**Work Paper PGECOAPP124**

**Energy Efficient Refrigerators**

**Revision # 2**

**Pacific Gas & Electric Company**

**Customer Energy Solutions**

**Energy Efficient Refrigerators**

**Measure Codes RFBI, RFBS, RFEE, RFMC, RFSI, RFSSI, RFSSZ, RFSZ, RFTL, RFTM, RFTS, RFCM**

# At-a-Glance Summary

|  |  |  |
| --- | --- | --- |
| Applicable Measure Codes: | RFBI, RFBS, RFEE, RFMC, RFSI,  RFSSI, RFSSZ, RFSZ, RFTL, RFTM,  RFTS | RFCM |
| **Measure Description:** | Energy Efficient Mid- or Full-Sized Refrigerator that is 20% more efficient than the federal standard | Energy Efficient Compact Refrigerator that is 10% more efficient than the federal standard (Energy Star) |
| **Energy Impact Common Units:** | Each | Each |
| **Base Case Description:** | Title 20 / Federal Standard  Source: DEER and PG&E Calculations | Title 20 / Federal Standard  Source: Energy Star and PG&E Calculations |
| **Base Case Energy Consumption:** | Varies by volume and configuration  Source: federal code UEC equations | 265 kWh  Source: 2015 DEER |
| **Measure Energy Consumption:** | Varies by volume and configuration  Source: federal code UEC equations | 294.5 kWh  Source: 2015 DEER |
| **Energy Savings (Base Case – Measure)** | Varies by volume and configuration  Source: PG&E Calculations and 2015 DEER | 25.6 kWh  Source: 2015 DEER |
| **Costs Common Units:** | $ each | $ each |
| **Base Case Equipment Cost ($/unit):** | Mid- and Full-Sized Refrigerators  Source: 2008 DEER  Average $1,205.42 / unit | Compact Refrigerators  Source: Energy Star  $175 |
| **Measure Equipment Cost ($/unit):** | Mid- and Full-Sized Refrigerators  Source: 2008 DEER  Average $1,336.79 / unit | Compact Refrigerators  Source: Energy Star  $185 |
| **Full Measure Cost ($/unit)** | Mid- and Full-Sized Refrigerators  Source: 2008 DEER  Average $131.37 / unit (ROB IMC) | Compact Refrigerators  Source: Energy Star  $10 |
| **Measure Incremental Cost ($/unit):** | Mid- and Full-Sized Refrigerators  Source: 2008 DEER  Average $131.37 / unit (ROB IMC) | Compact Refrigerators  Source: Energy Star  $10 |
| **Effective Useful Life (years):** | Source: 2011 DEER v4.01  14 years | Source: 2011 DEER v4.01  14 years |
| **Program Type:** | Replace on Burnout (ROB) | Replace on Burnout (ROB) |
| **Net-to-Gross Ratios:** | Source: DEER 2015, READI version 2.1.0  NTG = 0.55[[1]](#endnote-1) Res-Default>2 index 45 | |
| **Important Comments:** | **PG&E Measures cover the following:**  Mid- and full-sized refrigerators (20% above the Federal Standard)  Energy Star compact refrigerators (10% above Fed. Std.)  **SCE Measures cover the following:**  Mid- and full-sized refrigerators (10% above the Federal Standard)  Mid- and full-sized refrigerators (15% above the Federal Standard)  Mid- and full-sized refrigerators (20% above the Federal Standard)  Compact refrigerators (10% above Fed. Std.)  Compact refrigerators (20% above Fed. Std.)  Energy Star freezers (10% above Fed. Std.) | |

# Work Paper Approvals

The following Manager(s) approved this workpaper through the PG&E Electronic Data Routing System under Routing Requisition # 2015-02887

|  |
| --- |
|  |
| **Grant Brohard**  Manager, Technical Product Support |
| **Carolyn Weiner**  Manager, Core Products |

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision #** | **Revision Date** | **Section-by-Section Description of Revisions** | **Author (Company)** |
| **Revision 0** | 6/27/12 | PGECOAPP124 Energy Efficient Refrigerators R0.doc  PG&E 2010-2012 measure values included.  Values for statewide workpaper (PG&E and SCE) for 2013-2014 filing also included. Includes measure impacts for Federal Standard + 20% as well as Federal Standard + 30% efficiency levels. Compact Refrigerators included using SCE methodology (and DEER interactive effects) | Jenny Roecks (PG&E) |
| **Revision 0** | 8/24/12 | PGECOAPP124 Energy Efficient Refrigerators R0.doc  Corrected for Dates and ED reqts | Steve Blanc (PG&E) |
| **Revision 1** | 5/8/14 | PGECOAPP124 Energy Efficient Refrigerators R1.docx  Updated with new workpaper template. Updated NTG. | Jia Huang (PG&E) |
| **Revision 2** | 1/14/15 | PGECOAPP124 Energy Efficient Refrigerators R2.docx  Updated Savings values for 9/14/2014 Federal code change and DEER 2015. | Jia Huang (PG&E) |

# Table of Contents

[At-a-Glance Summary ii](#_Toc409004316)

[Work Paper Approvals iv](#_Toc409004317)

[Document Revision History v](#_Toc409004318)

[Table of Contents vi](#_Toc409004319)

[List of Tables vi](#_Toc409004320)

[Section 1. General Measure & Baseline Data 1](#_Toc409004321)

[1.1 Product Measure Description & Background 1](#_Toc409004322)

[1.2 Product Technical Description 5](#_Toc409004323)

[1.3 Measure Application Type 6](#_Toc409004324)

[1.4 Product Base Case and Measure Case Data 6](#_Toc409004325)

[1.4.1 DEER Base Case and Measure Case Information 6](#_Toc409004326)

[1.4.2 Codes & Standards Requirements Base Case and Measure Information 7](#_Toc409004327)

[1.4.3 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information 9](#_Toc409004328)

[1.4.4 Assumptions and Calculations from other sources—Base and Measure Cases 9](#_Toc409004329)

[Section 2. Calculation Methods 11](#_Toc409004330)

[2.1 Electric Energy Savings Estimation Methodologies 11](#_Toc409004331)

[CEE Tier 3 Refrigerators 12](#_Toc409004332)

[2.2. Demand Reduction Estimation Methodologies 12](#_Toc409004333)

[2.3. Gas Energy Savings Estimation Methodologies 12](#_Toc409004334)

[*Section 3. Load Shapes* 13](#_Toc409004335)

[3.1 Base Case Load Shapes 13](#_Toc409004336)

[3.2 Measure Load Shapes 13](#_Toc409004337)

[Section 4. Base Case & Measure Costs 13](#_Toc409004338)

[4.1 Base Case(s) Costs 14](#_Toc409004339)

[4.2 Measure Case Costs 15](#_Toc409004340)

[4.3 Incremental & Full Measure Costs 16](#_Toc409004341)

[4.3.1 Full Measure Cost 16](#_Toc409004342)

[4.3.2 Incremental Measure Costs 16](#_Toc409004343)

[References 18](#_Toc409004344)

# List of Tables

[Table 1 PG&E "Back-End” Measure Codes 2](#_Toc409004345)

[Table 2 Measure Application Type 6](#_Toc409004346)

[Table 3 DEER Net-to-Gross Ratios 7](#_Toc409004347)

[Table 4 TOU Adjustment Factors 10](#_Toc409004348)

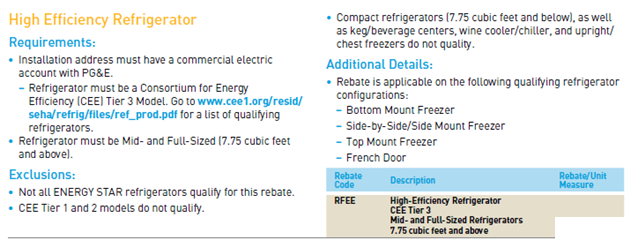
[Table 5 Baseline by Measure Application Type 11](#_Toc409004349)

# 

# Section 1. General Measure & Baseline Data

## 1.1 Product Measure Description & Background

***PG&E Catalog Description – High Efficiency Refrigerator (Full- and Mid-Sized)***



***PG&E Requirements: CEE Tier 3 Mid- and Full-Sized Refrigerators***

* Installation address must have an electric account with PG&E.
* Refrigerator must be a Consortium for Energy Efficiency (CEE) Tier 3 Model (20% above the federal standard). Go to (<http://library.cee1.org/content/qualifying-product-lists-residential-refrigerators>) for a list of qualifying refrigerators.
* Refrigerator must be Mid- and Full-Sized (7.75 cubic feet and above).
* Rebate is applicable on the following qualifying refrigerator
* Configurations:
  + Bottom Mount Freezer
  + Side-by-Side/Side Mount Freezer
  + Top Mount Freezer
  + French Door

***PG&E Requirements: Energy Star Compact Refrigerators***

* Installation address must have an electric account with PG&E.
* Customer must have electricity distributed by PG&E to the installation address.
* Not all ENERGY STAR® refrigerators qualify for this rebate. Refrigerators larger than 7.75 cubic feet and 36 inches or more in height do not qualify.
* ENERGY STAR qualified refrigerators are 10% more efficient than non-qualified models and are 10% more efficient than models that simply meet the federal minimum standard for energy efficiency.

The measure code that appears in the catalog is “RFEE”, which is a “front end” measure code that customers will apply for in their applications. The customer is required to report the refrigerator model number on the application, and this model number will be matched by PG&E to the CEE or Energy Star qualified products list (for either mid/full-sized Refrigerators or compact refrigerators) which includes data on refrigerator size and configuration. This model information will be processed through an internal programming routine to assign all of the refrigerator applications coming through the “front end” to more specific measure codes on the “back end” in the PG&E measure tracking system that differ by size and configuration. The measure codes in the measure tracking system are described below in Table 1.

Table 1 PG&E "Back-End” Measure Codes

|  |  |
| --- | --- |
| MDSS Measure Code | MDSS Measure Description |
| RFEE | ENERGY EFFICIENT REFRIGERATOR (FRONT END CODE) |
| RFBZ | REFRIGERATOR: BOTTOM FREEZER WITHOUT ICE >= 16.5 CU. FT. |
| RFBI | REFRIGERATOR: BOTTOM FREEZER WITH ICE >= 16.5 CU. FT. |
| RFBS | REFRIGERATOR: BOTTOM FREEZER WITHOUT ICE <16.5 CU. FT. |
| RFSZ | REFRIGERATOR: SIDE FREEZER WITHOUT ICE >= 23 CU. FT. |
| RFSI | REFRIGERATOR: SIDE FREEZER WITH ICE >= 23 CU. FT. |
| RFSSZ | REFRIGERATOR: SIDE FREEZER WITHOUT ICE <23 CU. FT. |
| RFSSI | REFRIGERATOR: SIDE FREEZER WITH ICE < 23 CU. FT. |
| RFTL | REFRIGERATOR: TOP FREEZER WITHOUT ICE >20 CU. FT. |
| RFTM | REFRIGERATOR: TOP FREEZER WITHOUT ICE 15 - 20 CU. FT. |
| RFTS | REFRIGERATOR: TOP FREEZER WITHOUT ICE < 15 CU. FT. |
| RFMC | REFRIGERATOR: MISCELLANEOUS |
| RFCM | COMPACT REFRIGERATOR |

***PG&E Program Restrictions and Guidelines***

**Terms and Conditions: CEE Tier 3 Mid- and Full-Sized Refrigerators**

* Customer must have electricity distributed by PG&E to the installation address.
* Must be on the ENERGY STAR qualifying list for relevant rebate
* Exclusions: Not all ENERGY STAR refrigerators qualify for the Energy Star rebate.
* Must be on the CEE qualifying list for relevant Tier rebate
* CEE Tier 1 and 2 models do not qualify (10% and 15% above the federal standard, respectively)
* Compact refrigerators (7.75 cubic feet and below), as well as keg/beverage centers, wine cooler/chiller, and upright/ chest freezers do not qualify

**Terms and Conditions: Energy Star Compact Refrigerators**

* Customer must have electricity distributed by PG&E to the installation address.
* Must be on the ENERGY STAR qualifying list for relevant rebate
* Not all ENERGY STAR® refrigerators qualify for this rebate. Refrigerators larger than 7.75 cubic feet and 36 inches or more in height do not qualify.
* ENERGY STAR qualified refrigerators are 10% more efficient than non-qualified models and are 10% more efficient than models that simply meet the federal minimum standard for energy efficiency.

**Market Applicability:**

* SF, MF, SMB
* All climate zones
* All building types

The rebate is downstream provided to the customer at the time of sale upon receipt of application and invoice. This is not a direct install program.

***Type of Transaction:*** This is a downstream rebate program seeking to influence customers to purchase a high efficiency refrigerator when they are at a participating retail location to replace their old refrigerator that is no longer working. These measures are assumed to be replace on burnout (ROB) in which the customer is going to purchase a new refrigerator no matter what.

***SCE Program Restrictions and Guidelines***

Customer must have electricity distributed by SCE to the installation address.

**Terms and Conditions: Energy Star Mid- and Full-Sized Refrigerators, Compact Refrigerators, and Freezers**

* Must be on the ENERGY STAR qualifying list for relevant rebate.
* ENERGY STAR qualified refrigerators are 10% more efficient than models that simply meet the federal minimum standard for energy efficiency.
* Refrigerators smaller than 7.75 cubic feet are classified as compact refrigerators.
* Keg/beverage centers and wine coolers/chillers do not qualify.

**Terms and Conditions: Energy Star Most Efficient Full-Sized Refrigerators**

* Must be on the ENERGY STAR qualifying list and be indicated as meeting the ENERGY STAR Most Efficient criteria.
* ENERGY STAR Most Efficient qualified refrigerators are 15% more efficient than models that simply meet the federal minimum standard for energy efficiency. They must also use less than or equal to 637 kWh per year.
* Compact refrigerators, all-refrigerators, and freezers do not qualify.
* Keg/beverage centers and wine coolers/chillers do not qualify.

**Terms and Conditions: CEE Tier 3 Mid- and Full-Sized Refrigerators and Compact Refrigerators**

* Must be on the CEE qualifying list for relevant Tier rebate.
* CEE Tier 1 and 2 models do not qualify (10% and 15% above the federal standard, respectively).
* CEE Tier 3 qualified refrigerators are 20% more efficient than models that simply meet the federal minimum standard for energy efficiency.
* Freezers do not qualify.
* Keg/beverage centers and wine coolers/chillers do not qualify.

**Market Applicability:**

* Building types: SF, MF, DMO
* All climate zones

**Type of Transaction:** Downstream rebate program, replace on burnout (ROB).

SCE solution codes and their descriptions are below.

|  |  |  |
| --- | --- | --- |
| Configuration and Volume | SCE Solution Code | SCE Solution Code |
| Freezerless Refrigerator | Energy Star | CEE Tier 3 |
| Compact (<7.75 cu ft) | AP-87223 | AP-38711 |
| Small (11-23 cu ft) | AP-40945 | AP-65210 |
| **Refrigerator/Freezer** |  |  |
| Compact (<7.75 cu ft) | AP-79111 | AP-54095 |
| **Bottom Freezer, No Ice** |  |  |
| Compact (<7.75 cu ft) | AP-90011 | AP-78911 |
| Small (8-16.5 cu ft) | AP-39992 | AP-45119 |
| Large (≥16.5 cu ft) | AP-68842 | AP-10698 |
| **Bottom Freezer, With Ice** |  |  |
| Large (≥16.5 cu ft) | AP-10114 | AP-64963 |
| **Top Freezer, No Ice** |  |  |
| Compact (<7.75 cu ft) | AP-29187 | AP-28176 |
| Small (10-15 cu ft) | AP-19411 | AP-31983 |
| Medium (15-20 cu ft) | AP-29410 | AP-71982 |
| Large (≥20 cu ft) | AP-45521 | AP-43980 |
| **Top Freezer, With Ice** |  |  |
| Medium (15-20 cu ft) | AP-39094 | AP-56770 |
| **Side Freezer, No Ice** |  |  |
| Medium (15-23 cu ft) | AP-74421 | AP-87902 |
| Large (≥23 cu ft) | AP-98888 | AP-89066 |
| **Side Freezer, With Ice** |  |  |
| Medium (15-23 cu ft) | AP-80244 | AP-90513 |
| Large (≥23 cu ft) | AP-12333 | AP-92303 |
| **Upright Freezer** |  |  |
| Upright, Automatic defrost | AP-85033 | N/A |
| Upright, Manual defrost | AP-53725 | N/A |
| Chest, Automatic defrost | AP-59600 | N/A |
| Chest, Manual defrost | AP-54389 | N/A |

|  |  |
| --- | --- |
| Configuration and Volume | SCE Solution Code |
| **Refrigerator/Freezer** | Energy Star Most Efficient |
| Average size | AP-80112 |
| Bottom Freezer, No Ice |  |
| Medium (≤18.0 cu ft) | AP-94456 |
| Large (18.1-22.5 cu ft) | AP-29677 |
| X-Large (>22.5 cu ft) | AP-82565 |
| Bottom Freezer, With Ice |  |
| Medium (≤18.0 cu ft) | AP-65945 |
| Large (18.1-22.5 cu ft) | AP-37895 |
| X-Large (>22.5 cu ft) | AP-39976 |
| Top Freezer, No Ice |  |
| Medium (≤18.0 cu ft) | AP-19658 |
| Large (18.1-22.5 cu ft) | AP-75456 |
| X-Large (>22.5 cu ft) | AP-94675 |
| Top Freezer, With Ice |  |
| Medium (≤18.0 cu ft) | AP-78564 |
| Large (18.1-22.5 cu ft) | AP-26754 |
| X-Large (>22.5 cu ft) | AP-10098 |
| Side Freezer, No Ice |  |
| Medium (≤18.0 cu ft) | AP-13536 |
| Large (18.1-22.5 cu ft) | AP-47785 |
| X-Large (>22.5 cu ft) | AP-47658 |
| Side Freezer, With Ice |  |
| Medium (≤18.0 cu ft) | AP-95467 |
| Large (18.1-22.5 cu ft) | AP-50694 |
| X-Large (>22.5 cu ft) | AP-59865 |

## 1.2 Product Technical Description

The measures in this workpaper pertain to residential refrigerators, freezers, and refrigerator-freezers.

A refrigerator is a cabinet that is designed for the refrigerated storage of food, including but not limited to solid food and wine, beer, and other beverages, at temperatures above 32°F, and that has a source of refrigeration requiring an energy input. It may include a compartment for the freezing and storage of food at temperatures below 32°F, but it does not provide a separate low temperature compartment designed for the freezing and storage of food at temperatures below 8°F. 4

A freezer is a cabinet that is designed as a unit for the freezing and storage of food, beverages, or ice at temperatures of 0°F or below and that has a source of refrigeration requiring an energy input.

A refrigerator-freezer is a cabinet that

(1) consists of two or more compartments with at least one of the compartments designed for the refrigerated storage of food, including but not limited to solid food and wine, beer, and other beverages, at

temperatures above 32°F;

(2) has at least one of the compartments designed for the freezing and storage of food or ice at temperatures below 8°F that may be adjusted by the user to a temperature of 0°F or below; and

(3) has a source of refrigeration requiring an energy input.

## 

## 1.3 Measure Application Type

The DEER Measure Cost Data Users Guide found on [www.deeresources.com](http://www.deeresources.com) under *DEER2011 Database Format* hyperlink, DEER2011 for 13-14, spreadsheet *SPTdata\_format-V0.97.xls*, defines the terms as follows:

Table 2 Measure Application Type[[2]](#endnote-2)

*Identifies the measure application type in the Measure Implementation table in DEER2014.*

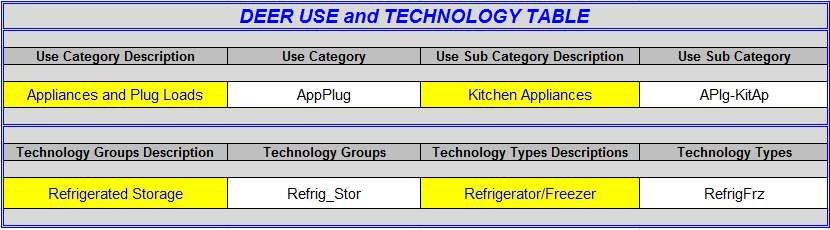
|  |  |  |
| --- | --- | --- |
| **Code** | **Description** | **Comment** |
| ER | Early retirement | *Measure is more efficient than code/std; Dual baseline, full measure costs required* |
| ROB | Replace on Burnout | *Single baseline (above code), incremental or full costs* |
| NC | New Construction | *Single baseline (above code), incremental or full costs* |
| REA | Retrofit Add On | *Single baseline (above pre-existing), full measure costs required* |

The measure application type for these measures is replace on burnout.

## 1.4 Product Base Case and Measure Case Data

## 1.4.1 DEER Base Case and Measure Case Information

* The DEER 2015 data includes energy impacts, EUL and NTG information for refrigerators, compact refrigerators, and freezers that are 10% and 30% better than the Federal Standard. The 2008 DEER v3.02 contains cost data for Energy Star refrigerators and freezers.



* The data cited by DEER 2015 is not exactly applicable to these measures because the size ranges in DEER 2015 do not coincide with the size ranges in the IOU measure descriptions. Consequently, the rated energy savings obtained from the DOE equations is multiplied by DEER basis factors to obtain claimed savings for the IOU size ranges. Savings for CEE Tier 3 (20% better than federal standard) measures are obtained by scaling impacts for Energy Star (10% better than federal standard). See section 2 for more details.

**Delta Wattage Assumption (ΔW):** The delta Watts for refrigerators and freezers were derived from 2015 DEER. The PG&E measures are based on the difference between a refrigerator that meets the federal standard and one that is 20% more efficient than the federal standard.

**Hours of Operation:** The hours of operation are embedded in the energy impacts in 2015 DEER. Energy Star assumes 8760 hours/year.

**Net-to-Gross Assumption:** NTG values for this workpaper were taken from 2015 DEER. The DEER did not list NTG values specific to energy efficient refrigerators so the default of “All other EEM with no evaluated NTGR; existing EEM with same delivery mechanism for more than 2 years” was selected for energy efficient refrigerators and freezers.

Table 3 below summarizes all applicable DEER based Net-to-Gross ratios for programs that may be used by this measure.

Table 3 DEER Net-to-Gross Ratios

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **DEER Spreadsheet** | |
| Program Approach | NTG | File name | Cell Number |
| Res-Default>2:  All other EEM with no evaluated NTGR; existing EEM with same delivery mechanism for more than 2 years | 0.55 | SupportTable\_NTGR.csv1 | D50 |

**Effective Useful Life / Remaining Useful Life:** The EUL is 14 years per 2008 DEER and 2011 DEER v4.01.[[3]](#endnote-3)

**In-service factor/first year installation rate**: There is an assumed 100% installation rate for these measures.

## 1.4.2 Codes & Standards Requirements Base Case and Measure Information

***Title 20:*** These measures fall under Section 1605.1 of Title 20 of the California Energy Regulations.[[4]](#endnote-4) These State Standards are based on the Federal Regulations for Refrigerators (see “Federal Standards” below).

***Title 24:*** These measures do not fall under Title 24 of the California Energy Regulations.

***Federal Standards:*** These measures fall under Federal DOE regulations. The National Appliance Energy Conservation Act (NAECA) dictates minimum energy consumption standards for both commercial and non-commercial refrigerators and freezers. These standards are as follows:

|  |  |  |
| --- | --- | --- |
| **Product Class** | **Equations for Maximum Energy Use (kWh/yr)** | |
|  | Based on AV (cu ft) | Based on av (L) |
| 1. Refrigerator-freezers and refrigerators other than all-refrigerators with manual defrost. | 7.99AV + 225.0 | 0.282av + 225.0 |
| 1A. All-refrigerators—manual defrost. | 6.79AV + 193.6 | 0.240av + 193.6 |
| 2. Refrigerator-freezers—partial automatic defrost | 7.99AV + 225.0 | 0.282av + 225.0 |
| 3. Refrigerator-freezers—automatic defrost with top-mounted freezer without an automatic icemaker. | 8.07AV + 233.7 | 0.285av + 233.7 |
| 3-BI. Built-in refrigerator-freezer—automatic defrost with top-mounted freezer without an automatic icemaker. | 9.15AV + 264.9 | 0.323av + 264.9 |
| 3I. Refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service. | 8.07AV + 317.7 | 0.285av + 317.7 |
| 3I-BI. Built-in refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service. | 9.15AV + 348.9 | 0.323av + 348.9 |
| 3A. All-refrigerators—automatic defrost. | 7.07AV + 201.6 | 0.250av + 201.6 |
| 3A-BI. Built-in All-refrigerators—automatic defrost. | 8.02AV + 228.5 | 0.283av + 228.5 |
| 4. Refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker. | 8.51AV + 297.8 | 0.301av + 297.8 |
| 4-BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker. | 10.22AV + 357.4 | 0.361av + 357.4 |
| 4I. Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service. | 8.51AV + 381.8 | 0.301av + 381.8 |
| 4I-BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service. | 10.22AV + 441.4 | 0.361av + 441.4 |
| 5. Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker. | 8.85AV + 317.0 | 0.312av + 317.0 |
| 5-BI. Built-In Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker. | 9.40AV + 336.9 | 0.332av + 336.9 |
| 5I. Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service. | 8.85AV + 401.0 | 0.312av + 401.0 |
| 5I-BI. Built-In Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service. | 9.40AV + 420.9 | 0.332av + 420.9 |
| 5A. Refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service. | 9.25AV + 475.4 | 0.327av + 475.4 |
| 5A-BI. Built-in refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service. | 9.83AV + 499.9 | 0.347av + 499.9 |
| 6. Refrigerator-freezers—automatic defrost with top-mounted freezer with through-the-door ice service. | 8.40AV + 385.4 | 0.297av + 385.4 |
| 7. Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service. | 8.54AV + 432.8 | 0.302av + 432.8 |
| 7-BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service. | 10.25AV + 502.6 | 0.362av + 502.6 |
| 8. Upright freezers with manual defrost. | 5.57AV + 193.7 | 0.197av + 193.7 |
| 9. Upright freezers with automatic defrost without an automatic icemaker. | 8.62AV + 228.3 | 0.305av + 228.3 |
| 9I. Upright freezers with automatic defrost with an automatic icemaker. | 8.62AV + 312.3 | 0.305av + 312.3 |
| 9-BI. Built-In Upright freezers with automatic defrost without an automatic icemaker. | 9.86AV + 260.9 | 0.348av + 260.9 |
| 9I-BI. Built-in upright freezers with automatic defrost with an automatic icemaker. | 9.86AV + 344.9 | 0.348av + 344.9 |
| 10. Chest freezers and all other freezers except compact freezers. | 7.29AV + 107.8 | 0.257av + 107.8 |
| 10A. Chest freezers with automatic defrost. | 10.24AV + 148.1 | 0.362av + 148.1 |
| 11. Compact refrigerator-freezers and refrigerators other than all-refrigerators with manual defrost. | 9.03AV + 252.3 | 0.319av + 252.3 |
| 11A.Compact all-refrigerators—manual defrost. | 7.84AV + 219.1 | 0.277av + 219.1 |
| 12. Compact refrigerator-freezers—partial automatic defrost | 5.91AV + 335.8 | 0.209av + 335.8 |
| 13. Compact refrigerator-freezers—automatic defrost with top-mounted freezer. | 11.80AV + 339.2 | 0.417av + 339.2 |
| 13I. Compact refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker. | 11.80AV + 423.2 | 0.417av + 423.2 |
| 13A. Compact all-refrigerators—automatic defrost. | 9.17AV + 259.3 | 0.324av + 259.3 |
| 14. Compact refrigerator-freezers—automatic defrost with side-mounted freezer. | 6.82AV + 456.9 | 0.241av + 456.9 |
| 14I. Compact refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker. | 6.82AV + 540.9 | 0.241av + 540.9 |
| 15. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer. | 11.80AV + 339.2 | 0.417av + 339.2 |
| 15I. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker. | 11.80AV + 423.2 | 0.417av + 423.2 |
| 16. Compact upright freezers with manual defrost. | 8.65AV + 225.7 | 0.306av + 225.7 |
| 17. Compact upright freezers with automatic defrost. | 10.17AV + 351.9 | 0.359av + 351.9 |
| 18. Compact chest freezers. | 9.25AV + 136.8 | 0.327av + 136.8 |

AV= adjusted volume in cubic feet; av = adjusted volume in liters.

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

In 2009 KEMA published the *Process Evaluation of Southern California Edison’s 2006-2008 Home Energy Efficiency Rebate (HEER) Program: Final Report.* SCE offered Energy Star refrigerator rebates through their HEER program in 2006-2008 and are currently offering Energy Star refrigerator rebates for the 2010-2012 program cycle. The KEMA study evaluated customer awareness of, and interest in, the SCE HEER program. This report did not provide information pertinent to the energy savings, NTG, EUL or cost estimates for this workpaper.

The EPA’s ENERGY STAR also published a *Refrigerator Market Profile* in 2009 to give energy efficiency program designers and policy makers an idea of market opportunities and savings potential for energy efficient refrigerators. The energy savings potential identified in the report was based on the difference in energy consumption between the installed refrigerator base leading up to 2009 and the Energy Star refrigerator specification. The savings potential from this study cannot be easily compared to the savings identified in this workpaper because the workpaper measures estimate the difference in energy consumption between a refrigerator that is more efficient than Energy Star and the federal standard for refrigerator energy consumption. Many refrigerators comprising the installed base in the ENERGY STAR report do not meet current federal standard.

## 1.4.4 Assumptions and Calculations from other sources—Base and Measure Cases

There are no further data or calculations provided for the support of the measures in this workpaper.

***1.4.5 Time-of-Use Adjustment Factor***

We are required by CPUC decision 06-06-063 dated June 29, 2006 to apply time-of-use (TOU) adjustment factors on residential A/C and commercial A/C (packaged and split-system direct-expansion cooling) measures only. Since this is not an A/C measure, the TOU adjustment factor is 0.

The specific values and results are summarized in Table 4.

Table 4 TOU Adjustment Factors

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure** | ***kWAC*** | ***kWTotal*** | **%** |
| Energy Efficient Refrigerators | 0 | 0 | 0 |

***1.5 Summary of Inputs for Savings Calculations***

The following table provides references to sections that document the inputs for calculation:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Input Variable** | **Variations** | **Base Case Average Value** | **Measure Case Average Value** | | **Reference Section** |
| **Electric Savings** | CZ | Varies | Varies | | Section 2.1 |
| **Gas Savings** | CZ | Varies | Varies | | Section 2.3 |
| **Hours of operation** | Any | 8760 | 8760 | | Section 1.4.1 |
| **Full Cost** | ROB | Varies | Varies | | Section 4.3.1 |
| **Incremental Cost** | ROB | Varies | Varies | | Section 4.3.2 |
| **EUL /RUL** | ROB | 14 / 4.7 | 14 / 4.7 | | Section 1.4.1 |
| **NTG** | many | Varies | Varies | | Section 1.4.1 |
| **ISR** | Applies -- No | 1 | 1 | | Section 1.4.1 |
| **TOU Factor** | *A/C projects only* | *N/A* | *N/A* | *Section 1.4.5* | |  |

# 

# Section 2. Calculation Methods

Table 5 Baseline by Measure Application Type

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Measure Life Basis** | **First Baseline Period: Energy Savings Baseline** | **Second Baseline Period: Energy Savings Baseline** |
| ***ER* (early retirement)** | **EUL** | Customer Average Baseline | Code Baseline |
| ***ROB* (replace-on-burnout)** | **EUL** | Code Baseline | N/A |
| ***NC* (new construction)** | **RUL/EUL-RUL** | Code Baseline | N/A |

Notes:

* For ROB measures, First Baseline is the baseline for the full EUL. There is no second baseline.
* For ER measures, First Baseline Period is the period for the RUL(remaining useful life), defined by the CPUC as RUL=1/3 EUL. Second baseline period for ER is Code baseline for the period EUL-RUL.

## 2.1 Electric Energy Savings Estimation Methodologies

* This measure includes HVAC interactive effects savings.
* This measure is not an Early Retirement measure.

**Energy Star Refrigerators**

DEER 2015 contains savings impacts for standard sized refrigerators in the following size categories: mini, small, medium, large, and very large. However, in order to retain consistency with the previous program cycle, the IOU measures for standard sized refrigerators are split into at most three size categories (same as DEER 2011): large, medium, and/or small. Therefore, the DEER 2015 impacts are not directly applicable and savings impacts are recalculated with IOU size categories. The following outlines the methodology to crosswalk the DEER 2015 size categories to the IOU size categories.

The average total volume of the size category is taken as the average of the lower and upper range of the applicable size category. The total volume is crosswalked to adjusted volume for the applicable refrigerator type using the methodology in the DOE’s Technical Support Document. Using the adjusted volume, the federal mandated maximum annual unit energy consumption can be derived from the energy standard equations in section 1.4.2. Similarly, the annual unit energy consumption of an Energy Star refrigerator can be calculated by applying the adjusted volume to Energy Star’s equation for determining eligibility. The difference between the federal code UEC and Energy Star UEC is the rated energy savings. The rated energy savings is converted to claimed energy savings by applying DEER basis factors. DEER basis factors are taken from DEER 2014: “RE-Appl-RefgCond-basis”. Below is an example for refrigerators with bottom mounted freezers without icemaker (climate zone 1, >= 16.5 cubic feet):

See file “Refrigerator Calculations – DEER 2015.xlsx” for calculations.

**Energy Star Most Efficient Refrigerators**

Savings impacts for Energy Star Most Efficient standard sized refrigerators are calculated the same way as for Energy Star refrigerators except that the total volume is calculated as an average of volumes in the Energy Star qualified products list.

**Compact Refrigerators**

Energy Saving impacts for Energy Star compact refrigerators is derived by taking an average of DEER 2015 (Tier 1) savings impacts for small and mini compact refrigerator categories.

## CEE Tier 3 Refrigerators

CEE Tier 3 measure impacts are scaled from the savings impacts for Energy Star. Since CEE Tier 3 refrigerators are 20% more efficient than federal standard and Energy Star refrigerators are 10 % better than federal standard, CEE Tier 3 savings are derived by scaling Energy Star savings by a factor of 2.

CEE Tier 3 savings = Energy Star savings \*(20%/10%)

**Energy Star Freezers**

Energy Savings for Energy Star Freezers are taken directly from DEER 2015.

## 2.2. Demand Reduction Estimation Methodologies

* This measure includes HVAC interactive effects savings.
* This measure is not an Early Retirement measure.

Demand savings are obtained either directly from DEER 2015 or by applying the applicable DEER basis factor for kW savings to the delta between the rated federal code UEC and the rated measure UEC.

See Section 2.1 for details.

## 2.3. Gas Energy Savings Estimation Methodologies

* Gas estimates are entirely those estimated increased gas us through calculated interactive effects.
* This measure includes HVAC interactive effects savings.
* This measure is not an Early Retirement measure.

Gas savings are obtained either directly from DEER 2015 or by applying the applicable DEER basis factor for therm savings to the delta between the rated federal code UEC and the rated measure UEC.

See Section 2.1 for details.

# Section 3. Load Shapes

## 3.1 Base Case Load Shapes

The closest load shape chosen for this measure is the DEER: Res.Refrigeration load shape. See the KEMA report [31] for a more thorough discussion regarding the load shapes for this measure.

## 3.2 Measure Load Shapes

The measure load shape for this measure is determined based on the applicable residential market sector and the refrigerator/freezer end-use. This load shape is different from the base case due to the savings impact of the measures and is shown by the load shapes listed below.

The closest load shape chosen for this measure is the DEER:RefgFrzr\_HighEff load shape. See the KEMA report [31] for a more thorough discussion regarding the load shapes for this measure.

# Section 4. Base Case & Measure Costs

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Measure Life Basis** | **First Baseline Period Full Measure Cost (RUL)** | **Second Baseline Period Full Measure Cost (EUL – RUL)** |
| ***NC (new construction)*** | EUL | Calculated as Incremental Measure Cost | N/A |
| ***ROB(replace on burnout)*** | EUL | Calculated as Incremental Measure Cost | N/A |
| ***ER (early retirement)*** | RUL/  EUL-RUL | Calculated as Full Gross Measure Cost | Calculated as Negative Full Gross Base Case Cost |

## 

## 4.1 Base Case(s) Costs

The following Transaction type is appropriate to these measures. The Base Case Costs are:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Measure Code*** | **DEER Measure Description** | **Measure Application Type** | **Baseline** | **Equipment Cost** | **Labor / Installation Cost** | **Maintenance / Other Cost** | **Total Base Case Cost** |
| RFBI | REFRIGERATOR: BOTTOM FREEZER WITH ICE LARGE | ROB | Code | $1,365.82 | 90.4 | $0.00 | $1,456.22 |
| RFBS | REFRIGERATOR: BOTTOM FREEZER WITHOUT ICE SMALL | ROB | Code | $1,088.54 | 90.4 | $0.00 | $1,178.94 |
| RFBZ | REFRIGERATOR: BOTTOM FREEZER WITHOUT ICE LARG | ROB | Code | $1,365.82 | 90.4 | $0.00 | $1,456.22 |
| RFMC | REFRIGERATOR: MISCELLANEOUS (PG&E ONLY, NON-DEER) | ROB | Code | $1,205.42 | 90.4 | $0.00 | $1,295.82 |
| RFSI | REFRIGERATOR: SIDE FREEZER WITH ICE LARGE | ROB | Code | $2,185.26 | 90.4 | $0.00 | $2,275.66 |
| RFSSI | REFRIGERATOR: SIDE FREEZER WITH ICE SMALL | ROB | Code | $1,934.71 | 90.4 | $0.00 | $2,025.11 |
| RFSSZ | REFRIGERATOR: SIDE FREEZER WITHOUT ICE SMALL | ROB | Code | $1,070.18 | 90.4 | $0.00 | $1,160.58 |
| RFSZ | REFRIGERATOR: SIDE FREEZER WITHOUT ICE LARGE | ROB | Code | $1,273.97 | 90.4 | $0.00 | $1,364.37 |
| RFTL | REFRIGERATOR: TOP FREEZER WITHOUT ICE LARGE | ROB | Code | $788.20 | 90.4 | $0.00 | $878.60 |
| RFTM | REFRIGERATOR: TOP FREEZER WITHOUT ICE MEDIUM | ROB | Code | $617.81 | 90.4 | $0.00 | $708.21 |
| RFTS | REFRIGERATOR: TOP FREEZER WITHOUT ICE SMALL | ROB | Code | $524.26 | 90.4 | $0.00 | $614.66 |
| RFCM | COMPACT REFRIGERATORS | ROB | Code | $175.00 | 14.94 | $0.00 | $189.94 |

*All costs are noted as $ per measure unit*

Base case costs for mid- and full-sized refrigerators were taken from DEER 2008[[5]](#endnote-5) for energy efficient refrigerators in lieu of better data. A large amount of retail price data was collected from participating retailers in the PG&E territory; however, the data did not indicate any reliable trends in price that would prove useful for this workpaper. Some incremental costs were negative and others positive. Therefore DEER costs were utilized. The 2010-2012 Work Order 17 Ex Ante Measure Cost Study contains cost information for refrigerators. However, it has yet to be approved for adoption. Therefore, DEER 2008 costs are utilized for this workpaper.

Compact refrigerator incremental measure cost of $10 was taken from the most recent Energy Star Appliance Savings calculator.7 A base case cost of $175 is assumed based on the previous version of the Energy Star Residential Refrigerator Calculator for compact refrigerators.

Freezer base case costs are from DEER 2008:

* Upright, automatic defrost: $627.40
* Upright, manual defrost: $433.62
* Chest, manual defrost: $508.10
* Chest, automatic defrost: Not in DEER, so $508.10 is used.

The labor cost for all non-compact refrigerators and freezers is assumed to be $90.40, which is from DEER 2008. The labor cost for a compact refrigerator is scaled by labor and measure costs from the Energy Star calculator default cost, to be $14.94.

## 4.2 Measure Case Costs

The following Transaction types are appropriate to these measures. The Measure Case Costs are:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***Measure Code*** | **DEER Measure Description** | **Transaction** | **Measure Case** | **Equipment Cost** | **Labor / Installation Cost** | **Maintenance / Other Cost** | **Total Base Case Cost** |
| RFBI | REFRIGERATOR: BOTTOM FREEZER WITH ICE LARGE | ROB | 20% better than Code | $1,511.11 | 90.4 | $0.00 | $1,601.51 |
| RFBS | REFRIGERATOR: BOTTOM FREEZER WITHOUT ICE SMALL | ROB | 20% better than Code | $1,227.15 | 90.4 | $0.00 | $1,317.55 |
| RFBZ | REFRIGERATOR: BOTTOM FREEZER WITHOUT ICE LARG | ROB | 20% better than Code | $1,511.11 | 90.4 | $0.00 | $1,601.51 |
| RFMC | REFRIGERATOR: MISCELLANEOUS (PG&E ONLY, NON-DEER) | ROB | 20% better than Code | $1,336.79 | 90.4 | $0.00 | $1,427.19 |
| RFSI | REFRIGERATOR: SIDE FREEZER WITH ICE LARGE | ROB | 20% better than Code | $2,287.13 | 90.4 | $0.00 | $2,377.53 |
| RFSSI | REFRIGERATOR: SIDE FREEZER WITH ICE SMALL | ROB | 20% better than Code | $2,036.58 | 90.4 | $0.00 | $2,126.98 |
| RFSSZ | REFRIGERATOR: SIDE FREEZER WITHOUT ICE SMALL | ROB | 20% better than Code | $1,232.17 | 90.4 | $0.00 | $1,322.57 |
| RFSZ | REFRIGERATOR: SIDE FREEZER WITHOUT ICE LARGE | ROB | 20% better than Code | $1,442.64 | 90.4 | $0.00 | $1,533.04 |
| RFTL | REFRIGERATOR: TOP FREEZER WITHOUT ICE LARGE | ROB | 20% better than Code | $921.80 | 90.4 | $0.00 | $1,012.20 |
| RFTM | REFRIGERATOR: TOP FREEZER WITHOUT ICE MEDIUM | ROB | 20% better than Code | $734.71 | 90.4 | $0.00 | $825.11 |
| RFTS | REFRIGERATOR: TOP FREEZER WITHOUT ICE SMALL | ROB | 20% better than Code | $637.82 | 90.4 | $0.00 | $728.22 |
| RFCM | COMPACT REFRIGERATORS | ROB | 10% better than Code | $185.00 | 14.94 | $0.00 | $199.94 |

*All costs are noted as $ per measure unit*

Measure costs were taken from DEER 20086 for energy efficient refrigerators in lieu of better data. A large amount of retail price data was collected from participating retailers in the PG&E territory; however, the data did not indicate any reliable trends in price that would prove useful for this workpaper. Some incremental costs were negative and others positive. Therefore DEER costs were utilized. The 2010-2012 Work Order 17 Ex Ante Measure Cost Study contains cost information for refrigerators. However, it has yet to be approved for adoption. Therefore, DEER 2008 costs are utilized for this workpaper.

Compact refrigerator incremental measure cost of $10 was taken from the most recent Energy Star Appliance Savings calculator.7 A base case cost of $175 is assumed based on the previous version of the Energy Star Residential Refrigerator Calculator for compact refrigerators. Thus, the measure cost of compact refrigerators is $185.

Freezer measure case costs are from DEER 2008:

* Upright, automatic defrost: $672.70
* Upright, manual defrost: $471.60
* Chest, manual defrost: $529.82
* Chest, automatic defrost: Not in DEER, so $529.82 is used.

The labor cost for all non-compact refrigerators and freezers is assumed to be $90.40, which is from DEER 2008. The labor cost for a compact refrigerator is scaled by labor and measure costs from the Energy Star calculator default cost, to be $14.94.

## 4.3 Incremental & Full Measure Costs

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Full Measure Cost**  **(RUL Period/First Baseline)** | **Full Measure Cost**  **(EUL-RUL Period/ Second Baseline)** | **Incremental Measure Cost** |
| ER | Measure Equipment Cost  +Measure Labor Cost | (-1)x(Base Equipment Cost  + Base Labor Cost) | Measure Equipment Cost  – Base Case Equipment Cost |
| ROB | Measure Equipment Cost  – Base Case Equipment Cost | N/A | Measure Equipment Cost  – Base Case Equipment Cost |
| NC | Measure Equipment Cost  – Base Case Equipment Cost | N/A | Measure Equipment Cost  – Base Case Equipment Cost |

## 4.3.1 Full Measure Cost

Full Measure Cost is the cost to install an energy efficient measure per the CPUC calculators. This definition implies a different meaning depending on the install type.

This measure transaction type is: **ROB**, so the Full Measure Cost (FMC) is represented by the equation below:

FMC = (Measure Equipment Cost + Measure Labor Cost) –

(Base Case Equipment Cost + Base Case Labor Cost)

\*Note: We assume that, unless stated otherwise, the measure case labor and base case labor are assumed to be the same value reducing the equation to the following:

FMC = Measure Equipment Cost – Base Case Equipment *Cost*

*FMC = $ per (unit) - $ per (unit) = $ per unit*

\*Note: Various complicated price fluctuations are not addressed in these equations, such as future costs due to inflation in labor, future costs due to deflation in material cost, and other variables that cannot be accurately described at this time.

## 4.3.2 Incremental Measure Costs

Incremental Measure Cost is the premium cost to install an energy efficient measure over a standard efficiency measure or code baseline measure. While IMC has a straight forward definition depending on the install type, the equation does vary.

This measure transaction type is: **ROB** so the Gross Measure Cost (GMC) is represented by the equation below:

IMC = (Measure Equipment Cost + Measure Labor Cost) –

(Base Case Equipment Cost + Base Case Labor Cost)

\*Note: Unless stated otherwise the measure case labor and base case labor are assumed to be the same value reducing the equation to the following:

IMC = Measure Equipment Cost – Base Case Equipment Cost

*IMC = $ per (unit) -- $ per (unit) = $ per (unit)*

**Summary Table for Section 4**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Measure ID** | **DEER Measure Description** | **Measure Application Type** | **Base Case Total Cost** | **Measure Case Total Cost** | **Gross Measure Case Cost** | **Incremental Measure Cost** |
| RFBI | REFRIGERATOR: BOTTOM FREEZER WITH ICE LARGE | ROB | $1,456.22 | $1,601.51 | $145.29 | $145.29 |
| RFBS | REFRIGERATOR: BOTTOM FREEZER WITHOUT ICE SMALL | ROB | $1,178.94 | $1,317.55 | $138.61 | $138.61 |
| RFBZ | REFRIGERATOR: BOTTOM FREEZER WITHOUT ICE LARG | ROB | $1,456.22 | $1,601.51 | $145.29 | $145.29 |
| RFMC | REFRIGERATOR: MISCELLANEOUS (PG&E ONLY, NON-DEER) | ROB | $1,295.82 | $1,427.19 | $131.37 | $131.37 |
| RFSI | REFRIGERATOR: SIDE FREEZER WITH ICE LARGE | ROB | $2,275.66 | $2,377.53 | $101.87 | $101.87 |
| RFSSI | REFRIGERATOR: SIDE FREEZER WITH ICE SMALL | ROB | $2,025.11 | $2,126.98 | $101.87 | $101.87 |
| RFSSZ | REFRIGERATOR: SIDE FREEZER WITHOUT ICE SMALL | ROB | $1,160.58 | $1,322.57 | $161.99 | $161.99 |
| RFSZ | REFRIGERATOR: SIDE FREEZER WITHOUT ICE LARGE | ROB | $1,364.37 | $1,533.04 | $168.67 | $168.67 |
| RFTL | REFRIGERATOR: TOP FREEZER WITHOUT ICE LARGE | ROB | $878.60 | $1,012.20 | $133.60 | $133.60 |
| RFTM | REFRIGERATOR: TOP FREEZER WITHOUT ICE MEDIUM | ROB | $708.21 | $825.11 | $116.90 | $116.90 |
| RFTS | REFRIGERATOR: TOP FREEZER WITHOUT ICE SMALL | ROB | $614.66 | $728.22 | $113.56 | $113.56 |
| RFCM | COMPACT REFRIGERATORS | ROB | $189.94 | $199.94 | $10.00 | $10.00 |

# References

1. California Public Utilities Commission (CPUC), Database for Energy Efficient Resources (DEER) v. 2014, Table Name: *NTGR*, NTG\_ID: *Res-Default>2*, *Com-Default>2yrs*, extracted from READI\_v1.0.5.zip, downloaded from [www.deeresources.com](http://www.deeresources.com). [↑](#endnote-ref-1)
2. The DEER Measure Cost Data Users Guide found on [www.deeresources.com](http://www.deeresources.com) under *DEER2011 Database Format* hyperlink, DEER2011 for 13-14, spreadsheet *SPTdata\_format-V0.97.xls.* [↑](#endnote-ref-2)
3. 2011 Database for Energy-Efficient Resources, Version 2011 4.01 (November 2011)k taken from *EUL\_Summary\_10-1-08.xls*, “DEER EUL Summary” tab, cell D103 found at <http://www.deeresources.com/index.php?option=com_content&view=article&id=68&Itemid=60> [↑](#endnote-ref-3)
4. California Energy Commission, Title 20 2010 Appliance Efficiency Regulations. <http://www.energy.ca.gov/2014publications/CEC-400-2014-009/CEC-400-2014-009-CMF.pdf>. 1605.1(a), Table A-3. [↑](#endnote-ref-4)
5. 2008 Database for Energy-Efficient Resources, Version 2008.2.05 (December 16, 2008). Technology and Measure Cost Values. Taken from *Revised DEER Measure Cost Summary (05\_30\_2008) Revised (06\_02\_2008).xls*, "Res - Appliance" Tab

   <http://www.deeresources.com/index.php?option=com_content&view=article&id=65&Itemid=57> [↑](#endnote-ref-5)