

Metropolitan Boston Health Care Energy & Greenhouse Gas Profile: 2011 through 2015, and 2020 Projection

Produced by Health Care Without Harm on behalf of
Boston Green Ribbon Commission Health Care Working Group
Analytics by Environmental Health & Engineering

This report summarizes an analysis of more than 24,000 energy and greenhouse gas (GHG) records covering 22 million square feet of metro Boston hospitals, in an update to our 2011-2013 first-in-the-nation, metro sector-wide database. Developed for the Boston Green Ribbon Commission's Health Care Working Group (GRC-HC) by its coordinator, Health Care Without Harm, the data tracks the sector's collective progress towards the GRC's shared goals of a 25 percent reduction in greenhouse gas emissions by 2020, and 100 percent by 2050.

SUMMARY HIGHLIGHTS

Virtually all major Metro Boston hospitals participate in the [Boston Green Ribbon Commission Health Care Working Group](#), and together they consume over 6.6 trillion British thermal units (Btu) of energy per year in their 22 million square feet of buildings. These hospitals routinely invest in energy efficiency projects, supported by utilities and other stakeholders, to tune and improve the performance of equipment and operating systems in their complex buildings that operate around the clock every day of the year.

From 2011 through 2015, the sector's energy efficiency efforts saved 537 billion Btu,¹ avoiding greenhouse gas (GHG) emissions equivalent to 126 million miles traveled by an average passenger vehicle.² In that period, energy use decreased 9.4 percent compared to “business as usual” growth.

Notable progress from 2011 to 2015 in energy efficiency, conservation, and greenhouse gas reductions,

¹ Without accounting for business as usual (BAU) of 1.5%, the total energy savings since 2011 would be 223 billion Btu. This is equivalent to 3.3% of absolute energy use of 2011.

² This reduction is equivalent to 52,732 MtCO₂eq greenhouse gas emission.
<http://www.epa.gov/cleanenergy/energy-resources/calculator.html>

includes absolute weather adjusted reductions:

- in electricity use of 7 percent or 18,162 metric tons of CO₂ equivalent (MtCO₂e),
- in natural gas of 20 percent, or 9,771 MTCO₂e and,
- in total energy use of 3.3 percent or 24,360 MtCO₂e, and
- generated cost savings of a conservatively estimated at \$15 million, enough to pay for health care for 1,357 Massachusetts Medicare enrollees.

According to the U.S. Environmental Protection Agency, a \$15 million cost savings is the equivalent of the hospitals finding \$300 million in new revenue every year. In addition, Health Care Without Harm's [Energy Impact Calculator](#) indicates these reductions avoid hundreds of incidents of asthma and respiratory symptoms and \$1.6 million in societal costs.

Compared to business as usual, the sector achieved reductions:

- in electricity use of 13.1 percent,
- in natural gas of 26.1 percent, and
- in total energy use of 9.4 percent.

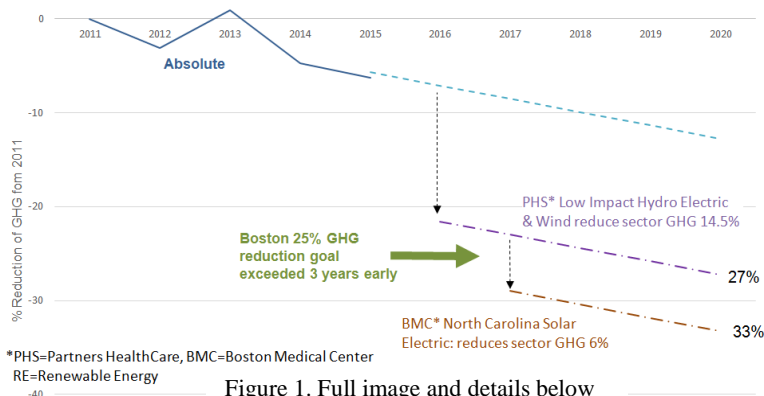
These achievements are substantial in light of three factors for Metro Boston hospitals:

1. Historically, their energy use has grown about 1.5 percent per year, driven by new buildings, repurposing space for more energy-intensive clinical use and growth in clinical equipment.
2. They treat an increasing proportion of more seriously ill patients, drawn from around the region, nation, and world. Demand for electricity for treating such patients is approximately twice that of standard inpatient care; nearly one in five area patient-days requires this level of special imaging, transplants, and other specialized care.
3. Our millions of square feet of world-famous biomedical research laboratories use much more energy per square foot than even acute care hospitals to meet safety requirements and equipment needs. Estimates vary, but labs likely comprise between 12 percent and 45 percent of our health care space, depending on the definition used. The report found strong correlations between energy use intensity and research intensity as reported by non-patient revenue and research funding.

In more than offsetting these energy intensive aspects, the sector's substantial energy reductions can also help increase facilities' resilience in the face of extreme weather events, which are becoming more frequent and severe as climate disruption accelerates. In reducing the energy health care facilities need to replace during interruptions in supply, resilient technologies such as combined heat and power plants become more feasible both economically and technically.

Looking ahead from 2015:
Beginning in 2017, significant renewable energy (RE) contracts undertaken by Boston Medical Center and Partners HealthCare are delivering absolute energy-related greenhouse gas (GHG) reductions of 29 percent for the entire Metro Boston health care sector. By 2020, these renewable energy deals will help the sector achieve a 33 percent absolute reduction, and a 47 percent reduction compared to business as usual, substantially exceeding the City of Boston and Massachusetts' GHG reduction goals of 25 percent by 2020.

Looking to 2020: Sector GHG absolute reduction w/ BMC & Partners recent RE buys=33%. Meets Boston's 25% GHG reduction goal 3 years early.



The 47 percent reduction is the equivalent to eliminating the annual greenhouse gas emissions of 42,220 passenger vehicles.

BACKGROUND

Health Care Without Harm (HCWH) retained Environmental Health & Engineering to analyze energy use information for Metro Boston health care organizations for 2011 through 2015 to identify what can be learned with respect to trending and drivers of energy and greenhouse gas emissions and to look toward 2020. HCWH coordinates the Health Care Working Group of the Boston Green Ribbon Commission (GRC). The latter includes more than 30 executives from health care, higher education, commercial real estate, non-profits, and hospitality in a cross-sector collaboration with the City to meet Boston's climate goals,³ and 22 hospitals, including all the major academic teaching hospitals, participate in the GRC Health Care Working Group.

HCWH provided more than 24,000 records of information that participating health care organizations entered in the U.S. Environmental Protection Agency (EPA) Portfolio Manager®, which were then screened to create a quality-assured, standardized set of records from 37 buildings and 13 institutions. These are representative of health care organizations in Metro Boston and range in gross floor area from 269,000 to 5,500,000 square feet with a median of 1,200,000 square feet. One institution accounts for nearly 25 percent of the sector floor area and is more than twice the size of the next largest institution. In comparison, the smallest institution occupies only about one-fourth the gross floor area of the median

³ Health Care Without Harm Boston, accessed April 18, 2017. <https://noharm-global.org/content/us-canada/boston-green-ribbon-commission>

institution in the sector. The larger institutions necessarily have the largest influence on energy performance of the sector.

HEALTH CARE SECTOR ENERGY USE and GHG TRENDS

Both site and source energy use intensity (EUI) for Metro Boston health care decreased from 2011 to 2015. About 70 percent of the reduction in source EUI is attributable to simply using less energy overall (site EUI). The remaining reductions come from increased reliance on chilled water for cooling and steam for heating, which can have higher production efficiency and/or lower transmission losses than grid electricity and natural gas, and therefore have lower source-to-site ratios.

As shown in Table 1 below, notable progress between 2011 and 2015 from energy efficiency, conservation, and greenhouse gas absolute reductions electricity use of 7 percent, in natural gas of 20 percent, and in total energy use of 3.3 percent.

Table 1 Sector Energy and Greenhouse Gas Trends: Absolute Energy Use and Percent Change in Energy Use Intensity from 2011 ⁴								
	Absolute Change from 2011				Percent Change from 2011 Normalized by Space			
	2012	2013	2014	2015	2011-2012	2011-2013	2011-2014	2011-2015
Electricity (kWh)								
Total Usage	(19,175,357)	(32,623,764)	(57,729,022)	(44,337,669)	(3.2)	(5.8)	(9.3)	(7.0)
MtCO ₂ eq EPA EF*	(6,330)	(10,769)	(19,057)	(14,636)	(3.2)	(5.8)	(9.3)	(7.0)
MtCO ₂ eq Energy Provider EF	(228)	6,873	(15,206)	(18,162)	(0.6)	2.2	(8.3)	(9.2)
Natural Gas (therms)								
Total Usage	(1,047,377)	(415,713)	(889,365)	(1,839,731)	(11.5)	(5.4)	(10.4)	(20.0)
MtCO ₂ eq EPA EF	(5,563)	(2,208)	(4,723)	(9,771)	(11.5)	(5.4)	(10.4)	(20.0)
Chilled Water (tons/hr)								
Total Usage	(709,498)	(1,209,719)	(5,332,956)	1,401,176	(1.3)	(2.6)	(7.6)	1.2
MtCO ₂ eq EPA EF	(539)	(919)	(4,501)	1,064	(1.3)	(2.6)	(7.6)	1.2
MtCO ₂ eq Energy Provider EF	(240)	(409)	(1,803)	474	(1.3)	(2.6)	(7.6)	1.2
Steam (MMBtu)								
Total Usage	(97,319)	18,359	83,358	137,014	(4.4)	(0.3)	2.3	4.9
MtCO ₂ eq EPA EF	(6,462)	1,219	5,535	9,098	(4.4)	(0.3)	2.3	4.9
MtCO ₂ eq Provider EF except one inst. steam GHG = 0	(5,295)	4,566	6,378	3,422	(4.3)	2.2	3.5	1.9
MtCO ₂ eq Energy Provider EF	(5,389)	4,366	7,198	3,112	(4.3)	2.0	4.0	1.6
Oil (lbs)								
Total Usage	1,768	(1,600)	(2,516)	(3,642)	7.5	(8.2)	(12.3)	(16.9)
MtCO ₂ eq EPA EF	157	(142)	(223)	(323)	7.5	(8.2)	(12.3)	(16.9)
All Fuel Types (MMBtu)								
Total Usage	(273,887)	(150,951)	(269,550)	(185,774)	(4.5)	(3.3)	(5.0)	(3.3)
MtCO ₂ eq EPA EF	(18,737)	(12,819)	(22,519)	(14,568)	(4.1)	(3.6)	(5.5)	(3.4)
MtCO ₂ eq Energy EF except one inst. steam GHG = 0	(11,169)	8,681	(15,578)	(24,360)	(3.1)	0.9	(4.7)	(6.3)

⁴ Abbreviations:

kWh	kilowatt hour	tons/hr	tons per hour
MtCO ₂ eq	metric tons of carbon dioxide equivalent	MMBtu	million British thermal unit
EPA	U.S. Environmental Protection Agency	GHG	greenhouse gas
EF	emission factor	lbs	pounds
therm	unit of heat equivalent to 100,000 Btu		

Carbon dioxide equivalent (CO_{2eq}) emissions for the sector decreased by 6.3 percent from 2011 to 2015. (See results for *All Fuel Types* in Table 1 above). Compared to BAU, CO_{2eq} emissions in 2015 were 12 percent lower than in 2011.⁵ The largest decreases in CO_{2eq} were attributable to natural gas and electricity use, with comparatively small decreases in CO_{2eq} for chilled water and steam.

Many of the institutions purchase their fuels from energy-efficient providers. Steam CO_{2eq} emissions are considered to be zero for one of the institutions, since they use steam from a power producer that already reports the emissions and would otherwise dump the steam as waste heat. The foresight and financial investments Metro Boston health care institutions have demonstrated in using efficient energy sources contributed to 12 to 18 percent lower CO_{2eq} emissions each year from 2011 through 2015 compared to using energy providers with emission factors that are U.S. average.

By extrapolating these results into the near future, we initially estimated Metro Boston health care was on track, compared to a 2011 baseline, to reduce greenhouse gas emissions 13 percent absolute, and 27 percent compared to 1.5 percent BAU by 2020. But there are important new developments to consider.

LOOKING AHEAD: 2016-2020 AND BEYOND

While this report is otherwise limited to examining data from 2011 through 2015, more recent major improvements in sector GHG emissions warrant discussion. Partners HealthCare and Boston Medical Center have dramatically lowered their greenhouse gas footprints, causing an additional more than 20 percent drop in GHG emissions for the sector in Metro Boston. Here is how:

2014 and 2015 saw Partners HealthCare hospitals⁶ with +-65 percent of their electricity counted as zero emission, resulting from hydropower-dominated purchases. Starting in January 2016, this jumped to 100 percent due to an additional 35 percent purchase of zero emission, certified low-impact hydroelectric power. In addition, Partners will be purchasing 75 percent of the capacity of a new Antrim, NH 28.8 MW wind farm starting in about 2019. The low-impact hydro reduced Metro Boston health care sector's GHG emissions by an additional 14.5 percent, and the new wind energy purchase will continue this into 2020 and beyond.

Boston Medical Center's (BMC) entire electricity consumption will be neutralized through a 20 MW power purchase agreement (PPA) with a solar electric project in North Carolina, which began commercial operation in March 2017, as part of BMC's largest-in-the-nation multi-institutional PPA collaboration with Massachusetts Institute of Technology and Post Office Square. The BMC portion of this PPA can be counted as reducing Metro Boston health care sector's greenhouse gas emissions by an additional 6 percent through 2020, on top of Partners' purchases, and BMC expects to be 92 to 100 percent carbon neutral for all energy by 2018, deepening sector progress.

⁵ Percent reductions are calculated using space normalized values

⁶ Except the MATEP-powered Brigham and Women's Hospital and municipally powered McLean Hospital

The figures which follow demonstrate sector GHG:

Figure 2) reductions to date, in absolute terms and compared to business as usual (BAU).

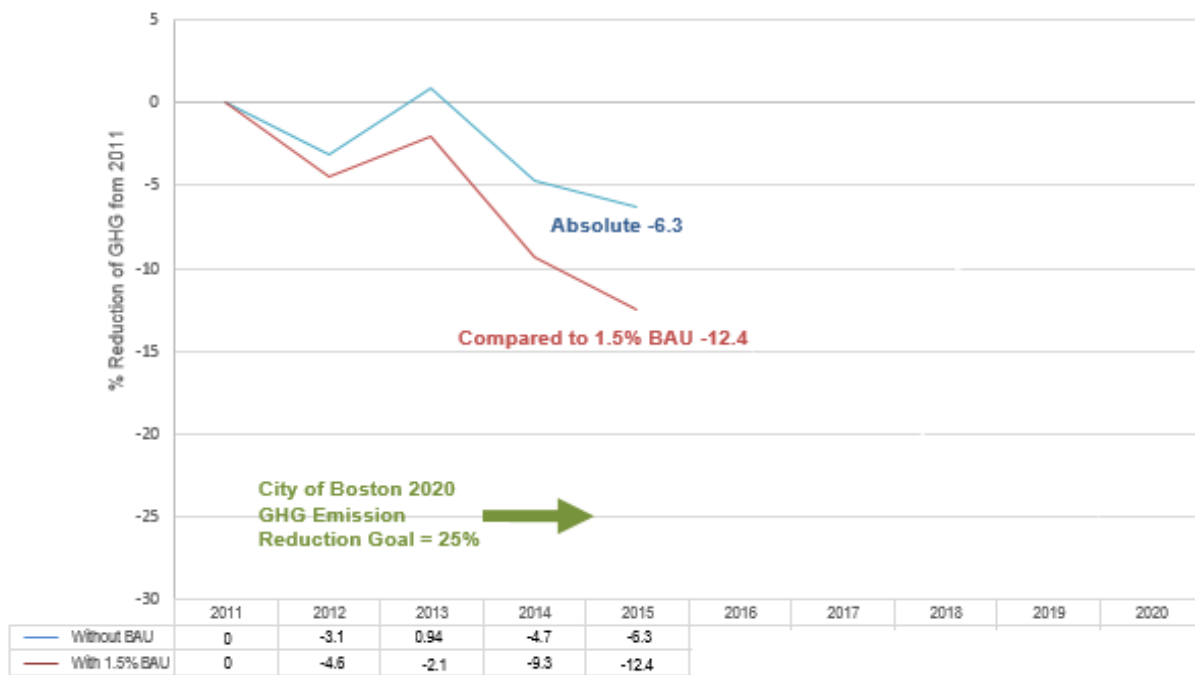
Figure 3) reductions to date and projected through 2020, in absolute terms and compared to BAU.

Figure 4) reductions through 2020, in absolute terms, including Partners HealthCare's and Boston Medical Center's renewable energy investments, and

Figure 5) reductions through 2020 compared to business as usual growth of 1.5 percent, including Partners HealthCare's and Boston Medical Center's renewable energy investments.

Thus, the Metro Boston health care sector will enjoy an absolute energy-related GHG reduction of 33 percent beginning in 2017, and 47 percent reduction compared to BAU in 2020, substantially exceeding the City of Boston and Massachusetts' GHG reduction goals of 25 percent by 2020, three and four years early, respectively.

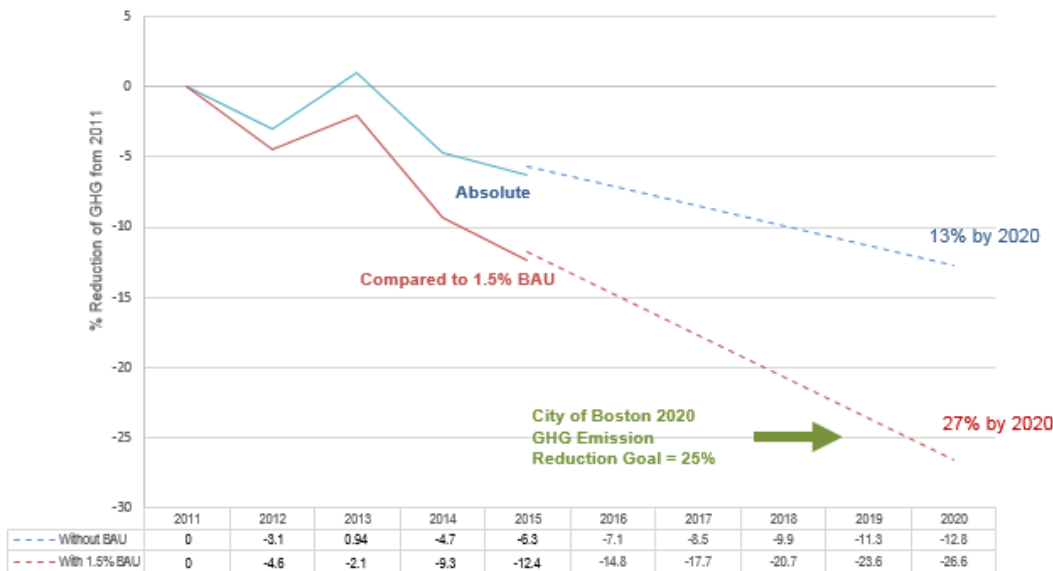
Sector GHG: w/ current EE, RE & BAU* 2011-2015



*EE=Energy Efficiency, RE=Renewable Energy, BAU=Business As Usual

Figure 2. GHG Reductions to Date, in Absolute Terms and Compared to BAU

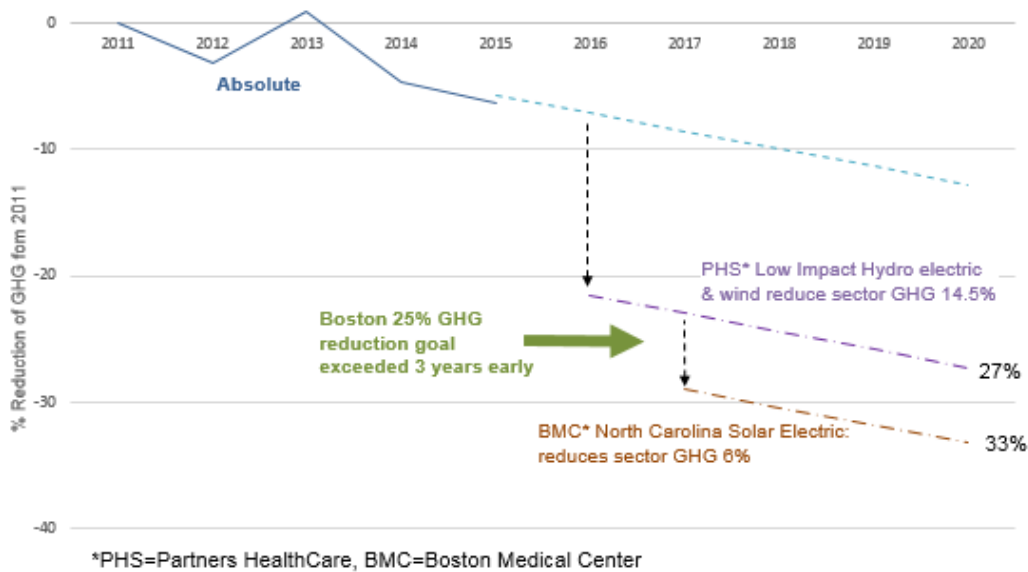
Looking to 2020: Sector GHG following prior EE + RE trends: reduced 13% absolute, 27% BAU



*EE=Energy Efficiency, RE=Renewable Energy

Figure 3. GHG Reductions to Date and Projections through 2020, in Absolute Terms and Compared to BAU

Looking to 2020: Sector GHG absolute reduction w/ BMC & Partners recent RE buys=33%. Meets Boston's 25% GHG reduction goal 3 years early.



*PHS=Partners HealthCare, BMC=Boston Medical Center

Figure 4. Absolute GHG Reductions through 2020 with Partners HealthCare and Boston Medical Center's Renewable Energy Investments

**Looking to 2020: Sector GHG *compared to BAU* w/
 BMC & Partners RE buys=47%.
 City goal met 4 yrs early, & exceeded by ~50%.**

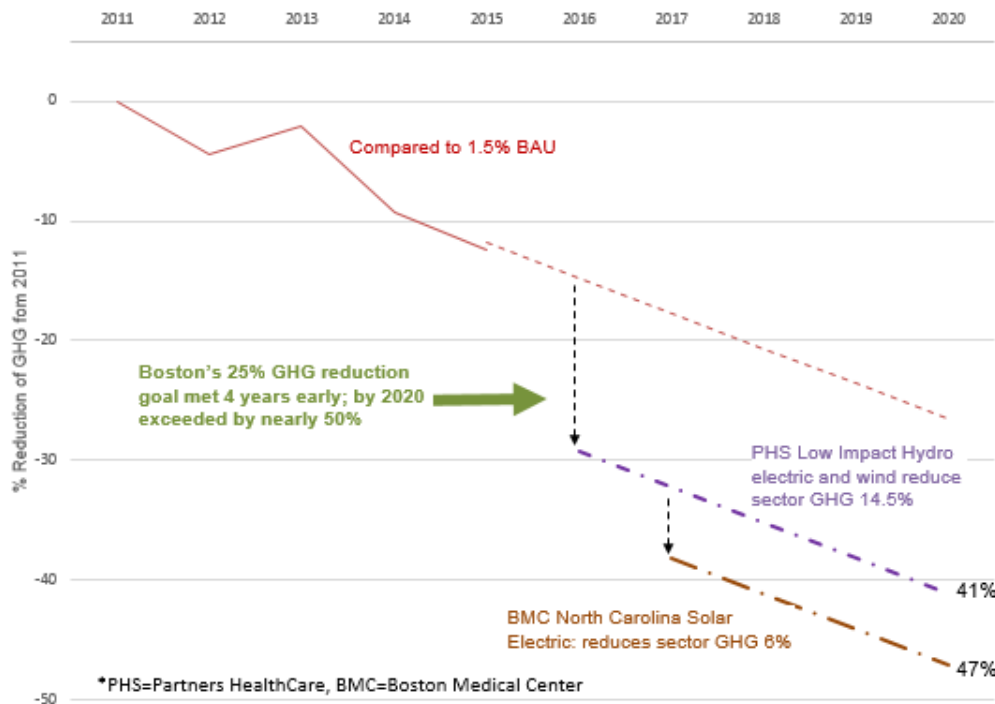


Figure 5. GHG Reductions through 2020 with Partners HealthCare and Boston Medical Center's Renewable Energy Investments Compared to BAU Growth of 1.5 percent

Looking toward Boston's and Massachusetts' goals of zero GHG emissions by 2050:

- De-carbonization of thermal loads (heating, cooling, and processing) looks to be a significant challenge for the region's health care facilities, since at present we don't yet foresee the outlines of GHG-free fuels or technologies capable of substituting for natural gas at the requisite scale.
- That said, grid modernization, energy storage, fuel cells, and solar thermal hold significant promise.
- Health care purchases of carbon offsets could indirectly reduce GHG if offset funds are invested in projects such as additional thermal energy efficiency measures, or fixing the region's many natural gas piping leaks.

Future changes will need to be implemented in ways that also increase resilience, since Boston health care, biomed research facilities, and supporting infrastructure have significant vulnerabilities in the face of climate-change's many threats.

This report can be found on both the Green Ribbon Commission's and Health Care Without Harm's websites:
<http://www.greenribboncommission.org/health-care>
<https://noharm-uscanada.org/content/us-canada/boston-green-ribbon-commission>

About the Boston Green Ribbon Commission

The Boston Green Ribbon Commission (greenribboncommission.org) is a group of business, institutional, and civic leaders in Boston supporting the implementation of the city's Climate Action Plan. The plan includes strong recommendations on how Bostonians can increase efficiency, reduce emissions and prepare for extreme weather and higher sea levels. Many cities have produced similar plans. But few have also enlisted the support and leadership of the local business community as effectively as Boston, to help reduce greenhouse gas emissions 25 percent by 2020 and 80 percent by 2050.

About Health Care Without Harm

Health Care Without Harm (HCWH) (noharm-uscanada.org) is an international coalition of hospitals, health care systems, medical professionals, community groups, health-affected constituencies, labor unions, environmental and environmental health organizations, and religious groups. The coalition seeks to transform the health sector worldwide, without compromising patient safety or care, to become ecologically sustainable and a leading advocate for environmental health and justice. [HCWH-Boston](#) leads some of its most ambitious efforts, covering toxic reductions, green building, energy efficiency, and climate change. As a result, Boston's health care sector is playing a leadership role in regional efforts to address climate change.

HCWH's work with the GRC is supported by the Barr Foundation.

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