Fuel Substitution Technical Guidance for Energy Efficiency

Version 1.0
9/16/2019

Table of Contents

Revision History

Version	Date	Updates
1.0	9/12/2019	Original Fuel Substitution Technical Guidance

Chapter 1 Introduction

1.1 Purpose

On August 1, 2019, California Public Utilities Commission (CPUC) Decision 19-08-009 directed CPUC staff to issue technical guidelines for fuel substitution measures, including, but not limited to, guidance on calculation of source energy savings and environment offsets for fuel substitution measures.

The purpose of this document is to provide guidance on methods and procedures to analyze fuel substitution energy efficiency measures supported under the CPUC-authorized energy efficiency (EE) portfolios.

1.2 CPUC Policy Background

- CPUC Decision **19-08-009**:[1] This Decision ordered the creation of this Fuel Substitution Guidance document. This Decision provides direction on the fuel substitution test, which replaces the prior three-prong test. This Decision also clarifies several other aspects, such as fuel substitution application and utility credits for savings claims.
- CPUC Decision **92-02-075**:[2] The fuel substitution test which was originally called the three-prong test was established in this Decision. As quoted from Decision 19-08-009, "…Decision 92-02-075, which was designed to avoid encouraging programs that involved substituting one fuel for another (electricity or natural gas) but had a 'predominantly load building or load retention character.'

1.3 Audience

The audience for this document is stakeholders involved with fuel substitution measures supported under the CPUC-authorized energy efficiency (EE) portfolios, such as investor-owned utilities, program implementers, end users, product manufacturers, Public Utility Commission, etc.

1.4 Terminology

This guidance uses a variety of terms defined in the glossary in Appendix A.

[1] CPUC Decision 19-08-009, 5 Aug. 2019 per rulemaking proceedings R1311005 (https://apps.cpuc.ca.gov/apex/f?p=401:56:0::NO:RP,57,RIR:P5_PROCEEDING_SELECT:R1311005) and can be located via the CPUC Document search, http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=310159146

[2] CPUC Decision92-02-075 issued in 1992 per consolidated rulemaking proceedings R9108003. CPUC Decisions prior to year 2000 are available through the Legacy CPUC Decisions FTP Archive, ftp://ftp2.cpuc.ca.gov/LegacyCPUCDecisionsAndResolutions/Decisions/

Chapter 2 Fuel Substitution Measure Criteria

2.1 Introduction

Fuel substitution measures involve energy efficiency projects where all or a portion of the existing energy use is converted from one CPUC-regulated fuel to another (i.e., natural gas to electricity or vice versa). Only electricity and natural gas fuels regulated by Commission or provided by a municipal utility are eligible as fuel substitution measures[3].

Measures involving non-utility (unregulated) fuels such as propane or fuel oil are termed as fuel switching measures. These measures along with measures not resulting in energy savings are outside the scope of the Fuel Substitution Decision (D. 19-08-009)[4] and hence, are not considered in this technical guidance.

This chapter describes the comparison (baseline) technology and measure technology in the fuel substitution measures and the fuel substitution test criteria.

2.2 Comparison (Baseline) Technology and Measure Technology

The comparison (baseline) technology for conducting the fuel substitution test and energy efficiency savings calculations is defined as the normally determined baseline complying with baseline policies in D.16-08-019 and Resolution E-4939-Attachment A and utilizing "original fuel". Original fuel is the same fuel as what was being utilized prior to the fuel substitution measure.

This section describes comparison (baseline) technology requirements based on the measure application types.

Measure Application Type (MAT)	**Comparison technology compliance**
Normal Replacement (NR)	Code or Industry Standard Practice (ISP)
Accelerated Replacement (AR)	Existing baseline for the 1st baseline (RUL period) Code or ISP for the 2nd baseline (EUL-RUL period)

Add-on Equipment (AOE), Behavioral, Retro-commissioning and Operational (BRO) and Building Weatherization (BW) measure application types are not associated with fuel substitution measures because these measures supplement the existing equipment or operations and do not involve fuel substitution.

New Construction (NC) measures are not subject to the fuel substitution test.

[3] CPUC Decision 19-08-009, 5 Aug. 2019, pages 12 and 53.
[4] Ibid page 53

The Fuel Substitution Test should not be applied to non-resource energy efficiency programs, since such programs typically do not involve installation of specific energy efficiency measures. This test also does not apply to energy storage technologies or systems.

The measure technology is the new fuel technology that is used to substitute for the original fuel to serve the same application.

The baseline and measure technology will be the same across fuel substitution test, cost-effectiveness calculations, and reported energy savings.

2.3 Fuel Substitution Test

The fuel substitution test as indicated in D.19-08-009 shall meet the following two requirements at the measure level to be eligible for energy efficiency program funding:

1. Source Energy
2. Environment

The fuel substitution test does not require individual measures to pass a cost effectiveness threshold to be eligible for energy efficiency incentives. The costs and benefits of any proposed fuel substitution measure are still included as part of the cost-effectiveness analysis of the Energy Efficiency portfolio.

2.3.1 Source Energy

Part One of the test requires that the fuel substitution measure reduces source energy consumption. Source energy is defined as the site energy plus all of the energy used upstream to generate and deliver that energy. For example, source energy includes the energy input to a natural gas generator to produce electricity and the losses in delivery through transmission and distribution to deliver that energy.

However, for the purpose of determining the source energy of fuel substitution programs funded within the Energy Efficiency portfolio, only with the source energy from depletable fossil-fuel resources are considered. The source energy for renewable generation, such as the sunshine that is the input to solar power, is abundant and non-depletable and therefore there is no resource used up when it is converted to electricity. Similarly, wind energy and potential energy captured by hydro-electric generation should be counted as zero source energy. Life-cycle source energy is the source energy over the effective useful life (EUL) of the technology.

The life-cycle source energy of the measure technology must be lower than the life-cycle source energy of the baseline technology to pass this requirement[5]. In other words, the life-cycle source energy savings corresponding to the life-cycle site energy savings should be positive.

[5] CPUC Decision 19-08-009, 5 Aug. 2019, page 18

In order to properly account for the source energy values of electricity it is important to recognize the interactive effects of increasing electricity load and decarbonizing our electricity supply. Since we are planning our electricity grid to meet greenhouse gas emissions targets, as we add load we will also add renewable energy to serve the load. We assume that the supply-side response to increased demand will include a sufficient portion of renewable generation to meet demand while not exceeding allowable CO_2 emissions. Furthermore, we assume that the GHG emissions targets established by the IRP Proceeding (R.16-02-007) can reasonably be translated to intensity levels as the adopted balance between the costs of GHG reductions and the urgency of reducing them within the economy-wide GHG goal of 40% below 1990 levels by 2030.

Given approach and assumptions indicated above and using the 2017-2018 Reference System Plan adopted in the IRP Proceeding (R.16-02-007), which has the allowable CO_2 emission over the years and the retail sales of electricity, the yearly CO_2 emissions intensity (short-ton CO_2 per kWh) and source energy (Btu/kwh) is calculated. When fuel substitution measures are added, depending on the load shape of the measure, it will add more or less, or subtract more or less emissions or source energy than in the Reference System Plan. The assumption is that the renewable portfolio will adjust to meet the target. So, for example, under the Reference System Plan which achieves a 42MMt target in 2030, the source energy intensity is 3,162 Btu per kWh delivered in 2030. If an electricity increasing measure is added with a shape that has largely thermal generation on the margin then the intensity will increase (since thermal generation and losses would be above 7,000 Btu/kWh). However, new renewables would also be added to again hit the intensity target. Using the standard natural gas carbon content of 0.0585 short-ton of CO_2 per MMBtu, the yearly source Btu per kWh is calculated. Please refer to the narrative in the reference document[6] for details of how these values were determined. These values, in BTU/ kWh (delivered) and BTU/ therms (delivered), are shown in the Table 1 and Table 2 below for electricity and natural gas respectively.

As shown in Figure 1 and Figure 2, the source energy and CO_2 emissions for electricity decrease over the years due to renewable statewide goals. A rebound in the trend around year 2026 is to account for Diablo Canyon shutdown. The data assumes that the referenced System Plan achieves a statewide electricity sector emissions of 42MMt of GHG emissions by 2030 with a simple linear progression between 2030 and 2045 based on goals established by SB100 for 2045. The source energy for natural gas remains constant over the years.

[6] Fuel Substitution Test Factors.docx from E3

Figure 1: Source Btu/ kWh delivered

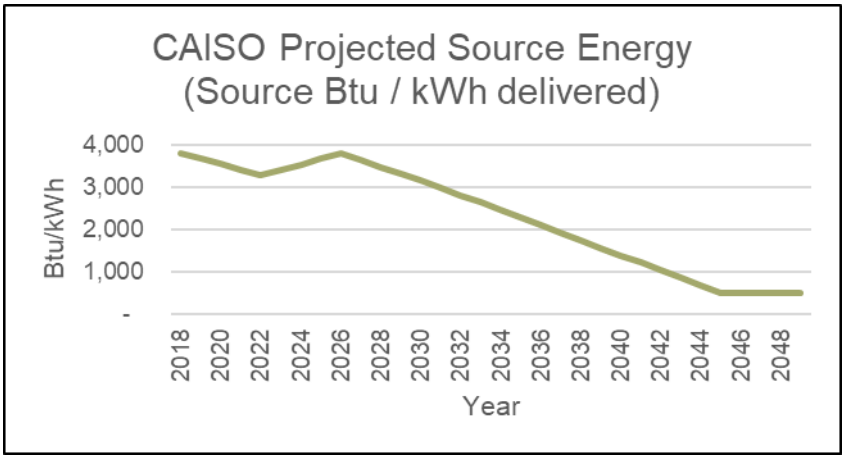

Figure 2: CO2 emissions (short tons)/ MWh delivered

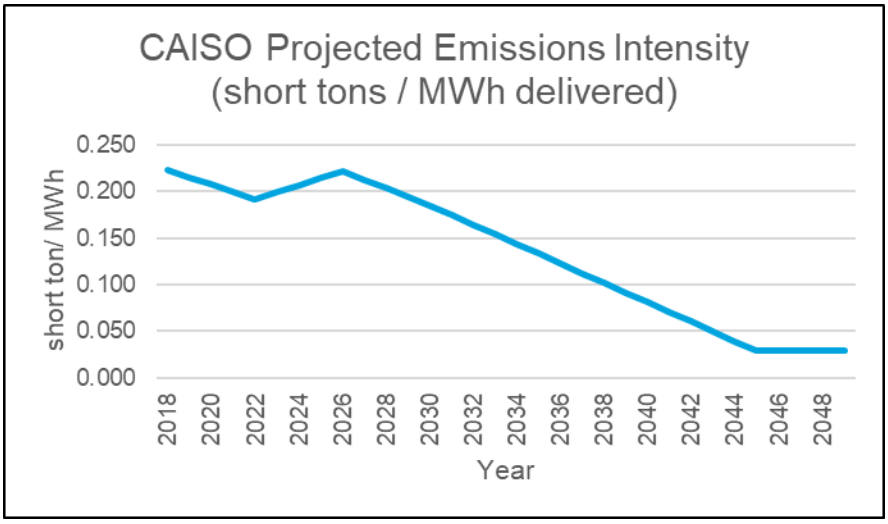

Table 1: Annual Source Energy and Emissions for Electricity

Year	Emissions Intensity (short tons CO_2/MWh)	Source Energy (Btu/kWh)
2019	0.215	3,675
2020	0.207	3,543
2021	0.200	3,411
2022	0.192	3,279
2023	0.199	3,406
2024	0.207	3,532
2025	0.214	3,659
2026	0.221	3,786
2027	0.212	3,630
2028	0.203	3,474
2029	0.194	3,318
2030	0.185	3,162
2031	0.175	2,984
2032	0.164	2,806
2033	0.154	2,629
2034	0.143	2,451
2035	0.133	2,273
2036	0.123	2,095
2037	0.112	1,917
2038	0.102	1,739
2039	0.091	1,561
2040	0.081	1,383
2041	0.071	1,205
2042	0.060	1,027
2043	0.050	849
2044	0.039	671
2045	0.029	494
2046	0.029	494
2047	0.029	494
2048	0.029	494
2049	0.029	494

Table 2: Annual Source Energy and Emissions for Natural Gas

Year	Emissions Intensity (Short Tons CO_2/MMBtu)	Emissions Intensity (Metric Tons CO_2/Therm)	Source Energy (Btu/Therm)
Constant over the years	0.0585	0.00531	100,000

2.3.2 Environment

Part Two of the test requires that fuel substitution measures should not adversely impact the environment. This means that the environmental impact quantified as life-cycle short tons of carbon dioxide (CO_2) from fuel emissions should be lower for the measure compared to the baseline technology[7]. In other words, the life-cycle CO_2 savings value should be non-negative for a measure to pass this test. Life-cycle CO_2 is the CO_2 over the EUL of the measure.

As explained in the previous section, using the 2017-2018 Reference System Plan adopted in the IRP Proceeding (R.16-02-007), values of CO_2 emissions per site energy for fuel substitution measure were generated. Please refer to narrative in the reference document[8] for details of how these values were determined along with corresponding assumptions. These values, in short-tons of CO_2/ MWh and short-tons of CO_2/MMBtu and metric-tons CO_2/Therm, are shown in the Table 1 and Table 2 above for electricity and natural gas respectively. Figure 2 plots the trend of CO_2 emissions in short-tons for MWh of site energy over the years. The natural gas emissions do not change over the years.

2.4 Cost Effectiveness

Fuel substitution measures are not required to pass cost-effectiveness thresholds at the individual measure level to be eligible for use of energy efficiency program funding[9]. Nevertheless, cost effectiveness input parameters driving the evaluation of cost effectiveness of the measure are described herein for clarity.

Cost Effectiveness Inputs

Measure Savings: The inputs to the Cost Effectiveness Tool (CET) for the fuel substitution tests are same as other (non-fuel substitution) energy efficiency measures. Energy savings is evaluated at the "site" level and shall include both the increased usage (load) for the substitute fuel and the displaced usage (load) of the original fuel. For example, if a natural gas technology is being replaced by an electric technology, the energy savings is represented as an increased electric load, kWh, and as decreased (displaced) natural gas load, therms. The site energy savings when used in the cost effectiveness analysis (total resource cost, TRC) shall not be normalized to a single fuel and/or the "measure" fuel (e.g., kWh).

NTG: A default net-to-gross (NTG) ratio 1.0 shall be used as directed by Decision 19-08-009 until impact evaluation results become available. Thereafter, the evaluated NTG ratio for the individual measure shall be used in the portfolio cost-effectiveness calculation.

[7] CPUC Decision 19-08-009, 5 Aug. 2019, page 18
[8] Fuel Substitution Test Factors.docx from E3
[9] CPUC Decision 19-08-009, 5 Aug. 2019, page 54

2.5 Potential Future Updates to Cost Effectiveness Calculations

Future updates to the CET and/or ACC under normal policy processes are expected to support and increase accuracy of the cost effectiveness evaluation process for fuel substitution measures. They could include (but not be limited to) the following:

GHG Adder
The current Avoided Cost Calculator uses the GHG Adder to value changes in GHG emissions. For the energy efficiency portfolio this captures the abatement cost savings from reduced renewable generation, and integration costs such as energy storage, and low-value emissions. For fuel substitution the GHG Adder will be the opposite and would include the additional renewable generation and integration costs. This symmetry seems reasonable. However, since the long-run GHG and source energy impacts in the Fuel Substitution Test are relative to the intensity targets, the GHG Adder should consider only applying the GHG Adder to the emissions greater than the target. In addition, there will be 'residual emissions' equal to the intensity for load increases and those could be valued at the GHG Adder or a different level. These issues should be coordinated and discussed to develop a cohesive evaluation of Distributed Energy Resources (DERs).

Levelized GHG Reduction Cost for Electricity and Natural Gas
There is a discrepancy between the GHG reduction costs for electricity and natural gas, as reflected in the electricity and natural gas avoided cost calculators which currently values the same GHG ton reduction from reducing kWh higher than from reducing therms (thus favoring gasification over electrification, instead of being neutral). Per referenced Policy (CPUC Decision **19-08-009**[10]), this issue is expected to be addressed in future updates of the Avoided Cost Calculator.

Energy Savings Credits
Given reporting requirements for fuel substitution energy measures (e.g., the full energy savings value is converted or normalized into the new fuel units from BTUs), there will be a need to update CEDARS and the CET to accommodate fuel substitution program's savings claims separate from the cost-effectiveness calculation (direct inputs into the CET of the kWh and therms). This could be accomplished with a Fuel Substitution flag in the CET inputs, so the CET knows to calculate cost-effectiveness and savings claims with their respective methodologies. Further, Commission staff are encouraged to work with the program administrators to implement practical reporting requirements associated with these provisions of referenced decision.

2.6 Reporting Energy Savings

For energy savings (reporting) credits, the net energy savings value (e.g., the sum of the electric and/or gas savings due to energy efficiency plus the energy savings accredited from the

[10] CPUC Decision 19-08-009, 5 Aug. 2019 per rulemaking proceedings R1311005 (https://apps.cpuc.ca.gov/apex/f?p=401:56:0::NO:RP,57,RIR:P5_PROCEEDING_SELECT:R1311005) and can be located via the CPUC Document search, http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=310159146

displaced fuel) is converted into the new fuel units from BTUs. The program administrator implementing the program utilizing fuel substitution measures can use the full energy savings value in their portfolio forecasts and claims. The full energy savings are normalized into the new fuel units using the site conversion factors (1 therm = 29.3 kWh and 1 kWh = 0.0341296 therm).

The site level energy savings should be presented as well for the change in original and substituted fuels. These values will be used in the CET for portfolio level analysis.

These normalized energy savings values and the savings values in the units of both the fuels should be included in the workpapers and custom project submittals.

Further, the original-fuel utility, whose fuel is being substituted, will experience a reduction in its energy efficiency potential, both from a savings and a potential participant perspective. Thus, it should receive a reduction in its overall savings goals for its energy efficiency portfolio, in order not to create a disincentive towards allowing fuel substitution.

2.7 Peak Demand Reduction

There will not be any peak demand reduction or penalty towards peak demand goal achievement from fuel substitution measures. For cost-effectiveness, the load shape of the electric measure takes into account the peak demand impact as part of the cost-effectiveness calculation (i.e., if an electrification measure's consumption load shape overlaps with peak hours, it will receive negative peak-related electric avoided cost benefits in the TRC calculation).

2.8 Eligible Measure Cost

The installed measure cost should include the full incremental cost to install the measure in a customer's home or business (technology, labor, and installation costs), but may exclude any additional upgrades required to increase the building total electric or natural gas load (e.g., electric panel upgrades, running new gas lines, increasing size of natural gas lines, etc.), if warranted and depending on the program design. Assumptions about building upgrade costs should be included in workpapers, with appropriate justification and rationale. The necessity of such building upgrades is specific to individual buildings and the cumulative total of installed technologies in the building, and therefore, in most cases, should not be attributed entirely to a single measure.

Chapter 3 Fuel Substitution Test – Calculation Methodology

3.1 Introduction

This chapter provides the step by step calculation methodology for fuel substitution test, energy savings calculations for cost-effectiveness calculations and reporting, and eligible measure cost.

3.2 Source energy consumption

The site-level annual energy savings for the fuel substitution measure should be calculated using the eligible baseline technology. These savings will include both the increased usage for the substitute fuel and the displaced usage of original fuel (e.g., from natural gas to electric measure there could be negative kWh savings indicating increase in electric usage and positive thermal savings.

For Accelerated Replacement (AR) measures, calculate the 1st baseline site savings (savings above existing baseline technology) and 2nd baseline site savings (savings above code/ ISP technology).

Identify the starting year when the proposed fuel substitution measure will be operational and apply the yearly source energy ratio values (BTU/kWh and BTU/ therms) from Table1 and Table 2 over the measure's EUL as shown in the equations below for Normal Replacement (NR) and Accelerated Replacement (AR)

Equation 1:

$$Life-cycle\ source\ energy\ savings_{NR}\ [BTU] = \left(site\ kWh\ savings\ X \sum_{start\ year}^{EUL+start\ year-1} \left(source\ energy\ value[\frac{BTU}{kWh}] \right) \right) + \left(site\ therms\ savings\ X\ source\ energy\ value\ \left[\frac{BTU}{Therm}\right] X\ EUL \right)$$

Equation 2:

$$Life-cycle\ source\ energy\ savings_{AR}\ [BTU]$$
$$= \left(1st\ baseline\ site\ kWh\ savings\ X \sum_{i=start\ year}^{RUL+start\ year-1} \left(source\ energy\ value\left[\frac{BTU}{kWh}\right]\right)\right)$$
$$+ \left(1st\ baseline\ therms\ savings\ X\ source\ energy\ value\ \left[\frac{BTU}{Therm}\right] X\ RUL\right)$$
$$+ \left(2nd\ baseline\ site\ kWh\ savings\ X \sum_{RUL+start\ year}^{EUL+start\ year-1} \left(source\ energy\ value\left[\frac{BTU}{kWh}\right]\right)\right)$$
$$+ \left(1st\ baseline\ therms\ savings\ X\ source\ energy\ value\ \left[\frac{BTU}{Therm}\right] X\ (EUL-RUL)\right)$$

The units for the values are included with-in [ ].
As with energy efficiency measures, the EUL and RUL values corresponds to the measure technology for the fuel substitution measures.

3.3 Environment

Apply the yearly emission intensity values (short tons of CO_2/ MWh and short tons of CO_2/ therm) from Table 1 and Table 2 over the measure's EUL starting with the year when the measure will be operational using the equations below:

Equation 3:

$$Life-cycle\ CO_2\ savings_{NR}\ [short\ tons]$$
$$= \left(site\ MWh\ savings\ X \sum_{start\ year}^{EUL+start\ year-1} \left(Emissions\ Intensity[\frac{short\ tons}{MWh}]\right)\right)$$
$$+ \left(site\ therms\ savings\ X\ Emissions\ Intensity\left[\frac{short\ tons}{Therm}\right] X\ EUL\right)$$

Equation 4:

$$Life-cycle\ source\ energy\ savings_{AR}\ [BTU]$$
$$= \left(1st\ baseline\ site\ MWh\ savings\ X \sum_{i=start\ year}^{RUL+start\ year-1} \left(Emissions\ Intensity[\frac{short\ tons}{MWh}]\right)\right)$$
$$+ \left(1st\ baseline\ therms\ savings\ X\ Emissions\ Intensity\left[\frac{short\ tons}{Therm}\right] X\ RUL\right)$$
$$+ \left(2nd\ baseline\ site\ MWh\ savings\ X \sum_{RUL+start\ year}^{EUL+start\ year-1} \left(Emissions\ Intensity[\frac{short\ tons}{MWh}]\right)\right)$$
$$+ \left(1st\ baseline\ therms\ savings\ X\ Emissions\ Intensity\left[\frac{short\ tons}{Therm}\right] X\ (EUL-RUL)\right)$$

The units for the values are included with-in [ ]

The EUL and RUL values corresponds to the measure technology.

Chapter 4 Claimed EE Savings - Calculation Examples

This chapter explains the fuel substitution test and calculation methodology though some hypothetical examples.

4.1 Natural Gas to Electric Fuel Substitution – Normal Replacement

Scenario: A residential customer in climate zone 9 would like to replace their 25-year-old 3-ton central air-conditioning with direct-expansion cooling and gas furnace heating (DXGF). The equipment efficiency rating is SEER10 and 78% AFUE. The customer is considering replacing with a central heat pump (DXHP) where both heating and cooling are provided by electricity. The expected equipment operational date is May, 2020 and is expected to be completed in one week.

This measure is considered fuel substitution because a mixed-use fuel (electricity and natural gas) is being substituted with all electric fuel.

This will be considered normal replace (NR) measure application type because the equipment has passed its effective useful life.

The baseline comparison technology will be DXGF meeting the prevalent code in May 2020. Title-20 2019[11] which would be prevent code in 2020 requires SEER14 and 82% AFUE for central residential AC units.

The measure technology will be DXHP exceeding the code requirements because to be eligible for NR measure application type, the proposed measure should exceed the prevalent code. Title 20 requires SEER14 and 8.2 HSPF for DXHP. Hence, the measure technology should be at least SEER15 and 8.7 HSPF.

The site level energy savings were calculated using CPUC's supported building simulation tools and prototypical documentation to be -1,093 kWh/year and 180 therms/year. Negative kWh indicates increase in electricity usage when natural gas space heating is substituted with electricity powered space heating. Positive therms indicates the therm reduction when the baseline is removed from the customer's site.

With start year of 2020, EUL of 15 years and using *Equation 1* and the source energy values in *Table 1* and *Table 2*, the life-cycle source savings were calculated to be 216 MBtu.

Similarly applying the emission values from *Table-1* and *Table 2* and using *Equation 2*, the life-cycle CO_2 savings were calculated to be 12.66 short tons of CO_2 savings.

Since the measure has both life-cycle source energy and CO_2 savings, this measure passed the fuel substitution test.

[11] California Energy Commission (CEC). 2019. *2019 Appliance Efficiency Regulations*. CEC-140-2019-002.

For the inputs to CET, the site level savings of -1,093 kWh/year and 180 therms/year will be used. For reporting, the site level savings are converted to new fuel units which is kWh in this case; the normalized savings will be 4,181 kWh (= -1,093 +(180*29.3)). The split savings and the normalized savings should be included in the workpaper and the custom project applications.

Except for the equipment replacement, the customer did not have to make additional upgrades for the increased electrical loads. The full measure cost of SEER15 and 8.7 HSPF DXHP is $3,285.00 and the cost of SEER14 and 82% AFUE DXGF is $2,523.00. Hence, the incremental measure cost is $762.00.

4.2 Electric to Natural Gas Fuel Substitution – Normal Replacement

Scenario: A residential customer in climate zone 6 would like to replace their 30-year-old baseboard heating in the living (2 kW) and bed room (1 kW) with gravity wall furnace (28,000 Btuh). This measure is considered fuel substitution because electricity is being substituted with natural gas.

This will be considered normal replace (NR) measure application type because the equipment has passed its effective useful life.

The baseline comparison technology will be electric resistance heating and the efficiency of electric resistance heating is 100% (1 kWh electric input provides 1 kWh heat output)

The measure technology will be gravity wall furnace exceeding the code requirements because to be eligible for any energy efficiency program, the proposed measure should exceed the prevalent code. Title 20 requirement for gravity wall furnace between 27,000 and 46,000 Btuh is 66% AFUE. Hence, the measure technology should be at least 68% AFUE.

The site level energy savings were calculated using building simulation tools to be 2,200 kWh/year and -70 therms/year. Negative therms indicates increased gas usage.

With start year of 2020, EUL of 15 years and using *Equation 1* and the source energy values in *Table 1* and *Table 2*, the life-cycle source savings were calculated to be 2.9 MBtu.

Similarly applying the emission values from *Table 1* and *Table 2* and using *Equation 2*, the life-cycle CO_2 savings were calculated to be 0.17 short tons of CO_2 savings.

Since the measure has both life-cycle source energy and CO_2 savings, this measure passed the fuel substitution test.

For the inputs to CET, the site level savings of 2,200 kWh/year and -70 therms/year should be used. For reporting, the site level savings are converted to new fuel units which is therms in this case; the normalized savings will be 5.08 therms (= 2,200*0.0341296 - 70). The split savings and the normalized savings should be included in the workpaper and the custom project applications.

Except for the equipment replacement, the customer did not have to make additional upgrades for the increased electrical loads. The full measure cost of gravity wall furnace with installation is $1,500 and the cost of baseboard heating with installation is $800. Hence, the incremental measure cost is $700.00.

Appendix A – Glossary

Term	Definition
Accelerated Replacement (AR)	See Measure Application Type.
Accelerated Replacement Cost (ARC)	The full measure cost incurred to install the new high-efficiency measure, reduced by the net present value of the full measure cost that would have been incurred to install the standard efficiency equipment at the end of the remaining useful life period. See Section 2.3.3.1.4 for more information.
Add-On Equipment (AOE)	See Measure Application Type.
Behavioral, Retrocommissioning, and Operational (BRO)	See Measure Application Type.
California Public Utilities Commission (CPUC)	Regulates investor-owned electric and natural gas utilities operating in California. Regulates privately owned electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation companies, in addition to authorizing video franchises.[12]
Code	In California energy efficiency context, generally refers to Title 20 (appliance energy efficiency) and Title 24 (building energy efficiency) of the California Code of Regulations but can be any codes and regulations enacted by federal and local governments and regulatory agencies that mandate a particular technology to be utilized.[13]
Database of Energy Efficiency Resources (DEER)	Database located at: http://www.deeresources.com that contains information on energy efficiency technologies and measures, including estimates of energy savings potential and measure costs for these technologies in residential and non-residential applications.
Deemed Measure	A prescriptive energy efficiency measure. Energy efficiency measures with predefined savings calculations, cost, eligibility, and other measure attributes.[14]
DEER Peak Demand Savings (through 12/31/2019)	The average demand impact, for an installed measure, as would be "seen" at the electric grid level, averaged over the nine hours, between 2 p.m. and 5 p.m., during the three-consecutive weekday period which contains the highest average temperature during the 12 p.m. to 6 p.m. period for those three days.[15,16]

[12] http://www.cpuc.ca.gov/aboutus/.
[13] California Code of Regulations, Title 24 (Building Standards Code) and Title 20, Division 2, Chapter 4, Article 4 (Appliance Energy Efficiency Regulations).
[14] *Energy Efficiency Policy Manual*, p. 49.
[15] California Public Utilities Commission, May 10, 2012, *D.12-05-015: Decision Providing Guidance on 2013-2014 Energy Efficiency Portfolios and 2012 Marketing, Education, and Outreach*.
[16] D.12-05-015, Attachment A: Summary of Changes to Database for Energy Efficiency Resources 2011, p. 14.

Term	Definition
DEER Peak Demand Savings (after 1/1/2020)	The average demand impact as would be "seen" at the electric grid level, averaged across 15 hours from 4 p.m. to 9 p.m. during the three-consecutive weekday period containing the highest algebraic sum of: • The average temperature over the three-day period, • The average temperature from noon to 6 p.m. over the three-day period, and • The peak temperature within the three-day period. The Peak Period shall fall within the dates of June 1 through September 30, inclusive. The three Peak Period days shall not include a holiday. Holidays within this window of dates include July 4th, or the nearest weekday to July 4th, and Labor Day.
Dual Baseline	Means that an existing baseline is used for the calculation of energy savings for the remaining useful life of the removed equipment. At the end of the remaining useful life (RUL), the customer would have needed to replace the failed equipment with equipment that reflected current energy efficiency standards and/or standard practices. This second baseline is used to calculate the [reduced] savings for the remainder of the effective useful life of the measure.
Early Retirement (ER)	See Measure Application Types.
Effective Useful Life (EUL)	An estimate of the median number of years that the measures installed under the program are still in place and operable.[17]
Energy Efficiency (EE)	Activities or programs that influence customers to reduce energy use by making investments in more efficient equipment or controls, which reduce energy use while maintaining a comparable level of service.[18]
Energy Efficiency Measure or Measure	Energy using equipment, control system, or practice whose installation and/or implementation results in a reduction of energy purchased from the distribution utility (while maintaining a comparable or higher level of a specific service or to accomplish a specific amount of work). For purposes of these Rules, solar-powered, non-generating technologies are eligible energy efficiency measures. To be included in a program, the CPUC must approve the measure assumptions to be used to report savings. Also referred to simply as "measure".[19]
Energy Efficiency Savings	Energy efficiency measures may result in both energy savings (measured in kilowatthours or therms) and demand (measured in kilowatts). The term "energy savings" may be used to refer to both energy and demand reductions.
Energy Efficiency Project	Implementation of an EE measure or group of measures at essentially one time, through a single incentive application.
Fuel Substitution	Programs/measures which are intended to substitute energy using equipment of one energy source with a competing energy source (e.g. switch from electric resistance heating to gas furnaces).[20]

[17] *Energy Efficiency Policy Manual*, p. 49.
[18] *Energy Efficiency Policy Manual*, p. 52.
[19] *Energy Efficiency Policy Manual,* p. 52.
[20] *Energy Efficiency Policy Manual*, p. 53. This document uses the terms "fuel switching" and "fuel substitution" interchangeably. Others use fuel switching to refer to changes to a non-regulated fuel (e.g. not electricity or gas), whereas fuel substitution refers to regulated fuels (electricity or gas). See the CEC Staff Paper: Framework for Establishing the Senate Bill 350 Energy Efficiency Savings Doubling Targets (January 2017) at pp. 18-19.

Term	Definition
Full Measure Cost (FMC)	The total cost of the EE measure which may include: audits, design, engineering, construction, equipment, materials, removal, recycling, overhead, sales tax, shipping, and labor directly related to the energy efficiency attributes of the measure. Product or feature choices not directly related to EE should be removed. Labor cost can be contractor or in-house if proof of direct project hours and costs are provided. Invoices should include the make, model, unit price, and quantity of equipment, the vendor name and address, the customer's name and address, the invoice number, the date of sale, and the total cost. [21] Participant costs include: • Initial capital costs, including sales tax • Ongoing operation and maintenance costs include fuel cost • Removal costs, less salvage value • Value of the customer's time in arranging for installation, if significant.
Gross Savings	Gross savings count the energy savings from energy efficiency measures installed by program participants irrespective of whether or not those savings are from free riders. Gross savings are adjusted by a net-to-gross ratio to produce net savings (that is, to remove the savings associated with free riders).[22] It should be noted that Gross Savings do include adjustments for Realization and Installation Rates. (See also GSIA.)
Incremental Measure Cost	The additional cost of installing a more efficient measure calculated from the price differential between energy efficient equipment and services and standard or baseline equipment or services. Note that any cost premium resulting from features or components that do not improve the efficiency of the equipment is excluded from the incremental measure cost calculation.[23]
Industry Standard Practice (ISP)	A measure or practice that represents the typical current equipment purchased, or a commonly used, currently trending practice in the applicable markets absent the program. ISP represents today's market trend, i.e., whether a technology would be commonly purchased by customers today (not in situ or saturation), with consideration of key factors or barriers driving the technology adoption. The practice is considered "ISP-by-code" when the selection and adoption of that specific measure or practice is required to meet government standards, codes or regulations (including non-energy regulations). The practice is considered "ISP-by-default" when the selected measure is the only viable option considered by customer. *See* Standard Practice. In addition, an ISP can be a method or technique that has been generally accepted as superior to any alternatives because it produces results that are superior to those achieved by other means or because it has become a customer's standard way of doing things (e.g., a standard way of complying with legal or ethical requirements, or a customer's preference for the best product with superior efficiency in customized design). This is generally applicable to custom measures and projects.

[21] California Public Utilities Commission, July 2002, *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects*, p. 11.
[22] *Energy Efficiency Policy Manual,* pp. 53-54.
[23] *Energy Efficiency Policy Manual*, p. 54.

Term	Definition
Life-cycle Source BTU Consumption	Source BTU over the EUL of the measure. For dual-baseline measures both first and 2nd baseline usage and RUL and EUL-RUL should be used respectively while calculating Life-cycle source BTU.

Term	Definition
Measure Application Type (MAT)	A categorization of energy efficiency measures based on measure attributes – each measure application type has its own baseline treatment, cost basis, eligibility, and documentation requirements. There are six approved measure application types, which include: Accelerated Replacement, Add-On Equipment, Behavioral, Retro-commissioning and Operational, New Construction/New Capacity, Normal Replacement, and Weatherization. Each of these measure application types is further defined below.[24] *Accelerated Replacement (AR):* A measure application type which includes three subtypes: Early Retirement (ER), Repair Eligible (RE), and Repair Indefinitely (RI).[25] *Add-On Equipment (AOE):* An Add-on Equipment (AOE) measure installs new equipment onto an existing host improving the nominal efficiency of the host system. The existing host system must be operational without the AOE, continue to operate as the primary service equipment for the existing load, and is able to fully meet the existing load at all times without the add-on component. The AOE must not be able to operate on its own. The actual energy reduction occurs at the host equipment, not at the add-on component, although any add-on component energy usage must be subtracted from the host savings. *Behavioral, Retro-commissioning, and Operational (BRO):* The BRO category includes measures that either restore or improve energy efficiency, and can be reasonably expected to produce multi-year savings. BRO measures include information or educational programs that influence energy-related practices (behavioral), activities and installations that restore equipment performance to its nominal efficiency (i.e. rated, intended, or original efficiency (retro-commissioning)) but do not enhance the measure's nominal efficiency, and measures that improve the efficient operation of installed equipment (operational). BRO subelements are abbreviated as follows: • *BRO-Bhv: BRO Behavioral* • *BRO-Op: BRO Operational* • *BRO-RCx: BRO Retrocommissiong* *Early Retirement (ER):* Subset of Accelerated Replacement. The ER category is a sub-type of the larger Accelerated Replacement category, which includes replacements of existing equipment with nominally higher efficiency equipment and where there is more evidence than not that a) the existing equipment would have remained in operation for at least the remaining life of the existing equipment, performing its current service requirement and b) the energy efficiency program activity induced or accelerated the equipment replacement. The existing equipment must have at least one year of remaining useful life to qualify as Early Retirement. *New Construction / New Capacity (NC):* NC includes eligible projects where equipment is installed in a new area or one that has been subject to a major renovation, or to expand capacity of existing systems, or to serve a new load. *Normal Replacement (NR):* NR includes measure installations where the existing equipment has failed or no longer meets current or anticipated needs or is being replaced due to remodeling, upgrading, or replacement activities that are undertaken in the normal course of business. Measure installations where the existing equipment is still functional but does not qualify for Accelerated Replacement fall into this category. This category now includes measures that previously fit into the now retired Replace on Burnout category. *Repair Eligible (RE):* A measure application type representing the replacement of equipment that needs a major repair to return the equipment to fully serving the load and that repair cost is less than 50% of the full measure cost.[26]

Term	Definition
Net-to-Gross (NTG) Ratio	A ratio or percentage of net program impacts divided by gross or total impacts. Net-to-gross ratios are used to estimate and describe the free-ridership that may be occurring among energy efficiency program participant s.[28]
New Construction/New Capacity (NEW)	See Measure Application Type.
Normal Replacement (NR)	See Measure Application Type.
Program	A collection of defined activities and measures that: • are carried out by the administrator and/or their subcontractors and implementers, • target a specific market segment, customer class, a defined end use, or a defined set of market actors (e.g. designers, architects, homeowners), • are designed to achieve specific efficiency related changes in behavior, investment practices or maintenance practice in the energy market, and are guided by a specific budget and implementation plan.[29]
Program Administrator (PA)	A person, company, partnership, corporation, association or other entity selected by the CPUC and any subcontractor that is retained by an aforesaid entity to contract for and administer energy efficiency programs funded in whole or in part from electric or gas Public Goods Charge funds. For purposes of implementing PU Code Section 381.1, an "administrator" is any party that receives funding for and implements energy efficiency programs pursuant to PU Code Section 381. PAs currently include investor-owned utilities, community choice aggregators, and regional energy networks.[30]
Regressive Baseline	Use of a Code or standard practice baseline when existing equipment efficiency exceeds code or standard practice efficiency.[31]
Remaining Useful Life (RUL)	An estimate of the median number of years that a measure being replaced under the program would remain in place and operable had the program intervention not caused the replacement.[32]
Repair Eligible (RE)	See Measure Application Type.
Repair Indefinitely (RI)	See Measure Application Type.
Source BTU Consumption	Conversion of retail energy forms (kWh, therms) into the BTU required to generate and deliver the energy to the site. This conversion is used to compare the relative impacts of switching between fuel sources at the source or BTU level for the fuel substitution test required for fuel-substitution programs.[33]

[24] California Public Utilities Commission, March 2, 2017, *Resolution E-4818. Measure level baseline assignment and preponderance of evidence guidance to establish eligibility for an accelerated replacement baseline treatment.*
[25] Accelerated Replacement currently includes ER, RE and RI, although rules regarding RE and RI are not yet defined per: California Public Utilities Commission, Energy Division, March 2, 2017, *Resolution E-4818: Measure level baseline assignment and preponderance of evidence guidance to establish eligibility for an accelerated replacement baseline treatment.*
[26] Working Group Created by D.16-08-019 to Develop Consensus Recommendations on Measure-Level Baseline Assignments, T1 Working Group Report, p. 13.
[27] T1 Working Group Report, p. 13.
[28] *Energy Efficiency Policy Manual*, p. 57.
[29] *Energy Efficiency Policy Manual*, p. 59.
[30] *California Energy Efficiency Evaluation Protocols*, p. 217.
[31] *D.12-05-015*.
[32] *Energy Efficiency Policy Manual*, p. 61.
[33] *Energy Efficiency Policy Manual*, p. 62.

Term	Definition
Standard Practice Baseline	A measure or practice used as the baseline for a specific measure that represents what the customer would implement in the absence of program influence or intervention. A standard practice can be established from an ISP study, from similar and recent typical activity, or from an analysis of the current viable options applicable to the customer and the customer's typical decision-making process. Where a standard practice is identified that exceeds the minimum efficiency established by a code or regulation, the standard practice is the appropriate baseline.
Title 24	Title 24 of the California Code of Regulations is known as the California Building Standards Code. Part 6 is the California Energy Code.
To Code	Refers to the installation of measures (or the resulting savings) with an efficiency level that complies with (but does not exceed) the current California Title 24 Building Efficiency Standards, Title 20 Appliance Efficiency Regulations, or industry standard practice.[34]
Weatherization (WEA)	See Measure Application Types.

[34] California Public Utilities Commission, November 9, 2017, D.17-11-006: *Decision Regarding To-Code Pilots*, p. 3.