Work Paper WPSDGEREMI006

**Revision 0**

**San Diego Gas & Electric**

**Prescriptive Window Retrofit**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | 464071 |
| **Measure Description** | Window U-0.32/SHGC 0.23 |
| **Base Case Description** | Standard Window U-0.55/SHGC 0.65 |
| **Units** | Sq. ft. |
| **Energy Savings** | Refer to Excel Calculation Attachment |
| **Full Measure Cost ($/unit)** | $38.80/sq.ft. |
| **Incremental Measure Cost ($/unit)** | $13.59/sq.ft. |
| **Effective Useful Life** | BS-Win: EUL 20 yrs, RUL 6.7 yrs |
| **Measure Installation Type** | Retrofit or Early Retirement (RET/ER) |
| **Net-to-Gross Ratio** | Res-Default>2: 0.55 |
| **Important Comments** | This work paper has a complementary Ex Ante Database data set that will be provided in a separate submission to the California Public Utilities Commission (CPUC). |

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Rev** | **Date** | **Author** | **Summary of Changes** |
| 0 | 11/13/17 | Phillip Hasley, Hasley Consulting | Adopted Work Paper SCE13HC051.   * Updated workpaper to include DMO building type and remove SFM and MFM building types * Updated measure case to new window with U-factor of 0.32 & SHGC 0.23 * Updated base case to U-factor 0.55 and SHGC 0.65 based on Federal Codes for manufactured homes * Updated GMC and IMC based on CMHP cost data |

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

This work paper details energy savings for the energy efficiency measure consisting of retrofitting existing manufactured home window assemblies with high performance glass/window assemblies having a rated U-factor of 0.32 and SHGC 0.23 or better.

**Base Case**

The base case is a double-pane low-E (e3=.2) clear window with typical glass/window assembly U-factor of 0.55 and Solar Heat Gain Coefficient (SHGC) of 0.65 that meets federal code requirements for manufactured homes as determined by the DEER team in the DOE-2 prototype double-wide mobile home.

**Measure Case**

The measure case is a high performance glass/window with maximum allowable U-factor of 0.32 and SHGC of 0.23. The measure can be met by various alternatives - using a double and/or triple pane glass window with Low-E clear and/or tint and/or double electrochromic glass window. Energy savings on the measure are estimated using a double pane Low-E window/glass assembly. See Section 2 for additional performance documentation on Base case and Measure case windows.

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | Prescriptive Window U-0.32/SHGC 0.23 |
| Existing Condition | Standard Window U-0.55/SHGC 0.65 |
| Code/Standard | Standard Window U-0.55/SHGC 0.65 |
| Industry Standard Practice | N/A |

Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
| N/A | 464071 | N/A | N/A | Prescriptive Window U-0.32/SHGC 0.23 replacing Standard Window U-0.55/SHGC 0.65 |

## 1.2 Technical Description

Prescriptive glass/window assembly with U-0.32/SHGC 0.23 replacing a Standard glass/window assembly with U-0.55/SHGC 0.65

## 1.3 Installation Types and Delivery Mechanisms

The install type is Retrofit (RET).

**Installation Type Descriptions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Installation Type** | **Savings** | | **Life** | |
| 1st Baseline (BL) | 2nd BL | 1st BL | 2nd BL |
| Retrofit or Early Replacement (RET/ER) | Above Customer Existing | Above Code or Standard | RUL | EUL-RUL |

The delivery mechanisms are Direct Install and Down-Stream Incentive.

A delivery mechanism is a delivery method paired with an incentive method. Delivery mechanisms are used by programs to obtain program participation and energy savings.

**Delivery Method Descriptions**

|  |  |
| --- | --- |
| **Delivery Method** | **Description** |
| Financial Support | The program motivates customers, through financial incentives such as rebates or low interest loans, to implement energy efficient measures or projects. |

**Incentive Method Descriptions**

|  |  |
| --- | --- |
| **Incentive Method** | **Description** |
| Direct Install | The program implements energy efficiency measures for qualifying customers, at no cost to the customer. |
| Down-Stream Incentive | The customer installs qualifying energy efficient equipment and submits an incentive application to the utility program. Upon application approval, the utility program pays an incentive to the customer. Such an incentive may be deemed or customized. |

## 1.4 Measure Parameters

### 1.4.1 DEER Data

DEER Difference Summary

|  |  |
| --- | --- |
| **DEER Item** | **Used for Workpaper?** |
| Modified DEER methodology | Yes |
| Scaled DEER measure | No |
| DEER Base Case | Yes |
| DEER Measure Case | No |
| DEER Building Types | Yes |
| DEER Operating Hours | Yes |
| DEER eQUEST Prototypes | Yes |
| DEER Version | DEER 2014 |
| Reason for Deviation from DEER | Change in unit from “100 sq ft” to “Square Foot” |
| DEER Measure IDs Used | N/A |

**Net-to-Gross Ratio**

The NTG values were obtained using the DEER READI tool. The relevant NTG values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NTGR ID** | **Description** | **Sector** | **BldgType** | **Measure Delivery** | **NTGR** |
| Res-Default>2 | All other EEM with no evaluated NTGR; existing EEM with same delivery mechanism for more than 2 years | Res | Any | Any | 0.55 |

Note: Direct install measures that are not hard-to-reach will use the default NTG value.

**Spillage Rate**

Spillage rates are not tracked in work papers; they are tracked in an external document which will be supplied to the Commission Staff.

**Installation Rate**

The IR values were obtained using the DEER READI tool. The relevant IR values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **GSIA ID** | **Description** | **Sector** | **BldgType** | **ProgDelivID** | **GSIAValue** |
| Def-GSIA | Default GSIA values | Any | Any | Any | 1 |

**Effective and Remaining Useful Life**

The EUL and RUL values were obtained using the DEER READI tool. DEER defines the RUL as 1/3 of the EUL value. The RUL value is only applicable to the first baseline period for an RET measure with an applicable code baseline. The relevant EUL and RUL values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| BS-Win | High Performance Windows | Res | BldgEnv | 20 | 6.7 |

### 1.4.2 Codes and Standards Analysis

Manufactured home construction is governed by Federal code under the Housing and Urban Development (HUD) 24 CFR Part 3280\_2008. The Federal code requires a total building envelope U-factor for a manufactured home by climate zone. The DEER team developed the default double-wide mobile home prototype to meet the Federal code requirements. The resulting prototype home has glazing with an area weighted average U-factor of 0.55 and a SHGC of 0.65, Glass Type Code 2610 in the DOE-2 glass library.

Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| 24 CFR Part 3280\_2008 | HUD Energy Efficiency Standards | October 25, 1994 |

## 1.5 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information

N/A

## 1.6 Data Quality and Future Data Needs

N/A

# Section 2. Calculation Methodology

Energy and demand savings on the measure were estimated using comparative (parametric) runs between the base case and measure case window/glass assemblies using the 2014 DEER Residential double-wide mobile home (DMO) DOE2.2 prototype with the prototypes generated using the latest MASControl2 software application.

Methodology for estimating energy savings is based on the GLASS-TYPE-CODE method within the eQuest/DOE2.2 energy modeling software. The GLASS-TYPE-CODE method selects a glazing from the DOE library which contains pre-determined performance data on window/glass assemblies including center of glass and glass plus window frame heat transfer coefficient “U-factor”, Solar Heat Gain Coefficient (“SHGC”), and Visible Transmittance (“VT”) among others.

The measure is based on a specific window made by a specific manufacturer. The window selected for the program is the MI 5800 vinyl slider Lo E3-366 with the Intercept Ultra spacer. The properties for this window as published by the manufacturer are unit U-value of 0.32 Btu/hr-ft2- F and unit solar heat gain coefficient (SHGC) of 0.23.

Modeling for the measure case was accomplished in MASControl2 by selecting a glass type from the standard glass type library that gave reasonable values for center-of-glass (COG) U-value and glass SHGC. The frame factor (frame-to-total unit area ratio) was assumed to be 17% for the model. The selected glass type was library #2668, which has a COG U-value of 0.231 Btu/hr-ft2-F and a glass SHGC of 0.28. With a frame U-value of 0.82 Btu/hr-ft2-F, glass type 2668 gives a unit U-value of 0.320 Btu/hr-ft2-F and a unit SHGC of 0.232.

Performance parameters for both the measure case and base case window/glass assemblies and selected GLASS-TYPE-CODE utilized in the energy analysis are summarized below:

**Base Case Fenestration:**

**U-0.55/SHGC 0.65 [Double Low-E (e3=.2) Clear]**

**GLASS-TYPE-CODE: 2610 [Double Low-E (e3=.2) Clear]|U-0.46/U-53 (Center G./Alum w/ break)| SHGC 0.65**

**Measure Case Fenestration:**

**U-0.32/SHGC 0.23 [Double Low-E (e2=0.04) Tint] Modified frame as discussed above**

**GLASS-TYPE-CODE: 2668 [Double Low-E (e2=0.04)|U-0.23/U-0.33 (Center G./Alum w/ break)| SHGC 0.28**

Energy savings on the measure were normalized based on total square footage of window in corresponding building (home). For instance, the total energy and demand impacts as estimated by the building energy model were divided by the total window area as indicated by the building energy model’s LV-D report.

Attachment 1 includes the MASControl2 simulation results along with results formatted for the ex-ante database and a data review graphic. The results were produced using the updated MASControl2 rules database file and were processed using SQL functions and queries. The process for updating the MASControl2 database as well as for manipulating the technology results into the weighted measure savings values is described in Attachment 2. The additional tables, queries and functions used in this processing are included in Attachment 3.

# Section 3. Load Shapes

The ideal load shape for net benefits estimates would represent the difference between the base case and measure case. The closest load shapes that are applicable to the measures in this work paper are listed in the table below.

Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **Load Shape** | **E3 Alternate Building Type** |
| Residential Manufactured Housing | Window\_Tint-Ret | NON\_RES |

# Section 4. Costs

Estimated measure material cost information is based on MSRP information from the manufacturer of the window being installed in SDG&E territory. Estimated labor costs are based on Residential Cost Data (RSMeans Residential Cost Data 2010 – [408]). The measure case labor costs are expected to be equal to the base case labor costs. Thus, the incremental measure cost is the difference between the measure case material cost and the base case material cost.

Base Case cost is based on DEER05 documentation.

## 4.1 Base Case Cost

Base Case cost from DEER05 is $16.41 per square foot of window and Labor cost is $8.80 per square foot of window.

## 4.2 Measure Case Cost

Measure cost is $30.00 per square foot of window and Labor cost is $8.80 per square foot of window.

## 4.3 Full and Incremental Measure Cost

**Full and Incremental Measure Cost Equations**

|  |  |  |  |
| --- | --- | --- | --- |
| **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| RET/ER | (MEC + MLC) – (BEC + BLC) | MEC + MLC | (MEC + MLC) – (BEC + BLC) |

MEC = Measure Equipment Cost; MLC = Measure Labor Cost

BEC = Base Case Equipment Cost; BLC = Base Case Labor Cost

**Full and Incremental Costs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure** | **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
|  | **1st Baseline** | **2nd Baseline** |
| Prescriptive Window  U-.32/SHGC 0.23 | RET | $13.59 | $38.80 | $13.59 |

# Attachments

# References