COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC UTILITIES

Joint Petition of the Department of Environmental Protection and the Department of Energy Resources Requesting the Department of Public Utilities To Adopt the Avoided Costs of Complying with The Global Warming Solutions Act, using the Marginal Abatement Cost Curve Method, In assessing the Cost Effectiveness of Energy Efficiency Programs	)	**D.P.U. 14-86**

Second Amended Direct Testimony of Tim Woolf

On Behalf of the Department of Energy Resources and the Department of Environmental Protection

Regarding the Cost of Compliance with the Global Warming Solutions Act

December 4, 2014

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1. INTRODUCTION AND QUALIFICATIONS

Q. Please state your name, title and employer.

A. My name is Tim Woolf. I am the Vice President at Synapse Energy Economics, located at 485 Massachusetts Avenue, Cambridge, MA 02139.

Q. Please describe Synapse Energy Economics.

A. Synapse Energy Economics is a research and consulting firm specializing in electricity and natural gas industry regulation, planning, and analysis. Our work covers a range of issues, including economic and technical assessments of energy resources; electricity market modeling and assessment; integrated resource planning; energy efficiency policies and programs; renewable resource technologies and policies; and climate change strategies. Synapse works for a wide range of clients, including attorneys general, offices of consumer advocates, public utility commissions, environmental advocates, the U.S. Environmental Protection Agency, U.S. Department of Energy, U.S. Department of Justice, the Federal Trade Commission and the National Association of Regulatory Utility Commissioners. Synapse has over 25 professional staff with extensive experience in the electricity industry.

Q. Please summarize your professional and educational experience.

A. Prior to my current position at Synapse Energy Economics, I was a commissioner at the Massachusetts Department of Public Utilities (Department). In that capacity, I was responsible for overseeing a considerable expansion of clean energy policies, including significantly increased ratepayer-funded energy efficiency programs; an update of the Department energy efficiency guidelines; the implementation of decoupled rates for electric and natural gas companies; the promulgation of net metering regulations; review of smart grid pilot programs; and review of long-term contracts for renewable power. I was also responsible for overseeing a variety of other dockets before the commission, including several electric and natural gas rate cases.

Prior to being a commissioner at the Department, I was employed as the Vice President at Synapse Energy Economics; a Manager at Tellus Institute; the Research Director of the Association for the Conservation of Energy; a Staff Economist at the Massachusetts

Department of Public Utilities; and a Policy Analyst at the Massachusetts Executive Office of Energy Resources.

I hold a Master's in Business Administration from Boston University, a Diploma in Economics from the London School of Economics, and a BS in Mechanical Engineering and a BA in English from Tufts University.

Q. Please describe your professional experience as it relates to energy efficiency policies and programs.

A. Energy efficiency policies and programs have been at the core of my professional career. While at the Massachusetts D.P.U., I played a leading role in updating the Department's energy efficiency guidelines, in reviewing and approving the 2010-2012 three-year energy efficiency plans, in reviewing and approving energy efficiency annual reports, in leading a working group on rate and bill impacts, and in advocating for allowing energy efficiency to participate in the New England wholesale electricity markets.

As a consultant, my work has encompassed all aspects of energy efficiency program design and implementation, including cost-benefit analyses, avoided costs, program budgeting, program assessment, utility financial incentives, and other relevant regulatory policies. I am currently the lead technical consultant for the National Efficiency Screening Project, which includes a group of efficiency experts and stakeholders working to improve efficiency cost-effectiveness screening practices throughout the United States. I recently completed three national studies on demand resource cost-effectiveness, including one for the US Department of Energy and the Federal Energy Regulatory Commission.

I have reviewed and critiqued utility energy efficiency policies and programs throughout the United States, and I have testified on these issues in British Columbia, Colorado, Delaware, Kentucky, Massachusetts, Minnesota, Nevada, Nova Scotia, Québec, and Rhode Island. I have also represented clients in several energy efficiency collaboratives, where policies and programs were discussed and negotiated among a variety of stakeholders. I work for a variety of clients on energy efficiency issues, including consumer advocates, environmental advocates, regulatory commissions, and the U.S. Department of Energy.

Q. On whose behalf are you testifying in this case?

A. I am testifying on behalf of the Massachusetts Department of Energy Resources (DOER) and the Massachusetts Department of Environmental Protection (MassDEP).

Q. What is the purpose of your testimony?

A. The purpose of my testimony and the testimony of Dr. Stanton is to support the petition of DOER and MassDEP requesting that the Department open a proceeding on the costs of complying with the Global Warming Solutions Act (GWSA). My colleague, Dr. Stanton, has developed a methodology for estimating these costs that can be used when screening energy efficiency programs, the marginal abatement cost curve methodology. In my testimony, I demonstrate that the Department has clear authority to adopt this methodology. I also describe the requirements of the GWSA; explain why the Program Administrators have an obligation to account for the costs of GWSA compliance when screening energy efficiency programs; and propose estimates of the GWSA compliance costs that should be used by the Program Administrators when screening energy efficiency resources.

2. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Q. Please summarize your primary conclusions.

A. My primary conclusions include the following:

- Since 2000 the Department has clearly required that that the cost of complying with current and future environmental regulations be accounted for when evaluating the cost-effectiveness of energy efficiency resources.
- Since the GWSA was passed in 2008 the Department has clearly required that GWSA compliance costs be accounted for when evaluating the cost-effectiveness of energy efficiency resources.

- Energy efficiency is one of the most abundant and lowest-cost resources available for Massachusetts to reduce greenhouse gas (GHG)[1] emissions. Using energy efficiency resources to comply with the GWSA emissions limits will significantly reduce costs to electricity and natural gas customers.

- Reducing the cost of GWSA compliance will reduce costs to all Massachusetts electricity and natural gas customers.

- When screening energy efficiency resources the Massachusetts energy efficiency Program Administrators[2] already include a forecast of the cost of complying with the Regional Greenhouse Gas Initiative (RGGI), and future federal carbon dioxide (CO_2) regulations. The projected cost of compliance with GWSA will be higher than these compliance costs, because the GWSA establishes more stringent GHG emissions limits.

- Dr. Stanton has developed marginal abatement cost curves for the Buildings and Electric Supply sectors to estimate the GWSA compliance costs for these sectors. She has developed one marginal abatement cost curve for meeting the 2020 GHG emission reduction requirements established in the Massachusetts Clean Energy and Climate Plan ("CECP"), and one marginal abatement cost curve for meeting the forecasted 2030 GHG reduction requirements.

- It is important to develop estimates of GWSA compliance costs through at least 2030, despite uncertainties about the 2030 GHG emissions limit, because the energy

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[1] The Department has previously stated it is investigating "the appropriate method to calculate the benefits of avoided CO_2 emissions." *See, Vote and Order Opening Investigation*, at 14, D.P.U. 11-120 (November 29, 2011). It is noted that Massachusetts law defines GHG to include "…any chemical or physical substance that is emitted into the air and that the department [of environmental protection] may reasonably anticipate will cause or contribute to climate change including, but not limited to, carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride." M.G.L. c. 21N, § 1. While carbon dioxide (CO_2) is the predominant GHG emitted during fuel combustion, methane and nitrous oxide are GHGs that are also emitted. In addition, electric and natural gas distribution systems use and emit non-combustion GHGs such as sulfur hexafluoride and methane. As such, focusing solely on CO_2 underestimates the total GHG emissions that contribute to climate change and that will create environmental compliance costs in the future. This testimony refers to GHG or CO_2, as appropriate to the underlying data source or pollutant(s) affected by particular policies and regulations cited.

[2] The Massachusetts energy efficiency Program Administrators include all electric and natural gas distribution companies, and all municipal aggregators that offer energy efficiency programs.

efficiency resources implemented in the next several years will operate well past 2020, and thus will provide an opportunity to reduce GWSA compliance costs in the years after 2020.

- Dr. Stanton estimates that GWSA compliance costs in 2020 will be $52 per metric ton of CO_2e.[3] This estimate is based on the finding that the marginal cost of compliance in 2020 is represented by purchases of clean energy imports from outside of New England, and that new transmission lines will be needed to support those purchases.

- Dr. Stanton estimates that GWSA compliance costs in 2030 will be $59 per metric ton of CO_2e. This estimate is based on the finding that the marginal cost of compliance in 2030 is represented by the purchase of clean energy imports from outside of New England and that new transmission lines will be required to support those purchases.

- The GWSA compliance cost can be converted to $ per MWh, $ per therm, and $ per MMBtu, for the purpose of comparing with other avoided costs of energy efficiency. To summarize, the 15-year levelized GWSA compliance costs are estimated to be $17 per MWh, $0.24 per therm, and $3.3 per MMBtu.

- Table 1 in Section 8 presents the complete forecast of annual and levelized GWSA compliance costs.

Q. Please summarize your primary recommendations.

A. I offer the following recommendations:

- The Department should find that the marginal abatement cost curve methodology is the appropriate methodology for estimating GWSA compliance costs. Furthermore, the Department should require Program Administrators to use this methodology to

[3] All costs in this testimony are presented in constant 2013 dollars. Also, all GHG quantities are presented as metric tons of CO_2 equivalent. Not all greenhouse gases have the same heat-trapping capacity. To account for these differences, a standard relating the heat trapping potential of each greenhouse gas to an equivalent quantity of carbon dioxide, over a given time horizon, has been developed. Emissions shown in this document utilize this standard, and are expressed in units of metric tons of carbon dioxide equivalent (CO_2e).

estimate future GWSA compliance costs, unless and until a better methodology is identified.

- The Department should require the Program Administrators to adopt the GWSA compliance costs presented in Table 1 for the purpose of determining the cost-effectiveness of energy efficiency programs for all future analyses of cost effectiveness, annual reports, and 3-year plan filings to the Department until these estimates are updated to account for new information or new developments.

3. THE GLOBAL WARMING SOLUTIONS ACT

Q. What is the Global Warming Solutions Act?

A. Massachusetts' 2008 Global Warming Solutions Act (St. 2008, c. 298) establishes requirements for reducing emissions of GHG in the Commonwealth. The GWSA includes the Climate Protection and Green Economy Act codified at M.G.L. c. 21N.

Q. What are the key requirements of the GWSA?

A. Key requirements of the GWSA include the following:

- Reduce 2020 statewide GHG emissions to between 10 and 25 percent below statewide 1990 GHG emissions.
- Reduce 2050 statewide GHG emissions to at least 80 percent below statewide 1990 GHG emissions.
- Establish regulations to require reporting of GHG emissions by the Commonwealth's largest sources by January 1, 2009.
- Establish baseline statewide GHG emissions for 1990.
- Establish a projection of "business-as-usual" GHG emissions for 2020 assuming that no measures beyond those formally adopted and implemented as of January 1, 2009 are taken to reduce GHG emissions.
- Establish a 2020 GHG emissions limit, and a plan for achieving this limit, by January 1, 2011.

- Establish 2030 and 2040 "interim GHG emissions limits [that] maximize the ability of the Commonwealth to meet the 2050 GHG emissions limit."

Q. What 2020 GHG emissions limit was set by the Secretary for Energy and Environmental Affairs?

A. On December 28, 2010, the Secretary for Energy and Environmental Affairs (EEA) established a legally binding statewide 2020 GHG emissions limit of 25 percent below statewide 1990 GHG emissions.[4]

Q. What are the implications of the GWSA for 2030 and 2040?

A. GWSA requires that 2030 and 2040 emissions limits be set to maximize the ability of the Commonwealth to achieve its 2050 statewide emissions limit of at least 80 percent below statewide 1990 GHG emissions.

4. THE MASSACHUSETTS CLEAN ENERGY AND CLIMATE PLAN

Q. What is the *Massachusetts Clean Energy and Climate Plan for 2020*?

A. On December 29, 2010, EEA published the *Massachusetts Clean Energy and Climate Plan for 2020* (CECP),[5] which describes a portfolio of policies aimed at enabling the Commonwealth to achieve its 2020 statewide GHG emissions limit of 25 percent below statewide 1990 GHG emissions.

Q. What is the purpose of the CECP?

A. The CECP describes its purpose as follows:

> [P]rovid[ing] the means for meeting the Secretary's GHG emissions reduction requirement of 25 percent in 2020, putting the Commonwealth on track toward the GWSA's mandate of 80 percent reduction in 2050—and accelerating the development of a clean energy economy for Massachusetts.[6]

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[4] Massachusetts Executive Office of Energy and Environmental Affairs, *Determination of Greenhouse Gas Emission Limit for 2020*. December 28, 2010. (attached to Dr. Stanton's testimony as Exhibit EAS-5)

[5] Massachusetts Executive Office of Energy and Environmental Affairs, *Massachusetts Clean Energy and Climate Plan for 2020* (CECP), December 2010. A copy of the CECP is attached to Dr. Stanton's testimony as Exhibit EAS-6.

[6] CECP at p.ES-15.

Q. How does the CECP relate to estimating GWSA compliance costs?

A. The CECP sets out a portfolio of the specific GHG emissions reduction policies necessary to comply with the GWSA's 2020 statewide GHG emissions limit of 25 percent below statewide 1990 GHG emissions. The descriptions of these policies in the CECP include, in most cases, estimates of the expected GHG emissions reductions and some expected costs.

Q. What is the role of energy efficiency in the CECP?

A. The CECP includes many energy efficiency policies, including, all cost-effective energy efficiency implemented by the Program Administrators, advanced building energy codes, deep energy efficiency improvements for buildings, expanding energy efficiency programs to commercial and industrial heating oil, and federal appliance and product standards. These policies account for 9.6 percentage points of the CECP's 2020 25-percent statewide GHG emissions reduction from 1990 statewide GHG emissions. Taken together these policies are responsible for almost two-fifths of the GHG emissions reductions needed to meet this 2020 GHG emissions limit and represent the single largest policy approach for meeting the 2020 emissions limit.

Q. What work has EEA and its agencies done to follow-up on the CECP since its release?

A. On December 13, 2013, EEA published the *Commonwealth of Massachusetts Global Warming Solutions Act 5-Year Progress Report*,[7] describing the progress from 2008 to 2013 in meeting the GWSA statewide GHG emissions limit for 2020.

5. DEPARTMENT POLICIES ON COST-EFFECTIVENESS

Q. Please provide an overview of the Department's key orders on the cost-effectiveness of energy efficiency programs.

A. The Department began articulating policies regarding the cost-effectiveness of energy efficiency programs in the late 1980s.[8] When the electricity industry in Massachusetts

[7] A copy of this report is attached to Dr. Stanton's testimony as Exhibit EAS-12.
[8] *Investigation into Pricing and Ratemaking Treatment of New Electric Generating Facilities which are not Qualifying Facilities*, D.P.U. 86-36-F (November 30, 1988).

and New England was restructured in 1997, the Department promulgated a set of Energy Efficiency Guidelines (Guidelines), with clear directives on how to assess the cost-effectiveness of efficiency resources, among other directives.[9] After Governor Patrick signed into law the Green Communities Act (GCA) in 2008 (c. 169 of the Acts of 2008), the Department updated its Energy Efficiency Guidelines to be consistent with that Act.[10]

Q. How did the Department address the avoided cost of compliance with environmental requirements in the original Guidelines (D.P.U. 98-100)?

A. The Department determined that the Total Resource Cost Test is the appropriate test for determining the cost-effectiveness of energy efficiency programs. The Department noted that the Total Resource Cost Test allows for the inclusion of the benefits associated with avoiding future environmental compliance costs.[11] Accordingly, the Department made the cost-effectiveness of energy efficiency programs one of the central elements of the original Guidelines.

The original Guidelines included a detailed description of both the costs and the benefits to be included in evaluating energy efficiency programs. In terms of the benefits, the Guidelines were quite clear that the benefits should include all avoided costs including the avoided costs of complying with environmental requirements:

> Avoided Electric Generation and Gas Supply Costs, Avoided Transmission Costs, and Avoided Distribution Costs shall include environmental compliance costs that are reasonably projected to be incurred in the future because of rules and/or regulatory requirements that are not currently in effect, but which are projected to take effect in the foreseeable future.[12]

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[9] *Investigation by the Department of Telecommunications and Energy on its own Motion to Establish Methods and Procedures to Evaluate and Approve Energy Efficiency Programs, pursuant to GL c.25 s.19 and c.25A s.11G*, D.P.U. 98-100 (January 8, 1999).

[10] *Investigation by the Department of Public Utilities on its own Motion into Updating its Energy Efficiency Guidelines Consistent with An Act Relative to Green Communities*, D.P.U. 08-50-A (August 22, 2008). The Department also updated the Guidelines in 2013. *See Investigation by the Department on its own Motion into Updating its Energy Efficiency Guidelines*, D.P.U. 11-120 (January 31, 2013).

[11] *Investigation by the Department of Telecommunications and Energy on its own Motion to Establish Methods and Procedures to Evaluate and Approve Energy Efficiency Programs, pursuant to GL c.25 s.19 and c.25A s.11G*, D.P.U. 98-100 (November 10, 1998).

[12] *Investigation by the Department of Telecommunications and Energy on its Own Motion to Establish Methods and Procedures to Evaluate and Approve Energy Efficiency Programs, Pursuant to G.L. c. 25, § 19 and c. 25A, § 11G*, D.P.U. 98-100, *Guidelines for the Methods and Procedures for the Evaluation and Approval of Energy Efficiency Programs*, Section 3.3.2(d) (February 7, 2000).

Q. Have the Program Administrators included the avoided cost of compliance with environmental requirements as a result of these Guidelines?

A. Yes, to some extent. For many years, the Program Administrators have included estimates of the cost of compliance with future federal requirements to limit GHG emissions. I discuss these estimates in Section 6 of my testimony.

However, to date the Program Administrators have not included the full cost of compliance with the GWSA. That is why this docket is necessary.

Q. What did the Department do to respond to the new requirements of the Green Communities Act?

A. The Department opened D.P.U. 08-50 to ensure that its Energy Efficiency Guidelines were consistent with the GCA. One of the central elements of that docket was the criteria for establishing program cost-effectiveness. As the Department noted at the time, the GCA contains multiple references to energy efficiency program cost-effectiveness.[13] The GCA provides that each Program Administrator's Three-Year Energy Efficiency Investment Plan "shall provide for the acquisition of all available energy efficiency and demand reduction resources that are cost effective or less expensive than supply"[14] and that Program Administrators shall acquire all cost-effective energy efficiency resources. In light of these requirements and the anticipated expansion in energy efficiency program budgets and activities, the Department updated its Guidelines to address any new questions or new challenges that might arise.

Q. How did the Department address the avoided cost of compliance with environmental requirements in the updated Energy Efficiency Guidelines?

A. In the D.P.U. 08-50 docket, the Department reaffirmed the Total Resource Cost Test as the appropriate test for evaluating the cost-effectiveness of energy efficiency programs. The Total Resource Cost Test focuses on all avoided costs of supply including future environmental compliance costs.

In *Massachusetts Electric Company v. Department of Public Utilities*, 419 Mass. 239 (1994) (*Massachusetts Electric Company*), the Supreme Judicial Court stated that the

[13] M.G.L. c. 25
[14] M.G.L. c. 25 § 21(b)(1)

Department's regulatory authority extends to reasonably foreseeable environmental compliance costs but not environmental externalities. In D.P.U. 08-50, the Department followed the Supreme Judicial Court's Decision in *Massachusetts Electric Company* and concluded that the avoided costs of supply examined in the Total Resource Cost Test should include the reasonably foreseeable avoided costs of environmental compliance but not environmental externalities. Of this, the Department said:

> [T]he Supreme Judicial Court was careful to distinguish between the costs of complying with reasonably foreseeable environmental laws (i.e., those costs that are, or are expected to be, internal to electricity prices) and the costs of environmental externalities (i.e., those costs associated with environmental damages that are not, and cannot reasonably anticipated to be, covered by future laws and thereby included in electricity prices). Id. at 246. [footnote omitted] Accordingly, without legislative authority, the Department cannot directly require Program Administrators to include the cost of environmental externalities in the cost-effectiveness evaluations of energy efficiency programs, and we decline to do so here. *We may, however, require Program Administrators to include reasonably foreseeable environmental compliance costs in evaluating energy resources.* This authority is reflected in our existing Energy Efficiency Guidelines where we require Program Administrators to include in the Total Resource Cost test environmental compliance costs that are reasonably projected to be incurred in the future. Energy Efficiency Guidelines § 3.3.2(d).[15] (emphasis added)

The Department then cited two examples of reasonably foreseeable environmental compliance costs that should be included when evaluating energy resources: the GWSA and President Obama's commitment to establishing limits on GHG emissions and proposals for federal climate change legislation. The Department was clear that it "expects program administrators to include estimates of such compliance costs in the calculation of future avoided energy costs."[16]

Q. How did the Department modify the Efficiency Guidelines to reflect these findings?

A. The Department made a few relatively minor changes to the Guidelines on this point. There was no need to make substantive changes because the Efficiency Guidelines

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[15] *Investigation by the Department of Public Utilities on its own Motion into Updating its Energy Efficiency Guidelines Consistent with An Act Relative to Green Communities*, D.P.U. 08-50-A, pages 15-16 (March 16, 2009).

[16] D.P.U. 08-50-A, p. 16-17 (March 16, 2009).

already required Program Administrators to account for the benefits of avoiding reasonably foreseeable environmental compliance costs in evaluating efficiency programs. The final Efficiency Guidelines from the D.P.U. 08-50 docket, the Guidelines that are still in effect today, include the following language with regard to the electric energy efficiency programs:

> The avoided capacity, energy, transmission and distribution cost factors shall include related environmental compliance costs that are reasonably projected to be incurred in the future because of state or federal laws, rules and/or regulatory requirements that are currently in effect, or are projected to take effect in the future.[17]

The Efficiency Guidelines also include parallel language with regard to the natural gas energy efficiency programs.[18]

In sum, the Department has been clear since February 2000 that the energy efficiency Program Administrators should account for the avoided cost of reasonably anticipated future environmental requirements when evaluating the cost-effectiveness of energy efficiency resources. Furthermore, the Department has been clear since March 2009 that those avoided costs should include the costs of complying with the GWSA.

Q. What about other types of resources? Has the Department addressed related cost-effectiveness issues with regard to resources other than energy efficiency programs?

A. Yes. I discuss below three Department orders regarding other types of resources that have bearing on the energy efficiency cost-effectiveness policies at issue in this docket: the Department order regarding National Grid's purchase of a long-term contract from Cape Wind (D.P.U. 10-54[19]); the Department's most recent order regarding long-term

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[17] *Investigation by the Department of Public Utilities on its Own Motion into Updating its Energy Efficiency Guidelines Consistent with An Act Relative to Green Communities*, D.P.U. 08-50-B, Energy Efficiency Guidelines § 3.4.4.1(a)(v), p. 50 (October 26, 2009). The Department did not change this provision in 2013. *See Investigation by the Department on its own Motion into Updating its Energy Efficiency Guidelines*, D.P.U. 11-120 (January 31, 2013).

[18] D.P.U. 08-50-B, Energy Efficiency Guidelines § 3.4.4.2(a)(iii), p. 51 (October 26, 2009).

[19] *Petition of Massachusetts Electric Company and Nantucket Electric Company, each d/b/a National Grid, for approval by the Department of Public Utilities of two long-term contracts to purchase wind power and renewable energy certificates, pursuant to St. 2008, c. 169, § 83 and 220 C.M.R. § 17.00 et seq.* D.P.U. 10-54 (November 22, 2010).

renewable contracts (D.P.U. 13-146 through 13-149[20]); and the Department's order on modernization of the electric grid (D.P.U. 12-76-A[21]).

Q. Please describe the elements of the Department's findings in D.P.U. 10-54 that are relevant to the efficiency policies at issue in this docket.

A. In D.P.U. 10-54, the Department approved National Grid's petition to enter into a power purchase agreement with Cape Wind for the purchase of 50 percent of the output of the Cape Wind project. Section 83 of the GCA St. 2008, § 83, ¶ 3 and Department regulations 220 C.M.R. § 17.05(1)(c)(3), require that in order to approve a long-term contract for renewable power the Department must determine that the contract is "cost effective to Massachusetts electric ratepayers over the term of the contract."[22] The Department addresses the cost-effectiveness of the power purchase agreement in considerable depth, including the benefits associated with avoiding future GWSA compliance costs. On this point, the Department concluded that:

> the Cape Wind facility will provide benefits to National Grid customers and the Commonwealth in helping to avoid future GWSA compliance costs, and that these benefits should be considered in our evaluation of the cost-effectiveness of PPA-1.[23]

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[20] D.P.U. 13-146 through 13-149 (February 26, 2014).
Petition of Fitchburg Gas and Electric Light Company d/b/a Unitil for approval by the Department of Public Utilities of: (1) six long-term contracts for procurement of renewable energy and renewable energy credits from six individual wind projects, pursuant to St. 2008, c. 169, § 83A and 220 C.M.R. § 21.00 et seq.; and (2) a long-term renewable contract adjustment mechanism tariff, M.D.P.U. No. 239, D.P.U. 13-146.
Petition of Massachusetts Electric Company and Nantucket Electric Company, each d/b/a National Grid for approval by the Department of Public Utilities of: (1) six long-term contracts for procurement of renewable energy and renewable energy credits from six individual wind projects, pursuant to St. 2008, c. 169, § 83A and 220 C.M.R. § 21.00 et seq.; (2) a renewable energy recovery provision tariff, M.D.P.U. No. 1221; and (3) a basic service adjustment provision tariff, M.D.P.U. No. 1222, D.P.U. 13-147.
Petition of NSTAR Electric Company for approval by the Department of Public Utilities of: (1) six long-term contracts for procurement of renewable energy and renewable energy credits from six individual wind projects, pursuant to St. 2008, c. 169, § 83A and 220 C.M.R. § 21.00 et seq.; and (2) a long-term renewable contract adjustment mechanism tariff, M.D.P.U. No. 164B, D.P.U. 13-148.
Petition of Western Massachusetts Electric Company for approval by the Department of Public Utilities of: (1) six long-term contracts for procurement of renewable energy and renewable energy credits from six individual wind projects, pursuant to St. 2008, c. 169, § 83A and 220 C.M.R. § 21.00 et seq.; and (2) a long-term renewable contract adjustment mechanism tariff, M.D.P.U. No. 1051B. D.P.U. 13-149.

[21] *Investigation by the Department of Public Utilities on its own Motion into Modernization of the Electric Grid.*

[22] St. 2008, c. 169, § 83. (d)(3)(iii). D.P.U. 12-76-A, Order (December 23, 2013).

[23] D.P.U. 10-54, p. 179 (November 22, 2010).

Q. How did the Department address the issue of uncertainty associated with GWSA compliance costs in D.P.U. 10-54?

A. The Department was clear that GWSA compliance costs should be accounted for despite uncertainty regarding the magnitude of such costs. The Department noted that "[n]othing in the Supreme Judicial Court's decision suggests that costs must be precisely quantifiable for the Department to have authority to order their avoidance, so long as such costs are reasonably likely to be incurred."[24] The Department further noted that "[t]o ignore benefits simply because they are difficult to quantify would unjustifiably skew the comparison of costs and benefits."[25]

Q. How did the Department characterize the contribution of the electricity sector to GWSA GHG emissions reductions?

A. The Department concluded that the electric sector is likely to play a proportionately larger role in complying with the GWSA than other sectors,[26] and "that GHG emission reductions from the electric sector will be vitally important—likely even more important than reductions from other sectors—in complying with the GWSA."[27]

Q. Please describe the elements of the Department's findings in D.P.U. 13-146 through 13-149 that are relevant to the efficiency policies at issue in this docket.

A. In these dockets, the Department approved several long-term contracts for renewable power for Fitchburg Gas and Electric Light Company, Massachusetts Electric and Nantucket Electric Company, NSTAR Electric Company, and Western Massachusetts Electric Company. As noted above, in order to approve a long-term contract for renewable power, the Department must find that it is cost-effective to Massachusetts electric ratepayers. In describing its standard of review for cost-effectiveness, the Department referred to the D.P.U. 10-54 Cape Wind order, particularly the part of that order reiterating that the benefits of the renewable contracts should include the benefits of

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[24] D.P.U. 10-54, p. 172 (November 22, 2010).
[25] D.P.U. 10-54, p. 173 (November 22, 2010).
[26] The Department cited the following reasons for this conclusion; the electricity sector has opportunities to reduce emissions at lower cost than other sectors, the electricity sector has fewer emission sources relative to other sectors and thus is easier to regulate, and other sectors may need to reduce their own emissions through increased electrification. D.P.U. 10-54, p. 176-177 (November 22, 2010).
[27] D.P.U. 10-54, p. 177 (November 22, 2010).

complying with existing and reasonably anticipated future federal and state environmental requirements.[28]

Furthermore, the Department found that the contracts for renewable power will provide significant benefits with regard to compliance with the GWSA emissions limits, and that these benefits should be considered when determining the cost-effectiveness of the renewable power contracts.

> The contracts will, therefore, contribute to achieving a portion of the emissions reductions necessary to comply with the GWSA targets for the duration of the contracts. For these reasons, we conclude that the contracts will provide an unquantified, but significant, benefit to Massachusetts ratepayers and the Commonwealth by contributing to compliance with renewable energy and environmental requirements.[29]

Q. Please describe the elements of the Department's Grid Modernization order (D.P.U. 12-76-A) that are relevant to the efficiency policies at issue in this docket.

A. In this order, the Department establishes grid modernization objectives, and presents a straw proposal for achieving those objectives. The straw proposal includes a requirement that distribution companies file grid modernization plans with the Department on a regular basis. In its first plan, each electric distribution company is required to include a comprehensive advanced metering plan. The advanced metering plan should include a benefit-cost analysis, using a business case approach, which "assesses all costs and benefits, including those that are difficult to quantify."[30] In addition, the Department specifically cites avoided carbon and CO_2 compliance costs as one of the benefits to be included in the benefit-cost analysis.[31]

Q. Please summarize the Department's policies on the treatment of the costs of compliance with environmental requirements.

A. The Department has been consistent and clear on this matter since 2000 when it promulgated the original Energy Efficiency Guidelines. For energy efficiency resources, for long-term contracts for renewable power, and for advanced metering plans, the

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[28] D.P.U. 13-146 through 13-149, p. 39 (February 26, 2014).
[29] D.P.U. 13-146 through 13-149, p. 54 (February 26, 2014).
[30] D.P.U. 12-76-A, p. 20 (December 23, 2013).
[31] D.P.U. 12-76-A, p. 23 and 24 (December 23, 2013).

Department has explicitly stated that the benefits of these investments should include the avoided costs of complying with environmental requirements—both current requirements and reasonably anticipated future requirements. Furthermore, since March 2009, shortly after the GWSA was signed into law, the Department has been clear that the GWSA GHG emissions limits should be included in assessing the costs of complying with environmental requirements.

Program Administrators have not yet accounted for GWSA compliance costs when evaluating the cost-effectiveness of energy efficiency resources. I believe that the Program Administrators have been reluctant to include GWSA compliance costs, at least in part, because they did not yet have a reasonable estimate of such costs. With the analysis presented by Dr. Stanton and me, the Program Administrators now have good estimates of the avoided compliance costs associated with the GWSA based on the appropriate methodology and the best information available.[32] I recommend that the Department require the Program Administrators to use these estimates, as described in more detail in Section 9, in future efficiency planning initiatives.

Q. Why is it so important to properly account for GWSA compliance costs when estimating the cost-effectiveness of energy efficiency resources?

A. Energy efficiency resources are the most widely available and the lowest-cost option to reduce emissions of GHGs and other pollutants. It is essential that these low-cost resources be fully utilized to comply with current and future environmental regulations. Otherwise, the costs of complying with such regulations will be greater, and electricity and natural gas customers will end up paying higher costs than necessary.

Furthermore, energy efficiency offers policy options for reducing GHG emissions from the Buildings and Electric Supply sectors that result in *lower bills* for customers, by reducing customer electricity and natural gas consumption levels. Other GHG emissions reduction options typically result in higher bills for customers.

[32] These estimates are presented in Table 1.

In sum, it is important to properly account for GWSA compliance costs when screening energy efficiency resources, because this will minimize future costs to electric and natural gas customers.

6. CURRENT EFFICIENCY SCREENING ASSUMPTIONS

Q. Do the Massachusetts Program Administrators currently include the costs of compliance with environmental regulations when screening energy efficiency for cost-effectiveness?

A. Yes, to some extent. The New England Avoided Energy Supply Cost (AESC) Study 2013 (attached to Dr. Stanton's testimony as EAS-2) includes forecasts of wholesale energy market prices, which are used to determine avoided energy costs for efficiency screening.[33] The forecasts of wholesale energy market prices include the costs of compliance with several environmental regulations, including (a) the cost of purchasing sulfur dioxide (SO_2) and nitrogen oxides (NO_X) allowances; (b) the cost of purchasing CO_2 allowances in order to comply with the Regional Greenhouse Gas Initiative (RGGI); and (c) the cost of purchasing additional carbon allowances in order to comply with future CO_2 requirements established by the federal government. The AESC 2013 study accounts for additional impacts of future environmental regulations on the generation fleet, including potential generator retrofits, generator repowerings and generator retirements.

SO_2 and NO_X allowance prices have been included in the avoided cost studies since the first New England AESC study was prepared in 1999.[34] CO_2 prices from RGGI and from anticipated federal carbon requirements have been included in the avoided cost studies after the 2005 AESC Study.[35]

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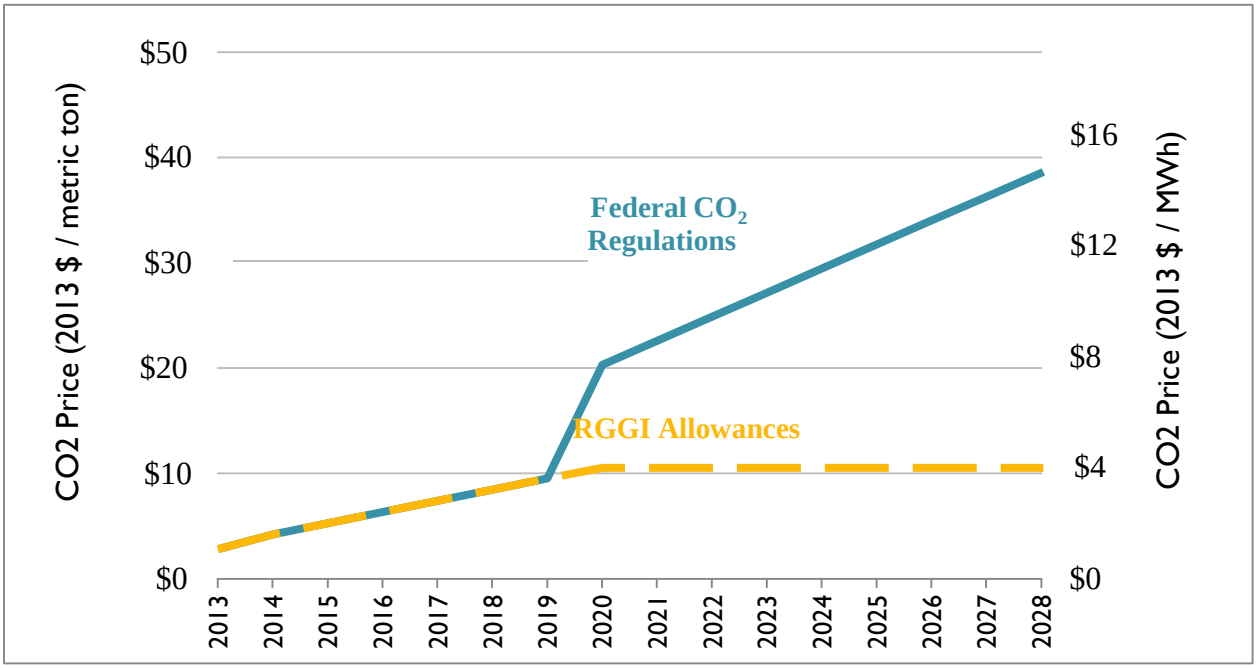
[33] AESC 2013 Exhibit EAS-2, p. 4-4.

[34] Resource Insight and Synapse Energy Economics, *Avoided Energy Supply Costs: for Demand-Side Management in Massachusetts*, prepared for the Avoided-Energy-Supply-Component Study Group, July 1999.

[35] ICF Consulting, *Avoided Energy Supply Costs in New England*, prepared for the Avoided-Energy-Supply-Component Study Group, December 2005.

Figure 1 presents the most recent estimates of the cost of RGGI allowances and anticipated federal CO_2 requirements from the AESC 2013 Study.[36]

Figure 1. Current Estimates of RGGI and Federal CO_2 Allowance Prices



The RGGI allowance prices are based on the results of Auction 19 and modeling of the RGGI Updated Model Rule. The federal CO_2 allowance prices are based on a Synapse study that analyzes likely federal carbon regulations, and reviews multiple forecasts of CO_2 prices currently in use in the electricity industry.[37] This study estimates that federal carbon regulations will be established by 2020, and that they will be more stringent than the RGGI requirements, and will thus result in higher CO_2 prices from that point on.[38]

[36] AESC 2013 Exhibit EAS-2. The cost per ton is converted to $ per MWh by multiplying the natural gas emissions rate from AESC 2013 (0.38 tons CO_2 per MWh) by the cost per metric ton in 2020 ($18 per metric ton CO_2).

[37] Wilson, R., P. Luckow, B. Biewald, F. Ackerman, E. Hausman, 2012 Carbon Dioxide Price Forecast. Synapse Energy Economics, October 4, 2012, p. 4.

[38] AESC 2013 Exhibit EAS-2, p. 4-3.

Q. How do these estimates factor in to the avoided costs currently used to screen energy efficiency resources?

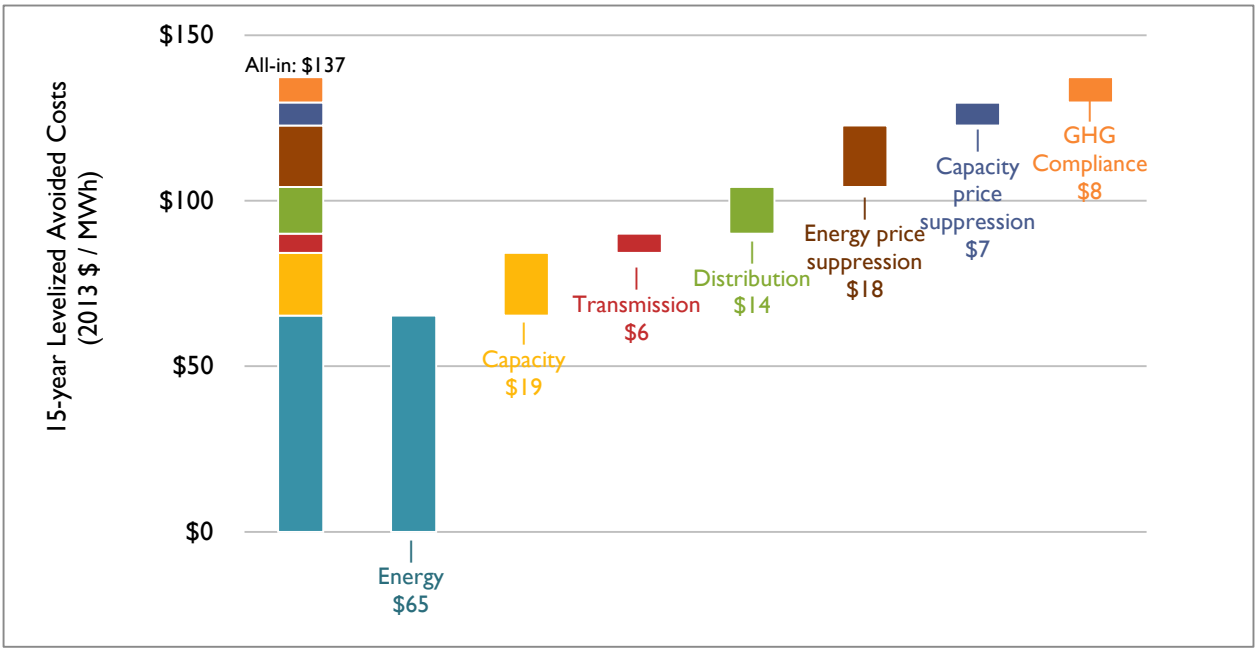
A. Figure 2 presents an overview of the avoided costs that are currently used to screen energy efficiency resources. The avoided costs are put in terms of 15-year levelized $ per MWh, so that they can be compared easily on a consistent basis.[39] The costs are provided separately for avoided energy generation, capacity, transmission, distribution, wholesale market price suppression, and cost of carbon allowances (i.e., RGGI and federal CO_2 allowance prices).[40]

(The estimates of the cost of GHG compliance are presented separately in Figure 2 for illustrative purposes. In AESC 2013, the GHG compliance component is embedded in the avoided energy and avoided energy price suppression cost components. Figure 2 shows the avoided GHG compliance costs as being subtracted entirely from the avoided energy cost component. Separating GHG compliance costs out results in a slight underestimation of the avoided energy cost component and a slight overestimation of the energy price suppression component in Figure 2.)

[39] 15-year levelized costs are the constant unit cost (in $/MWh) that if paid over 15 years would have the same net present value as the total costs over the 15-year lifetime.

[40] Note that the avoided costs presented in Figure 2 only include avoided costs related to the electricity system. They do not include other resource savings, (e.g., water), other fuel savings (e.g., oil) or non-energy benefits (e.g. low-income benefits). These additional benefits are included in the Massachusetts TRC test, but are not included in Figure 2, for simplicity purposes.

Corrected Figure 2. Current Electricity Avoided Costs by Component (15-year levelized)[41]



Q. How do these avoided costs compare with the costs of the energy efficiency programs themselves?

A. Figure 3 presents a summary of the 2012 annual cost of saved energy of the Massachusetts energy efficiency programs, using actual results from the 2012 efficiency reports.[42] Each block in Figure 3 represents one of the energy efficiency programs offered by the Massachusetts Program Administrators. The width of the block along the horizontal axis indicates the amount of energy saved by the program, in MWh. The

[41] Avoided energy, capacity, energy price suppression, and capacity price suppression are taken from AESC 2013 Exhibit EAS-2, Appendix B: MA, Table 1. The 15-year levelized avoided costs of energy, capacity, energy price suppression, and capacity price suppression are calculated as a weighted average of the number of hours that occur in peak- and off-peak winter and summer periods. The levelized cost of GHG compliance ($8/MWh) is then subtracted out of the avoided energy cost ($74/MWh) yielding $65/MWh. The 15-year levelized avoided transmission and distribution costs are taken from AESC 2013 Exhibit EAS-2, Appendix G, Exhibit G-1 and are an average of each company's costs in proportion to retail sales.

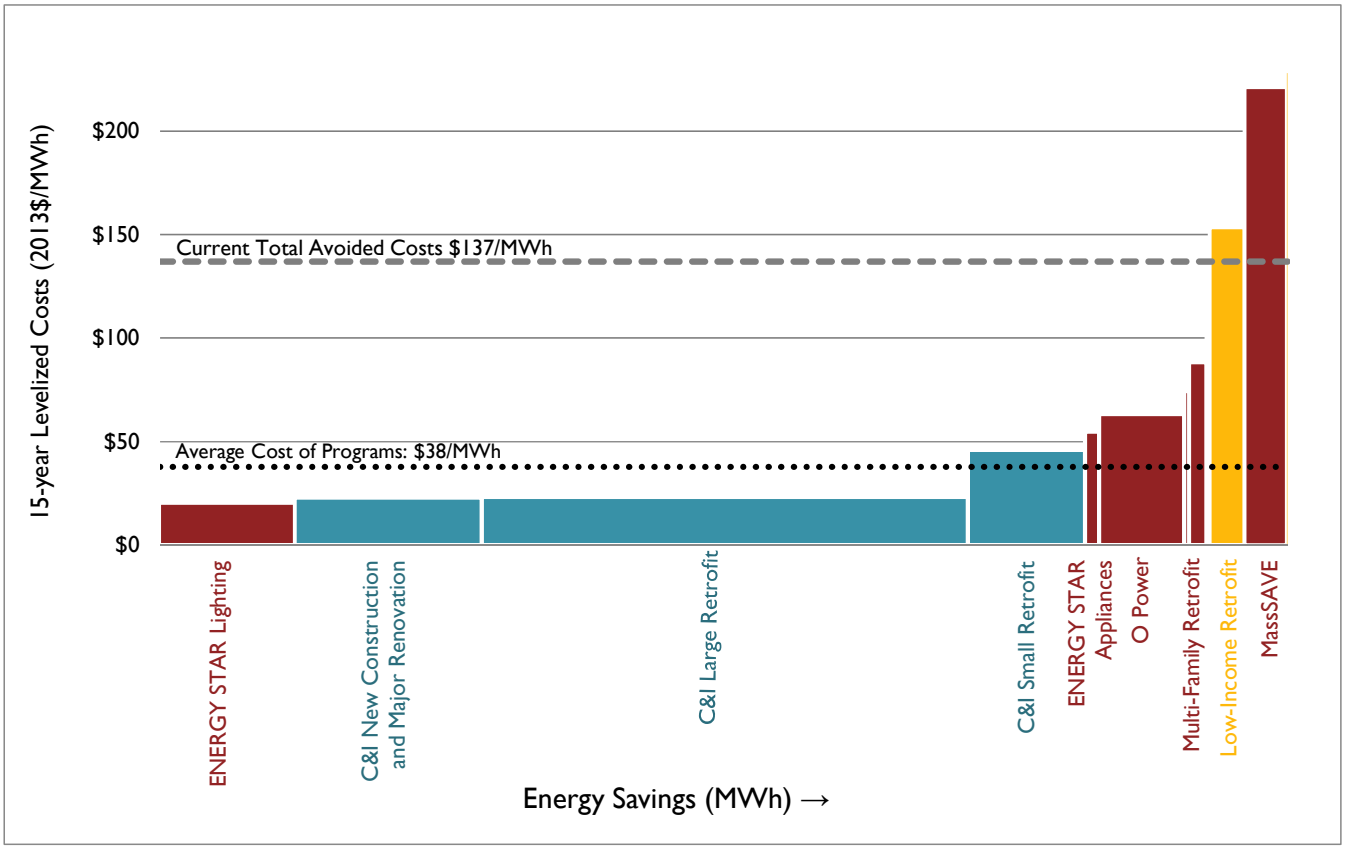
[42] NSTAR 2013. NSTAR Electric Company, *Petition of NSTAR Electric Company for approval of its 2012* Energy *Efficiency Annual Report*, D.P.U. 13-121 (August 1, 2013). Cape Light Compact 2013. Cape Light Compact, *Petition of Cape Light Compact for approval of its 2012 Energy Efficiency Annual Report*, D.P.U. 13-118 (August 1, 2013). WMECo 2013. Western Massachusetts Electric Company, *Petition of Western Massachusetts Electric Company for approval of its 2012 Energy Efficiency Annual Report*, D.P.U. 13-122 (August 1, 2013). Unitil 2013. Fitchburg Gas and Electric Light Company d/b/a Unitil, *Petition of Fitchburg Gas and Electric Light Company d/b/a Unitil for approval of its 2012 Energy Efficiency Annual Report*, D.P.U. 13-119 (August 1, 2013). National Grid 2013. Massachusetts Electric Company and Nantucket Electric Company, each d/b/a National Grid, *Petition of Massachusetts Electric Company and Nantucket Electric Company, each d/b/a National Grid, for approval of its 2012 Energy Efficiency Annual Report*, D.P.U. 13-119, (August 1, 2013).

height of the block along the vertical axis indicates the levelized cost of saved energy of the program, in $ per MWh. Programs presented in blue are commercial and industrial programs; program presented in red are residential programs; and programs presented in yellow are low-income programs.

The average 15-year levelized cost of saved energy for all the programs combined (indicated with the dotted line) is $38 per MWh. This is equivalent to 3.8 cents per kWh.

Figure 3 also presents the 15-year levelized avoided cost without adjusting for GWSA compliance costs (indicated with the dashed line). This includes total avoided costs, including avoided energy, capacity, transmission, distribution, market price suppression and environmental compliance costs. The current avoided cost line in Figure 3 is the same total avoided cost of $137 per MWh presented in Figure 2.

Corrected Figure 3. 2012 Annual Cost of Saved Energy of Massachusetts Energy Efficiency Programs[43]



Note that this graph only includes the electric system avoided costs, which are calculated as benefits in the Massachusetts Total Resource Cost (TRC) test. It does not include the non-energy benefits associated with resource savings (e.g., water savings, oil, propane) or with non-resource benefits such as avoided operations and maintenance costs. Two of the programs appear to cost more than the total avoided cost, but when all applicable benefits are factored in, according to the TRC test, the programs' benefits exceed their costs, and thus they are also cost-effective.

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[43] NSTAR 2013. NSTAR Electric Company, *Petition of NSTAR Electric Company for approval of its 2012 Energy Efficiency Annual Report*, D.P.U. 13-121 (August 1, 2013) Cape Light Compact 2013. Cape Light Compact, *Petition of Cape Light Compact for approval of its 2012 Energy Efficiency Annual Report*, D.P.U. 13-118 (August 1, 2013). WMECo 2013. Western Massachusetts Electric Company, *Petition of Western Massachusetts Electric Company for approval of its 2012 Energy Efficiency Annual Report*, D.P.U. 13-122 (August 1, 2013). Unitil 2013. Fitchburg Gas and Electric Light Company d/b/a Unitil, *Petition of Fitchburg Gas and Electric* Light Company d/b/a Unitil for approval of its 2012 Energy Efficiency Annual Report, D.P.U. 13-119 (August 1, 2013). National Grid 2013. Massachusetts Electric Company and Nantucket Electric Company, each d/b/a National Grid, *Petition of Massachusetts Electric Company and Nantucket Electric Company, each d/b/a National Grid, for approval of its 2012 Energy Efficiency Annual Report*, D.P.U. 13-119, (August 1, 2013).

As indicated in Figure 3, most of the programs are currently well below the total avoided cost ($137 per MWh), and the average cost of saved energy ($38 per MWh) is well below the total avoided cost. Furthermore, the average cost of saved energy ($38 per MWh) is less than the avoided *energy* costs alone ($65 per MWh, as indicated in Figure 2).

Q. Is your recommendation for including GWSA compliance costs in the efficiency screening process conceptually any different from what is currently being done today by the Massachusetts Program Administrators?

A. No. The Department and the Program Administrators have already accepted the need for including forecasted costs of compliance with environmental regulation. The estimates of SO_2, NO_X and RGGI allowances are all based on existing regulations, and they are all forecasts that include some degree of uncertainty. The estimates of an additional CO_2 allowance cost under future federal climate regulations (used by the Massachusetts Program Administrators since 2005) are based on reasonably anticipated future regulations. In fact, the GWSA compliance requirements themselves are more certain than the federal carbon requirements, because they are already in place.

In sum, the Department and the Program Administrators have already accepted the need for including forecasted costs of compliance with environmental regulations. The forecasted cost of GWSA compliance is missing from current practice.

Q. If the Program Administrators already account for the cost of complying with future federal carbon regulations, is it necessary to also account for GWSA compliance costs?

A. Yes. The GWSA requirements are likely to be more stringent than anticipated federal carbon requirements, and therefore are likely to result in higher avoided costs. This is true for several reasons. First, the near-term GWSA requirements are more stringent then the near-term federal requirements. The GWSA and the CECP require that Massachusetts reduce GHG emissions in 2020 by 25 percent relative to 1990 emissions. President Obama has set a 2020 GHG reduction goal of 17 percent relative to 2005 emissions, which is a reduction of roughly 3 percent relative to 1990 emissions.

Second, achieving a given emission reduction goal across the entire United States will naturally cost less than achieving the same goal in a single state. Utilities across the

United States have a wider range of GHG abatement options available to reduce GHG emissions, relative to any single state such as Massachusetts.

Third, political considerations suggest that, at least in the near- to mid-term future, federal GHG requirements are not likely to be as stringent as those in the GWSA and CECP. The GWSA is an existing statute with clear and aggressive GHG reduction goals, while the federal requirements are based on President Obama's goals at a time when the federal government has not expressed unified support for federal GHG requirements. When federal GHG requirements are eventually established, either though United States Environmental Protection Agency regulations or through Congress, they are likely to be less stringent than the GWSA requirements, due to these political considerations.

7. METHODOLOGY FOR ESTIMATING GWSA COMPLIANCE COSTS

Q. Is it feasible to develop reasonable estimates of GWSA compliance costs at this time, given the uncertainties associated with future GHG emissions limits and options?

A. Yes. While the precise magnitude of expected GHG emissions reduction costs is uncertain, it is nonetheless certain that GWSA compliance will require some combination of emissions reduction policies from the electric and natural gas sectors, and that the costs of those policies will eventually be passed on to customers. As the Department has noted in previous dockets, uncertainty as to the exact magnitude of the costs of compliance with environmental requirements does not justify ignoring those costs.[44] Planners in general, and the Program Administrators in particular, have an obligation to make the most accurate forecast possible, using the appropriate methodology and the best information available.

Q. What methodology should be used to estimate GWSA compliance costs?

A. Dr. Stanton's testimony provides a detailed description of the methodology that should be used to estimate GWSA compliance costs. We recommend that a GHG emissions "marginal abatement cost curve" be used to determine the marginal cost of compliance with the GWSA.

[44] D.P.U. 10-54, November 22, 2010.

Q. What is a GHG emissions marginal abatement cost curve?

A. A GHG emissions marginal abatement cost curve is a graphical representation of policies or resources necessary to meet a particular GHG emissions reduction target. Such a curve is constructed by representing each policy or resource necessary to meet the target, in terms of its average cost per unit of emissions reduction (e.g., $ per ton), and its units of expected GHG emissions reductions (e.g., tons). Marginal abatement cost curves present policies or resources from left to right according to their average cost per unit of emissions reduction, from least to most expensive. The marginal cost of compliance is the cost of the most expensive policy needed to achieve the desired emissions reduction target.

One well-known example of using a marginal abatement cost curve for GHG emissions was presented in a report by McKinsey and Company.[45] The methodology used by Dr. Stanton to identify the marginal cost of complying with the GWSA is essentially the same methodology used in that study, but on a smaller scale.

Q. In general terms, what types of policies are available to reduce GHG emissions in the Commonwealth?

A. The CECP identifies GHG emission policies applied to several components of the Massachusetts economy, including the Buildings sector, the Electric Supply sector, the Transportation sector, sources of non-energy GHG emissions, and others. Dr. Stanton's analysis is limited to emission policies available in the Buildings and Electric Supply sectors, because these are generally expected to cost less than those of the other sectors, and energy efficiency resources are most relevant to the policies applicable to these sectors.

The Buildings and Electric Supply sector policies primarily include (1) measures to reduce the end-use of electricity, natural gas, and other fuels through energy efficiency; and (2) measures to decrease the emissions per MWh of Massachusetts' electricity generation. Dr. Stanton develops marginal abatement cost curves that rely upon these

[45] McKinsey & Company, *Reducing US Greenhouse Gas Emissions: How Much at What Cost?,* US Greenhouse Gas Abatement Initiative, December 2007, page xiii.

policies. Her marginal abatement cost curves include, for example, energy efficiency resources, renewable portfolio standard (RPS) Class I and Class II, Clean Energy Performance Standard (CEPS)[46] resources (with and without transmission upgrades), and Clean Energy Imports. Her marginal abatement cost curves include efficiency resources relating to electricity, natural gas, and oil end-uses.

Q. What time periods are addressed by Dr. Stanton's analysis?

A. Dr. Stanton begins with an analysis of the cost of complying with the 2020 GHG emissions limit. The CECP includes 2020 GHG emissions reductions for the Buildings and Electric Supply sectors, as well as the policies and resources needed to meet those reductions.

Dr. Stanton then analyzes the cost of complying with the 2030 GHG emissions limit. This is a logical point in time to analyze, because the Secretary is required to set a specific GHG limit and establish a plan for 2030. To develop the 2030 GWSA compliance costs, Dr. Stanton applies the same overall methodology that is used for 2020 GWSA compliance costs.

Dr. Stanton does not analyze the cost of complying with the 2040 GHG emissions limit. There are relatively few energy efficiency resources that, if installed in the next few years, would have savings well past 2030. Future estimates of GWSA compliance costs should include estimates for the years 2030 to 2040, as that time period becomes more relevant.

Q. What GHG emissions limit does the GWSA require for 2030?

A. The GWSA requires the Secretary to establish a 2030 GHG emissions limit, and to set the 2030 limit in such a way as to maximize the ability of the Commonwealth to achieve its 2050 statewide GHG emissions limit of at least 80 percent below statewide 1990 GHG emissions.[47] The Secretary has not yet established a 2030 GHG emissions limit.

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[46] CEPS is a portfolio standard that provides an incentive for additional clean resources, beyond those required by a Renewable Portfolio Standard. *See A Clean Energy Standard for Massachusetts, Final Report* attached to Dr. Stanton's testimony as Exhibit EAS-4.

[47] M.G.L. c. 21N

Nonetheless, it is appropriate to estimate a 2030 GHG emissions limit for the purpose of forecasting GWSA compliance costs. Dr. Stanton estimates the 2030 GHG emissions limit by making a linear interpolation between the two limits that are known at this time: the 2020 GHG emissions limit and the 2050 GHG emissions limit. Under this reasonable but conservative assumption, the 2030 GHG emissions limit would be a 43 percent reduction below statewide 1990 GHG emissions, which would require a GHG emissions reduction of 40.9 million metric tons of CO_2e.[48]

Q. Given the lack of a specific 2030 GHG emissions limit, is it appropriate to make an estimate of the 2030 GWSA compliance cost at this time?

A. Yes. It is not only appropriate, it is necessary. It is appropriate because the Department has been very clear that uncertainty does not justify ignoring costs or benefits. The Program Administrators have an obligation to make the most accurate forecast possible, using an appropriate methodology and applying the best information available. I believe that using the marginal abatement cost curve methodology and the best information available represents the best approach for estimating the costs of complying with the GWSA.

It is necessary to estimate the 2030 GWSA compliance costs at this time, because the energy efficiency resources implemented in the next several years will operate well past 2020, and thus provide an opportunity to reduce GWSA compliance costs in the years after 2020. To properly capture the value of efficiency programs installed in the next several years, it is necessary to apply estimates of GWSA compliance costs past 2020 and through 2030.

More importantly, energy efficiency savings in the aggregate defer or avoid investments in new supply-side resources, which can last 30, 40, or more years. If energy efficiency resources are undervalued, and thus some remain untapped, this could result in the development of supply-side resources which then become "locked in," making it all the more difficult to comply with future GWSA limits, and increasing costs to electric and natural gas customers.

[48] Testimony of Dr. Stanton, p. 35

This is the main reason why it is so important for the Department to require the Program Administrators to apply an estimate of GWSA compliance cost when screening energy efficiency resources. It will ultimately allow more commensurate comparison of costs between new energy efficiency and new supply-side resources, and in so doing will reduce costs to electric and natural gas customers.

8. RECOMMENDED GWSA COMPLIANCE COSTS

Q. Please summarize Dr. Stanton's findings regarding 2020 GWSA compliance costs.

A. Dr. Stanton estimates that the marginal cost of complying with the GWSA in 2020 is $52 per metric ton of CO_2e. The 2020 marginal abatement cost curve developed by Dr. Stanton indicates that the marginal resource necessary to reach the 2020 emission goal for the Buildings and Electric Supply sectors will be clean energy imports from outside of New England, supported by new transmission lines to bring the imports to New England load centers. These clean energy imports and associated transmission lines are estimated to cost $52 per metric ton of CO_2e in 2020.

Q. Please summarize Dr. Stanton's findings regarding 2030 GWSA compliance costs.

A. Dr. Stanton estimates that the marginal cost of complying with the GWSA in 2030 is $59 per metric ton of CO_2e. The 2030 marginal abatement cost curve developed by Dr. Stanton indicates that the marginal resource necessary to reach the 2030 emission goal for the Buildings and Electric Supply sectors will be clean energy imports from outside of New England, supported by new transmission lines to bring the generation to New England load centers. These clean energy imports and associated transmission lines are estimated to cost $59 per metric ton of CO_2e in 2030.

Q. Please summarize Dr. Stanton's findings regarding GWSA compliance costs for other years, besides the years 2020 and 2030.

A. We provide an estimate of GWSA compliance costs for each year, for the next 20 years (2015-2034).[49] Dr. Stanton recommends the following approach for estimating annual GWSA compliance costs.

- For 2015, the GWSA compliance cost should be based on the linear trend between the most recent RGGI clearing price—$5.30 per metric ton in 2014—as reported in RGGI Auction 25 and the estimated 2020 marginal cost of compliance.[50] This price is equal to $5 per metric ton of CO_2e.
- For the years 2016 through 2019, the GWSA compliance costs should be approximated using linear interpolation between the 2015 and the 2020 cost of compliance.
- For the years 2021 through 2029, the annual values of GWSA compliance costs should be developed using linear interpolation between the 2020 and the 2030 values.
- For the years after 2030, the GWSA compliance costs should be assumed to be equal to the 2030 costs. This is clearly a conservative assumption, as the 2040 GHG emissions limit will be more stringent than the 2030 limit.

The annual GWSA compliance costs resulting from all of these assumptions are presented in Table 1 below.

Q. How should the forecast of GWSA compliance costs be applied to the electricity, natural gas, and oil savings of the efficiency programs?

A. For <u>electricity</u> efficiency savings, the GWSA compliance costs (in $ per metric ton of CO_2e) should ideally be included in the AESC modeling analysis that is used to determine avoided electricity system costs. In the absence of a full AESC modeling analysis at this time, I use a simplistic approach to illustrate how the GWSA compliance

[49] The 2013 AESC study provides estimates of avoided costs for 30 years into the future. It also presents the results in terms of 10-yr, 15-yr and 20-yr levelized costs, starting in 2014. For the purposes of this docket we present estimates for the next 20 years, as well as levelized estimates for the 10-yr, 15-yr and 20-yr periods starting in 2015.

[50] A copy of the RGGI Auction 25 results is attached to Dr. Stanton's testimony as Exhibit EAS-31.

costs (in $ per metric ton of CO_2e) might be converted into electricity terms (in $ per MWh). I assume a New England marginal CO_2 emissions rate of 0.38 metric ton CO_2 per MWh for this purpose, which is the emissions rate for non-cogenerating natural gas in New England.[51] The resulting estimates of GWSA compliance costs in $ per MWh are presented in Table 1.

[51] AESC 2013 Exhibit EAS-2 p. 4-58.

Table 1. GWSA Compliance Costs, 2015 -2030

	2013 $ / metric ton	2013 $ / MWh	2013 $ / therm	2013 $ / MMBtu
2015	$13	$5	$0.07	$1.0
2016	$21	$8	$0.11	$1.5
2017	$29	$11	$0.15	$2.1
2018	$36	$14	$0.19	$2.7
2019	$44	$17	$0.23	$3.2
2020	$52	$20	$0.28	$3.8
2021	$53	$20	$0.28	$3.9
2022	$53	$20	$0.28	$3.9
2023	$54	$21	$0.29	$4.0
2024	$55	$21	$0.29	$4.0
2025	$56	$21	$0.29	$4.1
2026	$56	$21	$0.30	$4.1
2027	$57	$22	$0.30	$4.2
2028	$58	$22	$0.31	$4.2
2029	$58	$22	$0.31	$4.3
2030	$59	$23	$0.31	$4.3
2031	$59	$23	$0.31	$4.3
2032	$59	$23	$0.31	$4.3
2033	$59	$23	$0.31	$4.3
2034	$59	$23	$0.31	$4.3
10-year levelized cost (2015-2024)	$40	$15	$0.21	$3.0
15-year levelized cost (2015-2029)	$46	$1718	$0.24	$3.3
20-year levelized cost (2015-2034)	$49	$19	$0.26	$3.6

For natural gas and oil efficiency savings, the GWSA compliance cost values need to be converted to $ per therm and $ per MMBtu. For this I assume the following emission rates: natural gas (0.0058547 metric ton CO_2 per therm); and oil (0.08069 metric ton CO_2

per MMBtu).[52] The resulting estimates of GWSA compliance costs in are presented in Table 1.

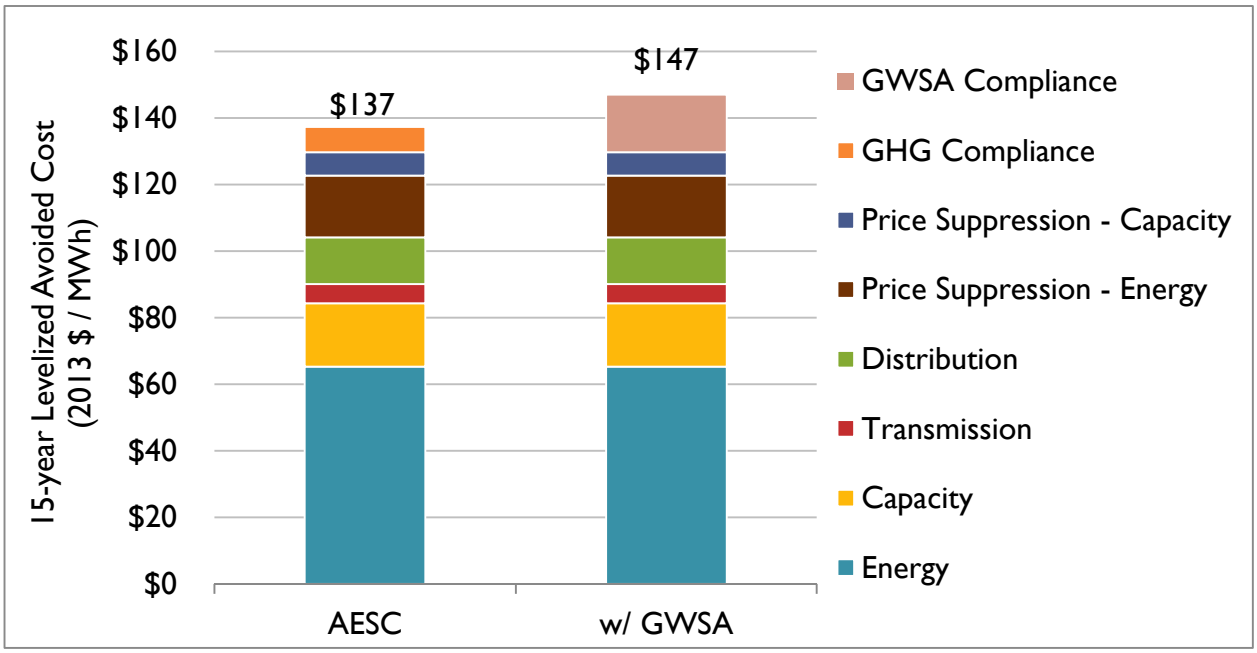
Q. How will these estimates of GWSA compliance costs affect the avoided costs of the energy efficiency programs?

A. First, it is important to note that if Massachusetts meets the GHG emissions limits of the GWSA, then it will also meet the less stringent requirements of RGGI and any future federal CO_2 regulations. Therefore, the current estimates of complying with RGGI and future federal CO_2 regulations should not be included separately in the analysis, once the GWSA avoided costs are adopted, to avoid double counting of compliance costs.

Figure 4 presents the set of levelized avoided electricity costs, both under current assumptions in AESC 2013 and including the proposed GWSA compliance costs. The avoided costs in the bar on the left are the same avoided costs presented in Figure 2 above.

[52] U.S. Energy Information Administration. *Electric Power Annual*. December 12, 2013. Table A.3 "Carbon Dioxide Uncontrolled Emissions Factors." Available here: http://www.eia.gov/electricity/annual/html/epa_a_03.html

Corrected Figure 4. Avoided Costs for Electricity Efficiency Savings (15-year levelized, $/MWh)[53]



Q. Do you believe that these estimates of GWSA compliance costs are reasonable?

A. Yes, I do. First, they were developed using an appropriate methodology, and with the best information available at this time. Second, the results presented in Figure 4 indicate that the GWSA compliance costs are greater than the cost of compliance with future federal regulations, but by an amount that is consistent with what one would expect given the stringency of the GWSA GHG emissions limits.

Q. Is there uncertainty associated with these estimates of GWSA compliance costs?

A. Yes, there is uncertainty in our estimates of GWSA compliance costs, because they are forecasts. It is important to recognize, however, that there are uncertainties associated with many of the estimates used by the Massachusetts Program Administrators to evaluate the cost-effectiveness of energy efficiency resources. There are significant uncertainties inherent in the forecasts of virtually all future prices and costs including

[53] Avoided energy, capacity, energy price suppression, and capacity price suppression are taken from AESC 2013 Exhibit EAS-2, Appendix B: MA, Table 1. The 15-year levelized avoided costs of energy, capacity, energy price suppression, and capacity price suppression are calculated as a weighted average of the number of hours that occur in peak- and off-peak winter and summer periods. The levelized cost of GHG compliance ($8/MWh) is then subtracted out of the avoided energy cost ($74/MWh) yielding $66/MWh. The 15-year levelized avoided transmission and distribution costs are taken from AESC 2013 Exhibit EAS-2, Appendix G, Exhibit G-1 and are an average of each company's costs in proportion to retail sales.

forecasts of natural gas prices, forecasts of power plant retirements in New England, forecasts of new resource development in New England, forecasts of transmission developments in New England, and more. The estimates of GWSA compliance costs are no different in this regard.

Q. Should uncertainty be used as a reason not to include GWSA compliance costs when evaluating the cost-effectiveness of energy efficiency resources?

A. No. Uncertainty associated with forecasts is inherent in planning and regulating electric and natural gas systems. In general, utilities, planners, Program Administrators and regulators must address uncertainty by preparing forecasts using appropriate methodologies and the best information available. The same concept should be used with regard to GWSA compliance costs.

Furthermore, the Department has been clear that uncertainty does not justify ignoring a particular cost or benefit. The Department has already allowed the Program Administrators to use forecasts of RGGI allowance prices and forecasts of future federal CO_2 regulations when screening energy efficiency resources—both of which include considerable uncertainty. The Department has also allowed electric utilities to include uncertain benefits associated with GWSA compliance in evaluating long-term contracts for renewable resources. And the Department has allowed cost-effectiveness analyses of advanced metering plans to include costs and benefits that are uncertain as well. To use uncertainty as a reason to exclude GWSA compliance costs from energy efficiency evaluations would be in conflict with Department precedent and lead to skewed results.

Q. Is there a risk that Massachusetts Program Administrators over-value energy efficiency because of the uncertainty associated with the GWSA compliance costs?

A. There are several factors that mitigate the risk of over-valuing energy efficiency resources. In addition, these same factors indicate that our recommendations are in the best interest of electricity and natural gas customers.

First, the GWSA compliance cost estimates presented here are conservative. Dr. Stanton makes several assumptions that will likely lead the marginal abatement cost curve methodology to underestimate GWSA compliance costs. For example, Dr. Stanton assumes that the Buildings and Electricity Supply sectors will have to account for only 64 percent of the statewide GHG emissions reductions in 2030, as set forth in the CECP for

2020, even though it is widely recognized that these sectors will likely need to account for a greater share of statewide GHG emissions reductions in 2030 than in 2020.

Second, energy efficiency, taken as a whole, is a very low-cost resource. As indicated in Figure 3, the current energy efficiency programs cost approximately $38 per MWh on average; far less than the cost of alternative energy resources. Including some higher-cost energy efficiency measures and programs into this mix will raise the average cost of saved energy, but the average will still be significantly less than current estimates of avoided costs.

Third, energy efficiency offers a variety of benefits to electricity and natural gas customers that are not currently captured in the cost-effectiveness methodologies and assumptions used by the Massachusetts Program Administrators. These benefits for the electricity industry include, for example, reduced system risk, enhanced system reliability, fuel diversity and moderation of system peak requirements. These unaccounted for benefits reduce the risk that Massachusetts Program Administrators will over-value energy efficiency resources.

Finally, and most importantly, it is essential to recognize that there is also a risk of *understating* the GWSA compliance costs, thereby *undervaluing* and *under-investing* in energy efficiency resources. If low-cost energy efficiency resources are not implemented to their full potential to comply with the GWSA, then other more expensive options will be called upon instead. This would lead to higher costs for electric and natural gas utility customers.

The best way to mitigate the risks associated with estimating GWSA compliance costs is to require the Program Administrators to update the estimates of GWSA compliance costs in conjunction with updated avoided cost estimates. This will allow the Program Administrators to develop the best available estimates of GWSA compliance costs and to implement the measures and policies that are most likely to minimize those costs.

9. RECOMMENDATIONS FOR APPLYING GWSA COMPLIANCE COSTS

Q. How should Program Administrators apply these estimates of GWSA compliance costs in their various energy efficiency analyses and plans?

A. I recommend that the Department require the Massachusetts Program Administrators to incorporate these estimates of GWSA compliance costs in all future energy efficiency analyses and plans. Specifically, I recommend that:

- The Department should find that the marginal abatement cost curve methodology is the appropriate methodology for estimating GWSA compliance costs. Furthermore, the Department should require the Program Administrators to use this methodology to estimate future GWSA compliance costs, unless and until a better methodology is identified.
- The Department should find that the GWSA compliance costs presented in Table 1 are the best available estimates of GWSA compliance costs at this time.
- The Department should require the Program Administrators to adopt the GWSA compliance costs presented in Table 1 for the purpose of determining energy efficiency cost-effectiveness.
- The Department should require that the Program Administrators use the GWSA compliance costs presented in Table 1 for all future analyses of energy efficiency cost-effectiveness, until these estimates are updated to account for new information or new developments.
- The Department should require the Program Administrators to periodically update the GWSA compliance cost estimates to account for new information or new developments.
- The Department should require the Program Administrators to apply the most recent GWSA compliance costs in all future reports and analyses, including Annual Energy Efficiency Reports, Three-Year Energy Efficiency Investment Plans, and other analyses that include cost-effectiveness calculations.

Q. Does this conclude your direct testimony?

A. Yes, it does.