

Fuel Substitution Technical Guidance for Energy Efficiency

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Revision History

Version	Date	Updates
1.0	09/17/2019	First draft of fuel substitution technical guidance for stakeholder feedback
1.1	10/31/2019	Incorporated stakeholder feedback Changed the structure for improved readability Incorporated a section for sites with on-site generation Deleted example 2 because it was not representing an actual scenario

Chapter 1 Introduction

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 the calculation of source energy savings and environmental offsets for fuel substitution measures.

The purpose of this document is to provide guidance on the methods and procedures used to analyze and approve fuel substitution energy efficiency measures supported by the CPUC-authorized energy efficiency (EE) portfolios. This guidance document outlines how users must a) determine a fuel substitution measure baseline, b) prove a fuel substitution measure passes the fuel substitution test, c) calculate the cost effectiveness of a fuel substitution measure, and d) report energy savings and goal reductions. This document is available online on the CPUC's website and may be updated periodically as needed.

CPUC Policy Background

- CPUC Decision **19-08-009**:¹ D.19-08-009 adopted the fuel substitution test and ordered the creation of this fuel substitution guidance document. D.19-08-009 provides direction on the fuel substitution test, fuel substitution measure eligibility, and utility credits for savings claims.
- CPUC Decision **92-02-075**:² D.92-02-075 established the “three-prong test” which established the original requirements for fuel substitution measures to be eligible for energy efficiency incentives. The three-prong test was designed to avoid encouraging fuel substitution programs with a predominantly load-building character. The fuel substitution test replaces the three-prong test as the eligibility standard for fuel substitution measures.

Fuel Substitution Measure Definition

Fuel substitution measures, in the context of energy efficiency programs, involve energy efficiency projects where all or a portion of the existing energy use is converted from one fuel to another (i.e., natural gas to electricity or vice versa). Only equipment powered by electricity and/or natural gas fuels and provided by a CPUC-regulated investor-owned utility or a municipal utility are eligible to participate under fuel substitution measures.³

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 Decision 92-02-075 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/>

³ CPUC Decision 19-08-009, 5 Aug. 2019, pages 12 and 53.

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

Fuel Substitution Criteria

D.19-08-009 stated that fuel substitution measures must pass the fuel substitution test to be eligible for energy efficiency incentives. The fuel substitution test has two components:

1. The measure must not increase total source energy
2. The measure must not adversely impact the environment

The above requirements are hereinafter referred to as Part One and Part Two of the fuel substitution test. The fuel substitution test no longer requires individual measures to pass a cost effectiveness threshold, as previously required in the three-prong test. Instead, fuel substitution measures are treated the same as other energy efficiency measures wherein cost-effectiveness is assessed at the portfolio level (i.e., Total Resource Cost test).

Audience

The audience for this document is stakeholders involved with fuel substitution measures supported under the CPUC-authorized energy efficiency (EE) portfolios, including but not limited to investor-owned utilities, program implementers, end users, product manufacturers, CPUC, and other indirectly affected stakeholders including National Resource Defence Council Building Decarbonization, publicly-owned utilities, environmental groups, and community choice aggregation (CCAs).

Key Terminology

The following section defines key terms used in the fuel substitution guidance document. For a full glossary of terms, see Appendix C.

Original Fuel: The fuel that was being utilized prior to the fuel substitution measure.

New Fuel: The fuel that replaces the original fuel as a result of the fuel substitution measure.

Source Energy: All the depletable energy used upstream to generate and deliver the energy at the site. Only the source energy from depletable fossil-fuel resources such as natural gas and coal are considered. The source energy from non-depletable (i.e. renewable energy) sources such as solar, wind, and hydro-electric is considered as zero BTUs. Please refer to Appendix A for details.

Site Energy Consumption: Energy consumed at the site of the fuel substitution measure installation, such as a home or business

⁴ Ibid page 53

Site Energy Savings: Energy savings evaluated at the “site” level which includes the net savings from the displaced original fuel usage and the increased new fuel usage.

Full Energy Savings: The increase or decrease in site energy usage reported by the investor-owned utility after converting the change in energy into new fuel units as prescribed by D.19-08-009.⁵The full energy savings value is used in utility reporting, and not used to calculate cost effectiveness.

New Energy Service: Serving loads in the existing building that were not served before, such as the addition of an air conditioning system which did not exist prior to the fuel substitution measure.

⁵ D.19-08-009, p. 37.

Chapter 2 Fuel Substitution Measure Procedures

Fuel Substitution Measure Procedures

This chapter describes the step-by-step procedures for the fuel substitution test.

Step 1 – Determine the New Measure & Baseline Technology

The new measure technology, referred to as “measure technology” through this document, is the new fuel technology that the program administrator or implementer plans to install as a replacement for an original fuel technology which served the same or similar purpose. The chosen measure technology is the same throughout the fuel substitution test, cost-effectiveness calculations, and reported energy savings. Measure technologies are technologies which utilize either natural gas or electricity. A measure is considered a fuel substitution measure when the measure replaces a similar technology utilizing a different fuel.

As with any energy efficiency measure, the fuel substitution measure requires a baseline technology as a basis for comparison. The baseline is the state of performance and/or equipment that would have happened in absence of the program-induced energy efficiency.⁶ The baseline technology for fuel substitution measures utilizes the original fuel. The baseline technology should comply with the baseline policies in CPUC Resolution E-4818⁷ and CPUC Resolution E-4939-Attachment A.⁸ As stated in these policies, the baseline technology varies based on the measure application type (MAT). The common MATs associated with the fuel substitution measures and the applicable baseline technology are listed below:

Table 1 Baseline Technology by Measure Application Type

Measure Application Type (MAT)	Baseline technology
Normal Replacement (NR)	Code or Industry Standard Practice (ISP)
Accelerated Replacement (AR)	Existing baseline for the 1 st baseline (RUL ⁹ period) Code or ISP for the 2 nd baseline (EUL ¹⁰ -RUL period)
Behavioral, Retro-commissioning and Operational (BRO), Add-on Equipment (AOE) and Building Weatherization (BW)	Existing baseline

Measures with a New Construction (NC) MAT are not eligible for fuel substitution. Baseline Technology for NC is selected based on the new fuel.¹¹

⁶ Energy Efficiency Policy Manual v5, pp. 47

⁷ CPUC Resolution E-4818, 2 March 2017

⁸ CPUC Resolution E-4939, 12 October 2018

⁹ RUL – Remaining Useful Life

¹⁰ EUL – Effective Useful Life

¹¹ Exceptions are made for expansions or additions of load. Examples include (1) when the new fuel technology is installed in a new area of an existing building, (2) when the new fuel technology is part of a major renovation of an existing building, (3) capacity expansions of existing systems to serve existing

Like the measure technology, a constant baseline technology is used for the fuel substitution test, cost-effectiveness calculations, and reported energy savings.

Step 2 – Calculate Site Energy, Source Energy, and CO₂ Emissions

2.1 Site Energy Calculations

In order to determine the energy savings of a fuel substitution measure, calculate the site energy consumption of the baseline technology and measure technology using CPUC-recognized methodologies, such as Database of Energy Efficiency Resources (DEER) assumptions, methods, and data. The site energy consumption is defined in either kWh or Therm.

There will not be any peak demand reduction or penalty towards peak demand goal achievement from fuel substitution measures.

As per the Decision 19-08-009, for sites with on-site generation, fuel substitution measures will be treated as any other energy efficiency measure. Please refer to Appendix B for details.

For a fuel substitution measure, the site energy savings are expressed as the kWh or Therm savings of the displaced original fuel baseline technology and the increased kWh or Therm consumption from the substituted new fuel measure technology.

Example: if a natural gas baseline technology is replaced by an electric measure technology, the site energy savings is represented as an increase in electric usage, in kWh, and as the decrease in natural gas usage, in Therm.

When performing the cost effectiveness calculations described in Step 5, input a positive value for the original fuel net savings and a negative or positive value for the new fuel net savings. This process is similar to energy efficiency measures with “interactive effects”, such as a high efficiency light bulb which decreases kWh and increases Therm usage due to greater space heating needs.

2.2 Source Energy Calculations

Part One of the fuel substitution test requires that the fuel substitution measure reduces source energy consumption, expressed in BTUs. Life-cycle source energy of a measure is the source energy used over the effective useful life (EUL) of the technology. To pass Part One of the fuel substitution test, the life-cycle source energy consumption of the measure technology must be lower than the life-cycle source energy consumption of the baseline technology.¹² In other words, fuel substitution measures should produce positive life-cycle source energy savings.

and/or new load, or (4) retrofits that require a new energy service. These exceptions will follow the same baseline technology requirements as a Normal Replacement measure application type.

¹² CPUC Decision 19-08-009, 5 Aug. 2019, page 18

Program developers must demonstrate that the life-cycle source energy savings of their measure is positive through the CPUC workpaper process, using the fuel substitution calculator.

To calculate source energy savings, program developers must use the Fuel Substitution Calculator available at: [LINK TBD¹³](#). Instructions are found in the “Introduction” tab of the calculator. After entering user-provided inputs in Section One of “Fuel Sub Calcs” tab, the Fuel Substitution Calculator calculates the measure’s life-cycle source energy savings in section two. Section Two also includes a field which states if the measure passes or fails Part One of the fuel substitution test.

Appendix A describes the methodology for calculating source energy. Briefly, the fuel substitution calculator converts site energy to source energy using yearly source energy factors. The yearly source energy factors were developed based on the 2017-2018 Reference System Plan adopted in the CPUC Integrated Resources Planning (IRP) proceeding (Rulemaking (R.)16-02-007),¹⁴ and extrapolated to 2045 based on assumptions to meet California Senate Bill 100 (“SB 100”) targets. Table 2 below lists the source energy factors for electricity over the years 2020 to 2049, while Table 3 lists the source energy factor for natural gas, which remains constant.

To calculate the life-cycle source energy savings, the fuel substitution calculator multiplies annual source energy factors from Table 2 and Table 3 (in BTU/kWh and BTU/Therm respectively, for electricity and natural gas) by the site energy savings for each year of the measure’s EUL. Please refer to the equations in Chapter 3 for additional detail on these calculations.

Table 2 Annual Source Energy and Emissions for Electricity used at the Site

Year	Emissions Intensity (metric tonnes CO ₂ /MWh)	Source Energy Heat Rate (Btu/kWh)
2019	0.195	3,675
2020	0.188	3,543
2021	0.181	3,411
2022	0.174	3,279
2023	0.181	3,406
2024	0.187	3,532
2025	0.194	3,659
2026	0.201	3,786
2027	0.193	3,630
2028	0.184	3,474
2029	0.176	3,318
2030	0.168	3,162
2031	0.158	2,984
2032	0.149	2,806
2033	0.139	2,629
2034	0.130	2,451
2035	0.121	2,273

¹³ The link to the CPUC fuel substitution webpage will be updated when it becomes available.

¹⁴ Integrated Resources Planning (IRP) proceeding (Rulemaking (R.)16-02-007), <http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=316460506>

Year	Emissions Intensity (metric tonnes CO ₂ /MWh)	Source Energy Heat Rate (Btu/kWh)
2036	0.111	2,095
2037	0.102	1,917
2038	0.092	1,739
2039	0.083	1,561
2040	0.073	1,383
2041	0.064	1,205
2042	0.055	1,027
2043	0.045	849
2044	0.036	671
2045	0.026	494
2046	0.026	494
2047	0.026	494
2048	0.026	494
2049	0.026	494

Table 3 Annual Source Energy and Emissions for Natural Gas used at the Site

Year	Emissions Intensity (metric tonnes CO ₂ /Therm)	Source Energy (Btu/Therm)
Constant over the years	0.00531	100,000

2.3 Calculate CO₂ Emission Savings

Part Two of the test requires that fuel substitution measures not adversely impact the environment. As per Decision D.09-12-022, measurement of environmental impact is limited to carbon dioxide (CO₂) emissions. To pass Part Two of the test, life-cycle CO₂ emissions must be lower for the measure technology than for the baseline technology.¹⁵ Life-cycle CO₂ emissions are defined as the total CO₂ emissions over the EUL of the measure technology.

To determine if a fuel substitution measure passes Part Two of the fuel substitution test, program developers must use the Fuel Substitution Calculator. Calculator instructions are included in the introduction tab. Users input measure specific values into section one of the “Fuel Sub Calcs” tab. In Part Two of section two, the calculator displays the life-cycle emissions savings and has a field indicating if the measure passed or failed. Section two of the “Fuel Sub Calcs” tab also states if the measure is eligible or ineligible for energy efficiency incentives based on the results of Part One and Part Two of the fuel substitution test.

The methodology for calculating a measure’s CO₂ emissions is described in greater detail in Appendix A. Briefly, the approach for calculating CO₂ emissions for electricity and natural gas is similar to the methodology used to calculate the source energy factors. Like the source energy calculation, the life-cycle CO₂ emissions of a fuel substitution measure are calculated by

¹⁵ CPUC Decision 19-08-009, 5 Aug. 2019, page 18

applying the annual factors from Table 2 and Table 3 (in metric tonnes/MWh and metric tonnes/Therm respectively, for electricity and natural gas) to the site energy savings in each year of the measure's EUL. Please refer to the equations in Chapter 3 for details.

Step 3 – Determine Submission Process: Deemed Workpapers or Custom Project

If the measure technology passes the fuel substitution test, it is eligible for energy efficiency programs. A measure may be offered as a deemed measure or within a custom project. CPUC EE program administrator should follow the standard deemed workpaper process or custom project process to seek approval to offer a fuel substitution measure technology, in accordance with the additional guidance below.

If the fuel substitution measure is deemed, a workpaper must be approved by the CPUC prior to use in energy efficiency programs. The workpaper must be submitted by the IOUs or other CPUC EE program administrators to the CPUC for review and approval.¹⁶ Workpapers with fuel substitution measures must include the completed Fuel Substitution Calculator. Workpapers must also include the site energy consumption and savings values calculated in Step 2.1. For a workpaper's required four ex ante tables, the Measure Impact Type field should be selected as "Fuel Sub-Deemed" for fuel substitution measures. Lastly, please consult the latest version of DEER for the appropriate "NTG_ID", to appropriately assign a net-to-gross for fuel substitution measures. For more information of deemed measures, please visit: <http://www.caltf.org/tools>

If the fuel substitution measure is part of a custom project, the custom energy efficiency project package must also include the completed Fuel Substitution Calculator, along with the site energy consumption and savings values calculated in Step 2.1. For more information of custom projects, please visit: <https://www.cpuc.ca.gov/General.aspx?id=4133>

Step 4 - Reporting Energy Savings

In 2020, the CPUC will update the cost effectiveness tool to streamline the goal reporting and savings reduction processes, described below. The CET will output goal attainment values appropriate to fuel substitution measures in the 'GoalAttainment' field. For single-fuel PAs, CEDARS will attribute goal attainment to the appropriate gas or electric utility. Program administrators should still report the full energy savings values and original fuel goal reductions, described below, in their measure specific workpapers and in their Annual Reports and Annual Budget Advice Letters.

4.1 Energy Savings

CPUC EE Program Administrators (PAs) report energy savings to the CPUC through a software platform called CEDARS. The reported energy savings are used to assess the PA energy efficiency portfolios. Step 4, reporting energy savings, applies only to program administrators.

The savings from energy efficiency measures are reported by kW, kWh, or Therm. For non-fuel substitution measures, PAs report the savings (or increases) in kW, kWh or Therm for each

¹⁶ Energy Efficiency Policy Manual, v5, pp. 30

measure through CEDARS. Due to the unique nature of fuel substitution measures, D.19-08-009 states that the site energy savings calculated in Step 2.1 should be converted into new fuel units before being reported.¹⁷ For example, if a fuel substitution replaces a gas appliance with a new electric appliance, PAs would convert the net energy savings referenced in step 2.1 into kWh savings for the purposes of energy savings reporting. This conversion applies to energy savings reporting only and does not impact the cost effectiveness calculations.

The CPUC's Cost Effectiveness Tool (CET) will be updated in 2020 to automatically apply this conversion to fuel substitution measures and report the appropriate fuel substitution energy savings in the gross and net savings outputs. These outputs relate only to PA energy savings reporting and are not used to analyze cost effectiveness. To calculate the fuel substitution energy savings, the CET (pending a 2020 update) converts the energy savings calculated in step 2.1 into new fuel units using the site conversion factors (1 therm = 29.3 kWh and 1 kWh = 0.03413 therm). These savings are defined as full energy savings by D.19-08-009.¹⁸

The fuel substitution calculator also outputs a measure's fuel energy savings value in section 3 of the "fuel sub calcs" tab. In section 3, the calculator displays the full energy savings value in MMBTU equivalent, then states whether the "new fuel units" are in kWh or Therm. Section 3 then converts the full energy savings value into the appropriate unit (either kWh or Therm) and displays the value to be reported.

4.2 Energy Savings Goal Reduction

The original fuel utility can reduce its kWh or Therm savings goals by the difference between the fuel substitution measure's energy use and the energy usage of the baseline measure.¹⁹ The reduction should be applied to the original fuel savings goals. This reduction reflects the original fuel utility's loss in energy savings potential.

To calculate the reduction in energy savings potential, PAs use the "Full Energy Savings" value referenced in the reporting "Energy Savings" section above. The Full Energy Savings value is shown in the fuel substitution calculator, tab "fuel sub calcs", Section 3. This energy value is then converted to the original fuel using the site conversion factors (1 therm = 29.3 kWh and 1 kWh = 0.03413 therm).

In instances where a single fuel utility sponsors the fuel substitution measure, the sponsoring fuel utility will receive the energy savings credit. The original fuel utility will reduce its goals by the full energy savings value converted to the original fuel units. In instances where a dual fuel utility sponsors a fuel substitution measure, the dual fuel utility will receive savings credit in new fuel units and a reduction in original fuel goals.

D.19-08-009 requires program²⁰ energy savings impacts associated with fuel substitution measures in their Annual Reports and Annual Budget Advice Letter filings. Dual fuel utilities can report new fuel and original fuel consumption at the same time, but single fuel utilities may need to wait until the new fuel utility reports the savings impacts of its fuel substitution activities. In

¹⁷ D.19-08-009, p. 37.

¹⁸ D.19-08-009, p. 37.

¹⁹ D.19-08-009, p.38.

²⁰ D.19-08-009, p. 38.

this case, single fuel utilities should reflect original fuel impacts in the following year unless the utilities agree to share data in a timelier manner.²¹ Please see D.19-08-009, section 17.2 for a discussion of the reporting responsibilities related to fuel substitution

Step 5 – Evaluate Cost Effectiveness

Fuel substitution measures are not required to pass cost-effectiveness thresholds at the individual measure level to be eligible for energy efficiency program funding.²² However, fuel substitution measures are included in the cost effectiveness analysis of PA energy efficiency portfolios. Therefore, program developers should calculate and evaluate the cost effectiveness of fuel substitution measures.

To calculate the cost effectiveness of fuel substitution measures, program developers should use the cost effectiveness tool (CET). Generally, fuel substitution inputs are the same as non-fuel substitution energy efficiency measures. The following CET inputs require different treatment for fuel substitution measures than non-fuel substitution measures:

- **Measure Impact Type:** In 2020, the CET will be updated to include fuel substitution specific measure impact types. Users should select either “Fuel Sub-Deemed” for deemed measures or “Fuel Sub-Custom” for custom measures.
- **Measure Savings:** Users will input both the increase kWh or Therm associated with the “new fuel” measure and the decrease in kWh or Therm associated with the replacement of the baseline “original fuel” measure.
- **Net-To-Gross (NTG):** As directed in the Decision 19-08-009, use a default NTG ratio 1.0 until impact evaluation results become available.
- **Incremental Measure Costs:** The incremental measure cost is the cost of the measure technology less the cost of the baseline technology. Calculate the baseline technology cost and the measure technology cost using the CPUC’s cost effectiveness policies described in the Energy Efficiency Policy Manual.²³ As directed in Decision 19-08-009, the measure technology cost may exclude any additional upgrades required to increase the building’s total electric or natural gas load (e.g., electric panel upgrades, running new gas lines, increasing size of natural gas lines, etc.). If additional upgrades are included in the measure technology cost, cost assumptions should be included in workpapers or project submittals, 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 technology.

²¹ CPUC Decision 19-08-009, 5 Aug. 2019, p. 38

²² CPUC Decision 19-08-009, 5 Aug. 2019, page 54

²³ Energy Efficiency Policy Manual, v5, pp. 17-25, 54

As of Q4 2019, the CET correctly outputs cost effectiveness ratios for fuel substitution measures. However, updates to the CET are required to identify fuel substitution measures and properly output savings and goal attainment values. The CET updates will occur starting in the first quarter in 2020 and will be applied in sufficient time for program administrators to submit their 2020 claims and 20201 filings.

Chapter 3 Fuel Substitution Calculator Methodology

This chapter provides greater details on the fuel substitution calculator, including information on the user provided inputs, calculator outputs, and formulas.²⁴ The fuel substitution calculator was developed by the technical guidance document team and will be updated along with the fuel substitution technical guidance, as required. The fuel substitution calculator can be accessed at: [LINK](#).²⁵

Calculator Overview

The fuel substitution calculator has the following tabs:

- Introduction
- Fuel Sub Calcs
- Dropdown
- Time Series Tables
- Annual Factors
- Long-run Emissions Inputs
- Reference

To utilize the calculator, users should focus on the introduction and fuel sub calcs tabs. The introduction tab provides background on fuel substitution, describes how to use the tool, and outlines the calculation methodology. The introduction also includes the calculator change log, which describes updates to the calculator as they occur.

The fuel sub calcs tab contains all of the user input fields and outputs related to the fuel substitution test results and energy savings reporting. User inputs are entered in section 1. Section 2 outputs the results for Part One (2.1) and Part Two (2.2) of the fuel substitution test. Section 3 displays the energy savings reporting values.

Section 1: Required Measure Inputs

Fuel Substitution Calculator (tool) requires the following inputs from the user to determine if the measure passes the fuel substitution test. These inputs are requested in Section 1 of the tool.

- Measure Description – Brief description of the measure. e.g. Commercial electric steam cooker replacing gas steam cooker
- Quantity – Quantity of the measure units
- EUL – Effective Useful Life of the measure
- Install Year – The year when the proposed measure will be installed and operational
- Original fuel and New fuel
- Measure Application Type
- RUL – Remaining Useful Life for AR measures
- Annual usage (kWh and/ or Therm) for the baseline technology
- Annual usage (kWh and/ or Therm) for the measure technology

²⁴ Fuel Substitution Calculator v1.0

²⁵ The CPUC fuel substitution web link will be updated when it becomes available.

- Annual usage (kWh and/ or Therm) for code/ industry standard baseline technology for AR measures

Section 2: The Fuel Substitution Test

Using the user entries for annual usage of the baseline and the measure technology, the tool calculates the increased usage for the new fuel and the reduced usage of original fuel. This combined value is the life-cycle energy savings, represented by MMBTUs. For accelerated replacement measures, the tool calculates the first and second baseline change in consumption. Section 2.1 displays the source energy savings for each measure in MMBTU and a “pass / fail” field which displays the results of the first part of the fuel substitution test.

Section 2.1 Source Energy Savings Calculations

Using the install year and applying the yearly source energy values (BTU/kWh and BTU/ Therm) from Table 1 and Table 2 (Section 2.3) over the measure’s EUL, the tool calculates the life-cycle source energy savings as shown in the equations below for Normal Replacement (NR) and Accelerated Replacement (AR)

Equation 1:

$$\begin{aligned}
 & \text{Life – cycle source energy savings}_{NR} [BTU] \\
 & = \sum_{i=\text{start year}}^{EUL+\text{start year}-1} \left(\Delta kWh \times \text{source energy}_i \left[\frac{BTU}{kWh} \right] \right) \\
 & + \left(\Delta Therms \times \text{source energy} \left[\frac{BTU}{Therm} \right] \times EUL \right)
 \end{aligned}$$

Equation 2:

$$\begin{aligned}
 & \text{Life – cycle source energy savings}_{AR} [BTU] \\
 & = \sum_{i=\text{start year}}^{RUL+\text{start year}-1} \left(\Delta kWh_{1st\ baseline} \times \text{source energy}_i \left[\frac{BTU}{kWh} \right] \right) \\
 & + \left(\Delta Therms_{1st\ baseline} \times \text{source energy} \left[\frac{BTU}{Therm} \right] \times RUL \right) \\
 & + \sum_{i=RUL+\text{start year}}^{EUL+\text{start year}-1} \left(\Delta kWh_{2nd\ baseline} \times \text{source energy}_i \left[\frac{BTU}{kWh} \right] \right) \\
 & + \left(\Delta Therms_{2nd\ baseline} \times \text{source energy} \left[\frac{BTU}{Therm} \right] \times (EUL - RUL) \right)
 \end{aligned}$$

Where:

*Life – cycle source energy savings*_{NR} [BTU] = Source energy savings for Normal Replacement (NR) Measure application type over the life of the measure.

start year = The year when the measure will go into operational.

EUL = Effective Useful Life of the measure

ΔkWh = Baseline kWh/year – Measure kWh/year in the 1st year. Negative value for increase and positive value for decrease in electricity usage from fuel substitution measure

*source energy*_i $\left[\frac{BTU}{kWh} \right]$ = Yearly source energy values in Table 1 for electricity

$\Delta Therms$ = Baseline Therm/year – Measure Therm/year in the 1st year. Negative value for increase and positive value for decrease in natural gas usage from fuel substitution measure

source energy $\left[\frac{BTU}{Therm} \right]$ = Source energy value for natural gas in Table 2

*Life – cycle source energy savings*_{AR} [BTU] = Source energy savings for Accelerated Replacement (AR) Measure application type over the life of the measure.

RUL = Remaining Useful Life of the measure

$\Delta kWh_{1st\ baseline}$ = ΔkWh over the existing baseline

$\Delta Therms_{1st\ baseline}$ = $\Delta Therms$ over the existing baseline

$\Delta kWh_{2nd\ baseline}$ = ΔkWh over code/ISP baseline

$\Delta Therms_{2nd\ baseline}$ = $\Delta Therms$ over code/ISP baseline

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.

Section 2.2: CO2 Emission Savings

Using the same user entries, the fuel substitution calculator calculates life-cycle emissions savings (metric tCO₂) in Section 2.2. Section 2.2 also states whether a measure passed or failed the section part of the fuel substitution test.

Like the source energy savings calculations, applying the yearly emission intensity values (metric tonnes of CO₂/ MWh and metric tonnes of CO₂/ therm) from Table 1 and Table 2 (section 2.3) over the measure's EUL, the life CO₂ emissions savings are calculated using the equations below.

Equation 3:

$$\begin{aligned} & \text{Life – cycle } CO_2 \text{ savings}_{NR} [\text{metric tonnes}] \\ &= \sum_{i=\text{start year}}^{EUL+\text{start year}-1} \left(\Delta MWh \times EI_i \left[\frac{\text{metric tonnes}}{MWh} \right] \right) + \left(\Delta Therms \times EI \left[\frac{\text{metric tonnes}}{Therm} \right] \times EUL \right) \end{aligned}$$

Equation 4:

$$\begin{aligned} & \text{Life – cycle } CO_2 \text{ savings}_{AR} [\text{metric tonnes}] \\ &= \sum_{i=\text{start year}}^{RUL+\text{start year}-1} \left(\Delta MWh_{1st \text{ baseline}} \times EI_i [\text{metric tonnes}] \right) \\ &+ \left(\Delta Therms_{1st \text{ baseline}} \times EI \left[\frac{\text{metric tonnes}}{Therm} \right] \times RUL \right) \\ &+ \sum_{i=RUL+\text{start year}}^{EUL+\text{start year}-1} \left(\Delta MWh_{2nd \text{ baseline}} \times EI_i \left[\frac{\text{metric tonnes}}{MWh} \right] \right) \\ &+ \left(\Delta Therms_{2nd \text{ baseline}} \times EI \left[\frac{\text{metric tonnes}}{Therm} \right] \times (EUL - RUL) \right) \end{aligned}$$

Where:

Life – cycle CO₂ savings_{NR} [metric tonnes] = CO₂ savings for Normal Replacement (NR) Measure application type over the life of the measure.

start year = The year when the measure will go into operational.

EUL = Effective Useful Life of the measure

ΔMWh = Baseline MWh/year – Measure MWh/year in the 1st year. Negative value for increase and positive value for decrease in electricity usage from fuel substitution measure

$EI_i \left[\frac{\text{metric tonnes}}{MWh} \right]$ = Yearly Emission Intensity [EI] values in Table 1 for electricity

$\Delta Therms$ = Baseline Therm/year – Measure Therm/year in the 1st year. Negative value for increase and positive value for decrease in natural gas usage from fuel substitution measure

$EI \left[\frac{\text{metric tonnes}}{Therm} \right]$ = Emission Intensity [EI] value for natural gas in Table 2

Life – cycle CO₂ savings_{AR} [metric tonnes] = CO₂ savings for Accelerated Replacement (AR) Measure application type over the life of the measure.

RUL = Remaining Useful Life of the measure

$\Delta MWh_{1st \text{ baseline}}$ = ΔMWh over the existing baseline

$\Delta Therms_{1st \text{ baseline}}$ = $\Delta Therms$ over the existing baseline

$\Delta MWh_{2nd \text{ baseline}}$ = ΔMWh over code/ISP baseline

$\Delta Therms_{2nd \text{ baseline}}$ = $\Delta Therms$ over code/ISP baseline

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

The EUL and RUL values corresponds to the measure technology.

Section 2.3: Results

Section 2.3 of the tool provides the cumulative results of the fuel substitution test for the measure(s). To pass the fuel substitution test, all measures must pass both Part One and Part Two. Measures which pass the fuel substitution test are eligible to receive energy efficiency incentives. Measures must still be approved by the CPUC through the workpaper or custom processes. Workpapers and custom filings should include evidence that the measure passed the fuel substitution test, such as an attachment of fuel substitution calculator completed with the relevant measure inputs.

Section 3: Reporting Energy Savings and Energy Savings Inputs into CET

Section 3 of the tool calculates the full energy savings and units based on the user entry of the new fuel type in Section 1. Section 3 also outputs the 1st and 2nd baseline savings that should be used as inputs in the cost-effectiveness tool.

Chapter 4 Claimed EE Savings - Calculation Examples

This chapter explains the fuel substitution test and calculation methodology through a hypothetical example. The data used in this example is for illustration purposes and may not represent an actual project.

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 installing a central electric heat pump (DXHP) that provides heating and cooling. The expected equipment operational date is May 2020.

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

Measure Application Type: This will be considered a normal replacement (NR) because the equipment has passed its effective useful life.

Baseline Comparison Technology: DXGF meeting the prevailing code in May 2020. Title-20 2019²⁶ which will be the prevalent code in 2020 requires SEER14 and 82% AFUE for central residential AC units.

Measure Technology: DXHP exceeding the code requirements. To be eligible for NR measure application type, the proposed measure is required to 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.

Energy Savings Calculations: 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 Therm/year. The negative kWh indicates increase in electricity usage when natural gas space heating is substituted with electric space heating. Positive Therm indicates the natural gas reduction when the gas furnace is displaced.

Fuel Substitution Test Part One: 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.

Fuel Substitution Test Part Two: Applying the emission values from *Table-1* and *Table 2* and using *Equation 2*, the life-cycle CO₂ savings were calculated to be 11.49 metric tonnes of CO₂ savings.

Fuel Substitution Results (Pass/ Fail): Since the measure has both life-cycle source energy and CO₂ savings, this measure passes the fuel substitution test.

²⁶ California Energy Commission (CEC). 2019. *2019 Appliance Efficiency Regulations*. CEC-140-2019-002.

CET Input Energy Savings: The site-level savings of -1,093 kWh/year and 180 Therm/year will be used.

Reporting Energy Savings: The site-level savings are converted to new fuel units which is kWh in this case; the converted full energy 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.

Eligible Projects Costs: 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.

Appendix A– Source Energy and Emissions Determination

Introduction

This appendix details the policies and methodologies which were used to create the fuel substitution calculator. It includes an explanation of how the emission intensity factors were derived, and how the single set of factors are used to determine the source energy and emissions of fuel substitution measures.

First, it is important to note that only the source energy from depletable fossil-fuel resources are currently considered in the intensity factors for fuel substitution measures. For the purpose of the fuel substitution test, the California Public Utilities Commission (CPUC) considers the source energy and emissions for renewable generation, such as solar, wind, and hydro-electric generation, to be zero.

Policy Background

At the time of this document’s creation, no source energy or emissions intensity factors existed for fuel substitution measures. It was necessary to develop the intensity factors and other relevant values based on available information, such as current GHG mandates and goals like as Senate Bill (SB) 350 and SB 100, and reasonable assumptions as to their implementation. The fuel substitution development team relied on values used by the CPUC’s Integrated Resources Planning (IRP) proceeding.²⁷

Recent California legislation also influenced the technical guide development. SB 350²⁸ requires reducing greenhouse gas (GHG) emissions by 40% by 2030, including efforts to achieve at least 50% renewable energy procurement. SB 350 mandates are currently being implemented in the CPUC’s IRP proceeding (Rulemaking (R.)16-02-007).²⁹ SB 100,³⁰ approved on September 10, 2018, requires 100% of retail sales from GHG-free sources by 2045. The implementation of SB 100 is still in the early stages.

Conceptual Framework

The primary purpose of this effort was to identify the change in source energy and greenhouse gas emissions attributable to fuel substitution measures. With the appropriate factors, program administrators can then test source energy (‘Part One’) and CO₂ emissions (‘Part Two’) to determine whether each measure saves both source energy and CO₂ emissions.

²⁷ Integrated Resources Planning (IRP) proceeding (Rulemaking (R.)16-02-007), <http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=316460506>

²⁸ The Clean Energy Pollution Reduction Act (Senate Bill 350) – Docket 16-OIR-01– General Rulemaking Proceeding for Developing Regulations, Guidelines and Policies for Implementing SB 350 and AB 802

²⁹ Integrated Resources Planning (IRP) proceeding (Rulemaking (R.)16-02-007), <http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=316460506>

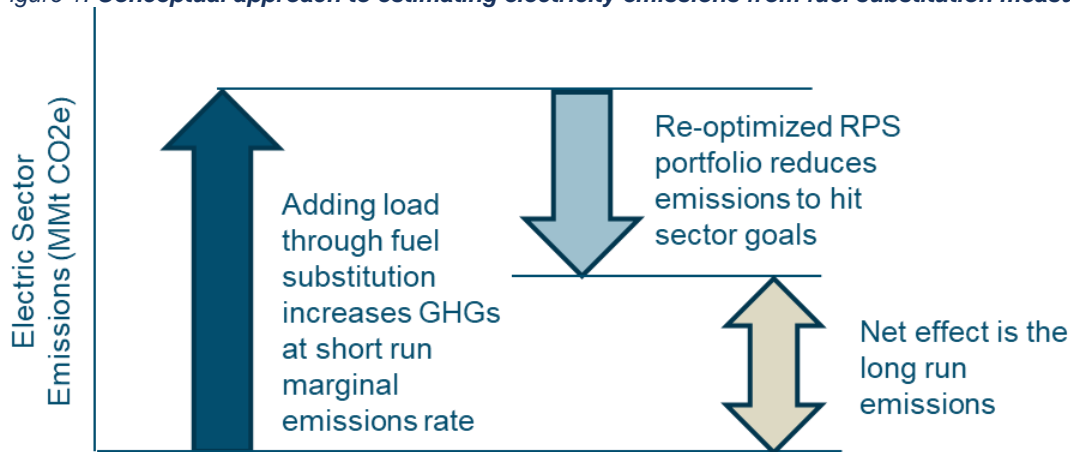
³⁰ Senate Bill 100 https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB100

For instance, SB 100 does not define “zero-carbon resources”. However, staff has done preliminary work on this topic: <https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/2018/2019%20IRP%20Preliminary%20Results%2020191004.pdf> slide 102.

Conceptually, both the source energy and the CO₂ emissions of fuel substitution occurs in two parts. First, there are the direct changes in source energy and CO₂ emissions which occur when a measure is implemented. This change is represented by an increase in sector-wide emissions resulting from the fuel substitution measure’s new gas or electric load. Second, there is a utility response to the direct change in the electric generation supply portfolio. When the electric or natural gas grid experiences an increase in source energy or CO₂ emissions from increased load, the electricity providers must re-optimize their renewables portfolio to achieve sector emissions goals. It is assumed that all investor-owned utilities will achieve the emissions targets mandated by the IRP proceeding and California legislation. The source energy and CO₂ emissions factors used in the Fuel Substitution Test should reflect the combined effect of both the direct change and the utility response to this change.

The following methodology description details the determination of annual source energy and CO₂ emissions factors for use in the fuel substitution test. As a visual aid, Figure 1 below illustrates the two parts of the CO₂ emissions impacts from fuel substitution measures. For this example, we assume an electricity load increase, but the inverse response would be expected from an electricity load decrease, including a corresponding change in the generation supply portfolio.

Figure 1: *Conceptual approach to estimating electricity emissions from fuel substitution measures*



Measuring the Direct Emissions Impact

The CPUC’s Avoided Cost Calculator (ACC)³¹ currently measures the direct emissions impact of increased load. In Figure 1, the direct emissions impact is represented by the dark blue arrow pointing upwards on the far left of the graph. For fuel substitution measures, the marginal generation emissions factors for each year (i.e., 8760 hourly factors) was multiplied by the hourly change in electricity load, while the change in natural gas consumption was multiplied by the CO₂ emissions that result from natural gas combustion (a fixed factor). This calculation is already embedded in the cost-effectiveness framework in the Avoided Cost Calculator, and the result is then multiplied by the ‘GHG Adder’ to determine the emissions component of a measure’s net benefit.

³¹ CPUC Avoided Cost Calculator at <https://www.cpuc.ca.gov/General.aspx?id=5267>

Measuring Supply Side Response to Increased Load

When load increases, the utility or supply side generation entity responds. This response is depicted in Figure 1 as the light blue arrow pointing downwards (middle arrow). To estimate the supply side response, the technical development team made some assumptions about the electricity supply portfolio. The 2017-2018 Reference System Plan³² has adopted a statewide target of 42MMt CO₂e in 2030. If taken strictly as a limit regardless of electricity load levels, then the response of the generation supply portfolio would be to fully offset the direct emissions of fuel substitution measures and the net effect would be that there are no emissions attributable to fuel substitution. This strict interpretation does not reflect the fact that the 42MMt CO₂e target was established after consideration of numerous scenarios of loads and resources as a reasonable balance of cost and GHG reductions. Therefore, it is reasonable to assume that a different target would have been established had there been significantly more electricity load from fuel substitution programs.

Rather than assume the supply portfolio fully offsets direct emissions in response to fuel substitution, we assume that supply-side investments will be made such that the emissions intensity trajectory adopted in the CPUC's IRP Reference System Plan is maintained. By using an assumption of constant intensity for the Fuel Substitution Test, we believe we can preserve the balance of cost and GHG reductions considered in the IRP proceeding. The implication is that we are assuming that if there were fuel substitution measures introduced then the electricity sector emissions would be allowed to rise above 42MMt CO₂e, as long as there were CO₂e savings in the economy overall.

The proposed test for life-cycle CO₂ emissions measures the change in electricity emissions assuming this intensity trajectory and compares that change to the change in natural gas emissions in order to verify that economy-wide reductions would be achieved.

Development of Source Energy and Emissions Intensity Factors

In order to estimate source energy, we develop factors to measure the increase or decrease in energy consumed by the change in electric generation and natural gas usage. We propose to use long-run factors that include the supply-side response to an increase in electricity load, in the same way that it is applied to CO₂ emissions.

A key question in developing the intensity factors is what the source energy content is of renewable energy and other zero-emission generation resources. We propose that the source energy of non-emitting, non-depletable resources be zero. For example, the solar irradiance that is the input to solar power is a non-depletable resource and should be considered zero source energy. We also apply the zero-source energy assumption to wind and hydro-electric generation.

With this definition, the only source energy Btu are from natural gas combustion. This is either through power generation or in direct combustion for the end-use. California does not have any non-natural gas fossil generation on the margin. Therefore, there is a simple conversion from source Btu to CO₂ emissions based on the CO₂ emissions per Btu of natural gas (~=18.84 MMBtu per tonne CO₂). The implication is that the Fuel Substitution Test for Source Energy

³² D.19-04-040.

(‘Part One’) and the Fuel Substitution Test for CO₂ emissions (‘Part Two) are effectively the same test with different units.

In order to develop the factors for the Fuel Substitution Test we rely heavily on the 2017-2018 Reference System Plan adopted in the CPUC’s IRP Proceeding (R.16-02-007). We believe that linking the input values for the Fuel Substitution Test to the IRP process has several benefits.

- 1) Using the CPUC adopted Reference System Plan closely aligns the Fuel Substitution Test with the CPUC’s long-term planning for the electricity sector and its associated emissions trajectory.
- 2) The CPUC IRP has been established with a regular two-year cycle and will therefore be regularly updated as the Commission moves along in its IRP process. Therefore, the appropriate factors used in the Fuel Substitution Test can easily be updated over time.
- 3) In its IRP proceeding the CPUC considers (among other things) the cost of the electricity portfolio and the GHG trajectory to adopt in the Reference System Plan. Therefore, linking the Fuel Substitution Test to the emissions intensity in the IRP process captures the result of this deliberation and is re-assessed in each two-year cycle.

Data Sources

To estimate the annual intensity factors, we used data from the 2017-2018 CPUC Reference System Plan as adopted in R.16-02-007. Table 6 includes the generation (GWh), retail load (GWh), and total emissions (CO₂e). The adopted plan achieves a statewide electricity sector emission of 42MMt of CO₂ emissions by 2030, and 34 MMt for the CAISO control area. This data is available from the CPUC website in the IRP proceeding using the RESOLVE results viewer for the Reference System Plan.³³

Table 4: Emissions and Load Results Data from Adopted 2017/2018 IRP Reference System Plan

		2018	2022	2026	2030
Load	<i>GWh</i>	239,107	245,583	251,286	255,038
Total Retail Sales	<i>GWh</i>	209,331	207,692	205,654	202,710
Total CAISO Emissions	<i>MMtCO₂e</i>	42.3	36.1	41.3	34.0

The adopted Reference System Plan provides retail sales and CO₂ emissions through 2030. The 2017-2018 IRP cycle did some assessment of longer time horizons, but those were not adopted in the Reference System Plan. Furthermore, the 2017-2018 was developed before California’s legislature adopted SB 100 with the goal of 100% retail sales from zero carbon energy by 2045. Therefore, to go beyond 2030 we use an assumption of the goals established by SB 100 for 2045, and a simple linear progression between 2030 and 2045. To the extent that future IRP cycles evaluate the years beyond 2030 in a more detailed approach and adopt them into the Reference System Plan this extension may no longer be necessary.

In order to estimate the emissions intensity in 2045, we assume that SB 100 is implemented and requires a minimum level of decarbonized generation equal to 100% of retail sales. With this assumption, up to approximately 7.25% of electric generation could be from natural gas generation (i.e., assuming a 7.25% loss factor³⁴). We therefore calculate the electricity sector

³³ See <https://www.cpuc.ca.gov/irp/proposedrsp/>

³⁴ Based on Avoided Cost Calculator v1b

emissions in 2045 using an assumption of the emissions intensity of a combined cycle gas turbine (CCGT) (a heat rate of 7,000 Btu/kWh) and an assumed volume of fossil fuel energy that could be used while still allowing the state to meet the SB 100 target. The remaining energy on the system is assumed to be zero emissions. The following table shows the input assumptions from the avoided cost calculator used estimate the emissions past 2030 through 2045.

Table 5: Input Assumptions from the Avoided Cost Calculator to Estimate 2045 Emissions (ACC_2019_v1b)

CCGT Heat Rate	Btu/kWh	7,000
Emissions Rate	tonnes/MWh generated	0.371
Statewide Average Energy Loss Factor	%	7.25%
Emissions Rate per Delivered MWh	tonnes/MWh delivered	0.398

2045 Intensity

Thermal generation share	% of Energy	7.25%
Emissions Rate per Delivered MWh	tonnes/MWh	0.398
2045 CO2 emissions intensity	tonnes/MWh	0.029

Intensity Factor Calculations

The CO₂ emission factors and Source Energy factors can then be calculated, as described in additional detail in the preceding sections.

Figure 2 and Figure 3, below, show the CO₂ emission factors and Source Energy factors respectively for electricity. These are annual factors based on the intensity in the 2017-2018 Reference System Plan and incorporate the net effect of both increases from direct emissions and the corresponding supply portfolio response. To use these factors to estimate the change in electricity emissions the annual energy increase (or decrease) is multiplied by the respective factor for CO₂ emissions and Source Energy.

Figure 2: Fuel Substitution CO₂ emissions Factors

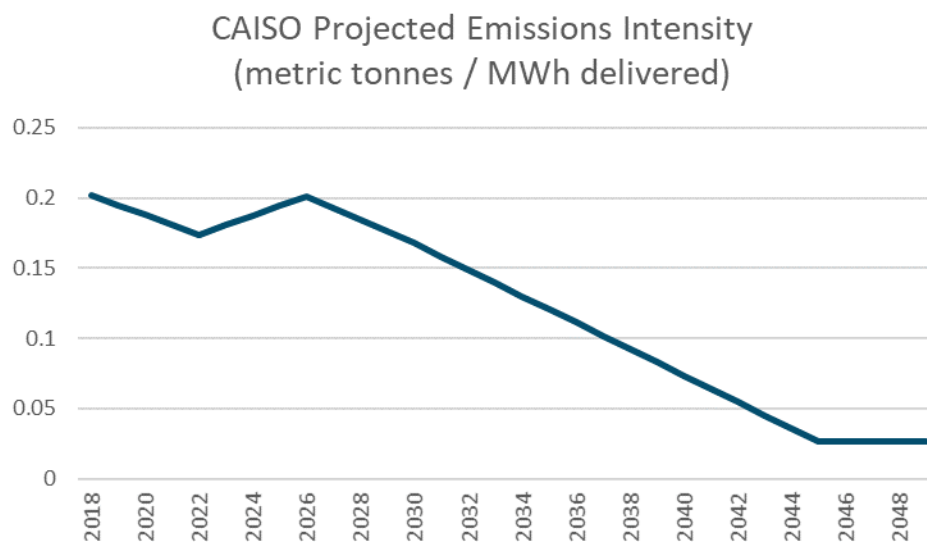
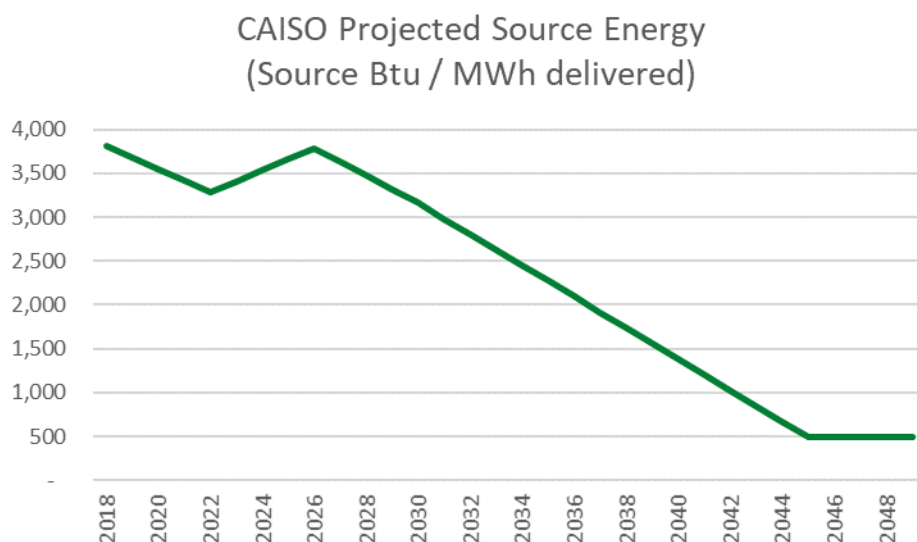


Figure 3: Fuel Substitution Source Energy Factors



As the natural gas emissions and source energy factors are based simply on the carbon content of this fossil fuel, these factors do not change over time and instead are represented by a single factor for emissions and a single factor for source energy, To calculate the increase (or decrease) in natural gas emissions or source energy, the total life-cycle change in natural gas use is therefore simply multiplied by the appropriate natural gas factor. Table 6, below, provides the natural gas CO₂ emissions and source energy factors.

Table 6: Fuel Substitution Factors for Natural Gas

Fuel Substitution Factor for Natural Gas	Units	Value
Natural Gas CO ₂ emissions	Metric tonnes/therm	0.00531
Natural Gas Source Energy Factor	Source Btu/therm	100,000

To complete the calculation of the Fuel Substitution Test for a given measure, the life-cycle changes are calculated. For Part One of the test, the life-cycle source energy impact is calculated as the sum of the source energy changes in electricity and the source energy changes in natural gas; for Part Two, the life-cycle emissions are calculated as the sum of the emissions changes in electricity and the emissions changes in natural gas. As long as the measure results in a net savings of both source energy and emissions, the measure passes the Fuel Substitution Test.

Appendix B – Sites with on-site generation

Presence of non-IOU fuel on-site generation sources does not impact the fuel substitution test used to determine the fuel substitution measure eligibility. The measures should comply with established fuel substitution test requirements.

For claimable energy savings used for incentive, reporting, and cost effectiveness calculations, the guidance established in Non-IOU Supplied Energy Sources – Guidance Document – V1.1³⁵ shall be followed with no exemptions.

The section below discusses potential impact of fuel substitution measures on claimable energy savings.

The main premise in CPUC’s non-IOU fuel guidance applies when non-IOU energy sources are present and there is a reduction in energy supplied from grid/ system that is subject to electric energy efficiency surcharges or the non-bypassable gas surcharge. Therefore, only the reduced fuel usage requires the non-IOU fuel analysis³⁶. The increased fuel usage does not require non-IOU fuel analysis unless new non-IOU on-site generation sources are added at the facility.

For natural gas to electric measures, the increase in kWh usage is not subject to non-IOU fuel analysis. The Therm savings are not subject to non-IOU fuel analysis because there is no on-site generation of natural gas which is regulated. Hence, the calculations of claimable energy savings are not impacted even when on-site natural gas generation is present.

For electric to natural gas measures, the decrease in kWh usage is subject to non-IOU fuel analysis similar to other energy efficiency measures. For the same reason explained above, the Therm increase does not require non-IOU fuel analysis. The kWh savings after non-IOU fuel analysis is added to the Therm savings (converted to kWh) for calculating the claimable energy savings.

Please note, for natural gas to electric measures, there could be scenarios where mixed fuel (electricity + natural gas) is substituted with one new fuel (electricity) and the increase in substituted fuel (gas to electricity) is outweighed by the savings from electricity part of the mixed fuel, resulting in decreased kWh. In such scenario kWh savings will require non-IOU fuel analysis.

³⁵ Energy Efficiency Savings Eligibility at Sites with non-IOU Supplied Energy Sources—Guidance Document. Version 1.1 November 6.2015

³⁶ Monthly or hourly analysis as required by Energy Efficiency Savings Eligibility at Sites with non-IOU Supplied Energy Sources—Guidance Document. Version 1.1 November 6.2015

Appendix C – 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. ³⁷
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. ³⁸
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. ³⁹
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. ^{40,41}
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: <ul style="list-style-type: none"> • 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 4 th , or the nearest weekday to July 4 th , and Labor Day.

³⁷ <http://www.cpuc.ca.gov/aboutus/>.

³⁸ California Code of Regulations, Title 24 (Building Standards Code) and Title 20, Division 2, Chapter 4, Article 4 (Appliance Energy Efficiency Regulations).

³⁹ *Energy Efficiency Policy Manual*, p. 49.

⁴⁰ 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*.

⁴¹ D.12-05-015, Attachment A: Summary of Changes to Database for Energy Efficiency Resources 2011, p. 14.

Term	Definition
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. ⁴²
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. ⁴³
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”. ⁴⁴
Energy Efficiency Savings	Energy efficiency measures may result in both energy savings (measured in kilowatt-hours or Therm) 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). ⁴⁵
Full Energy Savings	For fuel substitution measures energy savings will include two fuels, increased energy usage of new fuel and reduced energy usage of original fuel. These energy savings converted into the new fuel units using the conversion factors (1 therm = 29.3 kWh and 1 kWh = 0.03413 therm) are defined as full energy savings.

⁴² *Energy Efficiency Policy Manual*, p. 49.

⁴³ *Energy Efficiency Policy Manual*, p. 52.

⁴⁴ *Energy Efficiency Policy Manual*, p. 52.

⁴⁵ *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)	<p>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.</p> <p>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. ⁴⁶</p> <p>Participant costs include:</p> <ul style="list-style-type: none"> • 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	<p>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).⁴⁷ It should be noted that Gross Savings do include adjustments for Realization and Installation Rates. (See also GSIA.)</p>
Incremental Measure Cost	<p>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.⁴⁸</p>
Industry Standard Practice (ISP)	<p>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.</p> <p>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.</p>
Life-cycle Source BTU Consumption	<p>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.</p>

⁴⁶ California Public Utilities Commission, July 2002, *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects*, p. 11.

⁴⁷ *Energy Efficiency Policy Manual*, pp. 53-54.

⁴⁸ *Energy Efficiency Policy Manual*, p. 54.

<p>Measure Application Type (MAT)</p>	<p>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, Normal Replacement, and Weatherization. Each of these measure application types is further defined below.⁴⁹</p> <p><i>Accelerated Replacement (AR):</i> A measure application type which includes three subtypes: Early Retirement (ER), Repair Eligible (RE), and Repair Indefinitely (RI).⁵⁰</p> <p><i>Add-On Equipment (AOE):</i> 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.</p> <p><i>Behavioral, Retro-commissioning, and Operational (BRO):</i> 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 sub-elements are abbreviated as follows:</p> <ul style="list-style-type: none"> • <i>BRO-Bhv: BRO Behavioral</i> • <i>BRO-Op: BRO Operational</i> • <i>BRO-RCx: BRO Retrocommissioning</i> <p><i>Early Retirement (ER):</i> 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.</p> <p><i>New Construction (NC):</i> 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.</p> <p><i>Normal Replacement (NR):</i> 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.</p>
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Term	Definition
	<p><i>Repair Eligible (RE):</i> 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.⁵¹</p> <p><i>Repair Indefinitely (RI):</i> A measure application type representing the replacement of equipment that exceeds its EUL and has a history of repair and maintenance and could continue to be maintained to serve the load for the RUL of the existing equipment.⁵²</p> <p><i>Weatherization (BW):</i> The BW category includes improvements to non-mechanical building structures, improving the nominal efficiency of pre-existing equipment that is otherwise expected to perform essential building functions throughout the course of a building's life-cycle, without regular replacement. Such measures improve the efficiency of equipment that does not burn out or when it does burn out the building can function without them; thus, the equipment is typically not replaced unless there is a major building renovation.</p>
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 participants. ⁵³
New Construction (NEW)	See Measure Application Type.
Normal Replacement (NR)	See Measure Application Type.
Program	<p>A collection of defined activities and measures that:</p> <ul style="list-style-type: none"> • 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.⁵⁴
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. ⁵⁵

⁴⁹ 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.*

⁵⁰ 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.*

⁵¹ Working Group Created by D.16-08-019 to Develop Consensus Recommendations on Measure-Level Baseline Assignments, T1 Working Group Report, p. 13.

⁵² T1 Working Group Report, p. 13.

⁵³ *Energy Efficiency Policy Manual*, p. 57.

⁵⁴ *Energy Efficiency Policy Manual*, p. 59.

⁵⁵ *California Energy Efficiency Evaluation Protocols*, p. 217.

Term	Definition
Regressive Baseline	Use of a Code or standard practice baseline when existing equipment efficiency exceeds code or standard practice efficiency. ⁵⁶
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. ⁵⁷
Repair Eligible (RE)	See Measure Application Type.
Repair Indefinitely (RI)	See Measure Application Type.
Source BTU Consumption	Conversion of retail energy forms (kWh, Therm) 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. ⁵⁸
Standard Practice Baseline	<p>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.</p> <p>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.</p> <p>Where a standard practice is identified that exceeds the minimum efficiency established by a code or regulation, the standard practice is the appropriate baseline.</p>
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. ⁵⁹
Weatherization (WEA)	See Measure Application Types.

⁵⁶ D.12-05-015.

⁵⁷ Energy Efficiency Policy Manual, p. 61.

⁵⁸ Energy Efficiency Policy Manual, p. 62.