DEER Measure Database Update (January 2010)

Version 3.02 of the DEER measure database is the update to the mid-December DEER 2008 release for 2009-2011 Energy Efficiency Planning/Reporting. It was created with a new version of the DEER measure analysis software (MAS). The new MAS tool includes a number of changes and additions to the previous version that results in an improved and expanded DEER measure database. The database structure and the database viewing tool, MISer, have also been updated for this database release.

Changes to the MAS tool were made to either fix simulation errors or to improve the processing of hourly simulation data for the determination of demand impacts. In addition, the MAS tool was expanded to include additional measures and additional measure base cases that were requested by the utilities.

Outline of Contents:

Changes to the MAS tool

The changes described here are typically due to errors discovered in the previous MAS tool. Some of the errors were simply incorrect building prototype specifications, such as an incorrect schedule or an inappropriate equipment size. Other fixes were made in order to make the calculation of demand impacts more robust.

Large Office primary lighting schedule

The primary lighting schedule associated with linear fluorescent fixtures had been (incorrectly) set to the secondary schedule associated with CFL fixtures. The result was that the linear fluorescent fixtures were "on" more hours than intended, but with a decreased coincident demand. The end-use demand impacts increased by 14% due to this change while the annual electric end-use impacts decreased by 10%.

Boiler Sizing

The sizing method used for the HVAC boilers resulted in boilers over-sized by 50 - 100% in the older vintage buildings. The performance of these boilers operating at low part-load caused an over-statement of the heating energy required to compensate for reduced internal loads (such as associated with indoor lighting measures).

Hot Water Storage Heater Sizing

The size of the commercial hot water storage heaters was increased by 25% to account for lower mains water temperature in the winter months. In some building types and in some climate zones, the demand for water heating exceeded the specified capacity for long periods of time.

Packaged HVAC specifications

The single-phase and three-phase distinction for SEER-rated packaged HVAC equipment (SEER 12, 13 and 14) has been eliminated. There are still entries in the database for three-phase units, but their performance and energy impact results are the same as for the units that do not specify the phase distinction.

Revisions to the CEE tier 1, 2 and 3 efficiency levels have affected the EER rating of three packaged HVAC measures. The 10 EER unit in the size range from 240 – 760 kBTU/hr was changed to a 9.8 EER rated unit. In the size range greater than 760 kBTU/hr, the 9.7 and 10 EER units were changed to 9.5 and 9.7 EER, respectively.

Oldest building vintage HVAC system performance

Analysis of CEUS data indicates that many older vintage building have updated HVAC systems and that these older buildings are not well represented by a constant volume HVAC system, as was assumed for the oldest vintage DEER prototypes. Built-up HVAC system in the oldest vintage buildings are now modeled as a combination of constant volume and variable volume systems, represented by an variable air volume HVAC system with a high minimum flow rate (60% minimum flow).

Economizer set point

The controls for the economizer have been changed in climate zones CZ01, CZ03 and CZ05. In these climate zones, standard control settings allowed the economizer to be used during the peak cooling period, causing a large peak latent cooling load. Though compliant with the Title-24 ACM specifications, it is unlikely that an economizer would be utilized in a way that increases the peak demand. The economizer set point temperature,

above which the outside air is forced to its minimum flow rate, was lowered to 70 °F from 75 °F in these climate zones. This change results in more appropriate (i.e. smaller) design chiller size in these climate zones, especially in the older vintage buildings.

DOE2.2 bug fixes

These changes to the measure analysis software tool were prompted by an update to the DOE2.2 simulation engine that is used in the DEER MAS tool. The following fixes were identified as having some impact on the DEER measure results; there may be other bug fixes included in the update of the DOE2.2 simulation engine that do not affect the DEER results.

- Fix that affects the outside air volume associated with duct leakage: this mainly impacts the mobile home duct measures but has a small effect on the single-family and multi-family prototypes as well. DOE2.2 was previously over accounting for outside make-up air associated with duct losses to unconditioned spaces (in both base and measure cases). Non-commercial buildings were not impacted by this fix.
- Fix regarding default minimum heating flow rates. In some cases, the default zone minimum heating flow rate did not default to the system minimum heating flow rate as was intended. The impact of this fix on the DEER results is minor.

Residential Lighting profile for CFLs

The residential lighting profile used for indoor lighting in general, and for the CFL lamp replacement measure specifically, was reformulated using the same KEMA data set referenced in the 2008 Update documentation. Essentially, the summer season definition was shifted to include all of the various climate zones' peak periods. This offers a more consistent determination of peak period demand impacts, as the same hourly usage profile is used for all climate zones. Previously, the demand period for climate zones CZ01, CZ05, CZ07 and CZ08 fell within the fall lighting usage profile; the new summer profile includes all climate zone demand periods.

Peak-Period Demand Issues

In order to make results from standard energy simulation programs (specifically, eQUEST) consistent with the DEER demand impact results, the calculation used by the MAS tool to determine the demand impact was modified. The basic calculation remains the same: the demand savings due to an energy efficiency measure is calculated as the average reduction in energy use over a defined nine-hour demand period. The previous database version used the smoothed hourly impacts as the basis for these calculations while the latest version uses the non-modified results from the DOE2 simulations.

The difference in the demand values between these two methods is typically quite small, but occasional large deviations from expected values were observed. Changes to the HVAC control scheme for the affected system types were required in order to produce reliable demand results. These changes to the HVAC controls resulted in very little difference to the annual energy savings, but much more predictable behavior during the peak demand period. The following changes were implemented for all appropriate system types:

- Night cycle control setpoints were expanded (max 60 for heating and a minimum of 86 for cooling) so that the number of hours of night-cycling would not change significantly between the base and measures simulations. Changes in the hours of

night cycle control would occasionally shift the cooling load by an hour and result in relatively large differences in the hourly energy use of the base and measure simulations during the demand period.

- Outside air is turned off during night cycle control; though rare, the induction of some latent load associated with the outside air flow during night-cycling could exasperate the night-cycle issue discussed above.
- Space heating is turned off during the peak cooling period; though rare, the occasional need for space heating during the cooling season in some climate zones would shift cooling demands by an hour and cause large changes in the hourly demand between a base case simulation with high lighting loads and a measure case with low lighting loads.
- A single chiller is used for non-HVAC measures; this prevents a step-function change in demand when the controller switches between one and two chillers. When appropriate, multiple chillers are still used for the analysis of HVAC measures.

Additions to the DEER database

A number of additions were made to the DEER database at the request of the IOUs. The following list summarizes these new entries:

- **Non-residential lighting fixtures**; over 100 new lighting measures were added to the database. Refer to the accompanying spreadsheet for a description of all changes and additions.
- **The 2008 Title-24 code** was used as an additional base case for all applicable measures. This base case is in addition to the 2005 Title-24 code, which is retained in the database. The 2008 code change affects non-residential lighting measures and some packaged HVAC equipment.
- A total of **14 hot water and steam boiler measures** were added to the non-residential measure list.
- **Clothes washer and dishwasher measures** were added for all residential building types, including the multi-family apartment building.
- **Residential multi-family prototype** is now included in the database. All residential measures defined for the single-family building type have adapted to the multi-family prototype. Additional measures specific to the multi-family building type have also been added, including common water heater measure and common clothes washer measures.

Changes to the DEER database Structure

There are two minor changes to the DEER database structure with this release.

The electric demand impact fields have been changed and expanded. Previously, there were three demand values: a value based on the DEER 2005 peak period definition, a value based on the updated DEER 2008 peak period definition and an end-use only demand impact (based on the 2008 peak period definition). These field names for the two DEER 2008 demand impact values have not changed with this update. However, the demand impact based on the 2005 peak period definition has been dropped and three new demand values have been added. Refer to the table below for a summary of the previous and updated demand values:

Table 1. Demand impact fields in the DEER database

Description	Field Name	dB Version
DEER 2005 Demand Impact	ElecDem_D05	2.05
DEER 2008 Demand Impact *(with updated peak period definition)*	ElecDem_D08	2.05
DEER 2008 End-use Demand Impact	ElecDemD08_EU	2.05
DEER 2008 Demand Impact	**ElecDem_D08**	**3.02**
DEER 2008 End-Use Demand Impact	**ElecDemD08_EU**	**3.02**
DEER 2008 Demand Impact (from processed impact profile)	ElecDemD08_LS	3.02
Summer Demand Impact	ElecDem_Sum	3.02
Summer End-Use Demand Impact	ElecDemSum_EU	3.02
Summer Demand Impact (from processed impact profile)	ElecDemSum_LS	3.02

The summer period demand values are included mainly as a point of interest and a quality check on the official demand impact values (those highlighted in bold above). The summer values are generally a bit lower than the peak period values since they are based on a longer demand period (2p.m. to 5 p.m. for weekdays in June and July). A summer demand value that is higher than the corresponding DEER 2008 demand value may indicate a problem with the demand values. Education buildings that are closed during the peak demand period may have higher summer demand values than official demand values, so this is not a steadfast rule.

The only other change to the database structure is with the technology description fields that are used to populate the measure tree in MISer. The previous technology description fields were limited to four fields; the measure "tree" was limited to three branches and the final "leaf". For example, all linear fluorescent measures were listed under the three headings:

"Non-Residential" · "Indoor Lighting" · "Linear Fluorescent"

and the final "leaf" contained the measure description, such as:

"FL, (1) 46in, T5 lamp, Programmed Start Ballast, (BF: 1.00), Lumens=2750, W/fixt=33 (Replace, code reference)"

The final tree entry for the above measure contains a lot of information about the measure as well as applicability and some information about the existence of a code fixture, but lacks other essential information. For example, the customer average Watts per fixture, the code Watts per fixture, and the specific code that is being applied (Title-24 or Federal) are only available via a lookup in a support spreadsheet.

In an attempt to address these issues, a new tree structure was created. The new technology table can include up to eight branches plus the final "leaf" to describe a measure, and number of branches for a particular measure group is variable. Linear fluorescent measures now have seven branches, while most HVAC measures have four or five branches.

The branches for a linear fluorescent measure are now:

"Non-Residential" · "Indoor Lighting" · "Linear Fluorescent"
- Fixture Application (e.g. Retrofit)
  - Measure fixture description
    - Customer Average fixture description
      - Code fixture description (if applicable)

This structure was created before the idea of measure classification was fully developed. While this structure is much more compatible with the new measure classification scheme, it will need to be updated when the measure classification scheme is finalized.

Changes to the DEER impact naming scheme

The addition of another code base has changed the "tags" used to identify the measure impacts within the database. Previously the tag "-bCD" in an impact name would indicate that the base case was "code". This single tag has been replaced with three options, "-bC05", '-bC08" and "-bCB8", which indicates the base case as 2005 code, 2008 code or a base case that is valid for both codes, respectively.

Since using tags of a consistent length provides some processing efficiency, the tags "-bCA" and "-eMS" have been replaced with "-bCAv" and "-eMsr". The spreadsheet "DEER2008 MeasureID-RunID-ImpactID.xls" provides updated details on the tags used in the impact naming convention in the DEER database.

Update to the MISer database Viewer

A number of modifications were made to the MISer database viewer tool to support the new database and to improve functionality in general. The main changes are listed below:

- On the Select Impact tab, the measure tree now displays up to nine levels. The measure tree window is not scaled with the overall MISer program window, so that on wide computer screens the entire measure description can be viewed.
- On the Select Impact tab, the user can specify the base case of interest. The options are any combination of "Customer Average", "2005 Code/Standard", and "2008 Code/Standard".
- Once the selection criteria are established, the user must press the "Select" button to query the database and populate the results grid. This will hopefully avoid inadvertently choosing a very large selection criterion (such as "all measures") that might cause the MISer tool to appear to stall.
- When exporting data using the "Export Custom Data" button, the user can choose to have the impacts "normalized". If the user does opt to normalize the exported data, the impact values will be divided by the number of measure units and the output will be in the same format as the data on the "Review Impact Details" tab.

Changes to the DEER Results

The accumulation of changes listed in this document has caused a large portion of the DEER energy impact results to change at least slightly. Some updates have caused specific results to change significantly, such as the large office lighting profile fix.

Other changes, such as the various HVAC control and sizing issues listed above, have had only a small effect on the electricity energy and demand results, but have a profound effect on the secondary natural gas impact. In almost all cases, the heating energy "take back" associated with commercial lighting measures has decreased dramatically (on the order of 25 – 60%).

Figure 1 shows the large decrease in the negative gas impacts for a lighting measure in the multi-story retail building prototype. This result is typical of prototypes with central plant HVAC systems and is largely due to changes in the control mechanism of the oldest vintage HVAC system and the fix to the boiler sizing.

Figure 2 shows the same type of results for the small office building prototype, a building with packaged HVAC equipment. In this case, there is very little difference in the negative gas impacts since the two changes mentioned above do not apply to packaged HVAC equipment.

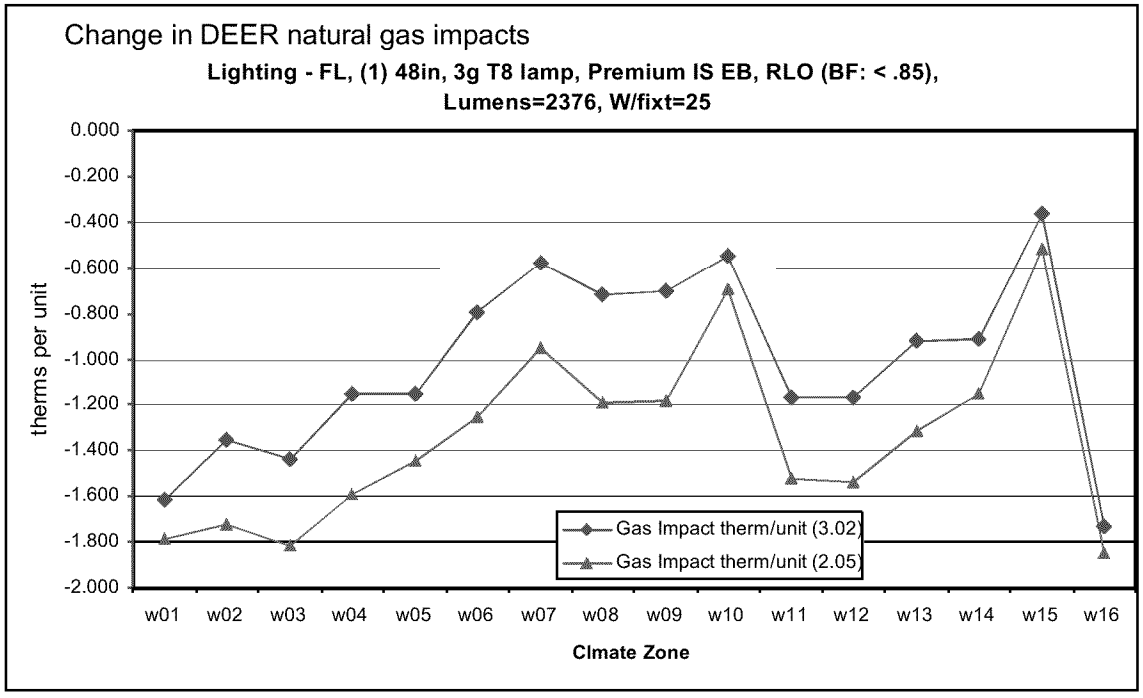

Figure 1. Showing a large decrease in the gas heating "take back" associated with a lighting measure in the **Multi-Story Retail, Existing Vintage** prototype

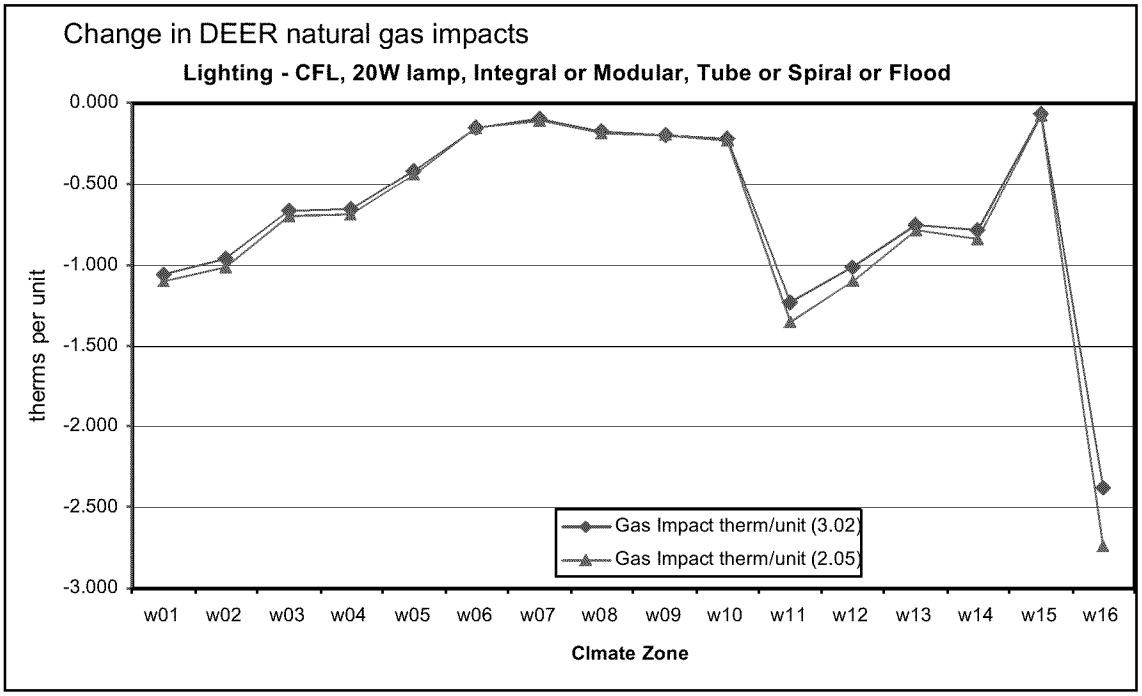

Figure 2. Showing a small change in gas heating "take back" associated with a lighting measure in the **Small Office Building, Existing Vintage** prototype

Figure 3 shows the energy and demand impacts for the recent vintage large office building prototype. The change in demand savings in climate zones CZ01, CZ03 and CZ05 is due to the design chiller size decreasing by approximately 20% in these climate zones. The change in chiller design size is a direct results of the economizer set point issue discussed above.

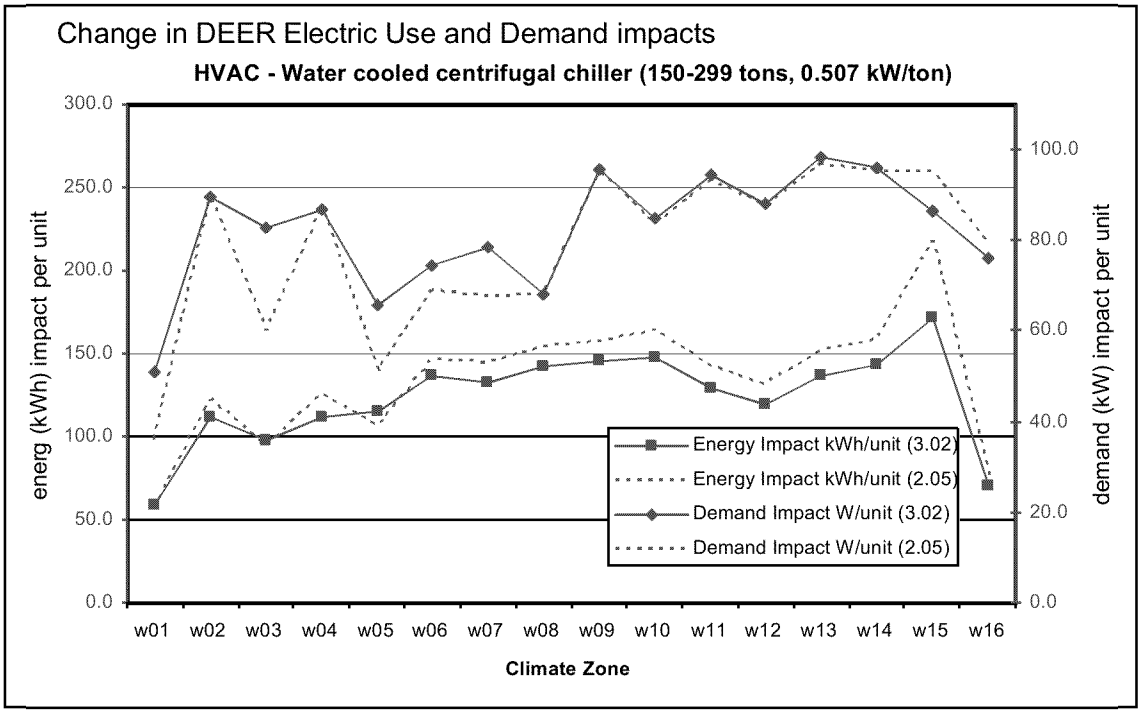

Figure 3. Showing the change in demand impacts for climate zones CZ01, CZ03 and CZ05 for the **Large Office Building, 2002-2005 Vintage** prototype

Figure 4 shows the decrease in the gas energy savings per kBTUh capacity for a hot water system in the small office prototype. This decrease per unit of capacity is due to the increase in assumed heating capacity of the hot water system, as discussed above. The actual energy savings in total therms is actually slightly larger in the new version, but the capacity increased by 25% in this case.

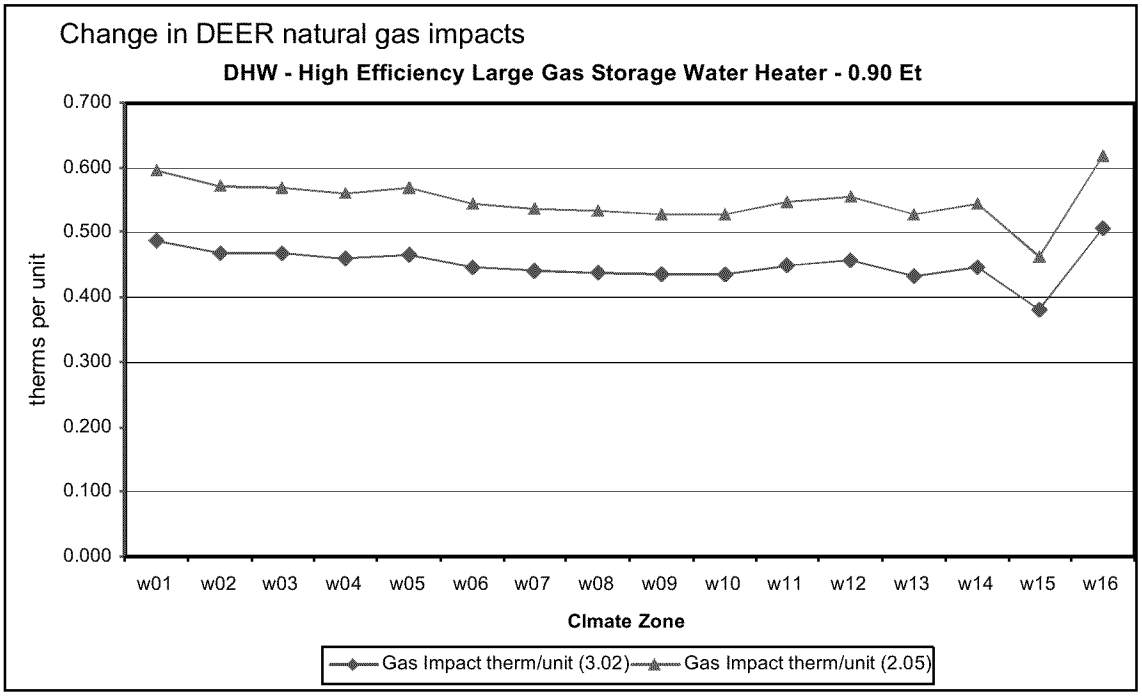

Figure 4. Showing the decrease in gas savings per kBTUh capacity of the hot water system for the **Small Office Building, Existing vintage** prototype

For the residential models, the largest change in the results is due to the DOE2.2 bug-fix that corrected the amount of outside air associated with duct losses to the outside. Figure 5 shows a significant drop in the demand and energy savings in most climate zones for a SEER 14 HVAC measure applied to the mobile home prototype. The earlier database savings values were exaggerated, especially in the hotter climate zones, due to the bug that increased the cooling and heating loads and made the duct system appear to be extremely inefficient. The mobile home prototype is assumed to have no return ductwork, thus all duct leakage is lost to the outside. The DOE2.2 code was basically doubling duct air losses to the outside before the bug fix.

This issue did not impact the single-family residence to the same degree, as a smaller fraction of the total duct air loss is assumed to be to the outside. Figure 6 shows the same impacts for the single-family residence; in this case the savings increase overall, and the largest decrease is on the order of a few percent.

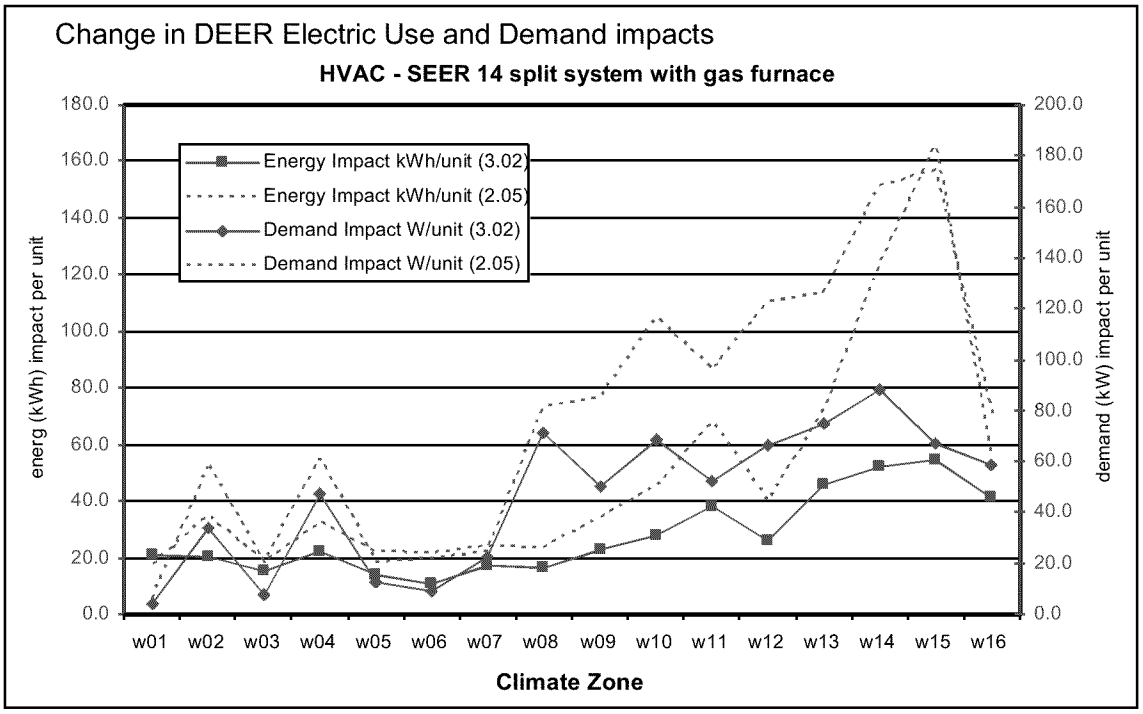

Figure 5. Showing a significant decrease in electricity energy and demand savings for an HVAC measures applied to the **Mobile Home, Existing Vintage** prototype

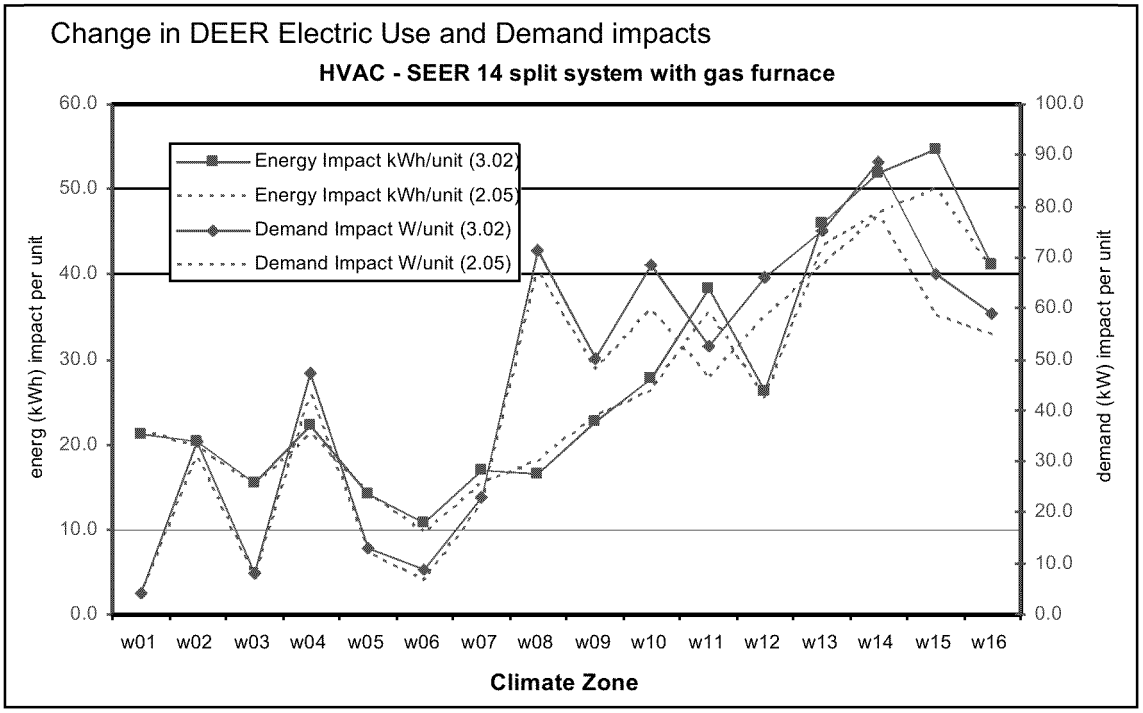

Figure 6. Showing a small change in electricity energy and demand savings for an HVAC measures applied to the **Single-Family, Existing Vintage** prototype

The accompanying spreadsheet "DEEER Database - Compare v2.05 to v3.02" demonstrates the changes in energy impacts for a variety of building types, measures categories and climate zones, including the weighted IOU territories.