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Analysis of Standards Proposal for Hearth Products

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Hearth Products

Codes and Standards Enhancement (CASE) Initiative
For PY 2017: Title 20 Standards Development

Analysis of Standards Proposal for
Hearth Products
18-AAER-06

June 11, 2018

Prepared for:



PACIFIC GAS &
ELECTRIC COMPANY



SOUTHERN
CALIFORNIA EDISON



SAN DIEGO GAS AND
ELECTRIC



SoCalGas®

Prepared by:

Cassidee Kido, Bijit Kundu, and Leslie Nelson, ENERGY SOLUTIONS

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TABLE OF CONTENTS

1. PURPOSE.....	5
2. PRODUCT/TECHNOLOGY DESCRIPTION	5
2.1 PRODUCT DEFINITIONS	5
2.1.1 Fireplaces	5
2.1.2 Inserts	7
2.1.3 Stoves	8
2.1.4 Gas Log Sets	9
2.1.5 Outdoor Hearth Products	9
2.2 SCOPE	10
2.3 APPLICATIONS	10
2.4 PRODUCT DESIGN	10
2.4.1 Ignition systems	10
3. STANDARDS PROPOSAL OVERVIEW	11
4. PROPOSED STANDARDS AND RECOMMENDATIONS	12
4.1 PROPOSAL DESCRIPTION	12
4.1.1 Design Standard	12
4.1.2 Operating Efficiency: Test-and-List	13
4.2 PROPOSAL HISTORY	13
4.3 PROPOSED CHANGES TO THE TITLE 20 CODE LANGUAGE	14
4.3.1 Proposed Definitions	14
4.3.2 Proposed Test Procedure	15
4.3.3 Proposed Standard	15
4.3.4 Proposed Reporting Requirements	15
5. ANALYSIS OF PROPOSAL	16
5.1 SCOPE/Framework	16
5.2 PRODUCT EFFICIENCY OPPORTUNITIES	16
5.3 TECHNICAL FEASIBILITY	17
5.4 STATEWIDE ENERGY SAVINGS	18
5.4.1 Per-Unit Energy Savings Methodology	18
5.4.2 Summary of Per-Unit Energy Use Impacts	19
5.4.3 Stock	21
5.4.4 Shipments	22
5.4.5 Current and Future Shipments	22
5.4.6 Statewide Energy Use – Non-Standards and Standards Case	23
5.4.7 Statewide Energy Savings - Methodology	27
5.5 COST-EFFECTIVENESS	27
5.5.1 Incremental Cost	27
5.5.2 Design Life	28
5.5.3 Lifecycle Cost / Net Benefit	28
5.6 ENVIRONMENTAL IMPACTS/BENEFITS	28
5.6.1 Greenhouse Gases	28
5.6.2 Indoor or Outdoor Air Quality	29
5.6.3 Hazardous Materials	29
5.7 IMPACT ON CALIFORNIA’S ECONOMY	29
5.8 CONSUMER UTILITY/ACCEPTANCE	30
5.9 MANUFACTURER STRUCTURE AND SUPPLY CHAIN TIMELINES	30
5.10 STAKEHOLDER POSITIONS	30
5.11 OTHER REGULATORY CONSIDERATIONS	30
5.11.1 Federal Regulatory Background	30

5.11.2	<i>California Regulatory Background</i>	31
5.11.3	<i>Utility and Other Incentive Programs</i>	31
5.11.4	<i>Model Codes and Voluntary Standards</i>	31
5.11.5	<i>Compliance</i>	32
6.	CONCLUSION	32
7.	REFERENCES	33
	APPENDIX A: NATURAL GAS RATES	37
	APPENDIX B: ELECTRICITY RATES	38
	APPENDIX C: LOAD FACTORS	39
	APPENDIX D: FE METRIC	40

LIST OF FIGURES

Figure 1: Example of masonry fireplace.	6
Figure 2: Example of factory-built fireplace.	7
Figure 3: Example of gas insert.	8
Figure 4: Example of vented gas stove.	8
Figure 5: Example of gas log set.	9
Figure 6: Example of outdoor hearth product (fire table/pit).	10

LIST OF TABLES

Table 1: Summary of Proposal	11
Table 2: Hearth Products Offered in California.....	17
Table 3: 2018 Breakdown of Standing Pilot Lights vs. Intermittent Pilot Lights for Hearth Products in California in 2018.....	18
Table 4: Sources Used for Per-Unit Energy Savings Methodology	18
Table 5: Annual Per-Unit Energy Use for Non-Qualifying Products	20
Table 6: Annual Per-Unit Energy Use for Qualifying Products	20
Table 7: Annual Per-Unit Energy Savings	20
Table 8: Hearth Products Stock in California: 2019-2033.....	21
Table 9: Hearth Product Shipments in California: 2019 - 2033	22
Table 10: California Shipments and Stock	22
Table 11: California Statewide Energy Use by Fuel Type - Non-Standards Case (After Effective Date)	23
Table 12: California Statewide Energy Use – Non-Standards Case (After Effective Date)	24
Table 13: California Statewide Energy Use by Fuel Type – Standards Case (After Effective Date)	24
Table 14: California Statewide Energy Use – Standards Case (After Effective Date)	25
Table 15: California Statewide Energy Savings by Fuel Type– Standards Case (After Effective Date)	26
Table 16: California Statewide Energy Savings – Standards Case (After Effective Date).....	26
Table 17: Incremental Product Costs.....	28
Table 18: Costs and Net Benefits Per-Unit for Qualifying Products	28
Table 19: Greenhouse Gas Savings 2019 - 2033.....	29
Table 20: Statewide Total Lifecycle Costs and Benefits for Standards Case ^a	30
Table 21: Statewide Sales Weighted Average Residential Natural Gas Rates 2018-2033 (PG&E, SCG, and SDG&E - Three Largest California Natural Gas Utilities) in 2018 \$/therm Including a 3% Discount Rate.	37
Table 22: Statewide Residential Electricity Rates 2018 – 2033 (PG&E, SCE, SDG&E, LADWP and SMUD - 5 Largest California Electric Utilities) in 2018 cents/kWh Including a 3% Discount Rate	38
Table 23: 2013 Electricity Consumption and Peak Demand for the Top Five Largest California Electric Utilities ^a	39

1. Purpose

The Codes and Standards Enhancement (CASE) initiative presents recommendations to support California Energy Commission's (Energy Commission) efforts to update California's Appliance Efficiency Regulations (Title 20) to include new requirements or to upgrade existing requirements for various technologies. The four California Investor-Owned Utilities (IOUs) – Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric (SDG&E), Southern California Edison (SCE), and SoCalGas® – sponsored this effort (herein referred to as the Statewide CASE Team). The program goal is to prepare and submit proposals that will result in cost-effective enhancements to improve the energy and water efficiency of various products sold in California. This report and the code change proposal presented herein is a part of the effort to develop technical and cost-effectiveness information for potential appliance standards. This CASE Report covers a design standard proposal as well as a testing and reporting requirement for residential hearth products.

In the U.S., there are currently no appliance efficiency standards for hearth products. In February 2015, the United States (U.S.) Department of Energy (DOE) considered standards and released a Notice of Proposed Rulemaking (NOPR) on energy conservation standards for hearth products (U.S. DOE 2015c). However, the rulemaking was never finalized and was ultimately withdrawn by U.S. DOE in March 2017.

2. Product/Technology Description

2.1 Product Definitions

U.S. DOE defines a hearth product as “a gas-fired appliance that simulates a solid-fueled fireplace or presents a flame pattern (for aesthetics or other purpose) and that may provide space heating directly to the space in which it is installed.” The Statewide CASE Team proposes using this same definition for hearth product coverage in California (U.S. DOE 2015d). Hearth products provide consumers with decoration, heating, lighting, or a combination of functions (U.S. DOE 2015d).

The product categories used in this analysis, as determined by U.S. DOE, are: vented fireplaces, inserts, and stoves; unvented fireplaces, inserts, and stoves; vented gas log sets; unvented gas log sets; and outdoor products. Each product is further described below. Overall, the Statewide CASE Team proposes the same product definitions as used in the U.S. DOE NOPR.

2.1.1 Fireplaces

Fireplaces are structures made of fireproof material which are designed to hold a fire; they are often built in conjunction with a chimney or other type of flue to allow smoke and combustion gases to vent to the outside. Fireplaces can be installed during new home construction or as part of a renovation and are installed into the housing envelope or against a wall (NRCAN 2015a). Traditional masonry fireplaces are made from brick, stone, or tile and are constructed by builders such that they connect directly to the flue and chimney in the home (Napoleon Fireplaces 2015). An example of a masonry fireplace is shown in Figure 1.



Figure 1: Example of masonry fireplace.

Source: Merlin Goble Masonry, Inc. 2017.

Fireplaces may be vented or unvented. A vented fireplace has a flue or chimney to channel the exhaust of the fire outside the room, while an unvented fireplace does not have a vent to expel the fumes from the room in which the fireplace is installed (NRCAN 2015a; Houselogic 2018).

Unvented fireplaces generally provide better space heating because the heated flue gas is not lost to the outside area. However, unvented fireplaces are prohibited in California through the Health and Safety Code (CA HSC 1998). These unvented products are banned because they vent unburned combustion products directly into the home. While unvented products are usually designed to include an oxygen depletion sensor which automatically shuts off the main burner if oxygen levels are depleted to a certain level, the potential release of harmful gases, including carbon monoxide, has led California to continue to implement this ban since 1970 (The Bulletin 2015).

2.1.1.1 Factory-built fireplace

Factory-built fireplaces (also referred to as prefabricated fireplaces) are flame-holding boxes, often made of metal, that resemble gas inserts (explained below in Section 2.1.2) but are entirely manufactured in a factory with an attached chimney or flue prior to being framed into a house's building envelope. Made of non-combustible materials and designed to be installed inches away from combustible materials, factory built fireplaces require no masonry work (Napoleon Fireplaces 2015). Because these units include the fireplace housing, firebox, and chimney, factory-built fireplaces are often less expensive than masonry fireplaces. An example of a factory-built fireplace is shown in Figure 2.



Figure 2: Example of factory-built fireplace.

Source: Fireplaces Doors Online 2018.

2.1.1.2 Flame Housing

The firebox, or flame housing, is the part of the hearth product where the actual fire resides. In factory-built gas fireplaces and gas inserts, the firebox is a sealed unit—usually with glass doors to showcase the flames and to dissipate the heat from the fire to the room (Fireside Hearth & Home 2018a). To vent any gases or smoke created by the fire, the firebox leads to the smoke chamber which eventually leads to the flue. Before the smoke can pass into the smoke chamber, it must also pass through the damper (a valve that closes the flue when the fireplace is not in use) (Wilkens Contracting, Inc. 2015).

2.1.2 Inserts

A gas insert is designed to be installed into an existing wood-burning fireplace as shown in Figure 3. Gas inserts are encased in a metal housing that fits into the existing fireplace cavity and resemble factory-built fireplaces, but unlike fireplaces (see Section 2.1.1) they can be installed anytime—not just during new construction or major renovations. Because gas inserts are more versatile, they are considered a low-cost option as compared to a renovation to install a gas fireplace or replacement of an existing masonry fireplace. Inserts may include gas log sets, rocks, or other materials in contact with the flames as decoration (Napoleon Fireplaces 2015).



Figure 3: Example of gas insert.

Source: Pine Lake Stoves 2014.

2.1.3 Stoves

A gas stove is a freestanding device, often made of cast-iron, that resembles a wood-burning stove as shown in Figure 4. This type of hearth product is not recessed into a wall; all surfaces are exposed to the room. It often has heat exchangers, high levels of insulation, and tight-fitting door hinges that help prevent heat from escaping—making it more efficient at heating the room (High’s Chimney Service 2018). Stoves can be vented (if the flue gas is vented to an outdoor area) or unvented (if the flue gas is deposited in the room containing the stove). However, unvented products are banned in California under the Health and Safety Code (CA HSC 1998). Stoves may include imitation logs, rocks, or other materials in contact with the flames as decoration.



Figure 4: Example of vented gas stove.

Source: Fireside Hearth & Homes 2018b.

2.1.4 Gas Log Sets

Gas log sets are “logs” made from ceramic, refractory cement, or other material that can withstand high heat as shown in Figure 5 (Woodland Direct 2018). In addition to imitation logs, units often include a burner and a grate (U.S. DOE 2015d). Gas log sets are often installed into masonry fireplaces to convert a naturally wood burning fireplace to gas burning (Nordic Stove & Fireplace Center 2013). Gas logs sets can be vented or unvented. Vented sets must be installed in a fireplace that has a chimney or other vent to dispose of the fire fumes. These gas log sets are known to have larger flame patterns, but produce less heat because much of the heat is vented out. Unvented gas log sets do not vent out the heat from the fire, and are therefore considered to be better for heating (Fleet Plummer 2014). However, unvented products are banned in California under the Health and Safety Code (CA HSC 1998).



Figure 5: Example of gas log set.

Source: The Fireplace Shop & Grill Center 2018.

2.1.5 Outdoor Hearth Products

Outdoor hearth products are very similar to the indoor hearth product categories mentioned but are designed with materials specifically for installation and use outdoors (U.S. DOE 2015d). They may take the form of a fireplace, insert, fire pit, or other design. One example of an outdoor product is shown in Figure 6. Outdoor products do not have a vented or unvented distinction because their outdoor installation inherently means any combustion byproducts are released outdoors. The units can be free standing or permanently installed into a structure of stone, brick, or other material. Similar to indoor hearth products, outdoor hearth products can serve a variety of purposes including heating, decoration, lighting, or some combination of the three.



Figure 6: Example of outdoor hearth product (fire table/pit).

Source: Star Fire Direct 2018.

2.2 Scope

The Statewide CASE Team proposes the same scope of coverage as defined in the U.S. DOE NOPR. A proposed Title 20 Standard should include coverage for the following product categories:

- Vented fireplaces, inserts, and stoves;
- Unvented fireplaces, inserts, and stoves;
- Vented gas logs;
- Unvented gas logs; and
- Outdoor products.

Unvented, indoor heaters of any kind are banned in California under the California Health and Safety Code, and therefore the Statewide CASE Team assumes there are no savings associated with these products. For clarity and to ensure full compliance, the Statewide CASE Team is still proposing to include these products in Title 20 to explicitly state that they are banned for sale by existing code (CA HSC 1998).

2.3 Applications

Both indoor and outdoor hearth products are designed for use in residential and commercial applications. Fireplaces, inserts, and stoves are usually used indoors, while hearth products used outdoors may include fire pits, inserts, and fireplaces.

2.4 Product Design

2.4.1 Ignition systems

This section describes the different ignition systems available for use in hearth products.

2.4.1.1 Standing Pilot

Standing pilot lights (also known as continuous pilot lights) are pilot lights that, once operating, remain lit until manually interrupted (NRCAN 2017b). They are designed such that a gas line terminates to a small burner, whose flame lights a thermocouple. A thermocouple is a device that can generate electricity directly from heat. The end of the thermocouple that produces electricity is connected to a valve in the gas line. When the pilot light goes out, the lack of electricity from the thermocouple closes the gas valve to prevent gas leakage into a home (Professional Heating & Air 2014).

2.4.1.2 Intermittent Pilot

Intermittent pilot ignitions (IPI), also known as electronic ignitions, are systems that require a switch, remote control, or toggle of some sort to start when the product is off (My Gas Fireplace Repair 2017). They remain ignited only while the main burner is in operation and are automatically extinguished when the main burner is off (NRCAN 2017b). Intermittent pilots involve both a spark ignition component and a sensor. When the sensor receives a signal that heat is needed, an electric solenoid valve opens to release gas to the pilot while the spark ignition component sparks to light the gas. As soon as the gas is lit, another electric solenoid opens to allow gas from the main burner to flow (Ward Burner Systems 2004).

2.4.1.3 On-Demand Pilot

On-demand pilots are designed such that once operating, they remain ignited for a specific period of time after operation of the main burner. They automatically shut off after a specified period of time when no operation of the main burner has occurred (NRCAN 2017b).

3. Standards Proposal Overview

The Statewide CASE Team proposes a design standard for hearth products which bans the use of standing pilot lights, as well as a test-and-list proposal to collect further information on the energy consumption of hearth products. The Statewide CASE Team's analysis shows this proposed standard will result in significant natural gas savings and will be cost-effective. Additionally, the standard will have significant environmental benefits by reducing the carbon dioxide released as a result of using hearth products.

Table 1: Summary of Proposal

Topic	Description
Description of Standards Proposal	The Statewide CASE Team proposes a design standard which bans standing pilot lights in all hearth products. Additionally, the Statewide CASE Team proposes that hearth products test and report to the CAN/CSA-P.4.1-15 test procedure for test-and-list purposes.
Technical Feasibility	Over 50 percent of the market already complies with the standard and all product categories have a comparable option that incorporates an intermittent pilot light.
Energy Savings and Demand Reduction	Eliminating standing pilot lights will yield first-year statewide savings of 107,783 MMBtu/year and stock turnover savings of 1,547,712 MMBtu. Preliminary calculations for a performance standard estimate that this would yield stock turnover savings between 1,000 and 15,000 MMBtu/year (0.01 and 0.15 million therms per year) assuming a minimum FE of 50%.

Environmental Impacts and Benefits	This proposal will yield first-year statewide savings of 6,509 metric tons of carbon dioxide equivalent (MTCO ₂ e) per year and a total of 86,906 MTCO ₂ e after stock turnover in 2033. These figures are based on the projected carbon intensity of the California electricity supply over the coming years (see Section 5.6.1). This does not account for an eventual operating efficiency standard.
Economic Analysis	This proposal will lead to significant cost savings for consumers with \$14.8 million in first-year savings and over \$186 million net present value (NPV) after stock turnover in 2033. Additionally, on a shipment weighted basis, there is a lifecycle benefit-to-cost (B/C) ratio of 9.2. These figures do not account for an eventual operating efficiency standard.
Consumer Acceptance	There are currently no Title 20 Standards in place for hearth products. However, there is already a ban on standing pilot lights for hearth manufacturers under Title 24, Part 6 for low-rise residential new construction, additions, and alterations. Thus, manufacturers and installers should be familiar with compliance to regulations regarding standing pilot bans.
Other Regulatory Considerations	The U.S. DOE withdrew their federal rulemaking on hearth products in March 2017, effectively removing any federal preemption concerns. Additionally, Title 24, Part 6 bans standing pilot lights for hearth products in low-rise residential new construction, additions, and alterations. This proposal will cover all products not already covered in Title 24. Unvented hearth products are banned by the Health and Safety Code but are covered here to highlight their ban in existing code (CA HSC 1998). Energy savings from unvented products are not included in this analysis.

4. Proposed Standards and Recommendations

4.1 Proposal Description

4.1.1 Design Standard

The Statewide CASE Team recommends the Energy Commission adopt a design standard to prohibit the use of standing pilot lights in hearth products, which is equivalent to efficiency level (EL) 1 in the U.S. DOE analysis presented in the NOPR. The Statewide CASE Team also proposes to prohibit controls that provide any means of operating the product with a continuous pilot, either as a default or as an option.

Standing pilot lights have been banned from numerous other appliances in California (including fan-type central furnaces, household cooking appliances,¹ pool heaters, and spa heaters) due to their high standby mode energy consumption (CEC 2014). Standing pilot lights are also banned in fireplaces, decorative gas appliances, and gas logs included in new construction, additions, and alterations of low-rise residential buildings under Title 24, Part 6, which has been factored into this analysis (CEC 2015). Expanding the standing pilot ban to all hearth products will result in significant natural gas savings once the standard goes into effect. The details regarding the potential savings are outlined in Section 5.4.6.

¹ Excludes appliances without an electrical supply voltage connection and those in which each pilot consumes less than 150 Btu (British thermal units)/hour.

4.1.2 Operating Efficiency: Test-and-List

In order to collect information on the energy consumption of hearth products, the Statewide CASE Team recommends a test-and-list requirement for the operating efficiency of hearth products. Since there is currently no U.S. DOE test procedure for hearth products, the Statewide CASE Team recommends referencing the CAN/CSA-P.4.1-15 test procedure from the Canadian Standards Association (CSA) Group for a test-and-list requirement (CSA 2015). The CSA Standard applies to vented gas fireplaces,² as well as vented gas fireplace heaters,³ but not decorative fireplaces.⁴ Vented gas fireplace heater means any vented appliance that simulates a solid-fuel fireplace and furnishes radiant heat and warm air to the space in which it is installed; it may or may not utilize duct connections (ANSI 2018). Given the definition described in Section 2.1 that hearth products, as defined in this report, may provide space heating, decoration, lighting, or some combination of the three, the Statewide CASE Team proposes that the vented gas fireplace heater definition provided by CSA is pertinent to all hearth products covered in this proposal and thus, allows for the test procedure to be used.

Gas fireplaces manufactured in Canada have been subject to testing and reporting requirements since June 1, 2003. In British Columbia, a label from a designated tester that displays Fireplace Efficiency (FE) has been required since 2007. Based on these requirements, Natural Resources Canada (NRCan) released a Notice of Intent in March 2017 to adopt minimum energy performance standards for gas fireplaces (NRCan 2017a). Additionally, British Columbia recently updated their efficiency standards for gas fireplaces in March 2018 (Ministry of Energy, Mines, and Petroleum Resources of British Columbia 2018). These requirements and updates are discussed further in Section 5.11.4.

The Statewide CASE Team's proposed code changes will create a new section within Title 20, Section 1605.3: State Standards for Non-Federally-Regulated Appliances.

4.2 Proposal History

The California Building Code addresses hearth product standards in Title 24, Part 6 which states that continuous burning pilot lights in the installation of fireplaces, decorative gas appliances, and gas logs are prohibited in low-rise residential new construction (CEC 2015). This effectively eliminates any savings from installations of hearth products in new construction and has been accounted for in this analysis. Title 24, Part 6 also addresses standing pilot lights in fireplaces, decorative gas appliances, and gas logs for additions and alterations. This analysis assumes most installations would not trigger the building code to require compliance with these sections, thus the Statewide CASE Team has covered all products to ensure standing pilot lights are eliminated from all hearth products. Additionally, unvented products have been banned in California under the Health and Safety Code (CA HSC 1998).

With the withdrawal of the federal rulemaking on energy conservation standards for hearth products, there are no federal preemption concerns for the regulation of hearth products in California. More information on this rulemaking can be found in Section 5.11.1.

To date, there have not been any hearth product standards developed as part of the Title 20 Appliance Efficiency Regulations in California.

² As defined in ANSI Z21.50/CSA 2.22.

³ As defined in ANSI Z21.88/CSA 2.33.

⁴ As defined in ANSI Z21.60/CSA 2.26.

4.3 Proposed Changes to the Title 20 Code Language

The proposed changes to the Title 20 standards are provided below. Changes to the 2017 standards are marked with underlining (new language) and ~~strike throughs~~ (deletions).

4.3.1 Proposed Definitions

The Statewide CASE Team proposes that the Energy Commission adopt the following definitions in a new “Hearth Products” subsection to Title 20 Section 1602 “Definitions.” Some definitions are adapted from Title 24.

“Factory-built fireplace” or “zero clearance fireplace” means a prefabricated fireplace that may be built in conjunction with an attached chimney or flue to be installed as a single entity in a home.

“Fireplace” means a hearth and fire chamber, or similarly prepared place, in which a fire may be made and which is built in conjunction with a flue or chimney.

“Fireplace Efficiency” or “FE” means the metric defined in CAN/CSA-P.4.1 – 15.

“Gas log” means a self-contained, free-standing, open-flame, gas-burning appliance consisting of a metal frame or base supporting simulated logs.

“Hearth product” means a gas-fired appliance that simulates a solid-fueled fireplace or presents a flame pattern (for aesthetics or other purpose) and that may provide space heating directly to the space in which it is installed.

“Insert” means an appliance designed for installation into an existing masonry fireplace.

“Intermittent pilot light” means a pilot light that is automatically ignited when an appliance is called on to operate and which remains continuously ignited during each period of main burner operation. The pilot is automatically extinguished when each main burner operating cycle is completed.

“Masonry fireplace” means a fireplace constructed from non-combustible material that is part of a home’s structural design.

“On-demand pilot light” means a pilot light that, once placed into operation, is intended to remain ignited for a predetermined period of time following an automatic or manual operation of the main burner gas valve. The pilot is automatically extinguished when no automatic or manual operation of the main burner gas valve occurs during the predetermined period of time.

“Outdoor product” means a hearth product that is specifically designed for installation and use outdoors.

“Remotely operated pilot (ROP)” means a pilot system that provides the user with a ready means of initiating the automatic ignition and extinguishment of a pilot ignition source. The pilot system includes a device that is external to the gas safety combination control and does not require direct interaction with the gas safety combination control by the user.

“Solid-fuel burning” means a hearth product that burns solid fuel which creates a flame pattern including but not limited to wood, coal, or pellets.

“Standing pilot light” or “continuous pilot light” means a pilot that, once placed in operation, is intended to remain ignited continuously until it is manually interrupted.

“Stove” means a freestanding gas-fired unit used for either heating or decorative purposes.

“Vented hearth product” means a hearth product designed to be used with a vent.

“Unvented hearth product” means a hearth product designed to be used without a vent.

4.3.2 Proposed Test Procedure

The Statewide CASE Team proposes a design requirement for hearth products. Thus, there is no applicable test procedure for meeting the prescriptive requirement.

For the purposes of test-and-list for entry into the Energy Commission’s Modernized Appliance Efficiency Database System (MAEDbS), the Statewide CASE Team recommends the Energy Commission require the new standard to reference to the CSA Group Standard CAN/CSA-P.4.1-15 (CSA 2015).

4.3.3 Proposed Standard

The standard would reside in Section 1605.3 State Standards for Non-Federally Regulated Appliances.

Hearth Products.

(a) Continuous burning pilot lights or any pilot light that offers the option of continuous operation in hearth products sold in California on or after August 1, 2019 are prohibited.

(b) All hearth products are subject to a test-and-list requirement which must include reporting of Fireplace Efficiency (FE) as tested to CAN/CSA-P.4.1-15.

The proposed regulation is a design requirement that will ban the use of standing pilot lights in hearth products. Manufacturer compliance involves replacing the standing pilot light with an approved type of pilot light. Given its prescriptive nature, there is no efficiency metric associated with this standard. However, the Statewide CASE Team also recommends the use of the CSA Standard CAN/CSA-P.4.1-15 to report FE, as calculated in the test procedure, to inform a potential future performance standard (CSA 2015). The calculation for FE is included in Appendix D: FE Metric.

4.3.4 Proposed Reporting Requirements

The Statewide CASE Team proposes the following pieces of information be required to report for entry into the MAEDbS:

- Manufacturer;
- Brand;
- Model number;
- Add date;
- Regulatory status
 - Federally-regulated consumer product
 - Federally-regulated commercial & industrial product
 - Non-federally regulated
 - Voluntarily certified
 - N/A
 - No match

- Maximum input rate (Btu/hour)
- Minimum input rate (Btu/hour)
- Fireplace efficiency (FE);⁵
- Type of ignition;
 - Intermittent pilot
 - On-demand pilot
 - Remotely operated pilot
- Energy source;
 - Natural gas
 - Liquefied petroleum gas
 - Oil
- Outdoor install;
 - True
 - False
- Electrical phase; and
- Auxiliary electrical power in watts (W).

5. Analysis of Proposal

5.1 Scope/Framework

The scope of hearth products subject to this proposed design standard is identical to the scope in U.S. DOE's NOPR for hearth product energy conservation standards (U.S. DOE 2015c). See Section 2 for more details regarding covered products. In addition, the Statewide CASE Team proposes that the Energy Commission subject all covered products to test-and-list requirements as described in Section 4.3.4.

5.2 Product Efficiency Opportunities

In crafting their prescriptive requirement, U.S. DOE first considered the following technology options which affect active mode energy consumption:

- Air-to-fuel ratio;
- Burner port design;
- Simulated log design;
- Pan burner media/bead type;

⁵ As defined in CAN/CSA-P.4.1-15.

- Reflective walls and/or other components inside the combustion zone;
- Air circulating fan;
- Electronic ignition; and
- Condensing heat exchanger.

After an initial screening analysis, U.S. DOE decided to only pursue a standby mode energy consumption standard, eliminating all the above listed active mode technologies (U.S. DOE 2015c). The Statewide CASE Team decided to align the proposed rulemaking with the U.S. DOE; this analysis only considers standby mode energy consumption, and recommends test-and-list requirements to help inform a potential performance standard. The future performance standard may incorporate one or more of the technology options which address active mode energy consumption.

5.3 Technical Feasibility

As noted in U.S. DOE's analysis, intermittent pilots (i.e., electronic ignitions) are currently commercially available and do not result in adverse impacts on health or safety (U.S. DOE 2015d).

Additionally, U.S. DOE concluded that a prescriptive standard banning standing pilot lights would not lessen the utility or performance of the covered hearth products; all product categories offer comparable products with intermittent pilot lights (U.S. DOE 2015c).

Based on the Hearth, Patio, & Barbecue Association membership⁶, the manufacturers provided in U.S. DOE's analysis⁷, and a general web search, the Statewide CASE Team estimates there are approximately 26 hearth manufacturers based in California and 68 additional hearth manufacturers in the rest of the U.S. and Canada.⁸ After doing a survey of the products offered, the Statewide CASE Team found that of the 94 total manufacturers, approximately 1,918⁹ products are offered for sale with approximately 70 percent¹⁰ of products meeting the proposed design standard.¹¹ These results are shown in Table 2.

Table 2: Hearth Products Offered in California

Hearth product type	Number of California manufacturers	Percentage of products that meet the proposed design standard	Number of additional national manufacturers	Percentage of products that meet the proposed design standard
Vented fireplaces,	3	70%	46	67%

⁶ <http://www.hpba.org/Membership/Organization-Search>

⁷ <https://www.regulations.gov/document?D=EERE-2014-BT-STD-0036-0045>

⁸ Manufacturer lists from U.S. DOE and HPBA also includes one manufacturer from Denmark and two manufacturers from the United Kingdom.

⁹ Estimated from surveying websites and assessing whether the products fall under the scope of this report.

¹⁰ This estimate is conservative as there are some gaps in data due to manufacturer websites not stating which type of pilot light their products use.

¹¹ Includes match-lit products as these products do not fall under the scope of this report.

inserts, and stoves				
Vented gas logs	5	51%	19	65%
Outdoor products	24	47%	41	76%

As of 2018, the Statewide CASE Team's analysis indicates that in California, over 55 percent of current hearth product stock already utilizes intermittent pilot lights. Detailed numbers are shown in Table 3 below.

Table 3: 2018 Breakdown of Standing Pilot Lights vs. Intermittent Pilot Lights for Hearth Products in California in 2018

	Stock (all product categories)	Stock market share	Total shipment (all product categories)	Shipments market share
Standing pilot	370,538	45%	24,703	45%
Intermittent pilot	461,838	55%	30,789	55%
Total	832,376	100%	55,492	100%

Source: Statewide CASE Team Analysis;^a U.S. DOE 2015d.

^aBased on national shipments from U.S. DOE Technical Support Document (TSD).

Considering that over half of current stock and shipments meet the proposed standard, the Statewide CASE Team has concluded that this proposed standard is technically feasible for manufacturers.

5.4 Statewide Energy Savings

5.4.1 Per-Unit Energy Savings Methodology

This section describes Statewide CASE Team methodology used to estimate energy and environmental impacts. The Statewide CASE Team calculated the impacts of the proposed code change by comparing non-qualifying products to qualifying products. The results reflected in this report do not currently reflect the recently adopted 2019 Title 24, Part 6 Building Energy Efficiency Standards¹² described further in 5.11.2.

The Statewide CASE Team drew heavily from the U.S. DOE analysis for information regarding per-unit energy consumption, product lifetime, shipments, and cost data by EL. The sources for this information are shown in Table 4 below.

Table 4: Sources Used for Per-Unit Energy Savings Methodology

Data used	Source
Per-unit energy consumption	TSD Chapter 7: Energy Use Analysis ^a

¹² The 2019 Title 24 Standards have not yet been adopted by the Building Standards Commission as of writing this CASE Report.

Product lifetime	TSD Chapter 8: Life-Cycle Cost and Payback Period Analysis ^a
Shipments	National Impact Analysis (NIA) ^b
Cost data	NIA ^b

Source: U.S. DOE 2015d;^a U.S. DOE 2015b^b.

The analysis assumes a standard effective year of 2019. In addition, the Statewide CASE Team chose the same scope as U.S. DOE after results showed it would deliver significant, cost-effective savings for California natural gas users.

5.4.1.1 Annual Per-Unit Energy Use Methodology

As described in Section 5.4.1 above, the per-unit energy use was adapted from the U.S. DOE analysis. Non-qualifying products are products that do not meet the proposed standard and qualifying products are products that meet the proposed standard. Based on survey data, tear down analysis, manufacturer literature, and consultant input, U.S. DOE calculated energy consumption for both qualifying and non-qualifying products in each product category (U.S. DOE 2015d). This included calculations for the main burner operating hours, standing pilot light energy consumption, intermittent pilot light energy consumption, and the secondary effects resulting from the use of hearth products (U.S. DOE 2015d). The Statewide CASE Team assumed that the energy consumption values determined in U.S. DOE's analysis were reasonable for products in California. Thus, U.S. DOE values for energy consumption are used throughout the analysis.

5.4.1.2 Peak Demand Methodology

Peak demand was calculated by multiplying daily electricity use by an assumed load factor. A load factor is the ratio of average annual load to coincident peak load. The Statewide CASE Team obtained end-use load factors through consultations with the Energy Commission. The load factors used in this report were developed by the Energy Commission using an Hourly Energy and Load Model (Brown and Koomey 2002) on 2013 utility-level energy demand data. A complete table of updated values for several end uses is included in Appendix C: Load Factors. For the purposes of this report, the Statewide CASE Team included hearth products in the residential space heating end-use category (see Appendix C: Load Factors), and used the corresponding load factor of zero (0) for hearth products. Thus, this proposed standard does not have any demand reduction benefits.

5.4.2 Summary of Per-Unit Energy Use Impacts

The per-unit energy use for both non-qualifying and qualifying products is shown in Table 5 and Table 6 below, respectively. Annual per-unit energy savings are presented in Table 7. Although qualifying products use more electricity than non-qualifying products, their lower natural gas usage outweighs the increased electricity usage, resulting in overall lower energy consumption, as shown in the columns displaying MM (a thousand thousand, or million) Btu usage. The methodology used to calculate these estimates is presented above in Section 5.4.1.

Table 5: Annual Per-Unit Energy Use for Non-Qualifying Products

Product class	Electricity use (kilowatt hours (kWh)/year)	Natural gas use (therms/year)	Peak demand (W)	Total site energy usage (MMBtu)
Vented fireplaces, inserts, and stoves	0	39.9	0	4.0
Vented gas logs	0	35.2	0	3.5
Outdoor	0	31.3	0	3.1

Source: Statewide CASE Team Analysis; U.S. DOE 2015d.

Table 6: Annual Per-Unit Energy Use for Qualifying Products

Product class	Electricity use (kWh/year)	Natural gas use (therms/year)	Peak demand (W)	Total site energy usage (MMBtu)
Vented fireplaces, inserts, and stoves	13.6	5.0	0	0.6
Vented gas logs	5.8	13.0	0	1.6
Outdoor	0.2	2.9	0	0.3

Source: Statewide CASE Team Analysis; U.S. DOE 2015d.

Table 7: Annual Per-Unit Energy Savings

Product class	Electricity savings (kWh/year)	Natural gas savings (therms/year)	Peak demand (W)	Total site energy savings (MMBtu)
Vented fireplaces, inserts, and stoves	-13.6	34.9	0	3.4
Vented gas logs	-5.8	22.2	0	2.8
Outdoor	-0.2	28.4	0	3.9

Source: Statewide CASE Team Analysis; U.S. DOE 2015d.

The Statewide CASE Team also estimates a range of between 0.01 and 0.19 therms of annual per-unit savings potential assuming an additional performance standard. This additional analysis came from leveraging data from NRCan's established database¹³ and data from Energy Trust of Oregon.¹⁴ NRCan's online database lists FE as well as a maximum input rating for each of its products. The Statewide CASE Team assumed the proposed performance standard would set the minimum

¹³ http://oee.nrcan.gc.ca/pml-lmp/index.cfm?action=app.search-recherche&appliance=FIREPLACE_G

¹⁴ U.S. DOE 2015e.

efficiency level at 50% FE¹⁵ and calculated a range of potential savings based on varying input rates and runtime hours.¹⁶ The savings calculated are assumed to come from a reduction in the use of the primary heating source given higher heating output from a more efficient hearth product. Further analysis is on-going and will be made available when completed.

5.4.3 Stock

To estimate stock for hearth products in California, the Statewide CASE Team used shipment data from the U.S. DOE NIA (U.S. DOE 2015b). These numbers were adjusted to California by removing new construction installations, removing match-lit products since they are not in the scope of this proposal, and using the Residential Energy Consumption Survey (RECS) 2009 data to determine how many Californians use hearth products as compared to the nation as a whole (CEC 2015; RECS 2009). Once the shipment numbers were adjusted, they were multiplied by the product lifetime to get an estimate of the stock. Table 8 shows a summary of projected stock data from 2019 (the year the standard would go into effect) until 2033 (the year stock would fully turnover).

Table 8: Hearth Products Stock in California: 2019-2033

Base case year	Stock (total)
2019	841,312
2020	832,291
2021	808,478
2022	796,751
2023	793,951
2024	797,252
2025	812,948
2026	821,636
2027	814,665
2028	800,947
2029	803,570
2030	808,211
2031	800,247
2032	775,472
2033	773,143

Source: Statewide CASE Team Analysis; U.S. DOE 2015b.

¹⁵ Equivalent to British Columbia's standard.

¹⁶ Runtime hours come from Energy Trust of Oregon and DOE TSD assumptions.

5.4.4 Shipments

Similar to stock information, the Statewide CASE Team used U.S. DOE shipment data from the National Impact Analysis (U.S. DOE 2015b). This data was used as a proxy for sales for the design standard proposal and was adjusted to California by removing new construction installations and match-lit products (which are not in the scope of this proposal), and using RECS 2009 data to determine how many Californians use hearth products as compared to the nation as a whole (CEC 2015; RECS 2009). Table 9 shows a summary of projected shipments from 2019 (the year the standard would go into effect) until 2033 (the year stock would fully turnover).

Table 9: Hearth Product Shipments in California: 2019 - 2033

Base case year	Shipments (total)
2019	56,087
2020	55,486
2021	53,899
2022	53,117
2023	52,930
2024	53,150
2025	54,197
2026	54,776
2027	54,311
2028	53,396
2029	53,571
2030	53,881
2031	53,350
2032	51,698
2033	51,543

Source: Statewide CASE Team Analysis; U.S. DOE 2015b.

5.4.5 Current and Future Shipments

Full stock turnover will occur in 2033, assuming a weighted average 15-year lifetime across all product classes and a standard effective year of 2019. Table 10 summarizes stock and shipment for 2019 and 2033 for the purposes of the design standard.

Table 10: California Shipments and Stock

	Annual shipments	Stock
2019 (standards take effect)	56,087	841,312
2033 (after stock turnover)	51,543	773,143

Source: Statewide CASE Team Analysis; U.S. DOE 2015d.

5.4.6 Statewide Energy Use – Non-Standards and Standards Case

In the following section, “non-standards case” is the term used to describe the scenario where no standard is enacted while “standards case” is used to describe the scenario that would occur with a standard in place. Table 11 shows the statewide electricity and natural gas usage for the non-standards case while Table 12 shows the cumulative non-standards case energy usage in MMBtu. As can be seen, the energy use remains relatively constant throughout the lifetime of the product. Alternatively, Table 13 shows the statewide electricity and natural gas usage for the design standards case, while Table 14 shows the design standards case energy usage in MMBtu. The difference between these two scenarios, which ultimately results in overall savings, is shown in Table 15 and Table 16. Table 15 shows the statewide electricity and natural gas savings for the design standards case, while Table 16 shows the statewide energy savings for the design standards case in MMBtu.

These tables show that with the implementation of a standard, electricity use increases slightly (with more products using intermittent pilots), natural gas usage decreases (with fewer products using excess natural gas from standing pilots), and overall Btu consumption decreases.

Table 11: California Statewide Energy Use by Fuel Type - Non-Standards Case (After Effective Date)

Year	Annual Shipments		Stock	
	Electricity use (gigawatt hours (GWh)/year)	Natural gas use (million therms/year)	Electricity use (GWh/year)	Natural gas use (million therms/year)
2019	0.3	1.3	4.5	19.9
2020	0.3	1.3	4.5	19.9
2021	0.3	1.3	4.5	19.9
2022	0.3	1.3	4.5	19.8
2023	0.3	1.3	4.5	19.8
2024	0.3	1.3	4.5	19.7
2025	0.3	1.3	4.4	19.7
2026	0.3	1.3	4.4	19.7
2027	0.3	1.3	4.4	19.6
2028	0.3	1.3	4.4	19.6
2029	0.3	1.3	4.4	19.5
2030	0.3	1.3	4.4	19.5
2031	0.3	1.3	4.4	19.5
2032	0.3	1.2	4.4	19.4
2033	0.3	1.2	4.4	19.3

Source: Statewide CASE Team Analysis.

Table 12: California Statewide Energy Use – Non-Standards Case (After Effective Date)

Year	Shipments	Stock
	Total site energy usage (MMBtu/year)	Total site energy usage (MMBtu/year)
2019	135,205	2,007,971
2020	133,755	2,007,958
2021	129,928	2,004,117
2022	128,044	1,998,392
2023	127,594	1,992,217
2024	128,124	1,986,572
2025	130,647	1,983,450
2026	132,043	1,981,724
2027	130,923	1,978,877
2028	128,718	1,973,826
2029	129,140	1,969,197
2030	129,886	1,965,314
2031	128,606	1,960,150
2032	124,624	1,951,005
2033	124,250	1,941,486

Source: Statewide CASE Team Analysis.

Table 13: California Statewide Energy Use by Fuel Type – Standards Case (After Effective Date)

Year	Annual shipments		Stock	
	Electricity use (GWh/year)	Natural gas use (million therms/year)	Electricity use (GWh/year)	Natural gas use (million therms/year)
2019	0.7	0.3	4.9	18.8
2020	0.7	0.2	5.3	17.8
2021	0.7	0.2	5.6	16.7

2022	0.6	0.2	6.0	15.6
2023	0.6	0.2	6.3	14.5
2024	0.6	0.2	6.6	13.4
2025	0.7	0.2	7.0	12.3
2026	0.7	0.2	7.4	11.2
2027	0.7	0.2	7.7	10.2
2028	0.6	0.2	8.1	9.1
2029	0.7	0.2	8.4	8.0
2030	0.7	0.2	8.8	6.9
2031	0.6	0.2	9.1	5.8
2032	0.6	0.2	9.4	4.7
2033	0.6	0.2	9.8	3.6

Source: Statewide CASE Team Analysis.

Table 14: California Statewide Energy Use – Standards Case (After Effective Date)

Year	Shipments	Stock
	Total site energy usage (MMBtu/year)	Total site energy usage (MMBtu/year)
2019	27,422	1,900,189
2020	27,128	1,793,548
2021	26,352	1,686,131
2022	25,970	1,578,332
2023	25,879	1,470,442
2024	25,986	1,362,659
2025	26,498	1,255,388
2026	26,781	1,148,400
2027	26,554	1,041,185
2028	26,107	933,522
2029	26,192	825,946
2030	26,343	718,520
2031	26,084	610,835
2032	25,276	502,342
2033	25,200	393,774

Source: Statewide CASE Team Analysis.

Table 15: California Statewide Energy Savings by Fuel Type– Standards Case (After Effective Date)

Year	Annual shipments		Stock	
	Electricity savings (GWh/year)	Natural gas savings (million therms/year)	Electricity savings (GWh/year)	Natural gas savings (million therms/year)
2019	-0.7	1.1	-0.7	1.1
2020	-0.7	1.1	-1.4	2.2
2021	-0.7	1.0	-2.0	3.2
2022	-0.6	1.0	-2.7	4.3
2023	-0.6	1.0	-6.3	5.3
2024	-0.6	1.0	-3.9	6.3
2025	-0.7	1.1	-4.6	7.4
2026	-0.7	1.1	-5.3	8.4
2027	-0.7	1.1	-5.9	9.5
2028	-0.6	1.0	-6.6	10.5
2029	-0.7	1.0	-7.2	11.6
2030	-0.7	1.0	-7.9	12.6
2031	-0.6	1.0	-8.5	13.7
2032	-0.6	1.0	-9.2	14.7
2033	-0.6	1.0	-9.8	15.7

Source: Statewide CASE Team Analysis.

Table 16: California Statewide Energy Savings – Standards Case (After Effective Date)

Year	Shipments	Stock
	Total site energy usage (MMBtu/year)	Total site energy usage (MMBtu/year)
2019	107,783	107,783
2020	106,627	214,410
2021	103,576	317,986
2022	102,074	420,060
2023	101,715	521,775

2024	102,138	623,913
2025	104,149	728,062
2026	105,262	833,324
2027	104,369	937,693
2028	102,611	1,040,304
2029	102,947	1,143,252
2030	103,542	1,246,794
2031	102,522	1,349,315
2032	99,348	1,448,663
2033	99,049	1,547,712

Source: Statewide CASE Team Analysis.

The Statewide CASE Team also conducted preliminary analysis assuming that the test and list requirement for performance efficiency would result in an eventual standard. Assuming that the minimum efficiency level would be set at 50% FE¹⁷, leveraging data from NRCan¹⁸ and Energy Trust of Oregon,¹⁹ stock turnover statewide savings would be between 0.01 and 0.15 million therms, additional to the design standard.

5.4.7 Statewide Energy Savings - Methodology

Statewide savings estimates were calculated by applying the per-unit energy savings for the design standard presented in Section 5.4.1.1 to the statewide stock and sales forecast for the design standard presented in Sections 5.4.3 and 5.4.4 of the report.

5.5 Cost-Effectiveness

This section describes the methodology and approach the Statewide CASE Team used to analyze the economic impacts of the proposed standard.

5.5.1 Incremental Cost

Incremental cost is the calculated difference between installation of equipment with a standing pilot and equipment without a standing pilot light for the purposes of the design standard proposal. The results presented in Table 17 are derived from the average installed costs in U.S. DOE's analysis by adjusting numbers to 2018 dollars (U.S. DOE 2015d). U.S. DOE calculated this installed cost using retail markups, sales, taxes, installation costs (including labor), overhead, and miscellaneous materials and parts which were obtained through various sources including: RS Means 2013, teardown analysis, and interviews with manufacturers (U.S. DOE 2015d). The U.S. DOE values for annual operating costs were not included in the incremental cost analysis since they are accounted for separately in the Statewide CASE Team analysis. As shown in the table, vented gas log sets have the highest incremental cost while vented fireplaces, inserts, and stoves have the lowest incremental cost.

¹⁷ Assuming the same level that British Columbia recently adopted (Ministry of Energy, Mines, and Petroleum Resources of British Columbia 2018).

¹⁸ http://oee.nrcan.gc.ca/pml-lmp/index.cfm?action=app.search-recherche&appliance=FIREPLACE_G

¹⁹ U.S. DOE 2015e.

Table 17: Incremental Product Costs

Hearth product category	Incremental cost over baseline (2018 \$)
Vented fireplace/insert/stove	\$37.99
Vented gas log sets	\$162.03
Outdoor	\$79.52

Source: Statewide CASE Team Analysis; U.S. DOE 2015d.

5.5.2 Design Life

To determine product lifetime for hearth products, U.S. DOE used warranty information and the lifetimes of similar appliances to estimate both hearth product and hearth product ignition system lifetimes (U.S. DOE 2015d). In their lifecycle cost analysis, U.S. DOE used a weighted average of 15 years across all products, which was the value used throughout the Statewide CASE Team's analysis (U.S. DOE 2015a).

5.5.3 Lifecycle Cost / Net Benefit

Table 18 presents the per-unit and total lifecycle costs and net benefits of the proposed standard. In this case, the period of analysis is the weighted average product life, 15 years. The cost impacts are presented in present value (PV) and NPV. The energy benefits savings per-unit over the 15-year period are presented for the hearth product classes evaluated, weighted by shipments.

Table 18: Costs and Net Benefits Per-Unit for Qualifying Products

Product Class	Product life (years)	Lifecycle costs per-unit (PV) ^a			Lifecycle benefits per-unit (PV)		NPV per-unit
		Incremental cost ^b	Additional cost ^c	Total PV costs	First-year natural gas savings	Total PV benefits	Natural gas
Shipment weighted hearth products	15.0	\$46.06	\$29.43	\$75.49	\$474.77	\$474.77	\$399.28

Source: Statewide CASE Team Analysis; U.S. DOE 2015b.

^aPV calculated using the Energy Commission's average statewide PV statewide energy rates, and a 3% discount rate (CEC 2017). See Appendix A: Natural Gas Rates for details regarding rates.

^b Incremental cost is the cost difference between the baseline non-qualifying product and the qualifying product.

^c Additional cost incurred from the cost of electricity due to increased electricity use.

5.6 Environmental Impacts/Benefits

5.6.1 Greenhouse Gases

Table 19 presents the annual and stock greenhouse gas (GHG) savings for the first year the design standard takes effect (2019) through the year of full stock turnover (2033). The estimated annual statewide GHG savings is 6,509 MTCO₂e the first year the design standard is in effect and 5,562

MTCO₂e after full stock turnover in 2033, with stock GHG savings reaching 64,300 MTCO₂e in year 2033. The Statewide CASE Team calculated the avoided GHG emissions from the adoption of the design standard assuming an emissions rate varying by year, in accordance with California’s projected emissions factors as outlined in the 2017 update to the California Air Resources Board (CARB) scoping plan to meet the 2033 greenhouse gas targets (CARB 2017).

Table 19: Greenhouse Gas Savings 2019 – 2033

Year	Annual GHG savings (MTCO₂e/year)	Stock GHG savings (MTCO₂e/year)
2019	6,509	6,509
2020	6,388	12,845
2022	6,149	18,878
2023	5,986	24,633
2024	5,892	30,223
2025	5,831	35,620
2026	5,941	41,531
2027	6,000	47,499
2028	5,947	53,429
2029	5,843	59,237
2030	5,790	64,300
2031	5,823	70,115
2032	5,764	75,860
2033	5,588	81,480

Source: Statewide CASE Team Analysis.

5.6.2 Indoor or Outdoor Air Quality

Indoor air quality enhancements are often associated with switching from an unvented product to a vented product. Given that unvented products are already banned in California under the Health and Safety Code, the Statewide CASE Team does not assume any changes to indoor or outdoor air quality as a direct result of this proposed prescriptive standard.

5.6.3 Hazardous Materials

There are no known incremental hazardous materials impact resulting from the proposed prescriptive standard.

5.7 Impact on California’s Economy

Table 20 below presents the total lifecycle costs and benefits for the design standards case. The first-year shipments in 2019 have a NPV of \$14.8 million while the stock turnover yields over \$186 million by 2033.

Table 20: Statewide Total Lifecycle Costs and Benefits for Standards Case^a

Product class	Lifecycle B/C ratio ^b	NPV (\$) ^c	
		First-year shipments (\$ million)	Stock turnover ^d (\$)
Hearth products (shipment weighted average)	9.2	14.8	186,087,801

Source: Statewide CASE Team Analysis.

^a The analysis does not include cost savings associated with embedded energy savings.

^b Total PV benefits divided by total PV costs. Positive value indicates a reduced total cost of ownership over the life of the appliance.

^c It should be noted that while the proposed standard is cost-effective, it may be more cost-effective if using alternative rate structures. For example, marginal utility rates may more accurately reflect what customers save on utility bills as result of the standard.

^d Stock turnover NPV is calculated by taking the sum of the NPVs for the products purchased each year following the standard's effective date through the stock turnover year (i.e. the NPV of "turning over" the whole stock of less efficient products that were in use at the effective date to more efficient products, plus any additional non-replacement units due to market growth, if applicable). For example, for a standard effective in 2015 applying to a product with a five year design life, the NPV of the products purchased in the fifth year (2019) includes lifecycle cost and benefits through 2024, and therefore, so does the Stock turnover NPV.

5.8 Consumer Utility/Acceptance

There are currently no equipment standards for hearth products. However, hearth manufacturers and installers must comply with the current ban on standing pilot lights for new construction under Title 24, Part 6. Thus, manufacturers and installers should be familiar with the necessity to comply with regulations around the standing pilot light ban.

5.9 Manufacturer Structure and Supply Chain Timelines

Based on calls to local suppliers, the Statewide CASE Team found that most local suppliers sell hearth products directly to consumers and subsequently perform home installation. Suppliers report occasional sales to contractors for installation in new homes. However, local suppliers most often act as both retailer and installer for these types of products.

5.10 Stakeholder Positions

The Statewide CASE Team is aware of three California-based hearth manufacturers who submitted comments in response to the 2015 U.S. DOE rulemaking. Williams Furnace Company wanted U.S. DOE to specify that vented direct heating equipment was not included in the rulemaking because they manufacture vented room heater gas furnaces to simulate solid fuel fireplaces (Williams Furnace Company 2015). R.H. Peterson Company, a manufacturer of vented and unvented gas log sets, argued (among other issues) that the cost of implementing this standard would fall on small businesses in the gas log industry (RH Peterson Company 2015). Finally, Rasmussen Iron Works, Inc., which manufactures gas log sets, argued that gas log sets should not be covered under the proposed U.S. DOE regulation (Rasmussen Iron Works 2015).

5.11 Other Regulatory Considerations

5.11.1 Federal Regulatory Background

In February 2015, U.S. DOE released a NOPR on energy conservation standards for hearth products (U.S. DOE 2015c). However, the rulemaking never made it to the final rule stage and was withdrawn in March 2017—removing any federal preemption concerns for California.

5.11.2 California Regulatory Background

There have not been any Title 20 Regulations passed for hearth products. In Title 24, Part 6, there is a provision which bans continuous burning pilot lights in the installation of fireplaces, decorative gas appliances, and gas logs²⁰ in new construction of low-rise residential buildings as well as additions and alterations (CEC 2015). This eliminates any savings associated with hearth product installation in new construction, which has been appropriately accounted for in this analysis.

The Statewide CASE Team is also aware that the recently adopted Title 24, Part 6 Building Energy Efficiency Standards will prohibit standing pilot lights for fireplaces in new construction, additions, and alterations of all building types starting in January 1, 2020. Savings estimates were not adjusted in this analysis, but can be accounted for post-adoption.

5.11.3 Utility and Other Incentive Programs

The Statewide CASE Team is not aware of any current utility or incentive programs for hearth products.

5.11.4 Model Codes and Voluntary Standards

The Statewide CASE Team recommends a test-and-list using the Canadian Standard CAN/CSA-P.4.1-15 for data entry into MAEDbS, similar to Canada's current requirement of reporting on gas fireplace models and their energy efficiency.²¹

While proposing no marking or labeling requirements for products in California at this time, the Statewide CASE Team is aware of voluntary requirements for products in Canada. Currently, gas fireplaces sold in Canada can voluntarily use the EnerGuide label that displays FE²² as a percentage; percentage increase directly correlates to higher product energy efficiency (NRCAN 2015b).

Since 2003, NRCAN has required that all gas fireplaces manufactured in Canada are subject to testing and reporting requirements (NRCAN 2017a). Based on data collected from testing and reporting, the Office of Energy Efficiency at NRCAN issued a Notice of Intent in March 2017 to adopt minimum efficiency performance standards for gas fireplaces. NRCAN differentiates between decorative gas fireplaces and fireplace heaters; their notice of intent proposes several efficiency requirements for each. They are considering regulating the types of pilots that can be used in any gas fireplaces as well as requiring gas fireplace heaters to have a minimum FE of 50 percent when tested using CAN/CSA-P.4.1-15. Additionally, they are considering requiring decorative gas fireplaces to draw combustion air directly from outside the building unless intended to be installed as a replacement only with proper markings (NRCAN 2017a).

Since 2007, British Columbia's Energy Efficiency Standard Regulation has required that any gas fireplace manufactured or sold in the province includes a label from a designated tester that displays the FE rating of the product. British Columbia also developed a voluntary certification called EnerChoice™ in 2010 to help bring awareness to gas fireplace energy performance. It is awarded to the 25 percent most efficient fireplace models in the categories of inserts, freestanding, and zero clearance (Berkhout and Nowell 2016). Subsequently, in March 2018, British Columbia updated standards for gas fireplaces. Fireplace heaters²³ manufactured on or after January 1, 2019 must be tested with CAN/CSA P.4.1-15 to have an FE of at least 50 percent which must be stated on a verification label; must not have a standing pilot light; and must have a pilot-on-demand,

²⁰ As defined in Title 24, Part 6.

²¹ <http://laws-lois.justice.gc.ca/eng/regulations/SOR-2016-311/>

²² As defined in CAN/CSA-P.4.1-15

²³ As defined in the scope of CSA 2.33-2016 and CSA 2.22-2016.

interrupted, or intermittent pilot ignition system. Decorative gas appliances²⁴ manufactured on or after January 1, 2019 must have an efficiency label which states the FE rating and must comply with the same pilot light restrictions as fireplace heaters mentioned previously (Ministry of Energy, Mines, and Petroleum Resources of British Columbia 2018). In calculating potential savings for their standard, British Columbia only included savings associated with taking out standing pilot lights and did not include savings associated with meeting the 50 percent FE rating, as at least 94 percent of products in each of their categories already meet this performance level (Berkhout and Nowell 2016).

5.11.5 Compliance

Currently, approximately 30 percent of products on the market do not comply with the proposed standard. However, each product category has a comparable product currently on the market that meets the proposed standard.

6. Conclusion

The Statewide CASE Team proposes that the Energy Commission adopt a prescriptive energy conservation standard which bans standing pilot lights for hearth products. Additionally, the Statewide CASE Team proposes testing and reporting requirements for hearth products based on the CAN/CSA-P.4.1-15 test procedure. The data generated from these efforts will help to inform future performance energy conservation standards. Due to U.S. DOE withdrawing their energy conservation standard on hearth products in March 2017, these products are eligible for a state level energy conservation standard. For this analysis, the Statewide CASE Team drew heavily on the analysis previously done by U.S. DOE.

The design standard proposed by the Statewide CASE Team will achieve significant, cost-effective, technically feasible energy savings. The first-year statewide savings are estimated at 107,783 MMBtu/year and 1,547,712 MMBtu after stock turnover. This proposal will yield savings of 6,509 MTCO₂e per year, and a total of 86,906 MTCO₂e total after stock turnover in 2033. The proposed design standard will lead to significant cost savings for consumers, with \$14.8 million in first-year savings, and over \$186 million NPV after stock turnover in 2033. Finally, on a shipment weighted basis, there is a lifecycle B/C ratio of 9.2.

Preliminary calculations for a potential performance standard estimate annual per-unit savings between 0.01 and 0.19 therms. This would result in stock turnover statewide savings being between 1,000 and 15,000 MMBtu per year (0.01 and 0.15 million therms per year) assuming a minimum FE of 50%.

²⁴ As defined in the scope of CSA 2.33-2016 and CSA 2.22-2016.

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Appendix A: Natural Gas Rates

The natural gas rates used in the analysis presented in this report were derived from projected future prices for the residential sector in the Energy Commission’s “Mid-case” projection of the 2018-2030 Demand Forecast (CEC 2017b), which used no discount rate and provided prices in 2016 dollars. The Statewide CASE Team applied a three percent discount rate to future years relative to 2018. Then, the sales weighted average of the three largest natural gas utilities in California was converted to 2018 dollars using an inflation adjustment of 1.03 (U.S. DOL 2018). See the rates by year below in Table 21.

Table 21: Statewide Sales Weighted Average Residential Natural Gas Rates 2018-2033 (PG&E, SCG, and SDG&E - Three Largest California Natural Gas Utilities) in 2018 \$/therm Including a 3% Discount Rate

Year	Residential natural gas rate (2018 \$/therm)
2018	1.19
2019	1.19
2020	1.17
2021	1.15
2022	1.12
2023	1.10
2024	1.08
2025	1.06
2026	1.04
2027	1.02
2028	0.99
2029	0.98
2030	0.96
2031	0.96
2032	0.94
2033	0.93

Appendix B: Electricity Rates

The electricity rates used in the analysis presented in this report were derived from projected future prices for the residential sector in the Energy Commission’s “Mid-case” projection of the 2018-2030 Demand Forecast (CEC 2017a), which used no discount rate and provided prices in 2016 dollars. The Statewide CASE Team applied a three percent discount rate to future years relative to 2018. Then, the sales weighted average of the five largest electric utilities in California was converted to 2018 dollars using an inflation adjustment of 1.03 (U.S. DOL 2018). See the rates by year below in Table 22.

Table 22: Statewide Residential Electricity Rates 2018 – 2033 (PG&E, SCE, SDG&E, LADWP and SMUD - 5 Largest California Electric Utilities) in 2018 cents/kWh Including a 3% Discount Rate

Year	Residential electricity rate (2018 cents/kWh)
2018	19.54
2019	19.53
2020	18.82
2021	18.38
2022	17.81
2023	17.35
2024	16.97
2025	16.56
2026	16.10
2027	15.65
2028	15.28
2029	14.84
2030	14.40
2031	13.98
2032	13.57
2033	13.17

Appendix C: Load Factors

Table 23: 2013 Electricity Consumption and Peak Demand for the Top Five Largest California Electric Utilities^a

Sector & End-Use	Coincident Load		Annual Energy		Load Factor ^b
	MW	% of Total	GWh	% of Total	
Residential					
Cooking	581.4	1%	2833.1	1%	56%
Clothes Dryer	759.4	1%	4419.5	2%	66%
Dishwasher	211.1	0%	2237	1%	121%
Freezer	302.4	1%	2132.1	1%	80%
Miscellaneous	2849.3	5%	23139.9	9%	93%
Multi-Family Water Heater	114.2	0%	1189.4	0%	119%
Pool Heater	33.0	0%	155.6	0%	54%
Pool Pump	769.3	1%	3689.7	1%	55%
Refrigerator	1736.4	3%	13996.2	5%	92%
Solar Water Heat - Back-up	0.0	0%	0.2	0%	63%
Solar Water Heat - Pump	0.8	0%	2.3	0%	31%
Spa Heater	64.9	0%	247.6	0%	44%
Spa Pump	261.5	0%	990.4	0%	43%
Single Family Water Heater	196.5	0%	1709.6	1%	99%
Television	807.2	1%	6003	2%	85%
Waterbed Heater	737.0	1%	12003.7	5%	186%
Clothes Washer	122.2	0%	824.6	0%	77%
Air Conditioning	15739.6	28%	8378.51	3%	6%
Space Heating	0.0	0%	3441.46	1%	0%
Commercial					
Other	3344.8	6%	23762.2	9%	81%
Domestic Hot Water	144.5	0%	675.7	0%	53%
Cooking	94.5	0%	721.9	0%	87%
Office Equipment	263.3	0%	1699.2	1%	74%
Refrigeration	888.4	2%	7872.6	3%	101%
Exterior Lighting	40.9	0%	5909.2	2%	1649%
Interior Lighting	4856.2	9%	30686.2	12%	72%
Ventilation	1787.3	3%	10366.1	4%	66%
Air Conditioning	7714.7	14%	15724.95	6%	23%
Space Heating	0.0	0%	2702.77	1%	0%
Subtotal	19134.6	34%	100120.82	38%	60%

Source: CEC 2016.

^aThe top five largest California Electric Utilities are Pacific Gas & Electric (PG&E), San Diego Gas & Electric (SDG&E), Southern California Edison Company (SCE), Sacramento Municipal Utility District (SMUD), and Los Angeles Department of Water and Power (LADWP).

^bLoad Factor is the ratio of average annual load to coincident peak load. The load factors for commercial exterior lighting and residential waterbed heaters are very high because their consumption is mainly off-peak.

^bLoad Factor is the ratio of average annual load to coincident peak load. The load factors for commercial exterior lighting and residential waterbed heaters are very high because their consumption is mainly off-peak.

Appendix D: FE Metric

As defined in CAN/CSA-P.4.1-15, FE is defined as:

$$FE = \frac{5200 \text{ Effy}_{SS,W} \text{ Effy}_{HS}}{5200 \text{ Effy}_{SS,W} + 2.08 (4600) \text{ Effy}_{HS} 0.7 P_F}$$

Resulting in a percentage, where:

5200 = average number of U.S. heating degree-days.

$\text{Effy}_{SS,W} =$

For fireplaces with single-stage controls, $\text{Effy}_{SS,W} = \text{Effy}_{SS,H}$, where:

- a) $\text{Effy}_{SS,H} = 100 - L_{L,A} - L_{S,SS,H}$ for all non-condensing fireplaces, where

$L_{L,A}$ = latent heat loss and

$L_{S,SS,H}$ = sensible heat loss at steady-state maximum input operation; or

- b) $\text{ffy}_{SS,H} = 100 - L_{L,A} - L_{S,SS,H} + L_{G,SS,H} - L_{C,SS,H}$,

Where $L_{L,A}$ and $L_{S,SS,H}$ are as defined above,

$L_{G,SS,H}$ = latent heat gain due to condensation at maximum input rate, and

$L_{C,SS,H}$ = steady-state heat loss due to condensate at maximum input rate.

For fireplaces without single-stage controls,

$\text{Effy}_{SS,W} = (X_H)(\text{Effy}_{SS,H}) + (X_R)(\text{Effy}_{SS,R})$, where

X_H = fraction of the heating load at maximum input,

X_R = fraction of the heating load at reduced input,

$\text{Effy}_{SS,H}$ is as defined above, and

$\text{Effy}_{SS,R} =$

- a) $\text{Effy}_{SS,R} = 100 - L_{L,A} - L_{S,SS,R}$ for non-condensing fireplaces without single-stage controls, where

$L_{L,A}$ is as defined above and

$L_{S,SS,R}$ = the sensible heat loss at steady-state reduced input; or

- b) $\text{Effy}_{SS,R} = 100 - L_{L,A} - L_{S,SS,R} + L_{G,SS,R} - L_{C,SS,R}$ for condensing fireplaces without single-stage controls, where

$L_{L,A}$ and $L_{S,SS,R}$ are as defined above,

$L_{G,SS,R}$ = latent heat gain due to condensation at reduced input rate, and

$L_{C,SS,R}$ = steady-state heat loss due to condensation at minimum input rate.

$\text{Effy}_{HS} = 2.08 = \frac{65-15}{24}$ for heating seasonal efficiency for vented gas fireplaces, where

- a) 65 = outside air temperature at which home heating fireplaces start operating in degrees Fahrenheit (°F),
- b) -15 = outdoor design temperature for home heating fireplaces in °F,
- c) 24 = number of hours in a day,
- d) 4600 = average number of U.S. non-heating season hours per year, and
- e) 0.7 = correction factor to account for pilot contribution.

$$P_F = \frac{Q_P}{Q_{IN,H}}, \text{ where}$$

Q_P = the energy input rate;

- a) For continuous pilots, Q_P = measured pilot input;
- b) For fireplaces with a remotely operated pilot ignition system, Q_P = measured pilot input x 0.5;
- c) For fireplaces with an intermittent ignition system that are capable of continuous pilot operation, Q_P = measured pilot input x 0.5;
- d) For fireplaces with an on demand pilot ignition system timed for a maximum of 7 days operation, Q_P = measured pilot input x 0.25; and
- e) For fireplaces with intermittent ignition systems, $Q_P = 0$.

$Q_{IN,H}$ = the steady-state maximum fuel input rate, determined by multiplying the measured higher heating value of the test gas by the steady-state gas input rate corrected to standard conditions of 60 °F (15.6 degrees Celsius (°C)) and 30 inHg (101.3 kilopascal). Measured values of gas temperature and pressure at the meter and the barometric pressure shall be used to correct the metered gas flow rate to standard conditions.

Source: CSA 2015.