new cooling system that is able to take advantage of cold outdoor air in the winter; sensors to turn off lights when rooms are not in use; and variable air volume boxes that allow the hospital to reduce air conditioning costs in areas of the hospital that close on weekends or at night.⁴² With nearly half of the costs of the upgrade covered by CEEF, the net cost of the project for the hospital was only \$38,221. With annual electric bill reductions of more than \$23,000, the payback period for the project was less than two years.⁴³

The total reduction in energy use amounted to 287,700 kilowatt-hours per year, equivalent to the annual energy use of 26 average American homes.⁴⁴ The investments CCMC made in energy efficiency have allowed the hospital to keep its energy costs down as it expands its core mission of keeping kids healthy. The energy savings achieved by CCMC will reduce state carbon dioxide emissions by approximately 141 metric tons each year, equivalent to taking 30 vehicles off the road.

By saving energy and reducing emissions, CCMC is showing that energy intensive operations like hospitals have an important role to play in statewide efforts to combat global warming and achieve climate goals.

Massachusetts

Swampscott and Wenham reduce town energy use with LED streetlights

Name	Towns of Swampscott and Wenham
Program	Green Communities Designation and Grant Program
Project	Installation of efficient LED streetlights
Result	More than 600,000 kWh of electricity saved per year.
Benefits	More than \$100,000 in annual energy savings. An estimated 294 metric tons of carbon pollution prevented per year. ⁴⁵

For Massachusetts to achieve its climate goals – including reducing carbon dioxide emissions by 80 percent below 1990 levels by 2050, as required by the Global Warming Solutions Act –everyone has a role to play. In Massachusetts, some of the most effective and important climate leadership has come from local government, thanks in part to funding from RGGI, which has helped enable cities to take action against global warming while creating real, tangible benefits for their citizens.

To encourage municipalities in these efforts, Massachusetts launched the Green Communities Designation and Grant Program in 2009, with the mission of helping cities and towns reduce environmental impact and increase adoption of renewable energy. The program is made possible by RGGI, which provides its primary funding source.⁴⁶ In order to be designated a Green Community and receive funding through the program, municipalities must first meet a set of criteria demonstrating commitment to renewable energy and energy efficiency.



LED streetlights like this one will save the towns of Swampscott and Wenham more than \$100,000 in energy costs every year.

As of December 2015, 155 towns and cities – home to more than half of the Massachusetts population – have earned the Green Communities designation, and so far \$29 million in Green Communities grant money has been put to use through the Massachusetts Department of Energy Resources to help communities reduce environmental impacts.⁴⁷ Many cities and towns around Massachusetts have chosen to save money by installing LED streetlights through the program, including in the towns of Swampscott and Wenham.

Street lighting consumes 11.5 percent of the municipal utility budget of Swampscott,⁴⁸ a town of 14,000, located on Massachusetts' North Shore, about 10 miles from Boston. Swampscott was one of 51 Massachusetts cities and towns grants to receive awards of up to \$250,000 in the July 2015 round of Green Communities.⁴⁹ The LED lighting improvements are predicted to reduce annual energy use by 477,091 kWh and save the town more than \$80,000 a year on its lighting bill.⁵⁰ The dollar savings will go into the town's general fund, according to Swampscott Director of Community Development S. Peter Kane, though the Renewable Energy Committee is looking into a home rule petition that would allow the funds to be earmarked for energy saving projects.

Town of Swampscott Street Lighting Upgrade Project Financials:

Item	Cost
Streetlight Purchase + Construction Cost	\$587,552
Utility Incentives	\$120,000 (estimated)
Green Communities Grant	\$225,000
Total Cost to Town	\$242,552
Estimated Annual Energy Savings	\$83,896
Estimated Annual Savings – energy + maintenance	\$95,040

The Town of Swampscott was one of the first Green Communities and had used earlier grants in 2010 and 2013 to reduce energy use at public facilities including schools, a public library, the town hall, and the fire department. "I think a lot of these energy improvement projects would not have happened had we not had the Green Community grants," Kane said. "There are so many competing interests for capital

projects. If we can show that we can do something through a state grant, the public is far more willing to support it. “

Another eight miles up the North Shore is the town of Wenham, with about 5,000 residents. In Wenham, street lighting has traditionally accounted for 15 percent of total municipal electricity usage.⁵¹ Wenham became a designated Green Community in 2010, and in 2015 used Green Communities grant funding to convert all street lighting to LED technology to reduce energy use.

The conversion is projected to reduce street light energy consumption by over 60 percent annually. The Town of Wenham and its residents will see related benefits including reduced maintenance costs due to longer fixture life; improved safety through enhanced visibility; and a visible public commitment to energy efficiency.

Altogether, the lighting efficiency projects in these two towns save an estimated 600,000 kWh of electricity per year. That prevents utilities from needing to burn dirty fuels to generate electricity – preventing on the order of 294 metric tons of dangerous carbon dioxide pollution per year – equivalent to the pollution from burning more than 33,000 gallons of gasoline.⁵²

Town of Wenham Street Lighting Upgrade Project Financials

Item	Cost
Streetlight Purchase	\$22,773
Construction Costs;	\$198,565
Utility Incentives	(\$23,000)
Green Communities Grant	(\$196,316)
Total Cost to Town	\$2,022
Estimated Annual Energy Savings	\$22,291

Maryland

Howard County Community Action Council reduces energy use for low- and moderate-income families

Name	Howard County Community Action Council (HC-CAC)
Program	EmPOWER Clean Energy Communities Low-to-Moderate Income Grant Program
Project	Providing efficiency upgrades to low and moderate income households
Result	HC-CAC's 2014 work created estimated annual energy savings of 499,569 kWh.
Benefits	<p>\$70,000 in annual savings for Maryland residents.</p> <p>Carbon dioxide pollution reduced by an estimated 338 metric tons per year, equivalent to taking more than 70 passenger vehicles off the road.</p>

In April 2016, Maryland Governor Larry Hogan signed the Greenhouse Gas Emissions Reduction Act, requiring Maryland to reduce greenhouse gas emissions by 40 percent from 2006 levels by 2030. Reducing energy use will play a major role in Maryland's climate goals – but for families that already struggle to pay their electric bills, paying upfront costs for energy efficiency improvements can be a challenge, even with long-term cost savings.

Since 2010, many of these families have benefited from Maryland's EmPOWER Clean Energy Communities Low-to-Moderate Income Grant Program (EmPOWER CEC), which has enabled nearly 12,000 families to reduce energy use.⁵³ In 2014 the EmPOWER CEC program created an estimated \$684,209 in energy savings, reducing global warming emissions by the equivalent of 3,108 metric tons of carbon dioxide, equivalent to taking 654 passenger vehicles off

the road. EmPOWER CEC is funded by the Maryland Strategic Energy Investment Fund, which receives more than 80 percent of its funding from RGGI auction proceeds.⁵⁴

EmPOWER CEC's efficiency projects are carried out by local governments and nonprofits, including the efficiency and weatherization program of the Community Action Council of Howard County (CAC-HC), which has helped install energy efficiency improvements both in Howard County and in homes all over Maryland. In 2014, CAC-HC's efficiency program created an estimated \$70,000 in annual savings for Maryland residents, and created 4,000 labor hours for Maryland workers.⁵⁵ These energy savings reduced pollution by approximately 338 metric tons of carbon dioxide, equivalent to taking more than 70 passenger vehicles off the road.⁵⁶

Gary Christopher directs CAC-HC's efficiency program, and says one aspect that makes the EmPOWER Clean Energy Communities program special is the broad flexibility it allows. "This isn't just a cookie cutter program," Christopher says.⁵⁷ "This program lets us take our own approach to achieve the best efficiency improvements for specific situations, whether that's through the installation of efficient water heating, or through LED lighting."

One of the biggest projects completed by CAC-HC's efficiency program was at Shalom Square, a senior residential complex of townhouses in Columbia, a planned community with about 100,000 residents in the Baltimore suburbs. At Shalom Square, CAC-HC improved energy efficiency at each of the complex's 50 housing units by retrofitting each unit with mini-split heating and cooling systems, which transfer heat from outside using high efficiency air source heat pumps, and avoid energy losses associated with air ducts. Today, the added efficiency at Shalom Square provides thousands of dollars in annual savings to the nonprofit organization that runs the complex, the Heritage Housing Partners Corporation.



Gary Christopher runs the efficiency and weatherization program at the Howard County Community Action Center, which has installed energy efficiency upgrades for low- and moderate-income families across Maryland. Photo: Maryland Energy Administration

Matthias Agriculture Program saves energy and money at Maryland poultry farms

Name	Poultry farm efficiency upgrades
Program	Kathleen A. P. Mathias Agriculture Energy Efficiency Program
Project	Providing efficiency upgrades to poultry farms
Result	2014 poultry farm upgrades save an estimated annual 208,821 kWh of electricity and 16,000 gallons of propane.
Benefits	An estimated 237 metric tons of carbon dioxide pollution prevented per year, equivalent to taking more than 50 passenger vehicles off the road.

In Maryland, RGGI funds are also bringing improved efficiency to agricultural operations. Like the efficiency program for low- and moderate-income households, the Matthias Agriculture Program is funded through the Strategic Energy Investment Fund, which is supported by RGGI proceeds. The program helps agricultural businesses across Maryland pay for energy efficiency and clean energy upgrades through grants that cover up to 50 percent of project costs.

Agriculture is important in Maryland, adding more than \$8 billion and 45,000 jobs to the state economy.⁵⁸ Maryland is home to more than 1,600 poultry operations, which account for 40 percent of state agricultural sales. Poultry farming is energy-intensive, requiring constant temperature control and lighting year-round. Efficient upgrades to poultry houses include LED lighting, insulated curtains to allow heating discrete areas of the chicken house, heating, weatherization, and efficient ventilation.⁵⁹

In 2014, efficiency upgrades at five poultry farms are estimated to cumulatively save more than 208,821 kWh of electricity every year, enough to power 16 Maryland homes.⁶⁰ These upgrades also will reduce propane usage by more than 16,000 gallons per year, directly reducing carbon dioxide emissions and providing cost savings for farmers, whose reliance on propane can be expensive when cold winters lead to propane shortages. Poultry farm upgrades should reduce carbon dioxide emissions by an estimated 237 metric tons per year, equivalent to taking 50 vehicles off the road.⁶¹ Total agricultural upgrades through the program from 2014, which also include efficiency upgrades at dairy farms and for field and greenhouse crops, are estimated to reduce carbon dioxide emissions by nearly 1,000 metric tons each year, the equivalent of taking more than 200 vehicles off the road.⁶²

New Hampshire

RGGI supports efficient new brewhouse at New Hampshire's leading craft brewery

Name	Smuttynose Brewery
Program	New Hampshire Saves
Project	Efficient new brewhouse
Result	11 million kWh of energy saved over equipment lifetime, equivalent to the energy needed to power 1,500 homes for a year.
Benefits	Lifetime energy savings over \$1 million. Carbon dioxide emission reduction will be approximately 5,300 metric tons.

For northern New England states like New Hampshire, global warming could bring rapid economic and environmental consequences. According to the EPA, by the end of the century New Hampshire summers could be as warm as North Carolina's are today; while New Hampshire's winter tourism industry could be devastated by winters that bring rain instead of snow.⁶³

To prevent these climate impacts, many New Hampshire residents and businesses are working to reduce emissions and to achieve regional climate goals under RGGI. These include the Smuttynose Brewing Company, New Hampshire's largest craft beer company, which distributes beers like Old Brown Dog Ale and Finestkind IPA in 25 states.

In 2014, after 20 years brewing in Portsmouth, Smuttynose was ready to expand to a new brewing facility in the town of Hampton. The move afforded an opportunity to increase the efficiency of the energy-intensive beer brewing process, with energy needs including refrigeration, hot water and steam. Smuttynose's sustainability web page notes that "without

our beautiful natural world, we wouldn't brew a drop of beer," and when the brewery expanded its operation it worked with the utility Unital to make its new brew house energy efficient.

To help include efficient technology in its new brewery, Smuttynose turned to the efficiency rebate program of New Hampshire Saves. New Hampshire Saves is the consumer and business facing online presence of New Hampshire's CORE Energy Efficiency Programs, a set of efficiency initiatives that were established when New Hampshire began restructuring its electricity market in the late 1990s. Funded primarily by a systems benefit charge on electric bill of electric customers, RGGI proceeds have allowed CORE to expand its efficiency programs, with \$2.6 million of RGGI funding in 2016.⁶⁴ In 2016, CORE goals include reducing electricity use by 53 million kWh, equivalent to the electricity consumption of nearly 5,000 U.S. homes.⁶⁵

With the help of New Hampshire Saves, Smuttynose incorporated efficient technology including an efficient compressed air system, water chilling systems that recycle heat ordinarily lost through refrigeration for use elsewhere in the brewery, and efficient natural-gas-fired steam boilers. Over the lifetime of the equipment, these efficiency upgrades will save more than 11 million kWh of energy, equivalent to the energy needed to power 1,500 homes for a year.⁶⁶ Over that time, Smuttynose will save more than \$1 million in energy costs.⁶⁷ That will prevent an estimated 5,300 metric tons of carbon pollution over time – equivalent to the amount of pollution a car would emit over almost 13 million miles of driving.⁶⁸

In part due to the efficiency measures built through work with RGGI proceeds, the Smuttynose Brewing Company was certified LEED Gold, the second-highest certification possible through the Leadership in Energy and Environmental Design green building certification program.



Efficient equipment at the new Smuttynose Brewhouse in Hampton will save 11 million kWh of energy saved over equipment lifetime, equivalent to the energy needed to power 1,500 homes for a year. Photo: Unital

Maine

Oxford Networks builds advanced efficiency into its data centers

Name	Oxford Networks
Program	Efficiency Maine
Project	Efficiency upgrades at the Brunswick data center
Result	Energy savings valued at between \$3,000 and \$5,000 per year

Maine is already feeling the effects of climate change. Since the 19th century, Maine’s average temperature has increased by 3.0°F. This temperature rise has brought about impacts including more Lyme disease, altered maple syrup schedules, shorter winters, and threats to Maine’s iconic wildlife, including moose.⁶⁹ In coming together to meet these challenges, Maine businesses are also finding opportunities to modernize their operations and save money – including businesses on the cutting edge of modern information technology.



Funding from Efficiency Maine helped Oxford Networks install new high-efficiency cooling systems at its data center in Brunswick, part of efficiency upgrades that are saving Oxford Networks between \$3,000 and \$5,000 per year in energy costs. Photo: © 2015 Darren Setlow. All Rights Reserved

One such business is Oxford Networks, which began as one of Maine's first telecommunications companies, opening its doors in 1900. Today, Oxford Networks has transformed into a modern information technology company, offering network and cloud services and operating five data centers across Maine and New Hampshire.

Information technology companies like Oxford Networks rely on large data centers for the core of their business. These data centers use enormous amounts of electricity to cool and power the electronics they contain, including servers and data storage equipment. In 2013, U.S. data centers consumed approximately 91 billion kilowatt-hours of electricity, equivalent to the electricity generated by more than 30 large coal plants.⁷⁰

Over the last three years, Oxford Networks wanted to reduce their energy use by installing modern, efficient equipment – and found the assistance they needed in Maine's statewide, RGGI-funded efficiency program, Efficiency Maine.

Since its creation in 2009, Efficiency Maine has worked to lower the cost and environmental impacts of energy through cost-effective energy efficiency and alternative energy sources. In FY15, Efficiency Maine invested nearly \$60 million in efficiency projects, leading to savings for homes and businesses of

\$30 million on their annual electric bills, while reducing energy use by the equivalent of 26 million gallons of oil.⁷¹ RGGI auction proceeds account for nearly a third of Efficiency Maine funding, alongside funding from ratepayers and other sources.⁷²

Over the last three years, Oxford Networks has completed four separate efficiency projects with Efficiency Maine.⁷³ Two crucial efficiency upgrades affected the cooling systems of Oxford Network's data center in Brunswick. The data center's older cooling systems were expensive to run and consumed large amounts of energy year-round – even during freezing Maine winters. The first project installed a distilled water coil system and an efficient chiller, the other cooling system used refrigerant and a compressor.⁷⁴ With the new systems in place, cool outside air can be used to provide nearly all the cooling the data center needs for more than half of the year.⁷⁵ These new efficiency upgrades should reduce Oxford Networks' energy costs by between \$3,000 and \$5,000 per year.⁷⁶

Since upgrading its Brunswick data center, Oxford Networks has continued its efforts to reduce energy use and reduce overall environmental impacts. In early 2016, more than \$50,000 in Efficiency Maine funds helped Oxford Networks install HVAC systems upgrades in its office spaces, upgrades that were completed in 2016.⁷⁷

Conclusion and Recommendations

The Regional Greenhouse Gas Initiative has reduced carbon pollution from the region's power plants, saved money for communities and businesses, and helped put the Northeast and Mid-Atlantic regions on a path toward a clean energy future. Over the past decade, we have learned a great deal about how to transform our power system, while creating widespread benefits for people across the region.

As the stories in this report show, people, businesses and institutions across our region can all participate in the transition to clean energy. Opportunities to reduce dangerous carbon pollution abound – from replacing dirty power plants with large-scale wind turbines off the coast, to covering a winery rooftop with solar panels, to improving the energy efficiency of a home.

States should use the Regional Greenhouse Gas Initiative as an important tool to achieve their economy-wide goals for reducing dangerous carbon pollution in order to protect our climate. **Doubling the strength of RGGI during the 2016 Program Review** is an important step.

Strengthen the Cap

- Currently, RGGI requires power plant emissions to decline at a rate of 2.5 percent per year through 2020. However, since 2005, power suppliers have been moving twice that fast on average – cutting pollution at 5 percent per year. States should lock in this rate of progress by doubling the strength

of RGGI during the 2016 Program Review from 2020 to 2030. This would lower dangerous carbon emissions to less than 40 million tons annually by 2030 – less than half of the pollution our power plants currently emit.

- States should also eliminate or reform the “Cost Containment Reserve,” a loophole which artificially inflates the cap when prices rise above a predetermined trigger. Eliminating this reserve will increase the integrity of the program while providing a strong signal to invest in clean energy solutions. At the very least, states should ensure that any additional pollution allowances added due to a price trigger are then subtracted from future years of the program to keep the overall limit on emissions intact.

Maximize Local Benefits

- States should continue to capture the revenue generated through allowance sales and invest it in efficiency and renewable energy projects that bring real rewards for local communities.
- As states investigate linking RGGI to other carbon markets that may result after the enforcement of the federal Clean Power Plan begins, they should ensure that they trade with states following similar stringency and similar rules. Linking without safeguards could result in the states exporting carbon pollution revenue to other states and undermining important local clean energy programs.

Notes

1 Specifically referring to the nine states that participate in the Regional Greenhouse Gas Initiative: ME, NH, MA, VT, RI, CT, NY, DE and MD. Data per U.S. Department of Energy, Energy Information Administration, *Form 923 State Level Generation and Fuel Consumption Data, Annual back to 1990*, Revised November 2015. Downloaded from <http://www.eia.gov/electricity/data.cfm#generation>.

2 Jordan Stutt et al., Acadia Center, *Regional Greenhouse Gas Initiative Status Report Part I: Measuring Success*, July 2016; carbon pollution comparison made using the U.S. EPA Greenhouse Gas Equivalencies Calculator at <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.

3 Calculated per U.S. Energy Information Administration, *Electricity Sales Form EIA-861 annual survey data*, 21 October 2015. Available at <http://www.eia.gov/electricity/data.cfm#sales>.

4 Jordan Stutt et al., Acadia Center, *Regional Greenhouse Gas Initiative Status Report Part I: Measuring Success*, July 2016; carbon pollution comparison made using the U.S. EPA Greenhouse Gas Equivalencies Calculator at <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.

5 Gideon Weissman, Bret Fanshaw and Rob Sargent, Frontier Group and Environment America, *Lighting the Way* 4, July 2016.

6 Deepwater Wind, *Block Island Wind Farm Completes First "Steel in the Water"* (press release), 27 July 2015, archived at web.archive.org/web/20160826140543/http://dwwind.com/press/block-island-wind-farm-completes-first-steel-in-the-water/.

7 Jordan Stutt et al., Acadia Center, *Regional Greenhouse Gas Initiative Status Report Part I: Measuring Success*, July 2016.

8 Elizabeth Stanton et. al., Sierra Club, Pace Energy and Climate Center, and Chesapeake Climate Action Network, *The RGGI Opportunity 2.0: RGGI as the Electric Sector Compliance Tool to Achieve 2030 State Climate Targets*, 4 March 2006.

9 NREL offshore potential data: Anthony Lopez et al., NREL, *U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis*, July 2012; state electricity consumption data: U.S. Energy Information Administration, *Electricity Data Browser*, accessed at eia.gov/electricity/data/state/ on 18 August 2016.

10 Gideon Weissman et al., Environment America and Frontier Group, *Lighting the Way: The Top States that Helped Drive America's Solar Energy Boom in 2014*, September 2015.

11 See Travis Madsen et al., Environment America and Frontier Group, *We Have the Power: 100% Renewable Energy for a Clean, Thriving America*, Spring 2016.

12 Sierra Club, Hart Research, and Chesapeake Beach Consulting, *Findings from a Survey in States Participating in RGGI*, 9 August 2016.

13 Recent emissions data from RGGI Inc., *RGGI CO2 Allowance Tracking System (RGGI COATS)*, available at rggi-coats.org, downloaded on 18 August 2016; historical data available from RGGI Inc., *Historical Emissions*, downloaded from rggi.org/historical_emissions on 18 August 2016.

14 Ibid.

- 15 Environment America, "Northeast States Plan Deeper Cuts in Power Plant Pollution," *press release*, 7 February 2013.
- 16 RGGI cap displayed in chart is before banked emissions adjustment. Recent emissions data from RGGI Inc., *RGGI CO2 Allowance Tracking System (RGGI COATS)*, available at rggi-coats.org, downloaded on 18 August 2016; historical data available from RGGI Inc., *Historical Emissions*, downloaded from rggi.org/historical_emissions on 18 August 2016.
- 17 Erin Ailworth, "The end of the coal era in Massachusetts," *The Boston Globe*, 18 June 2014.
- 18 Ibid.
- 19 SEIA, *New York Solar Market*, accessed at www.seia.org/state-solar-policy/new-york on 18 August 2016.
- 20 Jonathan L. Ramseur, Congressional Research Service, *The Regional Greenhouse Gas Initiative: Lessons Learned and Issues for Congress*, 27 April 2016.
- 21 RGGI Inc., *Investment of RGGI Proceeds Through 2013*, April 2015.
- 22 Peter Shattuck et al., Acadia Center, *The Regional Greenhouse Gas Initiative: A Model Program for the Power Sector*, July 2015.
- 23 See not 21.
- 24 \$3 billion represents cumulative economic impact based on research from two separate Analysis Group reports: Paul J. Hibbard et al., Analysis Group, *The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States*, 14 July 2015; Paul J. Hibbard et al., Analysis Group, *The Economic Impacts of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic States Review of the Use of RGGI Auction Proceeds from the First Three-Year Compliance Period*, 15 November 2011.
- 25 New York State, *Governor Cuomo, Joined By Vice President Gore, Announces New Actions to Reduce Greenhouse Gas Emissions and Lead Nation on Climate Change*, available at www.governor.ny.gov/news/governor-cuomo-joined-vice-president-gore-announces-new-actions-reduce-greenhouse-gas-emissions, 8 October 2016.
- 26 New York Green Bank, *Mission*, accessed at greenbank.ny.gov/About/Mission on 1 August 2016.
- 27 New York Green Bank, *Portfolio & Pipeline: Early Successes*, accessed at greenbank.ny.gov/Investments/Portfolio-and-Pipeline on 18 August 2016.
- 28 Don Cazentre, "Finger Lakes wineries are moving to solar power," *Syracuse.com*, 8 September 2015.
- 29 Personal communication, Art Hunt (telephone interview), 16 June 2016; personal communication, Suzanne Hunt (telephone interview), 16 August 2016.
- 30 Tompkins Weekly, "Wineries Join Forces for Solar Initiatives," available at sustainablecampus.cornell.edu/blogs/news/posts/wineries-join-forces-for-solar-initiatives, 11 October 2015.
- 31 New York Wine and Grape Foundation, *Facts and Figures*, archived at web.archive.org/web/20160829203230/http://www.newyorkwines.org/Pages/FactsAndFigures.
- 32 Personal communication, Art Hunt (telephone interview), 16 June 2016.
- 33 Project descriptions available at <http://greenbank.ny.gov/Investments/Portfolio-and-Pipeline> and www.governor.ny.gov/news/governor-cuomo-announces-four-new-ny-green-bank-transactions-generate-220-million-clean-energy.
- 34 New York State, *Buffalo Billion: Buffalo High-Tech Manufacturing Innovation Hub at RiverBend*, accessed at <http://buffalobillion.ny.gov/buffalo-hightech-manufacturing-innovation-hub-at-riverbend> on 18 August 2016.

35 SEIA, *U.S. Solar Market Sets New Record, Installing 7.3 GW of Solar PV in 2015*, accessed at www.seia.org/news/us-solar-market-sets-new-record-installing-73-gw-solar-pv-2015 on 18 August 2016.

36 Ibid.

37 2015 solar generation downloaded from: U.S. Energy Information Administration, *Electricity Data Browser*, accessed at eia.gov/electricity/data/browser on 18 August 2016; Emission reduction calculated using regional non-baseload emissions factor from EPA's eGRID2012 Summary Tables, available at https://www.epa.gov/sites/production/files/2015-10/documents/egrid2012_summarytables_0.pdf. Passenger vehicle equivalence calculated assuming 4.73 metric tons of CO₂ per vehicle, based on <https://www.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references>.

38 See note 34.

39 See note 37.

40 U.S. Energy Information Administration, *Energy Characteristics and Energy Consumed in Large Hospital Buildings in the United States in 2007*, 17 August 2012.

41 Energize CT, Energy Efficiency Board 2015 Programs and Operations Report, available at energizect.com/sites/default/files/uploads/Final-ALR-2015-Full-030316.pdf, 1 March 2016.

42 NEPEnergyefficiency channel on YouTube, *Connecticut Children's Medical Center_2014 Business Leader for Energy Efficiency*, available at youtu.be/B15_HRTtfUk, 6 June 2014.

43 Connecticut Energy Efficiency Fund, *Case Study | Connecticut Children's Medical Center*, accessed at rggi.org/docs/NU_EEF_CS_ChildrnMedical_f.pdf on 1 August 2016.

44 2014 average home energy use: U.S. Energy Information Administration, *How much electricity does an American home use?*, accessed at <https://www.eia.gov/tools/faqs/faq.cfm?id=97&t=3> on 1 August 2016; CMMS information: Connecticut Energy Efficiency Fund, *Case Study | Connecticut Children's Medical Center*, accessed at rggi.org/docs/NU_EEF_CS_ChildrnMedical_f.pdf on 1 August 2016.

45 Emission reduction calculated using regional non-baseload emissions factor from EPA's eGRID2012 Summary Tables, available at https://www.epa.gov/sites/production/files/2015-10/documents/egrid2012_summarytables_0.pdf. Pollution comparison made using the U.S. EPA Greenhouse Gas Equivalencies Calculator, <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.

46 Massachusetts Dept. of Energy Resources, *Green Communities Designation and Grant Program*, available at mass.gov/eea/docs/doer/green-communities/pubs-reports/gc-progress-report.pdf, November 2014.

47 Massachusetts Office of Energy and Environmental Affairs, *How to Become a Green Community and Qualify for Grants*, accessed at mass.gov/eea/energy-utilities-clean-tech/green-communities/gc-grant-program/ on 1 August 2016.

48 Telephone and e-mail conversations with S. Peter Kane by Sandra Larson. June 14-15, 2016.

49 Massachusetts EOEAA. *Baker-Polito Administration Announces Green Communities Clean Energy Grants for 51 Cities and Towns*, available at mass.gov/eea/pr-2015/51-green-communities-awarded-clean-energy-grants.html, 2015

50 LED lighting is expected to reduce annual municipal energy costs (including energy and maintenance) from the current \$137,775 down to \$42,735, a 69 percent reduction.

51 Town of Wenham, *Streetlight Conversion to LED*, available at wenhamma.gov/departments/Wenham_Streetlight_LED_Project_Page.pdf

52 See note 45.

53 RGGI Inc., *Maryland investments*, accessed at rggi.org/rggi_benefits/program_investments/Maryland on 1 August 2016.

54 Maryland Energy Administration, *Maryland Strategic Energy Investment Fund Report on Fund Activities FY 2015*, accessed at energy.maryland.gov/Reports/FY15_SEIF_Annual_Report.pdf.

55 Maryland Energy Administration, *Community Action Council of Howard County Case Study*, available at energy.maryland.gov/govt/Documents/CACHC_MEA_CaseStudy2014.pdf.

56 See note 37.

57 Personal communication with Gary Christopher, Howard County Community Action Council, 1 July 2016.

58 University of Maryland, *The Impact of Agriculture on Maryland's Economy*, available at agresearch.umd.edu/sites/default/files/_docs/programs/canrp/Summary%20Value%20of%20Ag.pdf.

59 Maryland Energy Administration, *2014 Mathias Ag Program Poultry Case Study*, available at energy.maryland.gov/govt/Documents/MEA_CaseStudy2014_poultry_v2.pdf.

60 Ibid.

61 Emission reduction calculated using propane emission factor, and regional non-baseload emissions factor from EPA's eGRID2012 Summary Tables. Summary tables available at https://www.epa.gov/sites/production/files/2015-10/documents/egrid2012_summarytables_0.pdf; propane emission factor available at https://www.eia.gov/environment/emissions/co2_vol_mass.cfm; passenger vehicle equivalence calculated assuming 4.73 metric tons of CO₂ per vehicle, based on <https://www.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references>.

62 Maryland Energy Administration, *The 2014 Kathleen A. P. Mathias Agriculture Energy Efficiency Program*, accessed at energy.maryland.gov/business/Pages/incen-tives/mathiasag-2014.aspx on 1 August 2016.

63 U.S. EPA, *Climate Impacts in the Northeast*, accessed at www3.epa.gov/climatechange/impacts-adaptation-renamed/northeast.html on 18 August 2016.

64 NHSaves, *New Hampshire Statewide CORE Energy Efficiency Plan*, available at [www.puc.nh.gov/Electric/NH%20EnergyEfficiencyPrograms/14-216/DE%2014-216%202016%20NH%20Statewide%20CORE%20EE%20PLAN%20\(FINAL\)%2009302015.pdf](http://www.puc.nh.gov/Electric/NH%20EnergyEfficiencyPrograms/14-216/DE%2014-216%202016%20NH%20Statewide%20CORE%20EE%20PLAN%20(FINAL)%2009302015.pdf), 30 September 2015.

65 Ibid.

66 NHSaves, *Smuttynose Brewery case study*, accessed at nhsaves.com/save-work/work-savings-profiles/smuttynose-brewery/ on 1 August 2016.

67 Ibid.

68 Emission reduction calculated using regional non-baseload emissions factor from EPA's eGRID2012 Summary Tables, available at https://www.epa.gov/sites/production/files/2015-10/documents/egrid2012_summarytables_0.pdf. Passenger vehicle miles equivalent calculated using EPA Greenhouse Gas Equivalencies Calculator.

69 IJ Fernandez et al., University of Maine, *Maine's Climate Future: 2015 Update*, 2015.

70 NRDC, *America's Data Centers Consuming and Wasting Growing Amounts of Energy*, available at nrdc.org/resources/americas-data-centers-consuming-and-wasting-growing-amounts-energy, 6 February 2015.

71 Efficiency Maine, *2015 Efficiency Maine Annual Report*, available at efficiencymaine.com/docs/2015-Efficiency-Maine-Annual-Report.pdf.

72 Ibid.

73 Personal communication with John Coray of Oxford Networks, 1 July 2016.

74 Ibid.

75 Ibid.

76 Ibid.

77 Ibid.