STATE OF NEW YORK DEPARTMENT OF PUBLIC SERVICE

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November 17, 2008

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Hon. Jaclyn A. Brilling
Secretary
Public Service Commission
Three Empire State Plaza
Albany, New York 12223-1350

Re: Case 08-E-1014
Niagara Mohawk Power Corporation

Dear Secretary Brilling:

On behalf of the Staff of the Department of Public Service, enclosed for filing are the original and five copies of *Staff's Initial Comments* in the above-reference proceeding. Copies have been served on all active parties in the manner listed on the attached service list.

Very truly yours,

Ashley Priscott

ASHLEY PRISCOTT
Assistant Counsel

Encl.

cc.: All Active Parties

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Case 08-E-1014
Niagara Mohawk Power Corporation
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STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

CASE 08-E-1014 – Petition of Niagara Mohawk Power Corporation for Approval of an Energy Efficiency Portfolio Standard "Fast Track" Utility-Administered Electric Efficiency Program

STAFF'S INITIAL COMMENTS

ASHLEY PRISCOTT
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Three Empire State Plaza
Albany, New York 12223-1350

Dated: Albany, New York
November 17, 2008

STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

CASE 08-E-1019 - Petition of Niagara Mohawk Power Corporation for Approval of an Energy Efficiency Portfolio Standard "Fast Track" Utility-Administered Electric Efficiency Program

Staff's Initial Comments

Background

On June 23, 2008, the Public Service Commission (PSC or Commission), issued an order (EEPS Order) in Case 07-M-0548 that among other things, allowed electric utilities and certain gas utilities to submit program proposals to implement two "Fast Track" electric utility programs and one "Fast Track" gas utility program.[1] The electric Fast Track programs consist of a Small Business Direct Installation Program (Small Business Program) and a Residential Energy Star electric heating, ventilation and air conditioning Program (Residential HVAC Program). The gas Fast Track program consists of a residential energy efficient gas equipment program. The EEPS Order also authorized collection of specified funding amounts and provided for an expedited process for the utility programs.

The EEPS Order required that the program proposals include detailed benefit/cost estimates using the Total Resource Cost (TRC) methodology and that they demonstrate the occurrence of collaborative discussions between the utilities, NYSERDA, and other interested parties to establish uniformity among the

[1] Case 07-M-0548, Proceeding on Motion of the Commission Regarding an Energy Efficiency Portfolio Standard, Order Establishing Energy Efficiency Portfolio Standard and Approving Programs (issued June 23, 2008).

proposals. The Commission was particularly concerned with uniformity with respect to eligible equipment and rebate levels although recognizing the need of utilities to design programs that meet the individual needs of their service territories.

On August 22, 2008, Niagara Mohawk Power Corporation (Niagara Mohawk or the Company) submitted its Fast Track proposal. Thereafter, the Department of Public Service Staff (Staff) commenced discovery concerning the Company's proposal. These Comments reflect Staff's analysis of Niagara Mohawk's Fast Track proposal and its responses to Staff interrogatories.

In analyzing all of the utility proposals, Staff evaluated ten parameters of the proposals:

1. Compliance with the EEPS Order concerning budget and energy savings.
2. Compliance with the program descriptions and data contained in Appendix 2 of the EEPS Order.
3. Conformity of proposed evaluation plans with the Evaluation Guidelines issued by Staff in consultation with the Evaluation Advisory Group. (Here the focus is on the level of evaluation rigor (e.g., statistical reliability), comprehensiveness (e.g., process and impact evaluation, multi-year strategy) and evaluation administration (e.g. budget priorities, functional separation of program and evaluation staff)).
4. Sufficiency of documentation supporting energy savings estimates by program and by measure.
5. Sufficiency of documentation provided relating to cost data.
6. Contractor training and program orientation plan.
7. Quality Assurance plan.
8. Marketing plan and sufficiency of coordination with other parties.
9. Delineation of operational coordination between utilities and NYSERDA.
10. Cost-effectiveness shown in a benefit/cost analysis incorporating methodology and input values supported by Staff for accuracy and

standardization/comparability across companies.

Following its review and analyses of the Niagara Mohawk proposal, Staff developed some recommendations that should apply to all the companies' electric Fast Track programs to help promote an effective and coordinated statewide effort. That discussion and some recommendations are presented in a "General Comments" section that follows Staff's review of Niagara Mohawk's proposals.

In addition, a series of interrogatories were issued to each electric and gas company related to project management of the proposed energy efficiency programs. As responses are not expected until later this month, Staff is not in a position to fully comment on project management related issues at this time. Further, because of the inherently complex nature of the proposals and the newness of implementing and administering such large energy efficiency programs, Staff continues to conduct discovery on other issues as well. Therefore, Staff respectfully reserves the right to supplement these comments in the near future.

Staff would also like to note an additional concern. The utilities are requesting SBC surcharge recovery of many internal costs in addition to many seeking recovery of service company or other affiliates' costs related to the energy efficiency programs. The utilities are seeking SBC surcharge recovery of these internal costs under the premise that the costs are incremental to those being recovered in base rates. However, determining whether any internal costs charged to a utility's energy efficiency program are truly incremental to the base rate expense allowances, and thus recoverable through a separate SBC surcharge, is very difficult, if not impossible to prove. Although Staff raises the issue here, ensuring that energy efficiency costs are not being "double counted" as part of base rates is better accomplished in utility rate cases.

Major Program Parameters

1. Compliance with the EEPS Order concerning budget and energy savings.

Staff compared Niagara Mohawk's proposed Fast Track program cumulative budget without the performance incentives and MWh savings goals through 2011 with the program budgets and goals that are implied or stated in the EEPS Order.[2] The results are shown in the following table:

Cumulative Budgets and MWh Savings Goals through 2011

	EEPS Order		Company Proposal		Percent Difference	
Program	**Budget**	**MWh**	**Budget**	**MWh**	**Budget**	**MWh**
Residential	$9,832,030	10,897	$2,113,650	542	-79%	-95%
Small Business	$67,772,243	252,641	$67,679,391	135,508	0%	-46%
Total	$77,604,273	263,538	$69,793,041	136,050	-10%	-48%

The Commission's EEPS Order listed the total 2008-2011 budget for Niagara Mohawk as $77,604,273 for its Residential HVAC and Small Business programs. Niagara Mohawk's proposed total cumulative budget for both programs is $84,536,351, including utility performance incentives. Niagara Mohawk proposes a cumulative annual budget of $2,314,902 for the Residential HVAC Program that includes utility performance incentives of $201,252. It proposes a budget of $75,853,304 for the Small Business program that includes performance incentives of $8,173,913. When the performance incentives are taken out of proposed budgets, they are $2,113,650 for Residential HVAC

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[2] Individual program savings targets and budgets are derived from Staff's disaggregation of the information provided in Tables 13 and 16 of Order Appendix 1.

Program and $67,679,391 for the Small Business Program. The two program budgets without performance incentives total $69,793,041, which is 10% less than the Commission authorized budget for the combined programs.

The cumulative 2011 MWh savings target from the EEPS Order Table 13, Appendix 1 for Niagara Mohawk is 263,538 MWh. Niagara Mohawk proposes savings of 136,050 MWh combined for the two electric programs which represents only 52% of the approved target. In a response to a Staff information request DPS-72, Niagara Mohawk attributes a portion of the lower amount to the low saturation rate of customers with central air conditioners in its service territory. Niagara Mohawk reasons that there is less existing central air conditioning in its upstate New York territory compared to other jurisdictions in which the Company offers such a program and, that the existing residential central air conditioning market is not expected to expand. Niagara Mohawk further reasons that in their New England territory, there has been a dramatic decrease in installation of central air conditioning because of the overall U.S. economic downturn. The Company does not expect this pattern to change until the economy improves. No information was provided by the Company as to why the Small Business Program also had a low proposed MWh savings such that the Company's overall proposal falls so far below the utility's EEPS Order target for 2011.

It appears, based on Staff's analysis of available information, that the Residential HVAC Program is not cost-effective at this time due to lower than expected projected value of electricity savings from the program. More information on this subject is provided below in the section on program cost-effectiveness. Staff recommends that the Residential HVAC Program not be approved for implementation pending further analysis.

For the Small Business Program, Staff recommends that the program as proposed by Niagara Mohawk should be rejected because the utility has not demonstrated that it is unable to achieve the savings that were expected within the budget allowed in the EEPS Order. Niagara Mohawk should be allowed to implement a Small Business Program if it adheres to the program budget and goals that are implied in the EEPS Order, as shown in the table above.

2. Compliance with the program descriptions and data contained in Appendix 2 of the EEPS Order.

Appendix 2 of the EEPS Order notes that a Residential HVAC Program should promote the use of ENERGY STAR and more energy efficient central air conditioners specifying two mechanisms will be used to promote these measures: 1) upstream incentives for promotion of efficient air conditioners, and 2) additional training, education, and incentives on quality installation of central air conditioners.

Niagara Mohawk's Residential HVAC Program does not meet the Appendix 2 guidelines with regards to rebates. The Company proposes that rebates for installing efficient central air conditioning equipment will be paid to residential customers by mail-in rebate form, and does not propose upstream incentives for promotion of efficient air conditioners. The Company does propose, however, higher incentives for installations by contractors who are Building Performance Institute (BPI)-certified, with the difference between the standard and higher incentive paid to contractor. Niagara Mohawk believes higher incentives to technicians who are BPI-certified will help support the efforts of NYSERDA's Home Performance with Energy Star programs and promotes market transformation of the residential HVAC industry.

Staff agrees that during the initial phase of the Residential HVAC Program incentives should be paid to residential customers to promote the installation of energy efficient central air conditioning equipment. The proposed incentives for BPI-certified HVAC contractors are appropriate if they are limited to efficient central air conditioner equipment and installations. The Company should require the contractor to submit an ACCA Manual J[3] calculation, as was used for Central Hudson, that demonstrates that installed equipment has been properly sized to be eligible for the incremental incentive amount.

Appendix 2 of the EEPS Order notes that a Small Business Program should deliver energy efficient retrofits targeting small C/I customers with monthly peak demand or energy usage less that 100kW. Eligible customers will be reached through a combination of direct outreach by contractors and utility customer's representatives. Measures to be addressed include lighting, selected refrigeration maintenance, gas energy efficiency measures, and other measures deemed cost effective. A requirement from Appendix 2 for the small business program is that the program will use a 70/30 split of measure costs with customers, with 70% of funding provided by the utility.

Staff finds Niagara Mohawk's proposed Small Business Program comports adequately with the requirements of the EEPS Order with the exception of the payment breakdown between the utility and customer for measure costs. The proposal does not fully meet Appendix 2 guidelines; the Company proposes to provide customer incentives representing 80% of measure costs, and not 70% as specified in the EEPS Order. However, Niagara

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[3] Air Conditioning Contractors of America (ACCA), Manual J Residential Load Calculations, 8th Ed., Virginia, 2008.

Mohawk's program does meet most aspects of Appendix 2 guidelines because: the proposed program addresses non-residential customers with electricity demand under 100-kW; the program will be implemented by several vendors selected through a competitive bidding process; customers will be reached by direct outreach and referrals from the Company's account management; the primary target end uses for efficiency improvements include lighting and refrigeration, and other custom efficiency measures that are cost-effective are also eligible.

Staff recommends that the Small Business Program be modified to comport with program description in the EEPS Order by using a 70/30 cost split with the Company paying 70% of the cost.

3. Conformity of proposed evaluation plans with the Evaluation Guidelines issued by Staff in consultation with the Evaluation Advisory Group.

Niagara Mohawk's proposal generally adheres to the Evaluation Guidelines issued by Staff.[4] It contains clear descriptions of the programs, the general evaluation methodologies, cost effectiveness measures, and evaluation approach from a multi-year perspective. However, the Plan lacks the finer details necessary in a comprehensive program evaluation plan.

With regard to impact evaluation, the proposal discusses the general approach to impact evaluation and identifies the primary data collection objectives. The proposal

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[4] The Evaluation Guidelines were formed with input from the Evaluation Advisory Group, which consists of Staff, utilities, NYSERDA, NYPA, LIPA, state and local government agencies, energy efficiency experts, energy efficiency advocacy groups, and consumer and business advocates.

addresses sampling precision objectives but does not address the specific issues and methods involved in meeting those objectives. The net to gross calculation and handling of free ridership issues is similar to programs operated by National Grid in New England. However, the plan does not discuss how it will address and quantify factors associated with net-gross analysis such as free ridership, spillover, and snapback effects in New York. Sampling precision is set at 90/10 confidence, but more detail on the actual sampling approach is required.

Niagara Mohawk provides a general description of its plan for process evaluation, including conducting initial evaluations, but offers little detail. While the Company plans to review program-tracking databases to ensure that the metrics collected support future evaluations, it does not clearly explain the process for using the "lessons learned" from the data to enhance program design or a definitive reporting process for results.

The Company also describes, by program, its method for determining cost effectiveness, which is based on a total resource cost test. Detailed information was provided separately in appendices to the Company's proposal. The plan indicates that research was done on the baseline assumptions and avoided energy and capacity costs. There was no information on how the cost benefit analysis would be updated based on market experience with the programs.

During discovery, the Company provided additional detail on how they will budget for evaluations for its programs, how the company plans to mitigate threats to data reliability, and how it will create and maintain separation between program implementation and program evaluation to ensure the integrity of the evaluation process. For example, the Company responded that it will implement a series of quality control checks on data imputation and savings assumption calculations. However, more information, particularly with regard to some of the actual measurement and verification techniques (e.g., specific sampling approaches, a detailed impact evaluation approach for all programs) should be presented clearly in the Plan.

Staff recommends that the Company provide additional details on Plan goals and objectives, evaluation budgets, program theory and logic models, cost effectiveness tests, a feedback mechanism to use "lessons learned" to enhance program design, and an explicit description of how program implementation will function separately from program evaluation so that objectivity will be ensured and transparency maintained. Staff is also interested in knowing if the Company plans to collaborate on evaluation issues with other utilities participating in the EEPS.

Staff recommends requiring additional detail before it can recommend acceptance of the Company's evaluation plan. Specifically, the Company should provide additional detail on the issues discussed above including the evaluation methodologies, logic model, and how the administrative structure will promote a transparent and objective evaluation process.

4. <u>Sufficiency of documentation supporting energy savings estimates by program and by measure.</u>

As Niagara Mohawk explains in discovery responses DPS-18 and DPS-22, the estimated annualized MWh savings for the Residential HVAC Program are calculated by multiplying the expected annual kWh savings per central air conditioning unit by the number of central air conditioning units expected to be installed through the program and applying an adjustment for free ridership to the product. The projected annual kWh savings per unit is 168 kWh and free ridership is 15%.

The Company estimated that the annual energy savings achieved from installing a SEER 14AC unit though the program instead of the standard SEER 13 AC unit is 168 kWh, of which 99 kWh is from an engineering calculation based on the efficiency difference between the new piece of equipment (SEER 14) and the baseline equipment (SEER 13) and an assumed 500 hours of use. The remaining 69 kWh of annual 168 kWh per unit savings is an engineering calculation based on the assumption that a quality installation will save 5% of the energy consumption of a baseline unit.

The Company assumes a 15% free ridership rate for this program. This is based on a 2002 baseline study done for the Massachusetts, Rhode Island and Connecticut electric utilities that estimated that 15% of the central air conditioners installed have SEER ratings greater than 13.

Niagara Mohawk states that savings in the Small Business Services Program were not developed on a measure level and combined to obtain a projected program level savings for each program year. Instead, the projected savings in the Small Business Program are based on average net savings for Small Business Program projects as implemented in Massachusetts in 2007, including discount for free ridership and an assumption of no spillover savings.

Supporting documentation that outlined the savings estimates used for program planning that included all assumptions and details were not fully explained by Niagara Mohawk. Further review of the expected savings for the Residential HVAC Program is needed at this time. Staff recommends that the energy savings estimates used for the Small Business program that were developed to enable the Commission's EEPS Order be used as goals for the program in Niagara Mohawk's service territory.

5. Sufficiency of documentation provided relating to cost data.

Niagara Mohawk responded to Staff information requests DPS 73-74, noting that the program planning and administration, program marketing and trade ally, and program implementation categories of the proposed budget for the Residential HVAC Program were estimated based on spending for the Residential High Efficiency Central Air Conditioning Program as implemented in Massachusetts in 2007. The customer incentives category of the proposed budget is the sum of the product of projected participants and per participant incentive for each year. The evaluation and market research category of the proposed budget is equal to 5% of the sum of the budget for program planning and administration program marketing and trade ally, program implementation and customer incentives for each year.

Niagara Mohawk explains that the program planning and administration, program marketing and trade ally, and program implementation categories of the proposed budget for the Small Business Program were estimated based on spending for the Small Business Services Program as implemented in Massachusetts in 2007. The customer incentives category of the proposed budget reflects the Small Business budget identified by the Commission in the June 23, 2008 EEPS Order, discounting the dollars in the earlier years to account for a ramping up period of the program in New York State for the Company's trade allies such as local electricians, material vendors, and recycling vendors that help provide these Small Business services. In addition, the proposed program marketing and trade ally budget reflects the Company's belief that these programs may require additional customer marketing than that allocated in the Company's Massachusetts service territory because the program is being rolled out in upstate New York. Niagara Mohawk claims that building customer awareness may require additional marketing efforts such as promotions through local Chambers of Commerce, Business Trade Groups and local media outreach. The evaluation and market research category of the proposed budget is equal to 5% of the sum of the budget for program planning and administration, program marketing and trade ally, program implementation and customer incentives for each year.

Staff found little supporting documentation detailing how the amounts were allocated to each category of the proposed budget. Further information is needed to better understand how the budget was constructed. Staff recommends that supporting documentation be provided that details how the amounts were allocated to each category of the proposed budget.

6. Contractor training and program orientation plan.

Niagara Mohawk proposes that the Residential HVAC Program equipment contractors and dealers, plumbers, and home builders are trade allies that will help to promote the highly efficient HVAC equipment endorsed by the program, and/or will deliver vital program services. However, a contractor training and program orientation plan was not provided in proposed plan. Staff recommends that such a program should be included in the program implementation plan. Additional discovery is pending, Staff may update comments based on the additional information when provided.

7. Quality Assurance plan.

Niagara Mohawk's Residential HVAC Program proposes to use a fulfillment house that will randomly select 10% of the completed rebate forms for inspections. The Company will hire a vendor to perform inspections of the selected installations. The vendor must have previous experience in inspecting heating system work. The nature of the inspection will be to ensure that the correct equipment was installed for which the customer received the rebate and that there are no obvious health and/or safety violations. The standard is to verify that the contractor followed state and local laws in installing the equipment.

In its Small Business Program proposal, Niagara Mohawk addresses Quality Assurance by asking the customer to indicate their satisfaction with the installation of the equipment by signing a Certificate of Installation. Installation projects will also include a post-installation inspection. Projects selected for post-installation inspection include all projects greater than $15,000 and a 25% random sampling of all other installed projects.

Staff recommends that the quality assurance program for the Residential HVAC Program should be modified to include provisions to ensure that equipment installed under the program is correctly sized and properly installed, including duct sealing as needed, to provide the expected level of savings. The proposed steps for ascertaining customer satisfaction and for inspections of installations under the Small Business Program appear satisfactory. Staff recommends that the plans for both programs should include provisions for remediation of any problems that are found during inspections.

8. Marketing plan and sufficiency of coordination with other parties.

In its Residential HVAC Program proposal, Niagara Mohawk proposes to use marketing approaches that will include direct mail campaigns, bill inserts, trade ally events, sponsorships, distributor and supply house visits, and education. Program brochures, builder kits and incentive applications will be the primary marketing materials utilized. The Company proposes to work with NYSERDA to develop cooperative marketing approaches.

In its Small Business program, Niagara Mohawk proposes to market the program to customers through direct mail by the Company's vendors under the direction of Niagara Mohawk and, where appropriate, referrals will come from the Company's account management.

The proposed program marketing plans have satisfactory elements but details of coordination with other parties including NYSERDA are lacking. Staff recommends that the marketing plans for both the Residential HVAC and Small Business Programs that are to be included in the implementation plan described below should provide the details of coordination with other parties including NYSERDA.

9. Delineation of operational coordination between utilities and NYSERDA.

Coordination with other parties including NYSERDA was not delineated but was addressed by Niagara Mohawk as follows: "The Company has and will continue to collaborate with the other NYS electric and natural gas utilities, NYSERDA, Staff and other interested stakeholders about planned energy efficiency efforts, including, but no limited to, discussions about the proposed expedited program designs, evaluation planning, and coordination of program services. These collaborative efforts to date have taken the form of numerous teleconferences and in-person meetings, as well as a webinar with interested stakeholders." The Company states that to avoid double payment of incentives by the two programs for the same measures, it will inform contractors and customers that they must choose between the NYSERDA and Niagara Mohawk programs in order to receive services. As part of the inspection process, the Company will check to see if the customer has participated in any other energy efficiency programs. Niagara Mohawk proposes that it can share customer participation data with NYSERDA assuming NYSERDA will reciprocate.

The proposal to avoid double payment of incentives to customers appears satisfactory but, Niagara Mohawk needs to gain NYSERDA's participation and cooperation in the process. Coordination of program delivery of services to customers is not described in the Company's filing. Staff recommends that the coordination of program delivery of services to customers be described in the Company's implementation plan filing.

10. <u>Cost-effectiveness shown in a benefit/cost analysis incorporating methodology and input values supported by Staff for accuracy and standardization/comparability across companies.</u>

Niagara Mohawk claims a TRC ratio of 1.68 for its Residential HVAC Program and 2.47 for its Small Business Program. Staff's preliminary estimates are ratios of 0.63 and 1.41, respectively. The reductions are in large part owing to replacement of the Company's estimates of avoided costs with Staff's updated October estimates, for accuracy and comparability.

Niagara Mohawk used its own estimates of avoided costs, with some good time-differentiation work. However, the Company's energy and generation capacity cost estimates, considering line losses, are much higher than Staff's current estimates. Furthermore, the Company modeled $65.77 in the first year of distribution capacity costs, while Staff estimates no such values at this time.

Niagara Mohawk modeled research-based net free rider rates for each program, preferable to, and averaging roughly the same as Staff's 10% placeholder. Staff adjusted the treatment of free rider costs, according to its formula, to count rebates paid to free riders as resource costs. The Company modeled utility performance incentives satisfactorily. Staff ratio estimates as presented are pending completion of discovery and thorough review of the measure costs and savings and the budget assumptions.

The TRC ratio of the Residential HVAC Program, shown at 0.63, means that the program is not cost effective with the Company's measure inputs and program design. Niagara Mohawk modeled only SEER 14 units replacing SEER 13 units, unlike other companies modeling SEER 15 and 16 units. The Company modeled 168 kWhs as the average annual savings per SEER 14 only units regardless of installer BPI certification, and about 0.3 kWs savings at summer system peak (varying with EER level). Some of costs/rebates spending, given these savings, may be uneconomic. As discussed above, the Company used the 168 kWhs for four incremental cost/rebate levels, with and without BPI-certified installation; above and below EER 12 (both SEER 14). Therefore, the Company shows no benefit for spending $200 for BPI certification. The EER difference yields a summer peak kW difference of about 0.1kW, not likely to be worth the $200 upfront cost, especially under Staff's current capacity costs estimates.

The Small Business Program has a tentative Staff benefit/cost ratio of 1.41 that seems reasonable given other Staff information, and high enough to mean that adjustments in measure inputs would not likely render the program not cost effective.

The Niagara Mohawk Residential HVAC Program is apparently not cost effective as designed, and Staff recommends at this time that it not go forward. Perhaps the program's cost effectivess would improve if rebates were restricted to SEER levels of 15 or 16, and/or if costs could be lowered.

General Comments

Eligible Measures and Customer Incentives

Residential HVAC Program

In the EEPS Order, the Commission requires utilities to collaborate with NYSERDA and other interested parties to establish uniformity in eligible measures and customer rebate amounts for the Residential HVAC programs. The Commission also recognizes that differences among the utilities may be warranted in order to meet the needs of their service territories (Order page 41). While the utilities have stated that they did collaborate, they nevertheless proposed a wide range in eligible measures, rebate amounts, and rebate structures, as shown in the following table:

Program/Measure	Central Hudson	Con Ed	Niagara Mohawk	Orange & Rockland
Residential HVAC		% of incremental installed cost		
Solar Attic Fan		60%		
Ductless Mini-Splits SEER=15		50%		
Central Air Conditioning SEER=14 w/ BPI	$100/ton	35%(SEER 14.5)	$700 EER => 12	
Central Air Conditioning SEER=14 w/out BPI	$100/ton	35%(SEER 14.5)	$500*	
Central Air Conditioning SEER=15 w/ BPI	$150/ton	40%	$700 EER => 12	$500 **
Central Air Conditioning SEER=15 w/out BPI	$150/ton	40%	$500*	$300 **
Central Air Conditioning SEER=16 w/ BPI		50%	$700 EER => 12	$575 **
Central Air Conditioning SEER=16 w/out BPI		50%	$500*	$400 **
Air Source Heat Pump SEER=14	$120/ton	35%		
Air Source Heat Pump SEER=15	$200/ton	40%		
Air Source Heat Pump SEER=16		50%		
Ground/Water Source Heat Pump SEER=15	$200/ton	35%		
Ground/Water Source Heat Pump SEER=16	$200/ton			
New Ground Loop (well or trench)	$700/ton			
Duct Sealing				$200
ECM Furnace Fan			$400	$200
Electric HP Water Heater	$500			
Energy Star Thermostat			$25	
Boiler Reset Controls			$100	
* - Lower incentive rates are for efficiency ratios from 11.5 - 11.99 ** - Refers to Quality Installations not BPI				

The utilities propose their own unique programs in their EEPS filings with little regard to the programs proposed by neighboring utilities with similar service demands, territories, and customer profiles. Programs vary in the type of eligible measures included, the acceptable qualifying efficiency levels for those measures, and the proposed incentive levels for each measure. Staff is concerned that if these programs are allowed to proceed as proposed, there will be great confusion in the market (particularly in adjacent service territories). Many retailers and contractors work in more than one utility service area and individual consumers could be easily confused by different utility offerings in the same media market. Marketing and educational information about a program offered by a neighboring utility could engender consumer confusion.

Many states with leading energy efficiency programs recognize this problem (frequently after several years of market confusion) and have directed their regulated utilities to coordinate their efforts to assure that the same, or very similar, programs are offered statewide. For example, this approach has been used in California, Connecticut and Massachusetts as well as in those states with a single statewide program operator such as Oregon, Wisconsin, Vermont and, up until recently, New York.

To address this problem, Staff strongly recommends that the same program attributes be offered by each utility statewide for the Residential HVAC program. Although every program would be administered separately, efficiency measures and eligibility levels would be effectively the same, thereby minimizing customer and trade ally confusion. In order to help develop such a statewide program, Staff has retained a consultant, the American Council for an Energy Efficient Economy (ACEEE), to examine the eligible measures and rebate amounts that are currently in place among successful programs around the United States and compare them with the New York utilities' proposals. Staff employs the results of the consultant's review to establish its recommendations for the expedited electric efficiency programs in New York. These recommendations are presented in the table below. We welcome feedback and plan to make final recommendations to the Commission based on this feedback.

Recommended Residential HVAC Program Measures and Customer Incentives[1]

Measure	Eligibility	Suggested Incentive	Rationale
Central A/C	SEER ≥15, EER ≥ 12.5 Plus quality installation	$400	The Energy Star minimum is SEER 14.
Central A/C	SEER ≥ 16, EER ≥ 13.0 Plus quality installation	$600	Manufacturers and programs in other states target whole number SEER levels, making 15 and 16 the next levels. There are fewer units available at SEER 14.5 than at SEER 15. EER is added for peak savings with the EER level based on the CEE tier associated with each SEER. National Grid has proposed EER levels and we are building on this proposal. Quality installation increases the energy savings. New Jersey utilities and LIPA have achieved good acceptance and participation with such provisions. We recommend drawing from their quality installation specifications. Recommended incentives are based on LIPA. We recommend that $150 of this for SEER 15 and $200 of this for SEER 16 go to the contractor to help pay for quality installation. There is a $300 federal tax incentive for equipment meeting these tiers; utility incentives are above and beyond this.
Central HP	SEER ≥15, EER ≥ 12,	$400	Same rationale as above, but with addition of HSPF

	HSPF ≥ 8.5 Plus quality installation		values for each tier. In New York State, heating season efficiency is at least as important as cooling efficiency. The federal tax incentive applies only at the higher level; the lower level misses on EER and HSPF.
Central HP	SEER ≥ 16, EER ≥ 13.0, HSPF ≥ 9.0 Plus quality installation	$600	
Duct and air sealing	Blower door and Duct Blaster[2] assisted sealing by certified contractors	$600	Offer both as a package, doing both with a single service call. The Connecticut utilities have a program that does both that has been well received. Total costs are running about or a little over $1000/home; our proposed incentive covers around half of this and is consistent with what other utilities in the region are offering. Niagara Mohawk proposes incentives for air sealing and O&R for duct sealing. Both should be offered statewide.
ECM furnace fan	ECM fan	$200	These fans reduce heating season energy use by more than 50%. There are more modest cooling season savings. National Grid and O&R have proposed incentives but these should be offered by all utilities. Recommended incentive is in the middle range offered by utilities surveyed.
Electric heat pump water heater	EF > 2.0	$400	This is the efficiency level for the new Energy Star program that will start in January 2009. Central Hudson has proposed this measure but other utilities should offer it as well. There is a $300

			federal tax credit available for this equipment in 2009. This tax incentive plus recommended incentives should cover most of the incremental costs relative to a conventional new electric water heater.
Energy Star thermostats	Energy Star	$25	This measure is proposed by National Grid (Key Span and Niagara Mohawk), Con Edison and several gas utilities. The incentive is that proposed by National Grid, St. Lawrence and Corning.

1 CEE - Consortium for Energy Efficiency, Boston, MA.
SEER - Seasonal Energy Efficiency Ratio
EER - Energy Efficiency Ratio
HSPF - Heating Season Performance Factor

2 Blower Door and Duct Blaster assisting sealing are two means of identifying leakages to and from interior conditioned spaces. Qualified contractors target improvements to HVAC system performance by pressurizing or de-pressurizing an HVAC system, or the conditioned interior space, and comparing that with an ambient condition for finding leakages.

Note: Central Hudson also proposes ground/water source heat pumps. This is a niche product and should be considered later, but not at startup.

While Staff strongly prefers common efficiency measures, eligibility levels and incentives, we would consider the application of utility territory or regional deviations if there is compelling rationale for why customers in one territory or region should be offered different efficiency measures and rebates or, should be treated differently from customers elsewhere in the State. Those utilities proposing such deviations from a statewide standard should be required to demonstrate that programs would result in minimal trade ally and customer confusion, and that the benefits of such deviations are greater than the burdens of any confusion. Simply stated, there should be a high bar to be cleared before deviations are allowed and any deviation from the standard should always be treated as an exception rather than the rule.

Staff recommends direct performance-based rebates (e.g., $400 if Central Heat Pump SEER $\geq$ 15 and EER $\geq$ 12) in order to make incentives easy for consumers to understand and to scale the amount of incentives on the basis of energy efficiency performance of measures installed. We prefer to avoid cost-based rebates that are stated in terms of a percent of installed measure costs for the Residential HVAC Program because the amount of incentive may vary considerably in different markets within the State, or could be difficult for consumers to understand. Staff's recommendations for specific performance-based rebate amounts however, are generally based on paying 70% of expected average measure cost (high enough to attract a lot of interest, but also leaving a significant share of the cost to the customer). Over time, we would expect that rebate levels could be reduced as customers become familiar with the various efficiency programs. Higher initial rebate levels would help programs achieve greater participation in the early years, participation levels that are needed to reach the EEPS goals.

Small Business Program

The Small Business Programs are structured so that the utilities will pay most of the cost of installed measures while customers will pay a lesser share of the total costs. The EEPS Order directed a 70/30% measure cost spilt between the utility and the customer, with the customer paying 30% of the measure cost. Most utilities followed this directive and propose incentives of 70% of measure cost. The only exception is Niagara Mohawk, which proposed 80/20% cost sharing with customers. Staff finds that Niagara Mohawk did not provide a sufficient justification for deviating from the cost spilt directed in the EEPS Order, and recommends that Niagara Mohawk revise its program accordingly.

There is variability among the utilities' proposed efficiency measures for the Small Business Program. Staff finds that such variability would be acceptable and less likely to lead to marketplace confusion that could result from variability among utility Residential HVAC Programs. Much of the Small Business Program variability results from differences in scale, demand, and potential combinations of efficiency measures that could be implemented in any given small business scenario. Custom installations are also far more likely to be tailored specifically to a single business enterprise than in the case of the Residential programs.

Unlike the Residential HVAC Program, where customers will be hearing about the program through equipment dealers, 'big-box' store promotions and mass-marketing crossing different utility territories, participants in the Small Business Program will be learning about the program and its offerings directly from program delivery contractors or from utility customer account managers. There will not be the same potential for conflicting information and confusion regarding eligible measures among the trade allies or target customers due to differences in eligible measures and rebates in the Small Business Program as there would be with the Residential HVAC Program.

The table below displays the eligible measures and rebate structures proposed by the utilities for the Small Business Program:

Program/Measure	Central Hudson	Con Ed	National Grid	O & R
Small Commercial & Industrial				
Compact Fluorescent Lamps	W	Free	X	Y
Low-flow Aerators		Free		
High-pressure Rinse Sprayers		Free		
Water-heater Thermostat Setback		Free		
LED Exit Signs		Z installed cost	X	Y
Water Pipe Insulation		Z installed cost		Y
Occupancy Sensors	W	Z installed cost	X	Y on/off-hi/lo
Vending Machine Controls		Z Installed cost		Y
HVAC Retroactive Commissioning	W	Z cost		Y
Programmable Thermostat	W	Z installed cost		
Evaporator Fan Controls	W	Z installed cost	X	
Anti-condensation Door Heater Controls		Z installed cost	X	
Efficient Lighting Package		Z installed cost	X	
High-efficiency Lighting Package		Z incremental installed cost		Y
Bi-level Control for Stairwell Lighting		Z installed cost		
LED Refrigeration Case Lights	W	Z incremental installed cost		
Electronic Commutated Motors (ECM)	W		X	
Duct Sealing				Y
Ventilation VFD	W			Y
Walk-in Refrigerator Retrofit	W			Y

W The Program will cover 70 percent of the cost of each efficiency-upgrade project. (Central Hudson)
X The program will pay 80% of the total project cost for lighting controls and refrigeration retrofit measures. (National Grid)
Y The initial customer incentive will be set at 70% of the total installed cost. (Orange and Rockland)
Z The program provides for 70% of cost, installed cost or incremental installed cost. (Con Ed)

Some utilities propose providing consumers with a free audit to identify cost-effective measures for the Small Business Program. Experience has shown that a free audit can, in many instances, result in customers taking no action whatsoever toward investing in cost-effective energy efficiency improvements; utilities incur program costs in order to deliver audits[5] while no actual energy savings are achieved. When an

[5] In responses to Staff information requests, both Con Edison and Central Hudson estimated the average energy audit cost for the Small Business program to be $400.

audit is free, customers may elect to have the audit performed without any serious intention of making energy efficiency improvements recommended during the audit. Staff recommends that the utilities' Small Business Programs include a reasonable charge to customers for an audit, and that the amount be deducted from the cost of the energy efficient measures ultimately purchased as a result of the audit recommendations. Such a nominal charge would deter frivolous requests for audit services and, at the same time, provide an additional incentive to customers to install the recommended cost-effective energy efficiency measures. The audit fee need not cover the entire program cost of providing an audit, but should only be sufficient to deter frivolous requests. Staff recommends an audit fee of $50.

Customer Eligibility for Incentive Payments

Staff recommends that only customers who pay System Benefits Charges (SBC) that fund energy efficiency programs, should be eligible to participate in the programs and receive incentive payments for installing energy efficiency measures. Customers who pay the SBC on a portion of their electricity usage should be allowed to participate, and their incentive payments for installing energy efficient measures should be adjusted according to the proportion of their SBC payments.

Standard Approach for Estimating Energy Savings-Technical Manual

Staff requested that the independent consultant providing EEPS related evaluation advisory services to Staff (TecMarket Works), develop a technical manual illustrating standardized approaches, calculations and assumptions for program administrators to estimate Fast Track program energy savings at the measure level.

The approaches proposed in the technical manual are based primarily on engineering factors, evaluation results from similar programs and general experience. Staff and TecMarket Works recognize that this is an initial effort at a challenging assignment and there could be differing opinions on the reliability of the recommended approaches and the scope of the measures. The initial draft of the technical manual covering selected residential and small commercial energy efficiency measures is attached for review and comment as Appendix A.

The use of the technical manual is not a substitute for the comprehensive program evaluation advocated by the Commission. A key limitation is that, approaches discussed in the technical manual are limited to gross energy savings and do not fully account for factors that can influence the actual savings attributable to a measure such as measure performance under real world conditions (e.g., poor quality installations) and human behavior (e.g., free riders, spillover). Because the Fast Track programs are new, it will take time to accumulate a full range of evaluation data for each program. For example, program administrators have indicated that it will be at least a year before they will begin evaluations to directly verify energy saving impacts. The technical manual will provide immediate and consistent methods for estimating energy saving impacts until the assumptions can be further refined based on actual program evaluation data. The use of the technical manual approach will also facilitate initial estimates of lost revenue recovery and incentives payments.

Procurement of Program Services and Equipment

Con Edison proposes that it be allowed to use sole-source procurement for energy efficiency equipment installed under its programs. Staff recommends that, to keep program costs low, competitive bidding be the preferred practice for all equipment purchases and service contracts in each of the utilities' programs. Staff further recommends that if a utility believes that sole-source procurement would be reasonable for a particular purchase or contract, it be required to submit a proposal to use sole-source procurement to the Director of the Office of Energy Efficiency and the Environment for review and approval.

Modifications to Approved Programs

Some of the utilities propose to be allowed to reallocate funds among program budgets and to make changes to eligible energy efficiency measures and/or customer incentives to adjust for customer responsiveness or changing market conditions during the program period extending through 2011. The utilities propose to inform Staff of such program changes after the modifications have been made. While Staff recognizes that changes to approved programs may be justified to improve their performance, Staff prefers that there be an opportunity for Staff review and comment, and potentially for Commission approval, before any efficiency program changes are implemented.

Program changes can create inconsistencies among the utility programs that can lead to market confusion and reduce the statewide program effectiveness. Also, a balance of programs should be maintained so that all customer sectors have fair opportunity to participate in energy efficiency programs. Finally, utility energy efficiency performance incentives could result in utilities giving preference to certain programs over others that may not be in the best interests of all customers. Accordingly, Staff recommends that any utility proposal for changes to approved program budgets, eligible energy efficiency measures, or customer rebates should be submitted to Staff for review and comment at least 90 days before the proposed implementation date. Proposals that would result in budget reallocations that would represent a cumulative change of 10% or more from the total approved annual budget should be submitted for Commission approval before implementation.

Implementation Plan

Staff recommends that each utility be required to submit an energy efficiency program implementation plan that describes in detail the overall program and how the individual programs operate. The implementation plan should be submitted within 60 days of Commission approval of the programs, and reflect all changes and enhancements to the program proposals that are approved by the Commission. An acceptable implementation plan would include the following:

- Overall program annual and cumulative budgets and energy savings goals;
- For both the Residential HVAC Program and the Small Business Program, include:
    - cumulative and annual budgets, energy savings, and customer participation goals;
    - annual budgets by spending category including descriptions of expenditures within each category (budget category definitions to be provided by Staff);
    - descriptions of roles and responsibilities of the utility and all contractors participating in the program;
    - contractor training and program orientation plan;
    - target customer market and detailed marketing plan, including sample customer and trade ally outreach materials;
    - training for retail partners;
    - eligible measures and associated customers incentives;
    - procedures for customer enrollment;

- contact information for customer inquiries and complaints;
- Quality Assurance plan;
- coordination with other New York energy efficiency programs, including plans for how the company will avoid duplication and confusion resulting from overlapping/neighboring programs, ensure no double counting of savings achieved, and ensuring that no more than one incentive payment is provided for an energy efficiency measure.

Project Management Assessment

On October 31, 2008, Staff issued a series of interrogatories to each electric and gas company related to project management of energy efficiency programs. Minor corrections to the information requests were subsequently issued around November 5, 2008. Company responses are not expected until later this month. Staff therefore is not in a position to fully comment on project management related issues at this time and respectfully reserves its right to do so at a later time.

Evaluation, Measurement and Verification Forum (EM&V Forum)

The Northeast Energy Efficiency Partnerships (NEEP) is a regional nonprofit organization that promotes the efficient use of energy in homes, buildings and industry, primarily in the Northeast United States. NEEP fosters the development of regionally coordinated policies and programs to remove barriers and motivate customers to use energy efficient products and services.

A current NEEP initiative is the Evaluation, Measurement and Verification (EM&V) Forum. The project is designed to facilitate the development of common EM&V protocols to estimate, track, and report the impacts of energy efficiency and demand-side resources (including energy and demand savings) and environmental benefits. Key objectives of this effort include increasing the reliability, uniformity, and quality of this data while reducing research costs through the pooling of resources contributed by EM&V Forum participants. New York State is represented on the EM&V Forum Steering Committee and various project committees.

NEEP has proposed a three-year program plan containing several research projects focusing on critical areas including load shapes, measure persistence, and database design and implementation. The first year budget is projected to be about $2 million, with New York's share estimated at approximately $651,000.

The Commission's June 2008 Energy Efficiency Portfolio Standard (EEPS) Order directed the formation of an Evaluation Advisory Group (EAG) to advise Staff on the development of evaluation protocols and other critical evaluation and reporting issues. Staff recommends that the EAG review New York's role in the EM&V Forum, including New York's potential funding commitment and research priorities and needs, and provide specific recommendations for Commission consideration.

Marketing

Market research, including studies of energy efficiency potential, business and consumer perceptions of energy efficiency, and the market viability of new energy efficiency technologies is a valuable tool for informing the design of energy efficiency programs. The role of market research in assessing the performance of energy programs is less clear. The five percent of energy program budgets that are dedicated to evaluation are earmarked to assess program performance, document impacts, and to enhance accountability. Staff is concerned that if evaluation funds are assigned to market research, targeting program design issues, the quality of the evaluation of specific programs may suffer. Staff recommends that proposals to use evaluation funding for market research be reviewed by the EAG and approved by the Director of the Office of Energy Efficiency and the Environment.

Reporting

Accountability is a key objective of the EEPS, making transparent and timely reporting of program progress essential. To ensure that program progress is monitored closely, all program administrators should report program data and evaluation results on both a quarterly and annual basis. Staff recommends that the quarterly reports should be due no later than 45 days after the conclusion of the calendar quarter; annual reports should be due no later than 60 days after the conclusion of the calendar year.

Staff also recommends implementation of a monthly "scorecard report," prepared by all administrators, to provide the Commission and the public with a summary of key program achievements (e.g., number of measures installed and customers served, dollars spent, progress toward goals). The report should be due 14 days after the conclusion of the month. The exact requirements and format of these reports should be considered by the EAG with recommendations transmitted to Staff for approval by the Director of the Office of Energy Efficiency and the Environment.

Staff also recommends that, in addition to the monthly, quarterly and annually reporting, all program evaluation reports should be easily accessible to the public through the Internet and other convenient formats (e.g., free copy by calling a toll free number).

Evaluation Compliance

The energy efficiency filings to date require additional information and detail, much of which is either missing or was provided by administrators after their initial filings. To provide the Commission and public with a comprehensive energy efficiency evaluation plan, Staff recommends program administrators submit revised evaluation plans addressing Staff recommendations within 60 days after approval of the Fast Track Order.

Staff's Summary Recommendations for the Niagara Mohawk Proposal

Niagara Mohawk's proposed Residential HVAC Program should not be approved at this time pending further Staff analysis of the program's cost-effectiveness. Niagara Mohawk's Small Business Program proposal should be rejected because the utility has not demonstrated that it is unable to achieve the savings that were expected in the EEPS Order within the allowed budget. Niagara Mohawk should be permitted to implement a Small Business Program if it adheres to the program budget and goals that are implied in the EEPS Order and that are specified above in these comments.

Niagara Mohawk's program proposals are in satisfactory compliance with the program design requirements in Appendix 2 of the EEPS Order except for its proposed measure cost-sharing between the utility and customers participating the in the Small Business Program. Niagara Mohawk should modify the program to comply with the EEPS Order. The proposed incentives for BPI-certified Residential HVAC Program contractors are appropriate if they are limited to efficient central air conditioner equipment and installations. The Company should require a contractor to submit an ACCA Manual J calculation, as described in Staff's comments, to be eligible for the incremental incentive amount.

Staff recommends requiring additional detail before it can recommend acceptance of the Company's evaluation plan. Specifically, the Company should provide additional detail on the issues discussed above including the evaluation methodologies, logic model, and how the administrative structure will promote a transparent and objective evaluation process.

At this time and until it can be replaced by actual program evaluation findings, the Company should apply the technical manual recommended by Staff in the General Comments section for determining the amount of energy savings achieved by measure and by program.

Niagara Mohawk's quality assurance program for the Residential HVAC program should be modified to include provisions to ensure that equipment installed under the program is correctly sized and properly installed to provide the expected level of savings. The quality assurance plan for both Fast Track programs should include provisions for remediation of any problems that are found during inspections.

In its program implementation plan described in the "General Comments", Niagara Mohawk should provide more details about the following subjects: program cost data including a breakdown of costs by function within each budget category; coordination of program marketing with other utilities and NYSERDA; and operational coordination of its energy efficiency programs with NYSERDA's programs.

Staff's cost-effectiveness analysis of the Small Business Program, based on currently available information, produces a Total Resource Cost ratio of 1.41. The ratio seems reasonable given other Staff information and high enough to mean that adjustments in measure inputs would not likely render the program not cost effective.

Summary of Recommendations for Fast Track Programs of All Utilities

If the Residential HVAC Programs are approved to go forward, all the utilities should offer the same set of energy efficiency measures, eligible equipment performance standards, and corresponding customer rebate amounts that are recommended by Staff. Differences among the utilities regarding eligible energy efficiency measures and rebates are acceptable for the Small Business Program. Each utility should establish a customer energy audit fee for the Small Business Program, with the audit fee to be deducted from the customer's share of the cost of energy efficiency measures that are installed based on the audit findings. Staff recommends an audit fee of $50.

For initial estimates of the energy savings attributable to the Fast Track programs, Staff recommends that standardized approaches, calculations and assumptions be used at the measure's level. We have provided a technical manual as Appendix A which covers approaches for estimating energy savings for selected residential and small commercial energy efficiency measures.

Only customers who pay System Benefits Charges (SBC) that fund energy efficiency programs should be eligible to participate in the programs and receive incentive payments for installing energy efficiency measures. For utility partial requirements customers, incentive payments for installing energy efficiency measures should be established according to the proportion of their total electric service on which they make SBC payments.

Competitive bidding should be the preferred procurement practice for all equipment purchases and service contracts for energy efficiency programs. A utility should be required to submit a proposal to use sole-source procurement to the Director of the Office of Energy Efficiency and the Environment for review and approval.

Any utility proposal for changes to approved program budgets, eligible energy efficiency measures, or customer rebates should be submitted to Staff for review and comments 90 days before the proposed implementation date. Proposals that would result in budget reallocations that represent a cumulative change of 10% or more from the total approved annual budget should be submitted for Commission approval before implementation.

Each utility should submit an energy efficiency program implementation plan within 60 days of Commission approval of programs. The plan should include the elements described above in Staff's comments.

To provide the Commission and public with comprehensive energy efficiency evaluation plans, Staff recommends that program administrators submit revised evaluation plans addressing Staff recommendations within 60 days after approval of the Fast Track programs. To increase the transparency of the evaluation results, it is essential that regular reporting of the achievements and evaluation results attributable to these programs be provided on a monthly, quarterly and annual basis.

Staff recommends that the Evaluation Advisory Group (EAG), established by the Commission under the EEPS Order, review New York's role in the EM&V Forum proposed by the Northeast Energy Efficiency Partnership. The EAG should provide specific recommendations for Commission consideration on issues including New York's potential funding commitment and research priorities. In addition, proposals to use evaluation funding for market research should also be reviewed by the EAG and subject to approval by the Director of the Office of Energy Efficiency and the Environment.

Public Comment Draft Report

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs

Selected Residential & Small Commercial Measures

November 17, 2008

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Introduction

This document presents the measure-specific energy and demand savings estimation approach to be used by organizations delivering energy efficiency programs to the citizens of New York that are funded via the Systems Benefits Charge.

This document is provided for public review and comment. Comments are requested on the recommended approaches presented in this document. This document is the first in a series of similar documents covering different measures across different market sectors. These documents will be released over the next few months to allow public comment on the recommended approaches. Once comments are received by the DPS, the recommended approaches will be revised and potentially modified to reflect the comments received. The documents will then be accumulated to a single document to present the approaches for estimating savings to be used by program planners and implementers. The approaches in these documents will become the prescribed approaches for estimating savings for the types of measures covered.

As evaluations are conducted the approaches will be revised and up-dated so that they move toward high levels of estimation accuracy.

This first document covers a limited set of residential and small commercial measures.

Reviewers are requested to review this document and provide comments on the following components of the document.

1. The approach for estimating energy savings. Please comment if you agree with the approach recommended or if you would recommend a change to that approach. If a change is recommended please indicate what approach you would suggest, an example of that approach, with references that support the estimation approach if available.

2. The measures covered. Please comment on the measures presented in this document and indicate if you agree that the measure is a residential or small commercial measure, and if desired, suggest other measures that you think should be added to the group of measures for the specific market sector.

Please note that we have started with a limited set of measures and we realize that other measures need to be added. We would like to hear comments on what reviewers think those measures should be.

Residential Measures

CFL Light Bulb - Residential (Single Family)

Measure Description

An EnergyStar compliant screw-based CFL bulb whose wattage is known. Programs with this characteristic include direct install, catalog, instant and mail-in coupon, and programs such as negotiated cooperative promotions in which product sales at the retail level are reported.

Savings Estimation Approach

Annual Energy Savings = Δ Watts x Hours x Days-per-Year/1000

Variables and Assumptions
1) Δ Watts (delta watts) – the difference between the bulb that is installed (replacement bulb) or would have been installed (new lamp) and the higher efficiency CFL bulb.

Because the purchase of light bulbs is diffuse, through many product sources (drug stores, supermarkets, hardware stores, discount stores, etc.), and are purchased by large numbers of people, it is not practical to obtain information directly from consumers about the wattage of the baseline bulb (what is being replaced or what would have been used instead of the CLF). The alternative approach is to use a method that avoids the determination of the baseline for each recorded CLF by assuming that that the CFL bulb purchased is one of the standard replacement products for the incandescent, in terms of light output equivalency (see http://www.energystar.gov/index.cfm?c=cfls.pr_cfls). The method is to assume that the baseline is an incandescent light source with a wattage which is 3.4 times higher than the wattage of the CFL bulb - the general relationship between the equivalency values between incandescents and CFLs. For dimmable or three-way CFL bulbs, assume the highest wattage/setting when calculating the baseline equivalent.

Δ Watts = 2.4 x CFL wattage. This is based on an "incandescent to CFL" wattage ratio of 3.4 to 1.

2) Hours of bulb use per day

Hours = 3.2 Hours per day

The 3.2 hours of use per day is a value derived from an extended (nine month – May through February) logger study conducted during 2003 in Massachusetts, Rhode Island,

and Vermont.[1] The Connecticut 2008 Program Savings Documentation uses 2.6 hours per day, based on a 2003 Connecticut-based study. A study of the 2005-2006 residential lighting program for Efficiency Maine reports daily hours of use at 4.8 hours from the markdown program component and 3.2 from the coupon program component.[2] This value represents a trade-off among factors which may affect the extent to which any out-of New York State value is applicable to NY. These include such factors as differences among the study area and NYS related to maturity of the CFL markets; program comparability; consumer knowledge of CFLs; and mix of locations within the house (which affects average hours of use). On balance, in considering the data and reports reviewed to date, 3.2 appears to be the most reasonable prior to New York specific impact studies.

3) Days per year the bulb is on.
Without any indication to the contrary it is assumed that the bulb is used 365 days per year.

The following chart can be used to derive annual savings for various size bulbs. This uses the assumed values above to provide the annual kWh savings. Note that actual bulb wattage should be used to calculate energy savings – using a default average could lead to a large margin of error.

CFL Bulb Wattage	Annual kWh Savings	CFL Bulb Wattage	Annual kWh Savings
7	19.6	19	53.3
8	22.4	20	56.1
9	25.2	21	58.9
10	28.0	22	61.7
11	30.8	23	64.5
12	33.6	24	67.3
13	36.4	25	70.1
14	39.2	26	72.9
15	42.0	27	75.7
16	44.9	28	78.5
17	47.7	29	81.3
18	50.5	30	84.1

Lifetime Energy Savings = Annual savings x measure life

Measure life: For program savings purposes, we believe that measure life should represent not only the engineering/rated life of the product but also the degree to which

[1] "Extended residential logging results" by Tom Ledyard, RLW Analytics Inc. and Lynn Heofgen, Nexus Market Research Inc., May 2, 2005, p.1.

[2] Process and Impact Evaluation of the Efficiency Maine Lighting Program, RLW Analytics, Inc, and Nexus Market Research Inc., April 10, 2007, Table 1-2, p. 12.

the product might be removed before its rated life. We thus propose that the term "measure life" be consistent with that used in the *Measure Life Report* prepared by GDS Associates for the New England State Program Working Group (SPWG):[3]

"For programs delivered by program administrators in New England, Measure Life includes equipment life and measure persistence (not savings persistence).

- Equipment Life means the number of years that a measure is installed and will operate until failure, and
- Measure Persistence takes into account business turnover, early retirement of installed equipment, and other reasons measures might be removed or discontinued."

A recent study for sponsors of residential lighting programs throughout New England derived the following measure lives for different residential lighting bulb program strategies.[4] We propose that these measure lives be used.

Product	Measure Life
Coupon CFLs	5
Direct Install CFLs	7
Markdown CFLs	7

Demand Savings

The demand savings here represent the level of reduction in demand at the time of system peak. They are typically calculated for a portfolio of installed or planned installations of lighting products rather than a single lamp. The calculation, however, is the same. Demand savings are calculated by multiplying the kW difference between the wattage or total load of the energy efficient product(s) and that of the baseline product(s), or delta watts, by the coincidence factor which reflects the amount of that demand which is in use at the time of system peak. The coincidence factors presented below are used to adjust the maximum delta watts into a demand value that is coincident to the specified peak summer and winter periods.[5]

Demand savings = delta watts x coincidence factor

The coincidence factors presented were derived from an examination of studies throughout New England which calculated coincident factors based on the definition of

[3] Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, prepared by GDS Associates, Inc. for the New England State Program Working Group for use as an Energy Efficiency Measures/Programs Reference Document for the ISO Forward Capacity Market (FCM), 2007, p. 1.2.

[4] Residential Lighting Measure Life Study, prepared for the New England Residential Lighting Program Sponsors by Nexus Market Research Inc. and RLW Analytics Inc., June 4, 2008, Table 1-2, p. 1.

[5] Coincidence Factor Study Residential and Commercial & Industrial Lighting Measures - For use as an Energy Efficiency Measures/Programs Reference Document for the ISO Forward Capacity Market (FCM), prepared for the New England State Program Working Group by RLW Analytics Inc., Spring 2007, p. III.

system peak period at the time, as specified by the New England Power Pool and later, ISO-New England.

Lighting Summer On-Peak Hours (1PM-5PM)	Coincidence Factor
June	0.07
July	0.09
August	0.09
Average Summer	0.08

Lighting Winter On-Peak Hours (5pm – 7pm)	Coincidence Factor
December	0.28
January	0.32
Average Winter	0.30

References/Sources Reviewed

1. This method is based on the documentation provided in the CL&P and UI Program Savings Documentation for 2008 Program Year. Other similar reports under review include the Efficiency Vermont and Efficiency Maine Technical Reference User Manuals.
2. Impact evaluations of residential lighting programs in several New England states reviewed in preparing the proposed hours-of-use values and coincidence factors include:

Impact Evaluation of the Massachusetts, Rhode Island, and Vermont 2003 Residential Lighting Programs, prepared for Cape Light Compact, Vermont Public Service Department, National Grid Massachusetts and Rhode Island, Western Massachusetts Electric Company, NSTAR Electric, Fitchburg G&E by Nexus Market Research Inc., and RLW Analytics Inc., Oct 1, 2004

"Extended residential logging results" memo to Angela Li, National Grid, by Tom Ledyard, RLW Analytics Inc., and Lynn Hoefgen, Nexus Market Research Inc., May 2, 2005

Market Progress and Evaluation Report for the 2005 Massachusetts ENERGY STAR Lighting Program, prepared for Cape Light Compact, National Grid – Massachusetts, NSTAR, Western Massachusetts Electric Company by Nexus Market Research Inc, RLW Analytics, Inc., Shel Feldman Management Company, Dorothy Conant. September 29, 2006

Process and Impact Evaluation of the Efficiency Maine Lighting Program, prepared for Efficiency Maine by Nexus Market Research Inc. and RLW Analytics Inc., April 10, 2007

Coincidence Factor Study Residential and Commercial & Industrial Lighting Measures - For use as an Energy Efficiency Measures/Programs Reference Document for the ISO Forward Capacity Market (FCM), prepared for the New England State Program Working Group by RLW Analytics Inc., Spring 2007

Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, prepared by GDS Associates, Inc. for the New England State Program Working Group for use as an Energy Efficiency Measures/Programs Reference Document for the ISO Forward Capacity Market (FCM), 2007

Residential Lighting Measure Life Study, prepared for the New England Residential Lighting Program Sponsors by Nexus Market Research Inc. and RLW Analytics Inc., June 4, 2008.

CFL Light Fixture - Residential (Single Family)

Measure Description

An Energy Star hardwired interior fluorescent fixture with pin based bulbs whose wattage is known. Programs focusing on installation of fixtures include new construction and major renovation programs. Fixtures with screw-based (CFL) bulbs are treated as CFL bulbs for savings calculations (the hours-of-use typically varies between pin and screw-based bulbs).

Savings Estimation Approach

Annual Energy Savings = Δ Watts x Hours x Days-per-Year/1000

Variables and Assumptions
1) Δ Watts (delta watts) – the difference between the bulb that is installed (replacement bulb) or would have been installed (new lamp) and the higher efficiency CFL bulb.

Because the purchase of light bulbs is diffuse, through many product sources (drug stores, supermarkets, hardware stores, discount stores, etc.), and are purchased by large numbers of people, it is not practical to obtain information directly from consumers about the wattage of the baseline bulb (what is being replaced or what would have been used instead of the CLF). The alternative approach is to use a method that avoids the determination of the baseline for each recorded CLF by assuming that that the CFL bulb purchased is one of the standard replacement products for the incandescent, in terms of light output equivalency (see http://www.energystar.gov/index.cfm?c=cfls.pr_cfls). The method is to assume that the baseline is an incandescent light source with a wattage which is 3.4 times higher than the wattage of the CFL bulb - the general relationship between the equivalency values between incandescents and CFLs. For dimmable or three-way CFL bulbs, assume the highest wattage/setting when calculating the baseline equivalent.

Δ Watts = 2.4 x CFL wattage. This is based on an "incandescent to CFL" wattage ratio of 3.4 to 1.

2) Hours of bulb use per day

Hours = 2.5 Hours per day

The 2.5 hours of use per day is a value derived from an extended (nine month – May through February) logger study conducted during 2003 in Massachusetts, Rhode Island,

and Vermont.[6] The Connecticut 2008 Program Savings Documentation uses 2.6 hours per day, based on a 2003 Connecticut-based study. A study of the 2005-2006 residential lighting program for Efficiency Maine reports daily hours of use at 2.4 for interior fixtures.[7] The proposed value represents a trade-off among factors which may affect the extent to which any out-of New York State value is applicable to NY. These include such factors as differences among the study area and NYS related to maturity of the CFL markets; program comparability; consumer knowledge of CFLs; and mix of locations within the house (which affects average hours of use). On balance, in considering the data and reports reviewed to date, 2.5 appears to be the most reasonable prior to New York specific impact studies.

3) Days per year the bulb is on.

Without any indication to the contrary it is assumed that the bulb is used 365 days per year.

The following chart can be used to derive annual savings for various size bulbs. This uses the assumed values above to provide the annual kWh savings. Note that actual bulb wattage should be used to calculate energy savings – using a default average could lead to a large margin of error.

CFL Bulb Wattage	Annual kWh Savings	CFL Bulb Wattage	Annual kWh Savings
7	15.3	**19**	41.6
8	17.5	**20**	43.8
9	19.7	**21**	46.0
10	21.9	**22**	48.2
11	24.1	**23**	50.4
12	26.3	**24**	52.6
13	28.5	**25**	54.8
14	30.7	**26**	56.9
15	32.9	**27**	59.1
16	35.0	**28**	61.3
17	37.2	**29**	63.5
18	39.4	**30**	65.7

Lifetime Energy Savings = Annual savings x measure life

Measure life: For program savings purposes, we believe that measure life should represent not only the engineering/rated life of the product but also the degree to which

[6] "Extended residential logging results" by Tom Ledyard, RLW Analytics Inc. and Lynn Heofgen, Nexus Market Research Inc., May 2, 2005, p.1.

[7] Process and Impact Evaluation of the Efficiency Maine Lighting Program, RLW Analytics, Inc, and Nexus Market Research Inc., April 10, 2007, Table 1-2, p. 12.

the product might be removed before its rated life. We thus propose that the term "measure life" be consistent with that used in the *Measure Life Report* prepared by GDS Associates for the New England State Program Working Group (SPWG):[8]

"For programs delivered by program administrators in New England, Measure Life includes equipment life and measure persistence (not savings persistence).

- Equipment Life means the number of years that a measure is installed and will operate until failure, and
- Measure Persistence takes into account business turnover, early retirement of installed equipment, and other reasons measures might be removed or discontinued."

Measure life studies reviewed to date either do not provide measure life estimates for interior fixtures or only focus on the measure life of the ballast, not the pin-based bulb. **We thus propose to use a measure life of 7 years** for pin-based bulbs associated with hard-wired fixtures, consistent with CLF bulbs reported in the most recent report reviewed.[9]

Demand Savings

The demand savings here represent the level of reduction in demand at the time of system peak. They are typically calculated for a portfolio of installed or planned installations of lighting products rather than a single lamp. The calculation, however, is the same. Demand savings are calculated by multiplying the kW difference between the wattage or total load of the energy efficient product(s) and that of the baseline product(s), or delta watts, by the coincidence factor which reflects the amount of that demand which is in use at the time of system peak. The coincidence factors presented below are used to adjust the maximum delta watts into a demand value that is coincident to the specified peak summer and winter periods.[10]

Demand savings = delta watts x coincidence factor

The coincidence factors presented were derived from an examination of studies throughout New England which calculated coincident factors based on the definition of system peak period at the time, as specified by the New England Power Pool and later, ISO-New England.

[8] GDS Associates, Inc. (2007) *Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures*. Prepared for The New England State Program Working Group for use as an Energy Efficiency Measures/Programs Reference Document for the ISO Forward Capacity Market (FCM).
[9] Residential Lighting Measure Life Study, prepared for the New England Residential Lighting Program Sponsors by Nexus Market Research Inc. and RLW Analytics Inc., June 4, 2008.

[10] Coincidence Factor Study Residential and Commercial & Industrial Lighting Measures - For use as an Energy Efficiency Measures/Programs Reference Document for the ISO Forward Capacity Market (FCM), prepared for the New England State Program Working Group by RLW Analytics Inc., Spring 2007, p. III.

Lighting Summer On-Peak Hours (1PM-5PM)	Coincidence Factor
June	0.07
July	0.09
August	0.09
Average Summer	0.08

Lighting Winter On-Peak Hours (5pm – 7pm)	Coincidence Factor
December	0.28
January	0.32
Average Winter	0.30

References/Sources Reviewed

1. This method is based on the documentation provided in the CL&P and UI Program Savings Documentation for 2008 Program Year. Other similar reports under review include the Efficiency Vermont and Efficiency Maine Technical Reference User Manuals.
2. Impact evaluations of residential lighting programs in several New England states reviewed in preparing the proposed hours-of-use values and coincidence factors include:

Impact Evaluation of the Massachusetts, Rhode Island, and Vermont 2003 Residential Lighting Programs, prepared for Cape Light Compact, Vermont Public Service Department, National Grid Massachusetts and Rhode Island, Western Massachusetts Electric Company, NSTAR Electric, Fitchburg G&E by Nexus Market Research Inc., and RLW Analytics Inc., Oct 1, 2004

"Extended residential logging results" memo to Angela Li, National Grid, by Tom Ledyard, RLW Analytics Inc., and Lynn Hoefgen, Nexus Market Research Inc., May 2, 2005

Market Progress and Evaluation Report for the 2005 Massachusetts ENERGY STAR Lighting Program, prepared for Cape Light Compact, National Grid – Massachusetts, NSTAR, Western Massachusetts Electric Company by Nexus Market Research Inc, RLW Analytics, Inc., Shel Feldman Management Company, Dorothy Conant. September 29, 2006

Process and Impact Evaluation of the Efficiency Maine Lighting Program, prepared for Efficiency Maine by Nexus Market Research Inc. and RLW Analytics Inc., April 10, 2007

Coincidence Factor Study Residential and Commercial & Industrial Lighting Measures - For use as an Energy Efficiency Measures/Programs Reference Document for the ISO Forward Capacity Market (FCM), prepared for the New England State Program Working Group by RLW Analytics Inc., Spring 2007

Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, prepared by GDS Associates, Inc. for the New England State Program Working Group for use as an Energy Efficiency Measures/Programs Reference Document for the ISO Forward Capacity Market (FCM), 2007

Residential Lighting Measure Life Study, prepared for the New England Residential Lighting Program Sponsors by Nexus Market Research Inc. and RLW Analytics Inc., June 4, 2008.

Electric Heat Pump Water Heater EF Greater than 2 - Residential Single Family

Measure Description
An electric heat pump water heater is a domestic water heater that uses a heat pump technology for moving heat from the air (inside or outside the home) to the water storage tank. The heat pump is essentially similar to a standard air conditioner, but instead of exhausting the heat to the outside of the home and putting the cooled air into the home, the heat pump water heater places the heat from the air into the water that is then stored in the hot water tank. The cooled air is exhausted into the home (for interior installed units) or can be vented outside of the home. If the cooled air is exhausted into the home it can affect the energy consumption of the home's heating and cooling system. When air conditioning is required, the water heat pump can lower the amount of air conditioning required. During cooler months, additional heating is required for the home to off-set the cold air from the water heater unless the chilled air is vented to the outside of the home. Savings calculation approaches need to consider the energy impacts to both the domestic water heating system and to the home in which the units are installed to estimate the energy impacts on the home (rather than just the hot water supply). Impacts for both electric and non-electric energy consumption need to be reported for programs that include systems that vent cooled air into the home.

Savings Estimation Approach

1. New Construction, Replace on Failure and Early Replacement
This savings will be estimated as follows:

<u>Annual kWh Savings</u>
Annual Energy Savings = (estimated baseline electric hot water energy consumption) - (estimated heat pump energy consumption for same water volumes and temperature conditions) = (estimated electric savings) + (positive or negative impacts on the home's heating and cooling system under average participant household conditions).

Total Energy Impacts[11] = (BE – HPWH) + HCI

Where: BE = Baseline electric energy consumption. If new construction, the baseline is the typical system that would have been installed without the program. If a replace on failure system, the baseline is the typical system would have been installed without the program. If it is an early replacement, the baseline is the typical system that was removed for the remaining useful life of the system, plus

[11] See FEMP Federal Technology Alert for Residential Water Heat Pump Water Heaters for detailed calculation approach. All temperature and environmental conditions will use New York specific temperature data. See page 32 of the FEMP publication for water input temperatures for New York. Typical historic temperatures should be used for heating and cooling degree days.

the savings associated with the system that would have been installed without the program based on market averages.
HPWH = Heat pump electric water heating consumption
HCI = Heating and cooling impact. The negative or positive impacts on the homes heating and cooling systems. If electric, the impacts are embedded in the calculation. If other than electric impacts, the impacts are reported separately (see below).

If participant's homes are heated or cooled with electricity, the impacts on the water heating estimate are adjusted to account for increases or decreases on the home's heating and cooling systems. If the participant's homes are heated by non-electric fuels, the impacts of the water heating system on the home's heating and cooling energy use are also reported. This will require multi-fuel impact reporting when non-electric heated homes are allowed to be participants.

Energy savings calculations will be estimated following FEMP's [12] Federal Technology Alert
http://www1.eere.energy.gov/femp/pdfs/FTA_res_heat_pump.pdf Appendix C, Calculations (page 31) for the typical program installation condition. Heating and cooling degree days will be the typical condition for the typical installation for the program participants.

Peak Savings
Peak savings calculation will follow FEMP's Technical Alert Appendix C approach for summer afternoon peak conditions for New York reflective of the typical conditions that apply to the program service area as a whole, weighted to the participant distribution across the state.

Sample Calculation
Inserted below is the sample calculation presented in FEMP's Technical Alert. However, this calculation is for a warmer climate than what New York experiences. The inputs for water temperature and climate will be based on typical program conditions for the typical installation (See following page).

[12] FEMP = Federal Energy Management Program

Sample Calculation Approach (from Appendix C of FEMP's Technical Alert.

Calculations
("eq" followed by individual numbers in brackets refer to results of the equation identified by the number)

(1) Hot-water Usage Estimate (Number of Occupants -1) x 10.7 gal/day/occupant + 32.2 gal/day) _______ gal/day
(2) Daily Hot-water Energy Load = 8.28 Btu/gal x _______ gal/day x (135-CW supply temperature) _______ Btu/day

HPWH EF
If supplemental electric resistance heat not anticipated
(3a) $EF_{hpwh} = EF_{rated}$

If supplemental electric resistance heat anticipated
(3b) $EF_{hpwh} = EF_{rated} \times (1 - FLR) + FLR$

Where FLR = Tank Size (gal) x 0.25 x 8.28 Btu/gal-°F x (135°F - CW supply temperature) x 25%/(eq2)

Annual Hot-water Energy Requirements

$$\textit{Annual Electric Energy} = \frac{\textit{Hot Water Energy Load (Btu/day)}}{\textit{Water Heater EF}} \times \frac{\textit{365 days/yr}}{\textit{3413 Btu/kWh}}$$

(4) Electric Resistance Water Heater _______ kWh/yr
(5) Heat Pump Water Heater _______ kWh/yr

Annual Space conditioning effect of ambient-air HPWHs

(6) DF = [A x HR65 + (1-A) x HR80)] / (HR65)

where $A = 2 \times$ (Design 2.5% T_{wb} °F/ Design 2.5% T_{db} °F) - 0.9
HR65 = number of hours per year with outdoor temperature > 65°F = _______ hr/yr
HR80 = number of hours per year with outdoor temperature > 80°F = _______ hr/yr

(7) Beneficial Space Cooling = DF x HR65 x (eq2) / 24 hr/day x $(1/EF_{res} - 1/EF_{hpwh})$ / 1000 = _______ kBtu/yr
(8) Detrimental Space Cooling = (8760-HR65) x (eq2) / 24 hr/day x $(1/EF_{res} - 1/EF_{hpwh})$ /1000 = _______ kBtu/yr

(9) Annual Space Cooling Energy Savings= (eq7)/(SEER) = _______ kWh/yr
(10) Annual Additional Space Heating Energy
(10a) Electric Resistance Heat= (eq8)/(3.413 kBtu/kWh) = _______ kWh/yr
(10b) Electric Heat Pump= (eq8)/HSPF kBtu/kWh) = _______ kWh/yr
(10c) Gas Heat= (eq8)/(EFF * 10) = _______ therms/yr

Annual Energy Requirements:
Electric Resistance Water Heater
(11) Electric Energy = (eq4) = _______ (kWh/yr

Heat Pump Water Heater
(12a)Electric Energy = (eq5) - (eq9) + (eq10a) + (eq10b) = _______ kWh/yr
(12b)Gas Energy = (eq10c) _______ therms/yr

Contribution to Demand (non-morning demand peak)
(13) Electric Resistance Water Heater Demand (kW) = (eq4) / 8760 hr/yr x 12 mo/yr = _______ kW-mo/yr
(14) HPWH Demand = (eq5) / 8760 hr/yr x 12 mo/yr = _______ kW-mo/yr

RESIDENTIAL CENTRAL AIR CONDITIONING

Description of Measure

Central air conditioning systems with rated efficiency of 14 SEER or higher in Single Family Residential applications.

Method for Calculating Summer Peak Demand and Energy Savings

$$\Delta kW_S = units \times \frac{tons}{unit} \times RLF \times \left(\frac{12}{EER_{base,pk}} - \frac{12}{EER_{ee,pk}} \right) \times DF_S \times CF_S$$

$$\Delta kWh = units \times \frac{tons}{unit} \times RLF \times \left(\frac{12}{\overline{EER}_{base}} - \frac{12}{\overline{EER}_{ee}} \right) \times CLH$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= the number of air conditioning units installed under the program
tons/unit	= tons of air conditioning per unit, based on nameplate data
$\overline{EER}$	= average energy efficiency ratio over the cooling season. (Btu/watt-hour)
EER_{pk}	= energy efficiency ratio under peak conditions (Btu/watt-hour)
CLH	= cooling load hours
RLF	= rated load factor
DF	= demand diversity factor
CF	= coincidence factor
12	= conversion factor (kBtuh/ton)

The ***rated load factor*** is the ratio of the peak cooling load imposed on the cooling equipment to the total rated cooling capacity. This factor compensates for oversizing of the air conditioning unit.

$$RLF = \frac{\text{peak cooling load}}{\text{nameplate capacity}}$$

The ***SEER*** is an estimate of the seasonal energy efficiency for an average US city. Programs should use the manufacturers' rated SEER until data can be developed that is more appropriate for NY climates.

Cooling load hours are defined as the ratio of the building annual cooling load to the building peak cooling load:

$$\text{CLH} = \frac{\text{Annual Cooling Load (Btu)}}{\text{Peak Cooling Load (Btu / hr)}}$$

Cooling **equivalent full-load hours** (EFLH) are sometimes used to estimate total energy savings. EFLH are defined as follows:

$$\text{EFLH} = \frac{\text{Annual kWh}_{\text{cooling}}}{\text{kW}_{\text{peak, cooling}}}$$

Since EFLH are calculated from the total kWh and peak kW of the air conditioner, the efficiency characteristics of the air conditioner affect the EFLH. To eliminate the dependence on HVAC system performance characteristics, the EFLH can be converted to CLH using the following equation:

$$\text{CLH} = \text{EFLH} \times \frac{\overline{\text{EER}}}{\text{EER}_{\text{pk}}}$$

where:

EFLH = equivalent full-load hours
$\overline{\text{EER}}$ = average air conditioning equipment energy efficiency ratio
EER_{pk} = air conditioning equipment energy efficiency ratio under peak conditions

The ***demand diversity factor*** is used to account for the fact that not all HVAC systems in all buildings in the population are operating at the same time. The demand diversity factor is defined as the average fraction of installed capacity of a population of HVAC systems that are operating at the time of the end-use peak.

The ***coincidence factor*** is used to account for the fact that peak measure savings may not be coincident with utility peak demands. The coincidence factor is defined as the portion of the end-use demand reduction that is coincident with the system peak.

Recommended values for the rated load factor, demand diversity factor and coincidence factors are shown below:

Parameter	Recommended Values
Rated Load Factor	0.8
Demand diversity factor	0.8
Coincidence factor	1.0

Baseline and measure efficiency assumptions for air conditioners and heat pumps in several SEER classes are shown below:

Baseline and Measure Efficiency Assumptions

System Type	Baseline or Measure Assumption	Seasonal Efficiency (SEER)	Peak Efficiency (EER)
Central Air conditioner	Early replacement baseline	SEER 10	9.2
	Replace on failure baseline	SEER 13	11.09
	Measure	SEER 14	11.99
		SEER 15	12.72
		SEER 16	11.61
		SEER 17	12.28
Central Heat Pump	Early replacement baseline	SEER 10	9.0
	Replace on failure baseline	SEER 13	11.07
	Measure	SEER 14	11.72
		SEER 15	12.32
		SEER 16	12.06
		SEER 17	12.52
		SEER 18	12.80

Early replacement units are assumed to be no more than 15 years old, with no less than 5 years remaining life. According to the 2004-5 DEER update study, equipment of this vintage is generally SEER 10.

Cooling load hours for residential buildings were calculated from a DOE-2.2 simulation of prototypical residential buildings. The prototype building characteristics are described in Appendix A. Residential prototypes for three different classes of building vintage were developed:

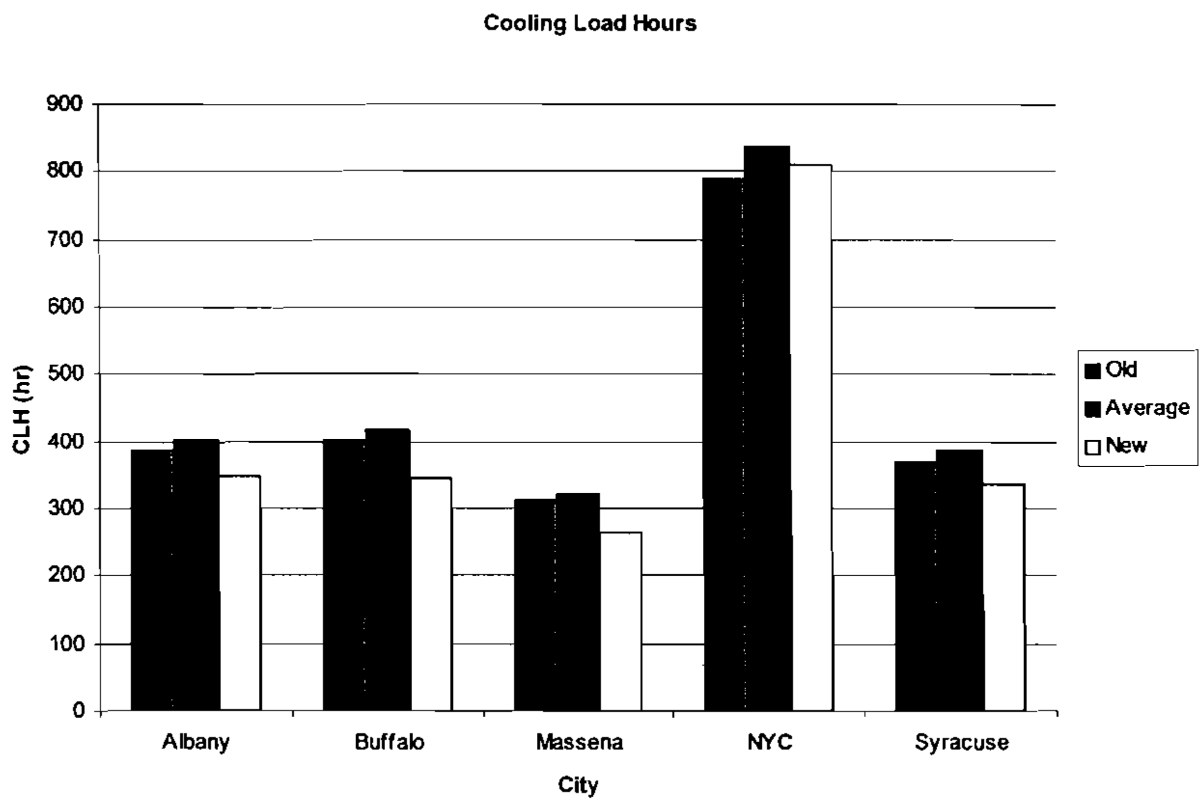
1. Old, poorly insulated building constructed in the 1950s or earlier. This vintage is referred to as the "old" vintage
2. Existing, average insulated building conforming to 1980s era building codes. This vintage is referred to as the "average" vintage.
3. New construction conforming to current NY state standards for residential new construction. This vintage is referred to as the "new" vintage.

The CLH for three building vintages and five different cities in NY are shown below:

Cooling Load Hours by Vintage and City

City	Old	Average	New
Albany	387	403	349
Buffalo	402	417	345
Massena	312	322	263
NYC	788	837	811
Syracuse	370	387	335

These data are also shown in the following Figure:



Note that the CLH are generally lower for new buildings, and that the CLH for old and average buildings are fairly consistent between Albany, Buffalo and Syracuse. CLH values are lower for Massena and much higher for New York City.

Baseline Efficiencies from which savings are calculated

The baseline efficiency for new construction and replace on failure is SEER 13. Baseline for early replacement is SEER 10.

Compliance Efficiency from which incentives are calculated

TBD

Operating Hours

The operating hours by climate zone and building vintage are shown above

Incremental Cost

TBD

Non-Electric Benefits - Annual Fossil Fuel Savings

Minor heating interactions are expected with efficient furnace fans utilized in most high efficiency air conditioners. These have not been quantified at this time.

Notes & References

1. Unit seasonal and peak efficiency data taken from the California DEER update study: 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report, Itron, Inc. Vancouver, WA. December, 2005. Available at http://www.calmac.org/publications/2004-05_DEER_Update_Final_Report-Wo.pdf

2. Typical values for demand diversity factor (DF), coincidence factor (CF) and rated load factor (RLF) taken from Engineering Methods for Estimating the Impacts of Demand-Side Management Programs. Volume 2: Fundamental Equations for Residential and Commercial End-Uses. TR-100984S Vol 2. Electric Power Research Institute, Palo Alto, CA August, 1993.

Revision Number

0

RESIDENTIAL CENTRAL HEAT PUMPS

Description of Measure

A heat pump with improved heating season performance factor (HSPF). Note only the heating savings is presented here; cooling savings from an efficient heat pump is the same as the cooling savings for an efficient air conditioner.

Method for Calculating Annual Energy Savings

$$\Delta kWh = units \times \frac{kBtuh}{unit} \times RLF_{heat} \times \left(\frac{1}{\overline{COP}_{base}} - \frac{1}{\overline{COP}_{ee}} \right) \times \frac{HLH}{3.413}$$

where:

ΔkWh	= gross annual energy savings
units	= number of heat pumps installed
kBtuh/unit	= the nominal rating of the heating capacity of the heat pumps in kBtu/hr
$\overline{COP}$	= average heating season coefficient of performance of heat pump
HLH	= heating load hours
RLF_{heat}	= heating mode rated load factor
3.413	= conversion factor (Btu/Wh)

The ***rated load factor*** is the ratio of the peak heating load imposed on the heating equipment to the total rated heating capacity, including the supplemental heating (strip heat). This factor compensates for oversizing of the heat pump.

$$RLF = \frac{peak\ heating\ load}{nameplate\ \text{heating}\ capacity}$$

Recommended value for the rated load factor is 0.8.

The ***HSPF*** is an estimate of the seasonal heating energy efficiency for an average US city. The average COP in the equation above is equal to the HSPF/3.413. Programs should use the manufacturers' rated HSPF until data can be developed that are more appropriate for NY climates. Efficiency assumptions for heat pumps of different SEER classes are shown below:

	Cooling Seasonal Efficiency (SEER)	Heating Seasonal Efficiency (HSPF)
Early replacement baseline	SEER 10	6.8
Replace on failure baseline	SEER 13	8.1
Measure	SEER 14	8.6
	SEER 15	8.8

	Cooling Seasonal Efficiency (SEER)	Heating Seasonal Efficiency (HSPF)
	SEER 16	8.4
	SEER 17	8.6
	SEER 18	9.2

Early replacement units are assumed to be no more than 15 years old, with no less than 5 years remaining life. According to the 2004-5 DEER update study, equipment of this vintage is generally SEER 10.

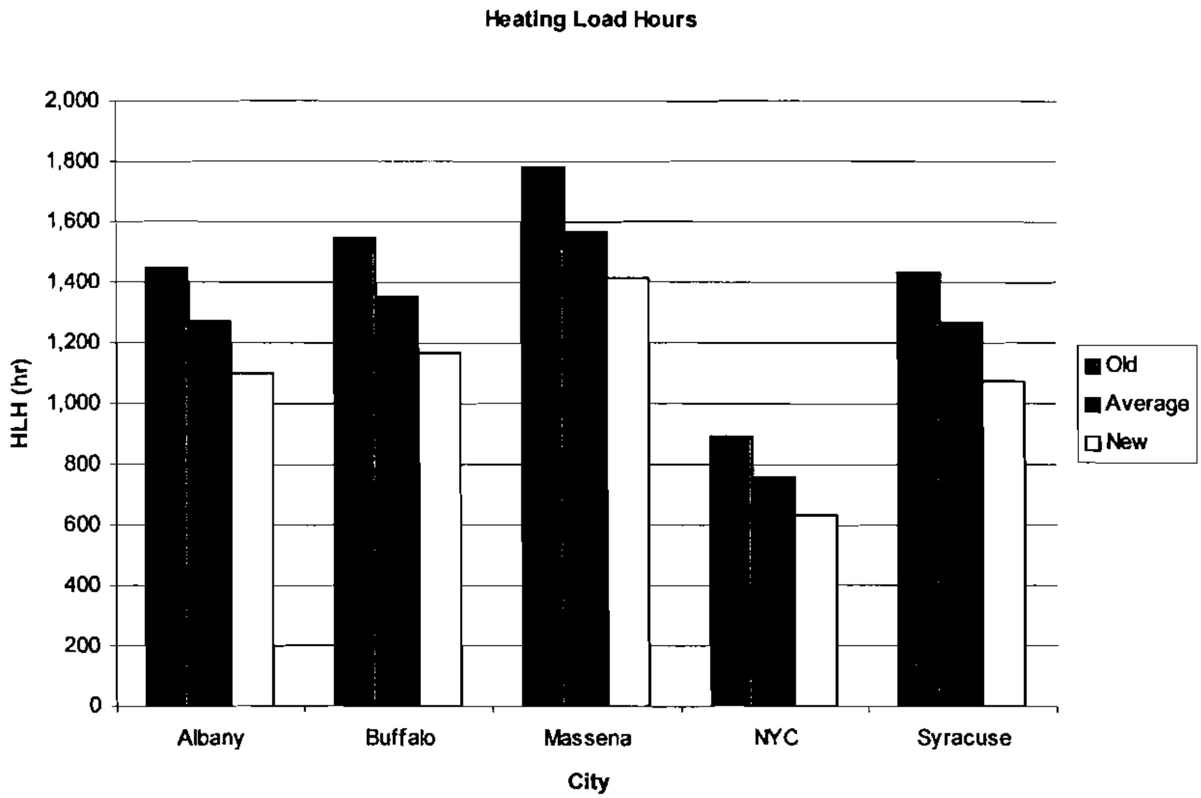
Heating load hours are defined as the ratio of the annual building heating load to the peak building heating load:

$$\text{HLH} = \frac{\text{Annual Heating Load (Btu)}}{\textit{Peak}\ \text{Heating Load (Btu/hr)}}$$

Heating load hours for residential buildings were calculated from a DOE-2.2 simulation of prototypical residential buildings. The prototype building characteristics are described in Appendix A. The HLH for three building vintages and five different cities in NY are shown below:

City	Old	Average	New
Albany	1,450	1,275	1,100
Buffalo	1,544	1,354	1,166
Massena	1,780	1,566	1,414
NYC	893	763	635
Syracuse	1,436	1,265	1,075

These data are also shown in the following Figure:



Note: the heating load hours decrease with newer buildings. As with the CLH, HLH are fairly comparable for Albany, Buffalo and Syracuse. New York City has much lower HLH, while Massena HLH are higher.

Baseline Efficiencies from which savings are calculated

New construction and replace on failure baseline efficiency should be consistent with a SEER 13 heat pump (HSPF = 8.1). Early replacement efficiency is assumed to be consistent with a SEER 10 heat pump (HSPF -=6.8).

Compliance Efficiency from which incentives are calculated

TBD

Operating Hours

Heating load hours vary by climate and building vintage. See table above.

Incremental Cost

TBD

Non-Electric Benefits - Annual Fossil Fuel Savings

None anticipated – electric heating system

Notes & References

1. Unit seasonal and peak efficiency data taken from the California DEER update study: 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report, Itron, Inc. Vancouver, WA. December, 2005. Available at http://www.calmac.org/publications/2004-05_DEER_Update_Final_Report-Wo.pdf

2. Typical values for rated load factor (RLF) taken from Engineering Methods for Estimating the Impacts of Demand-Side Management Programs. Volume 2: Fundamental Equations for Residential and Commercial End-Uses. TR-100984S Vol 2. Electric Power Research Institute, Palo Alto, CA August, 1993.

Revision Number

0

RESIDENTIAL REFRIGERANT CHARGE CORRECTION

Description of Measure

Correcting refrigerant charge on air conditioners and heat pumps in single family residential applications

Method for Calculating Summer Peak Demand and Energy Savings

$$\Delta kW_S = \text{units} \times \frac{\text{tons}}{\text{unit}} \times \text{RLF} \times \left(\frac{12}{\text{EER}_{\text{uncorr, pk}}} - \frac{12}{\text{EER}_{\text{corr, pk}}} \right) \times DF_S \times CF_S$$

$$\Delta kWh = \text{units} \times \frac{\text{tons}}{\text{unit}} \times \text{RLF} \times \left(\frac{12}{\overline{\text{EER}}_{uncorr}} - \frac{12}{\overline{EER}_{corr}} \right) \times \text{CLH}$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= the number of air conditioning units installed under the program
tons/unit	= tons of air conditioning per unit, based on nameplate data
$\overline{\text{EER}}$	= average energy efficiency ratio over the cooling season. (Btu/watt-hour)
EER_{pk}	= energy efficiency ratio under peak conditions (Btu/watt-hour)
CLH	= cooling load hours
RLF	= rated load factor
DF	= demand diversity factor
CF	= coincidence factor
12	= conversion factor (kBtuh/ton)

The **rated load factor** (RLF) is the ratio of the peak cooling load imposed on the cooling equipment to the total rated cooling capacity. This factor compensates for oversizing of the air conditioning unit.

$$\text{RLF} = \frac{\text{peak cooling load}}{\text{nameplate capacity}}$$

Cooling load hours are defined as the ratio of the annual building cooling load to the peak building cooling load:

$$\text{CLH} = \frac{\text{Annual Cooling Load (Btu)}}{\text{Peak Cooling Load (Btu / hr)}}$$

The ***demand diversity factor*** is used to account for the fact that not all HVAC systems in all buildings in the population are operating at the same time. The demand diversity factor is defined as the average fraction of installed capacity of a population of HVAC systems that are operating at the time of the end-use peak.

The ***coincidence factor*** is used to account for the fact that peak measure savings may not be coincident with utility peak demands. The coincidence factor is defined as the portion of the end-use demand reduction that is coincident with the system peak.

Recommended values for the rated load factor, demand diversity factor and coincidence factors are shown below:

Parameter	Recommended Values
Rated Load Factor	0.8
Demand diversity factor	0.8
Coincidence factor	1.0

The ***SEER*** is an estimate of the seasonal energy efficiency for an average US city. Programs should use the manufacturers' rated SEER until data can be developed that is more appropriate for NY climates.

Efficiency assumptions for properly charged air conditioners and heat pumps in several SEER classes are shown below:

AC Unit Efficiency Assumptions

Type	Seasonal Average Efficiency (SEER)	Efficiency under peak conditions (EER)
Air conditioner	SEER 10	9.2
	SEER 13	11.09
	SEER 14	11.99
	SEER 15	12.72
	SEER 16	11.61
	SEER 17	12.28
Air Source Heat Pump	SEER 10	9.0
	SEER 13	11.07
	SEER 14	11.72
	SEER 15	12.32
	SEER 16	12.06
	SEER 17	12.52
	SEER 18	12.80

Refrigerant charge adjustments applied to existing units should use the SEER 10 data. Adjustments to new units should use the SEER of the unit treated.

Refrigerant charge adjustments are assumed to have a 10% improvement in unit efficiency. That is, the efficiency of an uncorrected unit is 10% below that of a corrected unit.

Parameter	Recommended Values
$EER_{pk, uncorr}$	$0.9 \times EER_{pk, corr}$
$\overline{EER}_{uncorr}$	$0.9 \times \overline{EER}_{corr}$

Cooling load hours for residential buildings were calculated from a DOE-2.2 simulation of prototypical residential buildings. The prototype building characteristics are described in Appendix A. Residential prototypes for three different classes of building vintage were developed:

1. Old, poorly insulated building constructed in the 1950s or earlier. This vintage is referred to as the "old" vintage
2. Existing, average insulated building conforming to 1980s era building codes. This vintage is referred to as the "average" vintage.
3. New construction conforming to current NY state standards for residential new construction. This vintage is referred to as the "new" vintage.

The CLH for three building vintages and five different cities in NY are shown below:

Cooling Load Hours by Vintage and City

City	Old	Average	New
Albany	387	403	349
Buffalo	402	417	345
Massena	312	322	263
NYC	788	837	811
Syracuse	370	387	335

Baseline Efficiencies from which savings are calculated

See table above.

Compliance Efficiency from which incentives are calculated

TBD

Operating Hours

Cooling load hours vary by city and building vintage. See table above.

Incremental Cost

TBD

Non-Electric Benefits - Annual Fossil Fuel Savings

None anticipated

Notes & References

1. Unit seasonal and peak efficiency data taken from the California DEER update study: 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report, Itron, Inc. Vancouver, WA. December, 2005. Available at http://www.calmac.org/publications/2004-05_DEER_Update_Final_Report-Wo.pdf

2. Typical values for demand diversity factor (DF), coincidence factor (CF) and rated load factor (RLF) taken from Engineering Methods for Estimating the Impacts of Demand-Side Management Programs. Volume 2: Fundamental Equations for Residential and Commercial End-Uses. TR-100984S Vol 2. Electric Power Research Institute, Palo Alto, CA August, 1993.

Revision Number

0

Small Commercial Measures

Refrigerator LEDs – Small Commercial

Measure Description
The installation of LED bulbs in commercial display refrigerators, coolers or freezers. The light bulbs in a typical refrigerator, cooler or freezer add to the load on that unit by increasing power consumption of the unit when the light is on, and by adding heat to the inside of the unit that must be overcome thought additional cooling. Replacing incandescent and fluorescent lighting with low heat generating LEDs reduces the energy consumption associated with the lighting components and reduces the amount of waste heat generated from the lighting that must be overcome by the unit's compressor cycles.

Savings Estimation Approach

Annual Savings

kWh Savings
The savings approach is based on the estimated difference in refrigerator / cooler / freezer consumption before the change-out compared to the unit consumption after the change-out for the period of time the unit is turned on during a typical year of operation.

The estimation approach is as follows:

Savings in kWh per year = (Annual lighting kWh B – Annual lighting kWh A) + ComEffSav

Where:

Annual lighting kWh B = The total annual kWh usage of the unit per year with conventional baseline lighting.
Annual lighting kWh A = The total annual kWh usage of the units with the LEDs installed.
ComEffSav = the kWh savings of the refrigeration unit by not needing to cool the heat generated by the inefficient lighting.
kWh B = total lighting run hours per year x wattage of baseline lighting / 1000
kWh A = total lighting run hours per year x wattage of LED lighting / 1000

The ComEffSav from the compressor are estimated using the following approach:

ConEffSav = (Annual lighting kWh B – Annual lighting kWh A) * ComEffFac

Where:

ComEffFac = 1.52 for coolers and 1.66 for freezers * 0.8 for the portion of the saved energy that would have needed to be eliminated via the compressor[13]. Thus, ComEffFac for refrigerators and coolers = (1.52 * .8) = 1.2 and ComEffFac for freezers = (1.66 * .8) = 1.33.

kW Savings

Peak demand savings are calculated using the following approach.

KW = (kW B – kW A)* Compressor factor

Where:

KW = the total average kW savings of the refrigeration system, including both the kW reduction due to the bulb replacement and the kW reduced from the operation of the compressor not having to remove the excess lighting.
kW B = The total power usage of the lighting fixtures that are being replaced, kW.
kW A = The total power usage of the new lighting fixtures that are being installed,
Compressor factor = 1.52 for coolers and 1.66 for freezers. The factors are based on effective refrigeration compressor EER values of 6.7 and 5.25 Btu/Wh, respectively.

[13] Note: It is assumed that 0.2 of the saved energy escapes via conduction through the display case and does not have to be recaptured by the compressor. This adjustments should be confirmed via metering tests and adjusted when those tests have been concluded.

Evaporator Fan Controls - Small Commercial and Small Industrial

Measure Description

Walk-in cooler and freezer evaporator fans often run continually, requiring more air to be blown across the evaporator than needed to cool the evaporator. This measure consists of a control system that turns the fan on only when the unit's thermostat is calling for the compressor to operate, shutting the fan off shortly after the desired temperature is reached and the compressor is turned off.

Savings Estimation Approach

The savings from this measure is highly dependent on the type, size and condition of the coolers and freezers fitted with fan controls. As a result as estimate of the typical unit must be based on the program's projection of what types and sizes of units will be served and the condition of those units to function.

In general the following estimate approach must be made for the typical units that the program is expected to control:

<u>kWh Savings</u>

Annual kWh savings = (Hs * kW)

Where:

Hs = Annual hours per year shut off by the control system

kW = kW demand for the typical fan shut off (included system efficiency adjustments)

<u>kW Savings</u>

The units are expected to be operating at peak period. Peak savings are estimated as follows:

Peak demand savings = D * kW

Where:

D = diversity factor (typically about 10%)

kW = kW draw of operating fan

Vending Machine Central Controls - Small Commercial & Small Industrial

Measure Description

This measure is essentially an approach for controlling the operations of vending machines so that they are only operating when needed. The controls are typically a time-control system that allows the machines to be turned on and reach desired temperatures during the hours of business operations, but turned off during other time.

Savings Estimation Approach

<u>kWh Savings</u>

The savings approach is based on the estimated difference in machine consumption between a unit operating full time and operating only during controlled on-cycles. The estimation approach is as follows:[14]

Savings in kWh per year = (Annual kWh B – Annual kWh A)

Where:

> Annual kWh B = The total annual kWh usage of the vending machines that are being controlled without the control system installed.
> Annual kWh A = The total annual kWh usage of the vending machines with the control system installed.

Because different vending machines have different operational characteristics, consumption of the vending machines will need to be estimated for the pre-installation period for the typical program-covered unit. Where possible, this estimate should be based on a metered sample of units operated with kWh/kW meters to establish the baseline conditions. If metered data of a sample of machines in New York is not available, metered samples from other states or programs can be used. If metered data from other states are not available, manufacturer's data on unit consumption can be used. The consumption of the units for the baseline condition will be assumed to operate 8,760hours per year. Savings for the post-installation period will be estimated using the percent of time the units are turned on as a fraction of the total estimated consumption for 8,760 hours per year.

<u>kW savings</u>

Because the units typically operate during peak hours in the baseline condition, the peak demand reduction will be set at the average on-time duty-cycle adjusted kW draw of the typical unit. The typical kW draw will be estimated using the metered kW draw of the unit (if a metered sample is available) in a non-controlled condition. If meter sample data is not available, manufactures data of kW draw and estimated duty-cycle can be used. Thus, if the unit consumes X kW and is operating on a 50% duty cycle, the peak kW savings would be X/.5 or 1/2X.

Custom Measures - Small Commercial & Small Industrial

Measure Description
The term "custom" is used to describe any measure not specifically covered by a prescribed approach for estimating measure-level kWh or kW savings.

Custom measures are project-based. That is, the savings that can be projected are for a specific project rather than a group of projects.

Custom measures are typically segregated into two estimation categories; those that are weather sensitive (also called weather dependant) measures and those that are not weather sensitive. Savings from weather sensitive measures involve savings calculations that are based on normal weather conditions within a given geographical area. For example, weather sensitive measures installed in up-state New York will have different savings than those same measures installed in a different climate zone, such as in New York City where the climate is buffered by the thermal effects of the Atlantic Ocean and the Gulf Stream. Custom measures that are not weather sensitive, but are similar in type, size, function and user conditions can be expected to have similar energy impacts regardless of where they are installed.

Savings Estimation Approach
<u>kWh Savings</u>

Weather Sensitive
Estimating weather sensitive measures involves the use of climate adjustments that apply for the geographical area in which the measure is installed. In general, the savings for weather sensitive custom measures are based on project-specific consumption calculations taking into account the energy consumption of the baseline equipment and operating environment and the expected equipment and operating environment of the post-installation condition. These calculations are based on a specific set of weather conditions that apply to that individual project. To estimate savings, the calculation must first establish the baseline condition for a give set of equipment, operational conditions and weather. Typically this is "normal-weather" for a location based on the average daily weather over 30 or 40 years. For expediency, the state can be broken down into climate zones so that there are only a few pre-defined "typical" climate zones so that the same weather data is used for all custom projects within the same weather zone regardless of the utility or organization conducting the program or the service territory in which that program is offered. Next the post installation consumption is estimated for the equipment and operational conditions that apply to the new equipment under the same weather conditions. The difference in kWh consumption between the estimated baseline energy use and the post-installation estimated consumption is defined as the custom project estimated savings. For projects in which savings can be affected by customer use and application conditions, the savings are adjusted for expected changes in those conditions.

Non-Weather Sensitive
Non-weather sensitive custom measures do not need to adjust savings for normal or expected weather. In these cases the consumption calculations for the energy use of the baseline condition are compared to the consumption calculations for the custom project's post-installation conditions. In these cases the savings estimates are adjusted for expected changes in the post-installation conditions. However, in most cases the pre and post installation conditions are not significantly different enough to require adjustments for changing conditions. However, this assumption needs to be documented in the estimate of savings.

kW Savings[15]
Weather Sensitive Measures:
The methodology used to determine the annual kWh savings for temperature-dependent measures depends on the type of analysis used to estimate savings. Savings from temperature-dependent measures are typically determined by either full load hour analysis, bin temperature analysis, or a detailed computer simulation. The following will be the procedure used to estimate the kWh savings for these measures:

When annual savings are calculated using a full load hour analysis, an appropriately derived coincidence factor will be used for a measure that has a connected load that can be determined from rated or nameplate data. Demand savings will be the connected load kW savings times the appropriate coincidence factor. When using a temperature bin analysis to calculate the energy savings, the demand (kW) savings are averaged over the appropriate temperature bins. When a computer simulation is used to calculate savings, the demand savings will be averaged over the appropriated peak time period.

Non Weather Sensitive Measures:
Demand savings for measures that are not temperature-dependent will be determined by estimating the average estimated savings at the coincident peak time. For example, for a process VFD measure, the savings will depend on cycling of the load. This cycling may occur many times during an hour. If the process is operating throughout the summer period, the average demand savings will be:

(annual kWh savings)/(annual equivalent full load hours of operation).

If the process is operated only a portion of that time period the demand savings will be prorated based on that portion.

[15] This portion of the savings estimate approach is based on the Connecticut Energy Efficiency Funds Program Savings Documentation approach for 2008 published by Connecticut Light and Power Company.

ANTI-SWEAT HEATER CONTROLS

Description of Measure

Anti-sweat heater controls for glass reach-in doors on grocery store freezer cases

Method for Calculating Summer Peak Demand and Energy Savings

Gross Summer Coincident Demand Savings
ΔkW_S = qty doors × (ΔkW/door) × DF_S × CF_S

Gross Annual Energy Savings
ΔkWh = qty doors × (ΔkWh/door)

Δtherm = qty doors × (Δtherm/door)

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
qty doors	= quantity of reach-in freezer doors controlled
DF	= demand diversity factor
CF	= coincidence factor
ΔkW/door	= electricity demand savings per reach-in freezer doors controlled
ΔkWh/door	= electricity consumption savings per reach-in freezer doors controlled

The ***demand diversity factor*** is used to account for the fact that not all anti-sweat heaters in all buildings in the population are operating at the same time. The demand diversity factor is defined as the average fraction of installed capacity of a population of control systems that are operating at the time of the end-use peak.

The ***coincidence factor*** is used to account for the fact that peak measure savings may not be coincident with utility peak demands. The coincidence factor is defined as the portion of the end-use demand reduction that is coincident with the system peak.

Recommended values for the demand diversity factor and coincidence factor are shown below:

Parameter	Value
Demand diversity factor	1.0
Coincidence factor	1.0

Unit energy and demand savings were calculated from a DOE-2.2 simulation of a prototypical grocery store. The prototype building characteristics are described in

Appendix A. The unit energy and demand savings for five different cities in NY are shown below

Unit Energy and Demand Savings for Anti-sweat Heater Controls

Climate	Units	kWh/unit	kW/unit
Albany	per door	1850	0
Buffalo	per door	1843	0
Massena	per door	1896	0
NYC	per door	1764	0
Syracuse	per door	1784	0

Baseline Efficiencies from which savings are calculated

The baseline condition is assumed to be no anti-sweat heater controls

Compliance Efficiency from which incentives are calculated

TBD

Operating Hours

The control system is assumed to be active 24/7

Incremental Cost

TBD

Non-Electric Benefits - Annual Fossil Fuel Savings

Controlling door anti-sweat heaters increases space heating requirements. The therm impacts are shown below:

Δtherm = qty doors × (Δtherm/door)

where:

Δtherm/door = gas consumption change per reach-in freezer doors controlled

Therm impacts per unit are shown below:

Antisweat Heater Control Therm Impacts

Climate	Units	therm/unit
Albany	per door	-15
Buffalo	per door	-13
Massena	per door	-16

Climate	Units	therm/unit
NYC	per door	-13
Syracuse	per door	-11

Notes & References

1. Measure performance characteristics taken from the California DEER update study: 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report, Itron, Inc. Vancouver, WA. December, 2005. Available at http://www.calmac.org/publications/2004-05_DEER_Update_Final_Report-Wo.pdf

Revision Number

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C&I HIGH EFFICIENCY PACKAGED AIR CONDITIONERS

Description of Measure

Rooftop and split system AC in small commercial building applications.

Method for Calculating Summer Peak Demand and Energy Savings

$$\Delta kW_S = \text{units} \times \frac{\text{tons}}{\text{unit}} \times RLF \times \left(\frac{12}{EER_{base,pk}} - \frac{12}{EER_{ee,pk}} \right) \times DF_S \times CF_S$$

$$\Delta kWh = \text{units} \times \frac{\text{tons}}{\text{unit}} \times RLF \times \left(\frac{12}{\overline{EER}_{base}} - \frac{12}{\overline{EER}_{ee}} \right) \times CLH$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= the number of air conditioning units installed under the program
tons/unit	= tons of air conditioning per unit, based on nameplate data
$\overline{EER}$	= average energy efficiency ratio over the cooling season. (Btu/watt-hour)
EER_{pk}	= energy efficiency ratio under peak conditions (Btu/watt-hour)
CLH	= cooling load hours
RLF	= rated load factor
DF	= demand diversity factor
CF	= coincidence factor
12	= conversion factor (kBtuh/ton)

The ***rated load factor*** is the ratio of the peak cooling load imposed on the cooling equipment to the total rated cooling capacity. This factor compensates for oversizing of the air conditioning unit.

$$RLF = \frac{\text{peak cooling load}}{\text{nameplate capacity}}$$

Cooling load hours are defined as the ratio of the annual cooling load to the peak cooling load:

$$CLH = \frac{\text{Annual Cooling Load (Btu)}}{\text{Peak Cooling Load (Btu / hr)}}$$

Cooling **equivalent full-load hours** (EFLH) are sometimes used to estimate total energy savings. EFLH is defined as follows:

$$EFLH = \frac{\text{Annual kWh}_{cooling}}{kW_{peak,\ cooling}}$$

Since EFLH are calculated from the total kWh and peak kW of the air conditioner, the efficiency characteristics of the air conditioner affect the EFLH. EFLH are converted to CLH using the following equation:

$$CLH = EFLH \times \frac{\overline{EER}}{EER_{pk}}$$

where:

EFLH = equivalent full-load hours
$\overline{EER}$ = average air conditioning equipment energy efficiency ratio
EER_{pk} = air conditioning equipment energy efficiency ratio under peak conditions

The ***demand diversity factor*** is used to account for the fact that not all HVAC systems in all buildings in the population are operating at the same time. The demand diversity factor is defined as the average fraction of installed capacity of a population of HVAC systems that are operating at the time of the end-use peak.

The ***coincidence factor*** is used to account for the fact that peak measure savings may not be coincident with utility peak demands. The coincidence factor is defined as the portion of the end-use demand reduction that is coincident with the system peak.

Recommended values for the rated load factor, demand diversity factor and coincidence factors are shown below:

Parameter	Recommended Values
Rated Load Factor	0.8
Demand diversity factor	0.8
Coincidence factor	1.0

Recommended values from the 2004-5 DEER update study for baseline and measure efficiency are shown in the table below:

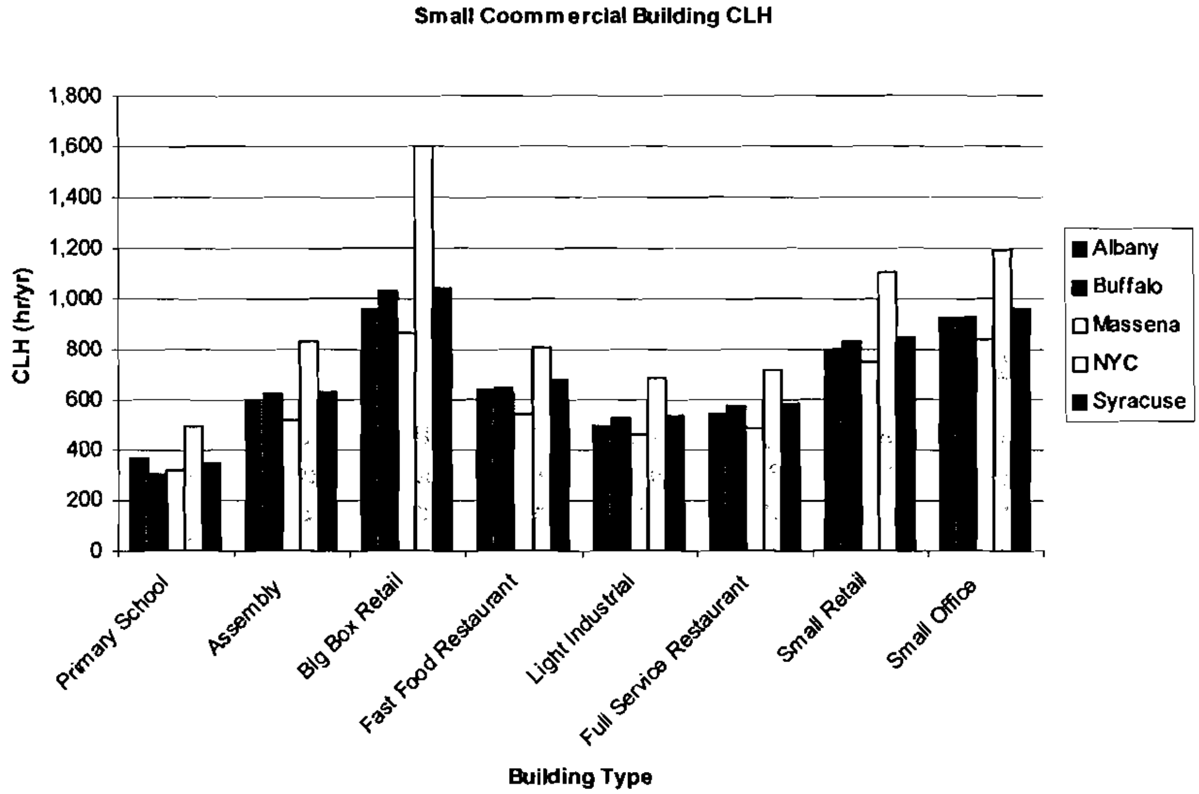
Baseline and Measure Performance Assumptions

Equipment Category	Capacity Range (Btu/hr)	Baseline Efficiency		Measure Efficiency	
		Average	Peak	Average	Peak
Unitary A/C (1) phase	<65,000 1 Ph	13.0	11.1	14.0	12.2
Unitary A/C (3) phase	<65,000 3 Ph	12.0	10.4	13.0	11.1
Unitary A/C (3) phase	65,000 - 135,000	9.1	10.1	9.6	11.0
Unitary A/C (3) phase	135,000 - 240,000	8.5	9.5	9.5	11.0
Unitary A/C (3) phase	240,000 - 760,000	8.4	9.3	8.9	10.0
Unitary A/C (3) phase	>760,000	8.1	9.0	8.9	10.0
Unitary HP (1) phase	<65,000 1 Ph	13.0	11.1	14.0	12.2
Unitary HP (3) phase	<65,000 3 Ph	12.0	10.4	13.0	11.1
Unitary HP (3) phase	65,000 - 135,000	8.8	9.9	9.5	11.0
Unitary HP (3) phase	135,000 - 240,000	8.2	9.1	8.8	10.0
Unitary HP (3) phase	>240,000	8.0	8.8	8.8	10.0

Cooling load hours were calculated from a DOE-2.2 simulation of prototypical small commercial buildings. The prototype building characteristics are described in Appendix A. The CLH for eight building types and five different cities in NY are shown below:

Building	Albany	Buffalo	Massena	NYC	Syracuse
Primary School	371	305	321	492	342
Assembly	597	621	519	836	632
Big Box Retail	961	1,033	860	1,599	1,039
Fast Food Restaurant	640	649	545	806	680
Light Industrial	500	529	463	686	536
Full Service Restaurant	546	575	486	718	583
Small Retail	803	833	749	1,102	848
Small Office	927	931	839	1,194	960

These data are also shown in the Figure below.



Note that the CLH vary widely depending on the building type and climate. Within each building type, the CLH for are fairly consistent between Albany, Buffalo and Syracuse, with lower values for Massena and much higher values for New York City.

Baseline Efficiencies from which savings are calculated

The baseline efficiency for new construction and normal replacement vary by equipment size, and are shown in the Table above.

Compliance Efficiency from which incentives are calculated

TBD

Operating Hours

The operating hours by climate zone and building type are shown in the Table above

Incremental Cost

TBD

Non-Electric Benefits - Annual Fossil Fuel Savings

None anticipated

Notes & References

1. Unit seasonal and peak efficiency data taken from the California DEER update study: 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report, Itron, Inc. Vancouver, WA. December, 2005. Available at http://www.calmac.org/publications/2004-05_DEER_Update_Final_Report-Wo.pdf

2. Typical values for demand diversity factor (DF), coincidence factor (CF) and rated load factor (RLF) taken from Engineering Methods for Estimating the Impacts of Demand-Side Management Programs. Volume 2: Fundamental Equations for Residential and Commercial End-Uses. TR-100984S Vol 2. Electric Power Research Institute, Palo Alto, CA August, 1993.

Revision Number

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C&I PACKAGED HEAT PUMPS

Description of Measure

A heat pump with improved heating season performance factor (HSPF). Note only the heating savings is presented here; cooling savings from an efficient heat pump is the same as the cooling savings for an efficient air conditioner.

Method for Calculating Annual Energy Savings

$$\Delta kWh = units \times \frac{kBtuh}{unit} \times RLF_{heat} \times \left(\frac{1}{\overline{COP}_{base}} - \frac{1}{\overline{COP}_{ee}}\right) \times \frac{HLH}{3.413}$$

where:

ΔkWh	= gross annual energy savings
units	= number of heat pumps installed
kBtuh/unit	= the nominal rating of the heating capacity of the heat pumps in kBtu/hr
$\overline{COP}$	= average heating season coefficient of performance of heat pump
HLH	= heating load hours
RLF_{heat}	= heating mode rated load factor
3.413	= conversion factor (Btu/Wh)

The ***rated load factor*** is the ratio of the peak heating load imposed on the heating equipment to the total rated heating capacity, including the supplemental heating (strip heat). This factor compensates for oversizing of the heat pump.

$$RLF = \frac{\textit{peak heating load}}{\textit{nameplate}\ \text{heating}\ \textit{capacity}}$$

Recommended value for RLF is 0.8

The ***HSPF*** is an estimate of the seasonal heating energy efficiency for an average US city. The average COP in the equation above is equal to the HSPF/3.413. Programs should use the manufacturers' rated HSPF until data can be developed that are more appropriate for NY climates. Efficiency assumptions for heat pumps of different SEER classes are shown below:

Equipment Type	Size Range	Baseline Heating Seasonal Efficiency (HSPF)	Measure Heating Seasonal Efficiency (HSPF)
Unitary HP (1) phase	<65,000 1 Ph	8.1	8.6
Unitary HP (3) phase	<65,000 3 Ph	7.7	8.1
Unitary HP (3) phase	65,000 - 135,000		
Unitary HP (3) phase	135,000 - 240,000		
Unitary HP (3) phase	>240,000		

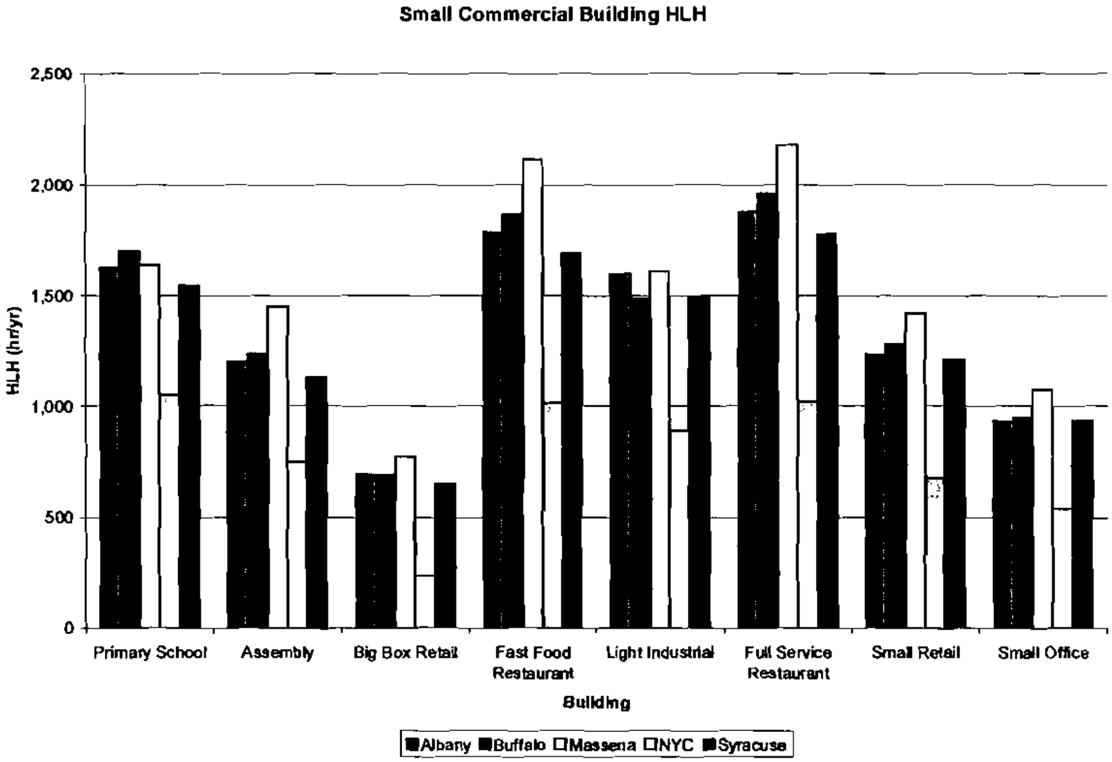
Heating load hours are defined as the ratio of the annual building heating load to the peak building heating load:

$$\text{HLH} = \frac{\text{Annual Heating Load (Btu)}}{\textit{Peak}\text{ Heating Load (Btu/hr)}}$$

Heating load hours were calculated from a DOE-2.2 simulation of prototypical small commercial buildings. The prototype building characteristics are described in Appendix A. The HLH for three building vintages and five different cities in NY are shown below:

Building	Albany	Buffalo	Massena	NYC	Syracuse
Primary School	1,625	1,696	1,639	1,050	1,545
Assembly	1,201	1,237	1,448	754	1,129
Big Box Retail	693	696	775	239	653
Fast Food Restaurant	1,782	1,864	2,112	1,016	1,689
Light Industrial	1,597	1,485	1,607	892	1,500
Full Service Restaurant	1,878	1,959	2,182	1,026	1,774
Small Retail	1,230	1,275	1,417	681	1,211
Small Office	934	950	1,076	539	938

These data are also shown in the following figure.



Note that the HLH vary widely depending on the building type and climate. Within each building type, the HLH for are fairly consistent between Albany, Buffalo and Syracuse, with higher values for Massena and much lower values for New York City.

Baseline Efficiencies from which savings are calculated

The baseline efficiency for new construction and normal replacement vary by equipment size, and are shown in the Table above.

Compliance Efficiency from which incentives are calculated

TBD

Operating Hours

Heating load hours vary by building type and city. See table above.

Incremental Cost

TBD

Non-Electric Benefits - Annual Fossil Fuel Savings

None anticipated – electric heating system

Notes & References

1. Unit seasonal and peak efficiency data taken from the California DEER update study: 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report, Itron, Inc. Vancouver, WA. December, 2005. Available at http://www.calmac.org/publications/2004-05_DEER_Update_Final_Report-Wo.pdf

2. Typical values for rated load factor (RLF) taken from Engineering Methods for Estimating the Impacts of Demand-Side Management Programs. Volume 2: Fundamental Equations for Residential and Commercial End-Uses. TR-100984S Vol 2. Electric Power Research Institute, Palo Alto, CA August, 1993.

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0

C&I REFRIGERANT CHARGE CORRECTION

Description of Measure

Correcting refrigerant charge on air conditioners and heat pumps in small commercial applications

Method for Calculating Summer Peak Demand and Energy Savings

$$\Delta kW_S = units \times \frac{tons}{unit} \times RLF \times \left(\frac{12}{EER_{uncorr,pk}} - \frac{12}{EER_{corr,pk}} \right) \times DF_S \times CF_S$$

$$\Delta kWh = units \times \frac{tons}{unit} \times RLF \times \left(\frac{12}{\overline{EER}_{uncorr}} - \frac{12}{\overline{EER}_{corr}} \right) \times CLH$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= the number of air conditioning units installed under the program
tons/unit	= tons of air conditioning per unit, based on nameplate data
$\overline{EER}$	= average energy efficiency ratio over the cooling season. (Btu/watt-hour)
EER_{pk}	= energy efficiency ratio under peak conditions (Btu/watt-hour)
CLH	= cooling load hours
RLF	= rated load factor
DF	= demand diversity factor
CF	= coincidence factor
12	= conversion factor (kBtuh/ton)

The ***rated load factor*** is the ratio of the peak cooling load imposed on the cooling equipment to the total rated cooling capacity. This factor compensates for oversizing of the air conditioning unit.

$$RLF = \frac{\text{peak cooling load}}{\text{nameplate capacity}}$$

Cooling load hours are defined as the ratio of the annual cooling load to the peak cooling load:

$$CLH = \frac{\text{Annual Cooling Load (Btu)}}{\text{Peak Cooling Load (Btu / hr)}}$$

The ***demand diversity factor*** is used to account for the fact that not all HVAC systems in all buildings in the population are operating at the same time. The demand diversity factor is defined as the average fraction of installed capacity of a population of HVAC systems that are operating at the time of the end-use peak.

The ***coincidence factor*** is used to account for the fact that peak measure savings may not be coincident with utility peak demands. The coincidence factor is defined as the portion of the end-use demand reduction that is coincident with the system peak.

Recommended values for the rated load factor, demand diversity factor and coincidence factors are shown below:

Parameter	Recommended Values
Rated Load Factor	0.8
Demand diversity factor	0.8
Coincidence factor	1.0

Efficiency assumptions for properly charged air conditioners and heat pumps in several size classes are shown below:

Baseline and Measure Performance Assumptions

Equipment Category	Capacity Range (Btu/hr)	Efficiency	
		Average	Peak
Unitary A/C (1) phase	<65,000 1 Ph	13.0	11.1
Unitary A/C (3) phase	<65,000 3 Ph	12.0	10.4
Unitary A/C (3) phase	65,000 - 135,000	9.1	10.1
Unitary A/C (3) phase	135,000 - 240,000	8.5	9.5
Unitary A/C (3) phase	240,000 - 760,000	8.4	9.3
Unitary A/C (3) phase	>760,000	8.1	9.0
Unitary HP (1) phase	<65,000 1 Ph	13.0	11.1
Unitary HP (3) phase	<65,000 3 Ph	12.0	10.4
Unitary HP (3) phase	65,000 - 135,000	8.8	9.9
Unitary HP (3) phase	135,000 - 240,000	8.2	9.1
Unitary HP (3) phase	>240,000	8.0	8.8

Refrigerant charge adjustments are assumed to have a 10% improvement in unit efficiency. That is, the efficiency of an uncorrected unit is 10% below that of a corrected unit.

Parameter	Recommended Values
$EER_{pk, uncorr}$	$0.9 \times EER_{pk, corr}$
$\overline{EER}_{uncorr}$	$0.9 \times \overline{EER}_{corr}$

Cooling load hours for residential buildings were calculated from a DOE-2.2 simulation of prototypical small commercial buildings. The prototype building characteristics are described in Appendix A. The CLH for eight building types and five different cities in NY are shown below:

Building	Albany	Buffalo	Massena	NYC	Syracuse
Primary School	371	305	321	492	342
Assembly	597	621	519	836	632
Big Box Retail	961	1,033	860	1,599	1,039
Fast Food Restaurant	640	649	545	806	680
Light Industrial	500	529	463	686	536
Full Service Restaurant	546	575	486	718	583
Small Retail	803	833	749	1,102	848
Small Office	927	931	839	1,194	960

Baseline Efficiencies from which savings are calculated

The baseline (uncorrected) efficiency is assumed to be 10% lower than the nominal (corrected) unit efficiency.

Compliance Efficiency from which incentives are calculated

TBD

Operating Hours

The operating hours by climate zone and building type are shown above

Incremental Cost

TBD

Non-Electric Benefits - Annual Fossil Fuel Savings

None anticipated

Notes & References

1. Unit seasonal and peak efficiency data taken from the California DEER update study: 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report, Itron, Inc. Vancouver, WA. December, 2005. Available at http://www.calmac.org/publications/2004-05_DEER_Update_Final_Report-Wo.pdf

2. Typical values for demand diversity factor (DF), coincidence factor (CF) and rated load factor (RLF) taken from Engineering Methods for Estimating the Impacts of Demand-Side Management Programs. Volume 2: Fundamental Equations for Residential and Commercial End-Uses. TR-100984S Vol 2. Electric Power Research Institute, Palo Alto, CA August, 1993.

Revision Number

0

COOL ROOF

Description of Measure

Roofing material with reduced solar absorptance. The cool roof is assumed to have a solar absorptance of 0.3 compared to a standard roof with solar absorptance of 0.8.

Method for Calculating Summer Peak Demand and Energy Savings

Gross Summer Coincident Demand Savings
$\Delta kW_S = kSF \text{ cool roof} \times (\Delta kW/kSF) \times DF_S \times CF_S$

Gross Annual Energy Savings
$\Delta kWh = kSF \text{ cool roof} \times (\Delta kWh/kSF)$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
kSF cool roof	= thousand square feet of cool roof installed over a cooled space
DF	= demand diversity factor
CF	= coincidence factor
ΔkW/kSF	= electricity demand savings per thousand square foot of cool roof
ΔkWh/kSF	= electricity consumption savings per square foot of cool roof

The ***demand diversity factor*** is used to account for the fact that not all HVAC systems in all buildings where cool roofs were installed are operating at the same time. The demand diversity factor is defined as the average fraction of installed capacity of the HVAC systems that are operating at the time of the end-use peak.

The ***coincidence factor*** is used to account for the fact that peak measure savings may not be coincident with utility peak demands. The coincidence factor is defined as the portion of the end-use demand reduction that is coincident with the system peak.

DF = 0.8
CF = 1.0

Unit energy and demand savings were calculated from a DOE-2.2 simulation of a series of prototypical small commercial buildings. The prototype building characteristics are described in Appendix A. The unit energy and demand savings for eight building types across five different cities in NY are shown in Table below:

Building Type	City	Unit	KWh/unit	KW/unit

Assembly	Albany	1000 sq ft roof area	138	0.071
Assembly	Buffalo	1000 sq ft roof area	119	0.056
Assembly	Massena	1000 sq ft roof area	135	0.065
Assembly	NYC	1000 sq ft roof area	168	0.059
Assembly	Syracuse	1000 sq ft roof area	150	0.088
Big Box Retail	Albany	1000 sq ft roof area	155	0.124
Big Box Retail	Buffalo	1000 sq ft roof area	132	0.067
Big Box Retail	Massena	1000 sq ft roof area	150	0.083
Big Box Retail	NYC	1000 sq ft roof area	950	-0.150
Big Box Retail	Syracuse	1000 sq ft roof area	165	0.106
Fast Food	Albany	1000 sq ft roof area	117	0.050
Fast Food	Buffalo	1000 sq ft roof area	101	0.050
Fast Food	Messina	1000 sq ft roof area	124	0.050
Fast Food	NYC	1000 sq ft roof area	170	0.000
Fast Food	Syracuse	1000 sq ft roof area	131	0.050
Full Service Restaurant	Albany	1000 sq ft roof area	279	0.200
Full Service Restaurant	Buffalo	1000 sq ft roof area	233	0.150
Full Service Restaurant	Massena	1000 sq ft roof area	282	0.150
Full Service Restaurant	NYC	1000 sq ft roof area	344	0.050
Full Service Restaurant	Syracuse	1000 sq ft roof area	307	0.250
Light Industrial	Albany	1000 sq ft roof area	90	0.073
Light Industrial	Buffalo	1000 sq ft roof area	74	0.080
Light Industrial	Massena	1000 sq ft roof area	87	0.096
Light Industrial	NYC	1000 sq ft roof area	118	0.055
Light Industrial	Syracuse	1000 sq ft roof area	102	0.135
Primary School	Albany	1000 sq ft roof area	196	0.624
Primary School	Buffalo	1000 sq ft roof area	152	0.426
Primary School	Massena	1000 sq ft roof area	191	0.116
Primary School	NYC	1000 sq ft roof area	270	0.652
Primary School	Syracuse	1000 sq ft roof area	202	0.506
Small Office	Albany	1000 sq ft roof area	151	0.080
Small Office	Buffalo	1000 sq ft roof area	130	0.040
Small Office	Massena	1000 sq ft roof area	152	0.080
Small Office	NYC	1000 sq ft roof area	169	0.040
Small Office	Syracuse	1000 sq ft roof area	157	0.060
Small Retail	Albany	1000 sq ft roof area	175	0.109
Small Retail	Buffalo	1000 sq ft roof area	143	0.078
Small Retail	Massena	1000 sq ft roof area	164	0.125
Small Retail	NYC	1000 sq ft roof area	203	0.062
Small Retail	Syracuse	1000 sq ft roof area	184	0.109

Baseline Efficiencies from which savings are calculated

The baseline condition is assumed to be roofing material with a solar absorptance of 0.8

Compliance Efficiency from which incentives are calculated

TBD

Operating Hours

The HVAC system operating hours vary by building type. See Appendix A

Incremental Cost

TBD

Non-Electric Benefits - Annual Fossil Fuel Savings

Reducing roofing material solar absorptance increases space heating requirements. The therm impacts are shown below:

$$\Delta\text{therm} = \text{kSF cool roof} \times (\Delta\text{therm/kSF})$$

where:

Δtherm/kSF = gas consumption impact per thousand square foot of cool roof installed over a heated space.

The therm impacts per unit are shown below:

Building Type	City	Unit	Therm/unit
Assembly	Albany	1000 sq ft roof area	-16
Assembly	Buffalo	1000 sq ft roof area	-16
Assembly	Massena	1000 sq ft roof area	-19
Assembly	NYC	1000 sq ft roof area	-11
Assembly	Syracuse	1000 sq ft roof area	-18
Big Box Retail	Albany	1000 sq ft roof area	-11
Big Box Retail	Buffalo	1000 sq ft roof area	-10
Big Box Retail	Massena	1000 sq ft roof area	-14
Big Box Retail	NYC	1000 sq ft roof area	-61
Big Box Retail	Syracuse	1000 sq ft roof area	-12
Fast Food	Albany	1000 sq ft roof area	-28
Fast Food	Buffalo	1000 sq ft roof area	-24
Fast Food	Messina	1000 sq ft roof area	-25
Fast Food	NYC	1000 sq ft roof area	-19
Fast Food	Syracuse	1000 sq ft roof area	-28
Full Service Restaurant	Albany	1000 sq ft roof area	-47
Full Service Restaurant	Buffalo	1000 sq ft roof area	-40

Building Type	City	Unit	Therm/unit
Full Service Restaurant	Massena	1000 sq ft roof area	-47
Full Service Restaurant	NYC	1000 sq ft roof area	-30
Full Service Restaurant	Syracuse	1000 sq ft roof area	-47
Light Industrial	Albany	1000 sq ft roof area	-20
Light Industrial	Buffalo	1000 sq ft roof area	-18
Light Industrial	Massena	1000 sq ft roof area	-21
Light Industrial	NYC	1000 sq ft roof area	-14
Light Industrial	Syracuse	1000 sq ft roof area	-20
Primary School	Albany	1000 sq ft roof area	-29
Primary School	Buffalo	1000 sq ft roof area	-27
Primary School	Massena	1000 sq ft roof area	-32
Primary School	NYC	1000 sq ft roof area	-22
Primary School	Syracuse	1000 sq ft roof area	-33
Small Office	Albany	1000 sq ft roof area	-12
Small Office	Buffalo	1000 sq ft roof area	-11
Small Office	Massena	1000 sq ft roof area	-14
Small Office	NYC	1000 sq ft roof area	-8
Small Office	Syracuse	1000 sq ft roof area	-14
Small Retail	Albany	1000 sq ft roof area	-17
Small Retail	Buffalo	1000 sq ft roof area	-15
Small Retail	Massena	1000 sq ft roof area	-21
Small Retail	NYC	1000 sq ft roof area	-12
Small Retail	Syracuse	1000 sq ft roof area	-18

Notes & References

1. Roof absorptivity assumptions taken from California Title 24 Standards for conventional and cool roofs

Revision Number

0

ECONOMIZER

Description of Measure

Dual-enthalpy economizer installed on packaged rooftop units serving small commercial buildings

Method for Calculating Energy Savings

Gross Annual Energy Savings
ΔkWh = cooling tons × (ΔkWh/ton)

where:

ΔkWh = gross annual energy savings
cooling tons = size of cooling system retrofitted with an economizer
ΔkWh/ton = electricity consumption savings per ton of cooling system retrofitted with an economizer

No peak demand savings are expected from this measure.

Unit energy savings were calculated from a DOE-2.2 simulation of a series of prototypical small commercial buildings. The prototype building characteristics are described in Appendix A. The unit energy savings for eight building types across five different cities in NY are shown below:

Building Type	City	unit	KWh/unit
Assembly	Albany	ton	39
Assembly	Buffalo	ton	45
Assembly	Massena	ton	33
Assembly	NYC	ton	27
Assembly	Syracuse	ton	42
Fast Food	Albany	ton	49
Fast Food	Buffalo	ton	53
Fast Food	Messina	ton	44
Fast Food	NYC	ton	39
Fast Food	Syracuse	ton	49
Full Service Restaurant	Albany	ton	38
Full Service Restaurant	Buffalo	ton	41
Full Service Restaurant	Massena	ton	32
Full Service Restaurant	NYC	ton	31
Full Service Restaurant	Syracuse	ton	38
Light Industrial	Albany	ton	45
Light Industrial	Buffalo	ton	38

Building Type	City	unit	KWh/unit
Light Industrial	Massena	ton	33
Light Industrial	NYC	ton	25
Light Industrial	Syracuse	ton	54
Primary School	Albany	ton	49
Primary School	Buffalo	ton	52
Primary School	Massena	ton	38
Primary School	NYC	ton	42
Primary School	Syracuse	ton	41
Small Office	Albany	ton	202
Small Office	Buffalo	ton	195
Small Office	Massena	ton	188
Small Office	NYC	ton	186
Small Office	Syracuse	ton	186
Small Retail	Albany	ton	107
Small Retail	Buffalo	ton	113
Small Retail	Massena	ton	95
Small Retail	NYC	ton	95
Small Retail	Syracuse	ton	111

Baseline Efficiencies from which savings are calculated

The baseline condition is assumed to be a rooftop unit with fixed outside air (no economizer)

Compliance Efficiency from which incentives are calculated

TBD

Operating Hours

The HVAC system operating hours vary by building type. See Appendix A

Incremental Cost

TBD

Non-Electric Benefits - Annual Fossil Fuel Savings

No therm impacts are anticipated from this measure

Notes & References

1. Dual enthalpy economizers assumed as best available technology for humid applications.

Revision Number
0

EFFICIENT AIR-COOLED REFRIGERATION CONDENSER

Description of Measure

Install an efficient, close approach air-cooled refrigeration system condenser. This measure savings energy by reduces condensing temperatures and improving the efficiency of the condenser fan system.

Method for Calculating Summer Peak Demand and Energy Savings

Gross Summer Coincident Demand Savings
ΔkW_S = compressor tons $\times$ (ΔkW/ton) $\times$ $DF_S \times CF_S$

Gross Annual Energy Savings
ΔkWh = compressor tons $\times$ (ΔkWh/ton)

where:

ΔkW	= gross summer peak demand savings
ΔkWh	= gross annual energy savings
compressor tons	= refrigeration system compressor capacity
ΔkWh/ton	= electricity consumption savings per ton of compressor capacity
DF	= demand diversity factor
CF	= coincidence factor

The ***demand diversity factor*** is used to account for the fact that refrigeration systems in all buildings in the population are operating at the same time. The demand diversity factor is defined as the average fraction of installed capacity of a population of refrigeration systems that are operating at the time of the end-use peak.

The ***coincidence factor*** is used to account for the fact that peak measure savings may not be coincident with utility peak demands. The coincidence factor is defined as the portion of the end-use demand reduction that is coincident with the system peak.

The recommended values for demand diversity and coincidence factors are shown below:

Factor	Recommended Value
DF	1.0
CF	1.0

Unit energy and demand savings were calculated from a DOE-2.2 simulation of a prototypical grocery store. The prototype building characteristics are described in Appendix A. The unit energy and demand savings for five different cities in NY are shown below:

City	Unit	KWh /unit	KW/unit
Albany	per ton of compressor capacity	1296	0.136
Buffalo	per ton of compressor capacity	1297	0.103
Massena	per ton of compressor capacity	1301	0.123
NYC	per ton of compressor capacity	1220	0.152
Syracuse	per ton of compressor capacity	1283	0.149

Baseline Efficiencies from which savings are calculated

The baseline condition is assumed to a standard efficiency air-cooled refrigeration system condenser, with a 20°F approach temperature on low temperature applications and a 15°F approach temperature on medium temperature applications. Standard efficiency specific fan power of 45 Btu/hr of heat rejection capacity per watt of fan power.

Compliance Efficiency from which incentives are calculated

Must provide an efficient air-cooled refrigeration system condenser, with an approach temperature of 13°F or less on low temperature applications and an approach temperature of 8°F or less on medium temperature applications. Specific fan power must be greater than or equal to 85 Btu/hr of heat rejection capacity per watt of fan power.

Operating Hours

The refrigeration system is assumed to be active 24/7

Incremental Cost

TBD

Non-Electric Benefits - Annual Fossil Fuel Savings

No therm impacts anticipated for this measure

Notes & References

1. Measure performance characteristics taken from the California DEER update study: 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report, Itron, Inc. Vancouver, WA. December, 2005. Available at http://www.calmac.org/publications/2004-05_DEER_Update_Final_Report-Wo.pdf

Revision Number

0

HIGH PERFORMANCE GLAZING

Description of Measure

High performance glazing system with reduced solar heat gain coefficient and U-value replacing single pane clear glass

Method for Calculating Summer Peak Demand and Energy Savings

Gross Summer Coincident Demand Savings
ΔkW_S = Glazing area (100 SF) × (ΔkW/100 SF) × DF_S × CF_S

Gross Annual Energy Savings
ΔkWh = Glazing area (100 SF) × (ΔkWh/ 100 SF)

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
Glazing area	= Aperture area of glazing system in 100 SF
DF	= demand diversity factor
CF	= coincidence factor
ΔkW/100 SF	= electricity demand savings per 100 SF of glazing area
ΔkWh/100 SF	= electricity consumption savings per 100 SF of glazing area

The ***demand diversity factor*** is used to account for the fact that not all HVAC systems in all buildings where high performance glazing systems were installed are operating at the same time. The demand diversity factor is defined as the average fraction of installed capacity of the HVAC systems that are operating at the time of the end-use peak.

The ***coincidence factor*** is used to account for the fact that peak measure savings may not be coincident with utility peak demands. The coincidence factor is defined as the portion of the end-use demand reduction that is coincident with the system peak.

DF = 0.8
CF = 1.0

Unit energy and demand savings were calculated from a DOE-2.2 simulation of a series of prototypical small commercial buildings. The prototype building characteristics are described in Appendix A. The unit energy and demand savings for eight building types across five different cities in NY are shown below:

Building Type	City	Unit	KWh/unit	KW/unit
Big Box Retail	Albany	100 sqft glazing	283	0.169

Building Type	City	Unit	KWh/unit	KW/unit
Big Box Retail	Buffalo	100 sqft glazing	251	0.158
Big Box Retail	Massena	100 sqft glazing	277	0.236
Big Box Retail	Syracuse	100 sqft glazing	288	0.191
Fast Food	Albany	100 sqft glazing	297	0.086
Fast Food	Buffalo	100 sqft glazing	282	0.189
Fast Food	Messina	100 sqft glazing	285	0.086
Fast Food	NYC	100 sqft glazing	384	0.017
Fast Food	Syracuse	100 sqft glazing	304	0.207
Full Service Restaurant	Albany	100 sqft glazing	226	0.103
Full Service Restaurant	Buffalo	100 sqft glazing	214	0.138
Full Service Restaurant	Massena	100 sqft glazing	225	0.120
Full Service Restaurant	NYC	100 sqft glazing	282	0.034
Full Service Restaurant	Syracuse	100 sqft glazing	240	0.155
Light Industrial	Albany	100 sqft glazing	267	0.203
Light Industrial	Buffalo	100 sqft glazing	227	0.226
Light Industrial	Massena	100 sqft glazing	223	0.226
Light Industrial	NYC	100 sqft glazing	331	0.136
Light Industrial	Syracuse	100 sqft glazing	240	0.248
Primary School	Albany	100 sqft glazing	564	0.328
Primary School	Buffalo	100 sqft glazing	536	0.175
Primary School	Massena	100 sqft glazing	536	0.151
Primary School	NYC	100 sqft glazing	688	0.308
Primary School	Syracuse	100 sqft glazing	549	0.385
Small Office	Albany	100 sqft glazing	312	0.206
Small Office	Buffalo	100 sqft glazing	282	0.140
Small Office	Massena	100 sqft glazing	295	0.201
Small Office	NYC	100 sqft glazing	366	0.136
Small Office	Syracuse	100 sqft glazing	306	0.153
Small Retail	Albany	100 sqft glazing	358	0.186
Small Retail	Buffalo	100 sqft glazing	319	0.177
Small Retail	Massena	100 sqft glazing	332	0.224
Small Retail	NYC	100 sqft glazing	431	0.168
Small Retail	Syracuse	100 sqft glazing	362	0.214

Baseline Efficiencies from which savings are calculated

The baseline condition is assumed to be single pane clear glass with a solar heat gain coefficient of 0.87 and U-value of 1.2 Btu/hr-SF-deg F

Compliance Efficiency from which incentives are calculated

The efficient glazing must have a solar heat gain coefficient of 0.40 or less and U-value of 0.57 Btu/hr-SF-deg F or less

Operating Hours

The HVAC system operating hours vary by building type. See Appendix A

Incremental Cost

TBD

Non-Electric Benefits - Annual Fossil Fuel Savings

Reducing the solar heat gain coefficient increases space heating requirements, while reducing the U-value decreases space heating requirements. The net therm impacts are calculated as follows:

Δtherm = Glazing area (100 SF) × (Δtherm/ 100 SF)

where:

Δtherm/ 100 SF = gas consumption impact per 100 square foot of glazing.

The therm impacts per unit are shown below:

Building Type	City	Unit	Therm/unit
Assembly	Albany	100 sqft glazing	85
Assembly	Buffalo	100 sqft glazing	84
Assembly	Massena	100 sqft glazing	183
Assembly	NYC	100 sqft glazing	30
Assembly	Syracuse	100 sqft glazing	69
Big Box Retail	Albany	100 sqft glazing	61
Big Box Retail	Buffalo	100 sqft glazing	64
Big Box Retail	Massena	100 sqft glazing	79
Big Box Retail	Syracuse	100 sqft glazing	63
Fast Food	Albany	100 sqft glazing	81
Fast Food	Buffalo	100 sqft glazing	94
Fast Food	Messina	100 sqft glazing	89
Fast Food	NYC	100 sqft glazing	65
Fast Food	Syracuse	100 sqft glazing	83
Full Service Restaurant	Albany	100 sqft glazing	56
Full Service Restaurant	Buffalo	100 sqft glazing	69
Full Service Restaurant	Massena	100 sqft glazing	62
Full Service Restaurant	NYC	100 sqft glazing	52
Full Service Restaurant	Syracuse	100 sqft glazing	65
Light Industrial	Albany	100 sqft glazing	45
Light Industrial	Buffalo	100 sqft glazing	48

Building Type	City	Unit	Therm/unit
Light Industrial	Massena	100 sqft glazing	48
Light Industrial	NYC	100 sqft glazing	21
Light Industrial	Syracuse	100 sqft glazing	39
Primary School	Albany	100 sqft glazing	60
Primary School	Buffalo	100 sqft glazing	73
Primary School	Massena	100 sqft glazing	69
Primary School	NYC	100 sqft glazing	44
Primary School	Syracuse	100 sqft glazing	62
Small Office	Albany	100 sqft glazing	43
Small Office	Buffalo	100 sqft glazing	51
Small Office	Massena	100 sqft glazing	52
Small Office	NYC	100 sqft glazing	30
Small Office	Syracuse	100 sqft glazing	45
Small Retail	Albany	100 sqft glazing	65
Small Retail	Buffalo	100 sqft glazing	74
Small Retail	Massena	100 sqft glazing	72
Small Retail	NYC	100 sqft glazing	42
Small Retail	Syracuse	100 sqft glazing	70

Notes & References

1. Glazing properties taken from ASHRAE Handbook of Fundamentals
2. High performance glass conforms to ASHRAE Standard 90.1 – 2004.

Revision Number

0

REFRIGERATED CASE NIGHT COVERS

Description of Measure

Night covers installed on medium temperature open multi-deck cases in grocery stores to reduce energy consumption by reducing infiltration into the case during unoccupied hours. The analysis assumes a night cover is deployed 4 hours per night, reducing store air infiltration into the case by 50%.

Method for Calculating Energy Savings

Gross Annual Energy Savings
$\Delta kWh = LF\ of\ case \times (\Delta kWh/LF)$

where:

ΔkWh = gross annual energy savings
LF of cover = Lineal feet of case fitted with a night cover
$\Delta kWh/SF$ = electricity consumption savings per LF of case

No summer peak demand savings are expected from this measure.

Unit energy savings were calculated from a DOE-2.2 simulation of a prototypical grocery store. The prototype building characteristics are described in Appendix A. The unit energy savings for five different cities in NY are shown below:

City	Unit	KWh/unit
Albany	per lineal foot	27
Buffalo	per lineal foot	28
Massena	per lineal foot	28
NYC	per lineal foot	29
Syracuse	per lineal foot	27

Baseline Efficiencies from which savings are calculated

The baseline condition is assumed to be no night covers installed

Compliance Efficiency from which incentives are calculated

TBD

Operating Hours

The night curtains are assumed to be deployed 4 hours per night.

Incremental Cost

TBD

Non-Electric Benefits - Annual Fossil Fuel Savings

Installing night covers reduces space heating requirements, since the introduction of cold air into the conditioned space is reduced. The therm impacts are calculated as follows:

$$\Delta\text{therm} = \text{LF case} \times (\Delta\text{therm/LF})$$

where:

Δtherm/LF = gas consumption change per lineal foot of case

Therm impacts per unit are shown below:

City	Unit	Therm/unit
Albany	per lineal foot	2
Buffalo	per lineal foot	5
Massena	per lineal foot	2
NYC	per lineal foot	1
Syracuse	per lineal foot	4

Notes & References

1. Measure performance characteristics taken from the California DEER update study: 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report, Itron, Inc. Vancouver, WA. December, 2005. Available at http://www.calmac.org/publications/2004-05_DEER_Update_Final_Report-Wo.pdf

Revision Number

0

WINDOW FILM

Description of Measure

Window films with reduced solar heat gain coefficient applied to single pane clear glass in small commercial buildings

Method for Calculating Summer Peak Demand and Energy Savings

Gross Summer Coincident Demand Savings
ΔkW_S = Glazing area (100 SF) × (ΔkW/100 SF) × DF_S × CF_S

Gross Annual Energy Savings
ΔkWh = Glazing area (100 SF) × (ΔkWh/ 100 SF)

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
Glazing area	= Aperture area of windows treated by window films in 100 SF
DF	= demand diversity factor
CF	= coincidence factor
ΔkW/100 SF	= electricity demand savings per 100 SF of glazing area
ΔkWh/100 SF	= electricity consumption savings per 100 SF of glazing area

The ***demand diversity factor*** is used to account for the fact that not all HVAC systems in all buildings treated by window films were installed are operating at the same time. The demand diversity factor is defined as the average fraction of installed capacity of the HVAC systems that are operating at the time of the end-use peak.

The ***coincidence factor*** is used to account for the fact that peak measure savings may not be coincident with utility peak demands. The coincidence factor is defined as the portion of the end-use demand reduction that is coincident with the system peak.

DF = 0.8
CF = 1.0

Unit energy and demand savings were calculated from a DOE-2.2 simulation of a series of prototypical small commercial buildings. The prototype building characteristics are described in Appendix A. The unit energy and demand savings for eight building types across five different cities in NY are shown in Table ##.

Building	City	Unit	KWh/unit	KW/unit
Assembly	Massena	100 sqft glazing	268	0.090

Building	City	Unit	KWh/unit	KW/unit
Assembly	Syracuse	100 sqft glazing	436	0.190
Fast Food	Albany	100 sqft glazing	286	0.086
Fast Food	Buffalo	100 sqft glazing	263	0.189
Fast Food	Messina	100 sqft glazing	270	0.086
Fast Food	NYC	100 sqft glazing	390	0.017
Fast Food	Syracuse	100 sqft glazing	299	0.172
Full Service Restaurant	Albany	100 sqft glazing	180	0.103
Full Service Restaurant	Buffalo	100 sqft glazing	160	0.138
Full Service Restaurant	Massena	100 sqft glazing	168	0.120
Full Service Restaurant	NYC	100 sqft glazing	244	0.034
Full Service Restaurant	Syracuse	100 sqft glazing	187	0.138
Light Industrial	Albany	100 sqft glazing	265	0.203
Light Industrial	Buffalo	100 sqft glazing	215	0.158
Light Industrial	Massena	100 sqft glazing	222	0.226
Light Industrial	NYC	100 sqft glazing	352	0.136
Light Industrial	Syracuse	100 sqft glazing	266	0.271
Primary School	Albany	100 sqft glazing	448	0.246
Primary School	Buffalo	100 sqft glazing	380	0.399
Primary School	Massena	100 sqft glazing	396	0.189
Primary School	NYC	100 sqft glazing	558	0.272
Primary School	Syracuse	100 sqft glazing	413	0.470
Small Office	Albany	100 sqft glazing	334	0.188
Small Office	Buffalo	100 sqft glazing	292	0.153
Small Office	Massena	100 sqft glazing	302	0.188
Small Office	NYC	100 sqft glazing	406	0.127
Small Office	Syracuse	100 sqft glazing	319	0.171
Small Retail	Albany	100 sqft glazing	345	0.177
Small Retail	Buffalo	100 sqft glazing	303	0.168
Small Retail	Massena	100 sqft glazing	293	0.214
Small Retail	NYC	100 sqft glazing	440	0.140
Small Retail	Syracuse	100 sqft glazing	334	0.205

Baseline Efficiencies from which savings are calculated

The baseline condition is assumed to be single pane clear glass with a solar heat gain coefficient of 0.87 and U-value of 1.2 Btu/hr-SF-deg F

Compliance Efficiency from which incentives are calculated

The window film is assumed to provide a solar heat gain coefficient of 0.40 or less.

Operating Hours

The HVAC system operating hours vary by building type. See Appendix A

Incremental Cost

TBD

Non-Electric Benefits - Annual Fossil Fuel Savings

Reducing the solar heat gain coefficient through the application of window films increases space heating requirements. The net therm impacts are calculated as follows:

Δtherm = Glazing area (100 SF) × (Δtherm/ 100 SF)

where:

Δtherm/ 100 SF = gas consumption impact per 100 square foot of glazing.

The therm impacts per unit are shown below:

Building Type	City	Unit	Therm/unit
Assembly	Massena	100 sqft glazing	-91
Assembly	Syracuse	100 sqft glazing	-66
Fast Food	Albany	100 sqft glazing	-85
Fast Food	Buffalo	100 sqft glazing	-77
Fast Food	Messina	100 sqft glazing	-83
Fast Food	NYC	100 sqft glazing	-73
Fast Food	Syracuse	100 sqft glazing	-77
Full Service Restaurant	Albany	100 sqft glazing	-69
Full Service Restaurant	Buffalo	100 sqft glazing	-62
Full Service Restaurant	Massena	100 sqft glazing	-66
Full Service Restaurant	NYC	100 sqft glazing	-60
Full Service Restaurant	Syracuse	100 sqft glazing	-62
Light Industrial	Albany	100 sqft glazing	-69
Light Industrial	Buffalo	100 sqft glazing	-72
Light Industrial	Massena	100 sqft glazing	-75
Light Industrial	NYC	100 sqft glazing	-63
Light Industrial	Syracuse	100 sqft glazing	-64
Primary School	Albany	100 sqft glazing	-103
Primary School	Buffalo	100 sqft glazing	-98
Primary School	Massena	100 sqft glazing	-107
Primary School	NYC	100 sqft glazing	-100
Primary School	Syracuse	100 sqft glazing	-101
Small Office	Albany	100 sqft glazing	-47
Small Office	Buffalo	100 sqft glazing	-44
Small Office	Massena	100 sqft glazing	-52

Building Type	City	Unit	Therm/unit
Small Office	NYC	100 sqft glazing	-36
Small Office	Syracuse	100 sqft glazing	-44
Small Retail	Albany	100 sqft glazing	-72
Small Retail	Buffalo	100 sqft glazing	-68
Small Retail	Massena	100 sqft glazing	-84
Small Retail	NYC	100 sqft glazing	-63
Small Retail	Syracuse	100 sqft glazing	-70

Notes & References

1. Window film properties taken from ASHRAE Handbook of Fundamentals

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Appendix A Prototypical Building Descriptions

Single family residential

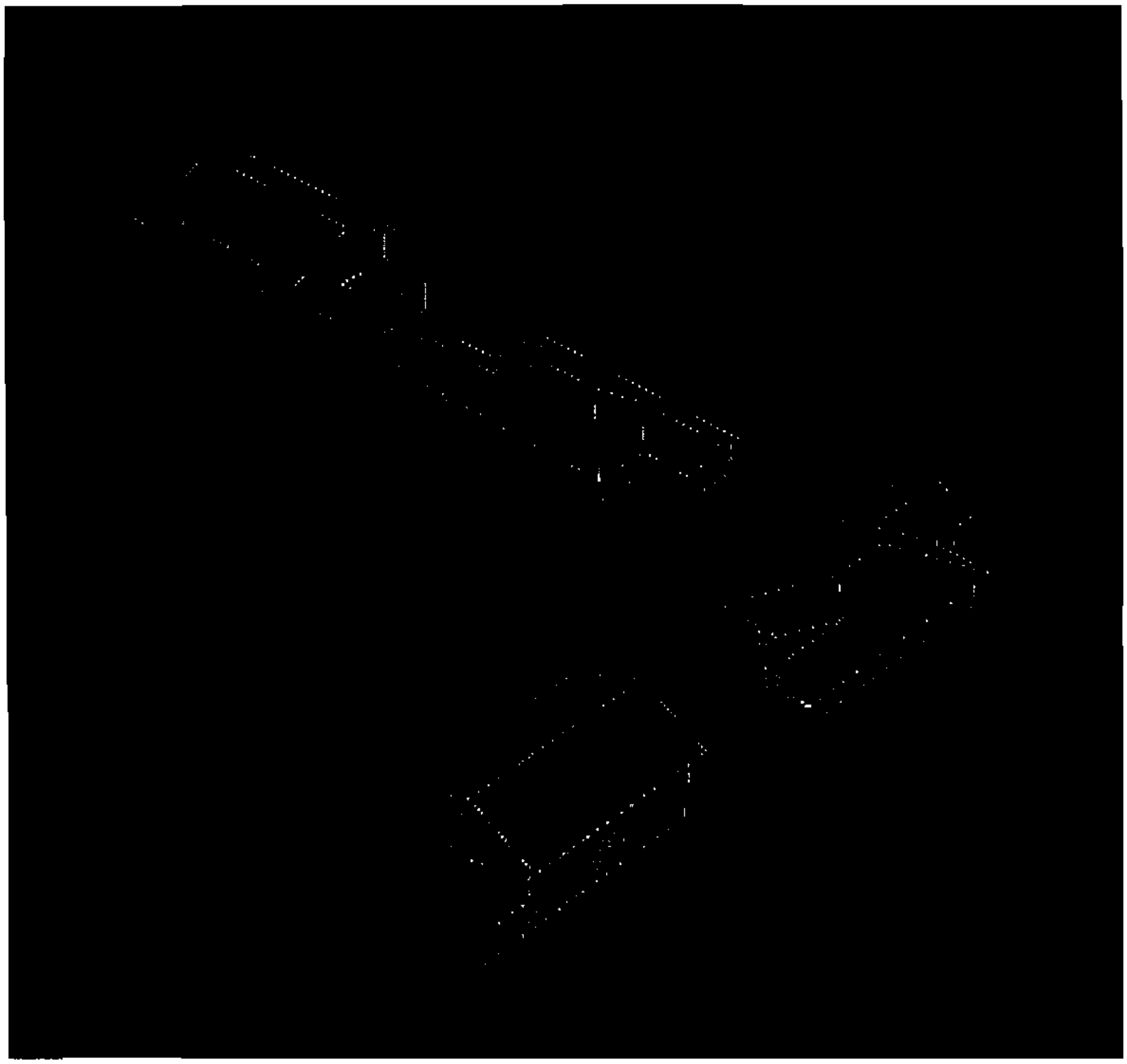
Analysis used to develop parameters for the energy and demand savings calculations are based on DOE-2.2 simulations of a set of prototypical residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER)[16] study, with adjustments make for local building practices and climate. The prototype "model" in fact contains 4 separate residential buildings; 2 one-story and 2 two-story buildings. Each version of the 1 story and 2 story buildings are identical except for the orientation, which is shifted by 90 degrees. The selection of these 4 buildings is designed to give a reasonable average response of buildings of different design and orientation to the impact of energy efficiency measures.

Three separate models were created to represent general vintages of buildings:

4. Old, poorly insulated building constructed in the 1950s or earlier. This vintage is referred to as the "old" vintage
5. Existing, average insulated building conforming to 1980s era building codes. This vintage is referred to as the "average" vintage.
6. New construction conforming to the NY State energy standards for residential buildings. This vintage is referred to as the "new" vintage.

A sketch of the residential prototype buildings is shown below.

[16] 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report, Itron, Inc. Vancouver, WA. December, 2005. Available at http://www.calmac.org/publications/2004-05_DEER_Update_Final_Report-Wo.pdf



Computer rendering of residential building prototypical DOE-2 model.

The general characteristics of the residential building prototype model are summarized below:

Residential Building Prototype Description

Characteristic	Value
Vintage	Three vintages simulated – old poorly insulated buildings, existing average insulated buildings and new buildings
Conditioned floor area	1 story house: 1465 SF (not including basement) 2 story house: 2930 SF (not including basement)
Wall construction and R-value	Wood frame with siding, R-value varies by vintage
Roof construction and R-value	Wood frame with asphalt shingles, R-value varies by vintage
Glazing type	Average of single and double pane; properties vary by vintage

Table 3. Window Property Assumptions by Vintage

Vintage	U-value (Btu/hr-F-SF)	SHGC	Notes
Older, poorly insulated	0.93	0.87	Single pane clear
Existing, average insulation	0.68	0.77	Double pane clear
New construction	0.28	.49	Double low e per code

Infiltration

Infiltration rate assumptions were set by vintage as shown in Table 4.

Table 4. Infiltration Rate Assumptions by Vintage

Vintage	Assumed infiltration rate	Notes
Older, poorly insulated	1 ACH	
Existing, average insulation	0.5 ACH	
New construction	0.35 ACH	Minimum without forced ventilation per ASHRAE Standard 66.

Small Retail

A prototypical building energy simulation model for a small retail building was developed using the DOE-2.2 building energy simulation program. The characteristics of the small retail building prototype are summarized in Table 5.

Full-Service Restaurant

A prototypical building energy simulation model for a full-service restaurant was developed using the DOE-2.2 building energy simulation program. The characteristics of the full service restaurant prototype are summarized in Table 6.

Table 6. Full Service Restaurant Prototype Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	2000 square foot dining area 600 square foot entry/reception area 1200 square foot kitchen 200 square foot restrooms
Number of floors	1
Wall construction and R-value	Concrete block with brick veneer, R-5
Roof construction and R-value	Wood frame with built-up roof, R-12
Glazing type	Single pane clear
Lighting power density	Dining area: 1.7 W/SF Entry area: 2.5 W/SF Kitchen: 4.3 W/SF Restrooms: 1.0 W/SF
Plug load density	Dining area: 0.6 W/SF Entry area: 0.6 W/SF Kitchen: 3.1 W/SF Restrooms: 0.2 W/SF
Operating hours	9am – 12am
HVAC system type	Packaged single zone, no economizer
HVAC system size	140 – 160 SF/ton depending on climate
Thermostat setpoints	Occupied hours: 77 cooling, 72 heating Unoccupied hours: 82 cooling, 67 heating

A computer-generated sketch of the full-service restaurant prototype is shown in Figure 2.

Table 7. Small Office Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	10,000 square feet
Number of floors	2
Wall construction and R-value	Wood frame with brick veneer, R-5
Roof construction and R-value	Wood frame with built-up roof, R-12
Glazing type	Single pane clear
Lighting power density	Perimeter offices: 2.2 W/SF Core offices: 1.5 W/SF
Plug load density	Perimeter offices: 1.6 W/SF Core offices: 0.7 W/SF
Operating hours	Mon-Sat: 9am – 6pm Sun: Unoccupied
HVAC system type	Packaged single zone, no economizer
HVAC system size	230 - 245 SF/ton depending on climate
Thermostat setpoints	Occupied hours: 76 cooling, 72 heating Unoccupied hours: 81 cooling, 67 heating

A computer-generated sketch of the small office prototype is shown in Figure 3.

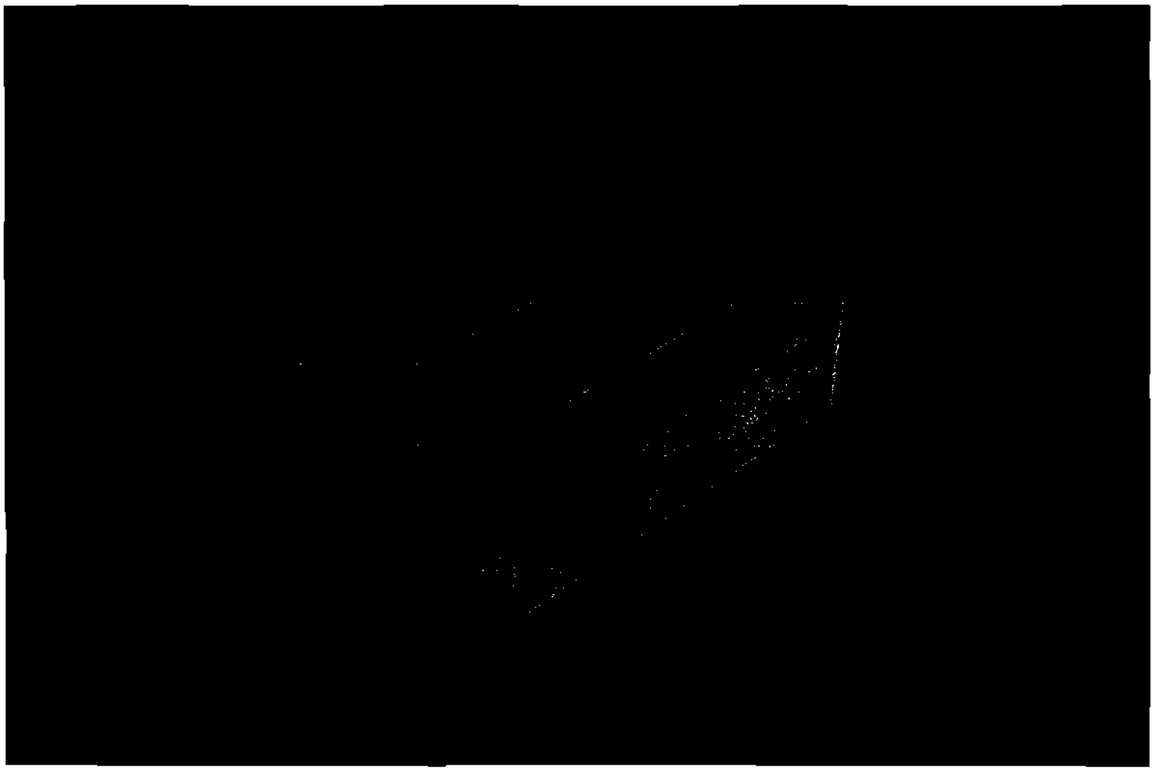


Figure 3. Small Office Prototype Building Rendering

Big Box Retail

A prototypical building energy simulation model for a big box retail building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in Table 9.

Table 9. Big Box Retail Prototype Building Description

Characteristic	**Value**
Vintage	Existing (1970s) vintage
Size	130,500 square feet Sales: 107,339 SF Storage: 11,870 SF Office: 4,683 SF Auto repair: 5,151 SF Kitchen: 1,459 SF
Number of floors	1
Wall construction and R-value	Concrete block with insulation, R-5
Roof construction and R-value	Metal frame with built-up roof, R-12
Glazing type	Single pane clear
Lighting power density	Sales: 3.36 W/SF Storage: 0.88 W/SF Office: 2.2 W/SF Auto repair: 2.15 W/SF Kitchen: 4.3 W/SF
Plug load density	Sales: 1.15 W/SF Storage: 0.23 W/SF Office: 1.73 W/SF Auto repair: 1.15 W/SF Kitchen: 3.23 W/SF
Operating hours	Mon-Sun: 10am – 9pm
HVAC system type	Packaged single zone, no economizer
HVAC system size	230 - 260 SF/ton depending on climate
Thermostat setpoints	Occupied hours: 76 cooling, 72 heating Unoccupied hours: 81 cooling, 67 heating

A computer-generated sketch of the prototype is shown in Figure 5.

Table 10. Fast Food Restaurant Prototype Building Description

Characteristic	**Value**
Vintage	Existing (1970s) vintage
Size	2000 square feet 1000 SF dining 600 SF entry/lobby 300 SF kitchen 100 SF restroom
Number of floors	1
Wall construction and R-value	Concrete block with brick veneer, R-5
Roof construction and R-value	Concrete deck with built-up roof, R-12
Glazing type	Single pane clear
Lighting power density	1.7 W/SF dining 2.5 W/SF entry/lobby 4.3 W/SF kitchen 1.0 W/SF restroom
Plug load density	0.6 W/SF dining 0.6 W/SF entry/lobby 4.3 W/SF kitchen 0.2 W/SF restroom
Operating hours	Mon-Sun: 6am – 11pm
HVAC system type	Packaged single zone, no economizer
HVAC system size	100 – 120 SF/ton depending on climate
Thermostat setpoints	Occupied hours: 77 cooling, 72 heating Unoccupied hours: 82 cooling, 67 heating

A computer-generated sketch of the prototype is shown in Figure 6.

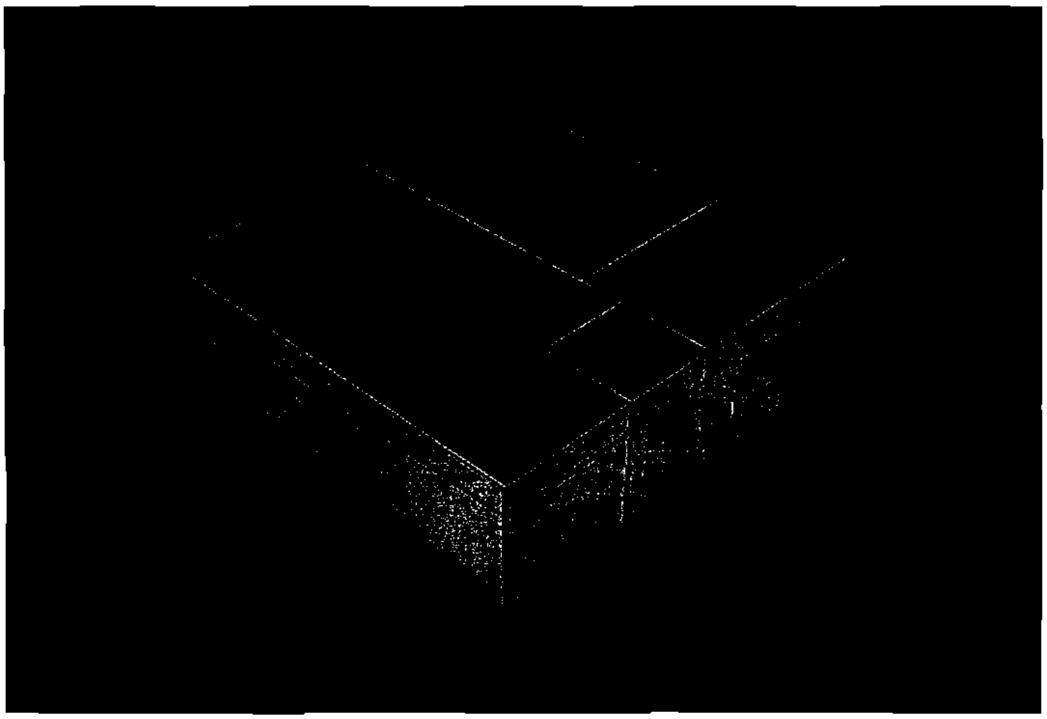


Figure 6. Fast Food Restaurant Building Rendering

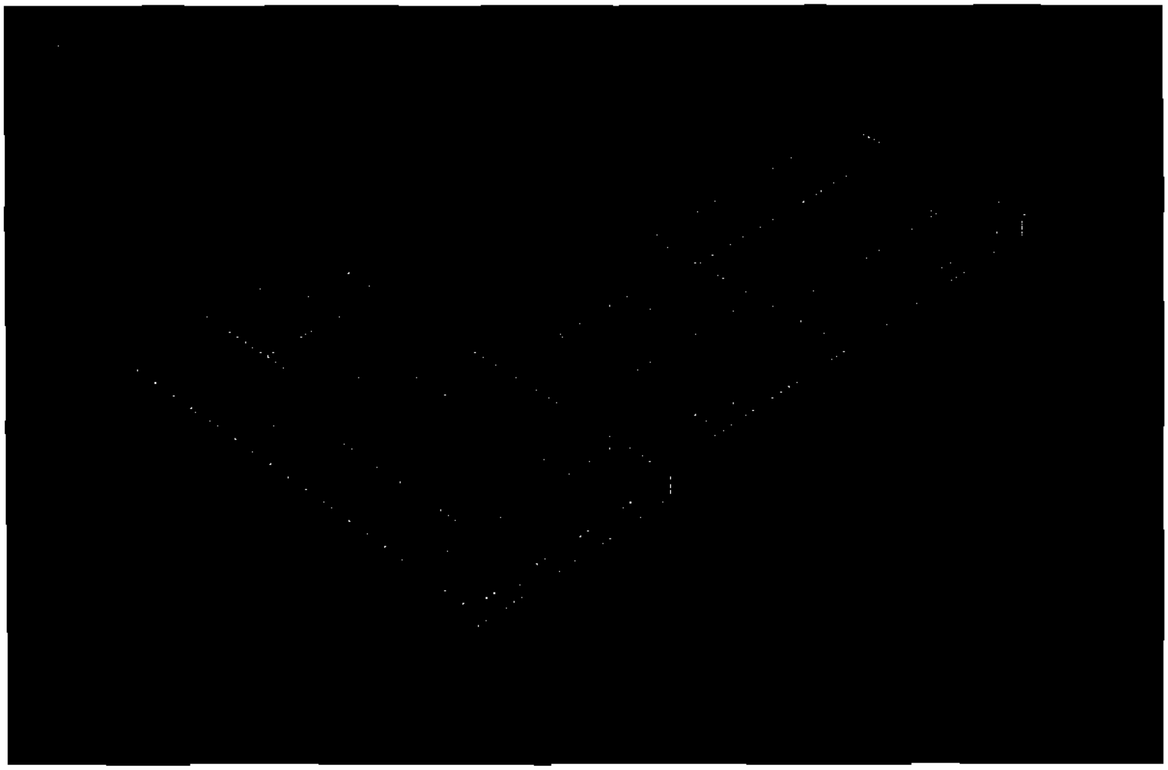


Figure 7. School Building Rendering

Assembly

A prototypical building energy simulation model for an assembly building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in Table 12.

Table 12. Assembly Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	34,000 square feet Auditorium: 33,240 SF Office: 760 SF
Number of floors	1
Wall construction and R-value	Concrete block, R-5
Roof construction and R-value	Wood frame with built-up roof, R-12
Glazing type	Single pane clear
Lighting power density	Auditorium: 3.4 W/SF Office: 2.2 W/SF
Plug load density	Auditorium: 1.2 W/SF Office: 1.7 W/SF
Operating hours	Mon-Sun: 8am – 9pm
HVAC system type	Packaged single zone, no economizer
HVAC system size	100 - 110 SF/ton depending on climate
Thermostat setpoints	Occupied hours: 76 cooling, 72 heating Unoccupied hours: 81 cooling, 67 heating

Characteristic	Value
	50°F prep area: 4.3 W/SF 35°F walk-in cooler: 0.9 W/SF - 5°F walk-in freezer: 0.9 W/SF
Equipment power density	Sales: 1.15 W/SF Office: 1.73 W/SF Storage: 0.23 W/SF 50°F prep area: 0.23 W/SF + 36 kBtu/hr process load 35°F walk-in cooler: 0.23 W/SF + 17 kBtu/hr process load - 5°F walk-in freezer: 0.23 W/SF+ 29 kBtu/hr process load
Operating hours	Mon-Sun: 6am – 10pm
HVAC system type	Packaged single zone, no economizer
Refrigeration system type	Air cooled multiplex
Refrigeration system size	Low temperature (-20°F suction temp): 23 compressor ton Medium temperature (18°F suction temp): 45 compressor ton
Refrigeration condenser size	Low temperature: 535 kBtu/hr THR Medium temperature: 756 kBtu/hr THR
Thermostat setpoints	Occupied hours: 74°F cooling, 70°F heating Unoccupied hours: 79°F cooling, 65°F heating

A computer-generated sketch of the prototype is shown in Figure 9.

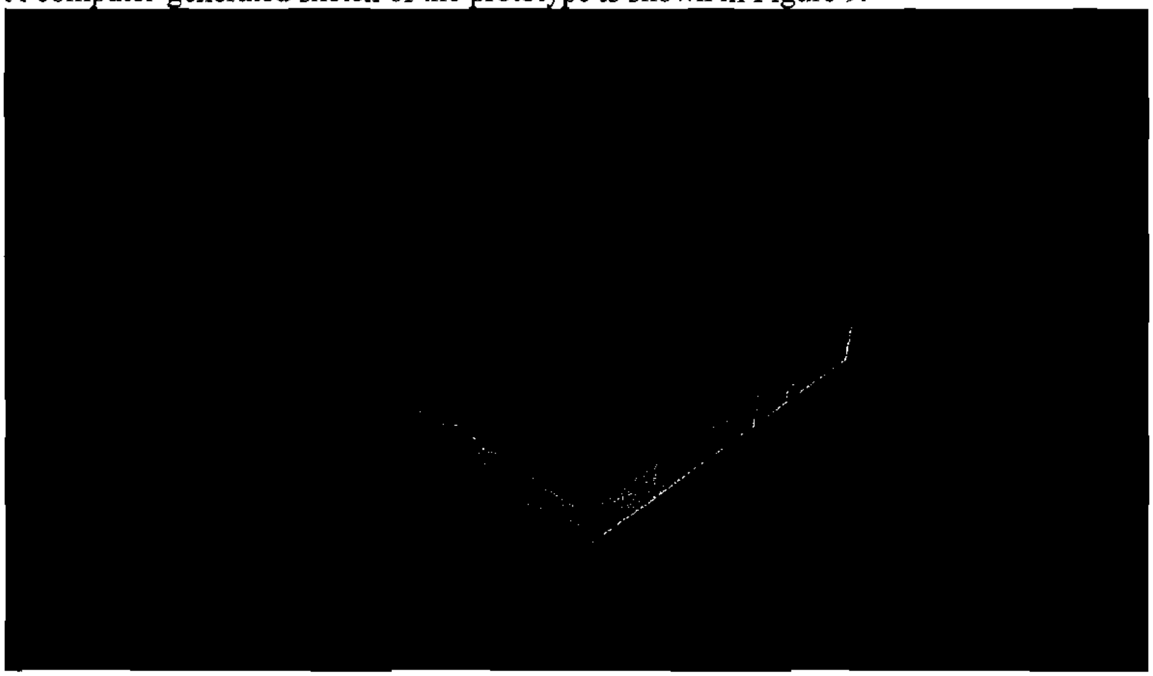


Figure 9. Grocery Building Rendering