Assessment of
All Available Cost-Effective Electric and Gas Savings: Energy Efficiency and CHP

Submitted to the MA EEAC by its Consultants
June 19, 2009

Based on the data collected and presented to the Council on May 26, 2009 (memo attached as Appendix A) and considering the limitations of energy efficiency potential studies (described in more detail in Appendix A), the Consultants have estimated that a reasonable long-term value for all available cost-effective electric energy efficiency savings from the combination of energy efficiency programs and combined heat and power (CHP) is at least 3 percent per year.[1] This is composed of at least 2.5 percent per year from electric efficiency programs and 0.5 percent per year from CHP. For natural gas, the Consultants estimated that a long-term value for all available cost-effective energy efficiency savings is at least 2 percent per year. These values reflect average annual potential over a ten year horizon and therefore are longer term values.

It should be noted that the longer it takes to ramp up to these savings levels, the higher future savings would need to be to capture all available cost-effective savings. In addition, we believe that for retrofit and early retirement markets it is possible to expedite savings acquisition and exceed these annual figures.[2]

See the sections below for the derivation of the individual estimates for electric energy efficiency programs, CHP, and gas energy efficiency programs.

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[1] The level of at least 3% annual energy savings would be reached at the end of the initial ramp up period, not immediately in 2010.

[2] For example, Efficiency Vermont captured approximately 4.5% electric efficiency savings in 2008 among geo-targeted areas by aggressively pursuing retrofit opportunities.

All Available Cost-Effective Electric Energy Efficiency Program Savings

Based on the data collected and presented to the Council on May 26th, the Consultants have estimated that a reasonable value for all available cost-effective electric energy efficiency savings is at least 2.5 percent per year.

The Consultants selected three studies, all from New England, from the thirteen studies reviewed and summarized for the Council (Appendix A) as most representative of the likely available cost-effective savings in Massachusetts. These are summarized in the following table:

State	Year of Study	Analysis Period (yrs.)	Achievable* (% of total forecast load)	Average Annual Achievable** (% of total forecast load)	Source	Notes
Connecticut	2009	10	22.5%	2.3%	KEMA	Total achievable potential estimated at 31% including codes & appliance/lighting standards. Accounted for the impact of federal lighting standards in 2012-2014 to reduce the program achievable savings.
New Hampshire	2009	10	22.7%	2.3%	GDS	Ignored most retrofit (early retirement) savings, so viewed as substantially low.
Vermont	2007	10	22.0%	2.2%	GDS	Constrained analysis to 50% of incremental cost incentive levels. For some markets, estimate of achievable was already being exceeded by Efficiency VT at the time of the study. In 2008 EVT achieved 2.5% savings statewide and 4.5% in geotargetted areas (unevaluated results).
Averages		**10.0**	**22.4%**	**2.24%**		Mean of data available.

Of the ten studies not included in the table above:
- Four did not present an estimate of achievable potential,
- Two were from mid-Atlantic states,
- Two others were older studies (one of which has been superseded by a newer study showing a lower potential), and
- Two (the study for NSTAR and the study of New England for NEEP) were not primary data studies, but were high-level assessments (similar to this assessment) drawing from a compilation of other, older studies, some of which have been superseded by more recent studies.

The three studies listed above:
- Cover a New England setting,
- Include an estimate of achievable potential,[3] and
- Were performed by different entities.

The average annual achievable potential reported by these studies is approximately 2.24% per year, all over a ten year horizon. This is very close to the 2.2% average of all nine studies in the list in Appendix A that presented an estimate of achievable potential. Therefore, whether the three studies in the table above or the longer list of studies in Appendix A are used, the studies report average achievable potential of about 2.2%.

There are several reasons why these studies are likely to have understated the available cost-effective savings in Massachusetts.

- As stated in the May 26 memo (Appendix A) and summarized directly below, potential studies generally underestimate the true potential for many reasons, including:

    o Many studies are arbitrarily constrained in scope.

    o Many studies ignore technology advancement.

    o Economic analyses tend to exclude all benefits.

    o Studies are limited by time and resources, and thus simplified by exclusion of many measures and/or categories of measures.

    o Interactions that magnify opportunities and systems that treat whole buildings comprehensively are often ignored.

    o Studies stretch out early replacement opportunities throughout the full analysis period.

In addition to these general conservatisms, we note below some specific issues with the above studies that would lead them to be low estimates of the true achievable potential.

- At least one entity in the region (Efficiency Vermont) has *already achieved statewide electric efficiency program savings of 2.5%*, higher than the estimate of achievable potential in the Vermont study, thus establishing this is possible. Note that only two (out of 13) studies have implied annual achievable potential that meets or

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[3] The Consultants consider the achievable potential values in these studies to be equivalent to "all available cost effective energy efficiency savings" because achievable potential includes only those savings that are cost-effective and available or achievable.

exceeds Vermont's 2008 statewide achievement. Further, EVT achieved 4.5% electric efficiency savings across several geographical targeted areas in 2008. [4]

- The New Hampshire study excluded most retrofit measures, and is therefore considered a highly conservative estimate of potential.

- The Vermont study was widely criticized as conservative. In some markets, the potential estimate was lower than actual achievements by Efficiency Vermont. A prior VT study completed in 2003 estimated 30% achievable potential, or roughly 36% greater potential.

Because the studies are likely to understate achievable potential, the Consultants estimated that the value for all available cost-effective savings in Massachusetts is *at least* 10 to 15 percent greater than the 2.24 percent per year average from the studies above. The Consultants therefore believe that a target of at least 2.5 percent savings per year from electric energy efficiency programs is a reasonable long-term estimate of all available cost-effective savings.

Combined Heat and Power

The Consultants previously reviewed two studies that estimated achievable CHP savings of 0.3 and 1.1 percent of load annually. We have reviewed additional efforts to estimate cost-effective electric savings from CHP in Massachusetts, one conducted by KEMA on behalf of the Massachusetts Renewable Energy Trust and one conducted by NESCAUM.[5] The two studies have been added to the table below. Because the number of available studies is limited, none was removed from consideration of the available cost-effective savings.

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[4] *Efficiency Vermont (EVT) Preliminary Annual Report*, March 2009

[5] KEMA, *The Market Potential for Combined Heat and Power in Massachusetts,* prepared for the Massachusetts Technology Collaborative, June 2006; and NESCAUM, *The Economic Potential for Combined Heat and Power in Massachusetts,* November 2007.

State	Year of Study	Analysis Period (yrs.)	Achievable Potential (% of total forecast load)	Average Annual Achievable* (% of total forecast load)	Source	Notes
Massachusetts (NSTAR Only)	2007	10	3.2%	0.3%	OEI	Constrained potential recognizing no programs existed at the time, no clear ability to coordinate with gas utilities, or assumptions about improved stand-by or interconnection policies.
New York	2002	10	10.5%	1.1%	Energy Next	Estimates are net of expected natural market adoption. The study did not estimate achievable potential. "Achievable" estimate represents assumed market penetration without any state or utility programs but with reduction by 50% of stand-by charges and a 10% federal tax credit only. Figures are based on installed load estimates, 65% of electricity used on-site (Study estimate for existing NY CHP load) and assumed 80% load factor.
Massachusetts	2008	see notes	4.3%	0.4%	KEMA/RET	Study extended through 2026, but figures here are based on reported results from 2010 through 2019. Figures are based on installed capacity estimate, assuming load factor of 80%.
Massachusetts	2007	see notes	5.7%	0.6%	NESCAUM	Study extended through 2026, but figures here are interpolated to the period 2010 through 2019. Figures are based on installed capacity estimate, assuming load factor of 75%.
Averages		10	5.9%	0.6%		Mean of data available.

The two newly-listed Massachusetts state-wide studies are both based on the Massachusetts technical potential study conducted in 2006 and included in the previous memo (Appendix A). Both studies assessed the economic feasibility of CHP installations, and the NESCAUM study included the effect of policy actions to encourage CHP installations. The potential estimates reported here are net of baseline installations assumed to occur in the absence of any changes to current conditions or policies.

The Consultants also considered the effect of the Alternative Portfolio Standard (APS) on CHP installations. This calls for 25% of load to come from "clean energy" by 2020, with 20% coming from renewables. This leaves 5% for three specific non-renewable clean energy technologies: CHP, flywheel storage, and IGCC with carbon capture and sequestration. The latter two technologies are not commercially viable at this time. Given that CHP is a commercially viable technology with an extensive installed base, it is extremely likely that the entire 5% non-renewable APS will need to be met with CHP within the next 11 years, rather than the other technologies. This translates to 0.45% per year for 11 years (2010-2020). As a result, in order to meet the APS standards, PAs would need to capture roughly half a percent of load per year on average from CHP.

Given these data points, the Consultants feel that the cost-effective savings available from CHP is *at least* 0.5 percent per year for the next 10 years. This is lower than the average of the quantitative studies available and comparable to the requirements of the APS, which can be viewed as a minimum level of effort.

All Available Cost-Effective Gas Energy Efficiency Program Savings

Based on the data collected and presented to the Council on May 26th, the Consultants have determined that a reasonable estimate for available cost-effective gas savings from energy efficiency programs is *at least* 2.0 percent per year.

The Consultants selected three of the four studies reviewed and summarized for the Council as most representative of the available savings in Massachusetts. These are summarized in the following table:

State	Year of Study	Analysis Period (yrs.)	Achievable * (% of total forecast load)	Average Annual Achievable** (% of total forecast load)	Source	Notes
Connecticut	2009	10	17.0%	1.7%	KEMA	Final draft. Gas efficiency only. Total achievable including codes & standards estimated at 22%.
New Hampshire	2009	10	21.1%	2.1%	GDS	Ignored most retrofit (early retirement) savings. Typically retrofit measures account for a large portion of EE opportunities over 10 years.
New York	2006	10	19.0%	1.9%	OEI	Conservative estimate of max achievable based on 67% of economic, without detailed analysis.
Averages		10.0	19.0%	1.9%		Mean of data available.

The only study excluded from those initially considered did not present an achievable potential estimate. The remaining studies:
- Included achievable potential[6] estimates, though we believe the studies understate the potential rather than overstate it, based on known factors discussed above and in Appendix A, and
- Were performed by three different entities.

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[6] The Consultants consider the achievable potential values in these studies to be equivalent to "all available cost effective energy efficiency savings" because achievable potential includes only those savings that are cost-effective and available or achievable.

The average annual achievable potential reported by these studies is approximately 1.9 percent per year. In addition to the general discussion above and in Appendix A about study results tending to be conservative, there are several specific reasons why these studies are likely to have understated the efficiency potential.

- The New Hampshire study excluded most retrofit measures, and is therefore likely highly conservative, as retrofit opportunities typically account for the majority of potential.
- The New York Study only reported economic potential, from which the Consultants derived achievable potential using a conservative factor of 67 percent. This is the same ratio of achievable potential to economic potential estimated by the Connecticut gas potential study, and lower than that from the three electric potential studies which reported both economic and achievable potential (i.e., 80, 78 and 68 percent).

Because these studies are likely to understate achievable potential, the Consultants estimated that *at least* 2.0 percent per year is a reasonable estimate of all available cost-effective natural gas savings from energy efficiency programs in Massachusetts.

Note that the Consultants have not estimated the amount of natural gas that will be used in CHP projects (thereby increasing natural gas consumption). The Consultants recommend that the gas savings from the energy efficiency programs be tracked specifically, distinct from the impacts of the CHP projects, and therefore have estimated the 2.0% gas savings for the energy efficiency programs specifically.

Appendix A

Assessment of All Available Cost-Effective
Energy Efficiency and Combined Heat and Power Resources:
Regional Findings

Submitted to the MA EEAC by its Consultants
May 26, 2009 (Revised)

Introduction and Caveats

The Green Communities Act requires the electric and gas program administrators to assess the available energy efficiency and combined heat and power (CHP) cost-effective potential as a part of establishing their statewide and individual goals. The assessments need to demonstrate that Program Administrators are seeking to acquire all available cost effective efficiency over the life of each three year plan. Correctly determining the assessment is an iterative process, a significant part of which is reviewing past work in Massachusetts and other states. All assessments are estimates, subject to many variables which are discussed in this paper.

This document provides the EEAC with historic results from relatively recent electric and gas energy efficiency and combined heat and power (CHP) potential studies. We also provide a summary of current efficiency program goals or legislative mandates in various states. Below are tables summarizing the results. It should be noted that many energy analysts believe that virtually all studies tend to produce conservative (*i.e.,* low) estimates of potential for a variety of reasons. Indeed, some studies have estimated achievable potential for some markets that were already being exceeded by reported results in the same area. There are many reasons why studies tend to estimate low potential.[7] Below are some of the major biases:

- **Many studies are arbitrarily constrained in scope.** For example, some studies have only considered efficiency opportunities from "lost opportunity" markets (driven by natural investments in buildings and equipment over time), thus eliminating large opportunities for early retirement (retrofit) of equipment and systems. Other studies constrain overall funding available, program designs, incentive levels, policies and other parameters. Where possible, we have tried to note major constraints.
- **Many studies ignore technology advancement.** Advances in technology can range from reductions in costs and improvements in performance over time, as well as dramatic new technologies that have potentially large impacts on future efficiency opportunities (*e.g.,* LED lighting). Even those studies that attempt to include emerging technologies typically only include a very limited set.
- **Economic analyses tend to exclude all benefits.** For example, rarely are demand induced price effects considered. It is also common to omit non-electric benefits from electric studies (and non-gas benefits from gas studies). Many analyses of retrofit opportunities (early retirement) do not take

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[7] See, for example, Goldstein, David, *Extreme Efficiency: How Far Can We Go if We Really Need To?*, Natural Resources Defense Council, ACEEE Summer Study, 2008 for a more comprehensive list of reasons studies tend to be biased on the low side.

full accounting of the long term cost savings from deferral of the natural equipment replacement cycle and often substantial O&M benefits.

- **Studies are limited by time and resources, and thus simplified by exclusion.** An analyst can never include a fully comprehensive assessment of all possible technologies and practices. As a result, any exclusions are implicitly valued at zero, simply because they are not researched and analyzed. Rather than including approximate estimates for their inclusion, they are completely eliminated. For example, many studies omit measures that do not address the major end uses such as lighting, HVAC and refrigeration. As a result, things like plug load and other miscellaneous measures may be ignored. Some studies also do not fully address industrial process opportunities.
- **Interactions that magnify opportunities and systems that treat whole buildings comprehensively are often ignored.** Most studies do a good job of reducing savings from one measure as a result of prior assumed measures (*e.g.,* if a building shell is improved, it can reduce the savings from an efficient air conditioner). However, they nonetheless consider discrete measures rather than using a more systems-based approach. These approaches can often take advantage of significant synergies that may allow for dramatic down-sizing or even eliminating of major capital equipment, thus rendering a much greater package of measures with deeper savings cost-effective.
- **Studies stretch out early replacement opportunities throughout the full analysis period.** Many studies do not consider the ability to fast-track early retirement savings, but simply spread the estimated achievable participation rates across the whole timeframe. In some cases, with unconstrained funding programs could target and capture these opportunities faster.

Indeed, the mean of annual achievable program electric efficiency potential shown in the table below is 2.2%. However, Efficiency Vermont has already exceeded this level in 2008 with statewide savings of 2.5%.[8] Further, EVT captured 4.5% of the current electric load from efficiency savings in specifically targeted geographic areas in 2008.[9]

One should not view efficiency potential as a finite amount that goes away once captured. Indeed, experience has shown that technologies have generally at least kept pace with past improvements in codes & standards, public efficiency program investments, and naturally adopted efficiency. For example, in 1989 the American Council for an Energy Efficient Economy (ACEEE) estimated the economic potential in New York to be approximately 30% of forecast load. After more than two decades of significant electric DSM program delivery in NY, a team led by Optimal Energy in 2003 (which included ACEEE) re-estimated the efficiency economic potential at 32.7% of forecast load, or approximately the same level. Thus, in a state that has been a leader in efficiency programs throughout the 1990s and 2000s, roughly the same proportional electric efficiency opportunities exist now as did when programs began. As a result, studies with longer time horizons tend to result in conservative implied annual achievable potential estimates.

Potential Results

The tables below provide summaries of results from available studies throughout the Northeastern U.S. -- most within the past decade. While we report, where available, the estimates of technical and economic potential, our focus is on achievable potential, as that should most closely align with Massachusetts' goal of

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[8] Efficiency Vermont 2008 Annual Report, March 2009. These figures are not yet fully verified by the VT DPS and are subject to adjustment. Past adjustments based on VT DPS EM&V process have ranged from 2% to 12% reduction in tracking estimates.

[9] Ibid. Analysis of geo-targeted loads based on 2006 actual electric loads and assumed 1.5% annual underlying (*i.e.,* without efficiency programs) growth.

capturing all *available* cost-effective efficiency. All figures should reflect *net* savings, excluding naturally occurring efficiency and codes & standards.

While definitions can vary from one study to the next, in general *technical* potential is defined as the net savings from all technically feasible efficiency opportunities without regard to economics or a customer's willingness to adopt them. *Economic* potential refers to the subset of technical potential that is cost-effective based on an economic screening. The cost-effectiveness test used varies among jurisdiction. However, the prevailing cost-effectiveness criteria in the region is the total resource cost test (TRC), which is also used in MA. However, rarely if ever is DRIPE included. *Achievable* potential is generally defined as the maximum amount of efficiency that can be expected to be captured with fully funded, well designed programs. However, in some cases, estimates reflect achievable potential subject to various economic, programmatic, budgetary, or other constraints. As such, the average results for achievable potential can be viewed as a low estimate of true maximum achievable potential.

Electric Efficiency

Achievable electric efficiency potential estimates range from a low in Maine (14%)[10] to a high in the Mid-Atlantic (37%). The mean from these studies is 24.3% of the forecasted future load (at the end of the analysis period) assuming no other interventions in the market. The study periods range from 5-20 years, with an average of 12. The implied *annual* achievable potential is shown by dividing the ultimate achievable potential by the analysis period. This ranges from 1.4% to 3.1%, with a mean of 2.2%. It should be noted that only two (out of 13) studies have implied annual achievable potential that meets or exceeds Vermont's 2008 statewide achievement, and none that approach EVT's 2008 geo-targeting achievement. These numbers do not include any savings potential from CHP.

Note that the New England study for NEEP was a meta-analysis that relied on several older studies that reported relatively low potential, typically as a result of a limited scope.[11] For example, a 2005 study for Connecticut (that was also applied to Rhode Island) estimated only 13.5% achievable potential savings. However, this study has been superseded by the newer KEMA study shown above estimating 22.5%. Given the significant share of New England electric load represented by these two states, this single change to the estimated CT and RI potential would have dramatically increased the NEEP study findings for the region.

Also note that the 2007 study for NSTAR was not a primary data study, but was a high-level assessment (similar to the assessment developed by the Council's Consultants) drawing from a compilation of other, older studies, some of which have been superseded by more recent studies.

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[10] The Maine study excluded some major efficiency markets, including low income retrofit and all new construction opportunities.

[11] For instance, a potential study for Maine that was included in the meta-analysis excluded all low-income retrofit opportunities and the entire new construction market.

Electric Efficiency Potential

State	Year of Study	Analysis Period (yrs.)	Technical Potential (% of total forecast load)	Economic Potential (% of total forecast load)	Achievable * (% of total forecast load)	Average Annual Achievable** (% of total forecast load)	Source	Notes
Connecticut	2009	10	36.4%	33.1%	22.5%	2.3%	KEMA	Total achievable potential estimated at 31% including codes & appliance/lighting standards. Accounted for the impact of federal lighting standards in 2012-2014 to reduce the program achievable savings.
Maine	2002	10	N/A	18.0%	14.0%	1.4%	Exeter/ OEI	Simplified analysis based on prior utility data. Did not include low income retrofit (early retirement) nor all new construction markets.
Maryland	2008	17	N/A	N/A	29.0%	1.7%	ACEEE	
Mass (Nstar only)	2007	10	N/A	N/A	17.9%	1.8%	OEI	High level analysis, electric efficiency only figure. With CHP estimate is 21.1%.
Massachusetts	2001	5	N/A	24.0%	N/A		RLW	
Mid-Atlantic (NY/NJ/PA)	1997	14	N/A	N/A	37.0%	2.6%	ACEEE	Represents approximate weighted average of sector-specific estimates of 35% Residential, 35% Commercial and 41% Industrial.
New England	2004	10			23.0%	2.3%	OEI	Meta-analysis for NEEP. Older relatively low CT and ME estimates drove result down. CT study was also assumed to apply to RI. More recent CT and RI studies would have resulted in significantly higher estimate.
New Hampshire	2009	10	27.6%	N/A	22.7%	2.3%	GDS	Ignored most retrofit (early retirement) savings, so viewed as substantially low.
New Jersey	2003	17	N/A	17.0%	N/A		KEMA	
New York	2003	20	35.1%	32.7%	N/A	N/A	OEI	Forthcoming update with achievable potential has initially estimated about18% over 7 years, or approximately 2.5%/yr. Still in draft.
Rhode Island	2008	10	28.0%	24.0%	N/A		KEMA	Phase 1 high level study. Detailed study forthcoming in 2009.
Vermont	2003	10	N/A	38.4%	30.7%	3.1%	OEI	
Vermont	2007	10	34.6%	N/A	22.0%	2.2%	GDS	Constrained analysis to 50% of incremental cost incentive levels. For some markets, estimate of achievable was already being exceeded by Efficiency VT at the time of the study. In 2008 EVT achieved 2.5% savings statewide and 4.5% in geotargetted areas (unevaluated results).
Averages		**11.8**	**32.3%**	**26.8%**	**24.3%**	**2.18%**		Mean of data available.

* "Achievable potential" definitions can vary significantly. In some cases this is estimated as the maximum amount of EE that can be achieved from programs, with no constraints. However, many studies only analyze what could be achieved for a particular set of programs, incentive levels, or budget or rate impact constraints. In addition, some studies exclude some major EE markets completely. For example, some studies have excluded new construction, industrial process, early retirement, fuel switching, or other major opportunities. As a result, these figures should generally be viewed as conservative estimates. Finally, none of the these studies any savings from CHP.

** Average Annual Achievable represents the total estimated achievable potential percent divided by the planning period.

Combined Heat and Power

In MA the goal is to capture all available cost-effective energy efficiency *and* combined heat and power opportunities. As a result, it is useful to also consider estimates of CHP opportunities. There is less available experience and research on CHP achievable potential. CHP has generally not been promoted by efficiency programs. Rather, the installed CHP capacity now existing in the region has been mostly developed through natural market forces, and in some cases very limited incentives or tax breaks. As a result, the ability to dramatically influence CHP adoption with MA programs is unclear. However, a review of studies in NY and MA indicate *technical* CHP potential of between 40% and 62% of total electric load, with a mean of 51%.[12] Thus, it seems clear that the theoretical opportunities for CHP in MA are very large.

The NY study estimated "market potential" assuming a halving of current NY stand-by charges and a federal tax credit of 10% of installed cost, however, no other interventions in the market. Based on these assumptions it projected 10.5% CHP market potential, or 1.05% of total electric load per year. Certainly, well funded aggressive CHP programs in MA would presumably have been estimated by this study's authors to exceed this limited intervention scenario. In addition, a study for NSTAR that considered whether it was feasible to meet all load growth with EE and CHP made a high level estimate that, starting from scratch and assuming no changes to policies such as stand-by rates or interconnection agreements, could provide 3.2% of total load savings in 10 years, or 0.32%/yr. The mean implied annual achievable CHP potential from the two studies that provide estimates is 0.7%. Because the CHP studies are limited, and the range of estimated potential is large, more research is needed on CHP opportunities and likely customer adoption from well designed programs. This is being undertaken in RI, and will also be further analyzed in MA this year.

Electric CHP Potential								
State	**Year of Study**	**Analysis Period (yrs.)**	**Technical Potential (% of total forecast load)**	**Economic Potential (% of total forecast load)**	**Achievable Potential (% of total forecast load)**	**Average Annual Achievable* (% of total forecast load)**	**Source**	**Notes**
Massachusetts	2006	Instan-taneous	62.0%	N/A	N/A	N/A	U of MA, Amherst	Figure based on installed load estimate, 65% of electricity used on-site (NY Study estimate for existing NY CHP load) and assumed 80% load factor. Based on fraction of current MA load.
Massachusetts (NSTAR Only)	2007	10	N/A	N/A	3.2%	0.3%	OEI	Constrained potential recognizing no programs existed at the time, no clear ability to coordinate with gas utilities, or assumptions about improved stand-by or interconnection policies.
New York	2002	10	40.4%	N/A	10.5%	1.1%	Energy Nexus	Estimates are net of expected natural market adoption. The study did not estimate achievable potential. "Achievable" estimate represents assume market penetration without any state or utility programs but with reduction by 50% of stand-by charges and a 10% federal tax credit only. Figures are based on installed load estimates, 65% of electricity used on-site (Study estimate for existing NY CHP load) and assumed 80% load factor.
Averages		**10**	**51.2%**	**N/A**	**6.9%**	**0.7%**		Mean of data available.

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[12] The studies estimated installed capacity rather than energy production. Estimates assume 65% of electric generation is used on-site (thus reducing line losses, based on the historic CHP installed in NY) and an average load factor for CHP systems of 80%.

Total Electric Efficiency and CHP Potential

The mean implied annual achievable potential estimates for both electric efficiency and CHP sum to 2.9%. The range of annual levels is from a low of 1.7% to a high of 4.2%.[13]

Gas Efficiency

As with CHP, gas energy efficiency has not benefited from as long or as aggressive efficiency efforts as the electric sector. As a result, there are fewer studies for the region, and less experience with fully funded programs and portfolios. The table below includes 4 studies done in the past 6 years. The achievable potential ranges from a low in Connecticut 17% to a high in New Hampshire of 21%. The mean is 19%. Implied annual achievable potential from these studies is a mean of 1.9%, with a range of 1.7% to 2.1%. The 4 studies have substantially less variation than the electric studies, despite the fact that one study excluded all but a few retrofit (early retirement measures) because the policy focus was on capturing savings only at the time of natural customer investment in equipment and systems, and another study excluded new construction and other opportunities related to new load growth. The one study (NJ) that did not provide *achievable* potential had a slightly higher *economic* potential estimate than any of the other studies, indicating it likely would have found achievable potential to be equal or higher than the mean.

Gas Efficiency Potential

State	Year of Study	Analysis Period (yrs.)	Technical Potential (% of total forecast load)	Economic Potential (% of total forecast load)	Achievable * (% of total forecast load)	Average Annual Achievable** (% of total forecast load)	Source	Notes
Connecticut	2009	10	29.0%	25.0%	17.0%	1.7%	KEMA	Final draft. Gas efficiency only. Total achievable including codes & standards estimated at 22%.
New Hampshire	2009	10	29.2%	N/A	21.1%	2.1%	GDS	Ignored most retrofit (early retirement) savings. Typically retrofit measures account for a large portion of EE opportunities over 10 years.
New Jersey	2003	17	N/A	30.0%	N/A		KEMA	Constrained to existing load, so excluded new construction opportunities and other efficiency from load growth.
New York	2006	10	N/A	28.3%	19.0%	1.9%	OEI	Conservative estimate of max achievable based on 67% of economic, without detailed analysis.
Averages		11.8	29.1%	27.8%	19.0%	1.9%		Mean of data available.

* "Achievable potential" definitions can vary significantly. In some cases this is estimated as the maximum amount of EE that can be achieved from programs, with no constraints. However, many studies only analyze what could be achieved for a particular set of programs, incentive levels, or budget or rate impact constraints. In addition, some studies exclude some major EE markets completely. For example, some studies have excluded new construction, industrial process, early retirement, fuel switching, or other major opportunities. As a result, these figures should generally be viewed as conservative estimates. Finally, none of the these studies any savings from CHP.

** Average Annual Achievable represents the total estimated achievable potential percent divided by the planning period.

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[13] Summing the lowest efficiency and CHP values for the low range and the highest for the high range.

Energy Efficiency Resource Standards

In addition to the above data on regional potential studies, shown below are recent state regulatory or legislative goals set for electric and (where noted) gas efficiency. This is based on *Laying the Foundation for Implementing a Federal Energy Efficiency Standard,* ACEEE, March 2009, report no. E091. The far right column provides the "implied annual efficiency savings target" as a percentage of the ultimate years load. For some EERS, goals were set based on reducing load to a portion of current load. In this case, average annual underlying growth in the load forecast net of energy efficiency programs was assumed to be 1.5%. In some cases, states have adopted *Renewable* Portfolio Standards (RPS) that allow some goals to be met with efficiency. In this case, EE targets are shown based on the maximum allowable use of EE to meet the RPS.[14] In some cases, goals are not clearly defined, and the table shows current plans.

Annual electric efficiency savings goals (as a percent of total electric load) range from a low of 0.4% in NC to a high of 3.25% in MD. Ten of 22 states have implied annual electric efficiency goals of 2.0% or more. Of the 9 states in the Mid-Atlantic and New England region, all but 3 have electric efficiency goals in excess of 2.0% per year.[15] It is likely that most if not all of these estimates exclude CHP, although a thorough analysis of whether any do include CHP has not been completed.

Annual gas efficiency goals are much more limited. Of the 5 states with established goals, all but one (IA at 0.3%) are 1.5% or greater. Within the Region's 4 states, NY has a goal of 1.5%/yr., while the others require all cost-effective achievable potential (assumed here to be 2.0% or more).

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[14] Eenergy efficiency is generally far cheaper to capture than renewable energy. Experience has shown that utilities generally plan to maximize use of energy efficiency in meeting RPS goals.

[15] Note, a number of states – including MA -- require all available cost-effective efficiency. This is assumed to equal at least 2.0%/yr.

State	Date Established	Goal	Target End Date	Implied Annual % savings* (% of total forecast load)
		State Energy Efficiency Resource Standards Activity		
Texas	2007	20% of load growth	2010	0.5%
Vermont	2008	2.0% per year (contract goals)	2011	2.0%
California	2004	EE is first resource to meet future electric needs[1]	2013	2.0% +
Hawaii	2004	.4% - .6% per year[2]	2020	0.5%
Pennsylvania	2008	3.0% of 2009-2010 load	2013	0.6%
Connecticut	2007	All Achievable Cost Effective[3]	2018	2.0% +
Nevada	2005	0.6% of 2006 annually[4]	n/a	0.6%
Washington	2006	All Achievable Cost Effective	2025	2.0% +
Colorado	2007	1.0% per year	2020	1.0%
Minnesota (elec & gas)	2007	1.5% per year	2010	1.5%
Virginia	2007	10% of 2006 load	2022	2.2%
Illinois	2007	2.0% per year	2015	2.0%
North Carolina	2007	5% of load[5]	2018	0.4%
New York (electric)	2008	10.5% of 2015 load[6]	2015	1.5%
New York (gas)	2009	15% of 2020 load[6]	2020	1.5%
New Mexico	2009	All achievable cost-effective, minimum 10% of 2005 load	2020	1.0% +
Maryland	2008	15% of 2007 per capita load[7]	2015	3.3%
Ohio	2008	2.0% per year	2019	2.0%
Michigan (electric)	2008	1.0% per year	2012	1.0%
Michigan (gas)	2008	0.75% per year	2012	0.8%
Iowa (electric)	2009	1.5% per year	2010	1.5%
Iowa (gas)	2009	0.85% per year	2013	0.3%
Massachusetts	2008	All Achievable Cost Effective		2.0% +
New Jersey (electric & g	2008	20% of 2020 load[8]	2020	≤2.0%
Rhode Island	2008	All Achievable Cost Effective		2.0% +

Notes:

* Implied annual reduction for targets based on current year loads assumes average underlying load growth (not accounting for EE) of 1.5% per year. Texas based on recent load growth of 3%/yr.

1 CA programs exceeded 1.5%/yr. in 2007. While current mandated goals are lower, CA policy requires investment in efficiency whenever it is less costly than alternative new supply.

2 HI established a renewable portfolio standard that includes efficiency as a resource and requires 20% savings by 2020, or approximately 2.8%/yr. However, this can come from efficiency or renewable resources. Current efficiency savings has ranged from 0.4% - 0.6%/yr.

3 CT requires capture of all available cost-effective efficiency resources. Current utility plans reflect goals of about 1.5%/yr.

4 NV has an RPS requiring 15-20% of load and allows EE to meet 25% of the goal. Utilities are ramping up to meet the maximum level of 5% of load from efficiency. Figure reflects 2006 program achievements.

5 NC RPS ramps up to 12.5% of load in 2021, with EE capped at 40% of this target, or 5%.

6 NY established a 15% savings goal (July 2008) for electric efficiency by 2015, however this includes an estimated 4.5% savings from codes & standards. Electric figure is for efficiency programs only. NY just established a 14.7% goal for gas efficiency by 2020. However, it is unclear whether this includes any savings that might come from codes & standards.

7 MD goal is set as a reduction off of 2007 per capita load. Implied annual goal assumes underlying load growth per capita (net of efficiency programs) of 0.75%.

8 NJ legislature recently authorized the BPU to set electric and gas goals of 20% savings each by 2020. Goals still under development.