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Energy Efficiency Services Sector: Workforce Size and Expectations for Growth

Technical Appendix

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Environmental Energy Technologies Division

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Appendix A. Interview Protocols

Appendix A includes surveys that were used in our interviews with Program Administrators (PA) and representatives of Building and Construction Trade (BCT) Associations. We interviewed 38 Program Administrators; a slightly modified version of this survey was also used with 34 Program Implementation Contractors.[1] We used the BCT Association survey in our interviews with 186 professional and trade association members in 11 states as well as representatives from trade unions representing the construction trades.

A.1 Program Administrator survey

1. How would you describe your organization?
    a. Investor owned utility
    b. Publicly owned utility
    c. For-profit company administering EE programs
    d. Non-profit organization administering EE programs
    e. State agency that administers EE programs
    f. Program implementer (3rd party)
    g. Other (please specify)________________________

2. In what sectors do you administer and offer energy efficiency programs?
    a. Residential
    b. Low income
    c. Commercial
    d. Industrial
    e. Agricultural
    f. All of the above

3. Does your organization also offer and administer load management or demand response programs?
    a. Yes
    b. No
    c. Don't know

4. Comments on above question

5. Will you send a copy of your organization chart for your EE group?
    a. Yes
    b. No
    c. Don’t have one

Savings goals

6. What are your 2007 EE program savings goals (MWh) for <u>all of your EE programs</u>?

[1] This includes firms that do energy efficiency program evaluation.

7. What is the time period for achieving all of your 2007 EE program savings goals?

8. Could you tell me your 2007 EE program savings goals (MWh) for residential?

9. What is the time period for achieving the residential program savings goal?

10. Could you tell me your 2007 EE program savings goals (MWh) for commercial?

11. What is the time period for achieving the commercial program savings goal?

12. Could you tell me your 2007 EE program savings goals (MWh) for industrial?

13. What is the time period for achieving the industrial program savings goal?

14. What percent of C&I is actually small commercial?

Savings budget

15. Energy Efficiency Budget

Total EE budget __________
Incentive budget __________

16. Specific Budgets

a. Residential EE program budget __________
b. Low income EE program budget __________
c. Commercial and Industrial EE program budget __________
d. Other EE program budget __________

17. What percent of your total 2007 savings is achieved from implementation contractors, consultants, or other outsourced services?

Current Labor Force

18. Thinking about the total number of people working on energy efficiency in your organization, about how many staff work part time on EE and about how many are full time on EE? For instance, customer account representatives often work on energy efficiency part of their time, but not fulltime.

a. # of full time EE employees __________
b. # of part time EE employees __________
c. # contract employees for EE __________
d. Total employees working on energy efficiency __________

19. How many FTEs does your organization actually have to administer and manage EE programs that target C/I customers?

20. How many FTEs does your organization actually have to administer and manage EE programs that target residential customers?

21. Program administrator (FTEs for all of EE)

a. Management—organizational management (the people managing the EE department in a utility or large consulting firm; or entire organization like NEEA or PECI)	__________
b. Program planning, design, and budgeting—the activities to get a program into the program portfolio	__________
c. Program evaluation/market assessment—research done to improve program design and implementation (pre or post)	__________
d. Program implementation: management and administration—the program managers and lead staff, e.g., for a commercial lighting program or new construction program	__________
e. Program implementation: technical services (field work)—field staff (auditors, installers, verifiers)	__________
f. Program implementation: marketing—marketing for a specific program or for an energy efficiency brand (e.g., BetterBricks)	__________
g. Program support/incentive processing—reviewing and data entry of application data, incentive processing	__________
TOTAL	__________

22. Indirect - How many FTEs in your organization support the DSM/EE group (lawyers, contracting, IT)?

23. Third party contractors - I would like your estimate of FTEs employed by third party contractors/implementers that provide EE services under your programs.

a. Management—organizational management (the people managing the EE department in a utility or large consulting firm; or entire organization like NEEA or PECI)	__________
b. Program planning, design, and budgeting—the activities to get a program into the program portfolio	__________
c. Program evaluation/market assessment—research done to improve program design and implementation (pre or post)	__________
d. Program implementation: management and administration—the program managers and lead staff, e.g., for a commercial lighting program or new construction program	__________
e. Program implementation: technical services (field work)—field staff (auditors, installers, verifiers)	__________
f. Program implementation: marketing—marketing for a specific program or for an energy efficiency brand (e.g., BetterBricks)	__________
g. Program support/incentive processing—reviewing and data entry of	__________

application data, incentive processing
TOTAL __________

24. Comments on above question

25. What fraction of the FTEs working on EE in your organization do you expect to retire within the next 5 years?

26. What fraction of the FTEs working on EE in your organization do you expect to retire within the next 10 years?

27. What are your plans for replacing staff as your current EE energy services workforce retires?

28. When energy efficiency services positions open, has your organization generally been able to
    a. Fill positions from within
    b. Use contractors
    c. Fill positions through an open hiring process
    d. Other (please specify)

29. Comments on above question

30. Is there any difference in your ability to fill positions between residential EE programs and commercial/industrial EE programs? (e.g., easier, harder, about the same, time to train is shorter or longer)

31. What types of engineers are you typically most interested in hiring for energy efficiency work?

	Yes	No
a. Energy engineers	☐	☐
b. Mechanical engineers	☐	☐
c. Electrical engineers	☐	☐
d. Other engineers	☐	☐

32. Comments on above question

33. Do you hire engineering technicians with Associates degrees? (Probe for specific positions)

34. For each of the DSM/EE categories we talked about earlier, what types of skills do you look for? (probe for details and qualifications)

    a. Management—organizational management (the people managing the EE department in a utility or large consulting firm; or entire organization like NEEA or PECI) __________

    b. Program planning, design, and budgeting—the activities to get a program into the program portfolio __________

c. Program evaluation/market assessment—research done to improve program design and implementation (pre or post) __________
d. Program implementation: management and administration—the program managers and lead staff, e.g., for a commercial lighting program or new construction program __________
e. Program implementation: technical services (field work)—field staff (auditors, installers, verifiers) __________
f. Program implementation: marketing—marketing for a specific program or for an energy efficiency brand (e.g., BetterBricks) __________
g. Program support/incentive processing—reviewing and data entry of application data, incentive processing __________

35. Is there any difference in your ability to hire staff to work in one of these categories as compared to the others? What are the most difficult positions to fill?

36. Are there particular positions that have EE skill requirements (probe for difference between commercial, industrial, and residential)?

37. What types of jobs do not require specialized skills related to EE (e.g. database, technical skills, etc)?

38. When you have vacancies that require EE skills, how long does it typically take you to find qualified applicants who accept the position?

39. Are there any fields, industries, or educational backgrounds that seem to be particularly fruitful for producing qualified applicants for your DSM/EE positions? If yes, what are those fields and for what types of DSM/EE positions?

Training

40. Are there training requirements for EE energy services staff in your organization?
    - a. Yes
    - b. No
    - c. Not Sure
    - d. Other (please specify)

41. What type of training programs or classes do your employees attend to build the skills needed for providing energy efficiency services for C&I?

	41. What type of training….			42. What was the quality of each training on a scale of 1-10 with 1 being poor and 10 being excellent?										
	Yes	No	Not sure	N/A	1	2	3	4	5	6	7	8	9	10
a. On the job	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
b. Sending people to conferences	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
c. Short/brief in-person training	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

(brown bag)														
d. Webinar training (workshop)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
e. Mentoring program	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
f. In-person/on-site training (workshop)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
g. Community or technical college	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
h. Certified training (AEE training, BOC training, ASHRAE, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
i. Association training, no certificate - AESP, etc.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
j. Other	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

43. For any training that is rated as 7 or higher on quality, identify where it is and what was done if possible.

a. On the job __________
b. Sending people to conferences __________
c. Short/brief In person training (brown bag) __________
d. Webinar training (workshop) __________
e. Mentoring __________
f. Webinar training (brown-bags) __________
g. In-person on site training (workshop) __________
h. Community or Technical College __________
i. Certificated training (AEE training, BOC training, ASHRAE, etc.) __________
j. Association training, no certificate – AESP, etc __________
k. Other __________

Future Budget and Staffing Needs

We want to explore how you will provide EE services going forward, particularly if EE

budgets increase or you have higher savings goals.

44. How does your 2008 EE budget for Commercial Industrial markets compare to your 2007 budget that we discussed earlier? (Provide increase or decrease in % terms)

45. When will your next funding cycle begin and for how long will it last? (Year and duration e.g. 2010-2012).

46. What do you estimate your overall energy efficiency budget will be in that funding cycle?

47. What percent of the overall EE budget do you think will be allocated to….?
    a. Commercial services ________
    b. Residential services ________
    c. Industrial ________
    d. Other________

48. Has your state legislature or PUC set any long-term energy efficiency goals, or are such goals under discussion? The goals might be spending (budget increases) on energy efficiency, kWh savings, reduction in sales, or reduction in projected load growth.
    a. Yes; EE goal has been set
    b. Yes; EE goal is under discussion
    c. No; EE goal has not been set or discussed

49. What is the funding cycle period for this long-term energy efficiency goal (e.g. 2009-2015)?

50. What is the legislature or PUC's goal? Is it a…

    a. budget based goal ________
    b. kWh savings based goal ________
    c. reduction in sales based goal ________
    d. reduction in load growth based goal ________
    e. some other goal ________

51. What impact will this new goal have on your EE/CI staffing needs and how will you meet that need? (Probe for how many jobs and what types of jobs (engineers, evaluators, etc.). What skills will the new staff need?)

The next questions (Q52-Q55) assume that a long-term goal is developed, I have two types of goals that could be set: a budget based and a savings based goal. I would like to know how your staffing needs would increase if the legislature or PUC adopted...

52. …a 50% increase in EE budget ($) for next funding cycle. (Probe for how many jobs and what types of jobs (engineers, evaluators, etc.). What skills will the new staff need?)

53. …a 100% increase in EE budget ($) for next funding cycle. (Probe for how many jobs and what types of jobs (engineers, evaluators, etc.). What skills will the new staff need?)

54. How would your staffing needs be affected if the legislature or PUC adopted a savings based goal of: 1% reduction in sales (kWh) by 2015. (Probe for how many jobs and what types of jobs (engineers, evaluators, etc.). What skills will the new staff need?)

55. How about a 2% reduction in sales (kWh) by 2015. (Probe for how many jobs and what types of jobs (engineers, evaluators, etc.). What skills will the new staff need?)

56. Do you anticipate increasing, decreasing, or not changing the amount of outsourcing you currently do to third party contractors and consulting firms to achieve energy efficiency goals for 2010?
    a. Decrease
    b. Increase
    c. Not change allocation
    d. Don't know
    e. Other (please specify)

57. Comments on above question

58. Are there any EE services that you would like to offer for which you do not have staff or contracted staff to perform?

59. What types of skills, tools, services etc would be needed in order to provide this service?

60. Is there anything else that you‘d like to add to further our effort to estimate future workforce needs in the EE services industry?

A.2 Building and Construction Trade survey

1. What states does this association operate in (check all that apply)
    a. CA
    b. CT
    c. IA
    d. IL
    e. MA
    f. MD
    g. NJ
    h. NY
    i. TX
    j. WA
    k. WI
    l. National

2. How many organizations or companies does your chapter represent?

3. How many individuals does your chapter represent? For instance, you may have 50 member organizations and we are interested in how many people those 50 organizations have, plus any people that may have individual memberships

4. Comments on question above.

5. How many members -individuals - do you have in each of the following states?

   a. CA ___________
   b. CT ___________
   c. IA ___________
   d. IL ___________
   e. MA ___________
   f. MD ___________
   g. NJ ___________
   h. NY ___________
   i. TX ___________
   j. WA ___________
   k. WI ___________
   l. National ___________

6. About what percent of your members would you say are under 30 years old in each of the following states?

   a. CA ___________
   b. CT ___________
   c. IA ___________
   d. IL ___________
   e. MA ___________
   f. MD ___________
   g. NJ ___________
   h. NY ___________
   i. TX ___________
   j. WA ___________
   k. WI ___________
   l. National ___________

7. And about what percent of your members are over 50 years old in each of the following states?

   a. CA ___________
   b. CT ___________
   c. IA ___________
   d. IL ___________
   e. MA ___________
   f. MD ___________
   g. NJ ___________
   h. NY ___________
   i. TX ___________
   j. WA ___________
   k. WI ___________
   l. National ___________

8. Have you noticed any changes in your membership in the last 5 years (probe for demographic changes, different groups interested in membership, increase or decrease in membership)?

9. We are interested in the size of the market for your member's services and products. Can you estimate the total annual revenue of your membership? (Note we need to know whether they are talking about their specific region, nationally, state, etc. We want them to tell us about their region).

10. What motivates people to request your member organizations services and products? (Please briefly describe the drivers of the market demand for your members' services and products: What benefits are consumers seeking?)

11. Does energy efficiency have a…
    a. …dominant influence on your member's activities compared to the others things that they do?
    b. …moderate influence on your member's activities compared to the others things that they do?
    c. …minimal influence on your member's activities compared to the others things that they do?
    d. …no role whatsoever.

12. To the best of your knowledge, what percent of your members have actual hands-on experience designing and installing jobs/projects that involve energy efficient technologies or measures?
    a. None
    b. 1-20%
    c. 21-40%
    d. 40-60%
    e. 61-80%
    f. 81-99%
    g. 100%

13. To the best of your knowledge, what percent of your members have knowledge of energy efficiency (e.g. high efficiency technologies, measures, and methods to install them)?
    None
    a. 1-20%
    b. 21-40%
    c. 40-60%
    d. 61-80%
    e. 81-99%
    f. 100%

14. Comments on question above

15. Please complete the following sentence. On average, energy efficiency related work comprises ____________% of your members business.

16. Are there utility rebate or energy conservation programs available for your members or their customers to use to help with projects?

   a. Yes
   b. No
   c. Not Sure

17. Would you say that all, most, some, or very few of your members use the utility rebates or energy conservation programs to help sell products and services?
   a. All
   b. Most
   c. Some
   d. Very few
   e. None
   f. Other (please specify)

18. Is your organization working with utilities or other energy-efficiency program administrators in the design and planning of energy efficiency programs? (Are your members "on the team" that creates EE programs).
   a. Yes
   b. No
   c. Not Sure

19. Would you say that customers are requesting more, about the same, or fewer energy efficiency upgrades than they did 2 years ago?
   a. Customers are requesting more energy efficiency upgrades than they did 2 years ago.
   b. Customers are requesting about the same number of energy efficiency upgrades as they did 2 years ago.
   c. Customers are requesting fewer energy efficiency upgrades than they did 2 years ago.
   d. Other (please specify)

20. What percent of your members do you think would benefit from energy efficiency training?
   a. None
   b. 1-20%
   c. 21-40%
   d. 40-60%
   e. 61-80%
   f. 81-99%
   g. 100%

21. Do you know where your members would get energy efficiency training? (check all that apply) (do not read list)
   a. Technical schools
   b. Your association
   c. Another association
   d. College or community college
   e. Other (please specify)

22. Is there any effort to increase the energy efficiency experience and knowledge within your trade/professional group?
   a. Yes
   b. No
   c. Don’t know

23. Is your association
    a. currently encouraging or offering training in energy efficiency
    b. planning to offer training
    c. considering offering training in efficiency
    d. Other (please specify)

24. Which of the following training activities does your local or national organization offer to enhance the energy efficiency knowledge and skills of your members? (choose all that apply)
    a. Include energy efficiency in association conferences
    b. Short/brief in-person training (brown bag)
    c. Webinar training (workshop)
    d. In-person/on-site training (workshop)
    e. Developed certified training
    f. Work with other organizations to develop training
    g. Other (please specify

25. Has your association identified specific skill sets likely to be required for meeting future labor needs related to energy efficiency?
    a. Yes
    b. No
    c. Don't know

26. Comments on question above

27. Does your organization have curriculum materials on energy efficiency technologies?
    a. Yes
    b. No
    c. Don't know

28. Does your organization have curriculum materials on the practical application of energy efficiency solutions?
    a. Yes
    b. No
    c. Don't know

29. Does your organization have access to:
    a. A large pool of qualified EE trainers
    b. Just enough EE trainers for current needs
    c. Not many qualified EE trainers
    d. Other (please specify)

30. [If a large pool or just enough] Whom do you rely on for training/teachers? [Probe to learn if own members, educational/training institutes, other]. If not many or other, what has been your experience? [Probe also to see if this is a national problem or if it is more acute in their regions/areas.]

The next questions are about your current projections for growth in the energy efficiency aspects of your trade or profession.

31. Between now and the end of 2010 do you anticipate that…
    a. Energy efficiency will become a larger share of your members' business.
    b. Energy efficiency will continue at about the same level for your members' business.
    c. Energy efficiency will become a smaller share of your members' business.
    d. Energy efficiency is all we do so it cannot become a larger share of the members business.
    e. Other (please specify)

32. Energy efficiency funding available from utilities and public sources is likely to increase by 2015, and possibly even double or triple by that time. What effect do you think a 50% increase in funding for energy efficiency in your state or states you serve would have on the members of your association? Would you say…
    a. Energy efficiency will become a larger share of your members' business.
    b. Energy efficiency will continue at about the same level for your members' business.
    c. Energy efficiency will become a smaller share of your members' business.
    d. Other (please specify)

33. Can you estimate the percent increase in their business that would result from a 50% increase in funding for energy efficiency? _________________%

34. What effect do you think a 100% increase would have? Would you say…
    a. Energy efficiency will become a larger share of your members' business.
    b. Energy efficiency will continue at about the same level for your members' business.
    c. Energy efficiency will become a smaller share of your members' business.
    d. Other (please specify)

35. Can you estimate the percent increase in their business that would result from a 100% increase in funding for energy efficiency? _________________%

36. Comments on questions above

37. Where do your member organizations recruit new employees? (probe for trade schools, universities, unions, ex-military, etc)

38. Would you recommend anyone else we should contact about these issues - either inside or outside of your industry?

39. Is there anything that you'd like to add?

Appendix B. Accounting for the Employment Impacts of Economic Activity

Appendix B describes factors and approaches typically used by economists in estimating the net employment impacts of economic activity.

In Table B- 1, we list factors that economists often attempt to account for in estimating *net* employment impacts, indicate the factor's potential direction (positive or negative) on the size of the EESS workforce, give examples that are specific to the EESS, and indicate whether our study accounts for this effect in our estimate of the size of the EESS workforce.

Direct effects are employment impacts that occur in meeting the demand for a product or service (e.g., jobs created at an ESCO that develops energy efficiency projects).

Indirect effects describe employment impacts that occur as the supplying industries increase output in order to accommodate the increased activity of those firms directly meeting the change in demand (e.g., jobs created in the financial and legal sectors to support increased ESCO activity).

Induced effects are employment impacts generated by the spending on consumer goods and services of households who benefit from the additional income or profit they earn through increased direct and indirect activity.

In this study, we do not capture indirect or induced effects, yet see our discussion of substitution effects, below. A recent study of the Connecticut energy efficiency workforce estimated indirect effects related to worker and firm spending at 1.6 indirect jobs per direct job (Connecticut Clean Energy Fund 2009). [2]

Leveraging effects

In accounting for employment impacts from energy efficiency program spending, it is also important to recognize that most programs require customers and businesses to contribute a portion of the cost of high-efficiency equipment, in addition to financial incentives offered by the administrator. Thus, energy efficiency programs may leverage additional spending by customers and energy efficiency programs have employment impacts greater than suggested by the program administrators' budgets. We call these leveraging effects in Table B- 1and attempt to capture them in our estimates of the EESS spending and workforce size.

Other Induced effects

Other additional effects result from a characteristic unique to energy efficiency: energy efficiency lowers the cost of the *services* provided by energy such as comfortable indoor temperature or refrigerated food or the creation of a product. The demand for these services is fairly price-inelastic, especially for residential consumers, and the energy-cost savings result in increased income for consumers and increased profit for businesses that they can spend on other

[2] Most input-output models used to estimate net employment impacts tally three indirect and induced effects from changes in 1) worker spending, 2) firm spending, and 3) government spending of tax revenues.

goods (creating additional induced effects). In the commercial and industrial markets, energy efficiency activity also has the potential to retain jobs in the U.S. that might otherwise be lost or relocated in other countries. We do *not* quantify these additional induced effects in estimating the size of the EESS.

Leakage effects

Economists also identify employment “leakage,” as some of the jobs created will be located in neighboring states or countries. One of the economic advantages of investments in energy efficiency is that the leakage is comparatively low; energy efficiency is a relatively labor-intensive industry and it is primarily jobs associated with manufacturing that are moved offshore. Our study does not quantify leakage.

Substitution effects

Many proposed economic activities may be full or partial substitutes for existing economic activity. In some cases, the proponents of the economic activity frequently do not tally these effects. However, it is important to account for s***ubstitution effects*** in estimating net employment impacts. For example, the employee hired to sell hammers at a big-box store substitutes for the employee who lost a job at a local hardware store.

Direct substitution effects that would offset direct employment gains from energy-efficiency program administrator spending are small for ***new*** categories of equipment and services. For example, home performance specialists offer households a new service and do not substitute for the services of the furnace or insulation installer. The activities of home performance specialists may also generate increased spending on furnaces and insulation. Direct substitution effects are also small to the extent that program-administrator spending results in the early retirement of equipment and facilities. Early retirement accelerates a purchase and thus increases economic activity.

We believe that direct substitution is an issue for some sub-sectors of the EESS. One of our critiques of other “green jobs” studies is that they do not appear to consider substitution effects. To partially address this issue, we decided not to include jobs directly involved in the manufacture and distribution (including retail sales) of energy efficiency products and equipment in our estimate of EESS workforce size. We took this approach in part because we believe that most of the positive direct employment effects for firms that manufacture (or distribute) energy efficient equipment due to increased spending on high-efficiency equipment would likely be offset by negative substitution effects (e.g., loss of manufacturing jobs for less efficient products).

Energy efficiency activity also has the potential to generate indirect substitution effects to the extent that they enable postponement of investments in new energy generation infrastructure, such as resource extraction and refinement, electricity generation, natural gas and electricity transmission and distribution. However, the energy production and distribution sector has a lower labor-to-capital ratio than most other sectors of the economy. Public utilities and oil and gas extraction generate fewer jobs per million dollars of output than are generated by the typical consumer spending choices (Northwest Territories Bureau of Statistics 2007). Thus, any job loss due to the indirect substitution effects of increased spending on energy efficiency is likely to be less than the jobs gained through its positive indirect effects as consumers and business spend less on energy and more on goods and services with comparatively higher labor-to-capital ratios.

Table B- 1. Factors determining economy-wide changes in employment

Employment Impacts	Definition as applied to the EESS: *The number of person-years of employment…*	EESS Examples	Estimated in this study?
Direct Effects (+)	*… needed to satisfy a given amount of spending on energy efficiency*	EESS jobs as illustrated in Figures 3.1, 3.2, 3.3, and 3.4 of main report	Yes with exceptions noted in Figure 3.1.
Leveraging Effects (+)	*…needed to satisfy the market spending on EESS that would not have occurred in the absence of public sector spending and government policies*	Rebates, tax credits, and efficiency codes are all intended to stimulate a higher level of market activity than would occur in their absence	Yes
Substitution Effect – Decrease in jobs associated with manufacture of standard equipment (-)	…jobs *associated with standard products/equipment applications that have been replaced by installation of high efficiency equipment/products*	Sales of incandescent lights fall as the saturation of long-life energy efficiency lights (CFLs, LEDs) rises	Partially
Substitution Effect – Potential decrease in energy supply-side jobs (-)	*…associated with resource extraction and power/ energy production and delivery offset by high efficiency*	Strategic energy efficiency investments can postpone the need for supply-side energy infrastructure investments	No
Indirect Effects – From EESS Firms' Spending (+)	*…needed to provide the goods and services inputs to EESS firms*	Jobs in other sectors are supported to supply the increased activity of EESS firms,	No
Induced Effects – From EESS Workers' Spending (+)	*…needed to provide the goods and services consumed by workers in and owners of EESS firms*	Jobs in other sectors are supported when workers in and owners of EESS firms spend their incomes on other goods or services	No
Indirect Effects – Income Effects from Consumer's EE Investments (+)	*…needed to satisfy consumers' spending of income that previously went toward inefficient energy consumption*	Consumers and businesses spend less on energy than they would in the absence of the energy efficiency investment and are able to increase their purchases of other goods and services	No
Indirect Effects – Profit & Job Retention Effects from Business Investments in EE (+)	*…associated with the increase in business profitability and competitiveness*		
Leakage Effects (-)	*…that occur outside the region of interest*	Jobs associated with the manufacture in Japan of ductless heat pumps installed in the U.S.	No

Appendix C. Approach Used to Estimate Spending and Employment in the Energy Efficiency Services Sector

Appendix C describes the methodology used to estimate current and projected spending and person-years of employment for each of the sub-sectors within the Energy Efficiency Services Sector (EESS) that are included in this study.

C.1 Summary of Methods

C.1.1 Background Notes on Constant vs. Nominal Dollars

We derived estimates of person-years of employment (PYE)[3] from constant-dollar budgets and revenues (expressed in 2008 dollars). Yet the graphical presentations in the body of the report depict spending in terms of nominal dollars for future years (e.g. 2010, 2015, 2020). We use the Energy Information Administration Annual Energy Outlook (AEO) 2008 reference case forecast of the GDP chain-type price index. The index sets year 2000 = 1; year 2008 = 1.22; year 2010 = 1.26; year 2015 = 1.38; and year 2020 = 1.52—that is, $1 in 2000 purchases goods and services anticipated to cost $1.52 in 2020.[4]

We typically defined the base year as calendar year 2008. However, in some cases, the most current data available were from 2007 or a Fiscal Year cycle. For example, the federal fiscal year 2007 begins in the fourth quarter of 2007 and extends through the third quarter of 2008. Moreover, some of our interviews with program administrators occurred in 2008 and they provided their most recent program year expenditures (i.e., 2007) rather than 2008 program budgets. Finally, when asked about their staffing levels, some program administrators knew the number of staff at the time of our conversation, while others needed to obtain the information from organizational charts or staff directories, some of which were published in 2007.

C.1.1 Summary of Methods: Energy Efficiency Services Sector spending and workforce in 2008

Table C- 1 provides an overview of our data sources and methods used to estimate current budgets and workforce for the Energy Efficiency Services Sector (EESS).

[3] This study estimates person years of employment (PYE), which equals one person working full time in the EESS for a year. This is different from total number of employees, which can include people who either work part time or just work part time on EESS-specific activities. Many employees in the EESS only work part time or spend only a fraction of their full-time job providing energy efficiency services. For example, employees of a heating contractor may spend 20% of their time installing high-efficiency furnaces and 80% of their time installing conventional furnaces. We only count the fraction of that person-year that is spent on installing high-efficiency products in our estimates of EESS workforce size.

[4] We obtained these estimates of inflation for Annual Energy Outlook 2008 by accessing the Energy Information Administration (EIA) website in February 2009. EIA subsequently revised these data slightly downward, perhaps as a result of the economic downturn. As of November 18, EIA estimated the 2020 index at 1.50.

Table C- 1. 2008 EESS Budgets and Workforce Estimates: Data and Methods

Budget Data and Methods	Workforce Data and Methods	Parameter Estimates Developed from Data and Methods
Low Income Weatherization		
Obtained 2007 budget data (NASCSP 2007) for 11 states and national for DOE, LIHEAP, and "other." Removed from the Other category estimates of program administrator low-income budgets (CEE 2007)	Developed estimate of person-years employment (PYE) per $ million of funding from a re-analysis of detailed survey data collected and analyzed for Massachusetts low income weatherization activity (New England Clean Energy Council 2009)	Person-years of employment (PYE) per $1M funding: 8.9
Federal (DOE) and State Energy Efficiency Programs		
Obtained 2008 budget data from EERE website; selected EE program components (and excluded low income weatherization)	Used FY 2010 DOE EERE Budget data on actual FTE and applied percent of programs that were EE to total FTE (U.S. OMB 2009). Obtained 2008 efficiency workforce data for state energy offices from NASEO 2009 study.	Percent of DOE-EERE program expenditures for energy efficiency: 14%
Public Utility Commission		
Not possible to identify PUC budget (or staff) devoted to oversight of energy efficiency programs; typically represents a small part of total PUC activities.	Conducted brief survey in 2009 of utility commissions in 11 states; spoke with key contacts; staff estimate too small, with too large an error band, to warrant including in the analysis	Not available
Program Administrator (PA)		
Obtained 2007 budget data from interviews with 39 PAs. Aggregated administrator data by state for 11 states. Budgets for non-respondents' in the 11 states estimated as difference between surveyed responses for a state and CEE 2007 state totals. Obtained budgets for remaining 39 states from CEE (2007a)	Workforce data for 2007/2008 provided by interviewed program administrators. Conducted regression analysis of workforce on budget. Used regression to estimate workforce of non-respondents. For 39 non-surveyed states, assumed FTE in relation to budget is on the low side; proxied with data from the surveyed states with the lowest FTE to budget ratio	See Appendix C-7 for description of regression analysis. For CT, NJ, NY, MA, and MD regression yielded 0.71 PA FTE per $1M PA budget. For CA, IA, IL, TX, WA, and WI: regression yielded 1.83 PA FTE per $1M PA budget. Values applied to non-respondents according to their state. For 39 non-surveyed states, used 0.69 PA FTE per $1M PA budget
Program Implementation Contractor (PIC)		
Used PA budgets as described above	Workforce data for 2008 provided by 23 interviewed program implementation contractors and 11 efficiency program planning and evaluation consultants. Used respondents'	[NA]

	estimates of percent of work done in each of 11 states to allocate staff by state.	
Program Support Contractor (PSC)		
Used PA budgets as described above. Used respondents' estimates of incentive budgets. Calculated un-weighted average of proportion of budget going to incentives and all other costs	Workforce estimates for CA, IA, NY, and WA based on prior program evaluations conducted by Research Into Action. Estimated for remaining states as equal to 50% of the size of the program implementation contractor workforce. Corroborated validity of assumptions by estimating total PA budget needed to cover PA, PIC, and PSC and verified outcome was consistent with survey data on proportion of budget *not* allocated to incentives	Assumed budget per FTE at $125,000 (includes fully loaded employment costs plus organization overhead) Un-weighted average of proportion of PA budgets constituted by incentives: 53% Proportion of PA budgets constituted by all other costs: 47%
Building and Construction (B&C) Trades implementing Ratepayer-funded Activity		
Used PA total and incentive budgets reported by respondents, as described above. Used average proportion of budgets going to incentives. Interviewed key informants on average proportion of incentive cost to total EE project cost. Estimated ratio to convert from incentives to total project costs. Used Connecticut data (Connecticut Clean Energy Fund 2009) and key informants for allocating project costs into labor and equipment components. Estimated labor's share of total project cost.	Used Connecticut data (Connecticut Clean Energy Fund 2009) and BLS Occupational Code 472130 (insulation) data on average organization revenues per FTE (U.S. Census Bureau 2002). Re-analyzed Connecticut data, corroborated with BLS data, and estimated average revenues per FTE. Estimated person-years of B&C trades employment associated with labor's share of total project cost, as driven by PA budgets.	Proportion of PA budgets constituted by incentives: 53% Average proportion of *total* (note: not incremental) EE project cost covered by incentive: 33% Labor's share of total EE project cost: 60% Revenues per FTE: $100,000 (includes fully loaded employment costs plus organization overhead).
ESCOs		
Used Hopper et al. (2007) estimates of 2006 ESCO revenue attributable to energy efficiency and respondents' forecast of growth in revenues to estimate 2008 revenues.	Workforce data for 2008 provided by 9 interviewed ESCOs (over 50% of market as defined by 2006 revenues). Analyzed interview data as part of re-analysis of Hopper et al. (2007) data to estimate 2008 workforce for entire ESCO market.	ESCO EE revenue growth 2006 – 2008: 40% increase. ESCO EE FTE growth 2006 – 2008: 33% increase.
Building and Construction (B&C) Trades implementing ESCO projects		
Used ESCO budgets as described above.	Re-analyzed Hopper et al. (2007) respondent data on proportion of work done in-house vs. outsourced to B&C contractors. Calculated B&C contractor FTE.	Ratio of subcontractor staff to ESCO staff: 124% across ESCOs that were surveyed.
Building and Construction Trades implementing Code-related Activity: Building and Mechanical Insulation		

Applied to the workforce estimate (see next column) the average revenue per insulation worker as reported by the 2002 Economic Census (US Census Bureau 2009); escalated for inflation.	BLS data on number of workers in occupational codes 472131 (insulation workers: floor, ceiling, and wall) and 472132 (insulation workers: mechanical) working in five industry codes (2361-Residential Building Construction; 2362-Nonresidential Building Construction; 2382-Building Equipment Contractors; 2383-Building Finishing Contractors; 2389-Other Specialty Trade Contractors). Added to insulation workers estimated overhead workers of administrative support occupations (Occ. Code 43-0000) and management, business, and financial occupations (Occ. Code 11-1300).	National average revenue per insulation worker: $99,000 in 2002, escalated for inflation. Estimated FTE in administrative support as proportion of total employment in the five industry codes: 11%. Estimated FTE in management as proportion of total employment in the five industry codes: 9%.

C.1.2 Summary of Methods: Forecast of EE Spending and Workforce in 2010

Table C- 2 provides an overview of our data sources and methods used to estimate 2010 budgets and workforce.

Table C- 2. 2010 EESS Budgets and Workforce Estimates: Data and Methods

Budget Data and Methods	Workforce Data and Methods	Parameter Estimates Developed from Data and Methods
Low Income Weatherization		
Low Scenario: Obtained federal budget appropriation for WAP FY 2009 (ASE 2010). LIHEAP budget estimate obtained from discussion with policy expert. Other low-income program funds held constant at 2007 funding levels. *High Scenario*: Starting from low scenario, added ARRA funds to WAP. ARRA funds low income Wx at $5 billion over 3 years.	Applied estimate of person-years employment per $ million of funding (see Table C-1).	8.9 Person-years of employment (PYE) per $1M funding. ARRA appropriation: $1.67 B (one-third of $5 B).
Federal (DOE) and State Energy Efficiency Programs		
Low: Summed 3 DOE EERE ARRA funded programs (SEP, energy conservation block grants, and energy efficient appliances; weatherization addressed above) and EE ARRA funds for DOD, GSA, and VA programs (DOE 2009, ASE 2010). Divided sums by the number of year funds will be spent (3). *High*: Same as low scenario.	Applied PYE-per-million estimate to calculated budgets.	Person Years of Employment per $1M funding: 5.9 (calculated by taking EESS 2010 PYE (169,384) sum and dividing by EESS 2010 dollars ($32.8 B).
Public Utility Commission		

Not estimated, see rationale given in Table C-1.	Not estimated. Included as part of program administrator workforce projections.	
Program Administrator (PA)		
Used Barbose et al. (2009) study for 2010 spending (see Appendix D) scenarios by state. *Low:* Used medium scenario in Barbose et al. (2009); judged low scenario as low probability. *High:* Used high scenario in Barbose et al. 2009 study.	Used near-term FTE growth expectations reported by 11-state PAs. Calculated average PA growth rate 2008-2010. Applied average growth to non-respondents and to non-interviewed 39 states. Note that this yields a single PA workforce scenario for 2010 (not low and high).	Average reported near-term PA growth: 16%.
Program Implementation Contractor (PIC)		
Used program administrator budgets as described above for low and high scenarios	Used near-term FTE growth expectations reported by PICs. Calculated average PIC growth rate 2008-2010. Applied average growth to non-respondents. Note that this yields a single PIC workforce scenario for 2010 (not low and high)	Average reported near-term PIC growth: 48%.
Program Support Contractor (PSC)		
Used program administrator budgets as described above for low and high scenarios	By state, calculated average growth 2008-2010 for PA + PIC. Escalated 2008 PSC FTE estimates by that growth rate	Average growth rate PA + PIC: 34%.
Building and Construction (B&C) Trades implementing Ratepayer-funded Activity		
Used program administrator budgets as described above for low and high scenarios.	Applied method described in Table C-1 to revenue scenarios for B&C trades.	[NA]
ESCOs		
Low: Assumed 8% annual growth in constant-dollar (i.e., inflation adjusted) revenues based on interviews with key informants. *High*: Assumed 12% annual growth rate.	Staff per $1M in constant-dollar revenue estimated with regression analysis (see Section C.9).	ESCO staff per $1M revenue: 0.86.
Building and Construction (B&C) Trades implementing ESCO projects		
Used ESCO budgets as described above.	Used B&C estimation method as described in Table C-1.	Ratio of subcontractor staff to ESCO staff, on average: 124%.
Building and Construction Trades implementing Code-related Activity: Building and Mechanical Insulation		
Low: Held funds constant (in real terms) from 2002 levels. 2002 budgets obtained from the Economic Census.	*Low:* Used rate of growth in insulation employment forecasted by BLS. Calculated that growth rate from a comparison of BLS-forecasted 2016 workforce with BLS-estimated actual 2006 workforce	Low scenario annual growth in insulation employment for building envelope: 0.71%. Low scenario annual growth in insulation employment for mechanical: 0.84%.

C.1.3 Summary of Methods: Forecast of energy efficiency spending and workforce in 2015 and 2020

Table C- 3 provides an overview of our data sources and methods used to estimate energy efficiency spending and workforce in 2015 and 2020.

Table C- 3. 2015 and 2020 EESS budgets and workforce estimates: data and methods

Budget Data and Methods	Workforce Data and Methods	Parameter Estimates Developed from Data and Methods
Low Income Weatherization		
Low Scenario: Escalated WAP budget data from FY2007 (NASCSP 2007) by assuming an increase in weatherization activity for 2015 & 2020 (150% from FY2007 levels). Held LIHEAP and Other funds constant (in real terms) at FY2007 funding levels. *High Scenario*: Held all budgets constant at 2010 high-scenario funding levels (see Table C-2).	Applied estimate of person-years employment per $ million of funding as described in Table C-1.	Person-years of employment (PYE) per $1M funding (2008): 8.9.
Federal (DOE) and State Energy Efficiency Programs		
Low: Took proportion of DOE EERE programs that were EE only in 2008 (excluding WAP) (U.S. OMB 2009); multiplied by total federal forecast budget for 2015. *High:* Estimated that the 2008 budget devoted to EE (excluding WAP) would increase 5% per annum.	Same as Table C-2.	Same as Table C-2.
Public Utility Commission		
Not estimated; see rationale given in Table C-1.	Not estimated. Included as part of program administrator workforce projections.	
Program Administrator (PA)		
Used Barbose et al. (2009) spending scenarios by state for 2015 and 2020. *Low:* as described in Table C-2. *High:* as described in Table C-2.	Conducted regression analysis of workforce on budget as described in Table C-1.Used regression analysis to estimate future PA workforce.	See Section C.3 for description of regression analysis. For CT, NJ, NY, MA, and MD regression yielded 0.71 PA FTE per $1M PA budget. For CA, IA, IL, TX, WA, and WI: regression yielded 1.83 PA FTE per $1M PA budget. For other states, regression yielded 1.61 PA FTE per $1M PA budget.
Program Implementation Contractor (PIC)		
Used program administrator budgets as described above for low and high scenarios.	Workforce data for 2007/2008 provided by interviewed PICs. Conducted regression analysis of workforce on budget to estimate workforce.	See Section C.4 for description of regression analysis. Regression yielded 1.23 PA FTE per $1M PA budget.

Program Support Contractor (PSC)		
Used program administrator budgets as described above for low and high scenarios.	Workforce estimated by using the budget labor allocation not spent on PAs and PICs and assuming a $125,000 per 1 FTE (includes fully loaded employment costs plus organization overhead).	47% of budget is used for labor costs.
Building and Construction (B&C) Trades implementing Ratepayer-funded Activity		
Used administrator budgets as described above for low and high scenarios.	Apply fully loaded wage rate to portion of PA dollars estimated for incentives and incentive-leveraged market spending.	Assume fully loaded rate of $100,000 per PYE (see Table C-1).
ESCOs		
Low: as described in Table C-2. *High*: as described in Table C-2.	Used method to estimate ESCO staffing as describe in Table C-2.	ESCO staff per $1M revenue: 0.86.
Building and Construction (B&C) Trades implementing ESCO projects		
Used ESCO budgets as described above.	Used method to estimate B&C staffing to implement ESCO projects as described in Table C-2.	Ratio of subcontractor staff to ESCO staff, on average: 124%.
Building and Construction Trades implementing Code-related Activity: Building and Mechanical Insulation		
Low: as described in Table C-2. *High:* estimated same annual growth rate of PA high growth scenario.	*Low:* Used method described in Table C-2 under Insulation: Envelope & Mechanical *High:* Estimated by multiplying 2006 BLS insulation workforce by PA high growth rate	Low scenario annual growth in insulation employment: 0.71% building envelope and 0.84% for mechanical. High scenario annual growth assumes rate of 8.8% (both groups)

C.2. Low Income Weatherization Program: Spending and Employment

C.2.1 2008 WAP Budget Data Source

The 2007-2008 weatherization budgets (WAP, LIHEAP, other) were obtained from the 2008 National Association for State Community Services Programs report (NASCSP 2008). These data were the most recently available and are for program year (PY) 2007, which spans April 1, 2007 through March 31, 2008 for most states and July 1, 2007 through June 30, 2008 for some states.

C.2.2 2010 DOE WAP Funding: Low and High Scenario

Low Scenario: The low estimate is the FY 2009 DOE WAP total appropriation of $450 million—$201 million in standard appropriations plus $250 million in supplemental funds (NASCSP 2009); FY signifies fiscal year, which runs from October 1, 2009 through September 30, 2010.)

High Scenario: WAP is allocated $5B in the ARRA legislation to be spent starting in 2009 and ending in 2012 (average of $1.67B per year over a three year period). This funding is in addition to the standard DOE WAP appropriation, which in FY2009 is $450 million (see Table C-4).

C.2.3 2015 and 2020 DOE WAP Funding: Low and High Scenario

Low Scenario: We derive the 2015 and 2020 low scenario funding as equal to the 2009 DOE WAP appropriation increased by 50% plus inflation. We based this assumption on a stated commitment by the federal government to expand weatherization efforts beyond the levels seen prior to 2008.

High Scenario: We assume that there is an ongoing long-term commitment by policymakers to increase the level of weatherization activity in low-income homes. To represent this scenario, we assumed that DOE WAP spending in 2015 and 2020 maintains much of the impetus from the ARRA and continues at roughly the magnitude achieved in 2010. At an average cost of $4,000 per home (constant 2008 dollars), about 650,000 homes can be weatherized per year (see Table C- 4). Such a public commitment to weatherization might translate into higher spending per house; Table C- 4 also shows that about 520,000 homes can be weatherized at an average cost per home of $5,000.

Table C- 4. Number of units weatherized at $4,000 and $5,000 per house: low and high funding scenarios

		Budget (M$)	Estimated spending per housing unit	Number of units weatherized	Estimated spending per housing unit	Number of units weatherized
Current	2008	$528	$4,000	131,967	$5,000	105,574
Low	2010	$920	$4,000	229,876	$5,000	183,901
	2015	$1,148	$4,442	258,507	$5,553	206,806
	2020	$1,270	$4,911	258,507	$6,139	206,806
High	2010	$2,586	$4,000	646,542	$5,000	517,234
	2015	$2,889	$4,442	650,285	$5,553	520,228
	2020	$3,194	$4,911	650,285	$6,139	520,228

C.2.4 2010 LIHEAP Funding

Based on discussions with a low-income weatherization policy expert, we assume LIHEAP funding in 2010 equals $400 million for both low and high scenarios.

C.2.5 2015 and 2020 LIHEAP Funding for Weatherization: Low and High Scenarios

Low Scenario: LIHEAP funding estimates for weatherization for 2015 and 2020 are derived from 2008 funding levels adjusted for inflation.

High Scenario: LIHEAP funding estimates for weatherization for 2015 and 2020 are derived from 2010 LIHEAP funding levels adjusted for inflation. We used the 2010 estimate because it represents a high budget level compared to 2008.

C.2.6 Other Funding Sources for Low-income Weatherization

Other funds represent a small fraction of total weatherization funds. We assume that funding levels in both the high and low scenarios remain at the same funding level from 2008 to 2020, adjusted for inflation.

C.2.7 Workforce Estimates for Weatherization Assistance

We relied on research led by the New England Clean Energy Council (NECEC) for National Grid and NStar and conducted by Kevin Doyle (Doyle 2009) to derive our estimate of workforce employment for low-income weatherization program activities given a specified expenditure level. Doyle used a bottom-up methodology similar to our own and developed estimates of person-years of employment per $1M in funding for low-income weatherization from analyses of detailed survey data that they collected from local weatherization program agencies . Doyle estimated total WAP funding in Massachusetts and the number of homes that could be weatherized for that funding level. Working from survey data, the study estimated the number of WAP managers needed to supervise varying activity levels as well as the number of administrative assistants, auditors, and contractor field workers needed given a varying mix of installed measures (e.g., window replacement, equipment replacement, and home repairs).

LBNL developed a partnership with NECEC and Kevin Doyle, the study director, as part of our study; Doyle provided LBNL with the raw workforce data from the Massachusetts study. We re-analyzed this data and conducted sensitivity testing assuming different proportions of the various measures installed for the funding. From this sensitivity testing, we derived our estimate of 9 person-years of employment (PYE) per $1M in WAP funding.

C.3 ARRA Funds for State, Local and Federal Agency Energy Efficiency Programs

C.3.1 Other American Reinvestment and Recovery Act (ARRA) Energy Efficiency Programs

ARRA provided a large infusion of money for energy efficiency programs and projects administered by the Department of Energy (DOE) and other federal agencies. In addition to low-income weatherization assistance, DOE is administering $3.1 billion for State Energy Program (SEP) grants, $3.2 billion for Energy Efficiency and Conservation Block Grants (EECBG) targeted at local governments, and $300 million for energy efficient appliances. Table C- 5 summarizes these programs including LBNL assumptions for funding allocation across different eligible uses (e.g. renewable vs. energy efficiency projects, buildings sector vs. transportation-oriented projects) and how much program spending will occur in 2010 (compared to other years).

In our high funding scenario, we also included estimates of ARRA funds provided to various federal agencies that could be allocated to energy efficiency projects: the Department of Defense ($3.69 billion total), General Services Administration ($4.5 billion total), and the Department of

Veterans Affairs ($1 billion total).[5] We treat these ARRA funds for federal agencies as one-time capital and deferred maintenance investments and do not assume that they will continue in 2015 and 2020.

Based on our assumptions and analysis, we assume that about $5.53 billion in ARRA funds will be spent on energy efficiency projects in 2010, of which $1.67 billion is included in our weatherization assistance analysis and $3.9 billion is additional energy efficiency program spending. We do not provide ARRA estimates for 2015 or 2020 because the legislation requires these funds to be spent by March 31, 2012.

C.3.2 Employment Assumptions for ARRA spending

Lacking better information, we assumed that employment associated with ARRA program funds was comparable to the average person-years of employment per million dollars in funding across all other EESS sectors in our analysis. Using this method, we assumed 6 jobs are created per $1 million of ARRA investment. We calculated this number by taking the total amount of EESS spending in 2010 from our program administrator, implementation contractor, ESCO, building trades, insulation, and weatherization assistance analyses divided by the total 2010 PYE we estimated for these categories.[6]

[5] Other government agencies (e.g.. Department of Housing and Urban Development) also received ARRA funds that could be directed towards energy efficiency projects; however, we limited our analysis of employment effects to SEP, EEBCG, appliances, and federal agency programs.

[6] The calculations are: $32 billion/193,235 PYE = $165,741 per PYE or 6 PYE on average per $1 million. Using this approach, we estimated the ARRA-funded workforce (non weatherization) in 2010 to be 23,309 person-years of employment.

Table C- 5. ARRA-funded energy efficiency programs and funding: 2010

Program (Agency)	Total ARRA Funds (Million $)	Performance Period	All Eligible Activities (*italicized items are non EE)*	Assumptions for how much funding will be targeted for energy efficiency in buildings	Estimated Budget targeted for energy Efficiency (Million $)	2010 EE Budget Estimate (Million $)
Weatherization Assistance Program - Low Income Weatherization (Department of Energy)	5,000	4/1/09 – 3/31/12	Any household at or below 200% of poverty, per the modified statue, is considered low-income. About 15 million eligible households are good candidates for Wx. Priority is given to the elderly, people with disabilities, and families with children. Activities include insulation, other building envelope and HVAC system improvements	100% for EE	$5,000	$1,667
State Energy Program (SEP) (Department of Energy)	3,100	4/1/09 – 3/31/12	State Energy Program (SEP) provides grants and technical assistance to states and U.S. territories to promote energy conservation. EE activities include establish lighting efficiency standards for public buildings, promote carpools and public transportation, incorporate EE into procurement procedures, implement thermal efficiency standards for new and renovated buildings, permit right on red policies at traffic lights	50% for EE	1,550	517

Energy Efficiency and Conservation Block Grant (EEBCG) (Department of Energy)	3,200	4/1/09 – 3/31/12	Grants will go to states, local , and tribal governments to support the development of audits, financial incentives, EE retrofits for government entities, EE retrofit for buildings, building codes and inspections, energy distribution, conservation of materials, LED traffic signals, landfill and renewable projects for government buildings	50% for EE	$1,600	$533
Energy Efficiency Appliance Rebate Program (Department of Energy)	300	4/1/09 – 3/31/12	Money for consumer rebates for the purchase of residential Energy Star products replacing existing appliances of the same type	100% for EE	$300	$100
Federal Buildings (Department of Defense)	3,690	4/1/09 – 3/31/12	Most funds to be used for EE-related capital projects. $300 million for EE demonstration projects	100% for EE	$3,690	$1,230
Federal Buildings (General Services Administration)	4,500	4/1/09 – 3/31/12	Funds can be used to retrofit GSA facilities into high performance, green buildings. $300 million dedicated to EE in transportation excluded from this analysis	93.3% for EE	$4,200	$1,400
Department of Veterans Affairs	1,000	4/1/09 – 3/31/12	Portion of funds will go towards EE projects but bulk of funds for non-recurring maintenance.	25% for EE	$250	$83
TOTAL	20,790				$16,590	$5,530

Source: Department of Energy 2009, Alliance to Save Energy 2009

C.4 Federal and State Energy Efficiency Programs (Appropriations Independent of ARRA Funded Programs and Weatherization)

C.4.1 Budget Data and Projections

We reviewed the FY2010 DOE budget data (U.S. OMB 2009) and determined that energy efficiency research, development, and demonstration (RD&D) and other EE programs comprised ~14% of the DOE budget, exclusive of weatherization assistance (see Table C- 6). Such activity spans the DOE offices, national laboratories, and federal support for state energy offices.

Table C- 6. FY2010 Department of Energy federal budget with 2008 spending and energy efficiency activities

Obligations by program activity:	Energy Efficiency (Non-transportation)	2008 Spending (Million $)
00.01 Hydrogen technology		$206
00.02 Biomass and biorefinery systems R&D		$262
00.03 Solar energy		$226
00.04 Wind energy		$49
00.05 Geothermal technology		$22
00.06 Water power energy		$10
00.07 Vehicle technologies		$209
00.08 Building technologies	EE	$108
00.09 Industrial technologies	EE	$63
00.10 Federal energy management program	EE	$20
00.11 Facilities and infrastructure	EE	$15
00.12 Weatherization and intergovernmental activities		$291
WAP portion of category	EE	$204
Non WAP portion of category	EE	$87
00.13 Progam direction/support for EE and RE		$115
EE share	EE	$37
RE share		$78
00.14 Congressionally directed projects		$184
10.00 Total budget		$1,780
Energy Efficiency Total (including WAP)		$534
Energy Efficiency budget (excluding weatherization)		$243
Total DOE EERE Employees 2008		479
Total DOE EERE Employees in EE (estimated based on proportion of total spending)		144
Total DOE EERE Employees in EE minus weatherization		65

2010 and Low Estimates for 2015 and 2020

Using federal budget forecasts through 2019 as published in the FY2010 Federal Budget for DOE, we extrapolated to estimate the 2020 DOE EERE budget based on the average per annum growth rate between 2010 and 2019. We then assumed that energy-efficiency-related activity would continue to account for 14% of the total DOE budget forecast for 2010, 2015, and 2020.

It is important to note that our low funding scenario estimates for weatherization assistance do not match the federal forecast total budgets for 2015 and 2020. Our estimated funding levels fir weatherization are higher because we assume that continued efforts to increase funding for weatherization in the coming years will supplant the current federal forecast. Our low scenario estimates for non-weatherization DOE EERE programs do not include a similar assumption of increasing funding levels.

2015 and 2020 High Estimates

For our high estimates, we assumed DOE EERE funding will increase at 5% per year from 2008 onward.

C.4.2 Employment Estimates

We estimated DOE EERE energy efficiency funding in 2008 generated 1,567 person-years of employment, exclusive of weatherization assistance. The FY2010 DOE EERE budget contains an estimate of 479 full-time equivalent employees. Assuming that energy efficiency staff comprise the same proportion of total staff as the efficiency budget comprises of total budget, we obtain a workforce estimate of 67 (14% of 479). This funding also supports the state energy offices. We spoke with the executive director of the National Association of State Energy Officials (NASEO), who was finalizing a study involving a brief survey of member organizations. This contact reported 1,500 state energy officials in 2008 (David Terry, personal communication, May 26, 2009). We estimate that energy efficiency comprises about 70% of that effort, or 1,050 PYE. Combining the federal and state efforts gives 1,117 person-years of employment.

For the forecast years (2010, 2015 and 2020), we assume that PYE will grow proportional to increases in energy efficiency funding.

C.5 Ratepayer-funded Energy Efficiency: Program Administrator spending and employment

We conducted in-depth interviews with 39 administrators of ratepayer-funded energy efficiency programs; of which, 38 provided spending data for 2007. Respondents also provided estimates of numbers of staff on a full-time equivalent basis and projections of near-term growth in staffing. These interviews comprise most but not all of the administrators in the targeted 11 states. We augmented our sample for missing data with 2007 spending data on energy efficiency published by the Consortium for Energy Efficiency (2008).

To estimate future staffing levels, we conducted a regression analysis to model program administrator staffing as a function of projected energy efficiency spending based on Barbose et al. (2009) forecasts of ratepayer-funded energy efficiency spending by state in 2015 and 2020.

C.5.1 Overview of Energy Efficiency Program Administrator Employment and Spending Analysis

Based on survey data collected from interviews with program administrators (PA) in 11 states, we analyzed the current relationship between program administrator staffing and spending (or budget) levels for energy efficiency across various states and explored several model specifications.

Our first set of models comprised different functional forms of univariate regressions of *PA Staff* as a function of *PA Budget* across the PA respondent population (38 respondents) in the 11 states (see Table C-7; univariate results). PA Staff was the dependent variable in these models.
A second set of models included a second explanatory variable in addition to *PA Budget* in an effort to explain more variance in the dependent variable (*PA Staff*). We segmented the 38 PA respondents into two regional groups and crafted an interaction term to account for segment differences.

We also tested several other variables that potentially were related to PA staffing levels using interaction terms that described unique characteristics of public administrators: investor-owned utilities (IOU) versus other program administrator organizations, small versus large PA organizations, and organizations in the east (CT, MA, MD, NJ, NY) versus the mid-west and west (CA, IA, IL, TX, WA, WI). After comparing various model specifications (see Table C-7, segmented results), we judged it most appropriate to use the regression model that included *Region* as an interaction variable for forecasting workforce estimates in the 11 states. For the remaining 39 states, we used the simple univariate model without a region variable, as it is premature to suppose that the regional difference observed in our 11 states will continue as other states ramp up energy efficiency efforts.

C.5.2 Regression Model Specifications

Table C- 7 lists all the regression based model specifications that were explored; Table C- 8 provides the definitions associated with those models. We selected the specification with the smallest sum of squared error term (SS error). Table C- 9 provides the parameters of the best fitting model, which we used to forecast future *PA Staff* levels using forecasts of future *PA Budgets* under low and high funding scenarios.

Table C- 7. Alternative regression models for Program Administrator staffing levels

	Equation	R^2	SS error	SS total
Univariate Models				
Linear	$Y = \beta_o + \beta_1 X_1 + \epsilon$	0.86	92844	701331
Logarithmic	$Y = \beta_o + \beta_1 \ln(X_1) + \epsilon$	0.37	440682	701331
Polynomial	$Y = \beta_o + \beta_1 (X_1)^2 + \beta_1 X_1 + \epsilon$	0.94	41374	701331
Multivariate Models (Dichotomous Segmentation Term)				
Small versus Large Organizations				
Not Possible - only 4 organizations clustered as large, which was insufficient for a segmentation based on size of program administrator EE organization				
IOU versus non-IOU Organizations (X_2)				
Linear	$Y = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_1 * X_2 + \epsilon$	0.95	36782	701331
East (CT, MA, MD, NJ, NY) versus Mid-West and West (CA, IA, IL, TX, WA, WI) (X_3)				
Linear	$Y = \beta_o + \beta_1 X_1 + \beta_2 X_3 + \beta_3 X_1 * X_3 + \epsilon$	0.96	29957	701331

Table C- 8. Definitions used in regression models

Y=Number of PA Staff in 2008
X_1=Total PA Energy Efficiency Budget in 2007/ 2008
X_2=dichotomous variable (IOU=0, non-IOU=1)
X_3= dichotomous variable (East=0, Mid-West or West=1)
$X_1 * X_2$= interaction term between X_1 and X_2
$X_1 * X_3$= interaction term between X_1 and X_3
B_0= Intercept (unconstrained)
β_1= Regression coefficient associated with X_1
β_2= Regression coefficient associated with X_2 or X_3
β_3= Regression coefficient associated with $X_1 * X_2$ or $X_1 * X_3$
ϵ = error/residual

C.5.3 Analysis Results

Three functional form specifications of the univariate model were tested. The logarithmic fit was tested because it proxies economies of scale (i.e., the rate of increase in program administrator staff is lower than the rate of budget increase), although this specification resulted in a poor fit. The polynomial (i.e., a quadratic functional form) explained the largest amount of variance for the univariate model. However, this specification was upward sloping, failing to represent economies of scale. The linear model explained almost as much of the variance as the polynomial model, thus the linear model was used in the multivariate regressions.

The multivariate regression models explained more variance than any of the three univariate model specifications (Table C- 9). The model using *Region* as a segmentation variable yielded the smallest sum of square error term. We selected this model for forecasting the workforce estimates for the 11 states, constraining the model intercept to zero to specify the following relationship: when budgets are zero the workforce equals zero.

Table C- 9. Program Administrator staffing in 11 states: Multivariate regression model

East (NY,NJ,CT, MA, MD) versus Mid-West and West (CA, WA, TX, WI, IA)	
Equation	
Linear	PA staff = 0 + 1.832*Budget(in Millions) -1.127*(Budget*Region)
R^2	0.96
Slope at 0	1.832
Slope at 1	0.705
Region = 1 if PA in the east (CT, MA, MD, NJ, NY); = 0 if PA not in east (CA, IA, IL, TX, WA, WI)	

C.5.4 Estimating Program Administrator Employment in remaining 39 states

To forecast the program administrator workforce in the remaining 39 states, we used a univariate intercept-constrained linear model (see Table C- 10). We did not believe it appropriate to include a term for region.

Table C- 10. Estimating Program Administrator staffing in 39 other states: Univariate regression model

Equation	
Linear	PA staff = 0 + 1.61*Budget(in Millions)
R^2	0.90

We used this model to forecast program administrator workforce for the remaining 39 states in 2015 and 2020.

For the near term, we believe that the regression model would overstate the program administrator workforce as our 11-state sample is dominated by states with relatively mature energy efficiency program efforts.
Thus, to estimate staffing in 2008 in the remaining 39 states, we assumed the total administrator/implementer/support workforce could best be proxied by the state within our 11-state sample that had the lowest staffing to budget ratio, which was 1.65 person-years of employment per million dollars in energy efficiency program administrator budget. (In this analysis, we defined staffing as the total of program administrator, implementation contractor, and support contractor employment.) We multiplied the program administrator budgets for the 39 states (source: Consortium for Energy Efficiency 2008) by the ratio of 1.65 to get an estimate of total staffing of 578. We then allocated this staffing for the 39 states across the categories of

program administrator, implementation contractor, and support contractor according to the 11-state average distribution of staff across these categories (42%).

For 2010, we assumed the program administrator workforce for the 39 states would grow at the same rate anticipated by our 39 administrator respondents in the 11 targeted states—19%.

C.6 Ratepayer-funded Energy Efficiency: Analysis of Program Implementation Contractor (PIC) Employment

We identified and ultimately interviewed 23 program implementation contractors (PIC) through professional contacts, program plans and evaluation reports filed by program administrators, and professional organizations (e.g., Association of Energy Services Professionals).

C.6.1 Estimating Program Implementation Contractor staffing

We sought to derive a best-fit model to estimate the relationship between *PIC Staff* and 2007 *PA Budget*, both measured at the state level (see Table C- 11). Model exploration was limited due to the small sample size (11 states).

Table C- 11. Estimating Program Implementation Contractor staffing: Regression model

Univariate Model (N=11)	
Equation	
Linear	PIC Staff = $\beta_0 + \beta_1$*PA State Budget
	β_0=0 and β_1=1.226
Adj. R^2	0.96
SS error	74946
SS total	1859409

C.6.3 Implementation Contractors in Remaining 39 States

Program implementation contractors (PIC) reported their total workforce and provided estimates of percentage of work done in each of the 11 targeted states. We determined their staffing in the 39 states by subtracting from their national totals our estimates of their 11-states totals (as derived by assuming that staffing proportions across states reflect distribution of work across states). Thus, the total number of PIC staff nationwide is from survey data.

C.7 Ratepayer-funded Energy Efficiency: Analysis of Program Support Contractor (PSC) Employment

We were unable to estimate the number of program support contractors (PSCs) through survey research, given budget and time constraints. Thus, we used a case study approach and extrapolated the findings across our 11 targeted states. Through prior professional work, we had detailed knowledge of the use of PSCs in California, Iowa, and New York and developed estimates of support contractor workforce based on that knowledge. For the remaining states (with the exception of Washington), we assumed the number of full-time equivalent PSC is half that of the implementation contractors. Our interviews with PA in Washington indicated that the municipal utilities prefer to use in-house staff; this finding was confirmed by the state's comparatively high level of program administrator staff in relation to budget. Thus, for Washington, we assumed support contractor staffing is one-fifth that of implementation contractor staffing.

We also conducted a "sanity check" of these assumed program support contractor staffing values. For each of the 11 targeted states, we totaled the person-year employment for program administrators, PICs, and PSCs. We multiplied this sum by an assumed fully loaded salary of $125,000 (includes fully loaded employment costs plus organization overhead) and confirmed that the total dollars were within a few percentage points of 47% of the total budget for ratepayer-funded energy efficiency programs in that state. This value (47%) represents the average percentage of program administrator budget not expended on incentives to customers, per our survey of 39 administrators in our 11-state sample.

To estimate the program support contractor workforce for the other 39 states, we used the following approach. From the 11 state sample, we calculated the proportion that PSC staff comprised of the program administrator, PIC and PSC total (i.e., 24%). We then multiplied the total program administrator/implementer/support estimate of 953 in the 39 states by 24% to get 232 PYE of PSCs working in the remaining 39 states.

(Note that for the 39 remaining states we used the same methodology for to estimate administrator and support contractor staffing, while we used implementation contractor self-reported data as our implementation contractor workforce estimates. Our estimates of total staffing for these states therefore is 400 program administrators, 806 implementation, and 232 support contractors, for a total of 1,437. This final number is equivalent to a combined program administrator/implementer/support staffing of 2.49 person-years of employment per million dollars of administrator budget. This value is higher than the analogous statistic for three of the 11 targeted states. Of the targeted states, the lowest value of program administrator/implementer/support employment per million in administrator budget was 1.65, the highest value was 5.46, and the average value was 3.59.)

C.8 Estimating Building and Construction Industry Employment Induced by Ratepayer-funded Energy Efficiency Spending

Our survey of 39 program administrators provided data on program spending for financial incentives for customers, which we totaled by state. We assume that on average incentives pay for one-third of the total cost of efficiency projects (note: not the incremental cost) and from that developed an estimate of total project spending. Based on discussions with industry professionals, and similar to the value for this parameter used by Navigant Consulting (Connecticut Clean Energy Fund 2009), we assume that 60% of total project cost covers labor (on average), while the remaining 40% covers materials and equipment. Finally, we assume an average, fully loaded (includes fully loaded employment costs plus organization overhead) salary for workers in the building and construction industry of $100,000 per year and calculate person-years of employment from the estimate of total labor spending for efficiency projects. The assumed fully loaded salary is comparable to assumptions made by Navigant (Connecticut Clean

Energy Fund 2009), as calculated from their statistics on number of energy efficiency job-years created by one million dollars investment. The assumed fully loaded salary is also consistent with the hourly mean wage of insulation workers (Bureau of Labor Statistics 2007) when multiplied by a loading factor of three. We believe loading factors between two and a half and three and a half are reasonable for most occupations.

C.9 Estimating ESCO Revenues and Employment

C.9.1 Projecting current and future ESCO Revenues

We developed estimates of future ESCO revenues for energy efficiency, performance contracting projects drawing on several sources: (1) results of the 2006 ESCO survey (Hopper et al. 2007) that provided ESCO projections for the near-term, (2) interviews with representatives from 9 ESCOs completed in December 2008, and (3) a Delphi process that involved discussions with four experts who consult on the ESCO industry.

We developed two scenarios to project future ESCO revenues: "business-as-usual" and "high growth" scenarios. In the business-as-usual scenario, we posit that ESCO energy efficiency revenues increase between 8% per year to 2020 based on the following market drivers:

- Continued expansion of the federal market for energy service performance contracts, as evidenced by the recent award of new contracts;
- Ongoing need for facility improvements and equipment replacement in public sector markets;
- Increasing momentum for performance contracting as a strategy that allows states to "lead by example" by retrofitting public sector buildings; and
- Near-term momentum and increased funding for state and local government markets created by ARRA-funded energy efficiency programs.[7]

In the high growth scenario, we forecast that ESCO revenues grow by about 12% per year to 2020, due to the combined impact of existing market drivers plus factors including:

- Aggressive, sustained commitment by the federal government to energy efficiency that is reflected in policy and legislation (e.g., a national Energy Efficiency Resource Standard, ongoing federal programs that target institutional sector markets which are administered by state energy offices); and
- Increased market penetration by ESCOs in several market segments (e.g., private universities, Section 8 housing, owner-occupied commercial buildings, large-scale energy efficiency initiatives sponsored by local government) that overcome barriers to performance contracting.

[7] In the near-term, there are contradictory forces at work that increase uncertainty in projecting ESCO revenues. The deep economic recession could dampen ESCO market activity because of additional constraints for customers and ESCOs to obtain financing for projects, risk aversion by ESCOs trying to ensure adequate working capital, and tightening lending standards. On the other hand, the ARRA provides a windfall increase in spending on public sector energy efficiency for "shovel ready" projects that could lead to large increases in near-term ESCO revenues, subject to constraints on available workforce capacity among state agencies that need to contract with ESCOs and workforce constraints faced by ESCOs.

C.9.2 Relationship between ESCO Revenues and Staffing

We explored several model specifications to derive a model that estimates the relationship between ESCO revenues and staffing using raw data from 31 ESCO respondents.[8] Ultimately, we concluded that an unconstrained, linear model provided the most appropriate representation to estimate ESCO staffing levels (see Table C- 12).

Table C- 12. ESCO revenues and staffing (2006 data)

N	B	Intercept	Adj. R^2	Error (Difference between predicted and expected scores)
Model 3: staff= f(total budget)				
29	0.86	41.66	0.65	-42

C.10 Estimating Building and Construction Industry Employment induced by ESCO Activity

We re-analyzed survey responses from ESCOs on the proportion of work done in-house in contrast to work outsourced to building and construction industry contractors (Hopper et al. 2007). Across all ESCO respondents, we found a proportion of ESCO staff to contractors of 1:1.24. We then used this information to develop estimates of person-years of employment for building and construction industry firms (e.g. lighting, HVAC contractors) that implement ESCO projects.

C.11 Estimating Insulation Industry Revenues and Employment

C.11.1 Insulation Market: Revenues

Revenues for the insulation market were obtained from the 2002 Economic Census (U.S. Census Bureau 2002) by specifying the "Drywall and Insulation" NAICS code (23831). We initially tried to retrieve more current data from the 2007 Economic Census; however, the five digit NAICS code data was not publicly available at the time. We adjusted the 2002 revenue numbers for inflation for the years 2007, 2010, 2015, and 2020 under the assumption (for lack of alternative data) that insulation revenues remained constant between 2002 and 2020 (in real $$ terms).

C.11.2 Workforce Estimates

We obtained current and projected workforce data for 2006 and 2016 from the Bureau of Labor Statistics (BLS) [Bureau of Labor Statistics 2007]. Specifically, we extracted insulation

[8] We tested models that segmented ESCOs into two groups based on size (employing more or fewer than 100 employees) as well as different functional forms for univariate models (e.g. polynomial, linear).

occupational data (Occupational code: 47-2130) within the industries representing the insulation market. Industries representing the insulation market included the following NAICS codes: 236100 (Residential building construction), 236200 (Non-residential building construction), 238200 (Building equipment contractors), 238900 (Other specialty trade contractors), and 541300 (Architectural, engineering, and related services).

The occupational codes only represented mechanical insulation work and building-envelope related insulation work (e.g., floors, ceilings, and walls) and do not account for administrative and management services within the insulation market. To derive a reasonable estimate of administrative and management services in the insulation industry, we compared total employment, administrative employment, and managerial employment across an aggregation of the five industries in which insulation workers are found (see Table C- 13). To derive insulation industry totals, we added to our counts of insulation workers another 20% to reflect administrative and managerial jobs conducted in support of insulation work.

Table C- 13. Derivation of adders to insulation workforce for administrative and management functions

Occupation Codes	Description	Grand Total (within Industry Codes 236100, 236200, 238200, 38300, 541300)	Percent of Total
00-0000	Total, all occupations within Industry Codes 236100, 236200, 238200, 38300, 541300	5,573,900	100%
43-0000	Office and administrative support occupations	576,932	10%
11-1300	Management, business, and financial occupations	441,553	8%
Total Administrative (43-0000) and Management (11-1300):		**1,018,485**	**18%**

For the low growth scenarios, we based workforce estimates on BLS 2006 to 2016 annual growth rate of 0.77 percent. For the high growth scenarios, we based workforce estimates on the annual growth rate from the program administrator high growth scenario (8.8 percent). For both scenarios, this annual workforce growth rate was applied from 2006 onward.

C.12 Estimating the Size of Total Building and Construction Industry Workforce

The construction and buildings workforce that works on energy efficiency-related projects represents a small portion of a larger building and construction market. In order to estimate the size of the total buildings/construction industry market, we examined 2006 BLS data and identified six industry areas as defined by the North American Industry Classification System (NAICS) and 48 occupations, as defined by the Bureau's Occupational Classification Code, that encompass professions and trades most likely to engage in energy efficiency project-related activities (see Table C- 14 and Table C- 15 respectively). The BLS provides employment counts for 2006 and projections for 2016 by industry and occupation. We summed the employment counts for the occupations listed in Table C- 14 that fall within the NAICS codes listed in Table C- 15 in order to estimate the size of the broader building and construction industry.

Table C- 14. NAICS codes used to estimate size of total Building and Construction Industry

NAICS Code	NAICS Name

236100	Residential Building Construction
236200	Nonresidential Building Construction
238200	Building Equipment Contractors
238300	Building Finishing Contractors
238900	Other Specialty Trade Contractors
541300	Architectural, Engineering, and Related Services

Table C- 15. Occupational Codes used to estimate size of total Building and Construction Industry Workforce

Occupational Code	Occupational Code Name
11-1011	Chief executives
11-1021	General and operations managers
11-2021	Marketing managers
11-2022	Sales managers
11-3011	Administrative services managers
13-1051	Cost estimators
13-2031	Budget analysts
17-1011	Architects (except landscape and naval)
17-2051	Civil engineers
19-3021	Market research analysts
47-1011	First-line supervisors/managers of construction trades and extraction workers
47-2011	Boilermakers
47-2031	Carpenters
47-2061	Construction laborers
47-2111	Electricians
47-2131	Insulation workers: floor, ceiling, and wall
47-2152	Plumbers, pipefitters, and steamfitters
47-2211	Sheet metal workers
47-3013	Helpers—electricians
47-3015	Helpers—pipe layers, plumbers, pipefitters, and steamfitters
47-4011	Construction and building inspectors
49-9021	Heating, air conditioning, and refrigeration mechanics and installers
11-9021	Construction managers
11-9041	Engineering managers
43-1011	First-line supervisors/managers of office and administrative support workers
43-3011	Bill and account collectors
43-4171	Receptionists and information clerks
43-5061	Production, planning, and expediting clerks
43-9061	Office clerks, general
47-2151	Pipe layers
47-3012	Helpers—carpenters
17-2141	Mechanical engineers
47-2132	Insulation workers: mechanical
49-2094	Electrical and electronics repairers, commercial and industrial equipment
49-9041	Industrial machinery mechanics
49-9099	Installation, maintenance, and repair workers, all other
17-3011	Architectural and civil drafters

17-3012	Electrical and electronics drafters
17-3013	Mechanical drafters
17-3024	Electro-mechanical technicians
17-3026	Industrial engineering technicians
17-3027	Mechanical engineering technicians
17-3029	Engineering technicians, except drafters, all other
41-9031	Sales engineers
27-1021	Commercial and industrial designers
17-2071	Electrical engineers
49-9098	Helpers--installation, maintenance, and repair workers
19-3011	Economists

C.13 Estimating total number of individuals involved in the Energy Efficiency Services Sector based on PYE Estimates

We also developed an estimate of the likely number of individuals involved in providing energy efficiency services based on a set of assumptions regarding the amount of time that various types of occupations spent on energy efficiency project activity for different sub-sectors of the EESS (see Table C- 16).

Table C- 16. Assumptions used to convert PYE estimates to likely numbers of individual employees that provide energy efficiency services

EESS Analysis Categories	Assumed % of time that typical worker spends on Energy Efficiency	Assumptions
Federal & State EE Administrator Employees	100%	Dedicated to energy efficiency
Federal & State ARRA Funded EE Employees	75%	Largely dedicated to energy efficiency
Weatherization Agencies and Contractors	40%	Agencies do more than energy efficiency; they also employ staff and contractors on a part-time basis
Program Administrators (PA)	100%	Dedicated to energy efficiency
Program Implementation Contractors	100%	Dedicated to energy efficiency
Program Support Contractors	75%	Largely dedicated to energy efficiency
Building and Construction Industry Induced by PA Spending	12.5%	Among those that do any energy efficiency project work, assume one-eighth time spent on efficiency on average
ESCO Staff	100%	Dedicated to energy efficiency
Building and Construction Industry Induced by ESCO Activity	33%	Among individuals working under contract to ESCOs, assume one-third time spent on ESCO work on average
Building and Construction Industry Codes Related—Building Insulation	50%	Interviews with industry leads indicated envelope insulation workers specialize in insulation; assumed 50% of full-time to reflect uneven workflow of construction market and work ancillary to insulation
Building and Construction Industry Codes Related—Mechanical	50%	Interviews with industry leads indicated mechanical insulation workers have five years

Insulation		of training and union membership; assumed workers are dedicated to insulation yet only 50% of insulation has energy efficiency benefits

Appendix D. Projections of Ratepayer-Funded energy Efficiency Program Spending and Savings: Methodology and Assumptions

In this appendix, we describe the methods and assumptions used by Lawrence Berkeley National Lab to develop projections of ratepayer-funded energy efficiency program spending (electric and natural gas) and savings (electric only) through 2020.

D.1 Electric Energy Efficiency Spending & Savings Projections

Low, medium, and high projections of future electric energy efficiency program savings and spending were developed on a state-by-state basis. Although many of the specific assumptions and the approach to defining scenarios varied by state, the basic methodology used in all states consisted of several common components, including:

- Developing projections of retail electricity sales and revenues from retail electricity sales
- Defining low, medium, and high scenarios of future ratepayer-funded energy efficiency program savings and spending for the electricity sector
- Defining the amount of spending required to achieve different levels of savings

Each of these elements is described further below.

D.1.1 Retail Sales and Revenue Projections

Projections of annual retail electricity sales and revenue from retail electricity sales were used to develop energy efficiency program spending and savings projections, and were also used to develop metrics that allow for comparison of spending and savings levels across states of differing sizes (e.g., savings as a percent of retail sales and spending as a percent of revenues).

Baseline Retail Sales and Revenue Projections

An initial set of baseline retail sales and retail price projections for each state was developed by applying annual growth rate projections from the Energy Information Administration (EIA)'s April 2009 update to its Annual Energy Outlook 2009 (AEO2009) reference case forecast to actual 2007 retail sales and price data for each state, as reported on EIA's Form-860. The electricity retail sales and retail price projections in AEO2009 are specified at the Electricity Market Module (EMM) level, the regions used in EIA's National Energy Modeling System (NEMS). Thus, the EMM-level growth rates were applied to each state in the respective region. Table D- 1 summarizes the annual average growth rates (2008-2020) of retail electricity sales and retail electricity prices in each EMM region, from the April 2009 AEO2009 reference case forecast (Energy Information Administration 2009). Revenue projections were calculated by multiplying projected retail electricity prices by projected retail electricity sales, and were converted to nominal dollars using the AEO2009 reference case forecast of the GDP chain-type price index.

Table D- 1. AEO2009 projected growth rates in retail electricity sales and prices

EMM Region	States	AEO2009 Average Annual Growth Rate (2009-2020)	
		Retail Electricity Sales	Retail Electricity Price (real)
East Central Area Reliability Coordination Agreement	IN, KY, MI, OH, WV	0.6%	-0.2%
Electric Reliability Council of Texas	TX	0.9%	-0.3%
Mid-Atlantic Area Council	DC, DE, ME, NJ, PA	0.7%	-0.4%
Mid-America Interconnected Network	IA, IL, MO, WI	0.7%	0.1%
Mid Continent Area Power Pool	MN, ND, NE, SD	0.8%	0.7%
Northeast Power Coordinating Council/New York	NY	0.5%	-0.1%
Northeast Power Coordinating Council/New England	CT, MA, ME, NH, RI, VT	0.7%	-0.8%
Southeastern Electric Reliability Council/Florida	FL	1.3%	0.6%
Southeastern Electric Reliability Council/ Excluding Florida	AL, AR, GA, LA, MS, NC, SC, NT, VA	0.9%	0.0%
Southwest Power Pool	KS, OK	0.9%	0.1%
Northwest Power Pool Area	ID, MT, OR, UT, WA, WY	1.0%	0.1%
Mountain Power Area, Arizona, New Mexico, and Southern Nevada	AZ, CO, NM, NV	1.5%	0.2%
California	CA	0.9%	-0.9%

State-Specific Adjustments for Each Scenario

Future retail sales and revenues in each state will depend, in part, on the amount of savings achieved from future ratepayer-funded energy efficiency programs. In order to maintain internal consistency, we adjusted the retail sales and revenue projections for each scenario in each state, to reflect the energy efficiency savings assumed for the given scenario. The adjustments consisted of increasing or decreasing the baseline sales and revenue in each year, to account for the cumulative difference between the savings assumed for the scenario and the savings assumed to be implicit in the AEO2009 forecast.

The NEMS model does not explicitly account for ratepayer-funded energy efficiency programs; however, it does model future energy efficiency improvements at the end-use level, which may be partly attributable to future ratepayer-funded energy efficiency programs. Lacking better information, we assumed that the baseline retail sales projections, derived from the AEO2009 forecasted growth rates, implicitly account for a continuation of ratepayer-funded energy efficiency programs with savings equal to 50% of historical levels, as summarized in Table D- 2. Historical savings at the level of each EMM region were calculated from data on actual savings achieved in each state from ratepayer-funded electric efficiency programs implemented in 2006, as compiled by ACEEE (Eldridge et al. 2008). To provide an example: if we project, under one scenario, that future savings in a given state will be equal to 0.3% of retail sales in each year, and the energy efficiency savings assumed to be implicit in the baseline retail sales forecast is 0.1%, then we would reduce the forecast in each year to account for the cumulative effect of the additional 0.2% of retail sales saved each year (i.e., reduce the retail sales projection by 0.2% in year 1, by 0.4% in year 2, and so on).

Table D- 2. Assumed baseline energy efficiency savings in AEO2009 forecast

EMM Region	Baseline Ratepayer-Funded Energy Efficiency Program Annual Savings (% of Retail Sales)
East Central Area Reliability Coordination Agreement	0.0%
Electric Reliability Council of Texas	0.1%
Mid-Atlantic Area Council	0.0%
Mid-America Interconnected Network	0.1%
Mid Continent Area Power Pool	0.2%
Northeast Power Coordinating Council/New York	0.3%
Northeast Power Coordinating Council/New England	0.4%
Southeastern Electric Reliability Council/Florida	0.1%
Southeastern Electric Reliability Council/Excluding Florida	0.0%
Southwest Power Pool	0.0%
Northwest Power Pool Area	0.3%
Mountain Power Area, Arizona, New Mexico, and Southern Nevada	0.1%
California	0.4%

D.1.2 Scenario Definitions

In order to simplify the scenario-development process, the 50 states and Washington D.C. were segmented into two groups (see Table D- 3). States in Tier I are those that either have a strong history of supporting ratepayer-funded energy efficiency programs (*Leaders*) or have recently enacted policies that will likely provide strong support going forward (*Up-and-Comers*). The spending and savings projections for these states were developed using varying degrees of state-specific methods and assumptions, drawing on policies or plans currently in place. For the remaining states (*Laggards*), in Tier II, spending and savings projections were developed using a relatively simple, standardized approach. In addition, savings and spending projections for municipal utilities and cooperatives in many Tier I states were developed using the same approach as used for Tier II states.

Table D- 3. Segmentation of states into Tier I and Tier II for electric efficiency projections

Tier I	AZ, CA, CO, CT, DC, DE, HI, IA, ID, IL, MA, MD, ME, MI, MN, MT, NC, NH, NJ, NM, NV, NY, OH, OR, PA, RI, TX, UT, VA, VT, WA, WI
Tier II	AK, AL, AR, FL, GA, IN, KS, KY, LA, MO, MS, ND, NE, OK, SC, SD, TN, WV, WY

Tier I Scenario Definitions

Low, medium, and high case scenarios were developed individually for each Tier I state. The starting point in defining the scenarios was the set of energy efficiency policies currently in place (or under consideration). Table D- 4 identifies the set of policies considered, and the states for which those policies were used as an input to one or more scenario. Table D- 5 describes the specific assumptions underlying each scenario in each Tier I state, and indicates more specifically how the policies listed in Table 4 were applied across the scenarios.

Table D- 4. Key policy drivers for Tier I State spending and savings scenarios

Policy Drivers	Applicable States*
Statutory requirement that utilities acquire all cost-effective energy efficiency	CA, CT, MA, WA
EEPS	CA, CO, IL, MD, MN, MI, NJ (proposed), NM, NY, OH, PA, TX, VA (provisional), WI (proposed)
Energy efficiency eligibility under state RPS	HI, NC, NV
Recently-approved IRP plan	CO, ID, OR, MT, UT
Recently-approved DSM plan or multi-year budget	AZ, CA, CT, CO, IA, MA, ME, NJ, RI (proposed), VT
System benefit charge	DC

* The list of applicable states for each policy driver indicates for which states that particular policy was used in developing spending and savings projections; it does *not* indicate the comprehensive set of states that have adopted each policy.

Table D- 5. Scenario descriptions for each Tier I State

State	Case	Scenario Description*
AZ	Low	APS, SRP, and TEP maintain savings at 0.7% of retail sales (equal to the 2010 net savings level in the approved APS 2008-2010 DSM plan)
	Medium	Same as Low Case
	High	APS, SRP, and TEP ramp up savings from 0.7% of retail sales in 2010 to 1.5% in 2020
CA	Low	IOU savings are equal to CPUC savings goals (the 2007-2013 goals and the more recently-adopted 2012-2020 goals, which supercede the old goals for 2012-2013). POU annual savings are equal to 75% of the average annual incremental savings from their 10-yr. EE plans
	Medium	Similar to Low Case, except POUs are assumed to attain 100% of the savings in the 10-yr plans.
	High	Similar to Medium Case, except IOU savings for 2012-2020 are equal to average annual savings of old CPUC IOU goals for 2007-2013 (rather than new 2012-2020 goals, which are considerably lower)
CO	Low	Full compliance with existing EEPS targets through 2020.
	Medium	Same as Low Case
	High	Follows EEPS compliance projection to 2010; assumes that IOUs ramp up savings to 1.5% of retail sales by 2020
CT	Low	Funding continues at 2008 percent of revenues (1.7%)
	Medium	Funding doubles from 2008 percent of revenues, ramping up over 2009-2011 to 3.4%
	High	Spending is derived from savings projection, which assumes acquisition of all cost-effective EE based on efficiency potential study results reported in CT Energy Excellence Report; annual spending capped at 6% of total revenues per year
DC	Low	Continuation of the authorized SBC level for 2011 through 2020 (under the assumption that 80% is directed towards electric EE and 20% towards RE).
	Medium	Savings ramp up from 0.6% of retail sales in 2011 (the projected savings under approved funding levels) to 0.7% of retail sales in 2020.
	High	The same as the Medium, except savings ramp up to 1.2% of retail sales in 2020.
DE	Low	Constant funding of $6.5M/yr for electric EE through 2020, equal to ACEEE's estimate of electric EE funding through 2011 under the recently established Sustainable Energy Utility (SEU).
	Medium	Assumes that savings ramp up from 0.2% of retail sales in 2011 (the projected savings under estimated SEU funding levels) to 0.7% of retail sales in 2020.
	High	The same as the Medium, except savings ramp up to 1.2% of retail sales in 2020.
HI	Low	EE savings exhaust, but do not exceed, 50% EE allowance under state RPS
	Medium	Same as Low Case
	High	Same as Low/Medium Cases through 2015; savings increase from 1.2% of retail sales in 2015 to 1.5% in 2020
IA	Low	Continue funding at 2008 approved budget (1.2% of retail sales, based on CEE 2007 electric EE budget data)

	Medium	For 2009-2013, IOU spending projections are based on the proposed budgets in their 2009-2013 EE plans, and POU EE spending is equal to the average annual spending in 2003-2005 (data from IUB presentation). For 2014-2020, continue funding at projected 2013 percent of revenues 2.5%
	High	Spending is derived from assumption that all utilities achieve savings equal to 1.5% of retail sales by 2011 (this is the target that IOUs were required to evaluate in their most recent EE plans) and continue at that level thereafter.
ID	Low	IOU savings based on most-recent IRP projection to 2020; POUs savings are 0.25% of retail sales less than IOUs
	Medium	IOU savings based on most-recent IRP projection to 2010 and maintain constant savings through 2020 (0.7% of retail sales); POUs savings are 0.25% of retail sales less than IOUs
	High	IOU savings based on most-recent IRP projection to 2010, ramping up to 1.5% of retail sales in 2020; POUs savings are 0.25% of retail sales less than IOUs
IL	Low	Spending is derived from assumed savings. For 2008-2010, savings are based on IOU EE plans. For 2011-2020, savings are equal to EEPS targets, but cost cap are assumed to be binding. Given assumptions about the cost of savings, cost caps become binding in 2012 (2% of revenues).
	Medium	Spending is derived from assumed savings. For 2008-2010, savings are based on IOU EE plans. For 2011-2020, cost cap is lifted, but savings are assumed to max out at 1.3% of retail sales in 2013 and remain at that level thereafter.
	High	Spending is derived from assumed savings. For 2008-2010, savings are based on IOU EE plans. For 2011-2020, cost cap is lifted, and EEPS targets are assumed to be fully achieved.
MA	Low	IOUs ramp up to a savings level of 1.5% of retail electricity sales in 2020
	Medium	IOU ramp up to 2012 savings level proposed in 2010-2012 statewide electric EE plan, and maintain annual savings percentage at that level through 2020
	High	Spending is derived from assumed savings. Savings projection assumes acquisition of all cost-effective EE, based on % of retail sales in CT EE potential study, up to a spending cap of 8% of revenue per year.
MD	Low	Spending through 2013 is based on the IOUs' and SMECO's approved EE plans, but with a 2-year lag. For 2014-2020, assume that spending remains flat at the 2013 level, equal to 1.7% of revenues. In all years, savings is derived from spending.
	Medium	Spending through 2016 is based on the IOUs' and SMECO's approved EE plans, but with a 1-year lag. For 2017-2020, spending remains flat at the 2016 level, equal to 2.1% of revenues. In all years, savings is derived from spending.
	High	Spending through 2011 is based on the IOUs' and SMECO's approved EE plans; savings are derived from spending. For 2012-2015, savings are based on achieving 50% of EmPower MD goals through utility programs, and spending is derived from savings. For 2016-2020, savings remain flat at the 2015 level
ME	Low	Continuation of Efficiency Maine's projected 2012 budget (0.8% of revenues from statewide electricity retail sales) through 2020.
	Medium	Savings ramp up from 0.6% of retail sales in 2010 (corresponding to Efficiency Maine's current budget for that year) to 1.2% of retail sales in 2020.
	High	The same as the Medium, except savings ramp up to 2.0% of retail sales in 2020.
MI	Low	Assumes full compliance with the EEPS.
	Medium	Same as Low Case
	High	Assumes that statewide savings ramp up from 1% of retail sales in 2012 to 1.2% in 2020.
MN	Low	Assume all utilities meet the minimum 1% EEPS target for conservation improvement programs.
	Medium	Assume utilities ramp up from 1% of retail sales in 2010 to 1.2% in 2020.
	High	Assume utilities ramp up from 1% of retail sales in 2010 to 2.0% in 2020.
MT	Low	NorthWestern savings follows its IRP savings projection to 2020; other utilities based on Group III approach
	Medium	Same as Low Case
	High	NorthWestern savings follows its IRP projection to 2010 and ramp up to 1.5% of retail sales in 2020; other utilities based on Group III approach

NC	Low	Assume that IOUs exhaust, but do not exceed, the EE allowance under the state RPS; assume that POUs first exhaust their allowable use of large hydro, and then meet 75% of their residual RPS needs (after all set-asides are met) with EE.
	Medium	Same as Low Case
	High	Assume that, on average, utilities ramp up from annual savings levels of 0.2% of retail sales in 2010 (as projected for that year in the Low/Medium Cases) to 1.0% in 2020.
NH	Low	Continuation of current SBC funding levels for electric EE (1.2%) of revenues from statewide electricity retail sales) through 2020.
	Medium	Savings ramp up from 0.6% of retail sales in 2010 (the projected savings under current funding levels) to 1.2% of retail sales in 2020.
	High	Same as the Medium Case, except savings ramp up to 2.% of retail sales in 2020.
NJ	Low	2009-2012 spending based on approved NJCEP funding; for 2013-2020, assume continuation of 2012 funding level (as a percentage of revenues).
	Medium	Equal to mid-point between Low and High case projections
	High	2009-2012 spending based on approved NJCEP funding. For 2013-2020, annual spending is derived from average annual savings level (1,500 GWh/yr) needed to meet the 2020 savings goal in the state's draft Energy Master Plan.
NM	Low	Full compliance with existing EEPS targets through 2020.
	Medium	Same as Low Case
	High	Follows EEPS compliance projection to 2010; assumes that IOUs ramp up savings to 1.5% of retail sales by 2020
NV	Low	Assumes savings equal to maximum EE allowance under the RPS through 2015; maintains constant savings from 2015-2020 (rather than tapering off, as would be the case if savings were equal only to RPS allowance in those years)
	Medium	Savings remain at 0.8% of retail sales from 2008-2010 (consistent with NPC DSM plan), rise to 1.0% in 2015, and remain at that level until 2020
	High	Savings remain at 0.8% of retail sales from 2008-2010 (consistent with NPC DSM plan) and rise to 1.5% in 2020
NY	Low	Maintain spending at a constant 1.5% of revenues (compared to 2007 budget equal to 1.0% of revenues)
	Medium	For 2009-2015, spending and savings levels are based on achieving the state's 15% by 2015 goal (as identified in a NYPSC Order). For 2016-2020, assume that spending as % of revenues continues at average level during 2009-2015 (2.8%)
	High	For 2009-2015, spending and savings levels are based on achieving the state's 15% by 2015 goal (as identified in a NYPSC Order). For 2016-2020, assume that that spending remains constant at 3.8% of revenues, which is 1% greater than the average during 2009-2015)
OH	Low	Assumes EE program savings levels achieved are equal to 50% of legislated EEPS targets, due to combination of: mercantile customer opt-out, reliance on T&D measures, PUC reduction of targets, and/or non-compliance
	Medium	Same as Low Case
	High	Assumes EE program savings levels achieved are equal to 70% of legislated EEPS targets, due to combination of: mercantile customer opt-out, reliance on T&D measures, PUC reduction of targets, and/or non-compliance
OR	Low	IOU savings follow IRP projections to 2020; POU savings are 0.25% less than IOUs
	Medium	Same as Low Case
	High	IOU savings follow IRP projections to 2010 and then ramp up to 1.5% of retail sales in 2020; POU savings are 0.25% less than IOUs
PA	Low	Assumes continued savings at the average annual level needed over 2010-2013 to reach the 2013 EEPS target.
	Medium	Same as Low Case
	High	Savings increase from 0.7% of retail sales in 2013 (the level in the Low/Medium cases) to 1.2% in 2020
RI	Low	Continuation of National Grid's proposed 2009 spending levels (1.7% of revenues).
	Medium	Savings ramp up from 1.0% of retail sales in 2010 (the projected savings under current funding levels) to 1.5% of retail sales in 2020.

	High	Same as the Medium Case, except savings ramp up to 2.3% of retail sales in 2020.
TX	Low	Spending is derived from projected peak demand savings under current goal of meeting 15% of incremental peak demand with EE in 2008 and 20% in 2009 and thereafter. Only IOUs are included in this calculation, as only IOUs are required by law to meet these targets.
	Medium	Spending is derived from projected peak demand savings under existing targets plus the additional, higher, target of 30% of incremental demand by 2015. In contrast to the Low Case, we assume both IOUs and POUs meet these targets.
	High	Assume total statewide savings (IOUs plus POUs) ramp up from .1% of retail sales in 2008 to 1.% in 2020.
UT	Low	Savings based on PacifiCorp's most-recent IRP proposal through 2020
	Medium	Savings based on PacifiCorp's most-recent IRP proposal through 2010; rise to 1.0% of retail sales in 2015 and remain at that level
	High	Savings based on PacifiCorp's most-recent IRP proposal through 2010; rise to 1.5% of retail sales in 2020
VA	Low	Assume that savings ramp up from 0% of retail sales in 2010 to 0.3% in 2020.
	Medium	Assume that savings ramp up from 0% of retail sales in 2010 to 0.5% in 2020.
	High	Assume that the proposed savings goals are formally adopted and achieved, with annual savings ramping up from 0% of retail sales in 2009 to 0.8-0.9% in 2013-2020 (the average annual level needed to meet the EEPS target).
VT	Low	Assume a continuation of Efficiency Vermont's approved 2011 spending levels plus Burlington Electric's 2008 EE budget (5.1% of revenues) through 2020.
	Medium	Same as Low Case
	High	Assume that savings ramp up from 2.09% of retail sales in 2011 (the projected amount for the approved budget in that year) to 2.3% in 2020.
WA	Low	Statewide acquisition of all achievable cost-effective potential at an avoided cost of $45/MWh (based on potential study results provided by Tom Eckman).
	Medium	Statewide acquisition of all achievable cost-effective potential at an avoided cost of $85/MWh (based on potential study results provided by Tom Eckman).
	High	Savings assumed to ramp up from 1.% of retail sales in 2010 to 1.5% in 2020.
WI	Low	Maintain electric EE spending at 2008 level of 1.2% of revenues
	Medium	Double spending on electric EE to 2.4% of revenues over 2009-2011
	High	Spending and savings based on achieving EEPS policy recommendation in Governor's Task Force on Global Warming (which directly provides spending as a % of revenues)

* Unless otherwise indicated, spending and savings projections for municipal utilities and cooperatives are developed using Tier II approach

Tier II Scenario Definitions

For Tier II states (and for municipal utilities and cooperatives in many Tier I states), spending projections were developed by employing a standardized set of assumptions about annual spending on ratepayer-funded energy efficiency, as a percentage of revenues (see Table D- 6). In the low-case scenario, ratepayer-funding for electric energy efficiency programs increases linearly from 0.1% of revenues in 2008 to 0.3% by 2020. In the medium case, spending increases from 0.1% of revenues in 2008 to 0.5% by 2012, and remains at that level through 2020. In the high case, spending increases linearly from 0.1% of revenues in 2008 to 0.8% by 2020 (which is slightly above the current national average of ~0.7% of revenues). The spending assumptions for Florida differ slightly from the other Tier II states, because Florida utilities currently administer electric energy efficiency programs with higher spending levels (i.e., ~0.4% of revenues) than other Tier II states. In the low case, Florida spending remains at 0.4% of revenues through 2020. The medium and high cases for Florida are the same as for the other

Tier II states, except that the initial spending level in 2008 is 0.4% of revenues (rather than 0.1%).

Table D- 6. Tier II State spending scenarios

Case		Ratepayer-Funded Electric EE Spending (% of Revenues from Retail Electricity Sales)												
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Generic	Low	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%
Generic	Medium	0.1%	0.2%	0.3%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Generic	High	0.1%	0.2%	0.3%	0.4%	0.5%	0.5%	0.6%	0.6%	0.7%	0.7%	0.7%	0.8%	0.8%
FL	Low	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
FL	Medium	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
FL	High	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.6%	0.6%	0.7%	0.7%	0.7%	0.8%	0.8%

D.1.3 Cost of Savings Assumptions

Depending on the particular state and scenario, the spending projection may have been estimated from projected first-year savings, or vice-versa. In either case, first-year savings were translated into annual spending (or vice-versa) using an assumed cost of savings. We assume that the average cost of savings depends on the savings level achieved. To capture this relationship, we developed a generic "cost function" that relates the average cost of first-year electricity savings to the savings level expressed as a percentage of the utility (or state)'s retail sales (see Figure D-1). The y-axis values in the figure are expressed on a normalized (unit-less) basis, with a cost of 1.00 at a savings level equal to 1.0% of retail sales. The rationale for this cost function is to reflect the fact that, based on our review of energy efficiency program experience, utility costs to acquire savings (on a dollar-per-MWh basis) can be somewhat higher when portfolio savings levels are low (i.e., annual savings <0.5% of retail sales), due to the effect of fixed program delivery costs and because the utility is implementing pilot programs or is ramping up the administrative and delivery infrastructure. There is also evidence to suggest that program costs increase at relatively high savings targets (i.e., annual savings >1.4% of retail sales) either because rebate levels may increase in order to achieve higher market penetration or because the utility includes more expensive energy efficiency measures in its program portfolio. The cost function was then applied to each state by "scaling" the generic cost function based on either state-specific program cost data or an assumed average cost of savings at savings equal to 1.0% of retail sales.[9] Average program costs in each year were escalated for inflation, using the AEO2009 reference case forecast of the GDP chain-type price index.

Table D-7 describes the state-specific program cost data, which are derived from recent program results or recently-approved program plans. All states not listed in Table D- 7 were categorized as either a Low-Cost state or a High-Cost state.[10] Low-Cost states were assumed to have

[9] For example, if data for a given state indicate that average program costs are $200 per 1st-yr. MWh saved at savings equal to 1.0% of retail sales, then the generic cost function would yield an average cost of $250 per 1st-yr. MWh at savings equal to 2.0% of retail sales (i.e., 1.25 times the cost at a savings level equal to 1.0% of retail sales).

[10] High-Cost states consist of: CO, HI, NH, and VT. All others (not listed in Table 7) are deemed Low-Cost.

average program costs equal to the national average in 2006: \$200 per 1st-yr. MWh saved at a savings level of 0.2% of retail sales, derived from data compiled by ACEEE (Eldridge et al. 2008). High-Cost states were assumed to have average program costs equal to \$275 per 1st-yr. MWh saved at a savings level of 1.0% of retail sales, which is based roughly on average costs currently observed among some Northeastern states.

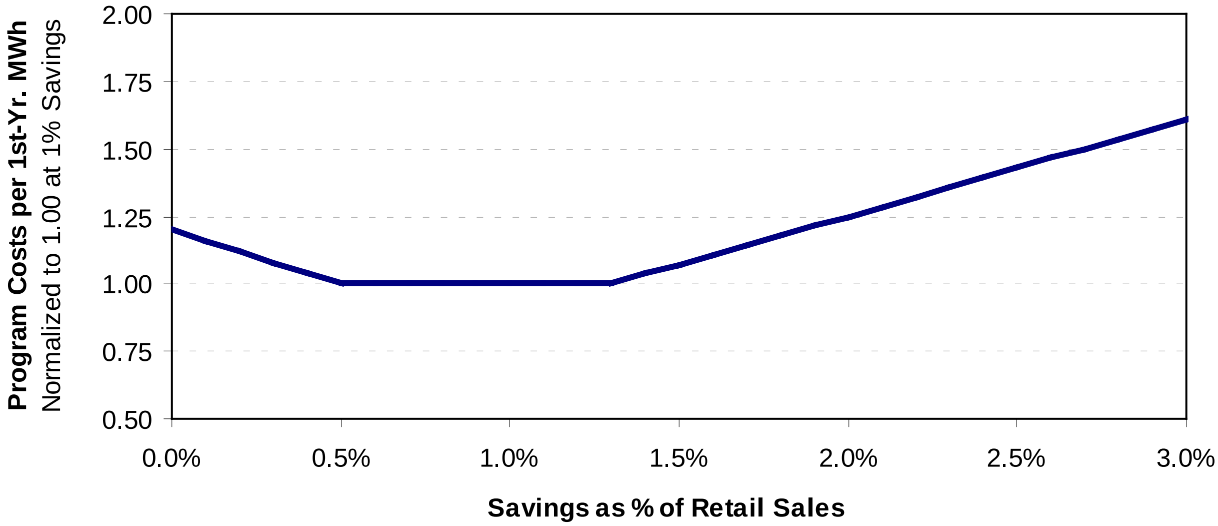

Figure D- 1. Generic program cost function

Table D- 7. State-specific program cost data

State	Unit Cost (2007\$ per 1st-yr MWh Saved)	Savings Level (% of retail sales)	Data Source and Notes
CA	246	0.8%	Unit cost value is derived from SCE verified savings data and budget for program years 2006/2007. Savings level value is derived from PG&E, SCE, and SDG&E verified savings in program years 2006/2007.
CT	276	1.1%	Based on the IOUs' 2007 C&LM program results.
IA	166	1.1%	Based estimated savings and spending in MidAmerican's and IP&L's 2009-13 EE program plans
IL	192	0.7%	Based on estimated savings and spending in 2010 from the IOUs' 2008-2010 EE program plans, including programs administered by the DCEO
MA	266	0.9%	Based on the IOUs' 2005 EE program annual reports
MD	177	0.8%	Based on the proposed spending and savings in 2009-2011 from the IOUs' and SMECO's 2009-2015 EE program plans
NJ	168	0.7%	Based on proposed 2008 spending and savings for the NJCEP

NY	284	0.9%	Estimated from data cited in the NYPSC order adopting annual savings targets (6/23/08). The PSC order indicates that the incremental annual EE savings above current annual savings levels will cost $305/MWh and that this is 25% higher than current program costs. Given the size of the proposed savings levels relative to current annual savings, this implies an average cost of savings of $284/MWh.
TX	188	0.2%	Based on the IOUs' 2007 program results
WA	260	1.0%	Estimated from market potential and total resource cost data provided by Tom Eckman (NPCC). We estimate program spending from the TRC by assuming that programs cover 50% of the incremental measure cost, and non-incentive program costs represent 25% of total program spending.
WI	213	0.5%	Based on 2006 statewide spending and savings data reported by ACEEE.

D.2 Natural Gas Energy Efficiency Spending Projections

Low, medium, and high projections of spending on ratepayer-funded natural gas energy efficiency programs through 2020 were also developed. Given that spending on natural gas programs represents a relatively small portion of total (electric plus gas) ratepayer-funded spending, we utilized a simpler, and more standardized approach to project future spending, compared to the electric energy efficiency projections.

D.2.1 Revenue Projections

Projections of revenue from retail natural gas sales to residential, commercial, and industrial customers (i.e., excluding sales to electric utilities) were developed in a similar manner as the baseline projections of revenue from retail electricity sales. Retail sales and retail price projections were first developed for each state by applying annual growth rate projections from the AEO2009 reference case forecast (April 2009 update) to actual 2007 retail sales and price data for each state, as reported by EIA. Retail gas sales include sales to residential, commercial, industrial, and transportation sectors, but exclude sales to the electric power sector. Average annual retail gas prices were calculated as the average of EIA's forecast of prices for the residential, commercial, industrial, and transportation sectors, weighted by the quantity of sales to each sector. The natural gas retail sales and retail price projections in AEO2009 are specified at the census-region level. Thus, the census-level growth rates were applied to each state in the respective region. Revenue projections were calculated by multiplying projected retail gas prices by projected retail gas sales, and were converted to nominal dollars using the AEO2009 reference case forecast of the GDP chain-type price index. Unlike the electricity revenue projections, no adjustments were made to the natural gas revenue projections to account for differing levels of energy efficiency savings across scenarios.

D.2.2 Scenario Definitions

States were categorized into one of two groups. Tier I states are those with 2008 natural gas efficiency budgets greater than 0.3% of revenues (approximately the national average in that year), based on CEE 2008 budget data (Consortium for Energy Efficiency 2008). Tier II consists of states with funding below that level and for which 2008 budget data was unavailable. Table D- 8 identifies which states are in each group.

Table D- 8. Segmentation of states into Group I and Group II for natural gas projections

Tier I	CA, CT, FL, IA, MA, ME, MN, NH, NJ, OR, RI, UT, VT, WA, WI
Tier II	AK, AL, AR, AZ, CO, DC, DE, GA, HI, ID, IL, IN, KS, KY, LA, MD, MI, MO, MS, MT, NC, ND, NE, NM, NV, NY, OH, OK, PA, SC, SD, TN, TX, VA, WV, WY

For most Tier I states, spending scenarios for gas energy efficiency programs were developed by simply stipulating the increase in spending, as a percentage of revenues, from 2008 to 2020, and assuming a linear ramp up to those spending levels. The stipulated spending increases, relative to 2008, are 0% of revenues for the low case, 0.2% for the medium case, and 0.4% for the medium case. There were several exceptions to this standardized approach, made for the three states with the largest natural gas efficiency budgets in 2008:

- For California, the low and medium scenarios assume statewide spending in each year is equal to ratio of the CPUC’s long-term gas savings goal in that year relative to the 2008 goal, multiplied by the statewide 2008 natural gas efficiency budget (as reported by CEE). Because the CPUC’s long-term natural gas savings goals decline over time, so do the projected spending levels in the low and medium cases. In the high case, we assume that spending on natural gas efficiency remains constant at the level of the 2008 budget, as a percentage of revenues.
- For New Jersey, in the high case, we assume that natural gas spending for 2009-2012 is equal to the approved budget for those years, and remains constant at the 2012 dollar amount through 2020. The low and medium cases are based on the standardized approach for Group I states.
- For Wisconsin, in the high case, we assume that natural gas spending through 2020 is equal to the level indicated in the Governor's Task Force on Global Warming: Interim Report (Feb 2008) as required to meet the proposed natural gas EEPS. The low and medium cases are based on the standardized approach for Group I states.

For Tier II states, gas efficiency spending levels were projected by stipulating the 2020 savings, as a percentage of revenue, for each scenario, and assuming a linear ramp-up from current spending levels. The stipulated 2020 spending levels were: in the low case, the greater of 0% of gas utility revenues or current spending; in the medium case, 0.3% of gas utility revenues; and in the high case, 0.5% of gas utility revenues.

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