15.1 Modeled Residential New Construction

Algorithms

$$Customer\ kWh = kWh_{Reference\ Home} - kWh_{As\ Built\ Home}$$

$$Summer\ Peak\ kW = Summer\ Peak\ kW_{Reference\ Home} - Summer\ Peak\ kW_{As\ Built\ Home}$$

$$WinterPeak\ kW = Winter\ Peak\ kW_{Reference\ Home} - Winter\ Peak\ kW_{As\ Built\ Home}$$

$$Customer\ Dth = Dth_{Reference} - Dth_{As\ Built\ Home}$$

$$\%\ Better\ Than\ Code = \frac{(MMBTU_{Reference\ Home} - MMBTU_{As\ Built\ Home})}{MMBTU_{Reference\ Home}}$$

$$MMBTU_{Reference\ Home} = \{(Heating\ kWh_{\ Reference\ Home} + Cooling\ kWh_{Reference\ Home} + Water\ Heating\ kWh_{Reference\ Home} + Lighting\ and\ Appliance\ kWh_{\ Reference\ Home}) \times \frac{3{,}412}{1{,}000{,}000}\} + \{(Heating\ th_{Reference\ Home} + Water\ Heating\ th_{Reference\ Home} + Lighting\ and\ Appliance\ th_{\ Reference\ Home}) \times \frac{1}{10}\}$$

$$MMBTU_{As\ Built\ Home} = \{(Heating\ kWh_{\ As\ Built\ Home} + Cooling\ kWh_{As\ Built\ Home} + Water\ Heating\ kWh_{As\ Built\ Home} + Lighting\ and\ Appliance\ kWh_{\ As\ Built\ Home}) \times \frac{3{,}412}{1{,}000{,}000}\} + \{(Heating\ th_{As\ Built\ Home} + Water\ Heating\ th_{As\ Built\ Home} + Lighting\ and\ Appliance\ th_{\ As\ Built\ Home}) \times \frac{1}{10}\}$$

$$ICC\ As\ Built\ Home = \left(\frac{ICC}{SFa} \times \%\ Better\ Than\ Code^3 + \frac{ICC}{SFb} \times \%\ Better\ Than\ Code^2 + \frac{ICC}{SFc} \times \%\ Better\ Than\ Code + \frac{ICC}{SFd}\right) \times ICC\ Adj\ Factor$$

$$ICC\ Adj\ Factor = 1 + (ICCAdj\ a \times \ln(Home\ Size) + ICCAdj\ b)$$

Variables

Coincidence Factor	90%	Deemed concidence factor
Lifetime	20	Deemed lifetime
$ICC_{ADJ\ a}$	Table 15.1.1	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 (Reference 4 and Reference 5).
$ICC_{ADJ\ b}$	Table 15.1.1	
ICC/SF_a	Table 15.1.2	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 (Reference 4 and Reference 5).
ICC/SF_b	Table 15.1.2	
ICC/SF_c	Table 15.1.2	
ICC/SF_d	Table 15.1.2	

Modeler Inputs	M&V Verified	
Percent Better Than Code	Yes	Calculated percent better than baseline code
Baseline Energy Code	Yes	IECC 2006 thru ~~IECC 2018~~ IECC 2021
Home Area (sq/ft)	Yes	Total modeled conditioned space of home (sqft)
Final HERS Index NoPV	Yes	As-Built Home's HERS Index Score calculated by the Home Rater using a software modeling tool and provided under HERS Index (Final)
EStar Certified	Yes	Energy Star v3 certified
Ref Home Heat Therms	Yes	Reference home gas heating energy
Ref Home Heat kWh	Yes	Reference home electric heating energy
Ref Home Cool kWh	Yes	Reference home electric cooling energy
Ref Home Water Heat Therms	Yes	Reference home gas water heating energy
Ref Home Water Heat kWh	Yes	Reference home electric water heating energy
Ref Home LightApp Therms	Yes	Reference home gas lights & appliance energy
Ref Home LightApp kWh	Yes	Reference home electric lights & appliance energy
As Built Home Heat Therms	Yes	As-built home gas heating energy
As Built Home Heat kWh	Yes	As-built home electric heating energy
As Built Home Cool kWh	Yes	As-built home electric cooling energy
As Built Home Water Heat Therms	Yes	As-built home gas water heating energy
As Built Home Water Heat kWh	Yes	As-built home electric water heating energy
As Built Home LightApp Therms	Yes	As-built home gas lights & appliance energy
As Built Home LightApp kWh	Yes	As-built home electric lights & appliance energy
Ref Home Peak kW Winter	Yes	Reference home winter demand
Ref Home Peak kW Summer	Yes	Reference home summer demand
As Built Home Peak kW Winter	Yes	As-built home winter demand
As Built Home Peak kW Summer	Yes	As-built home summer demand
Des OAT	Yes	Low Outdoor Ambient Temperature for caluclating heating load profile for electric heating equipment. Based on Low Temp Rating from NEEP QPL Data Sheets. Modeled at 5F (Reference 6)

Table 15.1.1 Incremental Cost per Square Foot Adjustment Factor Constants

Customer Type	Cost / SF Adjustment Factor Constants	$ICC_{ADJ\ a}$	$ICC_{ADJ\ b}$
Combo & Gas Only	IECC 2006	-0.7237094011964	5.8253260979282
	IECC 2009	-0.7237094011964	5.8253260979282
	IECC 2012	-0.2389969816525	1.9388419806113
	IECC 2015	-0.2389969816525	1.9388419806113
	IECC 2018	-0.2389969816525	1.9388419806113
	IECC 2021	-0.1239486286142	1.7564234894150
Electric Only	IECC 2006	-0.0331223345001	0.2235513199389
	IECC 2009	-0.0331223345001	0.2235513199389
	IECC 2012	-0.0331223345001	0.2235513199389
	IECC 2015	-0.0331223345001	0.2235513199389
	IECC 2018	-0.0331223345001	0.2235513199389
	IECC 2021	-0.0294627894100	0.2183458931159

Table 15.1.2 Incremental Cost per Square Foot Formula Constants

Customer Type	Cost / SF Adjustment Factor Constants	ICC/SF_a	ICC/SF_b	ICC/SF_c	ICC/SF_d
Combo & Gas Only	IECC 2006	0.0000000000000	-1.5873776258178	3.7927326153691	-0.0238069137844
	IECC 2009	0.0000000000000	-1.5873776258178	3.7927326153691	-0.0238069137844
	IECC 2012	0.0000000000000	27.2773059522290	-1.5760510381200	0.1307241656023
	IECC 2015	0.0000000000000	27.2773059522290	-1.5760510381200	0.1307241656023
	IECC 2018	135.4064974001910	-32.1556080746469	3.6616218361661	-0.0002624153096
	IECC 2021	10.8580000000000	-2.8741000000000	2.8922000000000	0.0442000000000
Electric Only	IECC 2006	0.0000000000000	56.7265518419520	-0.7931310460476	0.0501196304125
	IECC 2009	0.0000000000000	56.7265518419520	-0.7931310460476	0.0501196304125
	IECC 2012	0.0000000000000	56.7265518419520	-0.7931310460476	0.0501196304125
	IECC 2015	0.0000000000000	56.7265518419520	-0.7931310460476	0.0501196304125
	IECC 2018	0.0000000000000	13.3182292174891	3.9975225576078	-0.0978142722627
	IECC 2021	0.0000000000000	10.4625000000000	2.8553000000000	0.0254000000000

References:

~~1. California Measurement Advisory Committee (CALMAC) Protocols, Appendix F (www.calmac.org/events/APX_F.pdf).~~
~~2. RSR (Residential Science Resources) energy savings measure modeling, 2016~~
~~3. RSR (Residential Science Resources) energy savings measure modeling, 2019~~
4. RSR (Residential Science Resources) energy savings measure modeling, 2020 and 2021
5. RSR (Residential Science Resources) energy savings measure modeling, 2022
6. NEEP QPL Data Sheets

Changes from Recent Filing:

Added IECC 2021 Incremental Cost Data to the program
Added in 3 Tiers of Rater Incentives
Modeling Software Updated to Ekotrope v4.0
Modeled Design OAT is defined at 5F for Electric Heating Equipment