



Assessment of DEER Grocery Model

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February 2011



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1. Executive Summary

The Database for Energy Efficiency Resources (DEER), developed with direction from the California Energy Commission and California Public Utilities Commission (CPUC), provides kWh, kW and therm savings estimates for select energy efficient technologies and measures. Following the 2004-2005 update of the database, the CPUC designated DEER as the source of *ex ante* energy savings values for measures addressed by the database.

The EnergySmart Grocer program, which PECEI has operated in California since 2002, is one of many California energy efficiency programs required to use DEER values in its program operations. In implementing the EnergySmart Grocer program for its utility clients, PECEI noted that many of the DEER energy savings values varied considerably from PECEI's site-specific calculations and from *ex ante* values approved for use in other regions.

In order to investigate these variances, PECEI analyzed its database of 4,368 store audits of existing buildings conducted by PECEI field staff across California since 2002. Additional market details not captured in the database were obtained by reviewing refrigeration schedules, measurement and verification (M&V) data and industry literature. Conversations with PECEI field staff and engineers, as well as with refrigeration contractors and technicians, provided additional market descriptors. This perspective is not meant to be exhaustive, but rather it reflects PECEI's real-world experience with grocery stores in California and general knowledge of the industry, and should be considered illustrative rather than statistically significant.

PECEI has reviewed the CPUC's 2010-2012 *Energy Efficiency Evaluation, Measurement and Verification Work Plan (Work Plan)*, Version 1, dated December 10, 2010 and participated in the public workshop held on January 14, 2011 to discuss the plan. PECEI hopes that the information included in this memorandum will provide sufficient indication that the current DEER grocery assumptions will need to be revised as part of this effort. As discussed in more detail below, PECEI has extensive experience, expertise and data on California grocery store characteristics. If deemed appropriate by the CPUC, PECEI would like to provide assistance through the Technology Workgroup meetings and/or other means.

1.1 Results

The availability of DEER as a standard resource is a tremendous asset for energy efficiency programs in California. PECEI's analysis validated many of the assumptions underlying the DEER 2005 model.

However, significant problems were found with the DEER 2005 grocery model assumptions. At its core, the most problematic assumption is that DEER 2005 uses a single "typical" grocery store of 50,000 square feet to derive refrigeration energy savings for all stores. PECEI's experience indicates that store characteristics such as refrigeration system design, refrigeration loads, operating schedules and HVAC systems vary significantly among store sizes. For instance, DEER assumes multiplex compressors as a base case for almost all measures. Yet data from PECEI's GrocerSmart™ auditing and energy simulation software tool¹ indicates that only 55% of grocery stores and only 2% of convenience stores had a multiplex unit. Although multiplex compressors may be a good assumption for larger supermarkets, this assumption is not supported by data for smaller stores. This finding alone supports the need for store segments that reflect the thresholds at which systems tend to change. PECEI's analysis indicates that three store segments would be appropriate: convenience store (<5,000 sq. ft.), grocery store (5,000–34,999 sq. ft.) and supermarket (≥ 35,000 sq. ft.).

¹ The GrocerSmart™ auditing and energy simulation software tool supports PECEI's California rate payer funded energy efficiency programs by enabling audits of the major electromechanical and mechanical systems of commercial retail refrigeration equipped facilities.

PECI's analysis further revealed other potential issues with the DEER 2005 grocery model assumptions, even for stores that are similar in size to the DEER model. For example, DEER assumes that 70% of display case evaporator motors have a rated output in the range of 9 watts. However, PEGI examined rebate data for almost 3,900 motors in supermarkets (stores similar in size to the DEER model) and found that the **dominant motor size ranges from 16 to 37 watts**. This discrepancy is significant enough to potentially impact *ex ante* energy savings from motor retrofits.

To further understand the magnitude of potential savings differences, PEGI used data inputs from its analysis to develop an eQUEST supermarket model of $\geq 35,000$ sq. ft. This model corresponds with the store segmentation size that most closely matches the DEER grocery store model of 50,000 sq. ft. To provide points of comparison between DEER 2005 and PEGI's supermarket model, five of the most commonly rebated refrigeration measures were selected and resultant kWh savings were calculated and compared to the *ex ante* savings values recorded in DEER 2005 for the same measures in an equivalent vintage. Four of the five measures demonstrated higher kWh savings in the PEGI supermarket model than in DEER, and estimates **showed an approximate 50% increase across all measures in *ex ante* kWh savings** using PEGI's supermarket model vs. the DEER model.

1.2 The 2005 DEER Grocery Model

The Energy Efficiency Policy Manual adopted by the CPUC in July 2008 requires that the IOU *ex ante* load impact and program cost-effectiveness calculations be based on the energy savings and costs outlined in the most up-to-date version of DEER for measures represented in the database.² However, several key points in the *2004-2005 DEER Update Study Final Report*³ deserve consideration.

For example, the report recommends that comprehensive DEER updates be carried out at least every three years. However, the study goes on to say: "Given the number of outstanding issues in the current DEER, the next comprehensive update should be completed before the end of 2007. In addition, interim DEER updates should be enabled and carried out more frequently (e.g., every 6 months or year)."⁴

DEER has not been comprehensively and regularly updated as planned, and using it as a source for claiming energy savings in a constantly changing industry is problematic. The *Summary of 2008 DEER Measure Energy Analysis Revisions*⁵ further indicated that grocery store-specific refrigeration measures were under development as of August 2008 and would be released for comment within several weeks of the report's release. Two years have elapsed without a public release or comment related to these measures.

The December 2005 *Update Study Final Report* also highlights the issue of DEER 2005's "typical" and singular store model used to calculate energy savings for all grocery market segments:

Future DEER projects should provide flexibility by offering segmented results *if differences in savings by market segment are defensible* (both in terms of savings estimation and marketing and program participation requirements) and *well documented*. Where segmented results are presented, efforts should be made to include statistically reliable population weights to indicate what fraction of the market is represented by each

² California Public Utility Commission. *Energy Efficiency Policy Manual, Version 4.0* July 2008, 12 & 24.

³ Itron, Inc. 2004-2005 DEER Update Study Final Report. December 2005.

http://www.deeresources.com/deer2005/downloads/DEER2005UpdateFinalReport_ItronVersion.pdf

⁴ 2004-2005 DEER Update Study Final Report, ES-4.

⁵ *Summary of 2008 DEER Measure Energy Analysis Revisions*.

<http://www.deeresources.com/deer2008exante/downloads/DEER2008UPDATE-EnergyAnalysisMethodsChangeSummaryV4.pdf>, p 31 section F

of the segments and provide a default weighted average result to allow users to obtain average impacts across segments if so desired. [Emphasis in original.]⁶

These recommendations alone warrant a re-examination of DEER 2005 as a source for prescriptive grocery energy efficiency program measure savings.

1.3 Recommendations

While PECEI has access to large data sets, the data were not gathered nor analyzed as part of a comprehensive study. This document presents a body of evidence, rooted in real-life data and in-field experience, to support the observation that the 2005 DEER grocery model is not representative of the existing grocery building stock.

In light of the recommendations from the December 2005 *Update Study Final Report* and these findings that *ex ante* energy savings currently being claimed by energy efficiency programs may be substantially impacted by issues with current model assumptions, PECEI urges the CPUC to take the following steps:

1. Prioritize updating grocery refrigeration measures and include these measures in currently ongoing efforts to review DEER as part of the 2010-2012 EM&V Work Plan.
2. Consider segmenting the DEER model for the grocery sector into three distinct models (convenience, grocery and supermarket).
3. Fund a thorough market characterization study to inform updated *ex ante* savings and determine the appropriate segmentation of the grocery market that more closely reflects the existing building stock.

PECEI would be pleased to review and advise the work of the CPUC in this effort to support more accurate *ex ante* kWh, kW and therm savings values for grocery measures addressed in DEER.

⁶ 2004-2005 DEER Update Study Final Report, ES-5.

2. Introduction

Since 2002, PECI has operated grocery refrigeration-oriented energy efficiency programs in California. Funded by the California Public Utilities Commission (CPUC) and California Investor Owned Utilities (IOUs), the programs provide energy efficient retrofit recommendations to grocers, facilitate IOU rebates for a broad range of energy efficiency measures, and calculate energy savings for the majority of installed measures. The programs rely on DEER as the source of *ex ante* energy savings values for measures addressed by the database.

Audits are a major component of these energy efficient programs. Members of the field staff at PECI conduct reviews of facility refrigeration systems using the GrocerSmart™ tool. On average, 150 equipment and operational data points are collected during convenience store audits and more than 1,000 data points are collected in supermarket audits.

In implementing these energy efficient programs for its utility clients, PECI noted that many of the DEER energy savings values varied considerably from PECI's site-specific calculations and from *ex ante* values approved for use in other regions.

2.1 Background and Scope

In order to investigate these variations, PECI analyzed data from 4,368 California store audits conducted from 2002 to 2010 in the course of PECI's energy efficiency programs. The data analysis focused on equipment and operational characteristics for three store segments: convenience (<5,000 sq. ft.), grocery (5,000-34,999 sq. ft.) and supermarket (≥35,000 sq. ft.) In practice there is no specific demarcation between store segments. These values were chosen as representative of the general boundary where store characteristics change markedly as indicated by the data.

Reviews of refrigeration schedules, measurement and verification (M&V) data and industry literature, as well as observations from PECI's engineers, field staff, refrigeration contractors and technicians supplemented commercial refrigeration system details not captured in the GrocerSmart™ tool.

The analysis focused on four key elements influencing savings estimates: refrigeration system design, refrigeration load, scheduling and HVAC. Actual store characteristics were compared between GrocerSmart™ audit data and the assumed store characteristics of the DEER 2005 model. Results of this analysis are presented in Section 3 of this report.

To further understand the magnitude of potential savings differences, PECI constructed a sample supermarket model (≥35,000 sq. ft.) using data inputs from its analysis. This model corresponds with the store segmentation size in the GrocerSmart™ tool that most closely matches the DEER grocery store model of 50,000 sq. ft. To provide points of comparison between DEER 2005 and PECI's supermarket model, five commonly rebated prescriptive DEER refrigeration measures were selected. Resultant savings were calculated and compared to the *ex ante* savings values recorded in DEER 2005 for the same measures in a comparable vintage. These findings are presented in Section 4 of this report.

3. Findings from PECE Assessment of the DEER 2005 Model

PECE's analysis validated many of the assumptions underlying the DEER 2005 model. However, this analysis indicates that a key shortcoming of DEER 2005 is its application of one "typical" store to derive grocery refrigeration energy savings for all stores. PECE's analysis of 4,368 stores found that characteristics such as refrigeration system design, refrigeration loads, operating schedules and HVAC systems vary significantly among three store segments: convenience (<5,000 sq. ft.), grocery (5,000-34,999 sq. ft.) and supermarket (\geq 35,000 sq. ft.). This issue is the foundation for much of the discussion that follows.

3.1 Refrigeration System Design

Refrigeration system design is an important consideration in calculating energy efficiency. It impacts compressor capacity control, compressor cycling, refrigeration compression ratios, condenser fan energy and HVAC loads. Incorrect assumptions about refrigeration system design could affect overall system efficiency, resulting in different energy efficiency measure savings for refrigeration measures.

PECE's analysis of GrocerSmart™ audit data and other sources showed marked variances in refrigeration system designs across the three store segments (convenience, grocery and supermarket), as well as significant differences between supermarket characteristics based on actual audit data and those in DEER 2005.

3.1.1 Compressor System Type

DEER 2005 assumes multiplex compressors as a base case for almost all measures. There are considerable differences between multiplex systems and less efficient condensers (single compressor units), the simplest being that the lower efficiency of single compressor systems improves the actual energy savings possible from many measures.

Each system has unique controls and configurations that could affect the system Energy Efficiency Ratio (EER) and resulting energy savings for many energy efficiency measures. For example, the multiplex system typically uses sophisticated, electronic, staged capacity controls; few single compressor systems have this advantage.

An analysis of GrocerSmart™ audit data from 863 grocery stores (3,680 compressors) and 265 convenience stores (485 compressors) showed that although multiplex compressors may be a good assumption for supermarkets, only 55% of grocery stores and 2% of convenience stores had a multiplex system (single compressor units were common systems in convenience stores).

Further, GrocerSmart™ audit data found that approximately 19% of compressors in refrigeration systems in convenience stores were single compressor systems with integral condensers and evaporators. These integral systems reject heat to the conditional sales area, which is then conditioned by their respective HVAC systems, and differ considerably from multiplex systems used in supermarkets.

A potential implication of these differences is understating the energy savings for the non-refrigeration system Energy Efficient Measures (EEMs), such as case lights, due to the refrigeration system efficiency being lower than predicted in the majority of the stores. Another potential implication is overstating energy savings for some refrigeration system EEMs, such as floating head pressure, because of the differences in controls and operation between the multiplex and single compressor systems

3.1.2 Mechanical Subcooling

DEER 2005 includes a low temperature (LT) mechanical subcooling system as the base case in many of the newer vintage stores. The LT subcooling system makes the refrigeration system more efficient (higher

EER) which affects the energy savings predictions for all refrigeration measures. Observations from refrigeration technicians, contractors and program field staff indicated that while subcooling could be included in the supermarket base case for vintages newer than 2002, supermarkets built before 2002 should not include mechanical subcooling as the base case and the majority of multiplex systems in existing grocery stores do not have subcooling. Sales information provided on a confidential basis from a major commercial refrigeration equipment manufacturer substantiates this: only 26% of their systems sold in California from December 1999 to June 2009 had subcooling.

In addition, single compressor systems do not integrate mechanical subcooling; therefore, subcooling should not be a base case assumption for grocery stores or convenience stores of any vintage, nor for the EEM single compressor system to multiplex system for either the customer or the code base case models. Systems with mechanical subcooling have higher refrigeration system efficiency; therefore, assuming mechanical subcooling artificially lowers energy savings for most EEMs.

3.1.3 Compressor Groups

One LT compressor group and one medium temperature (MT) group is assumed in DEER 2005. Refrigeration schedule reviews and surveys of PECE field staff indicate that supermarkets and grocery stores typically have more than one suction group per temperature (LT and MT). Supermarkets typically have two LT groups and three MT groups; grocery stores with multiplex systems typically have one LT group and two MT groups. With a more accurate number of suction groups, the saturated suction temperature of the cases can be better matched to that of the compressor groups. This results in improved compressor baseline efficiency. Improvement of the DEER model values here may decrease reported savings, but improve overall accuracy.

3.1.4 Compressor Sizing

The compressor size greatly affects calculated energy saving for refrigeration measures. Analysis of refrigeration schedules and discussions with refrigeration system designers show that the compressor is typically sized to have a heat rejection capacity equal to 1.2 times the evaporator load (also known as a "compressor sizing factor" of 1.2). Within DEER 2005, the compressor sizing factor is higher and can reach 1.6. This results in excessive oversizing of the compressors relative to the evaporator load and may artificially increase the calculated energy consumption, which could inflate or deflate calculated measure savings depending on the measure.

3.1.5 Condenser Capacity

In DEER 2005, condenser efficiency is appropriately varied by vintage and different capacities are used for air-cooled condensers and evaporative-cooled condensers. However, condenser capacity is not varied by climate zone. When refrigeration systems are designed, total heat rejected as well as the design temperature for the local climate are taken into account when sizing condensers. Larger condensers can improve overall efficiency and change the base case values for measures.

Condenser capacity has an appreciable impact on system efficiency. Improvements in condenser capacity in the DEER model will reduce energy savings in some climate zones and increase energy savings in other climate zones, with the largest impact being on EEMs that improve the efficiency or size of the air-cooled condensers.

3.2 Refrigeration Load

The refrigeration load is another important energy efficiency consideration. In general, the more heat a refrigeration system must remove, the more work the refrigeration system must perform. This section will address three areas of concern relative to refrigeration loads.

3.2.1 Display Cases

The display cases modeled in DEER do not match the configuration found in typical stores. Analysis of GrocerSmart™ data from 353 stores (1,904 display cases) found that 28% of refrigerated cases in convenience stores had a self-contained compressor, condenser and evaporator (integral unit). These cases should be modeled as plug-and-process load with heat rejected to the HVAC system, rather than as refrigeration system load.

The relative mix of LT and MT cases is another important assumption for prescriptive measures that use this weighting of LT and MT load system energy efficiency calculations. (If the prescriptive measures have separate savings for LT and MT cases, the model is not as important.) Differences between case temperatures in DEER 2005 values and GrocerSmart™ audit data are listed in Table 1.

The relative mix of open cases and cases with doors is also important, as this mix has different effects on refrigeration and HVAC loads. Case data from 430 large grocery stores ($\geq 35,000$ ft²) with 334,200 feet of case was evaluated to arrive at a percentage of open and closed cases. DEER 2005 values and results from the GrocerSmart™ audit data analysis are provided in Table 2. As with many of the examples above, the table indicates a significant difference between the values used by DEER 2005 and the results from PECEI's analysis.

Table 1. Display Case Results – LT/MT Mix

	DEER 2005	PECEI Supermarkets
% LT feet of case	51%	35%
% MT feet of case	49%	65%

Table 2. Display Case Results – Open/Closed Mix

	DEER 2005	PECEI Supermarkets
% feet of open cases	81%	68%
% feet of closed cases	19%	32%

3.2.2 Display Case Evaporator Motors

Display case evaporator fan motor power impacts *ex ante* energy savings for motor retrofits. DEER 2005 assumes that 70% of installed motors have a rated output in the range of 9 watts. PECEI analyzed invoice data from 92 retrofit projects in California supermarkets (3,878 motors) to determine installed motor output power and the frequency of installation in display cases. This analysis indicates that the dominant motor sizes found in supermarkets ranged from 16 watts to 37 watts. Table 3 shows the spread of motor sizes for both DEER 2005 and the PECEI analysis. Only results for display case evaporator fan motors are shown; however, the variance in motor sizes also applies to walk-in evaporator fan motors.

Table 3. Display Case Evaporator Fan Motor Output Power Results

	DEER 2005	PECEI Supermarkets
7-12 watts (represented by 9W)	70%	10%
16-23 watts (represented by 19.5W)	27%	50%
1/20 HP (37W)	3%	40%

Motor efficiency is another factor to consider when calculating energy savings. Reviews of manufacturer data and industry literature suggest that electronically commutated motors have an efficiency of approximately 65-80%,⁷ whereas DEER 2005 uses 58%. This difference is significant enough to warrant a reevaluation of this value in the DEER model.

3.2.3 Refrigeration Load of Walk-in Coolers and Freezers

Walk-in cooler and freezer refrigeration loads account for a substantial portion of a typical refrigeration system's total load. The number and size of walk-ins, as well as their temperature set points, are large contributors to these design loads. Walk-in height is also important, as it directly affects the total surface area where heat is transferred, as well as the total volume of refrigerated space that must be cooled.

PECI analyzed data from 442 large grocery stores (3,827 cooler/freezers) and interviewed experienced field energy analysts to determine basic characteristics of walk-in coolers and freezers in supermarkets. (The approximate height and location of walk-ins was determined through five interviews; the other data in Table 4 comes from analysis of GrocerSmart™ data.) Table 4 shows significant differences between DEER 2005 walk-in assumptions and supermarket characteristics noted in the GrocerSmart™ tool.

Table 4. Walk-in Cooler and Freezer Results

	DEER 2005	PECI supermarkets	Affect on refrig. load
Number of walk-ins	3	8	PECI higher
Size of walk-ins	Range of 813 ft ² to 1560 ft ²	437 ft ² (avg)	DEER higher
Number of walk-in reach-ins	0	1	PECI higher
Size of walk-in reach ins	n/a	657 ft ² (avg)	PECI higher
Height of walk-ins	25 ft	8-12 ft	DEER higher
Percent of LT Walk-ins	33%	25%	--
Percent of MT Walk-ins	66%	75%	--
Lowest Suction Temp	-9 °F	-20 °F	PECI higher
Walls adjacent to	Outside/sales floor	Unconditioned storage/sales floor	DEER higher

As can be seen in Table 4, the DEER 2005 model assumes walk-in heights that are twice as high as can be expected in the market, and assumptions regarding walk-in total load are different than what is found in actual walk-ins. Adjusting any one of these values would result in an increase or decrease in calculated measure savings, depending on the value adjusted.

3.3 Scheduling

Schedules impact the amount of time the equipment is operating and therefore are of primary importance in calculating *ex ante* energy savings.

⁷ Wellington, Energy Saving ECM Motors for Commercial Refrigeration, Product Catalog, WT6704, January, 2010.

Nailor Industries, Inc., The ECM Motor Story, product description

GE ECM by Regal-Beloit 2.3, product description, <http://www.gerbc.com/geecm23.html>

DEER 2005 assumes 16 hours for occupancy and lights for all grocery stores. PECE analyzed GrocerSmart™ audit data from 497 convenience stores, 840 grocery stores and 485 supermarkets and found that occupancy hours vary significantly by store segment. The median value for daily store “open” hours for supermarkets is 18; for grocery and convenience stores it is 14.

This is a sensitive variable; applying the same occupancy hours across all store segments could have a significant impact on *ex ante* energy savings—reducing reported savings in some instances and increasing reported savings in others. For example, night covers, an infiltration reduction measure for open refrigerated display cases, are typically used one-to-three fewer hours than the hours the store is closed. Thus, accurate store operating hours are particularly important for measures like night covers.

As another example, GrocerSmart™ audit data was analyzed from 76 stores that received rebates for LED lights in reach-in cases (affecting 4,737 feet of case). The data revealed that 34% of feet of reach-in cases had lights that operated fewer than 24 hours per day. DEER 2005 assumes that case lights are on 24 hours per day. This inflates calculated energy consumption and refrigeration load, which impacts calculated base case consumption and proposed case consumption and the resulting savings estimates.

3.4 HVAC

HVAC systems consume appreciable amounts of energy. The amount of outside air drawn in by these systems influences their energy consumption. Two parameters related to outside air warrant consideration here—the design requirement for outside air volume and the use of economizers.

The design requirement for outside air volume is driven by the design condition for people density. The assumption used in DEER 2005 is considerably higher than that used by other sources and results in higher predicted energy consumption. The impact on energy savings calculations will vary depending on the EEM. Table 5 shows the range of values and raises the question of the appropriateness of the DEER 2005 value.

Table 5. Design Requirements for People Density

	Occupancy Density (people/1000ft ²)
DEER 2005	22
NREL ⁸	8
ASHRAE ⁹	8

Economizers have the potential to reduce air conditioning energy consumption by taking advantage of cool outside air. Economizers have been required in new construction in California since 1978 under Title 24; however, this requirement exempts HVAC systems that interface with grocery store refrigeration (i.e., grocery sales floor HVAC).¹⁰ The DEER 2005 model assumes a 100% operable HVAC economizer in all grocery store vintages after 1978. However, multiple studies have shown that only 30-36% of installed economizers are actually operable and properly adjusted.¹¹ Therefore, DEER 2005 under-predicts the associated energy consumption for vintages with economizers (1978-current).

⁸ E.T. Hale et al. *Development of the Advanced Energy Design Guide for Grocery Store—50% Energy Savings*. (National Renewable Energy Laboratory: September 2008), NREL/TP-550-42829.

⁹ ASHRAE Standard 62 as reported by NREL/TP-550-42829.

¹⁰ 1978 CEC Building Energy Standards, section T20-1503.2b exception 2008 CEC Title 24, section 144.e.1. exception 2.

¹¹ Alan Cowan, New Buildings Institute, Review of Recent Commercial Roof Top Unit Field Studies in the Pacific Northwest and California, October 8, 2004, Prepared for Northwest Power and Conservation Council and Regional Technical Forum.

4. Results from Comparative Model Runs

In order to understand the potential implications of the model variations described above, PECl used results from its analysis to develop eQUEST models that represent supermarkets built between 1978 and 1992. The PECl models addressed the different California climate zones in the same manner as the DEER 2005 Vintage 85 (1978-1992) model.

Five prescriptive DEER refrigeration measures were analyzed using the PECl models. These measures were commonly rebated across climate zones within PECl's California grocery programs between 2006 and 2008. California programs reported DEER 2005 kWh *ex ante* energy savings values for these rebates to investor owned utilities, which, in turn, claimed these savings to the CPUC.

An average *ex ante* energy savings value was calculated for all climate zones by weighting the proportion of rebates PECl processed in each climate zone for each of the five measures. Resulting kWh savings/unit for each measure was then compared to DEER 2005 *ex ante* energy savings (see Table 6). The analysis indicates that the model variations discussed in Section 3 could have a considerable impact on energy savings calculations. The following table displays the energy savings values on a per unit basis for the DEER 2005 and PECl modeled approaches. Of the five measures analyzed, calculated savings varied up to 344%.

Table 6. DEER and PECl Model Savings Comparisons

MEASURE	DEER 2005 ID	UNIT	DEER 2005 kWh Savings / Unit	PECl SMKT kWh Savings / Unit	Difference
Efficient condenser for evaporatively cooled multiplex	D03-213	TONS	1,917	1,719	-10%
Evaporator coil motors—for refrigerated display case—shaded pole to electronically commutated motor	D03-203	LINEAR FT	116	312	169%
Floating head pressure control (FHPC) for evaporatively cooled-condenser	D03-224	TONS	1,765	1,972	12%
FHPC for evaporatively cooled condensers with variable frequency drives	D03-226	TONS	1,800	1,991	11%
Night covers—vertical	D03-205	LINEAR FT	16	73	344%

To better understand the programmatic impact of these differing savings calculations, PECl applied the savings from its models to rebates for these five measures with 85 vintage from the 2006-2008

Architectural Energy Corporation. *Small HVAC System Design Guide*. (Prepared for the California Energy Commission: October 2003), 500-03-082-A12, as reported in Robert Mowris, *Strategies for Improving HVAC Efficiency with Quality Installation and Service*. (Robert Mowris and Associates, 2006).

EnergySmart Grocer program. (Appropriate climate zones were included in this calculation.) The results indicated approximately 50% higher *ex ante* energy savings for these five measures using the PECl model as compared to DEER. Extrapolated to the statewide level, the kWh and kW savings differences could be significant. Furthermore, although therm savings were not assessed in this analysis, adjusting the DEER model as it relates to the vertical night covers measure could show significantly different therm savings as well.

5. Conclusion

The availability of DEER as a standard resource is a tremendous asset for energy efficiency programs in California. PECl's analysis supports many of the assumptions underlying the DEER 2005 model. However, PECl's analysis indicates that the DEER grocery model is not representative of the existing grocery building stock. These findings also suggest potential issues with key modeling assumptions in DEER. The modeling comparison undertaken by PECl indicates these issues may have a substantial impact on the *ex ante* energy savings being claimed by energy efficiency programs.

PECl is not proposing correct *ex ante* savings numbers for DEER. However, given the potential impact on calculated savings, and considering that DEER grocery refrigeration measures have not been updated since 2005, PECl urges the CPUC to take the following steps:

1. Prioritize updates to grocery refrigeration measures and include these measures in currently ongoing efforts to review DEER as part of the 2010-2012 EM&V Work Plan.
2. Consider segmenting the DEER model for the grocery sector into three distinct models (convenience, grocery and supermarket).
3. Fund a thorough market characterization study to inform updated *ex ante* savings and determine the appropriate segmentation of the grocery market that more closely reflects the existing building stock.

The models should be calibrated and based on real world experience. The market characterization study's results should account for the key distinctions among grocery segments and the impact that those differences could have in calculating energy savings for retrofit measures. Resources such as store audit data collected through the implementation of grocery energy efficiency programs could be used to inform the key model parameters.

PECl would be pleased to support the CPUC's effort to ensure the most accurate *ex ante* savings values for grocery measures addressed in DEER.