

## DEEMED SAVINGS TECHNICAL ASSUMPTIONS

### Program: ENERGY STAR New Homes

#### Description:

The CO ENERGY STAR New Homes (ESNH) product provides residential homebuilders with an incentive to build new single-family, small multi-family and town homes that are at least 10% more energy-efficient than what local building codes require. Builders are encouraged to consider a “whole-house” approach and have the flexibility to install any combination of efficient technologies and building techniques to meet the program requirements and qualify for rebate. The product utilizes Performance testing per Residential Energy Services Network (RESNET) Home Energy Rating System (HERS) and each home will be modeled by a certified RESNET energy rater using the widely adopted REM/Rate™ software application or a Company approved equivalent.

#### Program References:

LEDs	Refer to Program "Home Lighting & Recycling" to find formulas for (Customer kW, Customer kWh, Customer PCKW, etc.) for the "LED" measure.
LEDs	Refer to Program "Home Lighting & Recycling" to find reference table for "Existing lighting wattage for
LEDs	Refer to Program "Home Lighting & Recycling" to find reference table for "Average Cost" values.
LEDs	Refer to Program "Home Lighting & Recycling" to find reference table for "Measure Life" values.
Heat Pump Water Heaters	Refer to Program "Water Heaters" to find formulas (Customer kW, Customer kWh, Customer PCKW, etc.) for the "Heat Pump Water Heater" measures.
Heat Pump Water Heaters	Refer to Program "Water Heaters" to find reference table for "Secondary Cooling and heating Benefits"
Heat Pump Water Heaters	Refer to Program "Water Heaters" to find reference table for "Incremental cost, NTG and lifetime" values.
Heat Pump Water Heaters	Refer to Program "Water Heaters" to find reference table for "Baseline Efficiency Coefficients" values.
Energy Star Smart Thermostats	Refer to Program "Smart Thermostat & Optimization" to find formulas (Customer kW, Customer kWh, Customer PCKW, etc.) for the "Energy Star Smart Thermostats" measures.

#### Algorithms:

Gross kW Saved at Customer Envelope Measures Envelope_kW	=MAX( summer peak kW savings ; winter peak kW savings ) Data for the summer and winter peak kW savings are included in the software model for each individual home as provided by the House Rating Agent.
Gross Coincident kW Saved at Customer Envelope Measures Coincident_Envelope_kW	= ( Envelope_kW ) x 90% CF
Gross Annual kWh Saved at Customer Envelope measure Envelope_kWh	= Total Reference Home kWh - Total As-built Home kWh Data for The Reference Home and As-Built Home kWh are included in the software model for each individual Home As provided by the House Rating Agent and based on Local codes.

### DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Gross Dth/Yr Envelope Measures Envelope_Dth/Yr	= (Total Reference Home Therms - Total As-built Home Therms ) / 10 Data for The Reference Home and As-Built Home Therms are included in the software model for each individual Home as provided by the House Rating Agent and based on Local codes.
Gross kW Saved at Customer kW_Saved	= Gross Annual kWh / Hours
Gross Coincident kW Saved at Customer Coincidence_kW_Saved	= Gross kW Saved at Customer * CF
As-Built_Home_MMBTU	= ( As-Built Heating (kWh) + As-Built Cooling (kWh) + As-Built Lights & Appliances (kWh) ) x 3412 / 1000000 + ( As-Built Heating (therms) + As-Built Water Heating (therms) + As-Built Lights & Appliances (therms) ) / 10
Ref_Home_MMBTU	= ( Reference Heating (kWh) + Reference Cooling (kWh) + Reference Lights & Appliances (kWh) ) x 3412 / 1000000 + ( Reference Heating (therms) + Reference Water Heating (therms) + Reference Lights & Appliances (therms) ) / 10
Percent better than code	= ( Ref_Home_MMBTU - As-Built_Home_MMBTU ) / Ref_Home_MMBTU
Incremental capital cost adjustment factor	= 1 + ( ICC_ADJ_a X LN ( Home_Size ) + ICC_ADJ_b )
As Built Incremental Capital Cost As-built ICC/SF	= ( ICC/SF_a x %_BTC^2 + ICC/SF_b x %_BTC + ICC/SF_c ) x ICC_Adj_Factor
summer peak kW savings	= Summer Peak kW (Reference) - Summer Peak kW (As Built)
winter peak kW savings Winter_Peak_kW	= Winter Peak kW (Reference) - Winter Peak kW (As Built)
Gross Annual kWh Saved at Customer ES Radon Measure	= (1-%EE Fans Installed) * (W <sub>base</sub> -W <sub>ES</sub> )*Radon Fan hours/1000
Peak Coincident kW Saved at Customer Radon Fan Measure	= ( Radon_kW ) x 100% CF
Gross Annual kWh Saved at Customer ES Radon Measure (Radon_kW)	= (1-%EE Fans Installed) * (W <sub>base</sub> -W <sub>ES</sub> )/1000
Incremental Cost Radon Fan Measure	= Efficient Radon Fan Cost - Baseline Radon Fan Cost

## DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Variables:	Value	Description
As-Built_HERS	Customer Input	As-Built Home's HERS Index Score calculated by the Home Rater using a software modeling tool and provided under HERS Index (Final)
Baseline Energy Code	Customer Input	Home Rater identified Baseline Energy Code for the jurisdiction in which the home is being built. IECC 2006, IECC 2009, IECC 2012, IECC 2015
Home_Size	Customer Input	Home's conditioned square footage, provided by the home rater.
ICC/SF_a ICC/SF_b ICC/SF_c	See Table 2	Constants for use in calculating an Incremental Cost / Square Foot of home. The cost curve is derived from information provided by Residential Science Resources estimates and home modeling of the most common measures implemented to improve the envelope performance over local codes. Curves are developed for IECC 2006/2009 and IECC 2012/2015.
ICC_ADJ_a ICC_ADJ_b	See Table 3	Constants for use in calculating an adjustment factor to correct the incremental cost for home size. An increase in homes size reduces the cost per square foot for the same set of measures due to economies of scale. This factor is used in conjunction with the As-built_ICC/SF cost formula
Clothes washer electric energy savings (Gross Annual kWh)	See Table 1	Energy savings for the clothes washer are based on the ENERGY STAR Clothes Washer Savings Calculator: Reference 7. This will vary based on source for domestic hot water heat; gas or electric.
Clothes washer Hours	312	Assumed Hours of operation for a clothes washer, based on number of duty cycles and a duty cycle of 1 hour.
Clothes washer natural gas savings (Gross Dth/Yr)	0.12	Energy savings for the clothes washer are based on the ENERGY STAR Clothes Washer Savings Calculator: Reference 7. For homes with gas domestic hot water heat.
Quantity_LEDs	See Table 4	Deemed quantity of high efficacy lamps used in the LED measures.
Eff_LED_Lamp_Wattage	See Table 4	Deemed efficient lamp wattage used in the LED measures. Based on weighted average lamps sold under the Home Lighting and Recycling program

### DEEMED SAVINGS TECHNICAL ASSUMPTIONS

Baseline_Lamp_Wattage	See Table 4	Deemed baseline lamp wattage used in the LED measures. Based on weighted average baseline lamps for the associated Eff_LED_Lamp_Wattages from the Home Lighting and Recycling program.
Refrigerator electric energy savings (Gross Annual kWh)	16	Energy savings for the refrigerator were based on the ENERGY STAR Refrigerator Savings Calculator: Reference 8.
Refrigerator Hours	8,760	Assumed Hours of operation for a refrigerator.
Incremental Cost Energy Star Certification	\$505.00	Incremental cost for completing the construction measures necessary and the paperwork required to achieve Energy Star Certification.
Non-energy O&M savings	See Table 1	Water Savings per year for an Energy Star Clothes Washer
CF Clothes Washer	See Table 1	Coincidence Factor of an energy star Clothes Washer
Measure Life As-built Home	20	Envelope Measures (Reference 1)
Measure Life Refrigerator	13	Life of an energy star refrigerator (Reference 4)
Measure Life Clothes Washer	11	Life of an energy star Clothes Washer (Reference 5)
Pipe Diameter (in)	4	Assumption based on contractor feedback (Reference 10)
Pipe Length (ft)	25	Assumption based on contractor feedback (Reference 10)
Efficient Radon Fan Airflow (CFM)	33	Reference 9
Baseline Radon Fan Airflow (CFM)	63	Reference 9
Efficient Radon Fan Operating Pressure	0.68	Operating Pressure in "WC (Reference 10)
Baseline Radon Fan Operating Pressure	1.30	Operating Pressure in "WC (Reference 10)
Radon Fan Hours	8,760	Assumed Hours of operation for a radon fan
$W_{base}$	53.6	Reference 9
$W_{ES}$	16.9	Reference 9
% EE Fans Installed	15%	Assumed percentage of Energy Star Radon Fans being sized correctly and installed currently based on contractor feedback (Reference 9)
Radon Fan Coincidence Factor	100%	Fans run 24x7x365
Baseline Radon Fan Cost	\$139.00	Reference 11
Efficient Radon Fan Cost	\$135.00	Reference 11
Incremental Cost	-\$4.00	Incremental cost of RP140 as compared to RP145 (Reference 11)
Measure Life Radon Fan	10	Life of an energy star Radon Fan (Reference 10)

## DEEMED SAVINGS TECHNICAL ASSUMPTIONS

### Inputs:

Home As-built energy model and the reference home energy model are developed by the House Rater using a modeling software tool. The

- Home Size (Square Footage)
- HERS Index (Final)
- Baseline Energy Code
- Reference Heating (therms)
- Reference Heating (kWh)
- Reference Cooling (kWh)
- Reference Water Heating (therms)
- Reference Lights & Appliances (therms)
- Reference Lights & Appliances (kWh)
- As-Built Heating (therms)
- As-Built Heating (kWh)
- As-Built Cooling (kWh)
- As-Built Water Heating (therms)
- As-Built Lights & Appliances (therms)
- As-Built Lights & Appliances (kWh)
- Reference Summer Peak kW
- As-Built Summer Peak kW
- Reference Winter Peak kW
- As-Built Winter Peak kW
- Energy Star Certification
- Water Heater Fuel
- Clothes Washer Installed
- Quantity high efficacy lamps Installed (Minimum 20) for IECC 2006 or IECC 2009 baseline homes
- 100% high efficacy lamps Installed for IECC 2012 or IECC 2015 baseline homes

## DEEMED SAVINGS TECHNICAL ASSUMPTIONS

### Assumptions:

Peak load and average annual load are not necessarily the same, though they could be depending on if the refrigerator is located indoors in a conditioned or not. In addition, if the refrigerator is located in a conditioned space, then there would be HVAC interactive effects.

### Tables:

<b>Table 1</b>	<b>Clothes Washer</b>
Total Water Savings/Year - Gallons	1,180
kWh Savings in home with electric water heater	32
kWh Savings in home with gas water heater	6
Coincidence_Factor (CF)	3.37%
Non-Energy O&M Savings	\$ 8.30
Incremental Cost	\$ 30.00

**Table 2**

<b>Inc Cost / SF Formula Constants</b>	<b>Customer Type</b>	<b>ICC/SF_a</b>	<b>ICC/SF_b</b>	<b>ICC/SF_c</b>
IECC 2006 Cost / SF Curve:	Combo & Gas Only	2.5326796975	1.6861528732	-0.0353771361
IECC 2009 Cost / SF curve:	Combo & Gas Only	2.5326796975	1.6861528732	-0.0353771361
IECC 2012 Cost / SF Curve:	Combo & Gas Only	29.8939902606	-2.6805872229	0.1117758817
IECC 2015 Cost/SF Curve:	Combo & Gas Only	29.8939902606	-2.6805872229	0.1117758817
<b>IECC 2018 Cost/SF Curve:</b>	<b>Combo &amp; Gas Only</b>	<b>18.2230000000</b>	<b>-1.8385000000</b>	<b>0.0000000000</b>
IECC 2006 Cost / SF Curve:	Electric Only	55.1740111052	-0.9506525740	0.0535285417
IECC 2009 Cost / SF curve:	Electric Only	55.1740111052	-0.9506525740	0.0535285417
IECC 2012 Cost / SF Curve:	Electric Only	55.1740111052	-0.9506525740	0.0535285417
IECC 2015 Cost/SF Curve:	Electric Only	55.1740111052	-0.9506525740	0.0535285417
<b>IECC 2018 Cost/SF Curve:</b>	<b>Electric Only</b>	<b>13.9410000000</b>	<b>0.4032000000</b>	<b>0.0000000000</b>

**DEEMED SAVINGS TECHNICAL ASSUMPTIONS**

**Table 3**

<b>Cost / SF Adjustment Factor Constants</b>	<b>Customer Type</b>	<b>ICC_ADJ_a</b>	<b>ICC_ADJ_b</b>
IECC 2006 Size Cost Adjustment:	Combo & Gas Only	-0.5309676898	4.2733450667
IECC 2009 Size Cost Adjustment:	Combo & Gas Only	-0.5309676898	4.2733450667
IECC 2012 Size Cost Adjustment:	Combo & Gas Only	-0.0608735672	0.4912500728
IECC 2015 Size Cost Adjustment	Combo & Gas Only	-0.0608735672	0.4912500728
<b>IECC 2018 Size Cost Adjustment:</b>	<b>Combo &amp; Gas Only</b>	<b>0.0000000000</b>	<b>0.0000000000</b>
IECC 2006 Size Cost Adjustment:	Electric Only	-0.0349222446	0.3123790541
IECC 2009 Size Cost Adjustment:	Electric Only	-0.0349222446	0.3123790541
IECC 2012 Size Cost Adjustment:	Electric Only	-0.0349222446	0.3123790541
IECC 2015 Size Cost Adjustment:	Electric Only	-0.0349222446	0.3123790541
<b>IECC 2018 Size Cost Adjustment:</b>	<b>Electric Only</b>	<b>0.0000000000</b>	<b>0.0000000000</b>

**Table 4**

	<b>Quantity LED Lamps</b>	<b>Eff Wattage LED Lamps</b>	<b>Baseline Wattage</b>	<b>Coincidence Factor</b>
IECC 2009 or earlier code	20	9.84	45.41	12.6%
IECC 2012 or newer code	10	9.84	45.41	12.6%

**Changes from Previous Filing:**

Updated costs  
 Converted deemed sheet to the new standardized format  
 Moved unused references to Useful Docs sheet  
 Removed Refrigerator replacement  
 Added heat pump water heater measure  
 Removed the stand alone lighting measures from the forecast and included lighting as a step into the envelope cost curves.  
 Added incremental cost calculation parameters for the Electric Only homes.

## DEEMED SAVINGS TECHNICAL ASSUMPTIONS

### References:

1. California Measurement Advisory Committee (CALMAC) Protocols, Appendix F ([www.calmac.org/events/APX\\_F.pdf](http://www.calmac.org/events/APX_F.pdf)).
2. National Energy Efficiency Best Practices Study - Residential Single-Family Comprehensive Weatherization Best Practices Report from December
3. US Lighting Market Characterization Study performed for the Department of Energy in 2002
4. [www.energystar.gov](http://www.energystar.gov)
5. Appliance Magazine, September 2007
6. Incremental cost data are estimates from Residential Science Resources
7. [http://www.energystar.gov/index.cfm?c=clotheswash.pr\\_clothes\\_washers](http://www.energystar.gov/index.cfm?c=clotheswash.pr_clothes_washers)
8. [http://www.energystar.gov/index.cfm?c=refrig.pr\\_refrigerators](http://www.energystar.gov/index.cfm?c=refrig.pr_refrigerators)
9. [http://wpb-radon.com/radon\\_fan\\_performance.html](http://wpb-radon.com/radon_fan_performance.html)
10. Information from manufacturer and contractors (Radonaway)
11. <https://www.radonaway.com/products/radon-fans/rp140-pro.php>