# CHAPTER 3

## Energy Efficiency Workgroup Resource Assessment

### 1. Introduction, Methodology and Approach, Overview

#### 1.1 Introduction

Energy efficiency has been aptly defined in the National Action Plan for Energy Efficiency,[26] issued in July 2006: "*Energy efficiency refers to using less energy to provide the same or improved level of service to the energy consumer in an economically efficient way. The term energy efficiency as used here includes using less energy at any time, including at times of peak demand through demand response and peak shaving efforts.*" The attainment of energy efficiency is a proactive and technology-driven process. It should be distinguished from energy conservation, which is a usage-driven process that results in the direct scaling back of energy consumption. When aggressively pursued, conservation may imply a reduced level of energy service, whereas energy efficiency always attempts to maintain or improve energy services while at the same time using less energy. Another distinction between energy efficiency and energy conservation is that conservation tends to be a reactive and temporary measure associated with high energy prices and adverse economic conditions. In contrast, energy efficiency is a long-term and capital intensive process yielding long-term benefits to energy consumers. It is the process of replacing new generation resources with end use technology improvements. Energy efficiency can make strong business sense irrespective of economic conditions.

#### 1.2 Methodology and Approach

The 21st Century Energy Plan (Plan) Energy Efficiency Workgroup assessed four major categories of energy efficiency resource options: (1) a statewide energy efficiency program, (2) an electric utility load response program, (3) a commercial building code update, and (4) state specific energy efficiency standards for appliances. Estimates of energy and demand savings, i.e., kilowatt hours (kWh) and kilowatts (kW) respectively, and program costs were developed using a sufficiently rigorous approach for the purposes of developing policy directions. However, actual program development and implementation, including Michigan program funding levels above a minimum program scope will require a more detailed analysis of the Michigan market. In the Policy document, Appendix Volume I, recommendations for an implementation and review process are detailed.

A major goal of estimating energy efficiency potential in Michigan for this report has been to affirm or modify the program scope included in the Capacity Need Forum (CNF) Report. This was accomplished by a statewide energy efficiency study managed by Staff on behalf of the

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[26] *The National Action Plan for Energy Efficiency*, issued July 2006, can be viewed online at, http://www.epa.gov/cleanrgy/pdf/ActionPlanReport_PrePublication_073106.pdf.

Workgroup. The resulting estimates were based on a resource modeling format that used "achievable" energy savings potential, as opposed to "economic" or "technical" potential. The distinction between types of estimated impacts is of critical importance. Only achievable potential estimates are useful in establishing actual program scope and funding levels. Achievable potential estimates take into consideration that actual program participation rates will always be less than 100 percent, even though program measures are economic. In addition, achievable potential estimates incorporate time dependence of program implementation, including a program ramp up period, growth phase, and leveling off period. From a technical perspective, modeling customers' behavior occurs through a market adoption curve, where parameters are adjusted to reflect each particular market's expected implementation rate, e.g., slow, moderate or aggressive. Adoption curves like these are used in many industries to forecast market acceptance of new products and programs. In contrast, an economic potential estimate assumes that all efficiency measures with favorable economics will be implemented, and that such implementation takes place by utility customers, both immediately and simultaneously. Economic potential has little value in estimating statewide energy efficiency program scope, in that such a level cannot be achieved in practice. Technical potential is a purely theoretical calculation that is far less conservative than an economic potential, in that cost does not have an impact on the assessment. Neither economic potential nor technical potential were deemed appropriate modeling perspectives for this energy efficiency study.

### 1.3 Overview

The results of the Michigan energy efficiency potential study described below, suggest that Michigan could implement a new statewide electric energy efficiency program having considerable scope and impact on electric use in Michigan. Based on the study, an aggressive program could reduce the projected growth rate in Michigan electric energy use (1.2 percent - as projected in load forecasts for the Plan) by more than one-half over a 10 year period and thus reduce the amount of new power generation needed in the state. The energy efficiency model estimated that after 10 years of energy efficiency programming, electric energy use in Michigan could be reduced within a range of 6,664 gigawatt hours (GWh) to 10,603 GWh. Electric peak demand could be reduced, over the same 10 year period, within a range of 876 megawatts (MW) to 1,889 MW. To achieve savings on this scale, modeling results suggest that annual average programming expenditures would need to be $114 million over the first five years of program operation, and average $146 million over the first 10 years of operation. Using a benefit/cost approach referred to as a utility cost test (UCT), the mean projected levelized cost of energy efficiency programming would be 2.57 cents/kWh, as compared to an avoided electric power cost of approximately 6 cents/kWh.

Not all Workgroup members were supportive of modeling energy efficiency potential using the UCT exclusively. Various other economic tests such as the total resource cost test (TRC), and ratepayer impact measure test (RIM), can be used as a basis for evaluation, and would result in different outcomes when compared to the results of the UCT. These alternate economic tests are discussed in more detail in Section 2 of this chapter.

Peak load reductions can be reduced by expanding the scope of residential and small commercial electric load response programs. Consumers Energy and Detroit Edison have conservatively estimated that a 10 year load management programming effort could reduce Michigan electric peak demand by 569 MW and annual energy use by 35 GWh.

The Energy Efficiency Workgroup also investigated the impact of updating Michigan's commercial building code and concluded that in the 10th year of a code update, annual electric energy savings of 477 GWh could be obtained. Additionally, peak demand could be reduced by 99 MW. The implementation of a new Michigan commercial building code was determined to result in an overall reduction to expected commercial building costs, according to a September 2006 study prepared for the U.S. Department of Energy. The study was undertaken upon the request of the State Energy Office on behalf of the Plan. The Staff estimated that construction cost savings in Michigan would be about $25 million. The results of the energy efficiency and demand response modeling are summarized in Figure 1 and Figure 2.

State appliance standards were investigated, albeit briefly due to time constraints. Estimates made for the Workgroup suggest that if Michigan instituted its own standards on the several appliances that are not currently under federal standards, that significant electric energy savings could be obtained. Additional modeling work will have to be done in order to adequately gauge the costs and benefits. This is discussed in the Policy document, Appendix Volume I.

**Figure 1: Plan Energy Efficiency Modeled - Annual Energy Savings (GWh)**

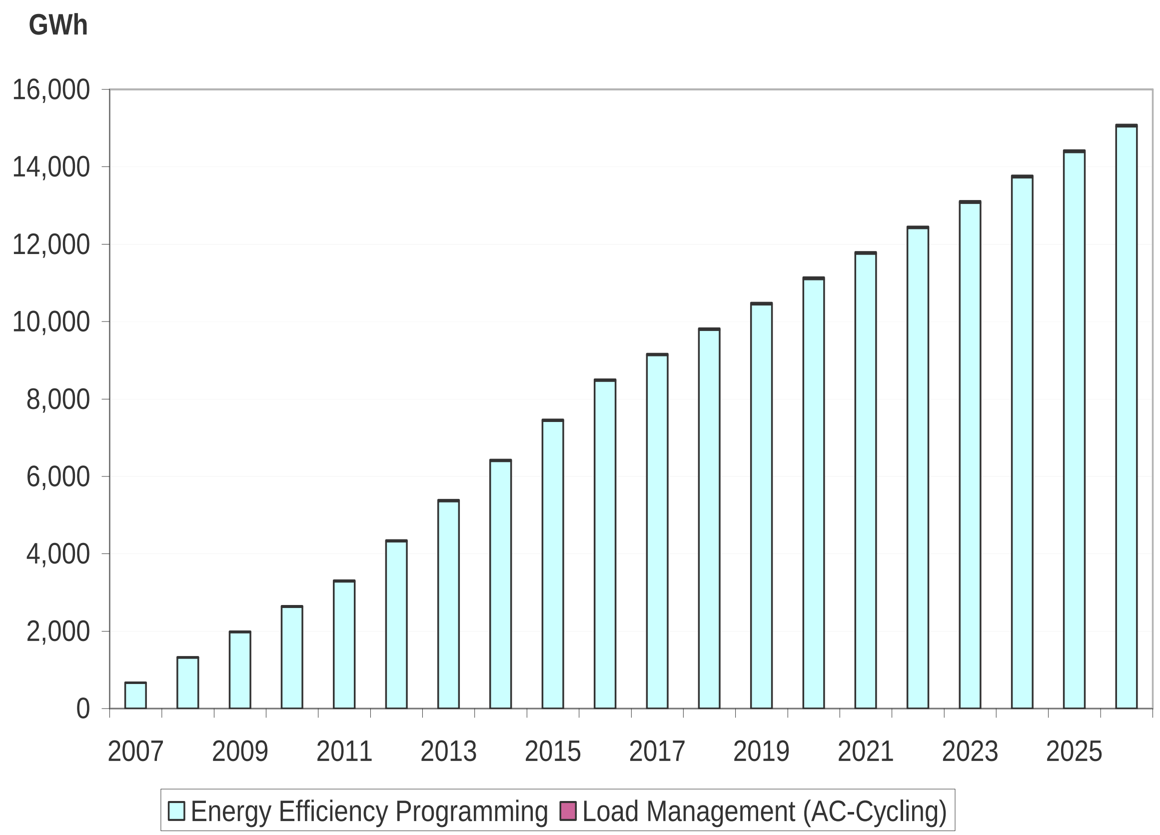
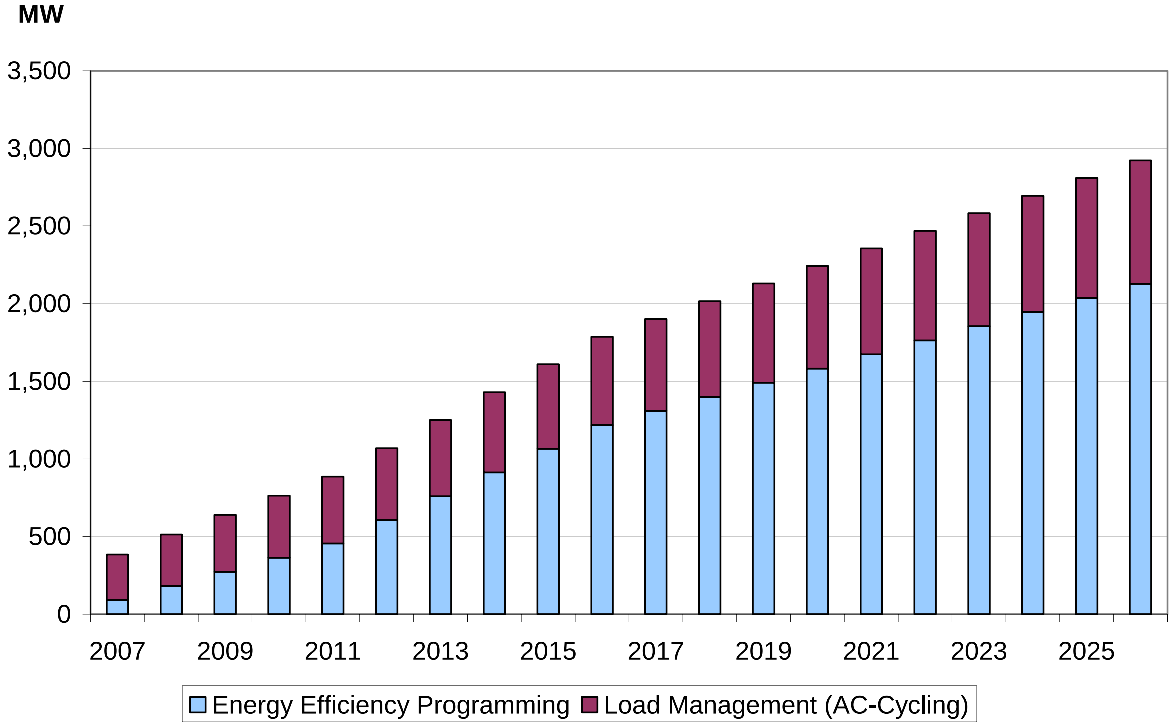


**Figure 2: Plan Energy Efficiency Modeled - Peak-Hour Reduction (MW)**




# 2. Energy Efficiency Resource Assessment

## 2.1 Energy Efficiency

For the CNF, the Demand Workgroup relied upon energy efficiency results from other states that have conducted energy efficiency programs. Extensive data has been collected in these states for several years, and the CNF used this data to estimate the savings that might be available in Michigan. The goal of the Plan's Energy Efficiency Workgroup, in part, was to take a more rigorous approach to estimating energy efficiency. Michigan has not undertaken significant energy efficiency programs in over a decade. Without recent experience or data from Michigan, the MPSC (MPSC or Commission) Staff proposed to model Michigan potential by modifying a recently issued (2005) study for the State of Wisconsin "Wisconsin Model," which was performed by the Energy Center of Wisconsin[26] (ECW). None of the Workgroup participants objected to this approach and several were supportive. A limited number of macro-scale modifications were made to the Wisconsin model in order to account for differences in the scale of Michigan markets and weather patterns that differ between Michigan and Wisconsin. The specific variables used to macro-scale are electric sales by residential, commercial and industrial sectors; population weighted heating and cooling degree days; real discount rate; and avoided cost of power.

Using a Wisconsin model as a basis for a Michigan study was deemed reasonable, since Wisconsin shares important characteristics with Michigan. Wisconsin is a Midwest state having

[26] Energy Center of Wisconsin website can be viewed online at http://www.ecw.org/.

a close proximity to Michigan, with a similar climate and electric use characteristics and a nearly identical commercial building code. In addition, the study was recent, the model reflects the existence of a relatively new statewide energy efficiency program in Wisconsin, and the model is robust in that many of the detailed inputs combine in such a way that scaling can occur at a relatively high (macro) level. The ECW, a non-profit corporation with particular expertise in energy efficiency modeling, was asked to perform the necessary modifications and make the modeling runs on behalf of the State of Michigan.

The ECW's original study for the State of Wisconsin was released in November of 2005. The study was entitled*: Energy Efficiency and Customer Sited Renewable Energy: Achievable Potential in Wisconsin 2006-2015.*[27] The primary objectives of the study were two-fold: (1) to estimate near-term five year and 10 year achievable energy efficiency potential; and (2) to quantify an economically justifiable funding level for a statewide energy efficiency program. These are also two major goals of the Plan. Thus, the ECW was asked by the Staff to translate and scale the original study into a model modified for Michigan.

The original ECW model divided the achievable energy efficiency potential for the state electricity market into manageable segments. The total market was divided into the residential and commercial/industrial sectors. The agricultural market was included in the latter sector. Each sector was subdivided into specifically identified markets. Thirty energy efficiency markets (see Table 1) were included in the ECW study: 15 residential markets and 15 commercial/industrial markets. Each market was classified into three categories of market opportunities: incremental, retrofit, and new construction.[28] In the final analysis, the 30 markets were extrapolated to represent all possible markets on the assumption that the specifically identified markets represented between 75 and 90 percent of the total energy efficiency potential. Of the 30 markets, some were associated with multiple programs. Thus, in all, 38 energy efficiency programs were evaluated for energy efficiency potential.

Demand response programs were not included in the ECW study. The Plan demand response forecast was provided by Detroit Edison and Consumers Energy.

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[27] *Energy Efficiency and Customer Sited Renewable Energy: Achievable Potential in Wisconsin 2006-2015*, online at http://72.36.212.11/prod/236-2.pdf.

[28] *Incremental markets* relate to energy measures that would likely occur at standard efficiency in the absence of program intervention. An example would be the replacement of a burned-out light bulb. The program would induce the replacement with an efficient unit.

*Retrofit markets* relate to the early replacement of working equipment having a continuing service life, with new high efficiency products. The replacement would not otherwise occur in the absence of program intervention. *New construction markets* are composed of energy efficiency upgrade opportunities in new buildings, which would otherwise be implemented with standard efficiency products.

**Table 1: Summary of Energy Efficiency Programs Evaluated for Plan Study**

| Commercial/Industrial Markets | Residential Markets |
|---|---|
| High performance new buildings | Consumer electronics |
| Unitary heating ventilating air-conditioning (HVAC) replacement and system improvements | Compact fluorescent lighting |
| Lighting remodeling and replacement upgrades | Multi-Family common area lighting |
| Boiler replacement and systems improvements | Variable speed furnaces |
| Lighting system retrofit improvements | Central air conditioning |
| Chiller replacement and system improvements | Multi-Family heating systems |
| Ventilation system improvements | Room air conditioning |
| Refrigeration improvements; | Water heater purchases |
| Motors | New home construction |
| Compressed air systems | Remodeling |
| Fan and blowers | Dehumidifier purchases |
| Pump systems | Direct install market |
| Manufacturing process upgrades | Shell improvements |
| Water and wastewater systems | Clothes washer purchases |
| Agriculture upgrades | Multi-Family fuel-switching |

The market characteristics included in the Wisconsin Model were specific to the State of Wisconsin, which has an ongoing statewide energy efficiency program. Michigan markets however, may differ somewhat from the Wisconsin markets. Therefore, actual Michigan program markets would need to be determined via a public hearing process, as outlined in the policy section of this report, prior to implementation of a statewide program.

For each individual energy efficiency market, a baseline of the measure's market was determined. Baseline market share consists of a forecast of naturally occurring implementation of efficiency measures, i.e. implementation that would occur in the absence of program intervention. A "base case" program impact was then developed by subtracting the naturally occurring baseline from the total forecasted market under base conditions. Thus, each base case program represents the net impact of the program, as compared to no program, i.e. the true impact that can be attributed to the program. Base case costs included program administrative costs, market management, field Staff costs, and incentives. Incentives recover a significant portion of the incremental efficiency cost, typically in the range of 50 to 75 percent. The study scales upward each market's base program scope using adoption curves. The study program's scope is increased each year until its marginal cost equals the target avoided cost of power, of approximately 6 cents/kWh, at which point program scope and participation is maximized. If the program does not provide savings at or below the avoided cost, the model attempts to scale the program to optimize the secondary resource, which in most cases is demand savings, at a target avoided peak capacity cost of $80/kW. A Monte Carlo[29] modeling process was used in which repeated random draws of input variables produced a probabilistic uncertainty model. Mean model results were stated in terms of a 90 percent confidence interval.

Modification of the energy efficiency study involved scaling at the sector (residential, commercial, industrial) level to account for Michigan's larger size, rather than scaling individual markets. There are several reasons why translation is not practical at the market input level (30 markets) for purposes of creating a Michigan specific model. Most significant is that Michigan does not have the required detailed data at the market level. The source of much of the required data would come from financial and performance audits of an ongoing energy efficiency program, as well as detailed data obtained in the course of administering and overseeing individual market programs. However, even if a portion of the necessary market level data was available for Michigan, scaling at the market level would not be practical, because data inputs are inter-dependent. For example, market penetration could not be changed without changing the efficiency measure growth rate as well, since such variables are not independent.

Fortunately, the model is sufficiently robust, so that scaling to Michigan can be done at the sector level. The ability to scale to Michigan is related to the characteristics of several key input variables. For example, the key input variables of market penetration and program growth rate are inversely related. This inverse relationship creates stability in programming levels from year to year and is one reason why national data for levelized program costs tends to remain stable over long periods of time. A specific example of how this phenomenon supports sector level scaling can be seen in the residential compact fluorescent light (CFL) market. In this market, Wisconsin has a much higher penetration level (at approximately 12 percent) than the national average of 2 percent. High penetration levels put upward pressure on programming costs in order to maintain market share. On the other hand, high penetration rates are associated with lower growth rates. Michigan, having a relatively untapped CFL market, likely near the national average, would be assumed to have high growth rates consistent with its low market penetration. Since the two variables offset each other, the end result is that Wisconsin CFL market potential can reasonably be scaled to Michigan using only the residential sector electric energy ratios between the two states.

In the commercial and industrial sector, lighting, pumping and compressed air dominate energy efficiency potential. Commercial lighting is highly correlated with the size of the commercial energy sector, thus scaling commercial lighting programs by relative commercial sector energy ratios is justified. With respect to the pumping and compressed air markets, the relative cost and impact between the two markets is similar. On a combined basis, the model is insensitive to the proportion of the industrial end-use market that is related to pumping as opposed to compressed air. Thus, despite the fact that Wisconsin has a higher relative level of pumping, due to a large paper industry, but a lower manufacturing base than Michigan, in which compressed air dominates, the aggregate potential scales by sector energy levels.

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[29] Monte Carlo modeling is a computer simulation with a built-in random process, allowing you to see the probabilities of different possible outcomes. Additional information can be found at this link: http://en.wikipedia.org/wiki/Monte_Carlo_Simulation

Michigan and Wisconsin share the same commercial building code foundation, which is the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE) 90.1-1999 Standard. When estimating attainable energy efficiency in the commercial-sector new-construction market, incremental energy savings brought about by program intervention is calculated with respect to the same minimum building standards in both states. Thus, scaling can be accomplished by means of sector energy use without having to make further adjustments.

One note of clarification concerning the interplay between the commercial building code forecast and the energy efficiency program forecast is needed. The Michigan commercial building code forecast assumed an implementation date of 2007, whereas the ECW's energy efficiency potential study assumed that a similar Wisconsin commercial code update would not occur until 2009. Thus, during the initial two years of the energy efficiency potential study, a portion of the energy savings associated with a commercial building code update is also included in an energy efficiency program. The overlap is not likely to be large since the assumed market penetration of a high performance commercial building program (which is one of the energy efficiency markets included in the energy efficiency potential study) is much less than the 100 percent penetration of a statewide building code update, and in addition occurs for only two years of the 20 year forecast period. Nonetheless, in order to avoid double counting when determining the aggregate impact of the combination of an energy efficiency program and an update of the commercial building code, the impact of the energy efficiency program should be offset by such overlap. The energy efficiency program overlap is equal to approximately 5 percent of forecasted electric energy savings, and 7 percent of demand, during 2007 and 2008.

Wisconsin does have a more recent and demanding residential new construction building code than Michigan. This may cause an error to be introduced by the sector scaling. However, the residential building code is primarily focused on natural gas consumption rather than electric consumption. Since the Plan is focused on electric energy use, the error introduced is insignificant, especially at the overall study level, because of the relatively small contribution of the residential new construction market with respect to the total electric energy efficiency potential.

Program costs and impacts can be scaled with a reasonable degree of accuracy by use of the ratio of each sector's electric sales levels for Michigan as compared to Wisconsin. Additionally, climate was adjusted by use of population weighted heating and cooling degree-days. The proportion of program level impacts that are heating or cooling related was applied to the climate adjustment factors. The real discount rate was changed to 6.78 percent plus/minus 2 percent uncertainty. This is a consistent basis used in all Plan modeling efforts. The projected Michigan avoided cost of power, of 6.0 cents/kWh, plus/minus 0.5 cents/kWh uncertainty, was used.

As was stated previously, the ECW's energy efficiency potential model incorporated a Monte Carlo modeling process. Repeated random draws of input variables were used to model related probabilistic uncertainty. Mean results were stated in terms of a 90 percent confidence interval. Similarly, a Monte Carlo modeling process was used by the ECW subsequent to scaling of the Wisconsin Model to Michigan. Thus, Michigan-specific output was represented both in terms of mean results and confidence intervals that represented probabilistic uncertainty. With respect to Michigan energy efficiency program potential, the results indicated that after 10 years of program operation, the projected cumulative mean energy savings was estimated to be 8,474 GWh, within a projected 90 percent confidence interval of 6,664 GWh to 10,603 GWh. The peak electric demand mean-reduction was estimated to be reduced by 1,218 MW, within a 90 percent confidence interval of 876 MW to 1,889 MW. The Michigan-specific energy efficiency results are predicated on the use of a utility cost test (UTC). Figure 3 and Figure 4 illustrate the confidence interval associated with the projected mean energy savings (GWh) and demand reduction (MW).

The results of the Michigan achievable energy efficiency study compare favorably to, and are corroborated by national experience for statewide energy efficiency programs. The Michigan achievable potential study resulted in a levelized cost of conserved energy, of 2.57 cents/kWh, within a 90 percent confidence interval of 2.25 to 2.9 cents/kWh. According to the National Action Plan for Energy Efficiency, programs across the country are demonstrating that energy efficiency can be delivered at a cost of 2 to 4 cents/kWh[30]. In addition, the ACEEE[31] has reported that the national average cost of saved energy lies within a range of 2.3 to 4.4 cents/kWh. The projected mean cost of conserved energy, for the state of Michigan, is within 17 percent of the national average. Although lower than the national average by approximately 0.43 cents/kWh, such lower levelized cost is within the range experienced by states with ongoing energy efficiency programs. Nationally, annual energy efficiency program savings as a percent of total electricity sales lies within a range of 0.1 - 0.8 percent (ACEEE). This measure indicates the relative program effectiveness. The national figures are based upon total reported electricity sales in the various states. Similarly, the results of the 10 year Michigan potential study indicate that the annual expected electricity savings as a percentage of sales would be 0.78 percent.

A final measure of program scope is reflected by the calculation of program funding in terms of mils/kWh. Nationally, public benefit funding levels for energy efficiency programming lie within a range of 0.03 mils/kWh and 3.0 mils/kWh (ACEEE). The 10 year results of the Michigan-specific achievable potential, for the mean case, yield an expected energy efficiency funding level of $146 million per year, which if implemented on a uniform statewide basis, would translate into a public benefits charge, applicable to all Michigan ratepayers, of approximately 1.34 mils/kWh. In contrast, the minimum case yielded a funding level of $68 million per year, or 0.62 mils/kWh.

[30] *National Action Plan for Energy Efficiency*, Chapter 1, page 6.

[31] The American Council for an Energy-Efficient Economy (ACEEE) is a nonprofit organization dedicated to advancing energy efficiency as a means of promoting both economic prosperity and environmental protection. See ACEEE website for more information http://www.aceee.org.

**Figure 3: Energy Efficiency Program Achievable Potential Demand Reduction 2007-2026**

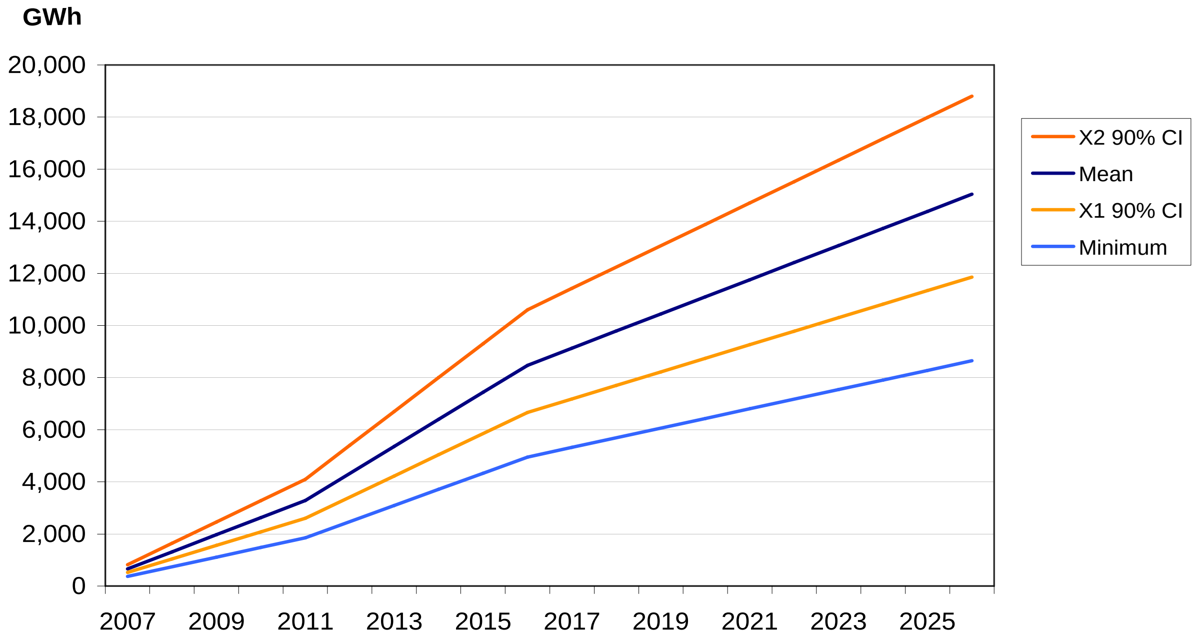
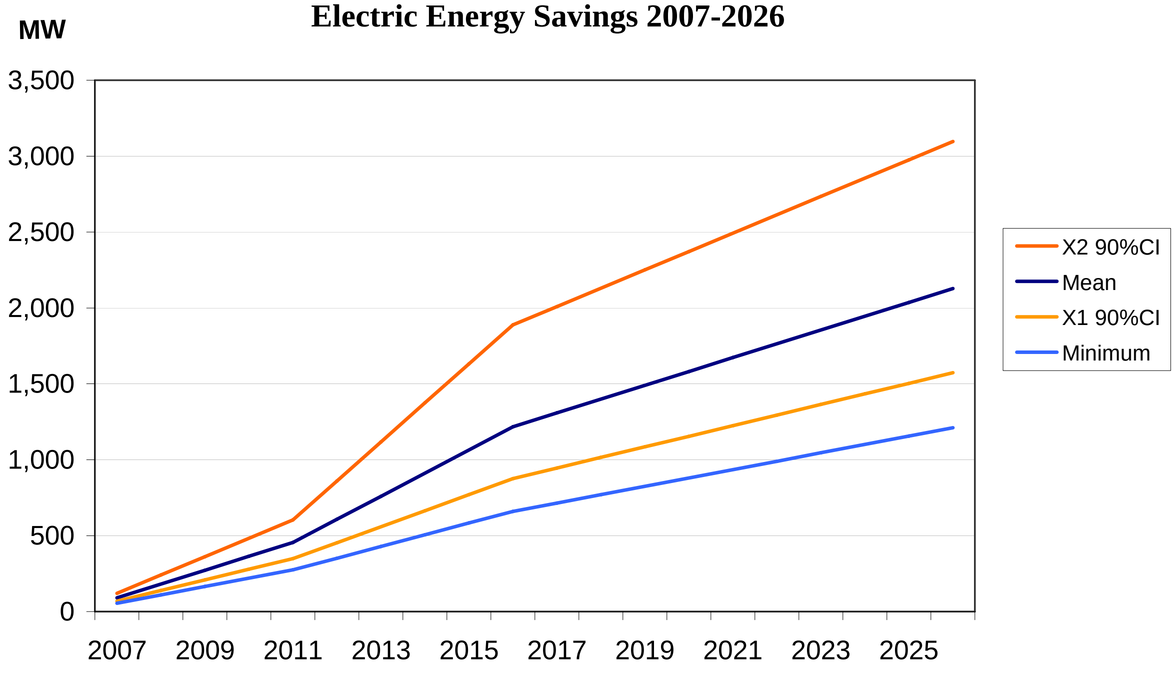



**Figure 4: Energy Efficiency Program Achievable Potential, Electric Energy Savings 2007-2026**



The mean results of the ECW's Michigan analysis are on the high side of current national experience, comparable to the best performing programs. The ability to achieve a high performing energy efficiency program, (as compared to national experience), will be strongly dependent upon actual program structure and sufficient time for the program administrator(s) to gain competence and expertise. Because utility energy efficiency programming in Michigan ceased more than 10 years ago, a high performing program may be difficult to achieve initially. However, the absence of energy efficiency programming for such an extended period of time has also likely left a considerable amount of "low hanging fruit" within easy reach of a new statewide initiative. It would be necessary to balance these factors if Staff were to recommend a statewide energy efficiency scope for Michigan. For example, it may be prudent to set the initial program funding for a statewide program at a lower level with the goal of increasing the budget as the state gains experience in implementing programs. Such a level should provide a readily attainable program scope that could be increased, over time, with the availability of actual programming data.

As mentioned previously, several benefit/cost tests are available to evaluate energy efficiency programming, including a utility cost test (UCT), a total resource cost test (TRC), a societal cost test (SCT) and a ratepayer impact measure (RIM) test. A recent update of the California Standard Practices Manual, an important source of information on benefit cost tests, identified three of the four tests mentioned above (the Societal test is a variant of the TRC test). The manual helps to understand the cost effectiveness of energy efficiency programs and describes the strengths and weaknesses of each.[32]

- Ratepayer Impact Measure (RIM) test – measures the impact on customer bills or rates due to changes in utility revenues and operating costs caused by the program.
- Total Resource Cost (TRC) test – measures the net costs of energy efficiency programs based on the total cost of the program, including both the participants' and the utility's costs.
- Utility Cost Test (UCT) – measures the net costs of a demand side management program as a resource option based on the costs incurred by the program administrator (including incentive costs) and excluding any net costs incurred by the participant. The benefits are similar to the TRC benefits but costs are defined more narrowly.

Each of these tests measures the benefits and costs of energy efficiency from a different perspective and provides useful information for determining the scope and type of energy efficiency programming that may be appropriate for a statewide program. The utility cost and total resource cost tests are the most widely used tests for determining energy efficiency program scope. According to the California Standard practice manual referred to above, the TRC test (and its variant the Societal test), and the UCT test should be compared not only to each other, but to the RIM test as well. However, this multi perspective approach will require the consideration of the tradeoffs (i.e., strengths and weaknesses) of each test.

[32] *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects*, Governor's Office of Planning & Research, State of California, July 2002.

The UCT and TRC tests both include a utility's avoided generation, transmission, and distribution costs as benefits of an energy efficiency program, but differ in their calculation of costs. Both tests include program administration costs and incentive payments made to participants. However, the TRC test goes one step further by including the participant's incremental costs to purchase an energy efficient measure. Although the TRC test is a more complete measure of the costs incurred by an energy efficiency program, in practice, it does not include all the benefits from such a program, such as reduced maintenance costs.

The type of benefit/cost test chosen as an economic basis for program planning has a direct effect on the estimated level of achievable energy savings. This modeling effect comes about because the chosen category of benefit/cost test determines the type, and thus the level, of costs input into that portion of the modeling process that is concerned with scaling individual market scope, via adoption curves. In this modeling process, the base case program scope for a particular efficiency market is expanded, via adoption curves, until incremental program costs equals the avoided cost of electric power. The amount of program costs, however, is dependant upon the chosen benefit/cost test. Choosing one of the more inclusive benefit/cost tests will have the effect of loading the model with additional program costs, thereby causing the incremental cost of program expansion to equal avoided costs more quickly. The end result is that maximum program scope will be curtailed at a lower kWh level. The Michigan energy efficiency potential study incorporated a utility cost test. Importantly, incentives were modeled to include a significant portion of the efficiency measure cost, typically between 50 and 75 percent. If a total resource cost basis had been used for the energy efficiency potential study, a lower achievable potential estimate would have resulted. However, since the levelized program cost, of 2.57 cents/kWh, is less than half of the avoided cost of electric power, of 6 cents/kWh, Staff does not anticipate that the difference produced by the two tests would cause a major change in program scope.

The Plan did model the impact of energy efficiency in a low case sensitivity scenario, referred to as the low penetration sensitivity. This scenario incorporated the "minimum" achievable energy savings of the Monte Carlo distribution results. The minimum Monte Carlo output can be considered approximately equivalent to the low side of the 95 percent confidence interval. Additionally, the low case sensitivity scenario doubled the levelized, per kWh, cost of saved energy (5.14 cents/kWh). Energy efficiency savings associated with the minimum case were approximately equal to those used in the last year's CNF modeling effort, and more closely approximated national experience.

The savings estimates total 660 MW and 4,952 GWh after 10 years of programming. These compare to 654 MW and 4,991 GWh that were used in the CNF. One of the major goals of the Workgroup was to confirm that the CNF estimates for energy savings and costs were reasonable and the analysis in this study provides a high degree of confidence that the CNF savings and costs were reasonable for planning and programming purposes. In fact, the findings in this report suggest a broader scope would also provide more cost effective benefits for Michigan. The scope of this programming will be addressed in the Policy document, Appendix Volume I. Figure 5 and Figure 6 illustrate the demand reductions and energy savings associated with the low case sensitivity scenario.

**Figure 5: Plan Low Penetration Scenario - Peak-Hour Reduction (MW)**

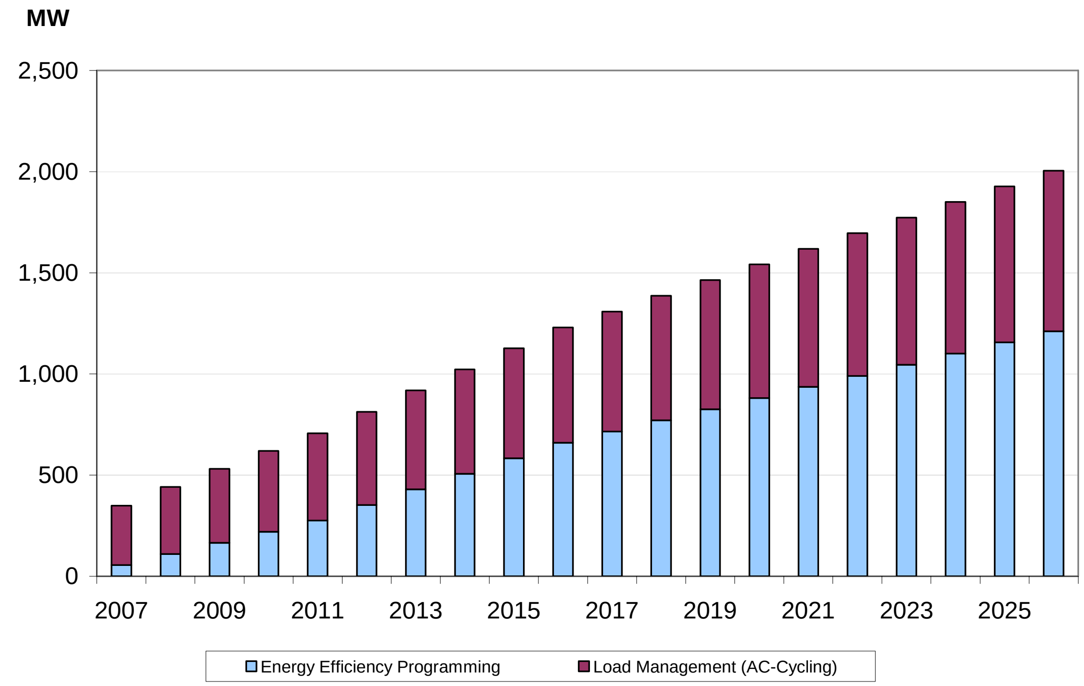
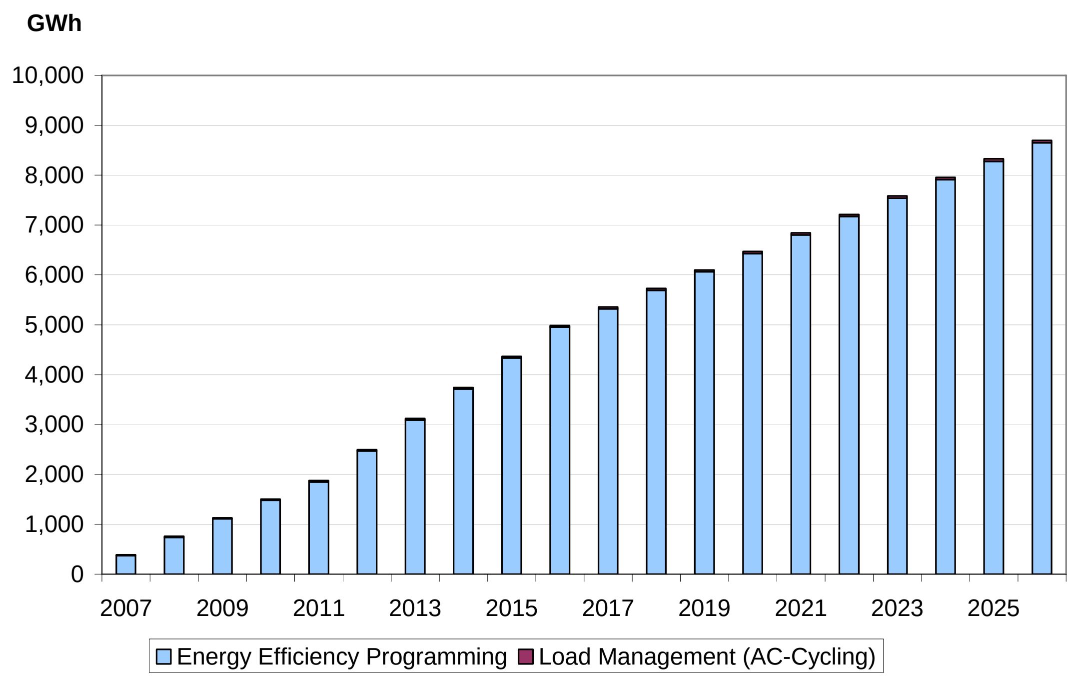



**Figure 6: Plan Low Penetration Scenario**
**Annual Energy Savings (GWh)**



### 2.2 Demand Response Programs

Statewide Utility Load Response programs were extensively analyzed by the Energy Efficiency Workgroup. The concepts of a statewide smart meter implementation and smart rate programs were discussed as resource options. These would include both active load control programs and time-of-use (TOU) rates. However, with respect to modeling of resource potential, only a limited study was performed, including a residential and small commercial air conditioning (AC) cycling program. The peak demand reduction estimates developed for modeling demand response should be considered conservative, and exclusive of demand reductions that could be available using new technologies. It should be noted that an expanded residential and small commercial AC cycling program is a high impact, low cost program, and perhaps the best opportunity for near-term reductions in peak demand. Demand response can be considered a reliable and valuable resource. One factor that should be noted with respect to demand response resource estimates is that unlike traditional power generation resources, reserve requirements are not necessary.

Expanded, active load control resource estimates were developed by Consumers Energy and Detroit Edison, and combined to yield the statewide total. Demand response estimates for Michigan cooperatives and municipal utilities were excluded.

Edison has a sizable existing residential AC cycling program, with over 284,000 customers currently participating. The company's residential air conditioning saturation is 76 percent, with 1.5 million central air conditioners. The potential market consists of the 1.2 million customers not on the current interruptible tariff. For modeling purposes, the assumption was made that an expanded program will replicate Detroit Edison's current interruptible AC program, with a customer take-rate of 3 percent annually. This yields 18,000 new customers per year. It was also assumed that a realistic maximum participation rate would occur at approximately 50 percent of the potential market, i.e., 600,000 customers. Central AC cycling occurs at 15 minute intervals, 15 minutes on, 15 minutes off. The demand reduction per customer is 0.9 kW. The results of the study indicate that after 10 years of program expansion, 162 MW of peak demand reduction would be available, in addition to 255 MW of existing program capacity, for a grand total of 417 MW. Annual direct costs are estimated as $2,970,000, with $14,848,000 of incentives (at 2 cents/kWh during June through October) for a total annual cost during the 10th year of programming of $17,818,000. For purposes of modeling input for the Plan 2025 forecast, extrapolation of the program for a further 10 year period assumed that the maximum cumulative participation rate of 50 percent of the potential market would be reached, adding 316,000 new central air conditioners to the program. The results indicate that 284 MW of peak demand reduction would be available to Edison, in addition to the 255 MW of existing program capacity, for a grand total of 539 MW. Annual direct costs are estimated as $2,970,000, with $19,200,000 of incentives (at 2 cents/kWh during June through October) for a total annual cost during the 20th year of programming of $23,578,000.

Consumers Energy does not have an existing AC cycling program. Thus, projected demand reductions assume the start up of a new program. Annual incentive payments are much lower than projected for Edison because they do not include payments for an existing customer base. Projections for Consumers include both residential and small commercial customers with central air conditioning. The direct load control program assumes that customers volunteer to have utility installed and operated switches with two-way communication on central AC systems. A mix of three incentive options underlies the demand and cost projections. Customers receive incentives in the form of a $ per ton credit during each of a four month season. AC is cycled no more than 100 hours per year with off intervals for each option not exceeding: (1) 15 minutes in a 30 minute interval; (2) 20 minutes in a 30 minute interval; and (3) 30 minutes in a 30 minute interval. The program's annual take rate is taken to be 1.25 percent of customers with central AC, i.e., 13,080 new units added annually. Annual new customer additions are moderated by a 10 percent drop-off rate of customers added in prior years. This assumption results in an exponential decline in the program growth rate. The results of Consumers' study indicate that in the 10th year of operation, the program will consist of 85,000 customers yielding 151 MW of available peak demand reduction. Annual direct costs are estimated at approximately $2,444,000, with $2,035,000 of incentives (averaging $23.88 per customer) for a total annual cost during the 10th year of programming of $4,479,000. Extrapolation of the program for an additional 10 years yields a projected customer base of 115,000 customers with 215 MW of peak demand reduction. In 2026, annual direct costs are estimated as $2,444,000, with $2,744,000 of incentives (averaging $23.88 per customer) for a total annual cost during the 20th year of programming of $5,188,000. For modeling purposes, it was assumed that the aggregate demand reductions of both Detroit Edison and Consumers Energy were representative of the statewide total.

### 2.3 Commercial Building Code Update, Lighting Standard

The Energy Efficiency Workgroup determined that updating Michigan's commercial building code for lighting represented a regulatory option that may provide a substantial energy efficiency improvement at a very modest cost. Improvements in lighting efficiency typically show the largest savings impact of any electricity efficiency program, and lighting in the commercial sector represents the dominant end use of commercial sector electricity consumption. Approximately 25 percent of commercial building electricity use is for lighting.[33]

Michigan's current commercial building code refers to the 1999 ASHRAE energy efficiency guidelines. ASHRAE revised its lighting density recommendations in the 2004 revision, AHSRAE Standard 90.1-2004. The 2004 revision forms the basis for the electric demand and energy savings resource assessment.

The ASHRAE 90.1-2004 Standard includes a completely revised set of Lighting Power Density (LPD) values from the 1999 Standard.[34] The LPD values are in watts per square foot, and the LPD standard varies for building and building space types under the ASHRAE Standard. The cumulative impacts of the revised light level recommendations, updated lighting equipment

[33] The 25 percent is a national figure. Michigan would be somewhat higher due to relatively lower air conditioning loads than included in the national average end use breakdown. National average commercial sector electricity end use is included in the U.S. Department of Energy's long-term forecasting model; a breakdown is included in tables from its Annual Energy Outlook, Table 5, at http://www.eia.doe.gov/oiaf/aeo/aeoref_tab.html.

[34] There was an interim update by ASHRAE, in 2001, and this update maintained the 1999 LPD values.

efficiencies, revised light loss factors, and changes in design practice were included in the modeling effort.

The impact of updating Michigan's building code for lighting was assessed by Pacific Northwest National Laboratory under a U.S. Department of Energy grant[35] on behalf of the Michigan Energy Office. The analysis consists of evaluation of 32 different building types. Multiple structures for each of the 32 building types were modeled, to capture variations in individual building size and envelope characteristics. The detailed size and envelope characteristics are based on a national survey of recently constructed buildings. The model results from the detailed analysis of 246 individual buildings that were aggregated to 32 building types.

Results from the Pacific Northwest National Laboratory analysis show there is a significant savings potential from updating the Michigan commercial building code to ASHRAE Standard 90.1-2004 (2004) from Michigan's current code. The analysis shows that 0.39 watts per square foot reduction in electric power density (on a weighted average basis across building types) can be achieved.[36] This represents a reduction of approximately 25 percent in lighting demand compared to the 1999 Standard.[37] Since lighting represents one fourth of electricity requirements for commercial buildings, a code update can achieve a better than 6 percent reduction in commercial building electricity requirements.

In addition, due to fewer number of fixtures required to meet the new and reduced ASHRAE lighting level recommendations, updating to the 90.1-2004 Standard actually reduces expected construction costs for 28 of the 32 building types analyzed.[38] Across building types, the reduction in equipment costs for new construction is estimated to be $0.63 per square foot.

Estimates of the per square foot peak demand savings and annual electricity savings were made for the Plan. For peak demand savings, it was assumed that commercial lighting is on at times of system peak demands, and as a result, the 0.39 watts per square foot reduction occurs on peak.[39] This is equivalent to 390 watts (0.39 kW) on a per thousand square foot basis. Energy savings are based on an assumed use of eight hours per day, five days per week, and 52 weeks per year. The 0.39 kW per thousand square foot electric demand reduction translates into an annual electricity savings of 811 kWh per thousand square foot of building space.

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[35] *Michigan State Code Adoption Analysis: Cost-Effectiveness of Lighting Requirements* – ASHRAE/IESNA 90.1-2004, E.E. Richman, Pacific Northwest National Laboratory, September 2006, prepared for the U.S. Department of Energy under Contract DE-AC05-76RL01830.

[36] This assumes the building mix in Michigan is essentially similar to nationwide.

[37] The ASHRAE 90.1-2004 lighting power density changes are a significant lowering of lighting wattage densities compared to ASHRAE's 2001, 1999, and 1989 recommendations. Indeed, the changes from 1989 to 1999 included raising the LPD for over half of these building types, whereas the 2004 Standard lowers the LPD for 30 of the 32 building types.

[38] The 32 building types analyzed are the 32 building area types covered by the ASHRAE Standard.

[39] While not 100 percent of lighting are on at times of system peak, the reduced lighting load contributes directly to reduced air conditioning load due to less interior heat gain induced by lighting systems. The Workgroup did not attempt to address this interaction.

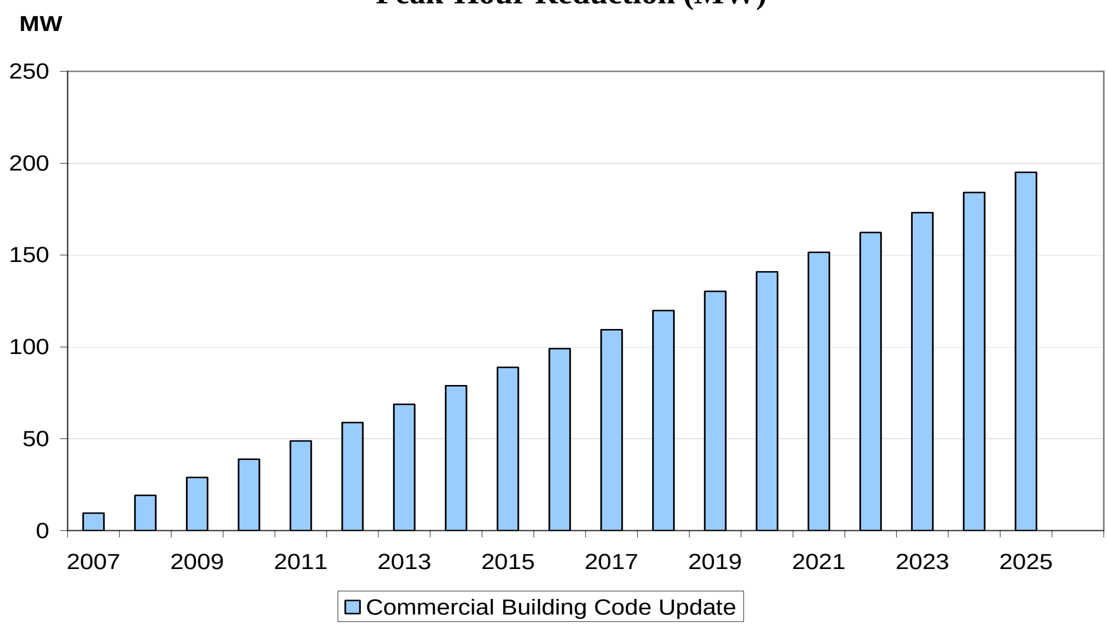
The next step in the modeling process was to convert the demand and energy savings, of 0.39 kW and 811 kWh respectfully, into a statewide total for new commercial construction. The calculation incorporated a projection of Michigan commercial floor space growth made by modifying the Energy Information Administration (EIA)'s National Modeling System Run (aeo2006) to include a growth rate projection for Michigan of 50 percent of the national rate. A base level of Michigan commercial floor space, of 2,238 million square feet was used for the year 2005.

Table 2 illustrates the projected savings from updating the commercial lighting code and Figure 7 and Figure 8, illustrate the projected peak hour demand reductions and energy savings from updating the commercial building code.

**Table 2: Projected Electricity Savings: Commercial Lighting Code Update**

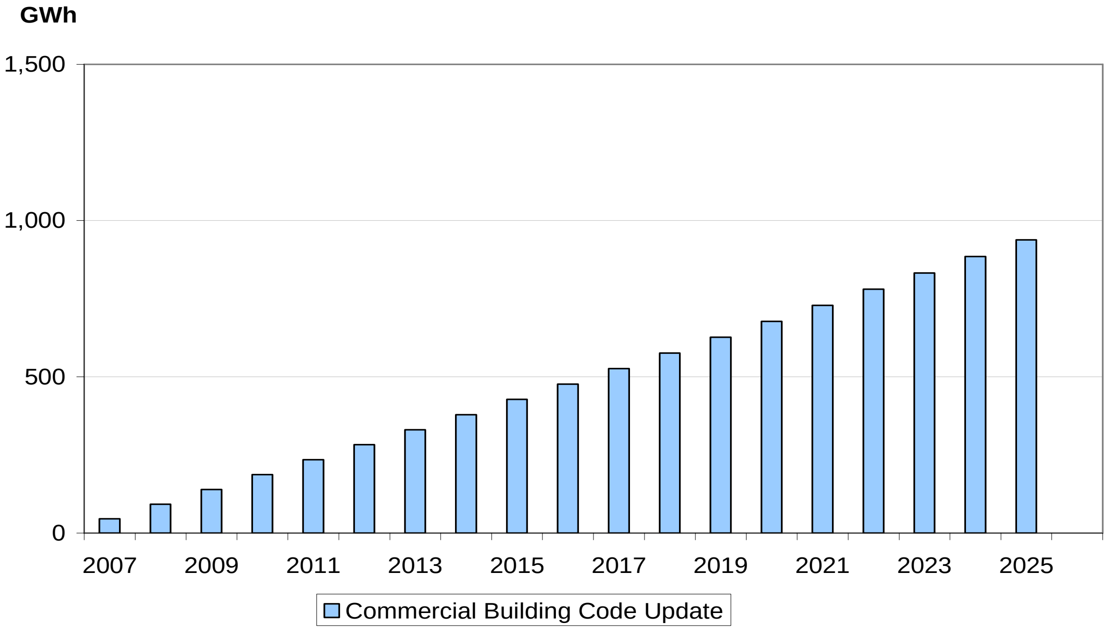
| | 2007 | 2016 | 2025 |
|---|---|---|---|
| MW | 9 MW | 99 MW | 195 MW |
| GWh | 46 GWh | 477 GWh | 938 GWh |

**Figure 7: Plan Commercial Building Code**
**Peak-Hour Reduction (MW)**




Note that the projected electric savings are achievable while actually reducing construction costs by 63 cents per square foot. Michigan's new commercial construction will average about 40 million square feet per year in the projection period, and so the expected construction cost savings would be about $25 million annually.

**Figure 8: Plan Commercial Building Code Annual Energy Savings (GWh)**




### 2.4 State Appliance Efficiency Standard

Most major appliances and energy consuming equipment is covered by federal appliance efficiency standards emanating out of the National Energy Efficiency Conservation Act of 1987,[40] the Energy Policy Act of 1992,[41] and the Energy Policy Act of 2005 (EPACT'05).[42] However, even with the expansion of products realized by EPACT'05 (16 new standards with five additional standards to be set by the DOE), federal standards are not all inclusive. According to the report, *Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards*[43] issued by the ACEEE and the Appliance Standards Awareness Project (ASAP), in addition to several natural gas fired appliances (which are not being addressed by this report), approximately 10 electric products not covered by federal standards may be appropriate for state regulation in all states, and result in significant electric energy and demand savings. Since the time of the report, March 2006, two of the ACEEE/ASAP recommended products have been subject to proposed DOE rulemaking: these are liquid immersed distribution transformers, and medium voltage dry type distribution transformers. The eight remaining electric products for which standards are recommended for all states are: (1)

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[40] Link to Energy Efficiency Conservation Act of 1987, http://www4.law.cornell.edu/uscode/html/uscode42/usc_sec_42_00006291----000-.html.

[41] Link to Energy Policy Act of 1992, https://energy.navy.mil/publications/law_us/92epact/hr776toc.htm.

[42] Link to Energy Policy Act of 2005, http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_public_laws&docid=f:publ058.109.

[43] *Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards*, available online at: http://www.aceee.org/pubs/a062.htm.

bottle type water dispensers; (2) commercial hot food holding cabinets; (3) compact audio products; (4) DVD players and recorders; (5) metal halide lamp fixtures; (6) single voltage external alternating current to direct current power supplies; (7) state-regulated incandescent reflector lamps; and (8) walk in refrigerators and freezers. In addition, among several standards that may be appropriate for particular regions of the country, two may be recommended for Michigan, these are portable electric spas, and residential furnace fans. The ACEEE/ASAP analysis concluded that the aggregate energy savings associated with the recommended state standards, if implemented nationally, would be about 20 percent of the impact of all federal standards. Exclusion of electric distribution transformers covered by proposed federal rules would lower the aggregate savings estimate vis-à-vis federal standards from 20 percent to approximately 16 percent.

The ACEE/ASAP March 2006 report is unique in that contains the only available cost/benefit analysis associated with implementing state appliance efficiency standards for Michigan. The report is very recent, and is substantially detailed. The cost/benefit analysis for Michigan was based on an allocation of national estimates for equipment sales, energy use, energy savings and peak demand. The analysis was updated by the ACEEE for purposes of the Plan. In the update, economic savings were based upon an avoided cost of 6 cents/kWh and a 6.78 percent real discount rate. The results of the analysis are summarized in Table 3.

**Table 3: Appliance Standards Benefits - Michigan (ACEE/ASAP)**

| | 2007 | 2015 | 2025 |
|---|---|---|---|
| MW | 9 MW | 266 MW | 531 MW |
| GWh | 402 GWh | 1385 GWh | 2771 GWh |

## 3. Summary

The Plan's Energy Efficiency Workgroup resource assessment, studied four categories to determine the energy efficiency potential for the state of Michigan. The assessment of these categories resulted in an estimated statewide potential savings shown in Table 4 and Table 5.

**Table 4: Total Projected Electric Savings (GWh)**

| | 2007 | 2015 | 2025 |
|---|---|---|---|
| Energy Efficiency Programming* | 611 | 8382 | 14948 |
| Load Management (AC-Cycling) | 18 | 35 | 48 |
| Building Code | 46 | 477 | 938 |
| Appliance Standards** | 402 | 1,385 | 2,771 |
| **TOTAL** | **1,077** | **10,279** | **18,705** |
| *Energy efficiency program net of building code overlap 2007-2008.<br>**Appliance standards will be updated by the Energy Office. | | | |

**Table 5: Total Projected Electric Demand Reduction (MW)**

| | 2007 | 2015 | 2025 |
|---|---|---|---|
| Energy Efficiency Programming* | 85 | 1205 | 2115 |
| Load Management (AC-Cycling) | 294 | 569 | 764 |
| Building Code | 9 | 99 | 195 |
| Appliance Standards** | 9 | 266 | 531 |
| **TOTAL** | **397** | **2,139** | **3,625** |

*Energy efficiency program net of building code overlap 2007-2008.
**Appliance standards will be updated by Energy Office.

The State of Michigan has not had a comprehensive statewide utility funded energy efficiency effort in more than 10 years. With that, it is assumed that there is a considerable amount of “low hanging fruit” within easy reach of a statewide initiative. Although preliminary, the work performed by the MPSC Staff and the Energy Efficiency Workgroup, indicates that there is indeed potential for a successful statewide energy efficiency program, and the assessment scenarios discussed in this report are reasonable to use in modeling various resource options for the state and for near-term policy consideration. The Policy document in Appendix Volume I will outline recommendations for a statewide energy efficiency program including details on program development and implementation.