Review and Update of Energy Efficiency Market Assessment For the State of New Jersey

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I. Executive Summary

In 2004, KEMA, Inc. completed an energy efficiency market potential study for the New Jersey Board of Public Utilities.[1] The project was managed by the Center for Energy, Economic and Environmental Policy (CEEEP) located within the Edward J. Bloustein School of Planning and Public Policy, Rutgers, the State University of New Jersey. KEMA provided estimates of the potential for energy and peak-demand savings from energy efficiency measures and for distributed generation for the State of New Jersey over two time frames, 2004 through 2007 and 2009 through 2020.

This report was prepared by CEEEP and Applied Energy Group, Inc., (AEG). References to "the Team" or "our Team" in this document refer to the combined efforts of CEEEP and AEG.

The New Jersey Board of Public Utilities' (BPU) Office of the Clean Energy (OCE) asked CEEEP to review and update the KEMA study in support of the BPU's ongoing Comprehensive Resource Analysis (CRA) proceeding and the OCE's Straw Proposal for the New Jersey Clean Energy Program 2009-2012 Funding Levels.[2] This project is not intended to be a detailed energy efficiency potential analysis like the KEMA study. Instead, the Team has reviewed the results of the KEMA study at a high level for the four-year period beginning in 2009. While this study does review some input assumptions made by KEMA based on quantitative analysis, our recommendations are based largely on qualitative assessments. These assessments may be used to establish energy savings objectives and to develop a recommended level of funding for New Jersey's Clean Energy Program for the period 2009 to 2012.

The major findings of our research are:

1. For electricity and natural gas, our Team found that the Achievable Potential estimated in the KEMA study for 2009-2012 is more than the OCE's proposed Savings Goal but less than the Energy Master Plan proposed Savings Goal for that period. The Economic Potential estimated in the KEMA study is much higher than both of these goals.
2. The OCE Savings Goal is less than 50% of the Energy Master Plan electricity Savings Goal and only 12% of the gas Savings Goal for the period. As noted in the OCE Straw Proposal, savings need to be increased 2 to 3 times to achieve the Energy Master Plan goals.
3. New Jersey's Clean Energy Program has saved 940 thousand MWh and 2,622 thousand DTh since 2004. These savings are less than the Achievable Potential in the KEMA study for this period, but with program design changes and inclusion of new technologies, more energy can be saved.

[1] KEMA, Inc. "New Jersey Energy Efficiency and Distributed Generation Market Assessment", August 2004.
[2] Document dated March 20, 2008, available at http://www.njcleanenergy.com/files/file/OCE%20Straw%20Proposal%20for%202009-2012%20revised%20straw2.pdf

4. Energy cost assumptions used by KEMA are no longer valid. Wholesale commodity prices have increased significantly since KEMA performed its analysis in 2004.
5. Certain technologies were not included in the KEMA report, and new technologies have reached the market with promises of increased energy savings. Acceptance of these technologies would increase the potential estimates reported by KEMA. These technologies should be reflected in future studies where energy savings potential is estimated
6. Improvements in program delivery may result in greater penetration of energy savings technologies and can affect the savings estimates provided by KEMA in its advanced case scenario.

The Team's findings show that the BPU can continue to utilize the results of the KEMA study to establish funding levels and program objectives for the years 2009-2012. However, we would recommend that the BPU initiate another review of the KEMA study or commission a revised market potential study within the next two years, prior to commencement of the next funding level review proceeding.

II. Background

In 2004, KEMA, Inc. completed an energy efficiency market potential study for the New Jersey Board of Public Utilities (BPU).[3] The project was managed by the Center for Energy, Economic and Environmental Policy (CEEEP) located within the Edward J. Bloustein School of Planning and Public Policy, Rutgers, the State University of New Jersey. KEMA provided estimates of the potential for energy and peak-demand savings from energy efficiency measures and for distributed generation for the State of New Jersey over two time frames, 2004 through 2008 and 2009 through 2020.

A. Purpose

The New Jersey BPU has initiated a proceeding, referred to as the Comprehensive Resource Analysis (CRA), to determine funding levels for New Jersey's Clean Energy Program for the years 2009-2012. The BPU's Office of the Clean Energy (OCE) asked CEEEP to review and update the KEMA study to assist the BPU in its consideration of 2009-2012 funding levels and in support of the OCE Straw Proposal for the New Jersey Clean Energy Program 2009-2012 Funding Levels.[4] This project is not intended to be a detailed energy efficiency potential analysis like the one conducted by KEMA. Instead, the Team has reviewed the results of the KEMA study at a high level, in order to estimate Achievable Potential for the four-year period beginning in 2009. While this study does review some input assumptions made by KEMA based on quantitative analysis, our recommendations are based largely on qualitative assessments. These estimates may be used to establish energy savings objectives and to develop a recommended level of funding for the State of New Jersey Clean Energy Programs for the period 2009 to 2012. The specific scope of work undertaken by the principle investigators, CEEEP and Applied Energy Group, Inc., (AEG), is presented later in this section.

References to "the Team" or "our Team" in this document refer to the combined efforts of CEEEP and AEG.

B. Principle Investigators

This study was conducted by CEEEP and AEG, who both have significant experience in the design and evaluation of energy efficiency programs, especially in the State of New Jersey. AEG also has significant experience in program planning, implementation, and tracking.

Established within the Bloustein School in 2003, CEEEP conducts applied research to evaluate and help develop energy policy at the state, regional, national, and international levels. The Center explores the interrelation of energy, economic and environmental

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[3] KEMA, Inc. "New Jersey Energy Efficiency and Distributed Generation Market Assessment", August 2004. http://www.policy.rutgers.edu/ceeep/events_03-04_new.html#pub
[4] Document dated March 20, 2008, available at http://www.njcleanenergy.com/files/file/OCE%20Straw%20Proposal%20for%202009-2012%20revised%20straw2.pdf

policy issues. CEEEP has been actively engaged in providing research and modeling support for the New Jersey's Energy Master Plan and in conducting various evaluations of the State’s portfolio of energy efficiency programs. . With respect to New Jersey’s Clean Energy Program, the umbrella group for the specific energy efficiency programs of the BPU, CEEEP is conducting various evaluations and assessments of the portfolio. These include cost-benefit, sensitivity, and trade-off analyses of programs including targeted reviews of certain technologies. These evaluation and research activities are aimed at providing yearly feedback to policymakers, program administrators, and program implementers.

In July 2007, AEG was awarded a contract to serve as the Program Coordinator for New Jersey’s Clean Energy Program including support of evaluation activities. AEG is an economic and management consulting firm, focusing its research and analysis on energy issues. AEG has extensive experience in developing portfolios of both gas and electric demand-side management programs and has provided these services to the industry since the 1980s. AEG’s projects have included program design, cost effectiveness screening, conducting analyses to provide estimates of market potential; developing documentation for clients to propose the programs for regulatory approval; assisting clients in developing tracking systems for participation, budget, and savings reporting; and developing high level evaluation plans. In addition, AEG has provided numerous audits of efficiency programs for its clients around the country.

C. Overview of the KEMA Study

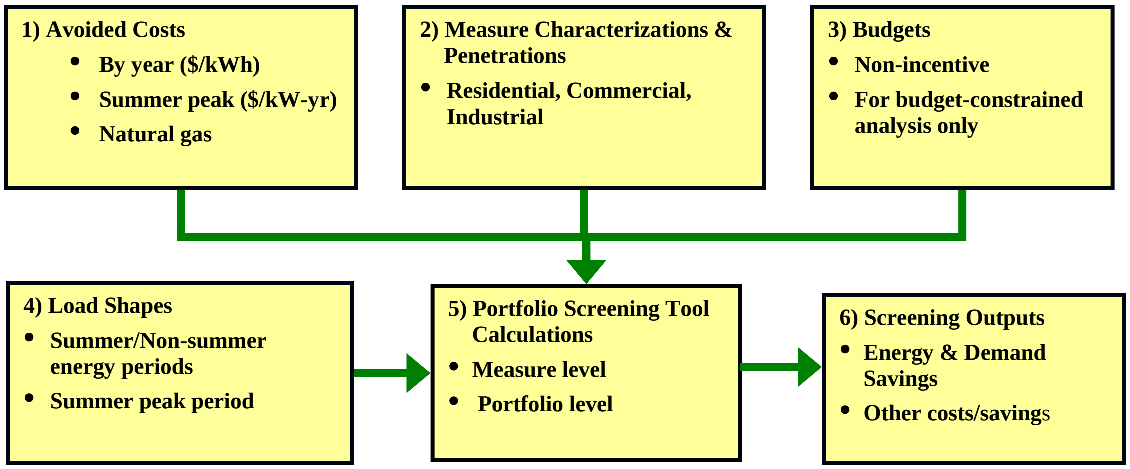
The KEMA study assessed the energy-efficiency potential for saving electricity and natural gas for all customer classes in the state. The study provided estimates of potential savings through 2020, and based its estimates on technologies and practices that were available at the time the study was conducted.

At the heart of every analysis of energy efficiency potential is a demand-side management (DSM) model and portfolio screening tool used for calculating the costs and benefits associated with various efficiency measures (technologies and design practices). Expanding on the following figure, the analysis of energy efficiency potential, whether Technical, Economic or Achievable, can be summarized as follows:

1. Identify the avoided costs of energy, line loss factors and related inputs to the DSM model.
2. Determine the potential efficiency measure characterizations, including costs and savings relative to a baseline where it assumes that efficiency measures will not be implemented. Determine measure penetration rates based on sales forecasts by sector.
3. Develop load shapes for distributing energy savings by period (e.g., summer and non-summer).
4. Apply these inputs into the portfolio screening tool, which calculates the energy and demand savings by efficiency measure and for the total portfolio.

Figure 1 below provides a high-level overview of the methodology that is typically used for conducting an efficiency savings analysis. Although KEMA did not provide an overview of its demand-side management model, our Team has significant experience in conducting energy potential studies and is familiar with the approach followed by KEMA.

Figure 1: Overview of the KEMA Study's Methodology[5]



The KEMA study identified the cost effectiveness of energy efficiency measures and for certain efficiency programs. Historically, the BPU has not relied exclusively on cost-effectiveness testing to set total program spending levels, establish incentives or prices to be paid for energy savings, or to determine which programs to implement. The BPU has used broader criteria to develop program designs and determine the incentives and prices paid for energy savings. For example, in its Order setting 2004 to 2008 funding levels, the Board indicated its desire to have programs that included funding for low-income programs, even though these programs were less cost effective than other programs.[6]

The KEMA study includes estimates of Technical, Economic, and Achievable Potential, though Achievable Potential is the only measure that is available annually for comparison. Figure 2 illustrates the relationships among these three categories of energy efficiency potential. The typical definitions of these potentials are relatively standard in these types of studies and are generally defined as follows:

- **Technical Potential**, or the total feasible efficiency savings using all efficiency technologies and design practices, unconstrained by budgets or cost-effectiveness;

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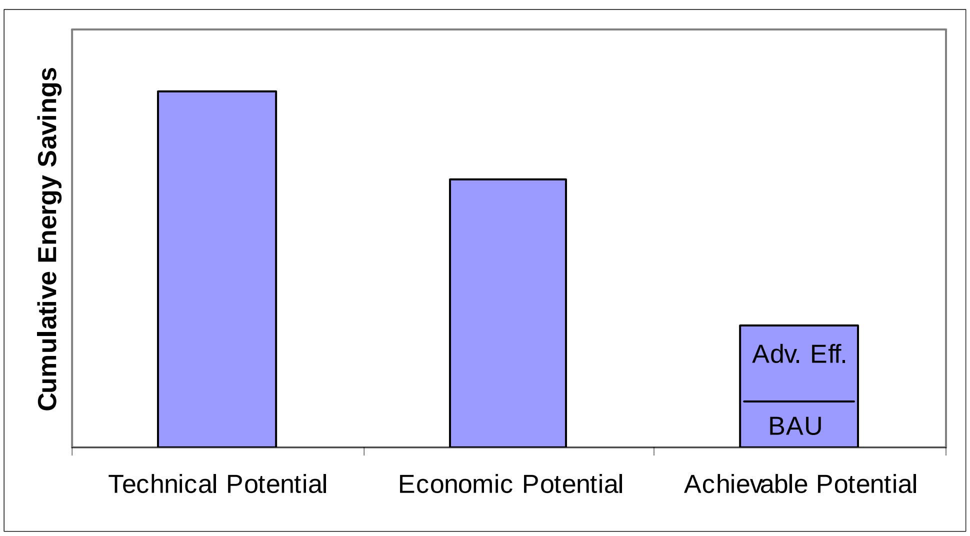
[5] Applied Energy Group, "Energy Efficiency Potential Study For Aquila Colorado", January 2008 & KEMA study, pg 2-5.

[6] BPU Order dated December 23, 2004, Docket No. EX04040276, page 33

- **Economic Potential**, or the feasible efficiency savings unconstrained by budgets, but using only cost-effective efficiency measures (based on either the total resource cost test or the societal cost-effectiveness test); and
- **Achievable Potential,** or the amount of energy use that efficiency can realistically be expected to displace assuming the most aggressive program scenario possible (e.g., providing end-users with payments for the entire incremental cost of more efficiency equipment). This is often referred to as maximum Achievable Potential. Achievable Potential takes into account real-world barriers to convincing end-users to adopt efficiency measures, the non-measure costs of delivering programs (for administration, marketing, tracking systems, monitoring and evaluation, etc.), and the capability of programs and administrators to ramp up program activity over time. KEMA defined Achievable Potential as the amount of savings that would occur in response to one or more specific program interventions.[7]

For the purpose of providing the BPU OCE with a basis for evaluating savings goals for the Clean Energy Program, KEMA provided "Business as Usual" (BAU) estimates for Achievable Potential based on the utility sponsored programs that were in place at the time the study was conducted. In addition, KEMA provided potential estimates for an "Advanced Efficiency" case. Under this case, KEMA assumed that efficiency program savings estimates would be based on spending levels of approximately $180 million per year (as compared to approximately $85 million per year in the Business as Usual case).[8] The results are presented and summarized in the KEMA study and supporting details are provided in the appendices of that study.

Figure 2: Comparison of Technical, Economic and Achievable Potential



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Throughout this report, there are several tables reporting energy savings estimates from the KEMA study. Except where noted, we are reporting cumulative energy savings over

[7] See KEMA study, chapter 3, p. 6.
[8] See KEMA study, pages ES-2 to ES-3.

the period of 2009 through 2012, not annual savings for each year. Also, to be consistent with the Office of Clean Energy Straw Proposal, the Team reports energy savings in units of thousand Megawatt hours (MWh) and thousand Decatherms (DTh).[9]

Figure 3 and Figure 4 show the KEMA estimates of Technical, Economic and Achievable Potential compared with the OCE Straw Proposal and proposed Energy Master Plan savings goals for electricity and gas, respectively. Table 1 presents this same information, but in tabular form. The data presented estimates cumulative savings for the years 2009 to 2012. Annual Technical and Economic Potential savings estimates were developed from Tables ES-3 and ES-6 in the KEMA study. These Potentials were reported for 2020 only, and the Team used this number to estimate the potential energy savings for 2009-2012 by assuming the 2020 savings potential was valid for every year. This will likely cause the 2009-2012 Technical and Economic Potential to be overestimated in this analysis. At our Team's request, KEMA did provide annual estimates of Achievable energy savings under both the Business-as-Usual and Advanced Efficiency cases.[10] The OCE and Energy Master Plan Goals were both estimated from tables on pages 18 and 19 in the OCE Straw Proposal.

Figure 3 shows that the OCE Straw Proposal Savings Goal for electricity is slightly less than the estimated KEMA Achievable energy savings potential by about 400 thousand MWh (Table 1). Figure 4 also shows that the OCE Goal for gas is less than the Achievable Potential, by about 10,000 thousand DTh. For both the electricity and gas savings, Table 1 shows that the OCE Straw Proposal Goal is significantly less than the goals set forth by the proposed Energy Master Plan. In fact, the Straw Proposal indicates that the 2008 Energy Efficiency Program savings would need to increase 2-3 times to achieve the EMP Goals. Both Figure 3 and Figure 4 also show that there is a large amount of Economic Potential energy savings to be found in New Jersey, and that neither the OCE Straw Proposal nor proposed Energy Master Plan Goals exceed this Economic Potential.

[9] In some cases, however, we did convert from GWh (1 GWh = 1000 MWh) and for BTU's (1 Therm = 100,000 BTU).
[10] March 10, 2008 email transmittal from KEMA (Liz Hicks) to F. Felder and R. Obeiter.

Figure 3: 2009 -2012 Cumulative Electricity Savings Potential from KEMA compared to OCE and EMP Savings Goals

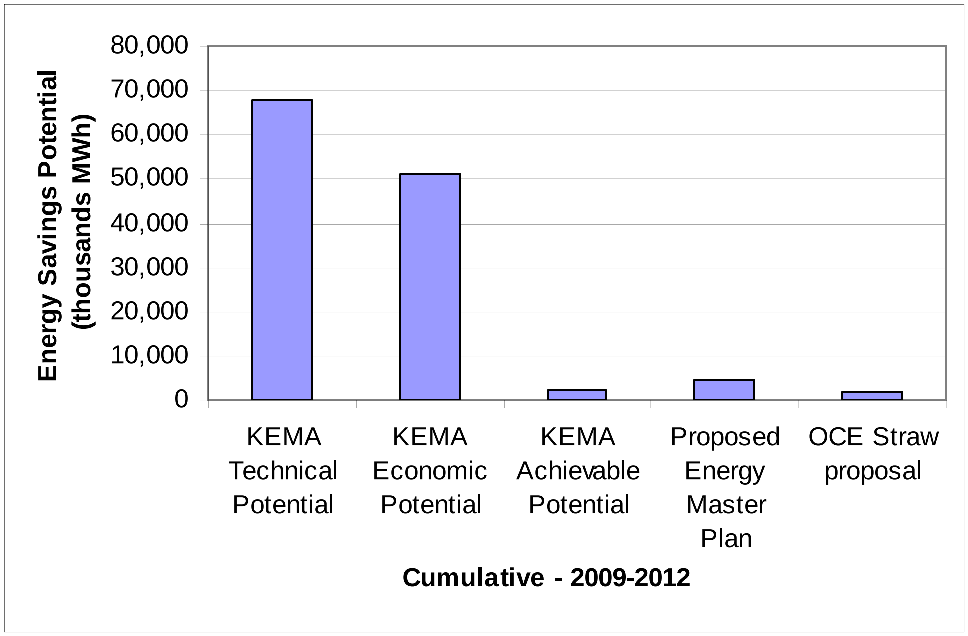

Figure 4: 2009 -2012 Cumulative Gas Savings Potential from KEMA compared to OCE and EMP Savings Goals

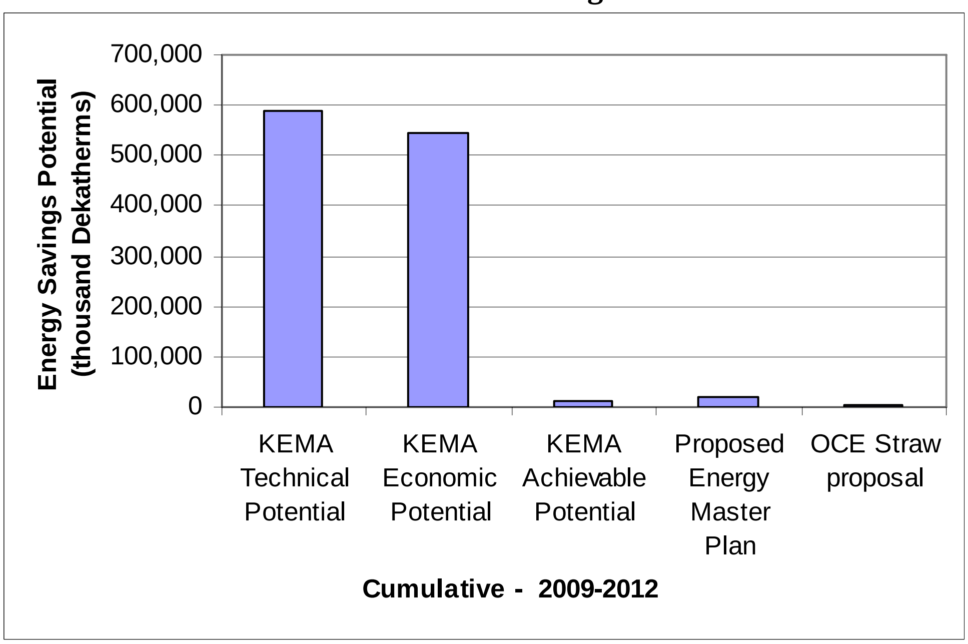

Table 1: 2009 -2012 Cumulative KEMA Energy Savings Potential, OCE Straw Proposal and EMP Savings Goals

	Electricity (Thousand MWh)	Gas (Thousand DTh)
KEMA Technical Potential	68,000	587,000
KEMA Economic Potential	51,000	546,000
KEMA Achievable Potential	2,144	12,488
Business as Usual	704	3,023
Advanced Efficiency	1,439	9,465
OCE Straw Proposal Goal	1,700	2,400
Energy Master Plan Proposed Goal	4,300	20,000

D. Our Analysis of the KEMA study

Our Team's analysis was focused broadly on two different areas. First, we verified the assumptions in the KEMA study. While our Team did not attempt to reproduce the analysis conducted by KEMA, we qualitatively assessed various input data used by KEMA, comparing their assumptions to current conditions. Specifically, we reviewed the technologies KEMA evaluated, its energy cost assumptions, and its energy efficiency penetration rate assumptions.

In addition, our Team identified and evaluated the effect that certain new information had on the savings potential estimates that were derived by KEMA for the 2009 to 2012 time horizon. Specifically, our Team:

- Reviewed multiple studies of energy efficiency potential conducted across the country
- Compared actual New Jersey Clean Energy Program results for the years 2004 to 2007 with the KEMA study estimates for those years
- Reviewed program design and implementation alternatives to those originally adopted by the Market Managers[11]
- Assessed the effect that broader economic and environmental issues could have on the estimates provided in the KEMA study.

E. Some Limitations

The KEMA study relied on the best available data at the time it was performed, which was reviewed by our Team in order to determine whether it needed to be updated. As is the case with most Energy Efficiency modeling studies, there are some methodological caveats. These include:

- *Energy efficiency measure curves simplify reality:* Energy efficiency consists of many heterogeneous groups of technologies and programs, making it difficult to

[11] Market managers include Honeywell International, Inc., TRC Energy Services, and the utilities who run the Low Income programs.

quantify accurately in a uniform dataset. In addition, there are a number of market barriers to the adoption of energy efficiency that often prevent consumers from making least-cost purchasing choices.[12]

- *Energy efficiency embedded in the load forecast and the natural rate of energy efficiency are hard to quantify*: To the extent possible, the KEMA study attempted to account explicitly for the amount of energy efficiency embedded in the load forecasts and the amount of energy efficiency built into each of the two reference cases (Business as Usual and Advanced Efficiency). As models are calibrated to historical data, they implicitly account for the effects of many years of energy efficiency programs. Historical data also reflect energy efficiency improvements that would have likely occurred even in the absence of energy efficiency programs simply due to the improvement of technology over time. It is difficult to quantify what level of "natural" energy efficiency improvements is included in the KEMA study energy savings forecasts.
- *The mix of available energy efficiency measures will change in the future in unpredictable ways.* Any forecast of the future is by definition uncertain; however there are particular uncertainties associated with the energy efficiency projections that are worth highlighting. In its analysis, KEMA relied upon data that were extrapolated from current economic conditions for avoided costs, technology costs, retail rates, etc. If avoided costs turn out to be higher than the KEMA study projected, for example, a larger set of energy efficiency measures would become economically feasible.
- *Adoption rates of energy efficiency may change in the future under different programs:* Before 2006, New Jersey energy efficiency programs were administered by utilities. Each utility defined the scope of energy efficiency measures and programs that each utility considered feasible. The utilities did not capture measure data in any database and, until recently, the Market Managers were not adding this detail to their databases or forwarding the information to the Program Manager. Therefore, our Team was not able to fully evaluate the penetration rate under the existing Clean Energy portfolio.
- *Rebound effect:* Rebound effect, also referred to as "take back" or "snap back" suggests that increasing energy efficiency and the cost of the resource could ultimately cause a rebound in demand. A commonly cited example is an increase in the efficiency of home air conditioning may reduce the resident's monetary incentive to conserve. The resident may opt to change the thermostat setting to keep the amount paid constant, but living at temperature that is more comfortable to the customer. Table 2 shows that when actually measured, rebound effect is in the range of 10 to 40%, depending on the affected technology or end use.[13] Resources for the Future suggests that estimates from particular efficiency

[12] For a more detailed discussion of the limitations of energy efficiency supply curves see: Rufo, Mike, "Developing Greenhouse Gas Mitigation Supply Curves for In-State Resources," PIER Consultant Report P500-03-025FAV, April 2003.

[13] Grotton, Frank, "Energy Efficiency and Rebound Effect: Does Increasing Efficiency Decrease Demand?", Congressional Research Service, July 2001. & Geller, Howard, "Experience with Energy Efficiency Policies and Programs: Lessons from the Critics", Presentation at the USAEE/IAEE Annual Conference, Denver, CO, September 2005.

enhancing investments also often fail to account for the fact that energy demand may rise with the investment, particularly if it lowers the marginal cost to consumers of energy services such as heating, lighting, or hot water.[14] For example, increasing the efficiency of home appliances showed no measurable rebound effect, while the rebound for space heating and cooling ranges from 0% to 50%. Future evaluation planning should include the requirement for an analysis of rebound effect associated with the some of the individual energy efficiency programs. The rebound effect is currently being assessed as part of an ongoing impact evaluation being performed for the BPU. In another study, Howard Geller found that while the direct rebound effect is real, it is small to moderate in most cases. In addition, Geller asserts that ex-post program evaluations confirm efficiency policy and program effectiveness.[15]

Table 2: Estimates of the Rebound Effect[16]

Sector	End Use	Size of Rebound Effect
Residential	Space Heating	10-30%
Residential	Space Heating	0-50%
Residential	Water Heating	<10-40%
Residential	Lighting	5-12%
Residential	Appliances	0%
Residential	Automobiles	10-30%
Business	Lighting	0-2%
Business	Process Uses	0-20%

[14] Gillingham, Kenneth, Richard G. Newell and Karen Palmer. Retrospective Examination of Demand-Side Energy Efficiency Policies. Resources for the Future. September 2004.
[15] Geller, Howard, "Experience with Energy Efficiency Policies and Programs: Lessons from the Critics", Presentation at the USAEE/IAEE Annual Conference, Denver, CO, September 2005.
[16] Grotton, Frank, "Energy Efficiency and Rebound Effect: Does Increasing Efficiency Decrease Demand?", Congressional Research Service, July 2001.

III. Overall Analytical Framework

The primary objective of the work underlying this report is to provide input to the BPU on establishing potential energy savings and associated funding levels for New Jersey's Clean Energy Program for the 2009-2012 timeframe. The market potential scenarios in the KEMA study assume a given set of future market conditions. Key market conditions like retail rates, avoided costs, and technology costs may have followed a very different path than what was assumed in the KEMA study. As these conditions change, it is necessary to review the current and planned goals and budgets of the Clean Energy Programs. Therefore, periodic reviews like this report are necessary. This section of the report outlines the framework followed by our Team to review the KEMA analysis.

As discussed previously, our Team performed a number of independent analyses designed to verify or recommend changes to the KEMA study. Specifically, we performed the following:

- **Review of other efficiency studies**. We reviewed other energy efficiency potential studies to see if the results derived by KEMA were consistent with those obtained in other jurisdictions.
- **Technology review.** The technology screening undertaken by KEMA was representative of the technologies typically used in measure screening analysis when the study was conducted. Technological advancements have occurred since the date the KEMA study was completed and therefore warrant an analysis of the impacts these technologies might have on forecasted energy efficiency savings estimates.
- **Program design.** Current and proposed program design components, as well as alternative approaches, were reviewed. Modifications to these components could influence the adoption rate of various energy savings technologies.
- **Interim year results.** Clean Energy Program results for the years 2004 through 2007 were reviewed and compared to the overall savings estimates included in the KEMA study for the same years. Variances between the KEMA estimates and actual results were reviewed and used as one indicator of potential future energy savings.
- **Changes in energy costs assumptions.** Changes in wholesale prices for natural gas and electricity supply can significantly impact retail rates, and customer bills. With increasing resource costs since the KEMA study, more energy efficiency measures are cost effective.
- **Energy efficiency penetration rates.** Decreases in natural penetration rates for the various residential and commercial/industrial measures over the rates that were used by the KEMA study would result in increases in the Achievable Potential energy savings available to the state. Our Team's analysis showed that there was no adjustment necessary for penetration rates.

A. Review of Energy Efficiency Studies from Other Jurisdictions

Our Team reviewed numerous energy efficiency potential studies performed for utilities in many areas of the country and Canada for our analysis.[17] A direct comparison of the KEMA study with the other studies reviewed was not straightforward or completely possible. These studies reflect many different assumptions and inputs from those used by KEMA. For example, most studies have different starting points, varying availability of key data (e.g., current saturations of energy efficiency technologies for end-use load shapes), different modeling techniques, etc. Accounting for the differences between the KEMA study and the framework employed in the other studies, our Team found that the results of the KEMA study are generally consistent with the results of the other studies that were reviewed:

- The KEMA study estimated Technical and Economic Potential at 16,999 GWh/year and 12,832 GWh/year respectively, based on a study timeframe extended to 2020. These estimates represent a Technical Potential of 23% and an Economic Potential of 17% of base usage.
    1. This relationship of Economic to Technical Potential is consistent with other studies. A study by the California Energy Commission reviewed a number of studies performed by both investor-owned-utilizes and municipal utilities in California.[18] On average, for all of these entities in California combined, the Economic Potential as a percentage of Technical Potential was 74% vs. 76% in the KEMA study.
    2. A study conducted by the American Council for an Energy Efficient Economy (ACEEE) reviewed results of 11 studies at the utility level in different parts of the country.[19] Technical Potential ranged from 15% to 35% and Economic Potential ranged from 12% to 27%. Another study conducted by ACEEE looked at Achievable energy savings for both electricity and natural gas in eight Midwest states.[20] The range of estimated Achievable savings for electricity in the 2020 (base year was 2004) ranged from 7.9% to 12.2%. This study also supports the estimates derived by KEMA. For the same timeframe, KEMA estimates an electric Achievable Potential savings of 6.9%.
- There are significantly fewer studies available where natural gas efficiency

[17] Since many of the studies reviewed contained data for multiple utilities, our Team reviewed results for over 50 utilities. The main studies examined included: Optimal Energy, Inc. et al., "Electric Energy Efficiency Potential from Southeast New York Government Customers", February 2008. Pakenas, Lawrence J., "Energy Efficiency and Renewable Energy Resource Development Potential in New York State", August 2003. "California Energy Efficiency Potential Study." Itron, Inc. et al. May 2006. Applied Energy Group, "Energy Efficiency Potential Study for Aquila Colorado", January 2008. Hogan, Erin P., "Natural Gas Energy Efficiency Resource Development Potential in New York", Octocer 31, 2006.

[18] California Energy Commission. "Statewide Energy Efficiency Potential Estimates and Targets for California Utilities", August 2007.

[19] Nadel, Steven, Anna Shipley, R. Neal Elliott. "The Technical, Economic and Achievable Potential for Energy-Efficiency in the U.S. – A Meta-Analysis of Recent Studies", From the proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings, 2004. (Nadel et. al., 2004)

[20] Kushler, Martin, Dan York and Patti Witte. "Examining the Potential for Energy Efficiency To Help Address the Natural Gas Crisis in the Midwest**",** Report U051, ACEEE, January 2005.

potential has been estimated. Based on our evaluation of the KEMA report, the Technical, Economic and Achievable estimates for the natural gas side are 32%, 30% and 11% (based on the Advanced Efficiency scenario) of base usage, respectively. A number of other studies estimated potential savings for several Western states and eight Midwestern states.[21] The range of estimates (as percent of base usage) for the study of the Western states was as follows:

1. Technical Potential: 40% to 47%
2. Economic Potential: 13% to 35%
3. Achievable Potential: estimates: 9% and 10% (only two estimates were provided)

For the eight Midwestern states only estimates of Achievable Potential were provided. These ranged from 6% to 12% of base usage.

Overall, the Team has determined that there is no study of energy efficiency potential that directly compares with the KEMA study. In general, though, KEMA's Technical, Economic and Achievable Potential results are consistent with those of other studies.

B. Technology Advancement since KEMA Study

In Appendices A-F, the KEMA study described and quantified the measures used by New Jersey's Clean Energy Program and detailed potential additional measures. Our Team evaluated the relevance and comprehensiveness of the technologies identified for residential, commercial and industrial energy efficiency for both the natural gas and electricity sectors.

Background

Generally speaking, the KEMA study is comprehensive in its research and provides significant documentation of source data. This is exemplified in the residential assessment and to a lesser extent in the commercial industrial markets. For each sector, common energy savings technologies are covered. These are limited to measures and practices that are currently available. Since the study was written, several technologies have emerged or in some instances become more readily accepted. The following paragraphs briefly provide an overview of the technologies and measures included in the KEMA study for all sectors and a listing of additional commercially available technologies that should be considered in the calculation of Technical Potential in addition to those presented by KEMA.

Residential

Nearly all the common technologies and measure for improving the performance of this sector are addressed in some way by KEMA. This includes high efficiency air conditioning, both room units and central systems, as well as natural gas fired heating systems, boilers and furnaces. Other common technologies like compact fluorescent lamps and Energy Star® rated appliances are included. While it is mentioned in the

[21] See Nadel et. al., 2004.

KEMA study, little attention is given to forced air furnace motors and it is unclear whether the assessment attributes any energy savings to this technology. Improved practices programs that target proper installation and repair options such as leakage reduction and duct sealing are included. All of these measures are part of a comprehensive approach to residential energy savings characterized by the Energy Star® program. Some of the current Energy Star® categories such as dehumidifiers, ceiling fans, ventilating fans and home electronics are not identified as potential energy efficiency measures in the KEMA study.

Additional residential measures not included in the KEMA study are the following[22]:

- Instantaneous Water Heaters (also referred to as tankless systems): With energy factors[23] of 0.84 and higher, this technology was identified for tax credits as part of the Energy Policy Act of 2005. Savings potential can be as high as 30% of the hot water heating energy.
- Radiant Heating: Combined with condensing boilers, energy savings can be gained provided proper thermostatic settings are applied; the same comfort level can be achieved with a lower thermostat setting, saving up to 4% of the energy normally consumed for every 1 to 2 degree change.
- Energy Recovery Ventilation: Using heat exchanger technology, up to 85% of the exhaust air heat can be recovered. This is especially important as new homes are constructed to meet or exceed Energy Star standards with respect to infiltration and mechanical ventilation.
- Light Emitting Diodes (LEDs): Mostly used in commercial refrigeration, LEDs are nonetheless available for residential use though they are not yet competitive on either cost or performance.[24] LEDs last over 35,000 hours, while compact fluorescent lights last between 6,000 and 15,000 hours.
- Duct Repair and Infiltration Control: Though mentioned in the KEMA study, no savings are specifically attributed to preventing the loss of air to attics, crawl spaces and the outdoors. According to the California Energy Efficiency Potential Study, about 60 kWh per year per home is lost.

Table 3 shows the incremental cost and per unit energy savings for four technologies discussed above. Note that the measure characteristics in this table are not specific to New Jersey, but were taken from California's Database for Energy Efficient Resources.[25] However, the results may indicate the increase in savings potential represented by these technologies.

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[22] The Team compared the technologies listed in the KEMA report to current lists of energy conservation measures that AEG maintains and updates regularly.
[23] The energy factor (EF) indicates a water heater's overall energy efficiency based on the amount of hot water produced per unit of fuel consumed over a typical day. (US Department of Energy, Energy Efficiency and Renewable Energy Division).
[24] U.S. Department of Energy. "Energy-Efficient Lighting and Light-Emitting Diodes." , May 2006. http://www.netl.doe.gov/ssl/PDFs/LED-FAQ.pdf
[25] http://www.energy.ca.gov/deer/

Table 3: Savings and Costs of New Technologies Available in New Jersey

Technology	kWh Savings per unit	Therm Savings per Unit	Incremental Cost
Duct Repair	55	21	$630
Duct Repair - Electric Space Heat	133	0	$630
Infiltration Control	3	4	$250
Infiltration Control - Electric Space Heat	6	0	$250
Point-of-use Water Heater - Electric	242	0	$310
Residential LED light (6 hours per day)	72	0	$34

Commercial/Industrial

The data presented in the appendices of the KEMA report are not as descriptive or comprehensive for the commercial and industrial sector as they are for the residential sector. More attention is paid to providing a scale for the likelihood of success than to describing the technical merits or energy savings opportunities of technologies in this market. In addition to technologies, energy savings can be achieved through improvements in operations and maintenance, and proper design and application of technologies. The KEMA report properly addresses this potential highlighted by commissioning services (Cx). Building commissioning is a method of risk reduction for new construction and major renovation projects to ensure that building systems meet their design intent, operate and interact optimally. This systematic process includes building HVAC, controls, lighting, and building systems and typically education and training of the building's facility management department.

While there are more than 40 individual measures described or presented in the KEMA study, several significant technologies were not identified. Technologies or measures missing from the commercial sector assessment include the following[26]:

- Thermal storage- provides significant summer peak reductions, although if not properly designed to produce energy savings, can result in increased off-peak kWh
- Frictionless chillers, with improved part load efficiencies approaching 0.3 kw/ton
- Evaporative cooling
- Heat recovery/energy recovery, for gas and electric savings
- Radiant heating- combined with the lower hot water temperature produced by condensing boilers, radiant floor heating can provide savings particularly in areas with high air infiltration rates

[26] The Team compared the technologies listed in the KEMA report to current lists of energy conservation measures that AEG maintains and updates regularly.

- Enthalpy based economizers, typically a factory offered option for packaged HVAC units
- Outdoor air delivery monitoring (also referred to as CO_2 demand based ventilation)
- Under floor air distribution
- Displacement ventilation
- High performance glazing to reduce unwanted solar gain in the summer
- Increased wall insulation, and in particular structurally insulated panels [roof insulation is considered, yet wall insulation was not addressed in the KEMA report]
- Cool roof technologies including Energy Star rated roof products
- Energy Conservation Measure (ECM) fan motors for Variable Air Volume (VAV) systems
- Ceramic metal halide lamps for retail applications- they provide similar savings potential as CFLs for the halogen accent lighting found throughout the retail sector and can be specified as a screw-in replacement
- Low-wattage T8 lamps (25, 28 and 30 watts) - simple cost effective retrofits for existing T8 systems
- Energy Star rated commercial food service equipment such as dishwashers, fryers and ice machines
- Refrigeration case lighting- significant savings can be achieved through a reduction of the heat rejected into the refrigerated space by removal of the ballast and a reduction in lamp wattage

The industrial list of measures in the KEMA study is rather vague, with process support as a measure name. More specifically, the Department of Energy's Best Practices in compressed air systems and steam should have been identified and specific measures in those programs could have been identified.[27] One of the largest areas of potential savings has to do with the identification and repair of leaks in the compressed air and steam systems.

Our Team's consideration of these technologies is largely focused on validating the current relevance of the overall estimates established by KEMA. New measures will also continue to emerge over time and others will decrease in price, which will reduce barriers to adoption. The promotion of these measures through the Clean Energy Program will provide new sources of program accomplishments. Therefore, the attainment and maintenance of high levels of annual program performance will require review and enhancement of the mix of measures offered by these programs over time.

C. Energy Efficiency Penetration Rates

Market trends may have changed the penetration rates and adoption of energy efficiency measures since the KEMA study. In an analysis of NYSERDA[28] market penetration rates from a March 2007 report, we found only six residential technologies that were

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[27] U.S. Department of Energy. "Steam System Opportunity Assessment for the Pulp and Paper, Chemical Manufacturing, and Petroleum Refining Industries" October 2002. U.S Department of Energy, "Improving Compressed Air System Performance: A Sourcebook for Industry", November 2003.

[28] NYSERDA "New York Energy Smart Program Evaluation and Status Report.", March 2007.

forecasted to increase in market penetration more than 10% between 2003 and 2012. These technologies include:

- Current standard (2003) Energy Star® model refrigerators
- MEF 1.7 rated model Clothes washer
- Television with current (2003) Energy Star® 3W or 1W or less stand by consumption
- LCD computer
- EER 9.7 – 10.7 model window/room air conditioner
- DVD or VCR with current (2003) Energy Star® 2W or less standby consumption

For three of these technologies, refrigerators, clothes washers, and air conditioners, the 2003 market penetration rates are very similar between the KEMA study and NYSERDA study, so no further evaluation is necessary. Additional studies on home electronics are needed to determine market penetration rates in New Jersey.

There were numerous commercial technologies that were forecasted to have a greater than 10% increase in market penetration between 2003 and 2012. A sample of these technologies included high efficiency air conditioners, high efficiency heat pumps, T8 lamps and ballasts, low mass copiers, high efficiency tank water heaters, daylight dimmers, and, premium efficiency motors. Many of these technologies are addressed in the KEMA study, but penetration rates are not provided, so an evaluation can not be made. In order to complete this analysis, it will be necessary to acquire data on the commercial and industrial sectors and their use of various technologies.

Overall, our Team has determined that the KEMA study penetration rates are consistent with those in the NYSERDA energy efficiency potential study for the measures that we could compare. KEMA did not publish penetration rates for commercial and industrial measures, so those sectors could not be analyzed.

D. Program Design Review and Alternative Delivery Options

Most of the state's energy efficiency programs transitioned from utility implementation to market manager implementation in 2007. In late 2007 the Market Managers, Honeywell International Inc., TRC Energy Services, and the utilities who operate low income programs, filed program plans for 2008, which included proposed modifications to some of the energy efficiency programs. Further, Summit Blue's July 2006 report also identified opportunities to modify programs to keep current with changes in the market.[29]

Our Team understands that the program modifications proposed by both Honeywell and TRC have been approved by the BPU and are waiting for contract amendments before implementing these modifications. Many of these recommendations are derived from the Summit Blue report. These recommendations included the following:

[29] Summit Blue Consulting, Quantec, LLC. And Gable Associates. "Energy Efficiency Assessment of New Jersey Clean Energy Programs", July 2006.

- Include duct sealing and Quality Installation Verification in the Residential HVAC Program
- Transition from builder-based incentives to targeted consumer marketing in the Residential New Construction program
- Implement a Zero Energy Home Program
- Offer Residential Lighting Program all year instead of seasonally
- Add a Municipal/Local Government Energy Audit Program
- Add a Pay for Performance Program whose target market is large C&I facilities
- Add a Direct Install Program for small commercial customers

While New Jersey's energy efficiency programs are well regarded, there are some trends in program delivery that are emerging and warrant discussion. For large commercial customers we are beginning to see the emergence of a "market-based approach" to program delivery. The large commercial sector includes large buildings where capital expansion, capital renewal, and possibly operations and maintenance products and services are procured through contracts with third parties – typically distributors, manufacturers or specialty contractors. The objective of a market-based approach to energy efficiency is to provide the most cost effective and comprehensive portfolio of program elements for the targeted customers (e.g., large commercial) in order to deliver a packaged solution involving the most efficient combination of electric energy (kWh), electric capacity (kW), gas commodity, demand response and distributed generation. In California, Pacific Gas & Electric's Large Commercial Program seeks to involve customers, industry vendors, trade allies, third parities, technical industry consultants, and various other partners in a cooperative environment that promotes energy efficiency.[30]

Another emerging best practice program addresses the residential HVAC market. In May 2006, NEEP issued a report that found there have been limited attempts by program implementers to deliver a fully comprehensive HVAC program.[31] Specifically, the NEEP study identifies duct-sealing as important but challenging component of a strategy to increase overall HVAC energy efficiency in residential buildings in the Northeast. The NEEP study states that the potential for duct sealing is large though current opportunities to deliver quality duct sealing are limited.

A number of studies stress the importance of program design best practices as a component of determining Achievable Potential. [32] As such, the above program design

[30] Pacific Gas and Electric Company, "Market Integrated Demand Side Management, Program Description, Large Commercial", February 2006.
[31] Titus, Elizabeth. "Strategies to Increase Residential HVAC Efficiency in the Northeast", NEEP, May 2006.
[32] U.S. Environmental Protection Agency. "Guide for Conducting Energy Efficiency Potential Studies", November 2007.
Optimal Energy, Inc. "Economically Achievable Energy Efficiency Potential in New England", Northeast Partnership for Energy Efficiency, May 2005.
Meyers, S., Guthrie, S., "More and Faster: Increasing the Achievable Energy Efficiency Potential through best Practices Processes and Data Management Tools", ACEEE Summer Study Conference Proceedings, 2006.

modifications should serve to increase the Achievable Potential estimated by the KEMA study. Additional program design best practices, including the market-based approach to program delivery and the HVAC program design enhancements discussed above would be expected to increase the Achievable Potential estimates in the KEMA study even further. Future reviews of the KEMA study should explicitly include a review of the program modifications that have been approved by the BPU OCE to further gauge the impact that these changes have on estimates of Achievable Potential.

E. Review of Clean Energy Program Energy Efficiency Program Savings

Data from the 2004-2007 New Jersey Clean Energy Programs was used to determine how much energy has been saved during these years. For this analysis, actual savings were used instead of committed savings. Committed savings represents the savings that will accrue from contractual commitments for program participation made in the reporting period, but scheduled for installation in future reporting periods. A large source of uncertainty was how to divide the programs into the end uses discussed in the KEMA study. These end uses were HVAC, appliances, water heating and lighting in the residential sector, HVAC, lighting and other in the commercial sector and processes, motor, lighting, HVAC and compressed air in the industrial sector.

Residential

To calculate the energy saved as a result of the New Jersey energy efficiency programs, it was necessary to divide the programs among the four residential end-use sectors discussed in the KEMA study: HVAC, lighting, appliances and water heating. HVAC was estimated using the summation of 2004 through 2007 Residential HVAC program savings. Appliance savings was estimated using the summation of 2004 through 2007 Energy Star® Room AC program savings and 25% of Comfort Partners savings[33]. Finally, lighting was estimated using 2004 through 2007 Energy Star® Lighting program savings and 25% of Comfort Partner energy savings. There were no programs that easily fit into the sector of water heating.

Commercial/Industrial

Since the Clean Energy Program data do not distinguish between commercial and industrial savings, it was necessary to approximate the proportion of energy saved in both the commercial and the industrial sectors. We used energy consumption as a proxy for this proportion. For electricity consumption, we used EIA-826 data from all New Jersey utilities for 2007 to find the percentage of commercial and industrial usage (80% and 20%, respectively). For natural gas consumption, we used EIA State Energy Data (SEDs) data from New Jersey in 2005 to find the percentage of commercial and industrial usage (70% and 30%, respectively).

[33] The Comfort Partners Program encompasses many different types of energy efficiency measures including light bulb replacement, appliance replacement and consumer education. We assumed that 25% of savings were attributable to lighting changes and 25% were attributable to appliance changes based on the program description.

To determine the percentage of the energy savings that could be attributed to the end uses identified in the KEMA study, an average from the Commercial & Industrial Measure Installed data from the 2004, 2005 and the second quarter of 2007 reports were used. It was assumed that the 16 measures listed in this table were a complete listing of possible measures. The measures include prescriptive lighting, lighting controls, performance lighting, LED Traffic signals, VFD's, electric chillers, gas chillers, motors, gas heating, gas water heaters, electric unitary HVAC, geothermal heat pump, design support, technical assistance, custom gas and custom electric. From this analysis, it was estimated that 70% of installed measures were lighting, 10% were HVAC, 11% were motors, and the remainder was in the other measure categories.

Table 4 shows the energy efficiency program savings from 2004-2007 for the residential, commercial and industrial sectors, and for various end use categories within them. Overall, 939 thousand MWh of electricity has been saved between 2004 and 2007 as a result of energy efficiency programs. This represents over 78% of the KEMA 2004-2007 Business as Usual scenario savings potential of 1,205 thousand MWh and almost 44% of the Advanced Efficiency scenario of 2,116 thousand MWh. Almost 36% of these energy efficiency savings have been realized through commercial lighting programs alone, and 42% of the savings has been realized through the residential programs. If the energy efficiency program savings stay at 2007 levels through 2011, almost 968 additional thousand MWh could be saved. This would represent about 1.4 times the KEMA 2009-2012 Business as Usual savings estimate of 704 thousand MWh and 67% of the KEMA 2012 Advanced Efficiency savings scenario.

Table 4: New Jersey Clean Energy Program Actual Energy Savings 2004-2007

	Thousand MWh Savings	**Thousand Decatherm Savings**
Residential	**393**	**1,609**
HVAC	55	710
Appliances	10	91
Water Heating	0	0
Lighting	166	91
Commercial	**437**	**709**
HVAC	44	35
Lighting	302	238
Other	39	68
Industrial	**109**	**304**
Processes	0	0
Motor	12	16
Lighting	76	102
HVAC	11	15
Compressed Air	0	0
Total	**939**	**2,622**

In the natural gas programs, 2,622 thousand DTh have been saved between 2004 and 2007. This represents almost 94% of the KEMA 2004-2007 Business as Usual scenario savings potential of 2,778 thousand DTh and almost 24% of the Advanced Efficiency scenario of 10,906 thousand DTh. If the energy efficiency program savings stay at 2007 levels through 2011, almost 3,727 additional thousand DTh could be saved. This would represent about 1.3 times the KEMA 2009-2012 Business as Usual savings scenario and 40% of the KEMA 2012 Advanced Efficiency savings scenario.

In Table 5, a comparison is made between the New Jersey Clean Energy Program Savings for the years 2004 to 2007 and the estimates under both the Business as Usual case and the Advanced Efficiency Case presented in the KEMA study. It is evident that the New Jersey energy efficiency programs captured significantly less electric and gas energy savings than estimated by the KEMA study. Continuing the programs "as-is" will likely result in New Jersey meeting the KEMA Business as Usual case; however the savings estimated under the Advanced Efficiency case are not likely to be attained. This discrepancy between actual savings and Advanced Efficiency estimated savings is to be expected because the budget for New Jersey's Clean Energy Program was about $87 Million/year between 2004 and 2007, while the Advanced Efficiency case budget was $160-$180 Million/year. The budget of the Clean Energy Program is only half of what the KEMA study estimated would be necessary to attain the Advanced Efficiency savings goals.

Table 5: New Jersey Clean Energy Program Energy Efficiency Program Energy Savings and KEMA Achievable Potential Estimates 2004 – 2007

	2004	2005	2006	2007	Total
Electric (Thousand MWh)					
NJ Energy Efficiency Program Savings	329	243	127	242	940
KEMA Achievable Savings BAU	325	315	297	268	1,205
KEMA Achievable Savings Advanced Efficiency	570	575	504	467	2,116
Gas (Thousand DTh)					
NJ Energy Efficiency Program Savings	432	617	640	932	2,622
KEMA Achievable Savings BAU	644	683	715	736	2,778
KEMA Achievable Savings Advanced Efficiency	2,676	2,755	2,761	2,714	10,906

F. Changes in Energy Cost Assumptions

A comparison of the electricity and natural gas rate forecasts from the KEMA study with data from the Energy Information Agency (EIA) are shown in Tables 6 and 7 respectively. [34] EIA 2006 New Jersey retail electricity prices were $0.1261/kWh for residential customers and $0.1051/kWh for commercial/industrial customers were used, with an annual adjustment for inflation. For the electricity rate forecasts, the KEMA study tended to under forecast the rates by about 10 to 30% in the residential and industrial sectors and up to 40% in the commercial sector.

For the natural gas rate forecast, EIA Annual Energy Outlook 2007 data from the Mid-Atlantic region was used for comparison.[35] Again, KEMA under forecasts the natural gas rates by between 30 and 50% in the residential and industrial sectors and between 20 and 40% in the commercial sector. The Team was not able to rerun the KEMA study's model with the higher energy costs since it is unavailable for public use.

Table 6: Electricity Rate Forecasts and Percent Difference between the KEMA study and EIA for Residential, Commercial and Industrial Sectors

Electricity Rate Forecast ($/kWh)									
Year	**Res KEMA**	**Res EIA**	**% Difference**	**Com KEMA**	**Com EIA**	**% Difference**	**Ind KEMA**	**Ind EIA**	**% Difference**
2006	$0.11	$0.13	-13%	$0.10	$0.11	-19%	$0.08	$0.11	-24%
2007	$0.11	$0.14	-21%	$0.10	$0.11	-28%	$0.08	$0.11	-25%
2008	$0.12	$0.14	-19%	$0.10	$0.11	-29%	$0.09	$0.11	-21%
2009	$0.12	$0.14	-17%	$0.10	$0.11	-30%	$0.09	$0.11	-22%
2010	$0.12	$0.15	-18%	$0.10	$0.11	-30%	$0.09	$0.11	-19%
2011	$0.12	$0.15	-20%	$0.11	$0.11	-32%	$0.09	$0.11	-21%
2012	$0.13	$0.15	-18%	$0.11	$0.12	-32%	$0.09	$0.12	-22%
2013	$0.13	$0.16	-16%	$0.11	$0.12	-33%	$0.10	$0.12	-19%
2014	$0.14	$0.16	-15%	$0.12	$0.12	-35%	$0.10	$0.12	-16%
2015	$0.14	$0.16	-13%	$0.12	$0.12	-35%	$0.10	$0.12	-18%
2016	$0.14	$0.16	-15%	$0.13	$0.12	-37%	$0.11	$0.12	-16%
2017	$0.15	$0.17	-13%	$0.13	$0.13	-38%	$0.11	$0.13	-13%
2018	$0.15	$0.17	-12%	$0.13	$0.13	-38%	$0.11	$0.13	-15%
2019	$0.16	$0.17	-11%	$0.13	$0.13	-39%	$0.12	$0.13	-12%
2020	$0.16	$0.18	-9%	$0.14	$0.13	-41%	$0.12	$0.13	-14%

[34] Energy Information Administration, U.S. Department of Energy, Annual Energy Outlook 2006. (EIA), 2006 Supplemental Tables to the Annual Energy Outlook 2006 Part 1: Consumption and Prices. Pg 78-82.
[35] Energy Information Administration. *Annual Energy Outlook 2007*. February 2007.

Table 7: Natural Gas Rate Forecasts and Percent Difference between the KEMA study and EIA for Residential, Commercial and Industrial Sectors

Natural Gas Rate Forecast ($/Therm)									
Year	**Res KEMA**	**Res EIA**	**% Difference**	**Com KEMA**	**Com EIA**	**% Difference**	**Ind KEMA**	**Ind EIA**	**% Difference**
2006	$0.90	$1.51	-40%	$0.83	$1.27	-35%	$0.45	0.91	-51%
2007	$0.81	$1.38	-41%	$0.75	$1.14	-34%	$0.45	0.88	-49%
2008	$0.83	$1.40	-41%	$0.75	$1.15	-35%	$0.55	0.875	-37%
2009	$0.92	$1.37	-33%	$0.85	$1.11	-23%	$0.45	0.825	-45%
2010	$0.81	$1.36	-40%	$0.70	$1.10	-36%	$0.50	0.8	-38%
2011	$0.90	$1.35	-33%	$0.80	$1.07	-25%	$0.45	0.77	-42%
2012	$0.85	$1.35	-37%	$0.75	$1.07	-30%	$0.39	0.76	-49%
2013	$0.65	$1.38	-53%	$0.60	$1.06	-43%	$0.50	0.75	-33%
2014	$0.90	$1.39	-35%	$0.85	$1.09	-22%	$0.51	0.77	-34%
2015	$0.95	$1.42	-33%	$0.90	$1.10	-18%	$0.52	0.78	-33%
2016	$0.95	$1.46	-35%	$0.90	$1.14	-21%	$0.53	0.8	-34%
2017	$0.96	$1.53	-37%	$0.91	$1.19	-24%	$0.54	0.85	-36%
2018	$0.98	$1.56	-37%	$0.93	$1.21	-23%	$0.55	0.87	-37%
2019	$1.00	$1.60	-38%	$0.95	$1.24	-23%	$0.56	0.88	-36%
2020	$1.02	$1.64	-38%	$0.97	$1.27	-24%	$0.58	0.91	-36%

In addition to the energy cost assumptions, we were able to review is the discount rate used in the KEMA analysis. They used a rate of 8.4%, which is similar to the rate of 8% used in the CEEEP cost-benefit analysis, and is within the normal range of discount rates used in other state's analyses.[36]

The relationship between energy costs and potential energy savings is a complicated one. Energy costs have increased since the KEMA study was performed in 2003, and this will have an impact on both the Economic Potential and Achievable Potential estimates. As energy costs rise, some measures that had previously been determined to be uneconomic will become more cost-effective, raising the Economic Potential. Achievable Potential may also rise, but this will be impacted by the program design changes in response to the increased prices.

[36]Goldberg, Miriam L., Valy Goepfrich, Lori Boeckeler and G. Kennedy Agnew. Focus on Energy Statewide Evaluation: Initial Benefit-Cost Analysis. State of Wisconsin Department of Administration, Division of Energy. March 31, 2003.
Pereira, Alvaro, Lou Sahlo, Zazy Atallah, Brian Tracy and Lawrence Masland. "2002 Energy Efficiency Activities A Report by the Division of Energy Resources: An Annual Report to the Great and General Court on the Status of Energy Efficiency Activities in Massachusetts.", Summer 2004.
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Additional information on discount rates in energy efficiency benefit-cost analyses is available from:

IV. Findings and Recommendations

The specific scope of work undertaken by our Team was focused broadly in two areas. First, we wanted to verify the assumption in the KEMA study. Our approach was to qualitatively assess various input data used by KEMA, comparing their assumptions to current conditions. Specifically, we reviewed the technologies KEMA evaluated, the study's resource cost assumptions, and its energy efficiency penetration rate assumptions. In addition, our Team undertook a number of additional qualitative assessments designed to evaluate other factors that may influence the savings potential estimates that were derived by KEMA for the 2009 to 2012 time horizon.

Figures 5 and 6 show an overview of our Team's results cumulatively for 2009-2012 for electricity and natural gas, respectively. These figures are similar to Figure 3 and Figure 4, and show the KEMA Technical, Economic and Achievable Potential compared with the OCE Straw Proposal and proposed Energy Master Plan savings goals. To see this data in tabular format, please refer to Table 1**.** They show a downward adjustment to the Technical, Economic and Achievable Potential based on the 2004-2007 Clean Energy Program savings in dark shading. In addition, qualitative adjustments to each potential estimate are shown using brackets. Our Team has noted a positive adjustment to Technical Potential due to new technologies not accounted for in the KEMA study, a positive adjustment to Economic Potential due to increasing energy prices since the study was completed, and a positive adjustment to Achievable Potential due to improved program design modifications. No quantitative adjustments have been made for this analysis, but it is important to note that in order for the State to meet the proposed Energy Master Plan savings goals, it will be necessary to explore all avenues for energy savings.

Figure 5: 2009 -2012 Cumulative Electricity Savings Potential from KEMA Adjusted for Clean Energy Program Savings and Various Qualitative Measures

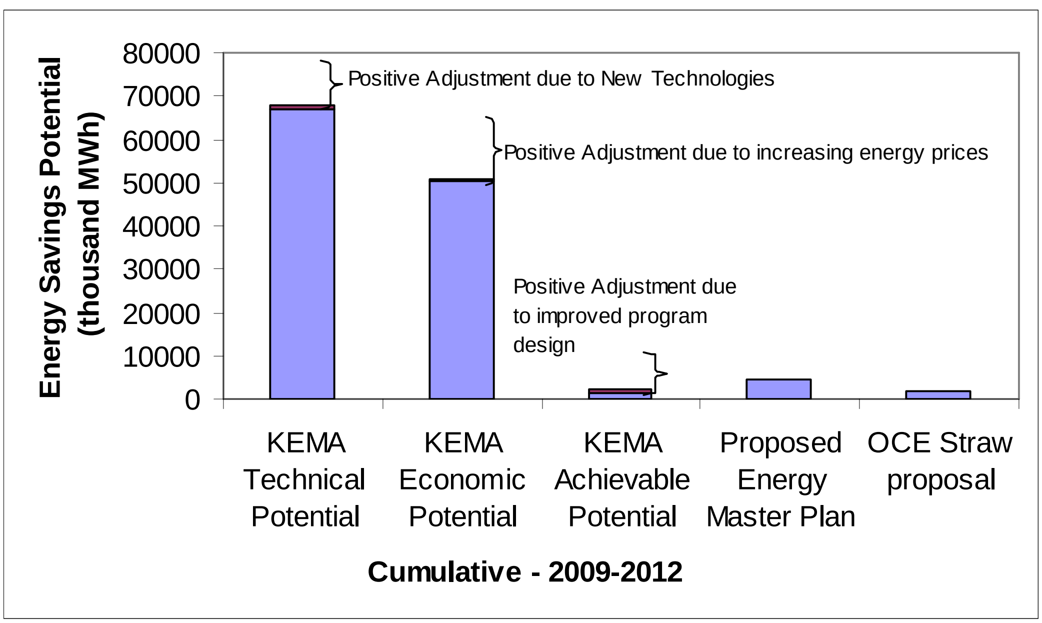
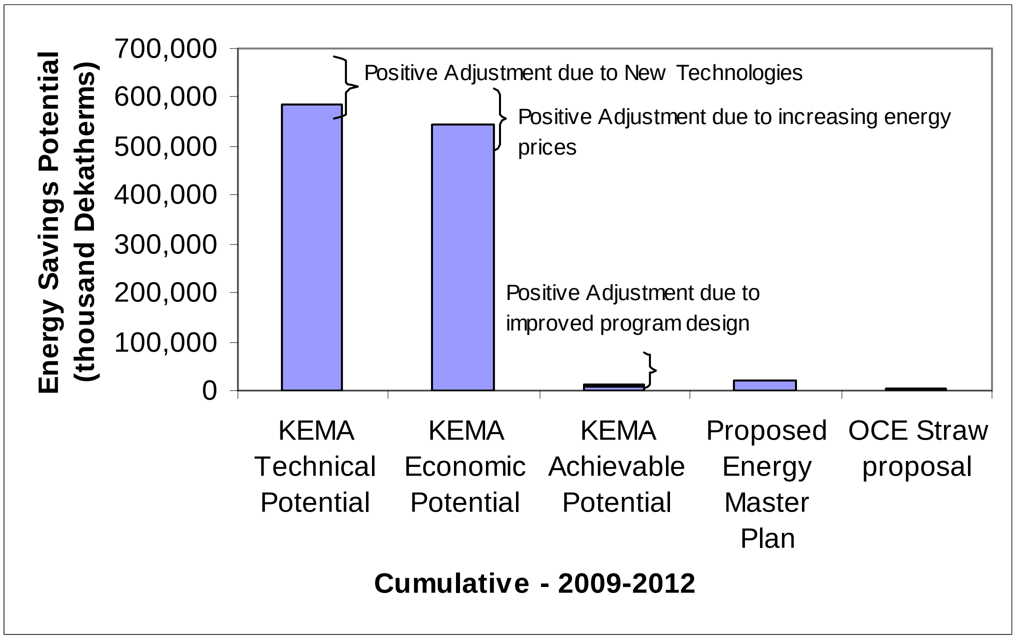


Figure 6: 2009 -2012 Cumulative Gas Savings Potential from KEMA Adjusted for Clean Energy Program Savings and Various Qualitative Measures



Following are our Team's findings and recommendations for 2009-2012 timeframe.

A. Findings

- For electricity, our Team found that the Achievable Potential of 2,144 thousand MWh estimated in the KEMA study for 2009-2012 is more than the OCE Savings Goal of 1,700 thousand MWh but less than the Energy Master Plan proposed Savings Goal of 4,300 thousand MWh for that period. The Economic Potential estimated in the KEMA study, 51,328 thousand MWh is much higher than both of these goals. (Section 2C)
- For natural gas, our Team found that the Achievable Potential of 12,488 thousand DTh estimated in the KEMA study for 2009-2012 is more than the OCE Savings Goal of 2,400 thousand DTh and less than the Energy Master Plan proposed Savings Goal of 20,000 thousand DTh for that period. The Economic Potential estimated in the KEMA study, 546,400 thousand DTh is much higher than both of these goals. (Section 2C)
- The OCE Savings Goal for the period 2009-2012 is less than 50% of the Energy Master Plan electricity Savings Goal and only 12% of the gas Savings Goal. (Section 2C). As noted in the OCE Straw Proposal, funding needs to be increased 2 to 3 times to achieve the Energy Master Plan goals.
- The New Jersey Clean Energy Program has saved 940 thousand MWh and 2,622 thousand DTh since 2004. These savings are less than the Achievable Potential in the KEMA study for this period, but with program design changes and inclusion of new technologies, more energy can be saved. (Section 3E)

A summary of the other major findings in this report follows:

- Certain technologies were not included in the KEMA report, and new technologies have reached the market with promises of increased energy savings. Acceptance of these technologies would increase the potential estimates reported by KEMA. (Section 3B)
- Residential market penetration rates in the KEMA study are similar to those used in the NYSERDA study. Commercial market penetration rates could not be compared. (Section 3C)
- Improvements in program delivery will result in greater penetration of energy savings technologies and can affect the savings estimates provided by KEMA in its advanced case scenario. (Section 3D)
- Energy cost assumptions used by KEMA are no longer valid. Wholesale commodity prices have increased significantly since KEMA performed its study in 2004. (Section 3G)

B. Recommendations

The Team's findings show that the BPU can continue to utilize the results of the KEMA study to establish funding levels and program objectives for the years 2009-2012. However, we recommend that the BPU initiate another review of the KEMA study or commission a revised market potential study within the next two years, prior to commencement of the next funding level review proceeding. Some suggestions for this study include:

- Report Technical, Economic, and Achievable Potential estimates on an annual basis in order to accurately compare these values to proposed savings goals.
- Include requirements for the analysis of rebound effect associated with selected individual programs.
- Investigate commercial, industrial and home electronics market penetration rates.
- Examine more specific measures in the industrial sector, including compressed air and steam systems.
- A limited scope market potential study reflecting changes in technology estimates should be considered within the next two years, prior to commencement of the next funding level review proceeding.
- Market potential studies need to be conducted in a way consistent with how the Clean Energy Program organizes its programs so comparison within sectors can be made.

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