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California Energy Commission

DRAFT STAFF REPORT

Analysis of Proposed Efficiency Standards and Marking for Gas Hearth Products

2018 Appliance Efficiency Rulemaking for Hearth Products

Docket Number 18-AAER-06

California Energy Commission

Gavin Newsom, Governor

May 2019 | CEC-400-2019-007-SD

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PREFACE

On January 17, 2018, the California Energy Commission issued an order instituting rulemaking to begin considering standards, test procedures, labeling requirements, and other efficiency measures to amend the *Appliance Efficiency Regulations* (California Code of Regulations, Title 20, Sections 1601 through Section 1609). In this order, the Energy Commission identified appliances with the potential to save energy or water or both. The goal of the rulemaking is to develop proposed appliance efficiency standards and measures to realize these savings opportunities.

On March 12, 2018, the Energy Commission released an invitation to comment to provide interested parties the opportunity to inform the Commission about the product, market, and industry characteristics of hearth products and to seek proposals for standards, test procedures, labeling requirements, and other measures to improve the efficiency and reduce the energy consumption of hearth products.

On April 26, 2018, Energy Commission staff held a teleconference with Hearth, Patio & Barbecue Association (HPBA) to inform its members about the rulemaking process, ways to participate in the rulemaking on gas hearth products, and the *Appliance Efficiency Regulations*.

On August 23, 2018, Energy Commission staff met with representatives of HPBA to discuss potential scope and definitions for the rulemaking on gas hearth products.

On October 3, 2018, Energy Commission staff met with representatives of HPBA and various control systems manufacturers to discuss safety controls, ignition systems, pilot operation, fireplace types, and market characteristics for gas hearth products.

On November 28, 2018, Energy Commission staff conducted a working group with HPBA, the California investor owned utilities (IOUs), and the Appliance Standards Awareness Project (ASAP) on potential definitions for the rulemaking on gas hearth products.

On December 12, 2018, Energy Commission staff met with representatives of HPBA and various fireplace manufacturers to discuss the potential definitions, fireplace efficiency, technical feasibility, and differences between heating and decorative fireplaces.

On January 31, 2019, Energy Commission staff held a teleconference with HPBA and industry to discuss the second draft of potential definitions as a result of the working group, test procedure requirements, and the subsequent phase in the rulemaking following the publishing of this report.

The Energy Commission reviewed all the information received. This report contains the proposed regulations for gas hearth products based on comments received during the meetings mentioned above and in writing in the Commission docket.

ABSTRACT

This report discusses proposed standards for gas hearth products in the *Appliance Efficiency Regulations* (California Code of Regulations, Title 20, Sections 1601 to 1609). These proposed standards are part of the 2018 Appliance Efficiency Pre-Rulemaking (Docket #18-AAER-06). California Energy Commission staff analyzed the cost-effectiveness and technical feasibility of proposed efficiency standards for gas hearth products. Statewide energy use, savings, related environmental impacts, and benefits are also included.

The proposed efficiency, design, and marking requirements for gas hearth products would take effect on January 1, 2021. The specific gas hearth products in the scope of this proposal are vented gas heating fireplaces, vented gas decorative fireplaces, vented gas logs, outdoor gas logs, and outdoor fireplaces. Staff also proposes to add definitions, a test procedure, test lab report requirements, and certification requirements to support the proposed efficiency and design standards. The proposal would save 105,157 million British thermal units (MMBtu) the first year the standards is in effect. By 2035, when the year that stock turns over, the proposed standards would have an annual savings of 2,429,175 MMBtu, which equates to about $31.4 million in annual savings.

Staff analyzed available market data and concluded that the proposed standards for gas hearth products would significantly reduce energy consumption and are technically feasible and cost-effective.

Keywords: *Appliance Efficiency Regulations*, appliance regulations, energy efficiency, gas hearth products, fireplaces

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EXECUTIVE SUMMARY

This report presents the California Energy Commission staff's analysis of proposed efficiency standards, design standards, and marking requirements for gas hearth products.

Staff is proposing new standards for gas hearth products. The scope covers vented heating gas fireplaces, vented decorative gas fireplaces, vented gas logs, outdoor gas logs, and outdoor fireplaces. Staff proposes to adopt a minimum fireplace efficiency standard for vented heating gas fireplaces and an industry-approved test procedure to obtain fireplace efficiency. The proposal also includes a design standard that prohibits continuous pilots and minimizes the use of on-demand pilots on all products within the proposed scope. Additional design standards are being proposed to minimize main burner operation on vented decorative gas fireplaces. Last, staff is recommending that vented decorative gas fireplaces be tested to measure and report fireplace efficiency and be marked for decorative use only and not for heating. The proposed standards would take effect on January 1, 2021.

The proposal that staff is recommending is derived from a proposal set by Natural Resources Canada (NRCan), a proposal by the U.S. Department of Energy (DOE), requirements in California's *2019 Building Energy Efficiency Standards,* and state rebate programs. The NRCan proposal covered vented heating gas fireplaces and vented decorative gas fireplaces manufactured on or after January 1, 2020. This proposal sets a lower fireplace efficiency standard and is limited in scope compared to the proposal staff is recommending for California. The U.S. DOE proposed prohibiting continuous pilots on all hearth products. The 2019 Standards prohibit the installation of natural gas, indoor and outdoor fireplaces with a continuous pilot on all occupancies beginning January 1, 2020. Moreover, several states (for example, Washington, Minnesota, Utah, Wyoming, Idaho, and Oregon) are offering or have offered rebates for gas fireplaces with a minimum 70 percent fireplace efficiency and an electronic ignition. Given this information and market availability data, the proposal that staff recommends is technically feasible and practicable.

The estimated efficiency savings for vented heating gas fireplaces after complete stock turnover in 2035 is 1,279,803 million British thermal units (MMBtu) per year, equivalent to $16.5 million in annual savings. The design standard, for all products in the scope, will yield an additional 1,149,371 MMBtu per year with $14.9 million in cost savings after complete stock turnover in 2035. Total savings from the proposed standards for the specified gas hearth products, previously mentioned, are 2,429,175 MMBtu per year after stock turnover for total consumer cost savings of $31.4 million per year. The benefit-to-cost ratio ranges from 1.1 to 19.8, indicating this proposal is cost-effective.

CHAPTER 1:
Legislative Criteria

Section 25402(c)(1) of the California Public Resources Code mandates that the California Energy Commission reduce the inefficient consumption of energy and water on a statewide basis by prescribing efficiency standards and other cost-effective measures[1] for appliances that require a significant amount of energy and water to operate. Such standards must be technologically feasible and attainable and must not result in any added total cost to the consumer over the designed life of the appliance.

In determining cost-effectiveness, the Energy Commission considers the value of the water or energy saved the effect on product efficacy for the consumer, and the life-cycle cost of complying with the standard to the consumer. The Commission also considers other relevant factors including, but not limited to, the effect on housing costs, the statewide costs and benefits of the standard over the lifetime of the standard, the economic impact on California businesses, and alternative approaches and the associated costs.

1 These include energy and water consumption labeling, fleet averaging, incentive programs, and consumer education programs.

CHAPTER 2:
Efficiency Policy

The Warren-Alquist Act[2] establishes the California Energy Commission as California's primary energy policy and planning agency. The act mandates that the Commission reduce the wasteful and inefficient consumption of energy and water in the state by prescribing statewide standards for minimum levels of operating efficiency for appliances that consume a significant amount of energy or water.

For nearly four decades, California has regularly increased the energy efficiency requirements for new appliances sold and new buildings constructed in the state. Through the Appliance Efficiency Program, appliance standards have shifted the marketplace toward more efficient products and practices, reaping significant benefits for California's consumers. The state's Title 20 Appliance Efficiency Regulations, along with federal appliance standards encompassing a variety of appliance types, saved an estimated 34,707 gigawatt-hours (GWh) of electricity and 1,775 million therms in 2017 alone, resulting in about $8.26 billion in savings[3] to California consumers.[4] In the 1990s, the California Public Utilities Commission (CPUC) decoupled the utilities' financial results from their direct energy sales, promoting utility support for efficiency programs. These efforts have reduced peak-load needs by more than 8,645 MW and continue to save about 32,594 GWh per year of electricity.[5] The potential for additional savings remains by increasing the energy efficiency and improving the use of appliances.

Reducing Electrical Energy Consumption to Address Climate Change

Appliance energy efficiency is identified as a key to achieving the greenhouse gas (GHG) emission reduction goals of Assembly Bill 32 (Núñez, Chapter 488, Statutes of 2006)[6] and Senate Bill 32 (Pavley, Chapter 249, Statutes of 2016),[7] as well as the recommendations

2 The Warren-Alquist State Energy Resources Conservation and Development Act, Division 15 of the Public Resources Code, § 25000 et seq., available at https://www.energy.ca.gov/2019publications/CEC-140-2019-001/CEC-140-2019-001.pdf.
3 Using current average electric power and natural gas rates of: residential electric rate of $0.182 per kilowatt-hour, commercial electric rate of $0.159 per kilowatt-hour, residential natural gas rate of $1.206 per therm, commercial natural gas rate of $0.846 per therm. This estimate does not incorporate any costs associated with developing or complying with appliance standards.
4 California Energy Commission. May 29, 2018. Workshops and Meetings for the 2017 Integrated Energy Policy Report – Committed Efficiency by Planning Area. Retrieved from California Energy Commission: https://www.energy.ca.gov/2017_energypolicy/documents/#demand.
5 California Energy Commission, *California Energy Demand 2016-2026 Revised Electricity Forecast,* January 2016, available at http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-03/TN207439_20160115T152221_California_Energy_Demand_20162026_Revised_Electricity_Forecast.pdf.
6 AB 32, California Global Warming Solutions Act of 2006, available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200520060AB32.
7 SB 32, California Global Warming Solutions Act of 2006, available at https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB32.

contained in the California Air Resources Board's *Climate Change Scoping Plan.*[8] Energy efficiency regulations are also identified as key components in reducing electrical energy consumption in the *2015 Integrated Energy Policy Report* (*IEPR*)[9] and the 2011 update to the CPUC's *Energy Efficiency Strategic Plan.*[10] Finally, former Governor Edmund G. Brown Jr. and the Legislature have identified appliance efficiency standards as a key to doubling the energy efficiency savings necessary to put California on a path to reducing its GHG emissions to 80 percent below 1990 levels by 2050.[11] California made this commitment made to the Subnational Global Climate Leadership Memorandum of Understanding (Under-2 MOU) agreement along with 167 jurisdictions representing 33 countries.[12]

On October 7, 2015, former Governor Brown signed the Clean Energy and Pollution Reduction Act of 2015 or Senate Bill 350 (De León, Chapter 547, Statutes of 2015), requiring the Energy Commission to establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a doubling of energy savings from buildings and retail uses by 2030.[13] Appliance efficiency standards will be critical in meeting this goal.[14] In addition, the Energy Commission adopted the *Existing Buildings Energy Efficiency Action Plan* in September 2015 and updated it in December 2016 to transform existing residential, commercial, and public buildings into energy-efficient buildings.[15] Appliance efficiency standards are essential to reducing the energy consumption in existing buildings from plug-in loads.

Loading Order for Meeting the State's Energy Needs

California's loading order places energy efficiency as the top priority for meeting energy needs. The *Energy Action Plan II* strongly supports the loading order, which describes the priority sequence for actions to address increasing energy needs. Energy efficiency and demand response are the preferred means of meeting the state's growing energy needs.[16]

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8 *Climate Change Scoping Plan* available at https://www.arb.ca.gov/cc/scopingplan/2013_update/first_update_climate_change_scoping_plan.pdf.
9 California Energy Commission, *2015 Integrated Energy Policy Report*, 2015, available at https://www.energy.ca.gov/2015_energypolicy/.
10 CPUC, *Energy Efficiency Strategic Plan,* updated January 2011, available at http://www.cpuc.ca.gov/general.aspx?id=4125.
11 Gov. Edmund G. Brown Jr., 2015 Inaugural Address, available at https://www.ca.gov/archive/gov39/2015/01/05/news18828/index.html.
12 Subnational Global Climate Leadership Memorandum of Understanding, available at http://under2mou.org/background/.
13 *2016 Integrated Energy Policy Report Update*, available at http://docketpublic.energy.ca.gov/PublicDocuments/16-IEPR-01/TN216281_20170228T131538_Final_2016_Integrated_Energy_Policy_Report_Update_Complete_Repo.pdf.
14 Jones, Melissa, Michael Jaske, Michael Kenney, Brian Samuelson, Cynthia Rogers, Elena Giyenko, and Manjit Ahuja. 2017. *Senate Bill 350: Doubling Energy Efficiency Savings by 2030.* California Energy Commission. Publication Number: CEC-400-2017-010-CMF, available at http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR-06/TN221631_20171026T102305_Senate_Bill_350_Doubling_Energy_Efficiency_Savings_by_2030.pdf.
15 *California's Existing Buildings Energy Efficiency Action Plan – 2016 Update,* available at http://docketpublic.energy.ca.gov/PublicDocuments/16-EBP-01/TN214801_20161214T155117_Existing_Building_Energy_Efficency_Plan_Update_Deceber_2016_Thi.pdf.
16 *Energy Action Plan II,* available at https://energyarchive.ca.gov/energy_action_plan/2005-09-21_EAP2_FINAL.PDF.

For the past 30 years, while per-capita electricity consumption in the United States has increased by nearly 50 percent, California's per-capita electricity use has been nearly flat. Continued progress in cost-effective building and appliance standards and ongoing enhancements to efficiency programs implemented by investor-owned utilities (IOUs), publicly owned utilities, and other entities have contributed significantly to this achievement.[17]

Zero-Net-Energy Goals

The *California Long-Term Energy Efficiency Strategic Plan*,[18] adopted in 2008 by the CPUC and developed with the Energy Commission, the California Air Resources Board (CARB), the state's utilities, and other key stakeholders, is California's roadmap to achieving maximum energy savings between 2009 and 2020, and beyond. It includes four "big, bold strategies" as cornerstones for significant energy savings with widespread benefit for all Californians:[19]

- All new residential construction in California will be zero-net energy (ZNE) by 2020.
- All new commercial construction in California will be ZNE by 2030.
- Heating, ventilation, and air conditioning (HVAC) will be transformed to ensure that energy performance matches California's climate.
- All eligible low-income customers will have the opportunity to participate in the low-income energy efficiency program by 2020.

These strategies were selected based on the ability to achieve significant energy efficiency savings and bring energy-efficient technologies and products into the market.

On April 25, 2012, former Governor Brown further targeted ZNE consumption for state-owned buildings. Executive Order B-18-12[20] requires ZNE consumption for 50 percent of the square footage of existing state-owned buildings by 2025 and ZNE consumption from all new or renovated state buildings beginning design after 2025.

To achieve these goals, the Energy Commission has committed to adopting and implementing building and appliance regulations that reduce wasteful energy or water consumption or both. The *Long-Term Energy Efficiency Strategic Plan* directs the Commission to develop a phased and accelerated "top-down" approach to more stringent codes and standards.[21] It also calls for expanding the scope of appliance standards to plug loads, process loads, and water use. The Commission adopted its detailed plan for fulfilling these objectives in the *2013 IEPR*.[22]

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17 *Energy Action Plan II,* available at https://energyarchive.ca.gov/energy_action_plan/2005-09-21_EAP2_FINAL.PDF.
18 California Energy Commission and CPUC, *Long-Term Energy Efficiency Strategic Plan,* updated January 2011, available at http://www.cpuc.ca.gov/general.aspx?id=4125.
19 California Energy Commission and CPUC, *Long-Term Energy Efficiency Strategic Plan Fact Sheet*, 2008, available at http://www.cpuc.ca.gov/general.aspx?id=4125.
20 Office of Edmund G. Brown Jr., Executive Order B-18-12, April 25, 2012, available at https://www.ca.gov/archive/gov39/2012/04/25/news17508/index.html.
21 California Energy Commission and CPUC, *Long-Term Energy Efficiency Strategic Plan*, updated January 2011, available at http://www.cpuc.ca.gov/general.aspx?id=4125.
22 California Energy Commission, *2013 IEPR*, https://www.energy.ca.gov/2013publications/CEC-100-2013-001/CEC-100-2013-001-CMF.pdf, pp. 21-26.

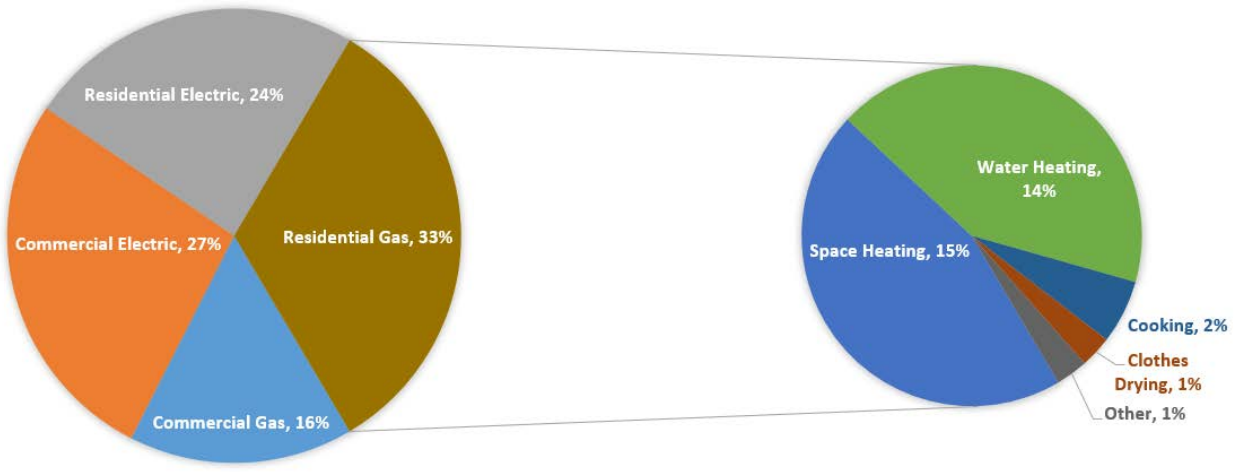
Governor Brown's Clean Energy Jobs Plan

On June 15, 2010, as a part of his campaign, then-Governor Brown proposed the *Clean Energy Jobs Plan*,[23] which directed the Energy Commission to strengthen appliance efficiency standards for lighting, consumer electronics, and other products. The Governor noted that energy efficiency is the cheapest, fastest, and most reliable way to create jobs, save consumers money, and cut pollution from the power sector. He also stated that California's efficiency standards and programs have triggered innovation and creativity in the market. Today's appliances are not only more efficient, but they are less expensive and more versatile than ever due, in part, to California's leadership in the area.

Building Decarbonization

The Energy Commission is exploring decarbonization to meet California's climate goals. Decarbonization strategies include energy efficiency and conservation, electrification, low-carbon fuels (including electricity), and reducing noncombustion GHG emissions across all sectors.[24] *Building decarbonization* reduces building emissions directly (as on-site combustion of fossil fuels) or embedded in the electricity consumed. *Building electrification* refers to substituting gas appliances with electric appliances. The opportunity for reducing natural gas usage is greatest in the residential sector, with most usage in water heating and space heating (**Figure 2-1**).[25]

Figure 2-1: 2016 Energy Use in California Buildings



Source: California Energy Commission

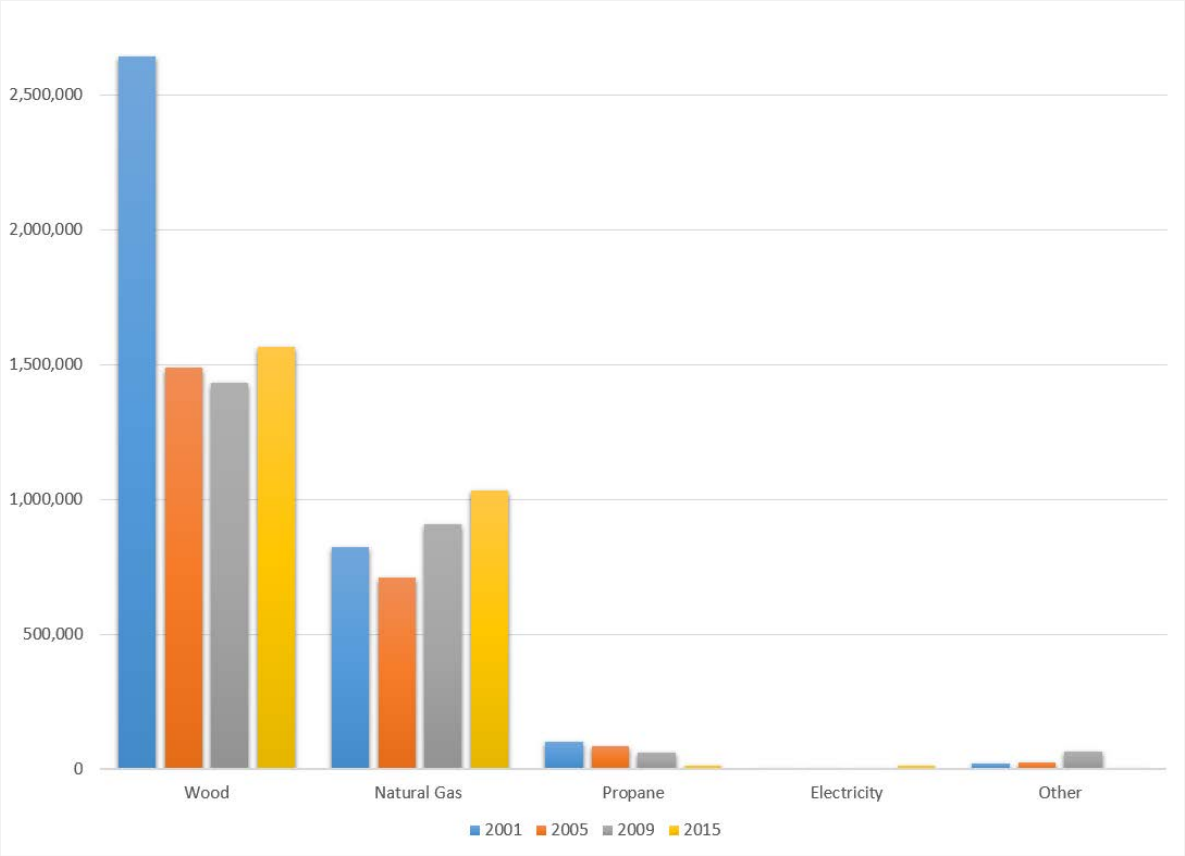
23 Office of Edmund G. Brown Jr., *Clean Energy Jobs Plan,* available at https://www.gov.ca.gov/wp-content/uploads/2017/09/Clean_Energy_Plan.pdf.
24 California Energy Commission. June 2018. *Deep Carbonization in a High Renewables Future.* CEC-500-2018-012. Energy and Environmental Economics, Inc.
25 California Energy Commission. September 2018. California Energy Commission - Tracking Progress - Energy Efficiency. Retrieved from https://www.energy.ca.gov/renewables/tracking_progress/documents/energy_efficiency.pdf.

CHAPTER 3:
Product Description

A hearth is the floor of a fireplace or the area in front of a fireplace. Hearth is also a symbol of a home since fireplaces traditionally provided a source of light, provided a source of heat, and were used for cooking, making them a fundamental part to a home. Hearth products, as the name implies, are fireplaces or products that simulate a fireplace.[26] Over time and as technology advanced to create central heating and cooling systems, fireplaces now provide more of an aesthetic appeal to a home and may provide space heating. Simultaneously, sources of fuel for fireplaces has also changed. Oil, coal, and wood have been traditional sources of fuel but are mostly inefficient and produce harmful emissions. In 1998, the U.S. Environmental Protection Agency (EPA) prohibited the sale of residential wood heaters that were not tested to obtain U.S. EPA certification, determining that the heater met the emission limits set in the original 1988 standard.[27] Considering these restrictions, wood fireplaces are still a popular addition to a home. **Figure 3-1** illustrates the number of fireplaces in homes by fuel type in the Pacific Division. An average of 68 percent of the fireplaces in the Pacific Division are from California homes. In 2009, about 947,000 wood fireplaces, 588,000 natural gas fireplaces, and 29,000 propane-fueled fireplaces were available in single-family California homes.[28] Although wood fireplaces are installed in more homes, gas-fueled fireplaces are gaining popularity for convenience, cleaner-burning properties, efficiency, safety, and inexpensive operation compared to wood fireplaces.[29]

26 Natural Resources Canada. March 2004. *All About Gas Fireplaces.* Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.
27 U.S. Environmental Protection Agency. February 2, 2017. FACT SHEET: Overview of Final Updates to Air Emissions Requirements for New Residential Wood Heaters. Retrieved 2019 from the U.S. Environmental Protection Agency: https://www.epa.gov/residential-wood-heaters/fact-sheet-overview-final-updates-air-emissions-requirements-new.
28 U.S. Energy Information Administration. 2001, 2005, 2009, 2015. *Residential Energy Consumption Survey (RECS).* Retrieved 2018, from https://www.eia.gov/consumption/residential/index.php.
29 Natural Resources Canada. March 2004. *All About Gas Fireplaces.* Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.

Figure 3-1: Number of Fireplaces in the Pacific Division Between 2001 and 2015



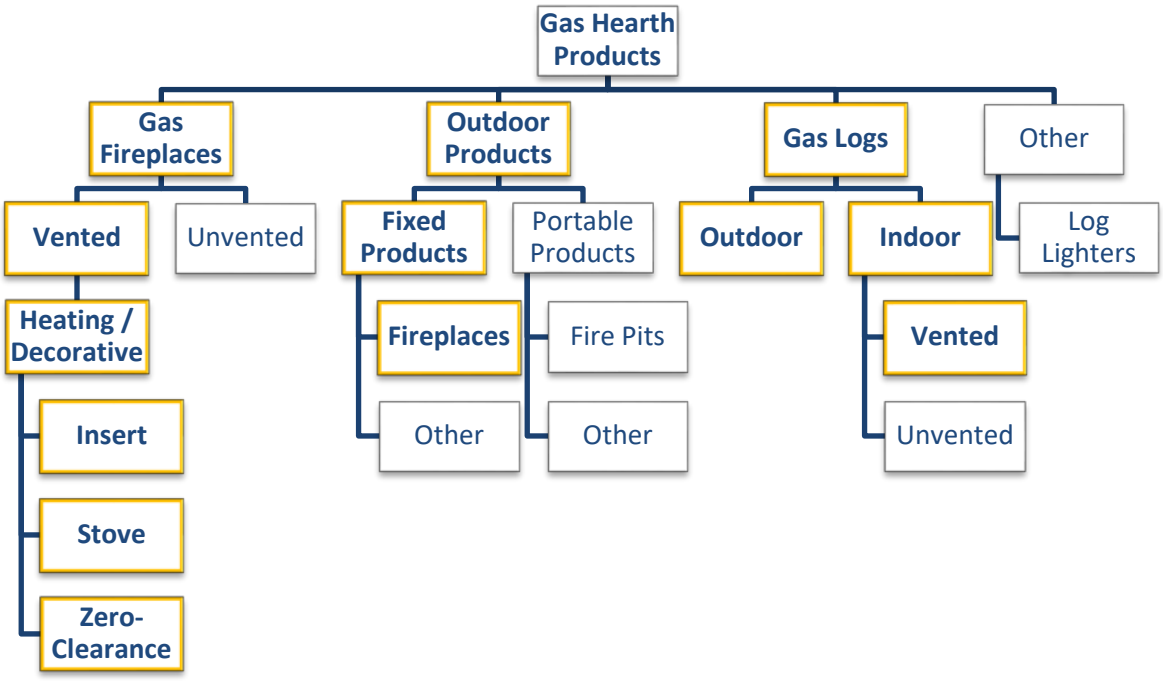
Note: Pacific Division: Alaska, California, Hawaii, Oregon, and Washington
Source: U.S. Energy Information Administration

Again, gas hearth products are appliances that maintain an aesthetically pleasing controlled fire or flame pattern that replicates the flame of a wood-burning fireplace to create a relaxing atmosphere and may be combined to provide space heating. These appliances come in all sorts of styles, configurations, venting options, and various applications, as shown in **Figure 3-2**. The remainder of this chapter will cover the majority of appliances that are recognized as gas hearth products as illustrated in **Figure 3-2**, but the scope of this analysis will focus on products that are bolded and highlighted in orange (for example, gas fireplaces, outdoor products, and gas logs). There are products some may consider as gas hearth products. For example, the U.S. DOE considered gas-fueled patio heaters as gas hearth products,[30] whereas the Energy Commission recognizes gas-fueled patio heaters as space heaters.[31] There are also products that are custom-built. Custom-built products are uniquely crafted with custom components to fit into a custom design. These products are different from custom made-to-

30 U.S. Department of Energy. February 9, 2015. Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products; Notice of proposed rulemaking and announcement of public meeting. EERE-2014-BT-STD-0036-0010. Washington, DC: U.S. Department of Energy.
31 California Code of Regulations, Title 20, Sections 1601 to 1609

order products. Custom made-to-order products are limited to a manufacturer's basic model, and the manufacturer limits the modification of that basic model. For example, a homeowner can tailor a basic model by selecting the type of media, the trim or fronts, the panels inside the firebox, and additional features.

Figure 3-2: Scope of Gas Hearth Products



Source: Energy Commission staff

Gas Fireplaces

A fireplace is described as a "fire chamber, or similar prepared place, constructed of noncombustible material in which a fire can be made" and that may "be built in conjunction with a flue or chimney."[32] Fireplaces may be installed into a wall or other framing structure, may be placed against a wall, or may replace existing fireplaces as illustrated in **Figure 3-3**.[33] Traditional fireplace structures (for example, wood-burning fireplaces) are made from masonry such as brick, stone, or tile.[34] A gas fireplace is a gas-fired fireplace that simulates the flame pattern of a solid-fueled fireplace. Consumers seek gas fireplaces mainly for the aesthetic

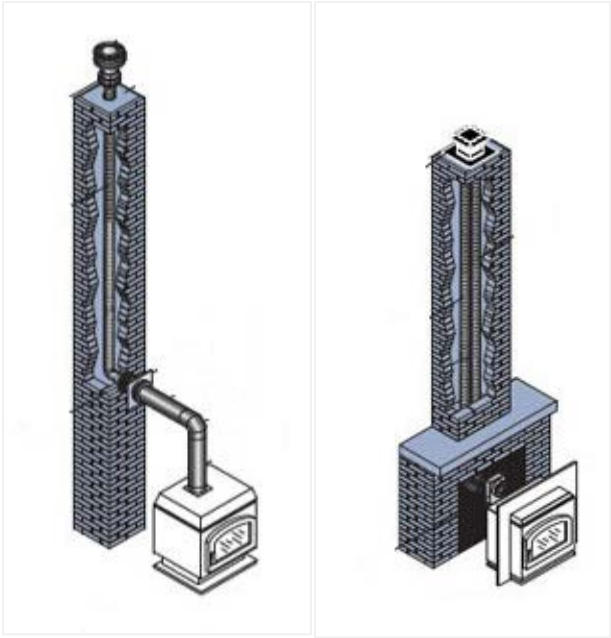
32 2016 California Building Code, Part 2

33 U.S. Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.

34 Kido, C., B. Boyce, B. Kundu, L. Nelson, L., and Energy Solutions. February 28, 2019. *Codes and Standards Enhancement (CASE): Analysis of Standards Proposal for Hearth Products.* 41. Energy Solutions, California Investor Owned Utilities. Retrieved March 2019.

appeal; therefore, manufacturers work to ensure that the flame resembles a wood-burning flame to be competitive with solid-fuel fireplaces.[35]

Figure 3-3: Fireplace Installation



Source: Duravent.com

Vented Gas Fireplaces

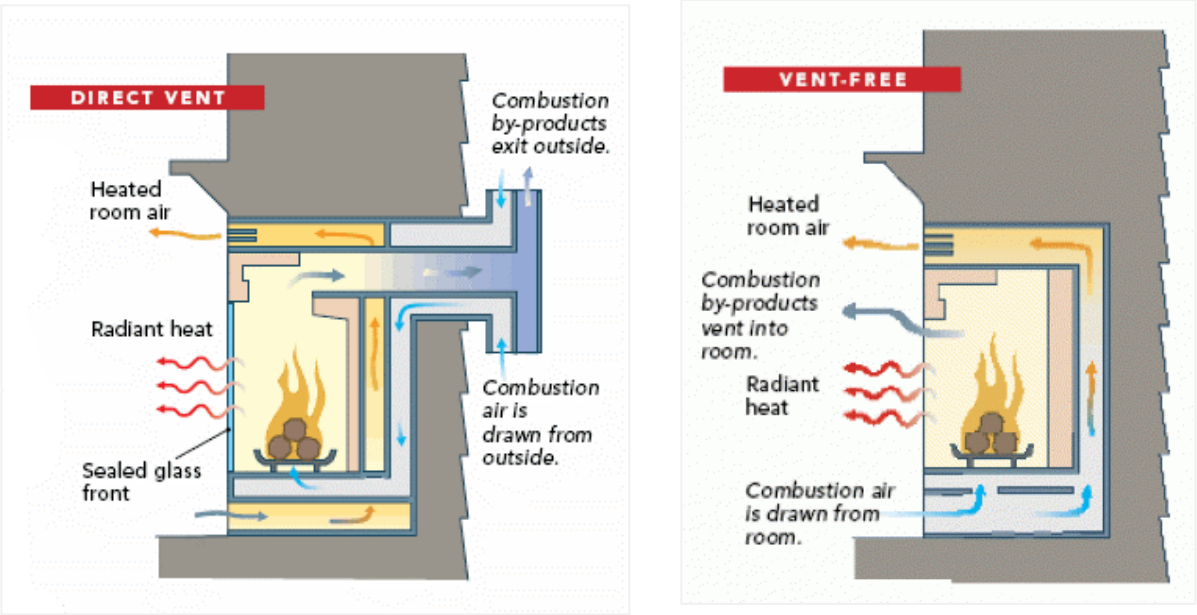
Burning natural gas requires oxygen. Natural gas consists primarily of methane. The complete combustion of methane and oxygen produces heat, water vapor, and combustion by-products such as carbon dioxide. Incomplete combustion produces additional harmful emissions such as carbon monoxide and particulate matter.[36,37]

For gas hearth products installed in homes, these emissions are either exhausted through a flue or released into the room in which they are installed. Vented gas hearth products are designed to draw air from the outside or the room to fuel the combustion process and exhaust the combustion byproducts out of the home through a combination of pipes, ducts, or a flue. Unvented gas hearth products (also known as vent-free or ventless) are designed to draw air from the room in which it is installed and release the combustion by-products safely into the

35 Manufacturer interviews, 2018.
36 U.S. Environmental Protection Agency. January 1995. 1.4 *Natural Gas Combustion. AP-42 Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, 5th.* Research Triangle Park, North Carolina
37 Natural Resources Canada. March 2004. *All About Gas Fireplaces.* Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.

room in which it is installed.[38,39,40] **Figure 3-4** illustrates the difference between vented and unvented fireplaces.

Figure 3-4: Vented and Unvented Fireplace Diagram



Source: FineHomeBuilding.com[41]

The scope of this analysis will focus on vented gas hearth products. Vented gas fireplaces come in a variety of venting configurations. A natural draft vent relies on the buoyancy of heat and, therefore, does not have a sealed combustion firebox, as shown in **Figure 3-4** for a direct-vent gas fireplace. A natural draft system draws air from the room and exhausts the combustion by-products without mechanical means.[42] A draft hood is required to allow combustion products escape in case there is no draft, to prevent a backdraft, and to neutralize a stack effect.[43] A power vent exhausts combustion by-products by mechanical means such as an electric fan and

38 Natural Resources Canada. March 2004. *All About Gas Fireplaces.* Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.
39 U.S. Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.
40 Canadian Standards Association Group. (2015). P.4.1-15 *Testing Method for Measuring Annual Fireplace Efficiency.* Ontario, Canada.
41 Fink, J. October 9, 2009. "Gas Fireplaces: Direct Vent vs. Vent-Free." Retrieved from FineHomebuilding: https://www.finehomebuilding.com/2009/10/09/gas-fireplaces-direct-vent-vs-vent-free.
42 Natural Resources Canada. March 2004. *All About Gas Fireplaces.* Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.
43 Canadian Standards Association Group. 2016. ANSI Z21.50 - 2016/CSA 2.22 - 2016 "Vented Decorative Gas Appliances". Ontario, Canada.

does not need a draft hood.[44] *Direct venting* is a vent system consisting of a fireplace specifically designed for direct venting and a vent to coincide with a direct-vent fireplace. A direct-vent fireplace draws air from the outside directly into the firebox through one pipe and the combustion byproducts are released through a different pipe **(Figure 3-5[b])**.[45]

Heating vs. Decorative

Vented gas fireplaces can be further separated into decorative and heating fireplaces. Although decorative fireplaces and heating fireplaces have similar physical characteristics, they function differently. Decorative gas fireplaces are intended only to provide an aesthetic flame that simulates a solid-fuel fireplace with little to no heat output into the space in which it is installed. A heating fireplace is also intended to provide an aesthetic flame that simulates a solid-fuel fireplace but provides heat to the space in which it is installed. Decorative fireplaces do not have thermostats to control the heat output or fans to distribute the hot air into the room, whereas heating fireplaces do have these options available.[46] Although decorative gas fireplaces are designed to direct the flow of heat to an outlet, staff recognizes decorative gas fireplaces provide some heat as a by-product of the flame. The heat generated should not greatly affect the temperature conditions of the room in which it is installed.

Configurations

Vented gas fireplaces are available in three configuration types: insert, zero-clearance, stove as illustrated in **Figure 3-5**. These configurations differentiate mainly by installation requirements.

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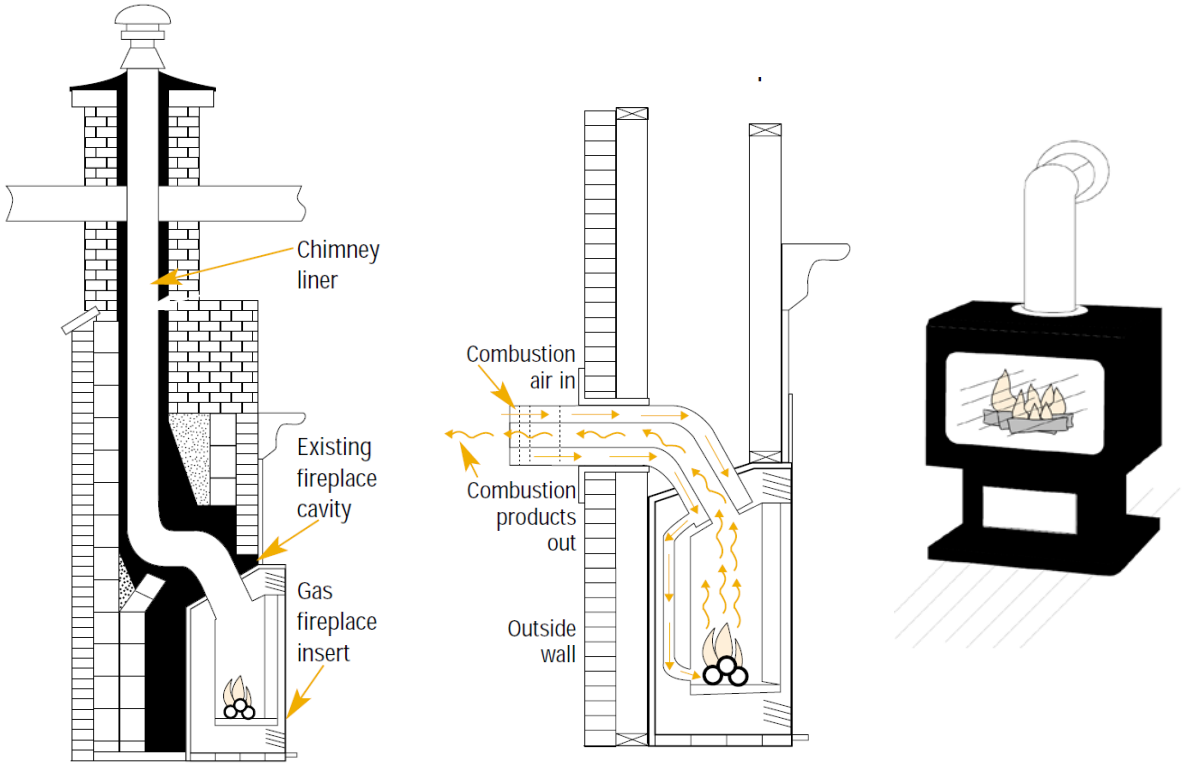
44 Natural Resources Canada. March 2004. *All About Gas Fireplaces.* Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.
45 Natural Resources Canada. March 2004. *All About Gas Fireplaces.* Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.
46 U.S. Department of Energy. April 16, 2010. "Energy Conservation Program: Energy Conservation Standards for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters; Final Rule." EERE-2006-BT-STD-0129-0005, 126. Washington, D.C.: United States Department of Energy. Retrieved 2018, from https://www.regulations.gov/document?D=EERE-2006-STD-0129-0005.

Figure 3-5: Gas Fireplace Configuration Types



(a) Insert **(b) Zero-clearance, Direct-vent** **(c) Stove**

Source: NRCan[47]

Gas Fireplace Insert

Inserts are a type of gas fireplace that is designed to be fully or partially installed in an existing solid-fueled fireplace or a factory-built metal fireplace, as shown in **Figure 3-5(a)**.[48]

An *insert* is a self-contained appliance that consists of a metal housing with a glass front that encloses a firebox (the compartment where fuel combustion occurs), the gas burner system, noncombustible media, and other components. Specified venting configurations must be followed to align with an existing flue.[49]

Zero-Clearance Fireplaces

A *zero-clearance fireplace*, or *factory-built fireplace*, is a type of gas fireplace that is designed to be installed in new construction or renovation projects and under minimum clearances can be

47 Natural Resources Canada. March 2004. *All About Gas Fireplaces.* Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.
48 Canadian Standards Association Group. (2015). P.4.1-15 *Testing Method for Measuring Annual Fireplace Efficiency.* Ontario, Canada.
49 Natural Resources Canada. March 2004. *All About Gas Fireplaces.* Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.

installed within combustible construction. (See **Figure 3-5[b])**. Zero-clearance fireplaces resemble gas fireplace inserts.[50]

Stove Gas Fireplaces

A *stove gas fireplace,* or *free-standing* gas fireplace, is a gas fireplace where all sides of the appliance are exposed, as shown in **Figure 3-5(c)**. Stoves radiate more heat because more surface area is exposed to the room. Similar to a gas fireplace insert and zero-clearance fireplace, it consists of a metal housing with a glass front that encloses the gas burner system, the media, and other components. It is designed to be installed away from a wall (**Figure 3-3,** right side).[51]

Gas Logs

Gas logs are decorative self-contained appliances that are designed to simulate a wood-burning fireplace. Unlike gas fireplaces, gas logs are not enclosed by a metal housing. They consist of a gas burner system, a metal grate or pan that holds noncombustible media, and its control system as shown in **Figure 3-6**. Similar to gas fireplace inserts, gas logs can be installed in only existing solid-fueled fireplaces and can be either be vented or unvented.[52] Again, the scope of this analysis will focus on vented gas logs.

50 Natural Resources Canada. March 2004. *All About Gas Fireplaces.* Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.
51 Ibid.
52 Kido, C., B. Boyce, B. Kundu, L. Nelson, and Energy Solutions. February 28, 2019. *Codes and Standards Enhancement (CASE): Analysis of Standards Proposal for Hearth Products. 41*. Energy Solutions, California Investor Owned Utilities. Retrieved March 2019.

Figure 3-6: Vented Gas Log

Source: Real Fyre[53]

Outdoor Gas Products

Outdoor gas hearth products are similar to vented gas hearth products (indoor products) except they are designed to be installed outdoors. Because they are open to the outdoor environment, critical components must be weatherproof to prevent deterioration. In addition, outdoor products are not designed to be vented or unvented, since the combustion by-products are released outdoors. Outdoor gas fireplaces are designed to be installed into a permanent structure and connected to a permanent gas-piping system, or for portability by using bottled gas. Outdoor fire pits, fire tables, and fire columns are designed to be used mostly with a fuel tank, making them portable.[54]

Pilot – Ignition Systems

The main burner of a gas hearth product is ignited directly or indirectly. A direct ignition system requires the user to physically turn on the gas flow and light the main burner with a match or a piezoelectric spark igniter.[55] An indirect ignition system uses a type of pilot to light the main burner. The pilot can be lit manually or automatically. Industry recognizes four basic

53 RH Peterson Co. 2018. *Catalogs and Manuals - Real Fyre Vented Catalog.* Retrieved from Realfyre: http://www.rhpeterson.com/pdf/2018_RF_Vented_Product_Catalog_WEB.pdf.

54 Kido, C., B. Boyce, B. Kundu, L. Nelson, and Energy Solutions. February 28, 2019. *Codes and Standards Enhancement (CASE): Analysis of Standards Proposal for Hearth Products. 41.* Energy Solutions, California Investor Owned Utilities. Retrieved March 2019

55 U.S. Department of Energy. February 9, 2015. "Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products; Notice of Proposed Rulemaking and Announcement of Public Meeting." EERE-2014-BT-STD-0036-0010. Washington, DC: U.S. Department of Energy

types of pilots: continuous, intermittent, interrupted, and on-demand. Intermittent, on-demand, and interrupted pilots are electric-based ignition systems and, therefore, require electricity.

A *continuous pilot* (also known as a *standing pilot)* is a pilot that, once lit, remains lit until the pilot is turned off.[56] This pilot can be left on year-round, consuming energy while the main burner is not being used.[57]

An *on-demand pilot* is a pilot that, once lit, remains lit while the main burner is being used, and is automatically extinguished after a predetermined time (for example, five days or seven days) when there is no active use of the appliance or the main burner during the predetermined time.[58] This type of pilot also can be left on continuously if the user actively operates the main burner settings during the predetermined time because the pilot timer resets itself after every active use.

An *intermittent pilot* (also known as an *electronic ignition*) is a pilot that is automatically lit when the appliance is turned on for active use, remains lit while the main burner is being used, and extinguishes when the appliance is turned off.[59]

An *interrupted* pilot is a pilot that is automatically lit and remains lit until the main burner is lit. In other words, the pilot is extinguished once the main burner is lit.[60] Staff has not identified a gas hearth product using this type of pilot. Industry has verified that this type of pilot is not being used in residential or commercial gas hearth products. Industry has also indicated that interrupted pilots are used in products with an input capacity greater than 400,000 Btu/hr.[61]

Dual-pilot capability is a pilot ignition system with the capability of operating under multiple pilot types. This capability allows the homeowner to switch from one pilot type to another. Staff has identified two examples of pilot ignition systems with this type of capability: intermittent with continuous capability and intermittent with on-demand capability.[62] Some manufacturers call this "alternating mode."[63] Other manufacturers, in product literature, present the intermittent pilot as the main pilot type and present the other type of pilot type (for example, continuous or on-demand) as a feature. This feature is sometimes called an "anticondensation" or "cold-climate" feature. During the heating season, switching to these

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56 Canadian Standards Association Group. 2015. P.4.1-15 *Testing Method for Measuring Annual Fireplace Efficiency.* Ontario, Canada.
57 Natural Resources Canada. March 2004. *All About Gas Fireplaces.* Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.
58 Canadian Standards Association Group. 2015. P.4.1-15 *Testing Method for Measuring Annual Fireplace Efficiency.* Ontario, Canada.
59 Ibid.
60 Canadian Standards Association Group. 2016. ANSI Z21.88-2016/CSA 2.33-2016 "Vented Gas Fireplace Heaters." Ontario, Canada.
61 Manufacturer interviews, 2018.
62 Kingsman Fireplaces, Montigo, Napoleon, Regency, and Manufacturer interviews
63 Kingsman Fireplaces.

features or these pilot types prevents condensation from forming on the glass and allows the system to overcome a cold start. A "cold start" is when the flue is filled with cold air preventing the pilot from lighting. Cold air is denser than hot air. The cold air essentially blocks the hot air or heat coming from the pilot to rise or stay lit. To overcome a cold start, the flue needs to be warmed by attempting to light the pilot a couple of times to produce some heat (per manufacturer instructions).[64]

Fireplace Efficiency

Industry has used three metrics to measure the efficiency of a fireplace: steady state, annual fuel utilization efficiency (AFUE), and fireplace efficiency (FE).

Fireplace efficiency is measured using the Canadian Standards Association (CSA) P.4.1 test procedure and is expressed as a percentage. A high efficiency rating means more fuel is converted to heat and less is being exhausted through the flue or through heat loss or both, while a lower rating indicates a less efficient product. The measurement takes into account all energy losses (for example, surface loss, stack loss, flue gas loss, and so forth) and the associated performance during a heating season.[65]

AFUE is measured using U.S. DOE's test procedure for vented home heating equipment (10 Code of Federal Regulations [CFR], Part 430, Subpart B, Appendix O). The AFUE rating takes into account some energy losses and averages efficiency over an entire heating season.[66]

Steady-state rating is not representative of real-world usage. It is measured by ignoring all energy losses, running the unit continuously, and measuring heat output from all the associated surfaces.[67]

64 Regency Fireplace Products. January 2019. "Tips for Starting a Fire in a Cold Fireplace." Retrieved from Regency Fireplace Products: https://www.regency-fire.com/en/Blog/January-2019/Tips-for-Starting-a-Fire-in-a-Cold-Fireplace.
65 Hearth, Patio & Barbecue Association of Canada. (n.d.). About EnerChoice. Retrieved 2019, from EnerChoice: http://enerchoice.org/about-enerchoice.
66 Ibid.
67 Ibid.

CHAPTER 4:
Regulatory Approaches

Energy Commission staff examined and considered several approaches for improving the efficiency of gas hearth products while achieving savings for California. Evaluated pathways included regulatory and voluntary at state, federal, and international levels. Staff also evaluated proposals submitted to the 2018 Appliance Efficiency Pre-rulemaking Docket #18-AAER-06 for Hearth Products as of March 2019.

California Appliance Efficiency Standards

In December 2013, the Energy Commission began a rulemaking to update the *Appliance Efficiency Regulations* (California Code of Regulations, Title 20, Sections 1601 to 1609) to align with federal regulations. The proposed amendments included changes to add definitions, a test method, performance standards, and certification requirements for vented hearth heaters set by the U.S. Department of Energy (DOE).[68]

In February 2014, the proposed amendments for vented hearth heaters were removed from the proposed 45-day language because the federal definition and standards were found invalid following a court ruling, where Hearth, Patio & Barbecue Association (HPBA) sued DOE.[69] For more information and history of hearth products at the federal level, see the section on Federal Approaches in this chapter.

There are no state appliance efficiency standards for gas hearth products.

Other California Codes

Health and Safety Code

Under Section 19881 of the California Health and Safety Code (HSC), "any new or unused unvented heater" is prohibited from being sold or to be offered for sale in the state of California for use inside dwellings, with the exception of electric heaters. Unvented decorative gas logs and fireplaces are also not permitted for sale, unless the California Department of Housing and Community Development (HCD) and the State Department of Health Services adopt regulations permitting them following the provisions in HSC 19881. As of the date this report was published, no regulations have been adopted or proposed.[70]

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68 California Energy Commission. December 2013. "Proposed Amendments to Appliance Efficiency Regulations - Federal Updates and Clarifications to Existing Regulations. CEC-400-2013-015-45-DAY." California: California Energy Commission.

69 California Energy Commission. February 2014. *Final Statements of Reasons - Amendments Adopted Into Appliance Efficiency Regulations.* CEC-400-2013-015-FSOR. California: California Energy Commission.

70 California Health and Safety Code, Division 13, Part 3, Chapter 12, Section 19881.

California Building Code

Staff examined definitions in the California Mechanical Code and the California Residential Code to ensure consistency among California regulatory definitions. The definitions found in these codes are related to solid-fuel fireplaces, which are beyond the scope of this proposal.[71]

California Energy Code

The *California Building Energy Efficiency Standards* (BEES), also referenced as the California Energy Code, apply to newly constructed buildings, additions, and alterations to existing buildings and are updated every three years.[72] The 2019 BEES have the following definitions related to gas hearth products (definitions remained the same from the 2016 BEES):[73]

- A *decorative gas appliance* is a gas appliance that is designed or installed for visual effect only, cannot burn solid wood, and simulates a fire in a fireplace.
- A *gas log* is a self-contained, free-standing, open-flame, gas-burning appliance consisting of a metal frame or base supporting simulated logs and designed for installation only in a vented fireplace.
- A *fireplace* is a hearth and fire chamber, or similar prepared place, in which a fire may be made and which is built in conjunction with a flue or chimney, including but not limited to factory-built fireplaces, masonry fireplaces, and masonry heaters as further clarified in the California Building Code (CBC).

The 2016 BEES prohibits the installation of fireplaces, decorative gas appliances, and gas logs with a continuous pilot light in low-rise residential buildings.[74]

The 2019 BEES prohibits the installation of indoor and outdoor natural gas fueled fireplaces with continuous pilots in all occupancies.[75]

71 California Department of General Services. (2018). California Building Standards Code. Retrieved from California Building Standards Commission: https://www.dgs.ca.gov/BSC/Codes.
72 California Code of Regulations, Title 24, Part 6, California Energy Code.
73 2016 and 2019 California Building Energy Efficiency Standards.
74 Section 150.0 of the 2016 Building Energy Efficiency Standards.
75 Section 110.5 of the 2019 Building Energy Efficiency Standards.

Other State Approaches

Hawaii prohibits new residential type gas appliances equipped with a pilot light[76] to be sold or installed[77] in the state after June 30, 1980. Gas appliances sold after June 30, 1980, must be equipped with an intermittent ignition device[78] or other nonpilot light.[79]

Industry Standards

Staff has identified several industry standards related to hearth products. **Table 4-1** lists industry standards related to the scope of products specified in this proposal.

Table 4-1: List of Industry Standards

Industry Standard
ANSI Z21.88/CSA 2.33 – Vented gas fireplace heaters
ANSI Z21.50/CSA 2.22 – Vented decorative gas appliances
ANSI Z21.60/CSA 2.26 – Decorative gas appliances for installation in solid-fuel burning fireplaces
ANSI Z21.84 – Manually lighted, natural gas decorative gas appliances for installation in solid-fuel burning fireplaces
CSA P.4.1 – Testing method for measuring annual fireplace efficiency

Source: Energy Commission staff research

The CSA P.4.1 testing method is applicable to appliances within the scope of ANSI Z21.88/CSA 2.33 and ANSI Z21.50/CSA 2.22.[80] The scope of ANSI Z21.88/CSA 2.33 covers vented gas fireplaces heaters with input ratings up to and including 400,000 Btu/hr. and for use with natural gas or propane.[81] The scope of ANSI Z21.50/CSA 2.22 covers vented decorative gas appliances with input ratings up to and including 400,00 Btu/hr. for use with natural gas or propane that are not for use with a thermostat, that are not a source of heat, and that are not for use with solid fuels.[82] Both contain provisions for construction, safety, and performance of the appliance, and instructions for markings and literature that accompany the appliance.

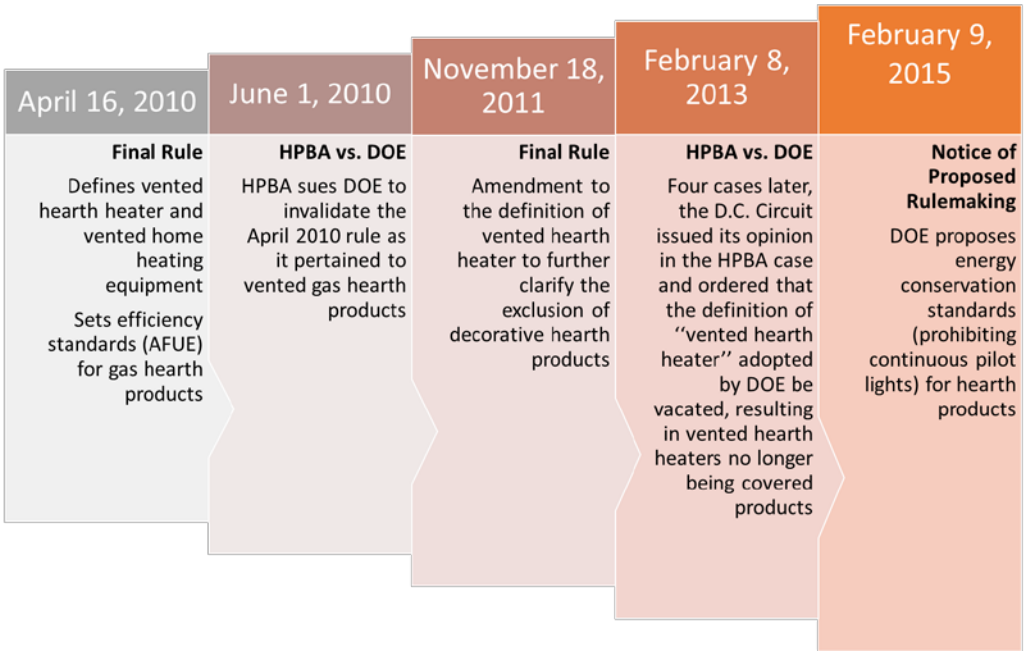
76 "Pilot light" means any gas-operated device that remains continually operated or lighted to ignite a gas appliance to normal operation.
77 "Gas appliance" includes any new residential-type heater, refrigerator, stove, range, dishwasher, dryer, air conditioner, decorative fireplace, or other similar devices.
78 "Intermittent ignition device" means an ignition device that is activated only when the gas appliance is in operation.
79 Hawaii Revised Statutes, Title 12, Chapter 196, Part 1, Section 5.
80 Canadian Standards Association Group. 2015. *P.4.1-15 Testing Method for Measuring Annual Fireplace Efficiency.* Ontario, Canada.
81 Canadian Standards Association Group. (2016). *ANSI Z21.88-2016/CSA 2.33-2016 Vented Gas Fireplace Heaters.* Ontario, Canada.
82 Canadian Standards Association Group. 2016. *ANSI Z21.50 - 2016/CSA 2.22 - 2016 Vented Decorative Gas Appliances.* Ontario, Canada.

Industry uses these standards to distinguish vented gas fireplace heaters from vented decorative gas appliances.

Federal Approaches

There are no federal standards for gas hearth products. However, gas hearth products have had a long regulatory history at the federal level beginning in 2009 and ending in 2017. **Figure 4-1** shows a brief history of major regulatory milestones for gas hearth products at the federal level.

Figure 4-1: U.S. DOE Historical Regulatory Timeline for Hearth Products



Source: U.S. DOE

2010 Final Rule

On December 11, 2009, the U.S. DOE published a Notice of Proposed Rulemaking (NOPR) on Energy Conservation Standards for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters. Then on April 16, 2010, the U.S. DOE published its final rule for these products. The standard set forth the following definitions and requirements for products manufactured on or after April 16, 2013:[83]

83 U.S. Department of Energy. April 16, 2010. "Energy Conservation Program: Energy Conservation Standards for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters; Final Rule." EERE-2006-BT-STD-0129-0005, 126. Washington, D.C.: United States Department of Energy. Retrieved 2018, from https://www.regulations.gov/document?D=EERE-2006-STD-0129-0005.

- Definitions
  - Vented home heating equipment or vented heater means a class of home heating equipment, not including furnaces, designed to furnish warmed air to the living space of a residence, directly from the device, without duct connections (except that boots not to exceed 10 inches beyond the casing may be permitted and except for vented hearth heaters, which may be with or without duct connections) and includes: vented wall furnace, vented floor furnace, vented room heater, and vented hearth heater.
  - Vented hearth heater means a vented appliance which simulates a solid fuel fireplace and is designed to furnish warm air, with or without duct connections, to the space in which it is installed. The circulation of heated room air may be by gravity or mechanical means. A vented hearth heater may be freestanding, recessed, zero clearance, or a gas fireplace insert or stove. Those heaters with a maximum input capacity less than or equal to 9,000 British thermal units per hour (Btu/hr.), as measured using DOE's test procedure for vented home heating equipment (10 CFR Part 430, Subpart B, Appendix O), are considered purely decorative and are excluded from DOE's regulations.
- Test Procedure
  - Test procedure for vented home heating equipment (10 CFR Part 430, Subpart B, Appendix O)
- Standard

Table 4-2: U.S. DOE Efficiency Standards for Vented Gas Hearth Products

Product Class	Annual Fuel Utilization Efficiency (AFUE)
Gas hearth up to 20,000 Btu/hr.	61
Gas hearth over 20,000 Btu/hr. and up to 27,000 Btu/hr.	66
Gas hearth over 27,000 Btu/hr. and up to 46,000 Btu/hr.	67
Gas hearth over 46,000 Btu/hr.	68

Source: U.S. DOE

2011 Final Rule

On July 22, 2011, the U.S. DOE published a NOPR on Energy Conservation Standards for Direct Heating Equipment, specifically for vented hearth heaters. On November 18, 2011, the final rule was published to amend the definition for vented hearth heater.[84]

The previous definition for "vented hearth heater" in the 2010 final rule defined a decorative hearth product as a hearth product with a maximum input capacity of 9,000 Btu/hr. and were not subject to any performance standards. The amended definition redefines decorative gas hearth products as products within the scope of ANSI Z21.50 (vented decorative gas appliances), not equipped with a thermostat, marked as decorative only, and not equipped with a continuous pilot if sold after January 1, 2015. The updated definition also clarifies that vented decorative gas hearth products gas are not subject to any performance standards. The updated definition would be effective on April 16, 2013, to coincide with the performance standards approved in the 2010 final rule. This amendment also requires decorative gas hearth products sold after January 1, 2015, not be equipped with continuous pilots. Vented gas log sets are not subject to this prescriptive requirement.[85]

2013 – HPBA vs. DOE

Hearth, Patio & Barbecue Association (HPBA), along with other stakeholders such as Lennox, raised concerns that the U.S. DOE did not "substantiate its authority to regulate decorative gas hearth product," such as decorative gas fireplaces and decorative gas log sets. HPBA stated that the U.S. DOE "cannot lawfully categorize decorative hearth products as direct heating equipment because at the time these categorizations were made, fireplaces and gas log sets existed but were recognized as entirely different categories of products."[86] HPBA also stated that defining decorative gas hearth products as heating products is incorrect, since decorative appliances do not provide heat and are intended for aesthetics purposes.[87] These concerns were the grounds on which HPBA pursued to challenge U.S. DOE in court. Following the 2010 final rule and before the 2011 NOPR, HPBA sued U.S. DOE twice. Four months after the publishing of the 2011 NOPR, the 2011 final rule was published, and thus HPBA sued again to cover the amendments made regarding decorative gas hearth products in the 2011 final rule. Then on February 8, 2013, the D.C. circuit sided with HPBA and ordered the U.S. DOE to vacate the

84 U.S. Department of Energy. November 18, 2011, "Energy Conservation Program: Energy Conservation Standards for Direct Heating Equipment; Final Rule." EERE-2011-BT-STD-0047-0376. Washington, D.C.: United States Department of Energy. Retrieved 2018, from https://www.regulations.gov/document?D=EERE-2011-BT-STD-0047-0376.
85 Ibid.
86 U.S. Department of Energy. July 22, 2011. "Energy Conservation Program: Energy Conservation Standards for Direct Heating Equipment; Notice of Proposed Rulemaking and Announcement of Public Meeting." EERE-2011-BT-STD-0047-0001. Washington, D.C.: United States Department of Energy. Retrieved 2018, from https://www.regulations.gov/document?D=EERE-2011-BT-STD-0047-0001.
87 Ibid.

definition "vented hearth heater," consequently vacating the standards associated with vented hearth heaters.[88]

2015 Notice of Proposed Rulemaking

On December 31, 2013, the U.S. DOE published a notice of determination stating gas-fired hearth products qualify as a covered product under the Energy Policy and Conservation Act (EPCA) of 1975.[89] Following the proposed determination of coverage, on February 9, 2015, the U.S. DOE published a NOPR on Energy Conservation Standards for Hearth Products. The proposal recommended defining "hearth product" to mean "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 proposal also recommended prohibiting hearth products to be equipped with a continuous pilot.[90]

On March 31, 2017, this rulemaking was withdrawn.[91]

International Approaches

Natural Resources Canada

In Canada, gas fireplaces (heating and decorative) manufactured on or after June 1, 2003, are required to be tested using CSA P.4.1 to measure fireplace efficiency,[92] and to report the fireplace efficiency to Natural Resources Canada (NRCan).[93] In addition to reporting the fireplace efficiency, manufacturers are required to provide the fuel type; maximum and minimum input rates; configuration (that is, freestanding, zero-clearance, or insert); type of ignition (that is, standing pilot, intermittent ignition device, on-demand pilot, or remotely operated pilot); and venting configuration (that is, natural venting, direct venting, or power venting).[94] As of October 2018, the NRCan database lists more than 1,800 gas fireplace models.

88 U.S. Department of Energy. December 31, 2013. "Energy Conservation Program for Consumer Products: Proposed Determination of Hearth Products as a Covered Consumer Product." EERE-2013-BT-DET-0057-0002. Washington, D.C. United States Department of Energy. Retrieved 2018, from https://www.regulations.gov/document?D=EERE-2013-BT-DET-0057-000.
89 Ibid.
90 U.S. Department of Energy. February 9, 2015. "Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products; Notice of Proposed Rulemaking and Announcement of Public Meeting. EERE-2014-BT-STD-0036-0010. Washington, DC: U.S. Department of Energy.
91 Docket Webpage of Energy Conservation Standards for Hearth Products. 2017. Retrieved from https://www.regulations.gov/docket?D=EERE-2014-BT-STD-0036.
92 If the product was manufactured on or after June 1, 2003, and before January 1, 2017, the product must be tested to CSA P.4.1. For products manufactured on or after January 1, 2017, the product must be tested to CSA P.4.1 – 2015.
93 "Energy Efficiency Regulations: Part 2 Energy-Using Products, Division 4 - Furnaces, Fireplaces, and Unit Heaters." January 8, 2019. Canada. Retrieved from https://laws-lois.justice.gc.ca/eng/regulations/SOR-2016-311/index.html.
94 Ibid.

On March 4, 2017, the Office of Energy Efficiency at NRCan issued a notice of intent to amend Canada's Energy Efficiency Regulations to adopt minimum energy performance standards for gas fireplaces.[95]

NRCan is proposing the following for gas fireplaces manufactured on or after January 1, 2020:[96]

- Redefine gas fireplace to mean "a decorative gas fireplace or a heating gas fireplace."
- Define decorative gas fireplace as a "vented fireplace that is fueled by natural gas or propane, is marked for decorative use only and is not equipped with a thermostat or intended for use as a heater."
- Define heating gas fireplace as a "vented fireplace that is fueled by natural gas or propane and is not a decorative gas fireplace."
- Define automatic shut-off device as "a device that automatically extinguishes the main gas burner flame if, in a 24-hour period, (a) a person has not used the fireplace controls to adjust the flame height or appearance; or (b) the fireplace has not received a signal indicating the presence of occupants in the room in which it is installed."
- Decorative gas fireplaces
    - Must be equipped with automatic shut-off device.
    - Unless it is marked for replacement use only, have a direct vent configuration.
- Heating gas fireplaces must have a minimum fireplace efficiency of 50 percent.
- Decorative and heating gas fireplaces
    - Will continue to be tested to measure fireplace efficiency using CSA P.4.1 – 2015.
    - Must be equipped with either an interrupted, intermittent, or an on-demand pilot (with a seven-day time limit).
    - Will continue to report fireplace efficiency and other criteria.
- Report whether the gas fireplace is heating or decorative, and whether a decorative gas fireplace is intended as a replacement unit.

British Columbia

In British Columbia, gas fireplaces manufactured on or after January 2, 2007, must be tested using CAN/CSA P.4.1 – 2002 to measure fireplace efficiency and must be marked displaying the fireplace efficiency rating.[97]

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95 Natural Resources Canada. January 18, 2019. "Gas Fireplaces - Technical Bulletin on Amending the Standards." Canada. Retrieved 2018, from https://www.nrcan.gc.ca/energy/regulations-codes-standards/19682.
96 Natural Resources Canada. October 20, 2018. "Canada Gazette, Part I, Volume 152, Number 42: Regulations Amending the Energy Efficiency Regulations, 2016 (Amendment 15) - Regulatory Impact Analysis Statement." Canada: *Canada Gazette*. Retrieved from http://www.gazette.gc.ca/rp-pr/p1/2018/2018-10-20/html/reg3-eng.html.
97 "British Columbia's Energy Efficiency Standards Regulation," Consolidation December 31, 2017.

On December 31, 2018, British Columbia amended its Energy Efficiency Standards Regulation with the following changes for vented gas fireplace heaters and vented decorative gas appliances manufactured on or after January 1, 2019:[98]

- Defined "FE rating" as "the annual fireplace efficiency rating of a gas fireplace, vented gas fireplace heater or vented decorative gas appliance."
- Defined "vented decorative gas appliance" as a "vented decorative gas appliance that is within the scope of ANSI Z21.50-2016/CSA 2.22-2016."
- Defined "vented gas fireplace heater" as a "vented gas fireplace heater that is within the scope of ANSI Z21.88-2016/CSA 2.33-2016."
- Vented gas fireplace heaters must have a minimum fireplace efficiency of 50 percent.
- Vented decorative gas appliances must be marked as decorative and not intended as a heating appliance.
- Vented gas fireplace heaters and vented decorative gas appliances
    - Will be tested to measure fireplace efficiency using CAN/CSA P.4.1-2015.
    - Must have pilot-on-demand, an interrupted or intermittent ignition system, and must not have a standing pilot.
    - Must be labeled displaying the fireplace efficiency rating, and the label must be affixed on the rating plate. Sales display models must also be labeled accordingly.

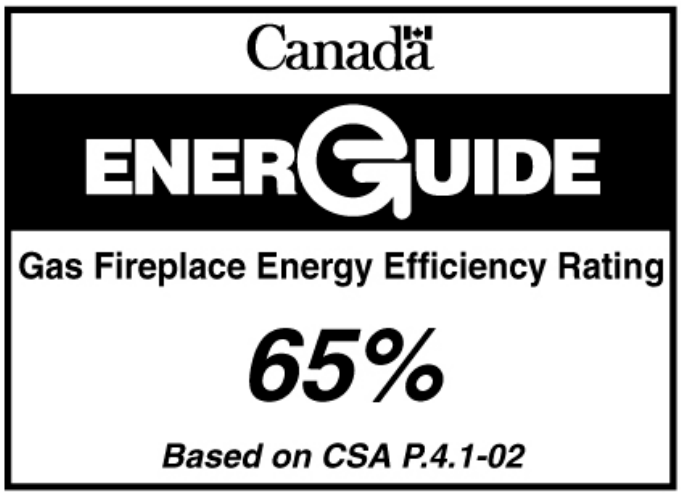
Voluntary Approaches

EnerGuide

Natural Resources Canada administers a labeling program called EnerGuide. EnerGuide labels display performance data to inform consumers about the energy consumption of an appliance to make educated purchases regarding the efficiency of the appliance. For gas fireplaces, the EnerGuide label is voluntary. The label must display the fireplace efficiency rating and test method, as shown in **Figure 4-2**.[99]

98 British Columbia's Energy Efficiency Standards Regulation, as of March 6, 2018.
99 Natural Resources Canada. September 28, 2018. "Gas Fireplaces – EnerGuide." Retrieved 2019, from Natural Resources Canada: https://www.nrcan.gc.ca/energy/products/energuide/label/reading/13718.

Figure 4-2: EnerGuide Label for Gas Fireplaces



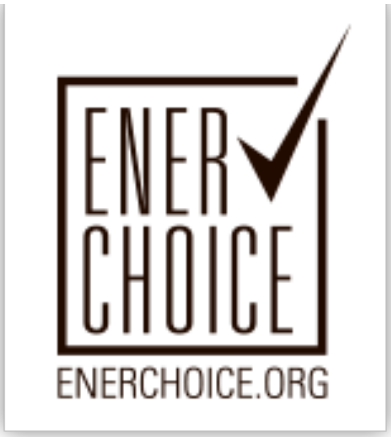
Source: NRCan

EnerChoice

Another voluntary labeling program is available in Canada. EnerChoice is administered by Hearth, Patio & Barbecue Association of Canada (HPBAC). To use the EnerChoice label as shown in **Figure 4-3**, gas fireplaces must meet the following minimum fireplace efficiency ratings:[100]

- Vented gas fireplace inserts – 61 percent
- Vented freestanding gas stoves – 66 percent
- Zero-clearance vented gas fireplace - 62.4 percent

Figure 4-3: EnerChoice Logo



Source: EnerChoice.org

100 Hearth, Patio & Barbecue Association of Canada. (n.d.). "About EnerChoice." Retrieved 2019, from EnerChoice: http://enerchoice.org/about-enerchoice.

Rebate Programs

The U.S. DOE identified several states that offer rebate programs for gas fireplaces in the hearth products rulemaking.[101] **Table 4-3** lists states with rebate programs for gas fireplaces in the United States. Puget Sound Energy for the state of Washington lists 324 qualifying models,[102] and Energy Trust of Oregon lists 143 qualifying models[103] to be eligible for the rebate.

Table 4-3: List of Rebate Programs in the United States

State	Utility	Requirement
Washington	Puget Sound Energy	FE ≥ 70% with an electronic ignition
Oregon	Energy Trust of Oregon	FE ≥ 70% with an electronic pilot ignition
Minnesota	CenterPoint Energy	Electronic ignition
Utah, Wyoming, Idaho	City Water Light and Power	AFUE ≥ 70%, direct vent, thermostatically controlled, include blower, and electronic ignition

Source: U.S. DOE, Energy Trust of Oregon

The CASE Report

In June 2018, the IOUs submitted the Code and Standards Enhancement (CASE) report recommending a proposal for gas hearth products in response to the Energy Commission's invitation to comment.[104] In February 2019, they submitted a revised proposal.[105] The proposal recommends prohibiting continuous pilots on all gas hearth products and sets a minimum fireplace efficiency level of 75 percent for gas fireplace heaters. The potential savings in the first year is 154,129 MMBtu and after stock turnover 2,213,231 MMBtu. The life-cycle benefit-to-cost (B/C) ratio is 4.35.[106]

101 U.S. Department of Energy. January 30, 2015. "Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products." EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy

102 Puget Sound Energy. 2019. "Fireplace Rebate." Retrieved March 2019, from Puget Sound Energy: https://www.pse.com/rebates/heating/fireplace-rebate.

103 Energy Trust of Oregon. 2019. "Gas Fireplaces." Retrieved March 2019, from Energy Trust of Oregon: https://www.energytrust.org/incentives/gas-fireplaces/#tab-one.

104 Kido, C., B. Kundu, L. Nelson, and Energy Solutions. June 11, 2018. *Codes and Standards Enhancement (CASE): Analysis of Standards Proposal for Hearth Products.* 41. Energy Solutions, California Investor-Owned Utilities. Retrieved 2018.

105 Ibid. Retrieved March 2019.

106 Ibid.

CHAPTER 5:
Alternative Considerations

State standards for five scenarios were considered: (1) no standards, (2) prohibiting continuous pilot lights only, (3) a stringent fireplace efficiency standard including the prohibition of continuous pilot lights, (4) a less stringent fireplace efficiency standard and other minimum design standards, and (5) a moderate fireplace efficiency standard plus other minimum design standards.

Alternative 1: No Standard

Under this alternative, the Energy Commission would adopt no standards. Proposing no standards for gas hearth products would be a lost opportunity to achieve energy savings in California and would not help attain California's climate and energy efficiency goals. For these reasons, staff believes proposing appliance efficiency standards for gas hearth products is necessary.

Alternative 2: Incorporate Federal Proposal – Prohibiting Continuous Pilots

The NOPR published by the U.S. DOE on February 9, 2015, proposed prohibiting continuous pilots on all gas-fired hearth products. This proposal included vented and unvented, indoor and outdoor, heating and decorative, and portable and fixed installation products. Outdoor products included radiant patio heaters. Radiant patio heaters are regulated by California's Appliance Efficiency Standards, unvented heaters are prohibited from being sold in California under HSC 19881, and continuous pilots are prohibited from being installed in fireplaces in new construction through California's BEES.

Prohibiting continuous pilots on the remaining products would still achieve significant savings. Industry has stated the market is moving toward using noncontinuous pilots to reduce energy consumption on gas fireplaces.[107] Although this alternative is attainable and would achieve significant savings, staff believes there is a greater opportunity to achieve energy savings by adopting performance standards.

107 Hearth, Patio & Barbecue Association. 2019. "Policy Positions." Retrieved from Hearth, Patio & Barbecue Association: https://www.hpba.org/Advocacy/Policy-Positions.

Alternative 3: Incorporate CASE Team Proposal – Stringent Fireplace Efficiency Standard and Prohibiting Continuous Pilots

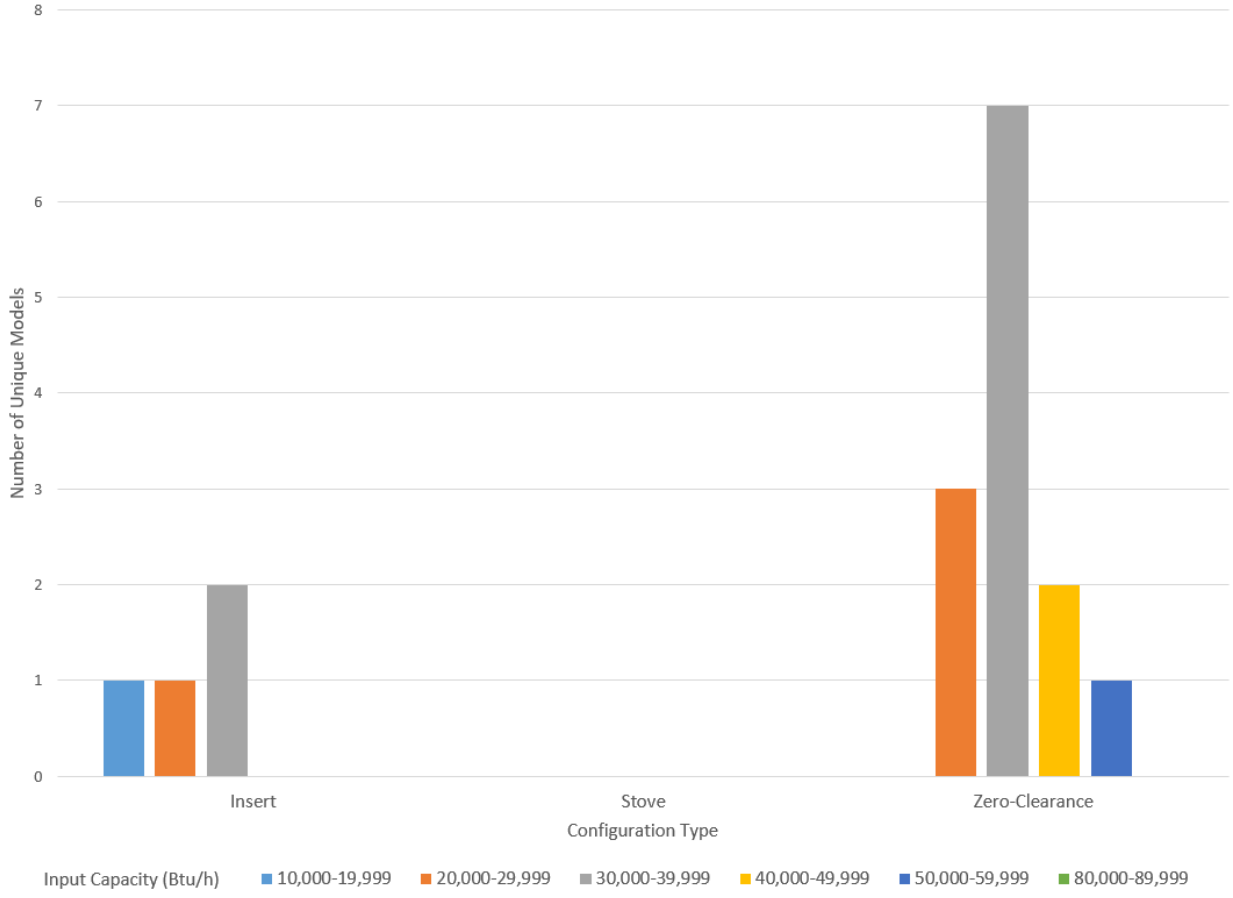
The CASE Team proposal would establish a more stringent efficiency standard for gas fireplaces heaters and prohibit continuous pilots. Specifically, the proposal recommends:

- Establishing a minimum fireplace efficiency standard of 75 percent for gas fireplace heaters.
- Incorporating CSA P.4.1 - 2015 as the test method.
- Prohibiting continuous pilots on gas-fueled indoor and outdoor hearth products. Indoor products include unvented and vented fireplaces and gas logs. Outdoor products include fire pits, gas logs, and outdoor fireplaces.

This proposal presents a significant opportunity for energy savings that are cost-effective and technically feasible. More than 55 percent of the market meets the proposed design requirements, and 3.4 percent of gas fireplace heaters in the market meet the proposed efficiency standard.[108] Although this alternative is attainable, staff believes this alternative would reduce consumer product availability by input capacity (that is, size), configuration (such as zero-clearance, insert, and stove), and pilot type. (See **Figures 5-1** and **5-2**.) For these reasons, staff believes this alternative is not a viable proposal at this time.

108 Kido, C., B. Boyce, B. Kundu, L. Nelson, and Energy Solutions. February 28, 2019. *Codes and Standards Enhancement (CASE): Analysis of Standards Proposal for Hearth Products. 41.* Energy Solutions, California Investor-Owned Utilities. Retrieved March 2019.

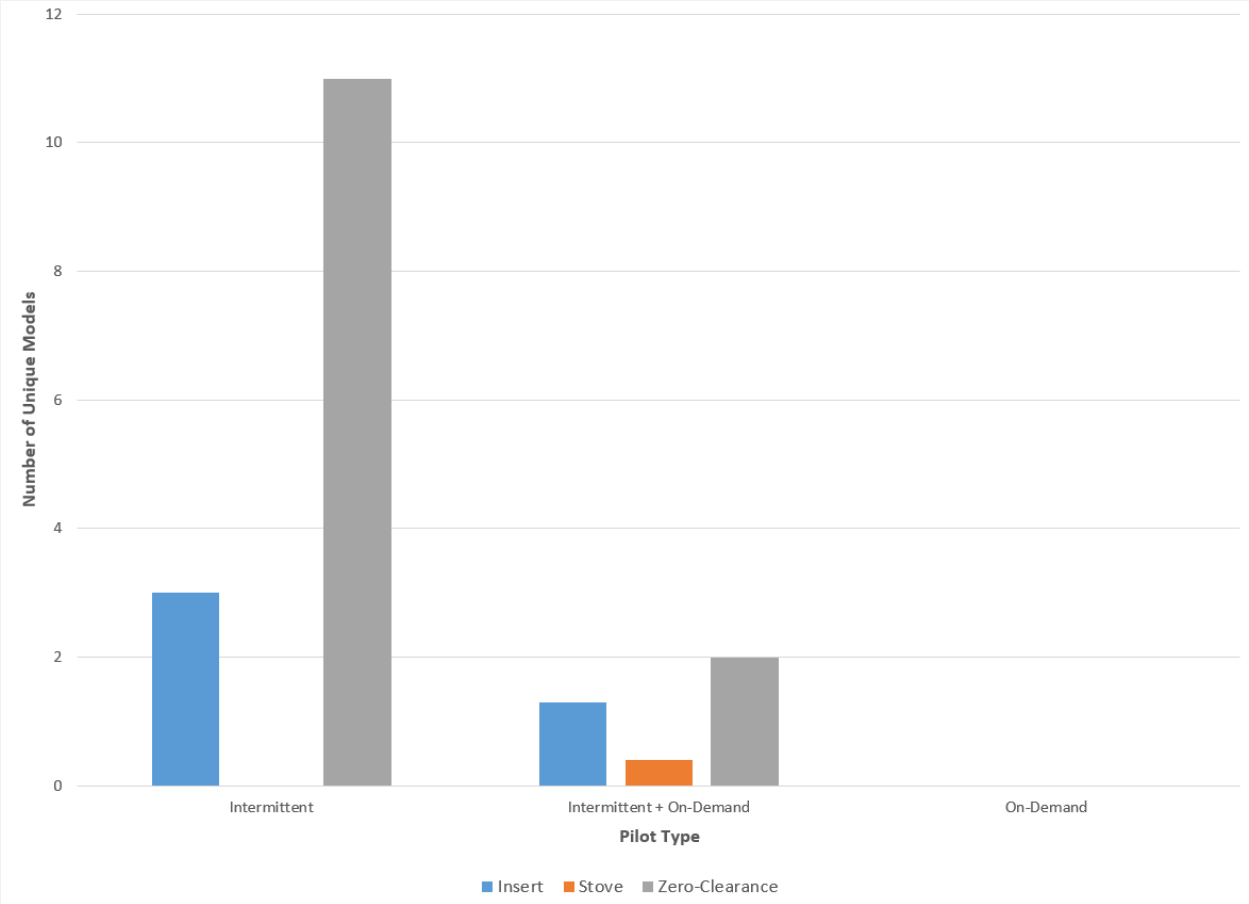
Figure 5-1: Alternative 3 – Product Availability by Input Capacity and Configuration



Note: Product availability is based on meeting both the efficiency and design standards.

Source: Energy Commission staff calculation

Figure 5-2: Alternative 3 - Product Availability by Pilot Type and Configuration



Note: Product availability is based on meeting both the efficiency and design standards.

Source: Energy Commission staff calculation

Alternative 4: Incorporate NRCan Proposal – Less Stringent Fireplace Efficiency Standard Plus Design Standards

Alternative 4 is NRCan's approach, described in **Chapter 4**. In summary, the proposal recommends the following for decorative gas fireplaces and heating gas fireplaces manufactured on or after January 1, 2020:[109]

- Updating definitions to support new requirements
- Prohibiting continuous pilots
- Allowing interrupted, intermittent, and on-demand pilots

109 Natural Resources Canada. October 20, 2018. *Canada Gazette*, Part I, Volume 152, Number 42: Regulations Amending the Energy Efficiency Regulations, 2016 (Amendment 15) - Regulatory Impact Analysis Statement. Canada: *Canada Gazette*. Retrieved from http://www.gazette.gc.ca/rp-pr/p1/2018/2018-10-20/html/reg3-eng.html.

- Requiring that decorative gas fireplaces be equipped with an automatic shut-off device with a time limit of 24 hours
- Requiring that decorative gas fireplaces not include a thermostat and be marked for decorative use only
- Requiring that heating gas fireplaces meet a minimum fireplace efficiency standard of 50 percent and continue to use CSA P.4.1 2015 to measure fireplace efficiency
- Continuing to test and list decorative gas appliances using CSA P.4.1. 2015

This proposal also presents a significant opportunity for energy savings and is technically feasible. More than 90 percent of heating gas fireplaces available in the market meet this proposed efficiency standard; see **Table A-20** in **Appendix A**. Although, this alternative aligns with the vast majority of the market, staff believes there are greater energy-saving opportunities that will reduce onsite gas consumption, onsite emissions, and consumer utility costs.

Alternative 5: Moderate Fireplace Efficiency Standard, Design Standards, Plus Expanded Scope

Alternative 5 is similar to Alternative 4, except it expands the scope and sets a higher minimum fireplace efficiency standard.

- The scope of gas hearth products is specified to vented heating gas fireplaces, vented decorative gas fireplaces, vented gas logs, outdoor gas logs, and outdoor fireplaces.
- For all specified gas hearth products, continuous pilots will be prohibited.
- The alternative would incorporate the CSA P.4.1 – 2015 test procedure with modifications to ensure consistency and clarity.
- Performance standards would apply to vented heating gas fireplaces to meet a minimum fireplace efficiency standard of 70 percent using the CSA P.4.1 – 2015 test procedure.
- Vented decorative gas fireplaces will be required to test and report fireplace efficiency using the CSA P.4.1 – 2015 test procedure. In addition, vented decorative gas fireplaces must be equipped with an automatic shut-off device (extinguishes the main burner after 24 hours of inactivity), must not include a thermostat, and must be marked for decorative use only.
- Several definitions would be added to support scope determination, efficiency and design requirements, and reporting requirements.
- The alternative would require reporting basic product characteristics, configurations, and other information to verify compliance.
- The alternative would implement test lab report requirements to verify compliance.

This alternative achieves significant savings and is cost-effective and technically feasible. This alternative further benefits California's efforts in energy efficiency and greenhouse gas emission reduction goals.

CHAPTER 6:
Proposed Standards for Gas Hearth Products

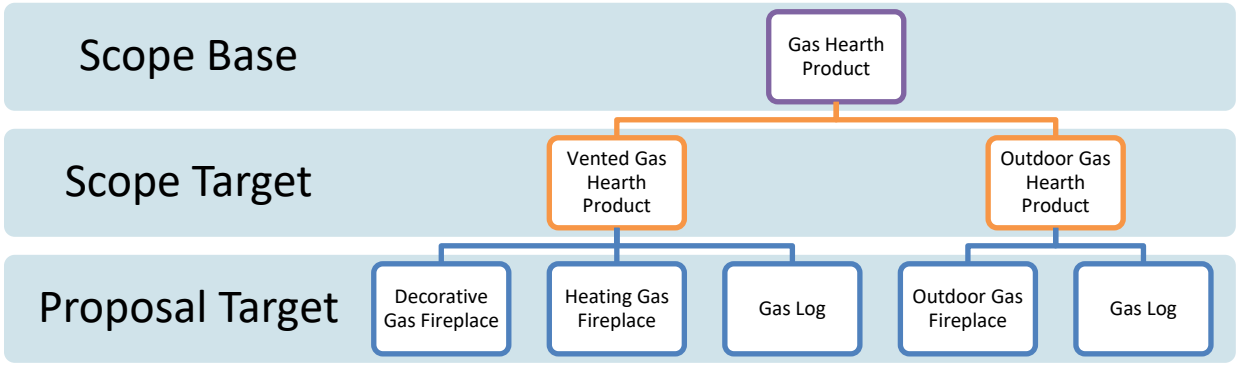
Staff analyzed the cost-effectiveness and technical feasibility of the fifth approach. Based on this information, as well as evaluations conducted by the U.S. DOE and NRCan, staff proposes the CSA P.4.1 2015 test procedure with some modifications for clarification, prescriptive measures to prohibit continuous pilot lights and minimize main burner operation, minimum efficiency standards, and marking requirements. The proposed standards are for vented heating gas fireplaces, vented decorative gas fireplaces, vented gas logs, outdoor gas logs, and outdoor fireplaces manufactured on or after January 1, 2021, or one year from the adoption date.

Staff concludes that the proposed regulations are cost-effective and technically feasible and will save a significant amount of energy statewide. Staff assumptions and calculation methods are provided in **Appendix A**.

Scope

Staff proposes to cover vented gas hearth products and outdoor gas hearth products. Specifically, this proposal covers vented decorative gas fireplaces, vented heating gas fireplaces, vented gas logs, outdoor gas fireplaces, and outdoor gas logs. Staff recommends adding definitions for these products to Section 1602(e) of Title 20 of the California Code of Regulations (CCR) to identify the scope of proposed regulations, as shown in **Figure 6-1**.

Figure 6-1: Scope Chart for Gas Hearth Products



Source: Energy Commission staff

The definition of a "gas hearth product" establishes the base or the area of products that are covered in this proposal. Gas hearth products include vented, unvented, and outdoor products. Although, the definition is broad and inclusive of all hearth products fueled by gas, the purpose is to define the area in which these products lie and provides a structure for the addition of new proposed regulatory language. This definition is further classified into vented gas hearth products and outdoor gas hearth products. These terms target the area of this proposal. The

specific products covered in this proposal are identified as either vented gas hearth products or outdoor gas hearth products, as illustrated in **Figure 6-1**. Lastly, heating gas fireplaces and decorative gas fireplaces can be further categorized by how they can be installed and associated style as an insert, stove, or zero-clearance fireplace, as shown in **Figure 6-2**.

Figure 6-2: Heating and Decorative Gas Fireplace Types

Source: Energy Commission staff

Staff believes the proposed definitions align with those in California's Building Energy Efficiency Standards (BEES) and NRCan's appliance efficiency regulations. Staff also examined definitions related to hearth products from other parts of the California Building Code, international codes, industry standards, and stakeholder comments to ensure consistency.

As noted, unvented gas hearth products are prohibited in California under Section 19881 of the California Health and Safety Code (HSC). For this reason, staff recommends updating the note in Section 1601(e) of Title 20 of the CCR, which states that the sale of unvented gas and oil space heaters are restricted in California per HSC 19881, to more general terms allowing the addition of gas hearth products to be covered under this note.

Additional definitions are being proposed to support the specific requirements of this proposal, such as certification reporting requirements and marking requirements. These terms and the related purpose will be discussed throughout this chapter. The proposed definitions will become effective as soon as the proposed regulations are adopted and published in Title 20 of the CCR, but all other proposed regulatory language will have an effective date of January 1, 2021, or one year from the adoption date.

Test Procedure

Staff recommends that vented decorative gas fireplaces and vented heating gas fireplaces be tested in accordance with CSA P.4.1 – 2015, with modifications, to determine fireplace efficiency. This recommendation aligns with proposals at the federal level and provincial levels in Canada. For vented decorative gas fireplaces, measuring and reporting the fireplace efficiency allow the Energy Commission to collect data to determine if setting efficiency standards is appropriate.

The test procedure CSA P.4.1 *Testing Method for Measuring Annual Fireplace Efficiency* was first published in March 2002 and established primarily by Canadian government agencies, utilities, industry, and trade associations. This test method closely follows the U.S. DOE test method for vented home-heating equipment (10 CFR Part 430, Subpart B, Appendix O) but reflects gas fireplaces.[110] The test method applies to vented gas fireplaces within the scope of the standard ANSI Z21.50/CSA 2.22 and vented gas fireplaces heaters within the scope of the standard ANSI Z21.88/CSA 2.33. The current version of CSA P.4.1 (Version 2015) is still consistent with the U.S. DOE test method for vented home-heating equipment.[111]

The modifications that staff recommends are to provide clarification and ensure consistency when testing. The test procedure, CSA P.4.1 – 2015, provides instruction for measuring the pilot energy input rate, Q_p, as shown in **Figure 6-3**.

Figure 6-3: Excerpt 5.7 From CSA P.4.1 – 2015 Test Method

5.7 Pilot light measurement

The energy input rate, Q_P, shall be measured to the pilot light on all fireplaces so equipped, except for fireplaces with controls that turn off the pilot when the main burner is shut down. The energy input rate shall be measured with an error not greater than 3%.

The energy input rate shall be determined as follows:

a) for fireplaces with a continuous pilot, Q_P = measured pilot input;
b) for fireplaces with a remotely operated pilot ignition system, Q_P = measured pilot input × 0.5;
c) for fireplaces with an intermittent ignition system that are capable of continuous pilot operation, Q_P = measured pilot input × 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 × 0.25; and
e) for fireplaces with an intermittent ignition system, Q_P = 0.

Source: CSA P.4.1-2015

A continuous pilot with an intermittent pilot capability is assigned a multiplication factor of 0.5, creating an efficiency advantage over a continuous pilot. In the case of an interrupted pilot and an intermittent pilot with on-demand pilot capability, the test procedure does not define or provide instruction for measuring Q_p. Manufacturers have explained for products with an intermittent pilot with on-demand pilot capability, the pilot energy input rate is determined as specified for a stand-alone on-demand pilot system. Therefore, staff recommends providing specific instruction for measuring the pilot energy input rate for intermittent and on-demand combination pilots as it is practiced in industry for clarification and consistency until the test procedure is updated. Staff also recommends assigning interrupted pilots with a pilot energy input rate (Q_p) of zero as an intermittent pilot. An interrupted pilot does not remain lit while

110 Canadian Standards Association Group. 2002. *CAN/CSA P.4.1-02 Testing Method for Measuring Annual Fireplace Efficiency*. Ontario, Canada.
111 Canadian Standards Association Group. 2015. *P.4.1-15 Testing Method for Measuring Annual Fireplace Efficiency.* Ontario, Canada.

the main burner is on, unlike an intermittent pilot. Therefore, assigning a pilot energy use of zero is reasonable.

Although interrupted pilots are not being used in the market, staff is recommending to ensure the fireplace efficiency of a product with an interrupted pilot can be determined.

In addition, the test procedure incorrectly defines some of the variables in the equation for determining the *effective flue gas temperature difference at start-up* for direct vent gas fireplaces. The test procedure assigns different terms based on the venting configuration of the appliance. To measure the temperature of the gas inside a vent for fireplaces with a draft relief system, this measurement is called the *stack gas temperature*. For direct-vent or power-vent gas fireplaces, the temperature of the gas inside the vent is called the *flue gas temperature*. As shown in **Figure 6-4**, Sections 6.14.2(a) and (b) in CSA P.4.1 – 2015 specify equations for determining the effective flue gas temperature for direct vent gas fireplaces. The equation correctly uses subscripts "F" for "flue" as assigned for direct vent gas fireplaces, but the variables are defined incorrectly, using the subscript "S" for "stack," which is assigned for fireplaces with a draft relief system or for other-than-direct vent (OTDV) vented gas fireplaces. Although flue gas temperature and stack gas temperature are mutually exclusive in this section, it is important to note these inconsistencies to reduce confusion. Thus, staff recommends correcting this discrepancy in the nomenclature of this test procedure for clarification and to ensure consistency.

Figure 6-4: Excerpt 6.14.2 From CSA P.4.1 – 2015 Test Method

6.14.2

For direct vent gas fireplaces, the effective flue gas temperature difference at start-up of the system burner, $\theta_{F,ON}$, shall be calculated, expressed in °C (°F) and defined as follows:

a) at the maximum input rate:

$$\theta_{F,ON,H} = \left[T_{F,SS,H} - T_{F,ON,H(\tau_1)}\right] e^{t_1/\tau_{ON,H}}$$

b) at the minimum input rate:

$$\theta_{F,ON,R} = \left[T_{F,SS,R} - T_{F,ON,R(\tau_1)}\right] e^{t_1/\tau_{ON,R}}$$

where

$T_{S,SS,H}$ = calculated stack gas temperature at steady state and maximum input rate, under typical field condition, °C (°F)

$T_{S,SS,R}$ = calculated stack gas temperature at steady state and reduced input rate, under typical field condition, °C (°F)

$T_{F,ON,H(\tau_1)}$, $T_{F,ON,R(\tau_1)}$ = values defined in Clause 6.12

e = base (2.718) of natural logarithms

t_1 = value defined in Clause 6.12

$\tau_{ON,H}$,$\tau_{ON,R}$ = values defined in Clause 6.12

Source: CSA P.4.1-2015

Since these modifications are being practiced by the industry, these modifications do not increase testing burden on manufacturers. In addition, should these modifications be corrected

in a future update of the test procedure before the adoption date of this proposal, these modifications will be removed.

Prescriptive Requirements

The proposed design standards will set limits on main burner operation, on-demand pilot operation, and prohibition of continuous pilots (see **Table 6-1**). These prescriptive requirements align with the proposed standards set by NRCan and British Columbia. (See section "International Approaches" in **Chapter 4** for more details.) Decorative gas fireplaces shall be equipped with an automatic shut-off device. An automatic shut-off device limits the operation of the main burner by extinguishing the main burner flame if, after 24 hours, the appliance has not been used actively or the appliance has not sensed occupant motion. This 24-hour limit accommodates commercial establishments such as restaurants and hotels.[112] On-demand pilots installed in vented decorative gas fireplaces, vented heating gas fireplaces, vented gas logs, outdoor gas logs, and outdoor gas fireplaces will be limited to remaining lit after the main burner is shut off for seven days. This seven-day period is consistent with the proposed test procedure.[113] Continuous pilots and continuous pilots with the capability of being switched to a different pilot type are prohibited in vented decorative gas fireplaces, vented heating gas fireplaces, vented gas logs, outdoor gas logs, and outdoor gas fireplaces. This requirement aligns with California's BEES, NRCan's proposed appliance efficiency regulations, and British Columbia's appliance efficiency regulations. The proposed design standards would take effect on January 1, 2021, or one year from the adoption date.

112 Natural Resources Canada. October 20, 2018. *Canada Gazette*, Part I, Volume 152, Number 42: Regulations Amending the Energy Efficiency Regulations, 2016 (Amendment 15) - Regulatory Impact Analysis Statement. Canada: *Canada Gazette*. Retrieved from http://www.gazette.gc.ca/rp-pr/p1/2018/2018-10-20/html/reg3-eng.html.
113 Canadian Standards Association Group. 2015. *P.4.1-15 Testing Method for Measuring Annual Fireplace Efficiency.* Ontario, Canada.

Table 6-1: Proposed Design Standards for Gas Hearth Products

Appliance		Design Standard #1	Design Standard #2	Design Standard #3
Vented gas hearth products	Gas logs	Not Applicable	On-demand pilots shall be timed for a maximum of 7 days.	No continuous pilots
	Decorative gas fireplaces	Shall be equipped with an automatic shut-off device with a time limit no greater than 24 hours		
	Heating gas fireplaces	Not Applicable		
Outdoor gas hearth products	Gas logs	Not Applicable		
	Gas fireplaces	Not Applicable		

Source: Energy Commission staff

Although not explicitly stated in the design requirements, all other pilot types that are not a continuous pilot nor have continuous pilot capability are allowed. However, reporting requirements may indirectly limit future technology. (See the "Reporting Requirements" in this chapter for details.)

The following terms are being added and defined to support the proposed design requirements: automatic shut-off device, continuous pilot, direct ignition, intermittent pilot, intermittent and on-demand combination pilot, interrupted pilot, and on-demand pilot.

Fireplace Efficiency

A fireplace efficiency minimum standard will be applied to vented heating gas fireplaces manufactured on or after January 1, 2021. Vented heating gas fireplaces shall meet a minimum fireplace efficiency of 70 percent. Vented decorative gas fireplace will be required to measure and report fireplace efficiency. Staff proposes to add and define "fireplace efficiency" to support the proposed efficiency standard. **Figure 6-5** shows the equation for fireplace efficiency.

Figure 6-5: Fireplace Efficiency Equation

$$FE = \frac{2889 Effy_{SS,W} Effy_{HS}}{2889 Effy_{SS,W} + 1.154(4600) Effy_{HS} + 0.7 P_F}$$

where

2889 (5200) = average number of US heating degree-days

$Effy_{SS,W}$ = value defined in Clause 6.9

$Effy_{HS}$ = heating seasonal efficiency for vented gas fireplaces

1.154 = (18.3 + 9.4)/24 {2.08 = (65 – 15)/24}
where
18.3 (65) = outside air temperature at which home heating fireplaces start operating, °C (°F)
9.4 (–15) = outdoor design temperature for home heating fireplaces, °C (°F)
24 = number of hours in a day

4600 = average number of US non-heating season hours per year

0.7 = correction factor to account for pilot contribution

P_F = value defined in Clause 6.1

Source: CSA P.4.1-2015

Marking Requirements

Similar to the requirements by British Columbia and proposed requirements by NRCan, staff proposes to add marking requirements for vented decorative gas fireplaces. The unit shall be marked, permanently and legibly, on an accessible and conspicuous place on the unit, on the packaging, and on the cover page of the instructions. The marking shall state "vented decorative gas appliance: not a source of heat."

The marking statement derives from the ANSI Z21.50/CSA 2.22 – 2016 *Vented Decorative Gas Appliances* standard. Section 4.27.2(c) requires the instructions shall include the following statement: "Vented decorative gas appliance: not a source of heat; not for use with solid fuel." Section 4.28.2(k) requires each unit to bear a permanent plate or permanent label with the same statement as required in Section 4.27.2(c).[114]

The proposed marking requirements for decorative gas fireplaces provides the ability to distinguish between decorative and heating gas fireplaces and, therefore, provide the ability to verify compliance.

Test Lab Report Requirements

The proposed test procedure does not include a test lab report template. Staff proposes to require test lab reports for heating and decorative gas fireplaces to include:

114 Canadian Standards Association Group. 2016. *ANSI Z21.50 - 2016/CSA 2.22 - 2016 Vented Decorative Gas Appliances*. Ontario, Canada.

- All applicable inputs defined in the test procedure, CSA P.4.1 – 2015, that are used to determine the fireplace efficiency rating;
- All certification requirements;
- The type of media installed in the testing unit; and
- Properties of the unit that rely on specific testing conditions such as the type of venting system, controls, condensing, and carbon dioxide measurement.

After reviewing sample test lab reports, staff has determined this recommendation is the best approach to verify compliance and is already practiced by the industry. Test lab reports are not required to be submitted with each appliance certification but can be requested at any time per California Code of Regulations, Title 20, Section 1608(c).

Reporting Requirements

For state-regulated and federally regulated appliances to be sold or offered for sale in California, each manufacturer must certify each appliance.[115] Manufacturers certify to the Energy Commission through the Modernized Appliance Efficiency Database System (MAEDbS). Manufacturers must report specific criteria as specified in the California Code of Regulations, Title 20, Section 1601 Table X. Staff proposes the following reporting requirements:

- Manufacturer's name
- Brand name
- Model number
- Date model is to be displayed in the database
- Regulatory status
- Type (select): vented gas hearth product, outdoor gas hearth product
- Energy source (select): natural gas, LPG, natural gas and LPG
- Pilot type (select): direct ignition, intermittent, interrupted, intermittent and on-demand combination, on-demand
- Outdoor gas hearth product type (select), gas fireplace, gas log
- Vented gas hearth product type (select), decorative gas fireplace, heating gas fireplace
- Gas fireplace type (select): insert, stove, zero-clearance
- Fireplace efficiency
- Time limit programmed into the on-demand pilot system
- Whether a decorative gas fireplace is equipped with an automatic shut-off device
- Time limit programmed into the automatic shut-off device
- Minimum rated input capacity
- Whether the unit is equipped with an automatic damper

115 California Code of Regulations, Title 20, Section 1606(a).

- Whether the unit is equipped with a thermostat
- Whether the unit is equipped with a fan
- Whether the unit is equipped with a battery power system

Reporting requirements are used to verify compliance through product determination and validating efficiency standards. Reporting requirements also provide the ability to monitor the market.

As mentioned, the design standards do not explicitly restrict the options for replacing a continuous pilot, but to certify a model to the Energy Commission, the manufacturer must select a pilot type from a set list (for example, intermittent, on-demand, interrupted, intermittent + on-demand, direct ignition). Indirectly, this selection restricts sales of gas hearth products with these pilot types. The selection of pilot types available for certification are all pilot types available in the market. If a new pilot type is created, a new rulemaking will need to be conducted to add the new pilot type and assign the new pilot type a multiplication factor, allowing that unit with that pilot type to be sold or offered for sale in California. Discussions with industry representatives have indicated that the emergence of a new pilot type is unlikely in the near future.[116]

Gas fireplaces and gas logs, whether they are vented or designed for the outdoors, share basic specifications such as pilot type, fuel type, and input capacity. The structure of the regulatory language allows manufacturers with a diverse product line to submit certifications under one appliance, in this case, a gas hearth product. Furthermore, the structure of the regulatory language allows manufacturers to submit one certification for a basic model that is available in natural gas and propane. Hence, the duplication of certain reporting requirements.

116 Manufacturers' interviews, 2018.

CHAPTER 7: Technical Feasibility

The proposed standards for gas hearth products are technically feasible based on information available from NRCan, U.S. DOE, industry, trade associations, and market availability. The regulatory approaches described in **Chapter 4** indicate the proposal for California is attainable.

Staff used the NRCan database of gas fireplaces to assess the California market for heating and decorative gas fireplaces.[117] Staff verified these models are available in California through supplemental research and data received from manufacturers of hearth products. Staff collected additional data to supplement this analysis to determine the California market for gas logs and outdoor gas fireplaces. The NRCan data and staff's data were collected as of October 2018. Since most manufacturers who sell in Canada also sell in California, staff believes the compliance rates will increase in California as the regulatory approaches in Canada at the federal and provincial level take effect.

Design Standard

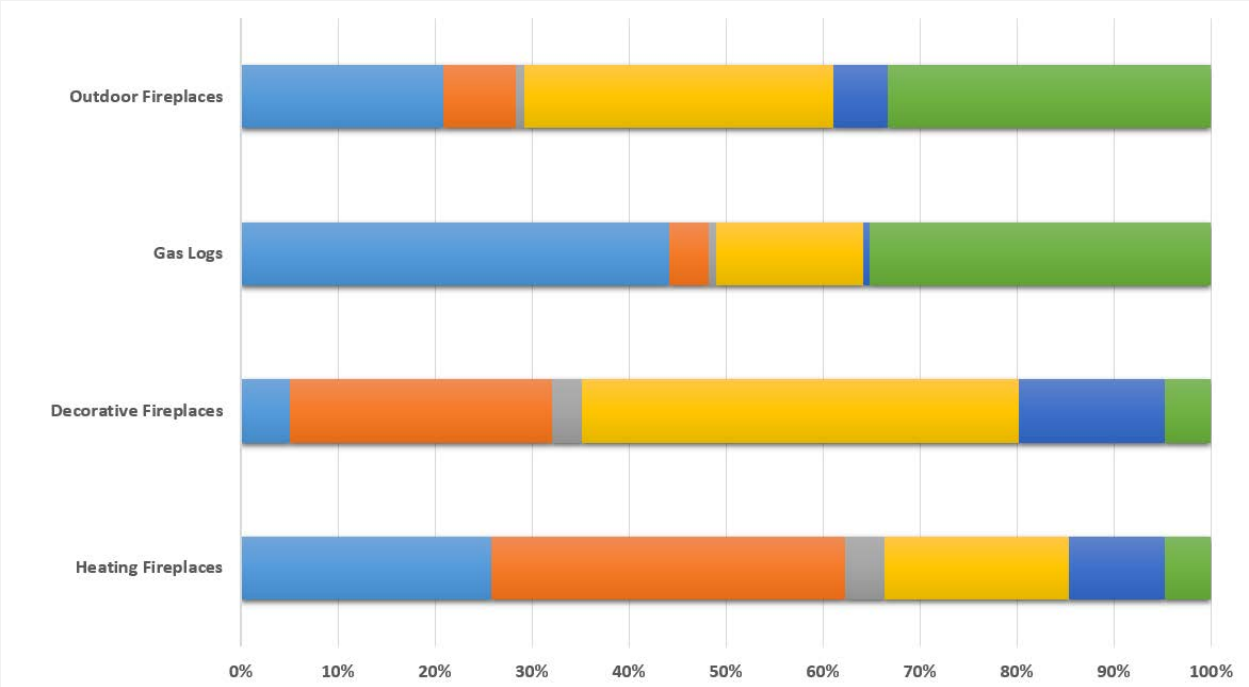
The industry supports phasing out continuous pilot lights to reduce unnecessary energy consumption in vented gas hearth products. The CSA Group has recognized the industry's goal in phasing out continuous pilots by proposing to update the ANSI Z21.50 and ANSI Z21.88 standards to prohibit continuous pilots with a target date sometime between 2022 and 2023.[118]

Market Availability

Figure 7-1 illustrates the compliance rates for gas hearth products specified in this proposal. The compliance rates that were derived using basic models[119] and were adjusted with information from U.S. DOE's hearth products rulemaking documents[120] and information provided through manufacturer interviews. These compliance rates are for natural gas- and propane-fueled hearth products.

117 Natural Resources Canada. 2018. "Energy Efficiency Ratings: Search for Gas Fireplaces." Canada. Retrieved October 2018, from http://oee.nrcan.gc.ca/pml-lmp/index.cfm?action=app.search-recherche&appliance=FIREPLACE_G.
118 Hearth, Patio & Barbecue Association. 2019. "Policy Positions." Retrieved from Hearth, Patio & Barbecue Association: https://www.hpba.org/Advocacy/Policy-Positions.
119 Models with the same manufacturer, pilot type, fuel type, configuration, and venting were set as a basic model.
120 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.

Figure 7-1: Compliance Rates of Pilot Lights for Gas Hearth Products



	Heating Fireplaces	Decorative Fireplaces	Gas Logs	Outdoor Fireplaces
Continuous	26%	5%	44%	21%
Intermittent + Continuous	37%	27%	4%	8%
Intermittent + On-Demand	4%	3%	1%	1%
Intermittent	19%	45%	15%	32%
On-Demand	10%	15%	1%	6%
Direct Igniton	5%	5%	35%	33%

Source: Energy Commission staff calculation

Note: Values are rounded.

Not including direct ignition, the compliance rate for heating gas fireplaces is 33 percent, for decorative gas fireplaces it is 63 percent, for gas logs it is 17 percent, and for outdoor fireplaces it is 39 percent, as shown in **Table 7-1**.

Table 7-1: Summary of Compliance Rates for Pilot Types

Compliancy	Heating Fireplaces	Decorative Fireplaces	Gas Logs	Outdoor Fireplaces
Noncompliant	62%	32%	48%	28%
Compliant	33%	63%	17%	39%
Direct Ignition	5%	5%	35%	33%

Source: Energy Commission staff calculation

Owner manuals and market literature do not indicate the time limit for on-demand pilots and do not indicate if the product has an on-demand pilot. Therefore, staff is unable to demonstrate using public data the compliance rate of gas hearth products that meet the design standard for

on-demand pilots. However, manufacturers have indicated their products are equipped with five-day or seven-day limits, both of which comply with the proposed standard.[121]

Through NRCan's rulemaking, one association and one manufacturer supported the proposal to set a 24-hour operation limit for the main burner on decorative gas fireplaces.[122]

Technology Options

As described in **Chapter 3**, there are several options available for manufacturers and consumers to choose from that will reduce pilot energy consumption and yield additional efficiency savings to the appliance overall. These options include interrupted pilots, intermittent pilots, on-demand pilots, or dual-capability pilot systems such as an intermittent and on-demand combination pilots. These alternative pilots are available in the market (**Figure 7-1**). They are also recognized by industry standards and do not hinder the safety of the pilot ignition system. Staff is not aware of any other technology available in the market.

Industry representatives raised several concerns during the U.S. DOE rulemakings about making products that require electricity for consumers who do not have electricity, have no access to electricity during a power outage, or have no access to an electrical power outlet near the installation of the product. Staff recognizes the need to have these products operable under conditions where there is no access to electricity. Staff notes that there are gas hearth products equipped with battery backup systems and gas hearth products with direct ignition.

Efficiency Standard

As discussed in **Chapter 4**, as a result of NRCan's requirements to test and list vented gas fireplaces and vented decorative gas fireplaces manufactured on or after January 1, 2003, most manufacturers have been testing their products using CSA P.4.1 for determining the fireplace efficiency. Voluntary programs such EnerGuide and EnerChoice, which require manufacturers to disclose the efficiency of their fireplace offerings, have driven industry to manufacture more efficient products.

Market Availability

Figure 7-2 illustrates the number of natural gas unique models[123] that fall within a specified fireplace efficiency range. Unique models with ranges 70-75 to range 85-90 meet the proposed fireplace efficiency standard. See **Figure C-1** in **Appendix C** to view the fireplace efficiency distribution for propane unique models.

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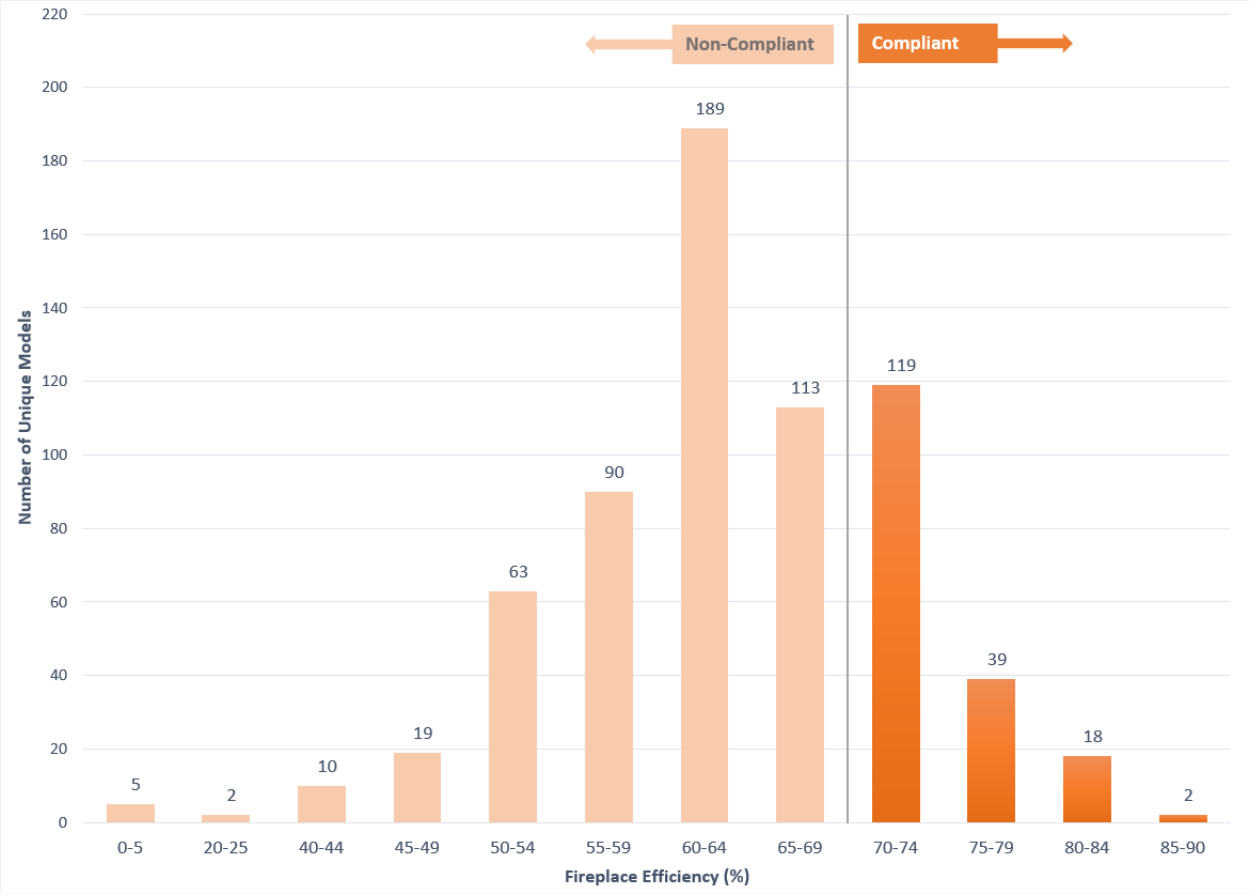
121 Manufacturer interviews, 2018

122 Natural Resources Canada. October 20, 2018. *Canada Gazette*, Part I, Volume 152, Number 42: Regulations Amending the Energy Efficiency Regulations, 2016 (Amendment 15) - Regulatory Impact Analysis Statement. Canada: *Canada Gazette*. Retrieved from http://www.gazette.gc.ca/rp-pr/p1/2018/2018-10-20/html/reg3-eng.htm.

123 Basic models with different input capacities or different fireplace efficiency ratings or both were set as a unique model.

Figure 7-2: Natural Gas Heating Fireplaces – Fireplace Efficiency Distribution



Source: Energy Commission staff calculation

Table 7-2 summarizes the compliance rates illustrated in **Figure 7-2** and **Figure C-1**, demonstrating the proposed efficiency standard is technically feasible.

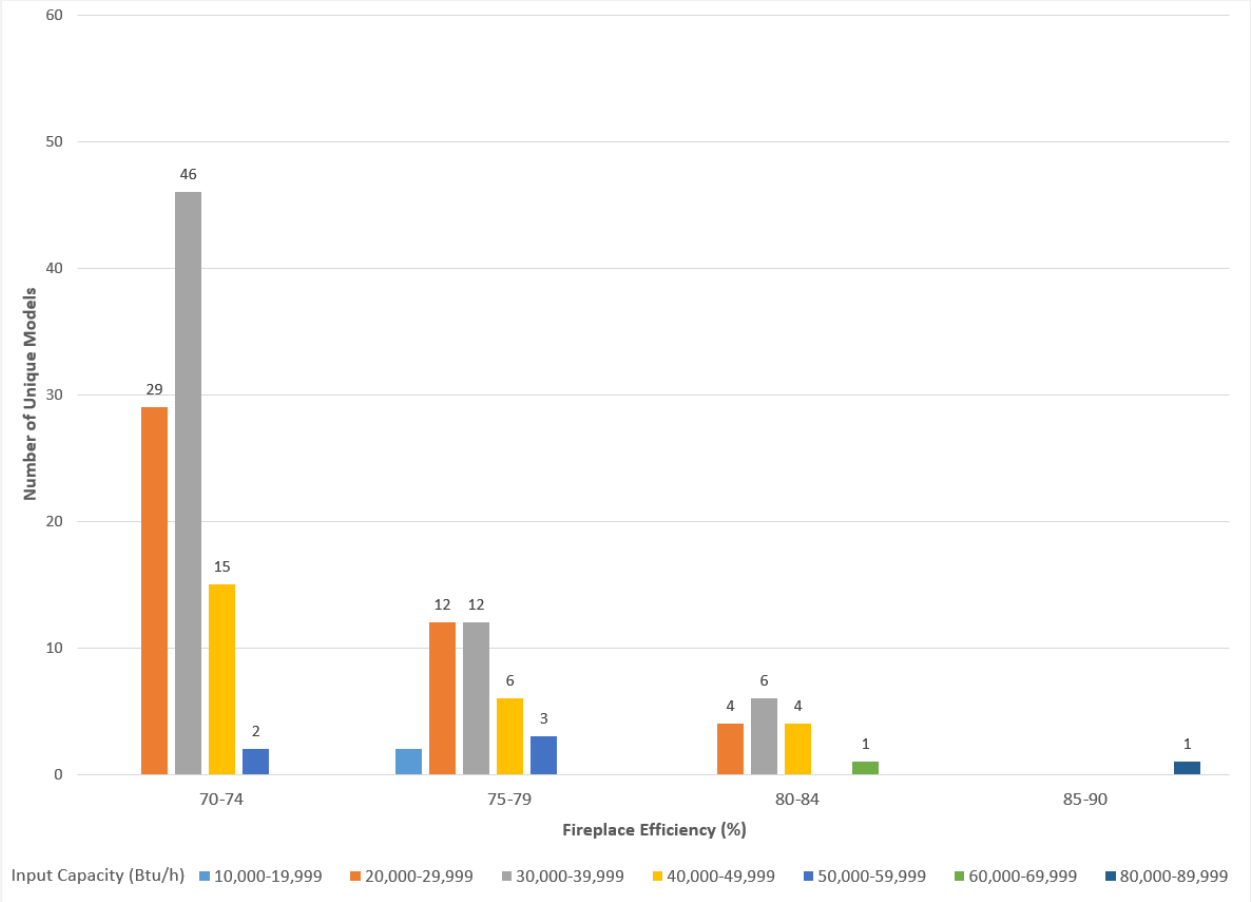
Table 7-2: Fireplace Efficiency Standard Compliance Rates

	Percentage (%)	
Compliancy	**Natural Gas Models**	**Propane Models**
Noncompliant	73.4%	71.2%
Compliant	26.6%	28.8%

Source: Energy Commission staff calculation

Figure 7-3 demonstrates the availability of compliant (meets both design and efficiency standards) natural gas heating fireplaces by input capacity. **Figures C-2** and **C-3** in **Appendix C** show the full distribution of input capacity availability of natural gas- and propane-fueled heating fireplaces, respectively, by fireplace efficiency.

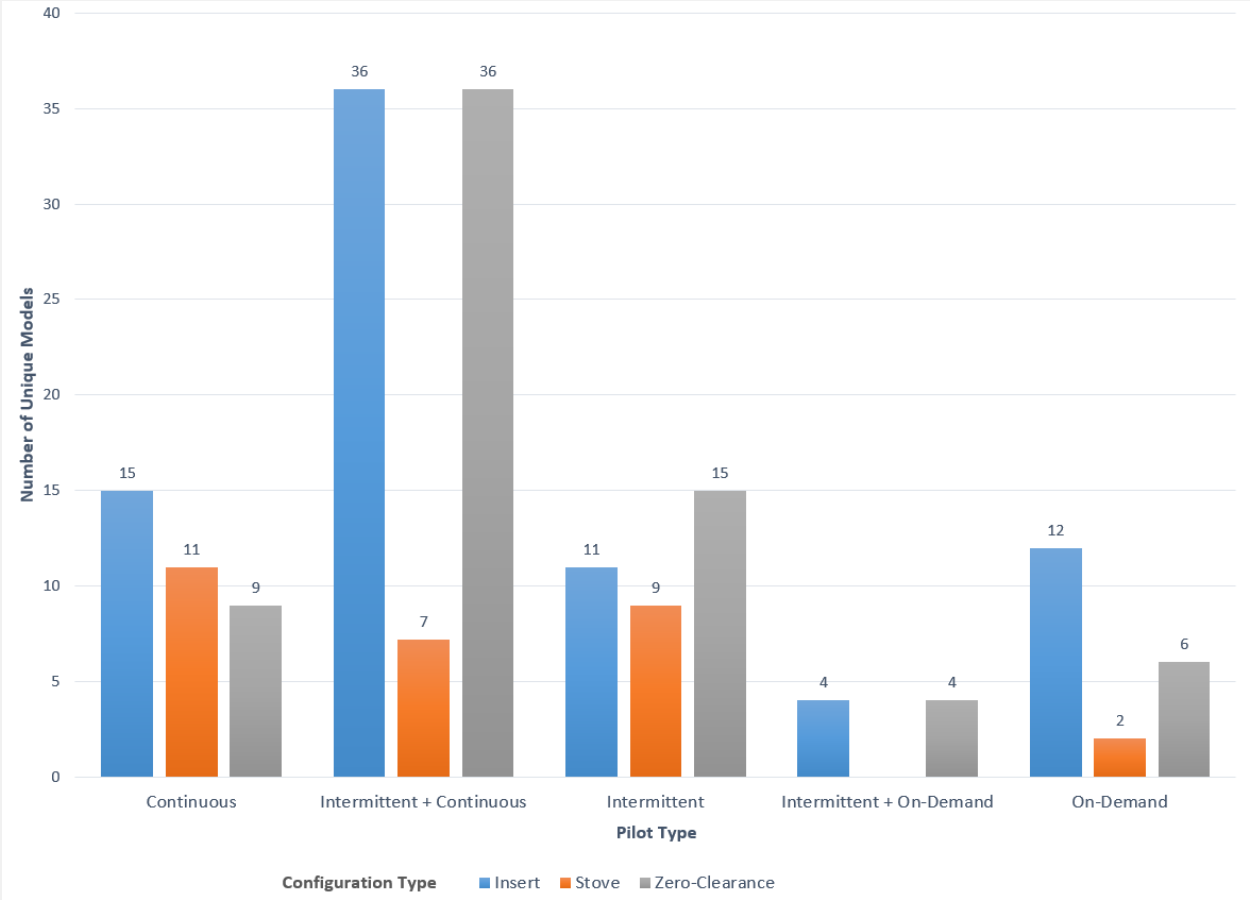
Figure 7-3: Compliant Natural Gas Heating Fireplaces – Fireplace Efficiency vs. Input Capacity



Source: Energy Commission staff calculation

Figure 7-4 demonstrates the availability of compliant natural gas heating fireplaces by pilot type and configuration type. **Figures C-4** and **C-5** in **Appendix C** show the full distribution of pilot type availability of natural gas- and propane-fueled heating fireplaces, respectively, by fireplace efficiency. **Figures C-6** and **C-7** in **Appendix C** show the full distribution of configuration type availability of natural gas- and propane-fueled heating fireplaces, respectively, by fireplace efficiency.

Figure 7-4: Compliant Natural Gas Heating Fireplaces – Pilot Type vs. Fireplace Configuration



Source: Energy Commission staff calculation

Figures 7-3, 7-4, and **C-2** through **C-7** demonstrate that the proposed efficiency standards do not hinder the availability of heating gas fireplaces by input capacity, pilot type, and configuration type.

Technology Options

The U.S. DOE has identified several options to reduce energy consumption or improve the energy efficiency of gas hearth products:[124]

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

124 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.

- Reflective walls
- Air-circulating fan
- Condensing heat exchanger

U.S. DOE states that installing a fan, a condensing heat exchanger, or an electronic ignition has a greater effect on the efficiency of a gas hearth product over the other technology options identified.[125] Other options identified to improve the efficiency of heating gas fireplaces include:[126,127]

- Baffling.
- Variable-setting controls.
- Automatic thermostat.
- Venting configuration.
- Insulation.
- Ceramic glass.

Manufacturers are willing to make changes to improve the efficiency, but not at the expense of flame quality. Resembling the flame pattern of a wood-burning fireplace is a priority to be competitive with solid-fueled fireplaces.[128] A combination of these technologies and design creativity would produce a compliant product.

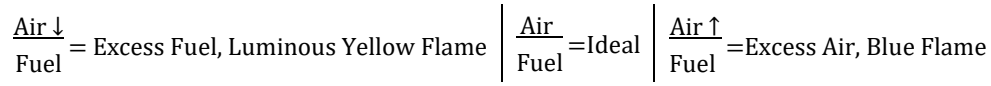
Air-to-Fuel Ratio

Every fuel type has an ideal air-to-fuel ratio where there is no excess air nor excess fuel for complete combustion. That is, the exact amount of oxygen is present to react with the fuel for complete combustion. A low air-to-fuel ratio means less air (oxygen) is present to completely burn the fuel, resulting in excess fuel (rich) and a lower temperature, yellow, luminous flame. A high air-to-fuel ratio means more air is present to completely burn the fuel, resulting in excess air (lean) and hotter flame. **Figure 7-5** summarizes these three air-to-fuel ratio scenarios. Excess fuel results in an incomplete combustion producing harmful emissions. Excess air ensures complete combustion but increases heat loss because hot air is lost up the flue. Manufacturers will take preference on a low air-to-fuel ratio to produce a flame pattern that simulates the

125 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.
126 Kido, C., B. Boyce, B. Kundu, L. Nelson, and Energy Solutions. February 28, 2019. *Codes and Standards Enhancement (CASE): Analysis of Standards Proposal for Hearth Products. 41.* Energy Solutions, California Investor-Owned Utilities. Retrieved March 2019.
127 Natural Resources Canada. March 2004. *All About Gas Fireplaces.* Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.
128 Manufacturer interviews, 2018.

flame pattern of a wood-burning fire.[129] Manufacturers have to balance and fine-tune their gas burner system to optimize flame aesthetics, reduce emissions, and reduce heat loss.

Figure 7-5: Air-to-Fuel Ratio



Source: U.S. DOE

Burner Port Design

Similar to a stovetop burner, the orifices (burner ports) designed in the burner control the flame pattern. The size and pattern of the burner ports in the burner head could be designed to reduce fuel consumption.[130]

Simulated Log Design

According to the U.S. DOE, changing the log design to optimize the flame pattern with less fuel is one approach to reduce energy consumption.[131]

Pan Burner Media/Bead Type

Use of media, such as sand, silica, and glass beads to cover the burner and produce an aesthetically pleasing flame pattern while reducing fuel consumption is another approach the U.S. DOE suggests may result in energy savings.[132]

Reflective Walls

For gas fireplaces where the fire can be viewed only from the front, painting the panels inside the firebox with reflective coating to give the illusion of a bigger flame could reduce energy consumption.[133]

Air Circulating Fan

A fireplace heats the room through radiation and convection. Integrating a fan increases the heat output into the room by circulating the air more effectively and thereby improving the efficiency.[134]

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129 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.
130 Ibid.
131 Ibid.
132 Ibid.
133 Ibid.
134 Ibid.

Condensing Heat Exchanger

During combustion, moisture is released and exhausted. Moisture holds much of the heat produced during combustion. A condensing heat exchanger will extract heat from the moisture in the gas, direct the heat into the room, and collect flue-gas condensate safely.[135]

Variable-Setting Controls

A larger flame creates more heat. A unit with variable-setting controls that can adjust the flame height and the heat output to the comfort level preferred by the user saves energy by preventing overheating. A wider range to adjust the heat output provides the user more latitude to regulate the energy use.[136] A modulating control allows the fireplace to operate at various input rates by a turning a knob from low to high, whereas a single-stage control allows a fireplace to operate at one input rate by switching it ON/OFF.[137]

Automatic Thermostat

An automatic thermostat adjusts the heat output accordingly to maintain the set temperature in the room. A thermostat combined with a modulating control is more effective and energy-efficient than one combined with a single-stage control because the unit will cycle on and off, resulting in wasted energy.[138]

Venting Configuration

Power venting uses an electric fan to exhaust flue gases and draws air into the combustion chamber, advancing the combustion process.[139]

Viewing Glass

The viewing glass is designed to withstand high heating temperatures. Ceramic glass can withstand higher heating temperatures than tempered glass. The viewing glass is one of the mechanisms that allows heat to radiate from the fireplace to the room. Therefore, a viewing glass that can withstand high temperatures radiates more heat.[140]

Baffling

Baffles are used to direct airflow, heat, and flue gases to a desired outlet. An efficient fireplace will be designed properly to transfer heat convectively.[141]

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135 Ibid.
136 Natural Resources Canada. March 2004. "All About Gas Fireplaces." Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.
137 Canadian Standards Association Group. 2015. *P.4.1-15 Testing Method for Measuring Annual Fireplace Efficiency.* Ontario, Canada.
138 Natural Resources Canada. March 2004. "All About Gas Fireplaces." Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.
139 Ibid.
140 Ibid.
141 Ibid.

CHAPTER 8:
Savings and Cost Analysis

The proposed updated standards for the specified gas hearth products in this proposal would significantly reduce energy consumption and are cost-effective and technically feasible. **Table 8-4** through **Table 8-7** summarize the potential energy savings of the proposed standards for gas hearth products. The energy savings include the energy saved from improving a noncompliant product to a compliant product and the effect on the main heating and cooling equipment system. For example, during the heating season, a pilot light makes a minor contribution to heating a room, reducing the load of the main heating equipment. During the cooling season, a pilot light adds heat to the room, increasing the load of the main cooling equipment. Energy savings are further separated into first-year savings and stock savings. First-year savings mean the annual energy reduction associated with annual sales one year after the standards take effect. Annual stock turnover savings mean the annual energy reduction achieved after all existing stock in use complies with the proposed standards. **Appendix A** provides staff's calculations and assumptions used to estimate the first-year savings and the stock change savings.

Incremental Costs

Incremental costs are additional costs the manufacturer imparts on the consumer for modifying a noncompliant product into a compliant product.

Table 8-1 lists incremental cost estimates from the CASE team[142] and U.S. DOE.[143] The CASE team estimates are derived from the average installed costs[144] in U.S. DOE's analysis. The U.S. DOE estimates in **Table 8-1** are derived from the manufacturer production costs in U.S. DOE's analysis, without consideration of installation costs. Installation costs were considered separately in U.S. DOE's analysis.

142 Kido, C., B. Boyce, B. Kundu, L. Nelson, and Energy Solutions. February 28, 2019. *Codes and Standards Enhancement (CASE): Analysis of Standards Proposal for Hearth Products. 41*. Energy Solutions, California Investor-Owned Utilities. Retrieved March 2019.

143 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.

144 U.S. DOE calculated this installed cost using retail markups, sales, taxes, installation costs (including labor), overhead, and miscellaneous materials and parts that were obtained through various sources including RS Means 2013, teardown analysis, and interviews with manufacturers.

Table 8-1: Design Standard Incremental Costs From Other Sources

Gas Hearth Product Type	CASE Team Incremental Cost Estimate (2018$)	U.S. DOE Incremental Cost Estimate (2013$)
Decorative Fireplaces	$100.42	$28
Heating Fireplaces	$100.42	$28
Gas Logs	$162.03	$70
Outdoor Fireplaces	$79.52	$55

Note: CASE Team estimates are for any compliant pilot type. U.S. DOE estimates are for intermittent pilots.

Source: CASE Report 2018, U.S. DOE

Table 8-2 lists the estimated incremental costs for the proposed design standard. These estimates were derived from the manufacturer production costs in U.S. DOE's analysis.[145] The incremental costs for intermittent pilots and intermittent + on-demand pilots include the minimal cost of the electrical energy consumption to function. The incremental cost for on-demand pilots and dual-pilot systems is greater because additional components are needed to support the software programming of these pilot types.[146] In addition, the incremental cost for gas logs and outdoor fireplaces is greater because of the additional material to weatherproof and enclose the pilot system.[147]

Table 8-2: Design Standard Incremental Cost Estimates

	Design Standard Incremental Cost ($/unit)		
Gas Hearth Product Type	Intermittent Pilot	On-Demand Pilot	Intermittent + On-Demand Pilot
Decorative Fireplaces	$30	$37	$37
Heating Fireplaces	$30	$37	$37
Gas Logs	$68	$85	$85
Outdoor Fireplaces	$59	$74	$74

Source: Energy Commission staff calculation

Table 8-3 lists the estimated incremental cost to improve the efficiency of gas heating fireplaces to meet the proposed standard. Both estimates are derived from a confidential NRCan 2018 study. The incremental cost includes a combination of options to improve the efficiency.

145 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.
146 Interview with control system manufacturers, 2018.
147 Ibid.

Table 8-3: Efficiency Standard Incremental Cost Estimates

Gas Hearth Product Type	CASE Team Incremental Cost Estimate (2018$)	Staff Incremental Cost Estimate (2018$)
Heating Fireplaces	$76.97	$84.60

Source: CASE Report 2018, Energy Commission staff calculation

Design Standard Savings

Table 8-4 summarizes the potential savings if the specified gas hearth products complied with the proposed design standard during the first year of implementation and after full stock turnover. After full stock turnover, California would save 1,149,371 MMBtu of gas per year. Using a residential rate of $12.06 per MMBtu of natural gas and $33.63 per MMBtu of propane gas, implementation of the proposed design standard for the specified gas hearth products would achieve an estimated $15 million a year in reduced utility costs after full stock turnover. Heating fireplaces contribute 988,772 MMBtu of gas savings per year and $12.8 million per year in reduced utility costs after full stock turnover. Decorative fireplaces contribute 58,666 MMBtu of gas savings per year and $0.80 million per year in reduced utility costs after full stock turnover. Gas logs (vented and outdoor) contribute 57,213 MMBtu of gas savings per year and $0.70 million savings per year after full stock turnover. Lastly, outdoor fireplaces contribute 44,720 MMBtu of gas savings per year and $0.60 million savings per year after full stock turnover. Detailed energy savings by pilot type are available in **Appendix A**.

Table 8-4: Statewide Design Standard Savings

	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces	Total
2021 Total Energy Use (MMBtu/yr.)	40,923	4,465	2,125	2,985	50,498
2021 Monetary Savings ($M/yr.)	$0.53	$0.22	$0.22	$0.04	$1.01
2035 Total Energy Use (MMBtu/yr.)	988,772	58,666	57,213	44,720	1,149,371
2035 Monetary Savings ($M/yr.)	$12.8	$0.8	$0.7	$0.6	$14.9
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

The proposed design standard prohibits the use of continuous pilots and encourages the use of electric-based pilots. **Table 8-5** estimates the potential savings (positive values) and increase (negative values) of electrical consumption for implementing the proposed design standard. After full stock turnover, California will see an increase of 33,007 kilowatt-hours (kWh) of electricity consumption per year as a result of substituting continuous pilots with intermittent pilots or electric based pilots. Using a residential rate of $0.1853 per kWh of electricity,

implementation of the proposed standards would yield an additional $6,116 a year of utility costs after full stock turnover. Based on a stock of 580,592 units with an intermittent pilot in 2035, this is $0.01 of annual electricity cost per unit.

Table 8-5: Statewide Electrical Consumption Contribution

	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces	Total
2021 Total Energy Use (kWh/yr.)	-789	24	-415	-206	-1,386
2021 Monetary Savings ($/yr.)	-$146	$4	-$77	-$38	-$257
2035 Total Energy Use (kWh/yr.)	-19,065	313	-11,167	-3,088	-33,007
2035 Monetary Savings ($/yr.)	-$3,533	$58	-$2,069	-$572	-$6,116
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Details of the energy savings by intermittent pilot type are available in **Appendix A**.

Efficiency Standard Savings

The potential savings if heating fireplaces complied with the proposed efficiency standard during the first year of implementation and after full stock turnover are listed in **Table 8-6**. California would save 1,279,803 MMBtu of gas per year after full stock turnover in 2035. Using a residential rate of $12.06 per MMBtu of natural gas and $33.63 per MMBtu of propane gas, implementation of the proposed efficiency standard for the heating fireplaces would achieve an estimated $16.5 million a year in reduced utility costs after full stock turnover. The savings are based on the assumption that the main burner operating hours or the duty cycle remains the same under the baseline and compliant scenario for a controlled comparison. A more efficient fireplace can achieve the desired temperature sooner than a less efficient fireplace, which in turn may lower the main burner operating hours. Therefore, additional savings could result from proposed efficiency standard.

Table 8-6: Statewide Efficiency Standard Savings

First-Year Savings - 2021		Stock Turnover Savings - 2035	
Energy Savings (MMBtu/year)	**Savings ($M)**	**Energy Savings (MMBtu/year)**	**Savings ($M)**
27,328	$0.354	1,279,803	$16.5

Source: Energy Commission staff calculation

Total Savings

The total savings for the specified gas hearth products in this proposal are summarized in **Table 8-7**. The total savings are a summation of the total savings as result of implementing the design standards and the efficiency standards, and the additional cost of electricity consumption. California would save 2,429,175 MMBtu of gas per year after full stock turnover, equivalent to about $31.4 million per year in reduced utility costs.

Table 8-7: Total Statewide Savings

	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces	Total
2021 Total Energy Savings (MMBtu/yr.)	68,252	17,058	16,861	2,986	105,157
2021 Total Monetary Savings ($Million/year)	$0.88	$0.22	$0.22	$0.04	$1.36
2035 Total Energy Savings (MMBtu/yr.)	2,268,575	58,667	57,213	44,720	2,429,175
2035 Total Monetary Savings ($Million/year)	$29.31	$0.76	$0.74	$0.58	$31.39
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Life-Cycle Benefits and Costs

The life-cycle benefits and costs of the proposed standards for heating gas fireplaces, decorative gas fireplaces, vented gas logs, outdoor gas logs, and outdoor fireplaces are shown in **Tables 8-8** through **8-10**. Life-cycle costs are based on the estimated incremental costs for improving the proposed standards. The life-cycle benefit represents the savings the consumer should receive over the life of the appliance. Due to the long design life of these products, staff applied a 3 percent discount rate to calculate the net present value of the anticipated savings. The net life-cycle benefits are the differences between the net present value of the savings and the incremental cost of each compliant unit.

Table 8-8 summarizes the energy savings, life-cycle benefits and costs for the proposed design standards. Calculations and other details are available in **Appendix A**. The benefit-to-cost ratio ranges from 1.1 to 19.8, suggesting the proposed design standards are cost-effective

Table 8-8: Design Standard – Life-Cycle Benefit and Costs

Gas Hearth Product Type	Pilot Type	Energy Savings per Unit (Btu/year)	Lifecycle Cost ($/unit)	Net Lifecycle Benefit ($/unit)	Lifecycle Benefit/Cost Ratio
Heating Fireplaces	Intermittent Pilot	4,312,333	$30	$591	19.8
	On-Demand Pilot	1,717,986	$37	$210	5.6
	Intermittent + On-Demand Pilot	1,569,241	$37	$189	5.0
Decorative Fireplaces	Intermittent Pilot	3,972,687	$30	$542	18.2
	On-Demand Pilot	2,413,814	$37	$310	8.3
	Intermittent + On-Demand Pilot	2,326,426	$37	$298	8.0
Gas Logs†	Intermittent Pilot	2,541,222	$37	$329	8.8
	On-Demand Pilot	1,323,178	$85	$106	1.2
	Intermittent + On-Demand Pilot	1,229,136	$85	$92	1.1
Outdoor Fireplaces	Intermittent Pilot	1,891,903	$59	$213	3.6
	On-Demand Pilot	1,160,913	$74	$93	1.3
	Intermittent + On-Demand Pilot	1,114,920	$74	$86	1.2
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Table 8-9 summarizes the energy savings, life-cycle costs, and life-cycle benefits for a scenario in which a heating fireplace with a noncompliant pilot type and a noncompliant fireplace efficiency is improved to meet the proposed efficiency and design standards. The life-cycle costs include the cost to substitute a compliant pilot for a noncompliant pilot and to improve the efficiency of the unit. The benefit-to-cost ratio ranges from 2.4 to 6.1, suggesting the proposed design and efficiency standards for heating fireplaces are cost-effective.

Table 8-9: Efficiency Standard – Life-Cycle Benefits and Costs – Scenario 1

Pilot Type	Energy Savings per Unit (Btu/year)	Lifecycle Cost ($/unit)	Net Life-Cycle Benefit ($/unit)	Life-Cycle Benefit/Cost Ratio
Intermittent Pilot	5,620,377	$115	$695	6.1
On-Demand Pilot	3,026,029	$122	$314	2.6
Intermittent + On-Demand Pilot	2,877,285	$122	$292	2.4

Source: Energy Commission staff calculation

Table 8-10 summarizes the energy savings, life-cycle costs, and life-cycle benefits for a scenario in which a heating fireplace with a compliant pilot type but with a noncompliant fireplace efficiency is improved to meet the proposed efficiency standards. The benefit-to-cost ratio is 1.2, suggesting the proposed efficiency standard for heating fireplaces is cost-effective.

Table 8-10: Efficiency Standard – Life-Cycle Benefits and Costs – Scenario 2

Energy Savings per Unit (Btu/year)	Life-Cycle Cost ($/unit)	Net Lifecycle Benefit ($/unit)	Lifecycle Benefit/Cost Ratio
1,308,043	$85	$104	1.2

Source: Energy Commission staff calculation

CHAPTER 9: Environmental Impacts

Greenhouse Gas Emissions

Natural gas is considered a clean-burning fossil fuel energy source compared to other fossil fuels such as coal and oil. However, natural gas is composed of mostly methane, a gas that directly contributes to the greenhouse gas effect and is 25 times more potent than carbon dioxide (the largest greenhouse gas contributor).[148] An inefficient gas hearth product can emit methane through incomplete combustion or from direct leakage.[149] Complete combustion of natural gas produces pollutants such as carbon dioxide (CO_2), carbon monoxide, nitrogen oxides, and particulate matter. In vented gas hearth products, these combustion products are exhausted to the outside air, potentially contributing to the ozone at the ground level.[150,151] Efficient gas hearth products with built-in technology that reduces wasteful usage will result in less energy use and reduce unnecessary gas burning.[152]

Staff estimates that the proposed standards will result in a reduction of 5,619 metric tons of CO_2 in the first year the standards are in effect and 129,721 metric tons of CO_2 after full stock turnover. Staff's calculations and assumptions used to estimate avoided emissions are in **Appendix A**.

The proposed standards will lead to improved environmental quality in California through reduction of fuel consumption, resulting in fewer emissions of greenhouse gases and criteria pollutants.

Materials

Intermittent pilots rely on an electrical power source to start the ignition process. In the case of a power outage, most gas hearth products with an intermittent pilot system will also include a battery backup power system to ignite the pilot. A battery backup power system may require the use of two D batteries or four AA batteries.[153,154] In California, all batteries are considered

148 U.S. Environmental Protection Agency. October 31, 2018. "Overview of Greenhouse Gases." Retrieved 2018 from https://www.epa.gov/ghgemissions/overview-greenhouse-gases.
149 Houck, J. September 2014. "Gas: Heart of the Hearth." *Hearth & Home Magazine.* Retrieved 2018 from http://hearthandhome.com/magazine/2015-09-22/gas:_heart_of_the_hearth.html.
150 Natural Resources Canada. March 2004. "All About Gas Fireplaces." Canada. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/all_about_gas_fireplaces.pdf.
151 U.S. Environmental Protection Agency. January 1995. *1.4 Natural Gas Combustion. AP-42 Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, 5th.* Research Triangle Park, North Carolina.
152 Natural Resources Canada. 2018. Energy Efficiency Ratings: Search for Gas Fireplaces. Canada. Retrieved October 2018, from http://oee.nrcan.gc.ca/pml-lmp/index.cfm?action=app.search-recherche&appliance=FIREPLACE_G.
153 Interview with control system manufacturers, 2018.
154 Owner manuals from Heatilator, Napoleon, Valor, and Montigo.

hazardous waste because of the metals or toxic corrosive materials contained within them and must be recycled or disposed of properly to prevent any harm to the environment.[155] Single-use batteries such as alkaline batteries have a shelf life of about 10 years while in storage.[156,157] If the unit is being powered by a permanent electrical power source and the batteries are installed, the batteries lose a small amount of charge over time, resulting in a life span less than 10 years. Assuming the batteries are replaced every five years to ensure they are at near to full charge during a power outage, it is possible to use six D batteries or 12 AA batteries over the 15-year life span of the unit. Rechargeable batteries are available and generate less waste than single-use batteries. In addition, manufacturers do recommend removing the batteries while using a permanent electrical power source to prolong battery life.[158] It is also recommended to remove batteries from the unit if it will be left unused for months at a time to prevent discharge and leakage. Most Californians have ready access to household hazardous waste disposal centers for batteries through their municipality or a large retailer.[159,160,161,162,163]

Gas hearth products are generally replaced at the end of the useful lives. Replacement with more efficient gas hearth products would not present an additional impact to the environment beyond the natural cycle. Staff has not identified any additional potential adverse environmental impacts from the proposed regulations.

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155 California Department of Resources Recycling and Recovery. (2019). Batteries. Retrieved from the California Department of Resources Recycling and Recovery (CalRecycle): https://www.calrecycle.ca.gov/reducewaste/batteries.
156 Duracell Inc. 2019. "Coppertop Battery." Retrieved from Duracell: https://www.duracell.com/en-us/product/coppertop-battery.
157 Energizer. 2019. "Energizer Max Alkaline Batteries." Retrieved from Energizer: https://www.energizer.com/batteries/energizer-max-alkaline-batteries?pstrack=G-HHB-PureBrand-Br&gclid=Cj0KCQiAn4PkBRCDARIsAGHmH3fLkjRZ_ho5mVxXSRbEQ7JSbTv7yzFne8vhlZYCAaaWEYmtRcmyQLwaAtfwEALw_wcB.
158 Hearth and Home Tech product owner manuals.
159 City of Sacramento. 2018. "Household Battery and Fluorescent Lamp Recycling." Retrieved from City of Sacramento: http://www.cityofsacramento.org/public-works/RSW/Collection-Services/Household-Hazardous-Waste/Batteries
160 Public Works Los Angeles County. 2019. "Battery Disposal." Retrieved from Public Works Los Angeles County: http://ladpw.org/epd/hhw/Batteries
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162 Inter IKEA Systems B.V. 2019. "Electrical Recycling." Retrieved from IKEA: https://www.ikea.com/gb/en/customer-service/services-at-ikea/removal-recycling/electrical-recycling/.
163 Home Depot Product Authority, LLC. (2019). "CALL2RECYCLE: THE HOME DEPOT RECYCLES TEN MILLION POUNDS OF RECHARGEABLE BATTERIES.: Retrieved from Corporate Home Depot: https://corporate.homedepot.com/newsroom/call2recycle-home-depot-recycles-ten-million-pounds-rechargeable-batteries.

CHAPTER 10:
Regulatory Language

Proposed new language appears as underline (example) and proposed deletions appear as strikeout (~~example~~). Existing language appears as plain text. Three dots or "…" represents the substance of the regulations that exists between the proposed language and current language.

§ 1601. Scope.

This Article applies to the following types of new appliances, if they are sold or offered for sale in California, except those sold wholesale in California for final retail sale outside the state and those designed and sold exclusively for use in recreational vehicles, or other mobile equipment. Unless otherwise specified, each provision applies only to units manufactured on or after the effective date of the provision.

NOTE: For the applicability of these regulations to appliances installed in new building construction, see sections 110.0 and 110.1 of part 6 of Title 24 of the California Code of Regulations

…[skipping (a) through (d)]

(e) Vented gas space heaters and vented oil space heaters, vented and unvented infrared gas space heaters, electric residential boilers, and gas-fired combination space-heating and water-heating appliances~~.~~, and gas hearth products.

NOTE: See Health and Safety Code section 19881 for restrictions on the sale of unvented ~~gas space~~ heaters ~~and unvented oil space heaters~~.

…[skipping (f) through (w)

§ 1602. Definitions.

…[skipping (a) through (d)]

(e) Gas and Oil Space Heaters, ~~and~~ Electric Residential Boilers~~.~~, and Gas Hearth Products

...[skipping "Annual fuel utilization efficiency (AFUE)" through "Automatic vent damper"]

"Automatic shut-off device" for a gas hearth product means a device that automatically extinguishes the main gas burner flame if, in a 24-hour period,

(1) A person has not used the product controls to adjust the flame height or appearance; or

(2) The product has not received a signal indicating the presence of occupants in the room in which it is installed.

…[skipping "Basic model"]

"Battery powered system" means a control system within a gas hearth product that is equipped to operate under a battery powered source when a direct electrical power source is not available.

…[skipping "Boiler" through "Condensing Boiler"]

"Continuous pilot" for a gas hearth product means a pilot that, once placed in operation, remains ignited continuously until it is manually interrupted.

"Decorative gas fireplace" means a gas fireplace that is not equipped with a thermostat, and presents a flame pattern primarily for aesthetic effects. Does not function as a primary or supplementary heat source.

"Direct ignition" for a gas hearth product means an ignition system with no pilot and the main burner is ignited directly.

…[skipping "Direct vent system" through "Fan type gas space heater"]

"Fireplace efficiency (FE)" means the fireplace efficiency rating of a decorative gas fireplace and a heating gas fireplace as determined in CSA P.4.1-2015.

…[skipping "Floor furnace" through "Floor-mounted unit heater"]

"Gas fireplace" means a gas hearth product designed to be installed permanently to a fixed-gas supply system, consisting of a fire chamber constructed of noncombustible material in which a fire may be made and a gas-fueled burner system that simulates the flame pattern of a solid-fueled fireplace.

"Gas hearth product" means a gas-fueled 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.

"Gas log" means a self-contained, gas hearth product designed to be installed permanently to a fixed-gas supply system, consisting of a metal frame or base supporting simulated logs, but not limited to other noncombustible media, and a gas-fueled burner system that simulates a solid-fuel fireplace.

…[skipping "Gravity type gas space heater"]

"Heating gas fireplace" means a gas fireplace that presents a flame pattern for aesthetic effects and is designed to provide space heating directly towards the space in which it is installed. Functions as a primary or supplementary heat source.

…[skipping "High intensity infrared heater" through "Infrared gas space heater"]

"Insert" means a type of gas fireplace that is designed to be fully or partially installed in an existing solid-fueled fireplace.

"Intermittent pilot" for a gas hearth product means a pilot 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.

"Intermittent and on-demand combination pilot" means a gas hearth product equipped with an intermittent pilot and an on-demand pilot where the pilot system that can be switched to an on-demand pilot from an intermittent pilot, and vice-versa.

"Interrupted pilot" for a gas hearth product means a pilot that is automatically ignited when an appliance is called on to operate and is automatically extinguished after the main burner operation has been initiated.

…[skipping "Low intensity infrared heater" through "Low static unit heater"]

"Maximum rated input capacity" for a gas hearth product means the maximum input capacity, in Btu/hr., as it appears on the nameplate of the product.

"Minimum rated input capacity" for a gas hearth product means the minimum input capacity, in Btu/hr., as it appears on the nameplate of the product.

…[skipping "Mobile home furnace" through "Non-packaged boiler"]

"On-demand pilot" for a gas hearth product means a pilot that, once placed into operation, remains 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.

…[skipping "Outdoor duct furnace" through "Outdoor furnace or boiler"]

"Outdoor gas hearth product" means a gas hearth product designed for installation in outdoor spaces only.

…[skipping "Output" through "Steam boiler"]

"Stove" means a type of gas fireplace designed to be installed within a distance away from combustible construction.

…[skipping "Thermal efficiency" through "Vented floor furnace"]

"Vented gas hearth product" means a gas hearth product that is designed and installed in such a manner that the products of combustion are conveyed directly from the appliance to the outside atmosphere through a chimney or vent system.

…[skipping "Vented gas space heater" through "Water boiler"]

"Zero-clearance fireplace" means a type of gas fireplace designed to be installed within combustible construction where the sides, back and top of the appliance may come in contact with that construction.

…[skipping through (w)]

The following documents are incorporated by reference in Section 1602.

Number	*Title*

…[skipping FEDERAL STATUTES AND REGULATIONS through ASSOCIATION OF HOME APPLIANCES MANUFACTURERS (AHAM)]

CANADIAN STANDARDS ASSOCIATION (CSA)

CSA C390-10	Test methods, marking requirements, and energy efficiency levels for three-phase induction motors
CSA P.4.1 – 2015	Testing method for measuring annual fireplace efficiency
Copies available from:	Canadian Standards Association 178 Rexdale Blvd. Toronto, Ontario, Canada, M9W 1R3 Phone: (416) 747-4044 http://shop.csa.ca/

§ 1604. Test Methods for Specific Appliances.

…[skipping (a) through (d)]

(e) Gas and Oil Space Heaters, ~~and~~ Electric Residential Boilers~~.~~, and Gas Hearth Products.

…[skipping (1) through (3)]

(4) Gas Hearth Products.

(A) The test method for vented gas hearth products is shown in Table E-2 and with the following modifications:

1. For vented hearth products listed in Table E-2 with an intermittent and on-demand combination pilot, the energy input rate (Q_D) shall be determined as specified in Section 5.7(d) of CSA P.4.1. – 2015.

2. For vented hearth products listed in Table E-2 with an interrupted pilot, the energy input rate (Q_D) shall be determined as specified in Section 5.7(e) of CSA P.4.1. – 2015.

3. In Section 6.14.2 of CSA P.4.1 – 2015, $T_{F,SS,H}$ and $T_{F,SS,R}$ are defined as the flue gas temperature (˚C or ˚F) at steady state measured at a maximum input rate and flue

gas temperature (°C or °F) at steady state measured at reduced input rate, respectively.

Table E-2

Vented Gas Hearth Product Test Methods

Appliance	**Test Method**
Decorative Gas Fireplaces	CSA P.4.1 - 2015
Heating Gas Fireplaces	

(B) Test lab report requirements for vented gas hearth products. For decorative gas fireplaces and heating gas fireplaces manufactured on or after January 1, 2021, test lab reports shall include: date of test, requirements in section 1606 Table X, applicable inputs defined in section 3.2 of CSA P.4.1-2015 used to determine the fireplace efficiency as specified in section 6 of CSA P.4.1-2015, type of media used during testing, and a description of unit characteristics that establish specific testing conditions according to CSA P.4.1-2015.

…[skipping rest of (f) through (w)]

The following documents are incorporated by reference in Section 1604.

Number	*Title*

…[skipping CALIFORNIA ENERGY COMMISSION TEST METHODS through THE ASSOCIATION OF POOL AND SPA PROFESSIONALS (APSP)]

CANADIAN STANDARDS ASSOCIATION (CSA)

CSA B45.1-2013	Ceramic Plumbing Fixtures
CSA P.4.1 – 2015	Testing method for measuring annual fireplace efficiency
Copies available from:	Canadian Standards Association 178 Rexdale Blvd. Toronto, Ontario, Canada, M9W 1R3 Phone: (416) 747-4044 http:/shop.csa.ca/

…[skipping to the end of section 1604]

§ 1605.1. Federal and State Standards for Federally-Regulated Appliances.

…[skipping (a) through (d)]

(e) Gas and Oil Space Heaters ~~and~~, Electric Residential Boilers~~.~~, and Gas Hearth Products.

…[skipping (1) through (5)]

(6) Gas Hearth Products. See section 1605.3(e) of this Article for energy efficiency and energy design standards for gas hearth products.

...[skipping to the end of section 1605.1]

§ 1605.2. State Standards for Federally-Regulated Appliances.

…[skipping (a) through (d)]

(e) Gas and Oil Space Heaters ~~and~~, Electric Residential Boilers~~.~~, and Gas Hearth Products.

…[skipping (1) through (2)]

(3) Gas Hearth Products. See section 1605.3(e) of this Article for energy efficiency and energy design standards for gas hearth products.

§ 1605.3. State Standards for Non-Federally-Regulated Appliances.

…[skipping (a) through (d)]

(e) Gas and Oil Space Heaters ~~and~~, Electric Residential Boilers~~.~~, and Gas Hearth Products.

…[skipping (1) through (4)]

(5) Gas Hearth Products. Gas hearth products shall meet the standards shown in Table E-10.

Table E-10

Standards for Gas Hearth Products

Appliance		**Minimum FE %**	**Design Standards**		
Vented Gas Hearth Products Manufactured on or After January 1, 2021	Gas Logs	-	-	For units equipped with an on-demand pilot or an on-demand pilot in combination with another pilot type, the on-demand pilot shall be timed for a maximum of seven days.	Shall not be equipped with a continuous pilot or equipped with a continuous pilot in combination with another pilot type.
	Decorative Gas Fireplaces	-	Shall be equipped with an automatic shut-off device with a time limit no greater than 24 hours.		
	Heating Gas Fireplaces	FE ≥ 70	-		
Outdoor Gas Hearth Products Manufactured on or After January 1, 2021.	Gas Logs	-	-		
	Gas Fireplaces	-	-		

…[skipping to the end of section 1605.3]

§ 1606. Filing by Manufacturers; Listing of Appliances in Database.

(a) Filing of Statements.

…[skipping first paragraph through (3)]

Table X

Data Submittal Requirements

	Appliance	*Required Information*	*Permissible Answers*
	All Appliances	*Manufacturer's Name	
		*Brand Name	
		*Model Number	
		Date model to be displayed	
		Regulatory Status	Federally-regulated consumer product, federally-regulated commercial and industrial equipment, non-federally-regulated

…[skipping *Non-Commercial Refrigerators, Non-Commercial Refrigerator-Freezers Non – Commercial Freezers* through *Boilers*]

E	Gas Hearth Products Manufactured on or After January 1, 2021	*Type	Vented Gas Hearth Product, Outdoor Gas Hearth Product
		*Energy Source	Natural gas, LPG, Natural Gas and LPG
		Pilot Type	Direct Ignition, Intermittent, Interrupted, Intermittent and On-demand combination, On-demand
		Outdoor Gas Hearth Product Type (for outdoor gas hearth products only)	Gas Fireplace, Gas Log
		Vented Gas Hearth Product Type (for vented gas hearth products only)	Decorative Gas Fireplace, Heating Gas Fireplace, Gas Log
		Gas Fireplace Type (for heating gas fireplaces only)	Insert, Stove, Zero-clearance Fireplace
		Natural Gas Fireplace Efficiency (%) (for natural gas: decorative gas fireplaces, heating gas fireplaces only)	

		LPG Fireplace Efficiency (%) (for LPG: decorative gas fireplaces, heating gas fireplaces only)	
		On-Demand Pilot Time Limit (days) (for on-demand pilot type, intermittent and on-demand combination pilot type only)	
		Equipped With an Automatic Shut-Off Device (mandatory for decorative gas fireplaces only, voluntary for other gas hearth product types)	True, False
		Automatic Shut-Off Device Time Limit (hours) (mandatory for decorative gas fireplaces only, voluntary for other gas hearth product types)	
		Natural Gas Minimum Rated Input Capacity (Btu/hr) (for natural gas models)	
		Natural Gas Maximum Rated Input Capacity (Btu/hr) (for natural gas models)	
		LPG Minimum Rated Input Capacity (Btu/hr) (for LPG models)	
		LPG Maximum Rated Input Capacity (Btu/hr) (for LPG models)	
		Equipped With an Automatic Flue Damper (for decorative gas fireplaces, heating gas fireplaces only)	True, False
		Equipped With a Thermostat	True, False
		Equipped With a Fan (for decorative gas fireplaces, heating gas fireplaces only)	True, False
		Battery Powered System	True, False

* "Identifier" information as described in Section 1602(a) of this Article.
1 = Voluntary for federally regulated appliances
2 = Voluntary for state-regulated appliances

…[skipping to the end of section 1606]

§ 1607. Marking of Appliances.

…[skipping (a) through (c)]

(d) Energy Performance Information.

…[skipping (1) through (14)]

(15) Vented Gas Hearth Products. Decorative gas fireplaces manufactured on or after January 1, 2021, shall be marked, permanently and legibly on an accessible and conspicuous place on the unit, on product market literature, and on the cover page of the instructions, "Vented decorative gas appliance: not a source of heat."

…[skipping to end of section 1607]

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APPENDIX A:
Staff Assumptions and Calculation Methods

Appendix A discusses the information and calculations used to characterize gas hearth products in California, the current energy use, and potential savings. The source of much of this information is the U.S. Department of Energy's (U.S. DOE) hearth products rulemaking documents, interviews of manufacturers, and literature and publications from NRCan; the Ministry of Energy, Mines and Petroleum Resources of British Columbia; trade organizations; and industry.

Assumptions

All calculations were based on the assumption of an effective date of January 1, 2021. **Table A-1** summarizes the values and assumptions used to estimate energy consumption and potential savings for this analysis. Where specific data were not available for California, staff estimated data for California by correlating data from national, Western Region,[164] Pacific Division,[165] and other known California data sources. Furthermore, the scope of this analysis is for vented decorative gas fireplaces, vented heating gas fireplaces, vented gas logs, outdoor gas logs, and outdoor fireplaces. Therefore, vented decorative gas fireplaces will be known as decorative fireplaces, and vented heating gas fireplaces will be known as heating fireplaces throughout this analysis, unless noted otherwise. Lastly, manufacturers have indicated interrupted pilots do not exist in the market for residential and commercial establishments within the services industry; thus, interrupted pilots are not included in this analysis.

164 Western Region: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.
165 Pacific Division: Alaska, California, Hawaii, Oregon, and Washington.

Table A-1: Summary of Values and Assumptions

Value	Description	Source
15.1%	Average percentage of fireplaces[a] in existing California homes	Residential Energy Consumption Survey for 2001, 2005, 2009, 2015 U.S. Energy Information Administration
5%	Percentage of commercial fireplace market	Staff estimate
32.2%	Average percentage of gas fireplaces in existing homes with fireplaces in California	Residential Energy Consumption Survey for 2001, 2005, 2009, 2015 U.S. Energy Information Administration
96%	Percentage of natural gas-fueled fireplaces with respect to total gas fireplaces in California	Residential Energy Consumption Survey for 2001, 2005, 2009, 2015 U.S. Energy Information Administration
4%	Percentage of propane-fueled fireplaces with respect to total gas fireplaces in California	Residential Energy Consumption Survey for 2001, 2005, 2009, 2015 U.S. Energy Information Administration
90%	Average percentage of vented gas fireplaces in California	Residential Energy Consumption Survey for 2001, 2005, 2009, 2015 U.S. Energy Information Administration
6%	Average percentage of gas fireplaces in California that are used as main space-heating equipment	Residential Energy Consumption Survey for 2001, 2005, 2009 U.S. Energy Information Administration
94%	Average percentage of gas fireplaces in California that are used as a secondary space heating equipment	Residential Energy Consumption Survey for 2001, 2005, 2009 U.S. Energy Information Administration
0.1853 $/kWh	Average Residential Retail Price in California for Electricity	U.S. Energy Information Administration, Retrieved June 2018
12.06 $/MMBtu	Average Price of Natural Gas Delivered to Residential Consumers in California	U.S. Energy Information Administration, Retrieved June 2018
33.63 $/MMBtu	Average Retail Price of Propane in the West Coast	Alternative Fuel Report April 2018 U.S. Department of Energy
0.0053 metric tons CO_2/therm	Carbon dioxide emissions per therm of natural gas	U.S. Environmental Protection Agency, Retrieved April 2019
139.05 pounds CO_2/MMBtu	Carbon dioxide emissions per million Btu of propane	U.S. Energy Information Administration, Retrieved April 2019
[a] The term “fireplaces” is assumed to include all indoor fireplace types and fuel types		

Source: California Energy Commission

Sample calculations may be different from results listed in tables and actual values due to rounding.

Design Life

The design life is an estimate of the length of the typical operation usefulness of a product. A gas hearth product has an average lifetime of 15 years.[166]

Market Characterization

Staff used the NRCan database of gas fireplaces to assess the California market for heating and decorative gas fireplaces.[167] Because the models in the NRCan database represent the Canadian market and not the Californian market, staff verified these models are available in California through supplemental research and data received from manufacturers of hearth products. The data received from manufacturers were under a confidentiality agreement for this analysis. The provided data were used solely to confirm models in the NRCan database are available for sale in California. The supplemental research conducted by staff included surveying more than 80 retail stores, as of October 2018, of hearth products across California and collecting basic information of each model sold by the retail store to confirm the models in the NRCan database are available for sale in California. Models that were unverifiable were not included in this analysis. Data collected from retail stores in California supplemented staff's analysis to determine the California market for gas logs and outdoor gas fireplaces.

Staff determined the number of basic models and unique models for the models available in the Californian market (**Table A-2**.) Models with the same manufacturer, pilot type, fuel type, configuration, and venting were set as a basic model. Basic models with different input capacities or different fireplace efficiency ratings or both were set as a unique model. The distribution of basic models was applied to determine the stock distribution and compliance rates of the proposed prescriptive standards. Staff used unique models for heating gas fireplaces to determine compliancy rates for the proposed performance standard.

166 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.

167 Natural Resources Canada. 2018. "Energy Efficiency Ratings: Search for Gas Fireplaces." Canada. Retrieved October 2018 from http://oee.nrcan.gc.ca/pml-lmp/index.cfm?action=app.search-recherche&appliance=FIREPLACE_G.

Table A-2: Basic Model and Unique Model Distribution

Gas Hearth Product Type	Basic Models		Unique Models	
	Number	Percentage*	Number	Percentage*
Gas Logs - Vented	35	7%	108	10%
Decorative Fireplaces - Vented	31	6%	80	7%
Heating Fireplaces - Vented	354	73%	815	73%
Outdoor Gas Logs	16	3%	38	3%
Outdoor Fireplaces	48	10%	82	7%
Total	484	100%	1,123	100%

*Percentages are rounded.

Source: NRCan Gas Fireplace Database, California Energy Commission

Table A-3 lists the estimated distribution of pilot types for each gas hearth product. The distribution was derived using basic models and adjusted with information from U.S. DOE's hearth products rulemaking documents[168] and information provided through manufacturer interviews. In addition, this distribution is for natural gas- and propane-fueled hearth products.

Table A-3: Pilot Type Distribution of Gas Hearth Products

Pilot Type	Heating Fireplaces*	Decorative Fireplaces*	Gas Logs*	Outdoor Fireplaces*
Continuous	26%	5%	45%	21%
Intermittent + Continuous	37%	27%	4%	8%
Intermittent	19%	45%	15%	32%
Intermittent + On-Demand	4%	3%	0	1%
On-Demand	10%	15%	0	6%
Direct Ignition	5%	5%	36%	33%

*Percentages are rounded.

Source: Energy Commission staff calculation

168 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.

Stock and Sales

Staff first modeled total housing units from 2000 to 2040 in California based on historical data. **Table A-4** lists all sources of housing data to estimate housing units in California.

Table A-4: Data Sources for Housing Units

Description	Source
Housing Starts Forecast for the United States	U.S. Energy Information Administration. (February 2018). Annual Energy Outlook 2018. Table 20. Macroeconomic Indicators. Retrieved from https://www.eia.gov/outlooks/aeo/tables_ref.php
Housing Units Completed for the United States. Period: 2000 to 2018	U.S. Census Bureau. (December 20, 2018). New Residential Construction - Historical Data. Retrieved July 24, 2018, from https://www.census.gov/construction/nrc/historical_data/index.html
Housing Units Started for United States. Period: 2000 to 2018	U.S. Census Bureau. (December 2, 2018). New Residential Construction - Historical Data. Retrieved July 24, 2018, from https://www.census.gov/construction/nrc/historical_data/index.html
Total Housing Inventory for the United States	U.S. Census Bureau. (February 27, 2018). Housing Vacancies and Homeownership. Table 7a. Estimates of the Total Housing Inventory for the United States: 2000 to Present. Retrieved from https://www.census.gov/housing/hvs/data/histtabs.html
Total Housing Units for the United States and California	Annual Estimates of Housing Units for the United States, Regions, Divisions, States, and Counties: April 1, 2010 to July 1, 2017. Source: U.S. Census Bureau, Population Division. Release Date: May 2018. Retrieved from https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml
Total Housing Units for the United States and California	U.S. Census Bureau, 2007-2016 American Community Survey
Housing Units for the United States, Pacific Division, and California. Period: 2001, 2005, 2009, and 2015	U.S. Energy Information Administration. (2001, 2005, 2009, 2015). Residential Energy Consumption Survey (RECS). Retrieved 2018, from https://www.eia.gov/consumption/residential/index.php

Source: California Energy Commission

Using housing characteristic surveys with information relative to fireplaces and correlating this information with the estimate of total housing units, staff estimated existing stock of fireplaces in California from 2000 to 2040. **Table A-5** lists the sources of housing characteristic data used to estimate fireplaces in California.

Table A-5: Data Sources for Housing Characteristics

Data Description	Source
Fireplaces in completed single-family units from 2000 to 2017 in the Western Region	U.S. Census Bureau. (2018). Characteristics of New Single-Family Houses Completed - Fireplaces. Retrieved 2018, from https://www.census.gov/construction/chars/completed.html
Fireplaces in completed multifamily units from 2000 to 2017 in the Western Region	U.S. Census Bureau. (2018). Characteristics of Units in New Multifamily Buildings Completed - Fireplaces. Retrieved 2018, from https://www.census.gov/construction/chars/mfu.html
Main space heating equipment and secondary heating equipment from 2001, 2005, 2009, and 2015[a] in California and in the United States	U.S. Energy Information Administration. (2001, 2005, 2009, 2015). Residential Energy Consumption Survey (RECS). Retrieved 2018, from https://www.eia.gov/consumption/residential/index.php
Main heating equipment and other heating equipment in housing units in the United States in 2011 and 2013	U.S. Census Bureau. (2011, 2013). American Housing Survey. Retrieved 2018, from https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml
Usable fireplaces in housing units in the United States in 2011 and 2013	U.S. Census Bureau. (2011, 2013). American Housing Survey. Retrieved 2018, from https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml
[a] RECS 2015 did not include estimates for California.	

Source: California Energy Commission

After estimating total housing units in California, staff estimated the number of fireplaces installed in homes while considering the number of fireplaces installed in new completed homes. According to RECS, about 15 percent of homes in California have fireplaces, and of those fireplaces, about 32 percent are gas-fueled.[169] In addition, 90 percent of Californian homes with gas-fueled fireplaces are vented.[170] **Table A-6** lists the estimated stock of total fireplaces (for example, all fuel, venting, and configuration types), total gas-fueled fireplaces (that is, all venting and configuration types), and total vented gas fireplaces (all configuration types) in California. The year 2021 signifies the proposed effective date, and 2035 signifies the year when the stock turns over.

169 U.S. Energy Information Administration. (2001, 2005, 2009, 2015). "Residential Energy Consumption Survey (RECS)." Retrieved 2018 from https://www.eia.gov/consumption/residential/index.php.
170 U.S. Energy Information Administration. (2001, 2005, 2009, 2015). "Residential Energy Consumption Survey (RECS)." Retrieved 2018 from https://www.eia.gov/consumption/residential/index.php.

Table A-6: California Stock of Indoor Fireplaces

Year	Total Fireplaces	Total Gas Fireplaces	Total Vented Gas Fireplaces
2021	2,344,300	755,393	676,207
2035	2,664,965	858,719	768,702

Source: Energy Commission staff calculation

Staff estimated the stock of outdoor fireplaces and outdoor gas logs based on the basic model distribution in **Table A-2**. **Table A-7** lists the estimated stock for gas-fueled outdoor fireplaces and outdoor gas logs in California.

Table A-7: California Stock of Outdoor Fireplaces and Outdoor Gas Logs

Year	Outdoor Fireplaces	Outdoor Gas Logs
2021	77,281	25,760
2035	87,852	29,284

Source: Energy Commission staff calculation

Staff also estimates 5 percent of the market is commercial, specifically from the hotel and lodging industry and the restaurant industry. This estimate is factored in the stock estimates presented in **Table A-6** and **Table A-7**.

The estimated stock in **Table A-5** was further sorted by gas hearth product based on the basic model distribution presented in **Table A-2**. Of the gas-fueled fireplaces, 96 percent are natural gas-fueled, and the remaining 4 percent are propane-fueled.[171] Through discussions with manufacturers, this estimate aligns with product sales in California. **Table A-8** shows the estimated annual stock for each gas hearth product by fuel type.

171 U.S. Energy Information Administration. (2001, 2005, 2009, 2015). "Residential Energy Consumption Survey (RECS)." Retrieved 2018 from https://www.eia.gov/consumption/residential/index.php.

Table A-8: Estimated Annual Stock for Gas Hearth Products

Fuel Type	Year	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces	Total
Natural Gas	2021	545,866	47,802	78,642	74,016	746,326
	2035	620,532	54,340	89,399	84,140	848,411
Propane	2021	24,080	2,109	3,469	3,265	32,923
	2035	27,374	2,397	3,944	3,712	37,427
†Stock for gas logs includes vented and outdoor types.						

Source: Energy Commission staff calculation

Table A-9 shows the estimated annual sales for each gas hearth product by fuel type. Annual sales were estimated by applying a 6.7 percent sales rate (1/15), based on the design life of 15 years, to the total stock in **Table A-8**.

Table A-9: Estimated Annual Sales for Gas Hearth Products

Fuel Type	Year	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces	Total
Natural Gas	2021	36,391	3,187	5,243	4,934	49,755
	2035	41,369	3,623	5,960	5,609	56,561
Propane	2021	1,605	141	231	218	2,195
	2035	1,825	160	263	247	2,495
†Stock for gas logs includes vented and outdoor types.						

Source: Energy Commission staff calculation

Table A-8 is further sorted by pilot type based on the pilot type distribution in **Table A-3**. For example, **Table A-10** lists the stock of natural gas hearth products by pilot type for the baseline scenario in 2021. The same method was applied for the full-stock turnover year, 2035. Complete stock tables of baseline and compliant scenarios for 2021 and 2035 are available in **Appendix C**.

Table A-10: Baseline First-Year Stock of Natural Gas Hearth Products by Pilot Type

Pilot Type	Fireplace Heater	Decorative Fireplace	Gas Logs†	Outdoor Fireplaces
Continuous Pilot	140,552	2,396	34,701	15,420
Intermittent Pilot	103,297	21,565	3,253	23,644
On-Demand Pilot	54,189	7,188	553	4,112
Intermittent + On-Demand Pilot	22,183	1,438	11,929	617
Intermittent + Continuous Pilot	199,651	12,939	553	5,551
Direct Ignition	25,994	2,276	27,653	24,672
Total	**545,866**	**47,802**	**78,642**	**74,016**
†Stock for gas logs includes vented and outdoor types.				

Source: Energy Commission staff calculation

From this point forward, vented gas logs and outdoor gas logs will be combined and known as "gas logs," unless noted otherwise.

Duty Cycle

The duty cycle of an appliance is an estimate of consumer behavior for that particular appliance. It is directly tied to how often the appliance is used and for how long. In the context of this report, the duty cycle is a combination of the usage of the main burner and the pilot light.

Main Burner Operating Hours

Annual operating hours of the main burner or active use of the appliance is based on usage and application. A homeowner who uses the gas hearth product for heating is more likely to use it longer and more regularly. A study from Lawrence Berkeley National Lab (LBNL) on hearth products in the United States reports a positive correlation between main burner operating hours (MBOH) and application.[172] **Table A-11** lists the MBOH estimates from the LBNL study.

172 Siap, D., H. Willem, S. Price, H-C Yang, and A. Lekov. June 2017. *Survey of Hearth Products in U.S. Homes.* LBNL-2001030, 93. Berkeley, California, U.S.A: Lawrence Berkeley National Laboratory. Retrieved 2018.

Table A-11: Estimate of Main Burner Operating Hours From LBNL Study

Application	Main Burner Operating Hours
Only for heat	382
Mostly heat	214
About evenly for heat and decorative	195
Mostly decorative	61
Only decorative	17

Source: Siap, Willem, Price, Yang, & Lekov, 2017

The REC surveys categorized fireplaces as either main space-heating equipment or secondary space-heating equipment.[173] **Table A-12** shows the average percentage of the gas-fueled fireplaces in California that were categorized as main space heating equipment or as secondary space-heating equipment.

Table A-12: Application of Gas-Fueled Fireplaces in California

Space-Heating Equipment Purpose	Average Percentage
Main	6%
Secondary	94%

Source: RECS 2001, 2005, 2009

The REC surveys also questioned homeowners of their usage of gas-fueled fireplaces that are used as a secondary source of space heating. **Table A-13** lists average usage from homeowners in California.

Table A-13: Secondary Space-Heating Equipment Usage – Fireplaces

Usage	Percentage of Homeowners
Most days	29%
About once a week	21%
Fewer than 4 times each month	49%

Source: RECS 2001, 2005, 2009

Staff estimated the MBOH for each gas hearth product within the scope of this analysis using the MBOH estimates from LBNL. **Table A-14** lists the MBOH estimates for each type of gas hearth product. Heating fireplaces were weighted using the RECS data presented in **Table A-11** and **Table A-12**. Decorative fireplaces were weighted based on being used solely for decorative

173 U.S. Energy Information Administration. (2001, 2005, 2009, 2015). "Residential Energy Consumption Survey (RECS)." Retrieved 2018 from https://www.eia.gov/consumption/residential/index.php.

purposes. Gas logs were weighted toward heating and decorative purposes. Outdoor fireplaces were weighted toward decorative purposes.

Table A-14: Annual Main Burner Operating Hours

Gas Hearth Product Type	Main Burner Operating Hours (hours/year)
Heating Fireplaces	354
Decorative Fireplaces	176
Gas Logs	235
Outdoor Fireplaces	176

Source: Energy Commission staff calculation

Pilot Operating Hours

The annual pilot light operating hours were estimated similarly to MBOH; it is based on usage and application. The U.S. DOE determined three possible pilot operating hour (POH) scenarios.[174] A year-round user leaves the pilot light on for the entire year. A seasonal user leaves the pilot light on for the entire heating season, including the shoulder months,[175] and turns off the pilot for the remainder the year. An efficient user closely monitors the operation of the pilot light and leaves the pilot light on only when necessary. **Table A-15** lists the pilot operating hours for each scenario.

Table A-15: Annual Pilot Operating Hour Scenarios

Usage Scenario	Pilot Operating Hours (hours/year)
Year-Round Use	8,760
Seasonal Use	3,650
Efficient Use	2,190

Source: Energy Commission staff calculation

The pilot operating hours for continuous pilots and on-demand pilots were determined using all three scenarios in **Table A-15** and adjusted for usage and application based on RECS data presented in **Table A-12** and **Table A-13**. **Table A-16** lists the POH estimates for continuous pilots and on-demand pilots by gas hearth product.

174 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.

175 The winter season or heating season occurs from December to February in California.

Table A-16: Pilot Operating Hours for Continuous and On-Demand Pilots

Gas Hearth Product Type	Continuous POH (hours/year)	On-Demand POH (hours/year)
Heating Fireplaces	4,693	2,975
Decorative Fireplaces	4,162	1,748
Gas Logs	3,681	1,881
Outdoor Fireplaces	2,190	920

Source: Energy Commission staff calculation

Because intermittent pilot lights are turned on for a short period before lighting the main burner and remain lit for as long as the main burner is lit, the POH for intermittent pilot lights is equal to the MBOH plus the short period before the main burner being lit. The POH for an intermittent pilot is determined as follows:[176]

$$POH_{Intermittent} = MBOH_{GHP} \cdot \frac{T_{ON}}{T_{Cycle}} + MBOH_{GHP} \qquad \textbf{Equation 1}$$

Where:

$POH_{intermittent}$ = pilot operating hours for intermittent pilots $\left(\frac{\text{hours}}{\text{year}}\right)$

$MBOH_{GHP}$ = main burner operating hours of the gas hearth product $\left(\frac{\text{hours}}{\text{year}}\right)$, see **Table A-14**

T_{ON} = on-time per cycle of the intermittent pilot, assumed to be 30 seconds

T_{Cycle} = on-time per cycle of the gas hearth product, assumed to be 20 minutes

176 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.

Table A-17 lists the resulting annual pilot operating hours for intermittent pilots.

Table A-17: Pilot Operating Hours for Intermittent Pilots

Gas Hearth Product Type	Intermittent POH (hours/year)
Heating Fireplaces	362
Decorative Fireplaces	180
Gas Logs	241
Outdoor Fireplaces	180

Source: Energy Commission staff calculation

For systems with dual-pilot systems such as intermittent with continuous pilot capability or intermittent with on-demand pilot capability, they are assumed to have the same POHs as continuous pilots and on-demand pilots, respectively. **Table A-18** lists the POHs for intermittent + continuous combination pilots and intermittent + on-demand combination pilot.

Table A-18: Pilot Operating Hours for Dual-Pilot Systems

Gas Hearth Product Type	Intermittent + Continuous POH (hours/year)	Intermittent + On-Demand POH (hours/year)
Heating Fireplaces	4,693	2,975
Decorative Fireplaces	4,162	1,748
Gas Logs	3,681	1,881
Outdoor Fireplaces	2,190	920

Source: Energy Commission staff calculation

Compliance Rates

Compliance rate is the percentage of compliant units over the total number of units. A compliance rate percentage indicates the ratio of compliant appliances to the total market or stock. Thus, a compliance rate of 40 percent means that 40 percent of that particular appliance already meets the proposed standard.

Pilot Light Compliance Rates

Table A-19 lists the distribution or compliance rates of pilot types for gas hearth products. The proposed standard prohibits continuous pilots and continuous pilots in combination with another pilot type (dual-pilot system). Thus, a dual-pilot system with a continuous pilot light in combination with an intermittent pilot is considered noncompliant. The compliance rates were derived using basic models and were adjusted with information from U.S. DOE's hearth

products rulemaking documents[177] and information provided through manufacturer interviews. In addition, these compliance rates are for natural gas- and propane-fueled hearth products.

Table A-19: Compliance Rate of Pilot Types for Gas Hearth Products

Compliancy	Pilot Type	Heating Fireplaces	Decorative Fireplaces	Gas Logs	Outdoor Fireplaces
Noncompliant	Continuous	26%	5%	44%	21%
	Intermittent + Continuous	36%	27%	4%	7%
Compliant	Intermittent	19%	45%	15%	32%
	Intermittent + On-Demand	4%	3%	1%	1%
	On-Demand	10%	15%	1%	6%
	Direct Ignition	5%	5%	35%	33%
	Total	100%	100%	100%	100%

Source: Energy Commission staff calculation

Fireplace Efficiency Compliance Rates

Table A-20 lists the distribution of heating fireplaces based on fireplace efficiency rates. The fireplace efficiency ratings are grouped into ranges of 10. This data distribution was derived using unique models.

177 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.

Table A-20: Distribution of Fireplace Efficiency for Heating Fireplaces

	Natural Gas		Propane	
Fireplace Efficiency Range	**Units**	**Percentage**	**Units**	**Percentage**
0-9	5	0.7%	5	0.8%
10-19	-	-	-	-
20-29	2	0.4%	1	0.2%
30-39	-	-	-	-
40-49	29	4.3%	27	4.4%
50-59	153	22.9%	118	19.1%
60-69	302	45.1%	288	46.7%
70-79	158	23.6%	152	24.6%
80-89	20	3.0%	26	4.2%

Source: Energy Commission staff calculation

The proposed standard sets a minimum fireplace efficiency rating of 70 percent. Thus, units with a fireplace efficiency less than 70 percent are noncompliant, and units greater than or equal to 70 percent are compliant. **Table A-21** lists the estimated compliancy rates for heating fireplaces based on fireplace efficiency. These compliancy rates were derived using unique models. For a detailed view, refer to **Table A-20**.

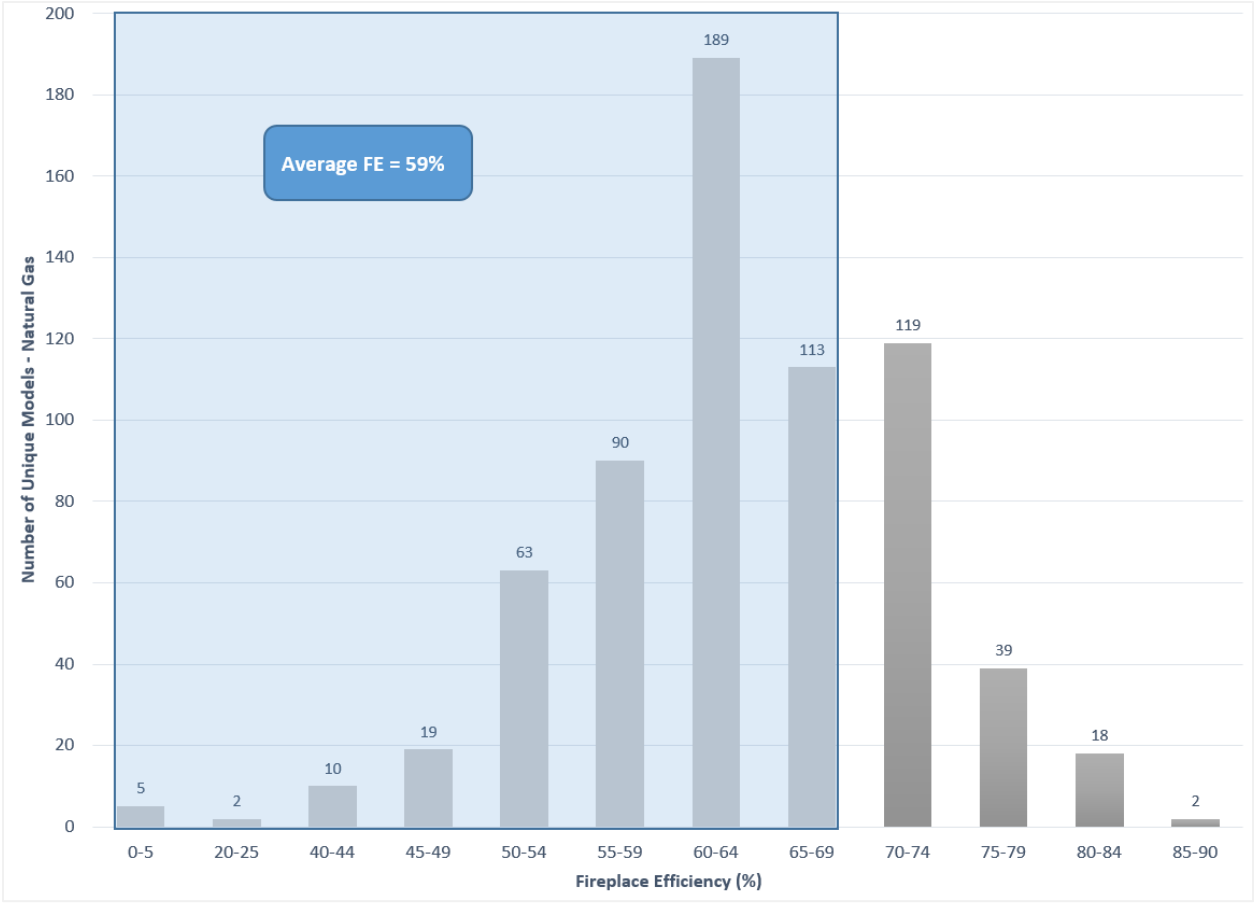
Table A-21: Compliance Rates for Heating Fireplaces

Fuel Type	**Natural Gas**	**Propane**
Compliancy	**Percentage**	**Percentage**
Noncompliant	73.4%	71.2%
Compliant	26.6%	28.8%

Source: Energy Commission staff calculation

The fireplace efficiency for a noncompliant product is determined by averaging the fireplace efficiency ratings of the unique models that are below 70 percent (within the blue box), as illustrated in **Figure A-1** for natural gas models. **Figure C-1** in **Appendix C** shows the baseline fireplace efficiency ratings distribution for propane models.

Figure A-1: Natural Gas Baseline Fireplace Efficiency Ratings Distribution



Source: Energy Commission staff calculation

Table A-22 lists the average fireplace efficiency ratings for compliant and noncompliant heating fireplaces fueled by natural gas and propane.

Table A-22: Average Fireplace Efficiency Ratings for Heating Fireplaces

	Fireplace Efficiency (%)	
Compliancy	**Natural Gas**	**Propane**
Compliant	70%	70%
Noncompliant	59%	60%

Source: Energy Commission staff calculation

Baseline Energy Use

The baseline energy consumption represents the energy consumption under the scenario in which no standards are applied to gas hearth products. The method for determining energy

consumption is similar to that used by NRCan and U.S. DOE. The total annual energy use for gas hearth products is as follows:[178]

$$Energy\ Use_{Total} = Energy\ Use_{Pilot,Type} + Energy\ Use_{Main\ Burner} + Secondary\ Effects \quad \textbf{Equation 2}$$

Where:

$EnergyUse_{Total}$ = total annual energy use for each type of gas hearth product

$EnergyUse_{Pilot,Type}$ = total annual fuel consumption as a result of the pilot type and the total annual electrical consumption of the intermittent pilot (when applicable)

$Energy\ Use_{MainBurner}$ = total annual fuel consumption as a result of the main burner (when applicable)

$Secondary\ Effects$ = total annual energy consumed by the primary heating or cooling appliance as a result of the heat input from the pilot and the main burner into the conditioned space (when applicable)

The total energy use is determined for each gas hearth product per pilot type per fuel type (**Figure A-2**.) That is 25 outputs per fuel type.

Figure A-2: Matrix of Total Energy Use Outputs

$$\begin{bmatrix} Natural\ Gas \\ Propane \end{bmatrix} \cdot \begin{bmatrix} Heating\ Fireplaces \\ Decorative\ Fireplaces \\ Gas\ Logs \\ Outdoor\ Gas\ Logs \\ Outdoor\ Fireplaces \end{bmatrix} \cdot \begin{bmatrix} Continuous \\ Intermittent + Continuous \\ Intermittent \\ On - Demand \\ Intermittent + On - Demand \end{bmatrix}$$

Source: Energy Commission staff calculation

For the rest of this section, a sample calculation will be performed for a natural gas heating fireplace. The following steps are covered:

1. Determination of main burner energy use per unit (applicable to heating fireplaces only)
2. Determination of pilot fuel consumption per unit
    a. Determination of the electrical consumption of intermittent pilots per unit
3. Determination of pilot secondary effects per unit
4. Determination of main burner secondary effects per unit (applicable to heating fireplaces only)
5. Determination of total energy use statewide

178 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.

Main Burner Energy Use

This proposal recommends setting minimum efficiency standards for heating gas fireplaces; therefore, this calculation applies to heating gas fireplaces only. The efficiency of an appliance is a measure of the how efficiently the appliance converts energy to heat. Specifically, the efficiency of an appliance is a ratio of the heat output compared to the total input capacity, as expressed in **Equation 3**. An appliance with an efficiency value of 90 percent means that 90 percent of the energy in the fuel becomes heat and the remainder is lost through varying factors of heat loss (such as exhausted through the flue, insulation, and so forth). Rearranging **Equation 3**, the heat output is calculated by multiplying the input capacity by the efficiency, as expressed in **Equation 4**. For natural gas- and propane-fueled heating fireplaces, the representative input capacity is 35,000 Btu/hour.[179]

$$Efficiency\ \% = \frac{Heat\ Ouput}{Input\ Capacity} \times 100 \qquad \textbf{Equation 3}$$

$$Heat\ Output = Input\ Capacity \times Efficiency\ \% \qquad \textbf{Equation 4}$$

The energy use of a heating fireplace is calculated by multiplying the heat output energy by the main burner operating hours, as expressed in **Equation 5**. The heat output increases when the fireplace efficiency increases. Therefore, the energy use of a compliant product will be greater than the energy use of a noncompliant product because a compliant product will have a higher fireplace efficiency than a noncompliant product. The energy savings is the difference between a noncompliant product and a compliant product.

$$Energy\ Use_{MB} = Q_{in} \cdot MBOH_{GHP} \cdot \eta_{FE} \qquad \textbf{Equation 5}$$

Where:

$Energy\ Use_{MB} =$ total energy as a result of the main burner $\left(\frac{Btu}{year}\right)$

$Q_{in} =$ representative input capacity of the heating fireplace $\left(\frac{Btu}{hour}\right)$, 35,000 $\left(\frac{Btu}{hour}\right)$

$MBOH_{GHP} =$ main burner operating hours of the gas hearth product $\left(\frac{hours}{year}\right)$, see **Table A-14**

$\eta_{FE} =$ fireplace efficiency, see **Table A-22**

The energy use is weighted with the energy use of a compliant product and a noncompliant product and the corresponding baseline market share, as expressed in **Equation 6**.

$$Energy\ Use_{MB} = EU_{MB,NC} \cdot (Non - Compliant\ Rate\%) + EU_{MB,C} \cdot (Compliant\ Rate\%) \qquad \textbf{Equation 6}$$

$$EU_{MB,NC} = Q_{in} \cdot MBOH_{GHP} \cdot \eta_{FE,NC} \qquad \textbf{Equation 7}$$

179 Ibid.

$$EU_{MB,C} = Q_{in} \cdot MBOH_{GHP} \cdot \eta_{FE,C}$$ **Equation 8**

Where

$EU_{MB,NC} =$ energy use as a result of the main burner of a non-compliant product $\left(\frac{Btu}{year}\right)$

$EU_{MB,C} =$ energy use as a result of the main burner of a compliant product $\left(\frac{Btu}{year}\right)$

$Compliancy\ Rates\ \% =$ market share compliancy rates (%), see **Table A-21**

Sample calculation for a noncompliant heating fireplace (result will vary from table results):

$$EU_{MB,NC} = 35{,}000\ \left(\frac{Btu}{hour}\right) \cdot 354\ \left(\frac{hours}{year}\right) \cdot (59\%) = 7{,}310{,}100\ \left(\frac{Btu}{year}\right)$$

Sample calculation for a compliant heating fireplace (result will vary from table results):

$$EU_{MB,C} = 35{,}000\ \left(\frac{Btu}{hour}\right) \cdot 354\ \left(\frac{hours}{year}\right) \cdot (70\%\ ) = 8{,}673{,}000\ \left(\frac{Btu}{year}\right)$$

Table A-23 lists the estimated energy use of compliant and noncompliant heating fireplaces fueled by natural gas and propane. The compliant energy use is greater than the noncompliant energy use because the energy use is based on heat output. The heat output is greater for compliant products because it is more efficient than a noncompliant product. The energy savings are the difference between a noncompliant product and a compliant product.

Table A-23: Unit Energy Use for Heating Fireplaces

	Energy Use per Unit (Btu/year)	
	Natural Gas	**Propane**
Non-Compliant	7,354,646	7,458,620
Compliant	8,662,689	8,662,689

Source: Energy Commission staff calculation

Sample calculation for a natural gas heating fireplace (result will vary from table results):

$$Energy\ Use_{MB} = \left(7{,}310{,}100\ \left(\frac{Btu}{year}\right) \cdot 73.4\%\right) + \left(8{,}673{,}000\ \left(\frac{Btu}{year}\right) \cdot 26.6\%\right) = 7{,}672{,}631\ \left(\frac{Btu}{year}\right)$$

Table A-24 lists the estimated weighted energy use of the main burner.

Table A-24: Baseline Weighted Energy Use

Gas Hearth Product	Energy Use per Unit (Btu/year)
Natural Gas Heating Fireplace	7,702,675
Propane Heating Fireplace	7,805,392

Source: Energy Commission staff calculation

Pilot Energy Use

The energy consumption for the pilot is estimated by multiplying the pilot operating hours and the input capacity of the pilot. The pilot operating hours are listed for each gas hearth product in **Table A-16**, **Table A-17**, and **Table A-18**. **Table A-25** lists the estimated input capacity for each pilot type per gas hearth product. Research indicates intermittent pilot systems use more energy to ensure pilot flame stability.[180] Staff used a conservative approach and applied the same input capacity of stand-alone intermittent pilots for intermittent pilot systems in combination with another pilot.

Table A-25: Representative Pilot Input Capacities

	Input Capacity (Btu/hour)			
Pilot Type	**Heating Fireplace**	**Decorative Fireplace**	**Gas Log**	**Outdoor Fireplaces**
Continuous Pilot	1,000	1,000	750	1,000
Intermittent + Continuous Pilot	1,050	1,050	800	1,050
Intermittent Pilot	1,050	1,050	800	1,050
On-Demand Pilot	1,000	1,000	750	1,000
Intermittent + On-Demand Pilot	1,050	1,050	800	1,050

Source: U.S. DOE[181], NRCan[182], Energy Commission staff

Sample Calculation:

$$Energy\ Use_{Pilot} = POH_{GHP} \times Q_{P,GHP} \qquad \textbf{Equation 9}$$

Where:

$Energy\ Use_{Pilot} =$ energy consumption of the pilot per unit $\left(\frac{Btu}{year}\right)$

$POH_{GHP} =$ pilot operating hours for the gas hearth product $\left(\frac{hours}{year}\right)$, see **Table A-16**, **Table A-17**, **Table A-18**

$Q_{P,GHP} =$ representative input capacity of the pilot per gas hearth product $\left(\frac{Btu}{hour}\right)$, see **Table A-25**

180 NRCan confidential study, 2018.

181 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.

182 NRCan confidential study, 2018.

For a heating gas fireplace with a continuous pilot:

$$Energy\ Use_{Pilot} = 4{,}693\ \left(\frac{hours}{year}\right) \times 1{,}000\ \left(\frac{Btu}{hour}\right) = 4{,}693{,}000\ \left(\frac{Btu}{year}\right) = 4.7\ \left(\frac{MMBtu}{year}\right)$$

Table A-26 lists the estimated pilot energy use for each gas hearth product.

Table A-26: Unit Pilot Energy Use

	Energy Use per Unit (Btu/year)			
Pilot Type	**Heating Fireplace**	**Decorative Fireplace**	**Gas Log**	**Outdoor Fireplace**
Continuous Pilot	4,692,873	4,161,569	2,733,807	2,080,784
Intermittent + Continuous Pilot	4,927,517	4,369,647	2,916,060	2,184,824
Intermittent Pilot	380,540	188,882	192,585	188,882
On-Demand Pilot	2,974,887	1,747,755	1,410,628	919,871
Intermittent + On-Demand Pilot	3,123,632	1,835,143	1,504,670	965,865

Source: Energy Commission staff calculation

Intermittent pilots require an outside power source, either battery or electrical connection, to function.[183] The annual electrical energy consumption of an intermittent pilot is calculated by multiplying the electric ignition operating hours and the input capacity. The electric ignition operating hours is determined as follows:[184]

$$EOH_{Intermittent} = MBOH_{Gas\ Hearth\ Product} \cdot \frac{T_{ON}}{T_{Cycle}} \qquad \textbf{Equation 10}$$

Where:

$EOH_{intermittent} =$ electric ignition operating hours for intermittent pilots $\left(\frac{\text{hours}}{\text{year}}\right)$

$MBOH_{GHP} =$ main burner operating hours by type of gas hearth product $\left(\frac{\text{hours}}{\text{year}}\right)$, see **Table A-14**

$T_{ON} =$ on-time per cycle of the intermittent pilot, assumed to be 30 seconds

$T_{Cycle} =$ on-time per cycle of the gas hearth product, assumed to be 20 minutes

183 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.
184 Ibid.

Sample calculation for heating gas fireplace:

$$EOH_{Intermittent} = 354\ \left(\frac{hours}{year}\right) \times \frac{30\ seconds}{20\ minutes} \times Conversion\ Factor = 8.84\ \left(\frac{hours}{year}\right)$$

Table A-27 lists the estimated electric ignition operating hours of intermittent pilots for each gas hearth product as a result from using **Equation 10**.

Table A-27: Electric Ignition Operating Hours for Intermittent Pilots

Gas Hearth Product Type	Electric Ignition Operating Hours (hours/year)
Heating Fireplace	8.84
Decorative Fireplace	4.39
Gas Log	5.87
Outdoor Fireplaces	4.39

Source: Energy Commission staff calculation

The electrical energy consumption of intermittent pilots is calculated by multiplying the electric ignition operating hours by the power usage, as expressed in **Equation 11**. The input capacity of an intermittent pilot was conservatively determined to be 50 watts by U.S. DOE.[185]

$$Energy\ Use_{Intermittent} = EOH_{Intermittent,GHP} \times P_{Intermittent} \qquad \textbf{Equation 11}$$

Where:

$Energy\ Use_{Intermittent}$ = electrical energy consumption of an intermittent pilot per unit $\left(\frac{watts}{year}\right)$

$EOH_{Intermittent,GHP}$

= electric ignition operating hours of an intermittent pilot for the gas hearth product $\left(\frac{hours}{year}\right)$

$P_{Intermittent}$ = representative input capacity of an intermittent pilot, 50 watts

Sample calculation for a heating gas fireplace:

$$Energy\ Use_{Intermittent} = 8.84\ \left(\frac{hours}{year}\right) \times 50\ watts = 442\ (watt - hours\ per\ year)$$

Table A-28 lists the estimated electric ignition energy consumption of intermittent pilots for each gas hearth product as a result from using **Equation 11**.

185 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.

Table A-28: Electric Ignition Annual Energy Use for Intermittent Pilots

Gas Hearth Product Type	Electric Ignition Energy Use per Unit (watt-hours per year)
Heating Fireplace	442
Decorative Fireplace	219
Gas Log	294
Outdoor Fireplaces	219

Source: Energy Commission staff calculation

Pilot Secondary Effects

Secondary effects are the effects the pilot light has on the conditions of the space in which the appliance is installed. For example, during the heating season a pilot light contributes to the heating of a room, reducing the load of the main heating equipment. During the cooling season, a pilot light adds heat to the room, increasing the load of the main cooling equipment. A continuous pilot is likely to have a greater effect than an intermittent pilot, since a continuous pilot remains lit the entire year versus an intermittent pilot that stays lit mostly when the appliance is in use. Staff used a similar approach used by U.S. DOE and NRCan for determining the secondary effects of a pilot. The calculation of the effects of the heat input of the pilot during the heating season and cooling season is as follows:[186]

$$HeatInput_{Pilot,HeatingSeason} = \frac{POH_{GHP} \times Q_{P,GHP} \times \eta_{Pilot}}{\eta_{MainHeat}} \quad \textbf{Equation 12}$$

$$HeatInput_{Pilot,CoolingSeason} = \frac{POH_{GHP} \times Q_{P,GHP} \times \eta_{Pilot}}{\eta_{MainCool}} \quad \textbf{Equation 13}$$

$$SE_{Pilot} = HeatInput_{Pilot,CoolingSeason} - HeatInput_{Pilot,HeatingSeason} \quad \textbf{Equation 14}$$

186 United States Department of Energy. January 30, 2015. *Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products.* EERE-2014-BT-STD-0036-0002, 526. Washington, DC: U.S. Department of Energy.

Where:

$HeatInput_{Pilot,HeatingSeason}$ = annual heat input of the pilot into the space during the heating season adjusted for main heating equipment operation $\left(\frac{Btu}{year}\right)$

POH_{GHP} = pilot operating hours for the gas hearth product $\left(\frac{hours}{year}\right)$, see **Table A-16**, **Table A-17**, **Table A-18**

$Q_{P,GHP}$ = representative input capacity of the pilot for the gas hearth product $\left(\frac{Btu}{hour}\right)$, see **Table A-25**

η_{Pilot} = efficiency of the pilot, see **Table A-29** below

$\eta_{MainHeat}$ = average efficiency of the main heating equipment, 80 percent

$HeatInput_{Pilot,CoolingSeason}$ = annual heat input of the pilot into the space during the cooling season adjusted for main cooling equipment operation $\left(\frac{Btu}{year}\right)$

$\eta_{MainCool}$ = average efficiency of the main cooling equipment, 14

SE_{Pilot} = secondary effects the pilot light $\left(\frac{Btu}{year}\right)$

The U.S. DOE, through a field study, estimated the percentage of heat output from the pilot that contributes to space heating (efficiency). **Table A-29** lists the average pilot efficiency for each gas hearth product.

Table A-29: Pilot Efficiency

Gas Hearth Product Type	Pilot Efficiency
Heating Fireplace	24%
Decorative Fireplace	12%
Gas Log	12%
Outdoor Products	Not Applicable

Source: U.S. DOE

The U.S. DOE projected the average efficiency ratings found in the Annual Energy Outlook (AEO) 2014 to the primary heating and cooling equipment found in RECS 2009.[187] These efficiency ratings were weighted to represent main heating and cooling equipment used primarily in California, according to RECS. The average efficiency ($\eta_{MainHeat}$) of the main heating equipment was determined to be 80 percent. The average coefficient of performance (COP) or efficiency ($\eta_{MainCool}$) of the main cooling equipment was determined to be 14.

187 Ibid..

Sample calculation for a heating gas fireplace with a continuous pilot (result will vary from table results):

$$HeatInput_{Pilot,HeatingSeason} = \frac{4{,}693\ \left(\frac{hour}{year}\right) \times 1{,}000\ \left(\frac{Btu}{hour}\right) \times 24\%}{80\%} = 1{,}407{,}900\left(\frac{Btu}{year}\right)$$

$$HeatInput_{Pilot,CoolingSeason} = \frac{4{,}693\ \left(\frac{hour}{year}\right) \times 1{,}000\ \left(\frac{Btu}{hour}\right) \times 24\%}{14} = 80{,}451\left(\frac{Btu}{year}\right)$$

$$SE_{Pilot} = 80{,}451\ \left(\frac{Btu}{year}\right) - 1{,}407{,}900\ \left(\frac{Btu}{year}\right) = -1{,}327{,}449\ \left(\frac{Btu}{year}\right)$$

Table A-30 lists the estimated pilot secondary effects for heating fireplaces, decorative fireplaces, and gas logs. For the results of the heat input effect on the main heating equipment and main cooling equipment as determined in **Equation 12** and **Equation 13**, refer to **Table C-1** in **Appendix C**. During the heating season, the heat input from the pilot reduces the heat load on the main heating equipment and increases the cooling load on the main cooling equipment during the cooling season. The results in **Table A-30** are negative because the effect to the main heating equipment during the heating season outweighs the effect of the main cooling equipment during the cooling season. Negative secondary effect values describes an overall reduction in space-conditioning load.

Table A-30: Pilot Secondary Effects

	Pilot Secondary Effects (Btu/year)		
Pilot Type	**Heating Fireplace**	**Decorative Fireplace**	**Vented Gas Log**
Continuous Pilot	-1,294,413	-561,722	-369,005
Intermittent Pilot	-104,962	-25,495	-25,995
On-Demand Pilot	-820,549	-235,909	-190,404
Intermittent + On-Demand Pilot	-861,577	-247,704	-203,098
Intermittent + Continuous Pilot	-1,294,413	-561,722	-369,005

Source: Energy Commission staff calculation

Pilot secondary effects are not applicable to outdoor gas logs and outdoor fireplaces.

Main Burner Secondary Effects

The main burner secondary effects are the impacts the main burner has on the conditions of the space in which the appliance is installed. Since this proposal recommends setting minimum efficiency standards for heating gas fireplaces, this calculation applies to heating gas fireplaces only for this analysis. In addition, if the heating gas fireplace is the main heating equipment, then there are no secondary effects. The effects were determined similarly to the calculation for

pilot secondary effects. Staff replaced the variables applicable to the pilot with variables applicable to the main burner. The main burner secondary effects calculation is as follows:

$$HeatInput_{MB,HeatingSeason} = \frac{MBOH_{GHP,Heating} \times Q_{IN,GHP} \times \eta_{FE}}{\eta_{MainHeat}} \quad \textbf{Equation 15}$$

$$HeatInput_{MB,CoolingSeason} = \frac{MBOH_{GHP,Cool} \times Q_{IN,GHP} \times \eta_{FE}}{\eta_{MainCool}} \quad \textbf{Equation 16}$$

$$SE_{MB} = HeatInput_{MB,CoolingSeason} - HeatInput_{MB,HeatingSeason} \quad \textbf{Equation 17}$$

Where:

$HeatInput_{MB,HeatingSeason} =$ annual heat input of the main burner into the space during the heating season adjusted for main heating equipment operation $\left(\frac{Btu}{year}\right)$

$MBOH_{GHP,Heating} =$ main burner operating hours of the gas hearth product during the heating season $\left(\frac{hours}{year}\right)$, 354 $\left(\frac{hours}{year}\right)$ for a heating fireplace

$Q_{IN,GHP} =$ representative input capacity of the main burner of the gas hearth product $\left(\frac{Btu}{hour}\right)$, 35,000 $\left(\frac{Btu}{hour}\right)$

$\eta_{FE} =$ average fireplace efficiency of the gas hearth product, see **Table A-22**

$\eta_{MainHeat} =$ average efficiency of the main heating equipment, 80 percent

$HeatInput_{MB,CoolingSeason} =$ annual heat input of the main burner into the space during the cooling season adjusted for main cooling equipment operation $\left(\frac{Btu}{year}\right)$

$MBOH_{GHP,Cool} =$ main burner operating hours of the gas hearth product during the cooling season $\left(\frac{hours}{year}\right)$, assumed to be zero

$\eta_{MainCool} =$ average efficiency of the main cooling equipment, 14

$SE_{MB} =$ secondary effects the main burner $\left(\frac{Btu}{year}\right)$

The main burner operation hours during the cooling season were assumed to be zero because most heating fireplaces are used during the heating season, and heating fireplaces are not typically operated while the main cooling equipment is being operated during the cooling season. Therefore, there is no effect on the main cooling equipment load.

The main burner secondary effect is determined for a compliant product and for a noncompliant product. The difference in calculating the secondary effects of the main burner for a compliant product versus a noncompliant product is the fireplace efficiency (η_{FE}). A compliant product has a minimum fireplace efficiency of 70 percent. The fireplace efficiency

for a noncompliant product is determined as described in section **Fireplace Efficiency Compliance Rates** in **Appendix A**.

The main burner secondary effects for a compliant product and a noncompliant product are weighted using the compliancy rates determined in **Table A-21** to represent the baseline scenario, as shown in **Equation 18**.

$$SE_{MB} = [(Compliancy\ Rate\ \%) \cdot (SE_{MB.C})] + [(Non - Compliance\ Rate\ \%) \cdot (SE_{MB,NC})] \qquad \textbf{Equation 18}$$

Sample calculation for a compliant heating fireplace (result will vary from table results):

$$Heat\ Input_{MB,HeatingSeason} = \frac{354\ \left(\frac{hours}{year}\right) \times 35{,}000\ \left(\frac{Btu}{hour}\right) \times 70\%}{80\ \%} = 10{,}841{,}250\ \left(\frac{Btu}{year}\right)$$

$$Heat\ Input_{MB,CoolingSeason} = 0$$

$$SE_{MB,C} = 0 - 10{,}841{,}250\ \left(\frac{Btu}{year}\right) = -10{,}841{,}250\ \left(\frac{Btu}{year}\right)$$

Sample calculation for a noncompliant heating fireplace (result will vary from table results):

$$Heat\ Input_{MB,HeatingSeason} = \frac{354\ \left(\frac{hours}{year}\right) \times 35{,}000\ \left(\frac{Btu}{hour}\right) \times 59\%}{80\ \%} = 9{,}137{,}625\ \left(\frac{Btu}{year}\right)$$

$$Heat\ Input_{MB,CoolingSeason} = 0$$

$$SE_{MB,NC} = 0 - 9{,}137{,}625\ \left(\frac{Btu}{year}\right) = -9{,}137{,}625\ \left(\frac{Btu}{year}\right)$$

Sample calculation of main burner secondary effects for a heating fireplace (result will vary from table results):

$$SE_{MB} = \left[(27\%) \cdot \left(-10{,}841{,}250\ \left(\frac{Btu}{year}\right)\right)\right] + \left[(73\%) \cdot \left(-9{,}137{,}625\left(\frac{Btu}{year}\right)\right)\right] = -9,597{,}604\left(\frac{Btu}{year}\right)$$

Table A-31 lists the estimated main burner secondary effects for natural gas- and propane-fueled heating fireplaces. Negative secondary effect values describes an overall reduction in space-conditioning load. Main burner secondary effects are applicable to heating gas fireplaces that are used as a supplementary heating equipment. In California, 94 percent of heating gas fireplaces are used as a secondary heating equipment (**Table A-12**). To simplify calculations upstream, staff multiplied the net main burner energy consumption by 94 percent to account for the stock of heating fireplaces that are used as supplementary heating equipment. The results are listed in **Table A-31**.

Table A-31: Baseline Weighted Main Burner Secondary Effects for Heating Fireplaces

Gas Hearth Product	Secondary Effects (Btu/year)	Secondary Use Stock Weighted Secondary Effects (Btu/year)
Natural Gas Heating Fireplace	-9,602,915	-9,014,098
Propane Heating Fireplace	-9,730,972	-9,134,303

Source: Energy Commission staff calculation

Baseline Total Energy Use Statewide

The baseline statewide energy consumption is calculated by multiplying the baseline unit energy use by the baseline stock in 2021 and in 2035. Complete stock tables are available in **Appendix C**. This section will cover the following calculation steps:

1. Statewide energy use of pilot plus pilot secondary effects
2. Statewide energy use of main burner energy use
3. Statewide energy use of main burner secondary effects

Statewide Total Pilot Energy Use

The total energy use of the pilot is the summation of the energy use of the pilot (**Table A-26**) and the pilot secondary effects (see **Table A-30**), as expressed in **Equation 19** below.

$$Total\ Pilot\ Energy\ Use = EnergyUse_{Pilot} + SE_{Pilot}$$ **Equation 19**

Sample calculation for a natural gas heating fireplace with a continuous pilot:

$$Total\ Pilot\ Energy\ Use = 4{,}692{,}873\ \left(\frac{Btu}{year}\right) + (-1{,}294{,}413)\left(\frac{Btu}{year}\right) = 3{,}398{,}460\ \left(\frac{Btu}{year}\right)$$

Table A-32 lists the estimated total energy use of each pilot type by gas hearth product fueled by natural gas and propane. The total pilot energy use for outdoor gas logs and outdoor fireplaces is equivalent to the fuel consumption of the pilot because secondary effects are not applicable.

Table A-32: Total Pilot Energy Use per Unit

	Total Energy Use per Unit (Btu/year)				
Pilot Type	**Heating Fireplace**	**Decorative Fireplace**	**Vented Gas Log**	**Outdoor Gas Log**	**Outdoor Fireplace**
Continuous Pilot	3,398,460	3,599,847	2,364,802	2,733,807	2,080,784
Intermittent Pilot	275,577	163,387	166,590	192,585	188,882
On-Demand Pilot	2,154,338	1,511,846	1,220,224	1,410,628	919,871
Intermittent + On-Demand Pilot	2,262,055	1,587,438	1,301,572	1,504,670	965,865
Intermittent + Continuous Pilot	3,633,104	3,807,926	2,547,056	2,916,060	2,184,824

Source: Energy Commission staff calculation

The statewide total energy use of the pilot is calculated by multiplying the total pilot energy use per unit (**Table A-32**) and the stock (**Appendix C**).

Sample calculation for a natural gas heating fireplace with a continuous pilot:

$$Total\ Pilot\ Energy\ Use_{Statewide} = Total\ Pilot\ Energy\ Use_{Unit} \times Stock$$

$$Total\ Pilot\ Energy\ Use_{Statewide} = 3{,}398{,}460\ \left(\frac{Btu}{year}\right) \times 140{,}552\ units = 4.78E+11\ \left(\frac{Btu}{year}\right)$$

$$= 477{,}659\ \left(\frac{MMBtu}{year}\right)$$

This calculation was repeated for each gas hearth product type per pilot type per fuel type. The summation of these results are presented in **Table A-33** for 2021 and **Table A-34** for 2035.

Table A-33: 2021 Baseline Statewide Total Pilot Energy Use

	Energy Use (Btu/year)				
Pilot Type	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Continuous Pilot	4.99E+11	9.01E+09	8.99E+10	3.35E+10	6.31E+11
Intermittent Pilot	2.97E+10	3.68E+09	5.94E+08	4.66E+09	3.87E+10
On-Demand Pilot	1.22E+11	1.13E+10	7.39E+08	3.95E+09	1.38E+11
Intermittent + On-Demand Pilot	5.24E+10	2.38E+09	1.70E+10	6.22E+08	7.24E+10
Intermittent + Continuous	7.57E+11	5.14E+10	1.54E+09	1.27E+10	8.23E+11
Total Energy Use (Btu/yr.)	**1.46E+12**	**7.79E+10**	**1.10E+11**	**5.54E+10**	1.70E+12
Total Energy Use (MMBtu/yr.)	**1,460,088**	**77,858**	**109,751**	**55,399**	1,703,096
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Table A-34: 2035 Baseline Statewide Total Pilot Energy Use

	Energy Use (Btu/year)				
Pilot Type	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Continuous Pilot	5.67E+11	1.02E+10	1.02E+11	3.81E+10	7.17E+11
Intermittent Pilot	3.38E+10	4.18E+09	6.75E+08	5.30E+09	4.39E+10
On-Demand Pilot	1.39E+11	1.29E+10	8.40E+08	4.49E+09	1.57E+11
Intermittent + On-Demand Pilot	5.96E+10	2.71E+09	1.93E+10	7.07E+08	8.23E+10
Intermittent + Continuous	8.61E+11	5.85E+10	1.75E+09	1.44E+10	9.36E+11
Total Energy Use (Btu/yr.)	1.66E+12	8.85E+10	1.25E+11	6.30E+10	1.94E+12
Total Energy Use (MMBtu/yr.)	1,659,807	88,508	124,763	62,976	1,936,054
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

The statewide total electrical consumption of intermittent pilots is calculated by multiplying the total electrical energy consumption by the stock. The statewide electrical consumption per intermittent pilot is in **Table A-28**.

Sample calculation for a natural gas heating fireplace with an intermittent pilot:

$$Total\ Electrical\ Energy\ Use_{Statewide} = Total\ Electrical\ Energy\ Use_{Unit} \times Stock$$

$$Total\ Electrical\ Energy\ Use_{Statewide} = 442\ Wh \times 103{,}297\ units = 45{,}657{,}274\ Wh = 45{,}657\ kWh$$

This process was repeated for each gas hearth product per intermittent pilot type per fuel type. The summations of those results are in **Table A-35** for 2021 and **Table A-36** for 2035.

Table A-35: 2021 Baseline Statewide Electrical Energy Use

	Energy Use (kWh/year)				
Pilot Type	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Intermittent Pilot	47,669	4,939	997	5,416	59,021
Intermittent + On-Demand Pilot	10,237	329	3,656	141	14,363
Intermittent + Continuous	92,133	2,964	170	1,272	96,539
Total Energy Use (kWh/yr.)	150,039	8,232	4,823	6,829	169,923
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Table A-36: 2035 Baseline Statewide Electrical Energy Use

	Energy Use (kWh/year)				
Pilot Type	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Intermittent Pilot	54,189	5,615	1,134	6,156	67,094
Intermittent + On-Demand Pilot	11,637	374	4,157	161	16,329
Intermittent + Continuous	104,736	3,369	193	1,445	109,743
Total Energy Use (kWh/yr.)	170,562	9,358	5,483	7,763	193,166
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Statewide Main Burner Energy Use

The statewide total energy use of the main burner is calculated by multiplying the total main burner energy use per unit (**Table A-24**) and the stock of gas hearth products with intermittent pilots (**Appendix C**). This calculation applies to heating fireplaces only.

Sample calculation for a natural gas heating fireplaces for 2021:

$$Total\ Main\ Burner\ Energy\ Use_{Statewide} = Total\ Main\ Burner\ Energy\ Use_{Unit} \times Stock$$

$$Total\ Main\ Burner\ Energy\ Use_{Statewide} = 7{,}702{,}675\ \left(\frac{Btu}{year}\right) \times 519{,}872\ units = 4.00E+12\ \left(\frac{Btu}{year}\right)$$

$$= 4{,}004{,}405\ \left(\frac{MMBtu}{year}\right)$$

This process was repeated for propane-fueled heating fireplaces. These results are in **Table A-37** for 2021 and for 2035.

Table A-37: Baseline Statewide Main Burner Energy Use

	2021		2035	
Energy Use	**Natural Gas**	**Propane**	**Natural Gas**	**Propane**
Total (Btu/year)	4.00E+12	1.79E+11	4.55E+12	2.03E+11
Total (MMBtu/year)	4,004,405	179,005	4,552,147	203,490

Source: Energy Commission staff calculation

State Main Burner Secondary Effects

The statewide total secondary effects of the main burner is calculated by multiplying the secondary effects of the main burner per unit (**Table A-31**) and the stock (**Appendix C**). This calculation applies to heating fireplace only.

Sample calculation for a natural gas heating fireplaces for 2021:

$$Total\ Main\ Burner\ Secondary\ Effects_{Statewide} = Main\ Burner\ Secondary\ Effects_{Unit} \times Stock$$

$$Total\ Main\ Burner\ Secondary\ Effects_{Statewide} = -9{,}014{,}098\ \left(\frac{Btu}{year}\right) \times 519{,}872\ \ units$$

$$= \ -4.69E+12\ \left(\frac{Btu}{year}\right) = -4{,}686{,}177\ \left(\frac{MMBtu}{year}\right)$$

This calculation was repeated for propane-fueled heating fireplaces. These results are in **Table A-38** for 2021 and for 2035.

Table A-38: Baseline Statewide Main Burner Secondary Effects

	2021		2035	
Secondary Effects Energy Load	**Natural Gas**	**Propane**	**Natural Gas**	**Propane**
Total (Btu/year)	-4.69E+12	-2.09E+11	-5.33E+12	-2.38E+11
Total (MMBtu/year)	-4,686,177	-209,482	-5,327,175	-238,136

Source: Energy Commission staff calculation

Compliant Energy Use

The compliant energy consumption represents the energy consumption under the scenario in which the proposed standards go into effect. The energy consumption of compliant products is estimated based on minimum requirements to the meet the proposed standards. The statewide total energy use is calculated using the same method as the baseline energy consumption, except the compliancy rates change at a rate of ± 6.67 percent – that is, one divided by the design life (15 years) of a gas hearth product. The noncompliant rates will decrease by 6.67 percent, while the compliant rates increase by 6.67 percent every year until full stock turnover in 2035, where the compliant rates are 100 percent.

Main Burner Energy Use

Following the same calculation method as the baseline scenario, **Table A-39** lists the estimated weighted energy use of the main burner under the compliant scenario for 2021 and 2035.

Table A-39: Compliant Weighted Energy Use

	Energy Use (Btu/year)	
Gas Hearth Product	**2021**	**2035**
Natural Gas Heating Fireplace	7,725,877	8,662,689
Propane Heating Fireplace	7,828,510	8,662,689

Source: Energy Commission staff calculation

Pilot Energy Use

The pilot energy use per unit for the compliant scenario remains the same as the baseline scenario (**Table A-26)**. The pilot electrical energy use per unit for the compliant scenario remains the same as the baseline scenario (**Table A-28**.)

Pilot Secondary Effects

The pilot secondary effects per unit for the compliant scenario remains the same as the baseline scenario (**Table A-30)**.

Main Burner Secondary Effects

Following the same calculation method as the baseline scenario, **Table A-40** lists the estimated main burner secondary effects for natural gas- and propane-fueled heating fireplaces for 2021 and 2035. To simplify calculations upstream, the net main burner energy consumption was multiplied by 94 percent to account for the stock of heating fireplaces that are used as supplementary heating equipment. The results are in **Table A-40**.

Table A-40: Compliant Weighted Main Burner Secondary Effects

Year	2021		2035	
Gas Hearth Product	**Secondary Effects (Btu/year)**	**Secondary Use Stock Weighted Secondary Effects (Btu/year)**	**Secondary Effects (Btu/year)**	**Secondary Use Stock Weighted Secondary Effects (Btu/year)**
Natural Gas Heating Fireplace	-9,631,841	-9,041,250	-10,799,763	-10,137,559
Propane Heating Fireplace	-9,759,793	-9,161,357	-10,799,763	-10,137,559

Source: Energy Commission staff calculation

Compliant Total Energy Use Statewide

The compliant statewide energy consumption is calculated by multiplying the compliant unit energy use by the compliant stock in 2021 and in 2035. Complete stock tables are available in **Appendix C**.

Statewide Total Pilot Energy Use

Following the same calculation method as the baseline scenario, **Table A-41** and **Table A-42** list the estimated statewide energy consumption of each pilot type per gas hearth product type for 2021 and 2035, respectively.

Table A-41: 2021 Compliant Statewide Total Pilot Energy Use

	Energy Use (Btu/year)				
Pilot Type	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Continuous Pilot	4.75E+11	8.23E+09	8.61E+10	3.10E+10	6.01E+11
Intermittent Pilot	3.24E+10	3.84E+09	6.50E+08	4.92E+09	4.18E+10
On-Demand Pilot	1.33E+11	1.18E+10	8.09E+08	4.17E+09	1.50E+11
Intermittent + On-Demand Pilot	5.71E+10	2.49E+09	1.86E+10	6.57E+08	7.88E+10
Intermittent + Continuous	7.22E+11	4.70E+10	1.47E+09	1.17E+10	7.82E+11
Total Energy Use (Btu/yr.)	1.42E+12	7.34E+10	1.08E+11	5.24E+10	1.65E+12
Total Energy Use (MMBtu/yr.)	1,419,166	73,392	107,626	52,412	1,652,596
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Table A-42: 2035 Compliant Statewide Total Pilot Energy Use

	Energy Use (Btu/year)				
Pilot Type	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Continuous Pilot	0	0	0	0	0
Intermittent Pilot	9.78E+10	6.31E+09	2.19E+09	9.22E+09	1.15E+11
On-Demand Pilot	4.01E+11	1.95E+10	2.72E+09	7.81E+09	4.31E+11
Intermittent + On-Demand Pilot	1.72E+11	4.08E+09	6.26E+10	1.23E+09	2.40E+11
Intermittent + Continuous	0	0	0	0	0
Total Energy Use (Btu/yr.)	6.71E+11	2.98E+10	6.75E+10	1.83E+10	7.87E+11
Total Energy Use (MMBtu/yr.)	671,035	29,842	67,550	18,256	786,683
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

The compliant statewide electrical energy consumption of intermittent pilots is calculated similarly under the baseline scenario. **Table A-43** and **Table A-44** list the estimated statewide electrical energy consumption of intermittent pilots for 2021 and 2035, respectively.

Table A-43: 2021 Compliant Statewide Electrical Energy Use

	Energy Use (kWh/year)				
Pilot Type	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Intermittent Pilot	51,915	5,157	1,092	5,720	63,884
Intermittent + On-Demand Pilot	11,149	344	4,002	149	15,644
Intermittent + Continuous	87,798	2,707	162	1,175	91,842
Total Energy Use (kWh/yr.)	150,862	8,208	5,256	7,044	171,370
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Table A-44: 2035 Compliant Statewide Electrical Energy Use

	Energy Use (kWh/year)				
Pilot Type	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Intermittent Pilot	156,796	8,467	3,673	10,707	179,643
Intermittent + On-Demand Pilot	33,672	564	13,469	279	47,986
Intermittent + Continuous	0	0	0	0	0
Total Energy Use (kWh/yr.)	190,468	9,031	17,142	10,986	227,627
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Statewide Main Burner Energy Use

Following the same calculation method as the baseline scenario, **Table A-45** lists the estimated statewide main burner energy use for 2021 and 2035 under the compliant scenario.

Table A-45: Compliant Statewide Main Burner Energy Use

	2021		2035	
Energy Use	**Natural Gas**	**Propane**	**Natural Gas**	**Propane**
Total (Btu/year)	4.02E+12	1.80E+11	5.12E+12	2.26E+11
Total (MMBtu/year)	4,016,467	179,535	5,119,498	225,841

Source: Energy Commission staff calculation

Statewide Main Burner Secondary Effects

Following the same calculation method as the baseline scenario, **Table A-46** lists the estimated statewide main burner secondary effects for 2021 and 2035 under the compliant scenario.

Table A-46: Compliant Statewide Main Burner Secondary Effects

	2021		2035	
Secondary Effects Energy Load	**Natural Gas**	**Propane**	**Natural Gas**	**Propane**
Total (Btu/year)	-4.70E+12	-2.10E+11	-5.99E+12	-2.64E+11
Total (MMBtu/year)	-4,700,292	-210,102	-5,991,121	-264,291

Source: Energy Commission staff calculation

Savings

The energy savings are the difference between the baseline scenario and the compliant scenario. Savings are presented for when the proposed standards become effective in 2021 and when complete stock turnovers occur in 2035.

Statewide Pilot Energy Use Savings

The statewide pilot energy use savings are calculated by subtracting the compliant energy use (**Table A-41** and **Table A-42**) from the baseline energy use (**Table A-33** and **Table A-34**).

Sample calculation for heating fireplaces with a continuous pilot for 2021:

$$E_{Savings} = E_{Baseline} - E_{Compliant}$$

$$E_{Savings} = 4.99E+11\left(\frac{Btu}{year}\right) - 4.75E+11\left(\frac{Btu}{year}\right) \approx 0.24\,E+11\left(\frac{Btu}{year}\right) = 23{,}465\left(\frac{MMBtu}{year}\right)$$

This calculation was repeated for each gas hearth product type per pilot type per fuel type. The summations of these results are in **Table A-47** for 2021 and **Table A-48** for 2035. Negative values indicate an increase in energy. The compliant pilot types (for example, intermittent, on-demand, and intermittent + on-demand) show an increase in energy because as units with noncompliant pilots are being discontinued, they are being replaced with units with compliant pilots, increasing the stock and, therefore, the total statewide energy. However, the energy savings from the discontinuation of units with noncompliant pilots outweigh the energy use of units with compliant pilots.

Table A-47: 2021 Statewide Pilot Energy Savings

	Energy Use (MMBtu/year)				
Pilot Type	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Continuous Pilot	23,465	779	3,795	2,543	30,582
Intermittent Pilot	-2,648	-162	-56	-262	-3,128
On-Demand Pilot	-10,859	-499	-70	-222	-11,650
Intermittent + On-Demand Pilot	-4,668	-105	-1,609	-35	-6,417
Intermittent + Continuous	35,633	4,452	65	961	41,111
Total Energy Use (MMBtu/yr.)	40,923	4,465	2,125	2,985	50,498
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Table A-48: 2035 Statewide Pilot Energy Savings

	Energy Use (MMBtu/year)				
Pilot Type	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Continuous Pilot	566,950	10,238	102,170	38,083	717,441
Intermittent Pilot	-63,977	-2,124	-1,512	-3,918	-71,531
On-Demand Pilot	-262,369	-6,552	-1,883	-3,318	-274,122
Intermittent + On-Demand Pilot	-112,778	-1,376	-43,310	-523	-157,987
Intermittent + Continuous	860,946	58,480	1,748	14,396	935,570
Total Energy Use (MMBtu/yr.)	988,772	58,666	57,213	44,720	1,149,371
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Table A-49 and **Table A-50** list the estimated electrical energy savings from intermittent pilots for 2021 and 2035, respectively. As discussed above, negative values indicate an increase in energy.

Table A-49: 2021 Statewide Electrical Energy Savings

	Energy Use (kWh/year)				
Pilot Type	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Intermittent Pilot	-4,247	-217	-94	-304	-4,862
Intermittent + On-Demand Pilot	-912	-14	-346	-8	-1,280
Intermittent + Continuous	4,335	256	7	97	4,695
Total Energy Use (kWh/yr.)	-824	25	-433	-215	-1,447
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Table A-50: 2035 Statewide Electrical Energy Savings

	Energy Use (kWh/year)				
Pilot Type	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Intermittent Pilot	-102,607	-2,852	-2,540	-4,550	-112,549
Intermittent + On-Demand Pilot	-22,035	-190	-9,313	-119	-31,657
Intermittent + Continuous	104,736	3,369	193	1,445	109,743
Total Energy Use (kWh/yr.)	-19,906	327	-11,660	-3,224	-34,463
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Statewide Main Burner Energy Use Savings

The statewide main burner energy use savings are calculated by subtracting the baseline energy use (**Table A-37**) from the compliant energy use (**Table A-45**), as expressed below in the sample calculation. The main burner energy use is based on heat output, where heat output is calculated by multiplying the input capacity by the fireplace efficiency. Therefore, the heat output increases as the fireplace efficiency increases.

Sample calculation for natural gas heating fireplaces for 2021:

$$E_{Savings} = E_{Compliant} - E_{Baseline}$$

$$E_{Savings} = 4{,}016{,}467 \left(\frac{MMBtu}{year}\right) - 4{,}004{,}405 \left(\frac{MMBtu}{year}\right) = 12{,}062 \left(\frac{MMBtu}{year}\right)$$

The calculation was repeated for propane-fueled heating fireplaces. These results are in **Table A-51** for 2021 and for 2035.

Table A-51: Statewide Main Burner Energy Savings

	2021		2035	
Energy Use	**Natural Gas**	**Propane**	**Natural Gas**	**Propane**
Total (Btu/year)	1.21E+10	5.30E+08	5.67E+11	2.24E+10
Total (MMBtu/year)	12,062	530	567,351	22,350

Source: Energy Commission staff calculation

Statewide Main Burner Secondary Effects Savings

The statewide main burner secondary effects energy load savings are calculated by subtracting the compliant energy use (**Table A-46**) from the baseline energy use (**Table A-38**).

Sample calculation for natural gas heating fireplaces for 2021 (result will vary from table results):

$$E_{Savings} = E_{Baseline} - E_{Compliant}$$

$$E_{Savings} = -4{,}686{,}177\ \left(\frac{MMBtu}{year}\right) - \left(-4{,}700{,}292\ \left(\frac{MMBtu}{year}\right)\right) = 14{,}115\ \left(\frac{MMBtu}{year}\right)$$

The calculation was repeated for propane-fueled heating fireplaces. These results are in **Table A-52** for 2021 and for 2035.

Table A-52: Statewide Main Burner Secondary Effects Savings

	2021		2035	
Energy Use	**Natural Gas**	**Propane**	**Natural Gas**	**Propane**
Total (Btu/year)	1.41E+10	6.20E+08	6.64E+11	2.62E+10
Total (MMBtu/year)	14,116	620	663,946	26,155

Source: Energy Commission staff calculation

Statewide Monetary Savings

The monetary savings are calculated by multiplying the energy savings (**Table A-53**) by the price of the energy source (**Table A-1**). **Table A-53** lists the estimated total state energy savings by gas hearth product and gas fuel type for 2021 and 2035.

Table A-53: Total Statewide Gas Fuel Savings

2021 Total Energy Savings (MMBtu/year)	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces	Total
Natural Gas	65,372	16,339	16,151	2,860	100,722
Propane	2,880	719	710	126	4,435
Total	68,252	17,058	16,861	2,986	105,157
2035 Total Energy Savings (MMBtu/year)	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Natural Gas	2,178,294	56,188	54,796	42,831	2,332,109
Propane	90,281	2,479	2,417	1,889	97,066
Total	2,268,575	58,667	57,213	44,720	2,429,175
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Sample calculation for natural gas heating fireplaces in 2021:

$$Savings\ (\$) = E_{Savings} \times \frac{\$12.06}{MMBtu}$$

$$Savings\ (\$) = 65{,}372\ \left(\frac{MMBtu}{year}\right) \times \frac{\$12.06}{MMBtu} = \$788{,}386 = \$0.79\ Million$$

Table A-54 lists the total monetary savings for each gas hearth product by gas fuel type for 2021 and 2035.

Table A-54: Total Statewide Gas Monetary Savings

2021 Total Monetary Savings ($Million/year)	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces	Total
Natural Gas	$0.789	$0.197	$0.195	$0.035	$1.22
Propane	$0.097	$0.024	$0.024	$0.004	$0.15
Total	$0.885	$0.221	$0.219	$0.039	$1.36
2035 Total Monetary Savings ($Million/year)	**Heating Fireplaces**	**Decorative Fireplaces**	**Gas Logs†**	**Outdoor Fireplaces**	**Total**
Natural Gas	$26.3	$0.7	$0.7	$0.5	$28.1
Propane	$3.0	$0.1	$0.1	$0.1	$3.3
Total	$29.3	$0.8	$0.7	$0.6	$31.4
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Table A-55 lists the estimate total electrical use, savings, and cost for 2021 and 2035.

Table A-55: Total Statewide Electrical Energy Consumption and Cost

	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces	Total
2021 Total Energy Use (kWh/yr.)	-789	24	-415	-206	-1,386
2021 Total Monetary Savings ($Million/year)	-$0.000146	$0.000004	-$0.000077	-$0.000038	-$0.000257
2035 Total Energy Use (kWh/yr.)	-19,065	313	-11,167	-3,088	-33,007
2035 Total Monetary Savings ($Million/year)	-$0.0035	$0.0001	-$0.0021	-$0.0006	-$0.0061
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

The net monetary savings are the summation of the monetary savings from the gas energy savings (**Table A-54**) and the cost of the electrical energy consumption (**Table A-55**). **Table A-56** lists the estimated net monetary savings of this proposal for 2021 and 2035.

Table A-56: Net Statewide Monetary Savings

	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces	Total
2021 Total Monetary Savings ($Million/year)	$0.89	$0.22	$0.22	$0.04	$1.37
2035 Total Monetary Savings ($Million/year)	$29.31	$0.76	$0.74	$0.58	$31.39
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Life-Cycle Costs and Benefits

The calculation for energy savings per unit is the difference between the baseline and compliant energy consumption per unit. The life-cycle cost includes the incremental cost. The life-cycle benefit is the product of the energy savings per unit, the life of the unit, and the average price of the energy source (for example, electricity, propane, or natural gas). In this analysis, the life-cycle benefits are based on the price of natural gas. The price of propane is about 2.8 times the price of natural gas. If the life-cycle benefits for natural gas-fueled hearth products exceed the life-cycle costs, then staff can assume the same conclusion for propane-fueled hearth products. Staff assumed a 3 percent discount rate to calculate the net present value of the energy savings or the life-cycle benefit. The life-cycle cost is subtracted from the net present value to determine the net life-cycle benefit.

The pilot energy use per unit for each gas hearth product is available in **Table A-26**. This analysis examines two noncompliant pilot types: continuous and intermittent + continuous. The energy use of a continuous pilot is less than the energy use of an intermittent + continuous pilot. For a conservative approach, the calculation of the pilot energy savings per unit uses the energy use of a continuous pilot as the baseline scenario. Therefore, staff can assume the conclusions about the cost-effectiveness of a continuous pilot is the same for intermittent + continuous pilots.

The main burner energy use per unit for heating fireplaces is available in **Table A-23**.

Sample calculation for a natural gas heating fireplace with a noncompliant pilot and fireplace efficiency to a compliant product (for example, intermittent pilot + minimum 70 percent FE):

$$\begin{aligned} Energy\ Savings_{Unit} &= \left[Pilot\ Energy\ Use_{Non-Compliant,Continuous} - Pilot\ Energy\ Use_{Compliant,Pilot}\right] \\ &+ \left[Main\ Burner\ Energy\ Use_{Compliant} - Main\ Burner\ Energy\ Use_{Non-compliant}\right] \end{aligned}$$

$$\begin{aligned} Energy\ Savings_{Unit} &= \left[4{,}692{,}873\ \left(\frac{Btu}{year}\right) - 380{,}540\ \left(\frac{Btu}{year}\right)\right] + \left[8{,}662{,}689\ \left(\frac{Btu}{year}\right) - 7{,}354{,}646\ \left(\frac{Btu}{year}\right)\right] \\ &\approx 5{,}620{,}376\ \left(\frac{Btu}{year}\right) \end{aligned}$$

$$Annual\ Savings_{Unit} = Energy\ Savings_{Unit} \times Retail\ Price\ of\ Natural\ Gas$$

$$Annual\ Savings_{Unit} = 5{,}620{,}377\ \left(\frac{Btu}{year}\right) \times \frac{\$12.06}{MMBtu} \times \frac{1\ MMBtu}{10^6 Btu} \approx \$68\ per\ year$$

$$Net\ Present\ Value\ (NPV)\ of\ Savings = \sum_{i=1}^{15} \frac{Annual\ Savings_{Unit}}{(1 + Discount\ Rate)^n}$$

$$NPV_{i=1} = \frac{\$68}{(1 + 0.03)^1} \approx \$66$$

Table A-57: Sample NPV Result by Year

	Savings ($/year)															
Year (n)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
Intermittent Pilot	66	64	62	60	58	57	55	54	52	50	49	48	46	45	44	810

Source: Energy Commission staff calculation

$$Net\ Lifecycle\ Benefit = NPV\ Savings - Lifecycle\ Costs$$

$$Net\ Lifecycle\ Beneft = \$810 - \$115 = \$695$$

$$Lifecycle\ Benefit - Cost\ Ratio = {}^{Net\ Lifecycle\ Benefit}/_{Lifecycle\ Cost}$$

$$Lifecycle\ Benefit - Cost\ Ratio = \frac{\$695}{\$115} \approx 6.0$$

Design Standard

The unit energy savings, life-cycle costs, and life-cycle benefits are presented in **Tables A-58** through **A-61** for improving a gas hearth product from a noncompliant pilot to a compliant pilot.

Table A-58: Life-Cycle Benefits and Costs for Heating Fireplaces

Pilot Type	Energy Savings per Unit (Btu/year)	Lifecycle Cost ($/unit)	Lifecycle Benefit ($/unit)	NPV Lifecycle Benefit ($/unit)	Net Lifecycle Benefit ($/unit)	Lifecycle Benefit/Cost Ratio
Intermittent Pilot	4,312,333	$30	$780	$621	$591	19.8
On-Demand Pilot	1,717,986	$37	$311	$247	$210	5.6
Intermittent + On-Demand Pilot	1,569,241	$37	$284	$226	$189	5.0

Source: Energy Commission staff calculation

Table A-59: Life-Cycle Benefits and Costs for Decorative Fireplaces

Pilot Type	Energy Savings per Unit (Btu/year)	Lifecycle Cost ($/unit)	Lifecycle Benefit ($/unit)	NPV Lifecycle Benefit ($/unit)	Net Lifecycle Benefit ($/unit)	Lifecycle Benefit/Cost Ratio
Intermittent Pilot	3,972,687	$30	$719	$572	$542	18.2
On-Demand Pilot	2,413,814	$37	$437	$348	$310	8.3
Intermittent + On-Demand Pilot	2,326,426	$37	$421	$335	$298	8.0

Source: Energy Commission staff calculation

Table A-60: Life-Cycle Benefits and Costs for Gas Logs

Pilot Type	Energy Savings per Unit (Btu/year)	Lifecycle Cost ($/unit)	Lifecycle Benefit ($/unit)	NPV Lifecycle Benefit ($/unit)	Net Lifecycle Benefit ($/unit)	Lifecycle Benefit/Cost Ratio
Intermittent Pilot	2,541,222	$37	$460	$366	$329	8.8
On-Demand Pilot	1,323,178	$85	$239	$191	$106	1.2
Intermittent + On-Demand Pilot	1,229,136	$85	$222	$177	$92	1.1

Source: Energy Commission staff calculation

Table A-61: Life-Cycle Benefits and Costs for Outdoor Fireplaces

Pilot Type	Energy Savings per Unit (Btu/year)	Lifecycle Cost ($/unit)	Lifecycle Benefit ($/unit)	NPV Lifecycle Benefit ($/unit)	Net Lifecycle Benefit ($/unit)	Lifecycle Benefit/Cost Ratio
Intermittent Pilot	1,891,903	$59	$342	$272	$213	3.6
On-Demand Pilot	1,160,913	$74	$210	$167	$93	1.3
Intermittent + On-Demand Pilot	1,114,920	$74	$202	$161	$86	1.2

Source: Energy Commission staff calculation

Efficiency Standard

Table A-62 lists the unit energy savings, life-cycle costs, and life-cycle benefits for a scenario in which a heating fireplace with a compliant pilot type but with a noncompliant fireplace efficiency is improved to meet the proposed efficiency standards.

Table A-62: Heating Fireplaces – Life-Cycle Benefits and Costs Under Scenario 1

Energy Savings per Unit (Btu/year)	Life-Cycle Cost ($/unit)	Lifecycle Benefit ($/unit)	NPV Lifecycle Benefit ($/unit)	Net Lifecycle Benefit ($/unit)	Lifecycle Benefit/Cost Ratio
1,308,043	$85	$237	$188	$104	1.2

Source: Energy Commission staff calculation

Table A-63 lists the unit energy savings, life-cycle costs, and life-cycle benefits for a scenario in which a heating fireplace with a noncompliant pilot type *and* a noncompliant fireplace efficiency is improved to meet the proposed efficiency and design standards. The life-cycle costs include the cost to substitute a noncompliant pilot to a compliant pilot and to improve the efficiency of the unit.

Table A-63: Heating Fireplaces – Life-Cycle Benefits and Cost Under Scenario 2

Pilot Type	Energy Savings per Unit (Btu/year)	Life-Cycle Cost ($/unit)	Life-Cycle Benefit ($/unit)	NPV Life-Cycle Benefit ($/unit)	Net Life-Cycle Benefit ($/unit)	Life-Cycle Benefit/Cost Ratio
Intermittent Pilot	5,620,377	$115	$1,017	$809	$695	6.1
On-Demand Pilot	3,026,029	$122	$548	$436	$314	2.6
Intermittent + On-Demand Pilot	2,877,285	$122	$521	$414	$292	2.4

Source: Energy Commission staff calculation

Avoided Emissions

Tables A-64 and **A-65** show greenhouse gas emissions reductions due to avoided gas consumption. The reduction of emissions is determined by multiplying the carbon dioxide

coefficient and the gas fuel savings in **Table A-53**. The carbon dioxide coefficients for natural gas[188] and propane[189] are listed in **Table A-1**.

Table A-64: First-Year Avoided Greenhouse Gas Emissions

2021 Avoided Greenhouse Gases (Metric tons CO_2)	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces	Total
Natural Gas	3,465	866	856	152	5,339
Propane	182	45	45	8	280
Total	3,647	911	901	160	5,619
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

Table A-65: After Full Stock Turnover Avoided Greenhouse Gas Emissions

2035 Avoided Greenhouse Gases (Metric tons CO_2)	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces	Total
Natural Gas	115,450	2,978	2,904	2,270	123,602
Propane	5,692	156	152	119	6,119
Total	121,142	3,134	3,056	2,389	129,721
†Stock for gas logs includes vented and outdoor types.					

Source: Energy Commission staff calculation

188 U.S. Environmental Protection Agency. December 18, 2018. "Greenhouse Gases Equivalencies Calculator - Calculations and References - Therms and Mcf of Natural Gas." Retrieved from U.S. Environmental Protection Agency: https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.

189 U.S. Energy Information Administration. February 2, 2016. "Carbon Dioxide Emissions Coefficients." Retrieved from U.S. Energy Information Administration: https://www.eia.gov/environment/emissions/co2_vol_mass.php.

APPENDIX B:
Acronyms

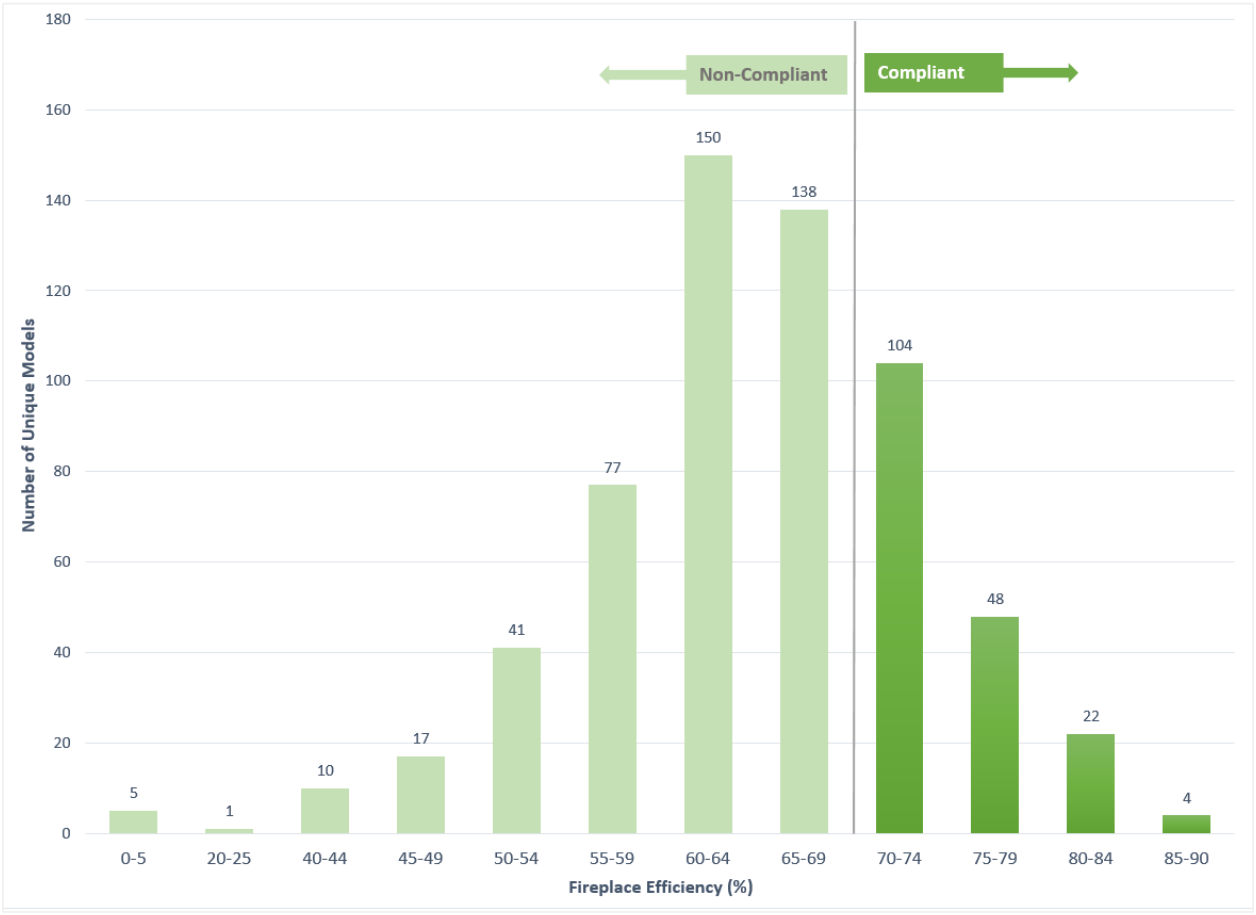
Acronym	Description
AB	Assembly Bill
AEO	Annual Energy Outlook
AFUE	Annual fuel utilization efficiency
ANSI	American National Standards Institute
ASAP	Appliance Standards Awareness Project
BEES	Building Energy Efficiency Standards
Btu	British thermal unit
CARB	California Air Resources Board
CASE Team	Codes and Standards Enhancement Team
CBC	California Building Code
CCR	California Code of Regulations
CEC	California Energy Commission
CFR	Code of Federal Regulations
COP	Coefficient of performance
CPUC	California Public Utilities Commission
CSA	Canadian Standards Association
DOE	Department of Energy
EPA	Environmental Protection Agency
EPCA	Energy Policy and Conservation Act
FE	Fireplace efficiency
GHG	Greenhouse gas
HCD	Department of Housing and Community Development
HPBA	Hearth, Patio & Barbecue Association

HPBAC	Hearth, Patio & Barbecue Association Canada
HSC	Health and Safety Code
HVAC	Heating, ventilation, and air conditioning
IEPR	Integrated Energy Policy Report
IOU	Investor-owned utility
kWh	Kilowatt-hour
LBNL	Lawrence Berkeley National Lab
LPG	Liquefied petroleum gas, includes propane, butane, and propane/butane mixtures
MAEDbS	Modernized Appliance Efficiency Database System
MBOH	Main burner operating hours
MMBtu	One million British thermal units
NOPR	Notice of proposed rulemaking
NRCan	Natural Resources Canada
PG&E	Pacific Gas and Electric
POH	Pilot operating hours
RECS	Residential Energy Consumption Survey
SB	Senate Bill
SCE	Southern California Edison
SDG&E	San Diego Gas & Electric
U.S. EIA	United States Energy Information Administration
ZNE	Zero net energy

APPENDIX C:
Additional Tables and Charts

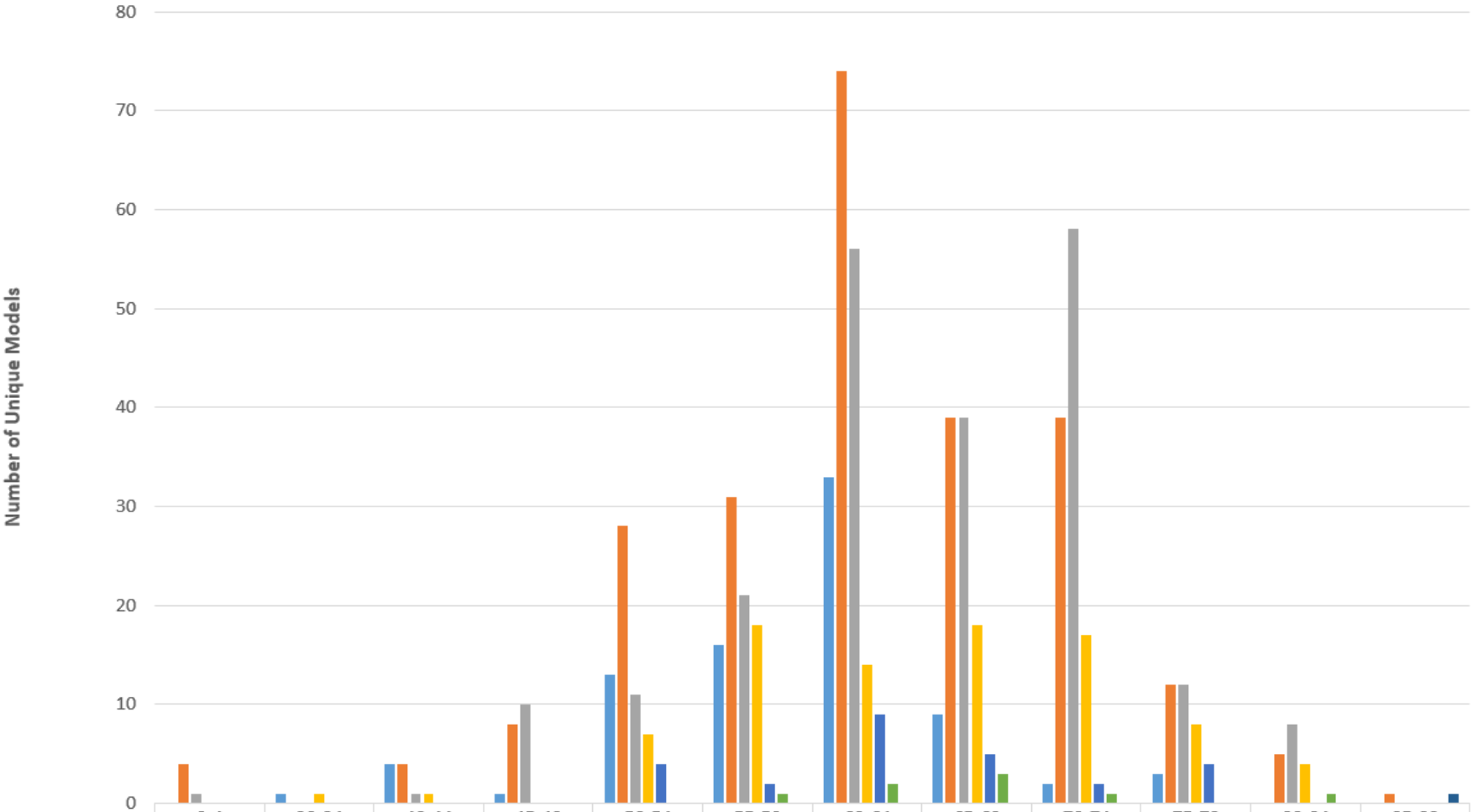
Charts

Figure C-1: Propane Gas Heating Fireplaces – Fireplace Efficiency Distribution



Source: Energy Commission staff calculation

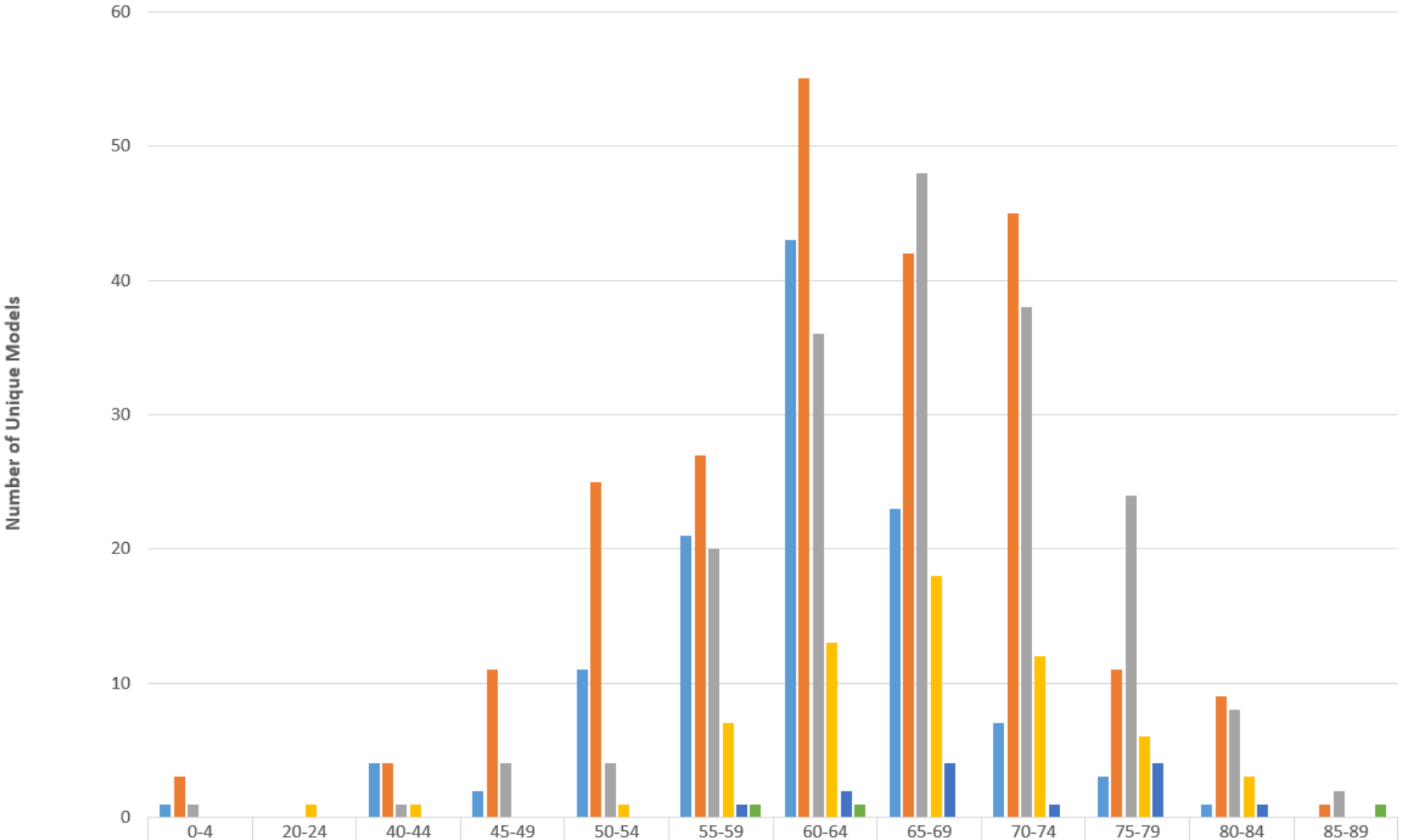
Figure C-2: Natural Gas Heating Fireplaces – Fireplace Efficiency vs. Input Capacity



	0-4	20-24	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89
10,000-19,999		1	4	1	13	16	33	9	2	3		
20,000-29,999	4		4	8	28	31	74	39	39	12	5	1
30,000-39,999	1		1	10	11	21	56	39	58	12	8	
40,000-49,999		1	1		7	18	14	18	17	8	4	
50,000-59,999					4	2	9	5	2	4		
60,000-69,999						1	2	3	1		1	
80,000-89,999												1

Source: Energy Commission staff calculation

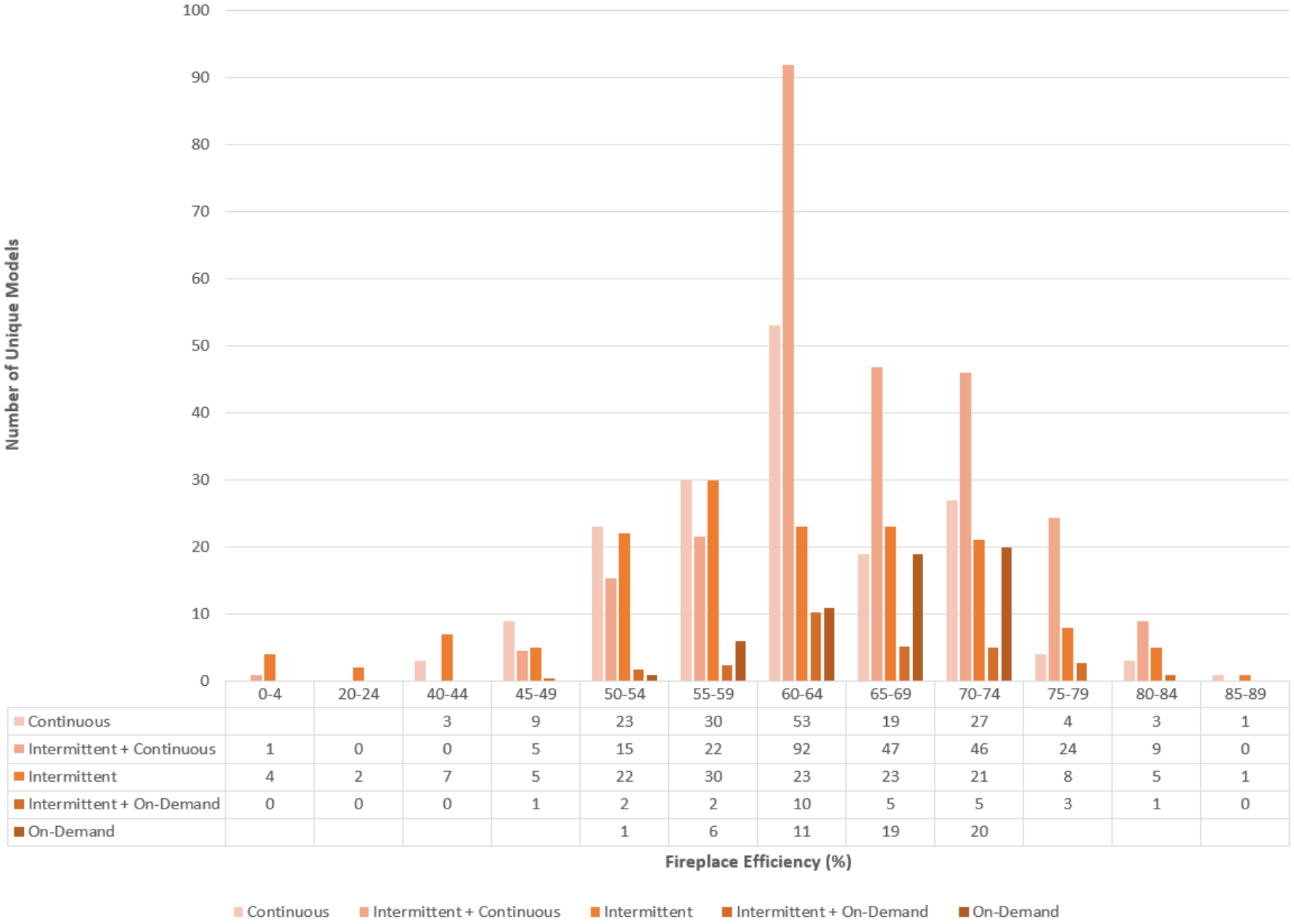
Figure C-3: Propane Gas Heating Fireplaces – Fireplace Efficiency vs. Input Capacity



	0-4	20-24	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89
10,000-19,999	1		4	2	11	21	43	23	7	3	1	
20,000-29,999	3		4	11	25	27	55	42	45	11	9	1
30,000-39,999	1		1	4	4	20	36	48	38	24	8	2
40,000-49,999		1	1		1	7	13	18	12	6	3	
50,000-59,999						1	2	4	1	4	1	
60,000-69,999						1	1					1

Source: Energy Commission staff calculation

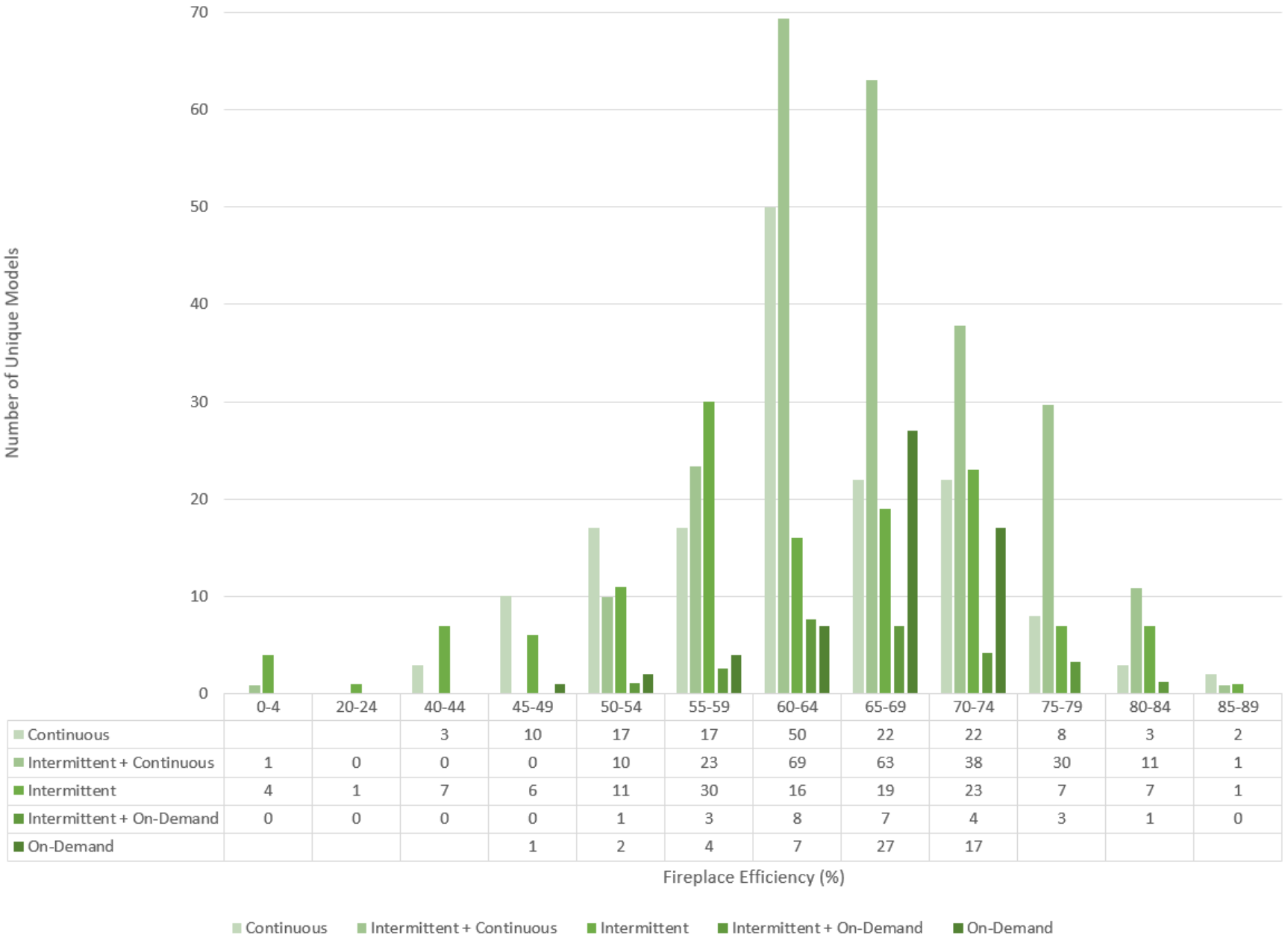
Figure C-4: Natural Gas Heating Fireplaces – Fireplace Efficiency vs. Pilot Type



	0-4	20-24	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89
Continuous			3	9	23	30	53	19	27	4	3	1
Intermittent + Continuous	1	0	0	5	15	22	92	47	46	24	9	0
Intermittent	4	2	7	5	22	30	23	23	21	8	5	1
Intermittent + On-Demand	0	0	0	1	2	2	10	5	5	3	1	0
On-Demand					1	6	11	19	20			

Source: Energy Commission staff calculation

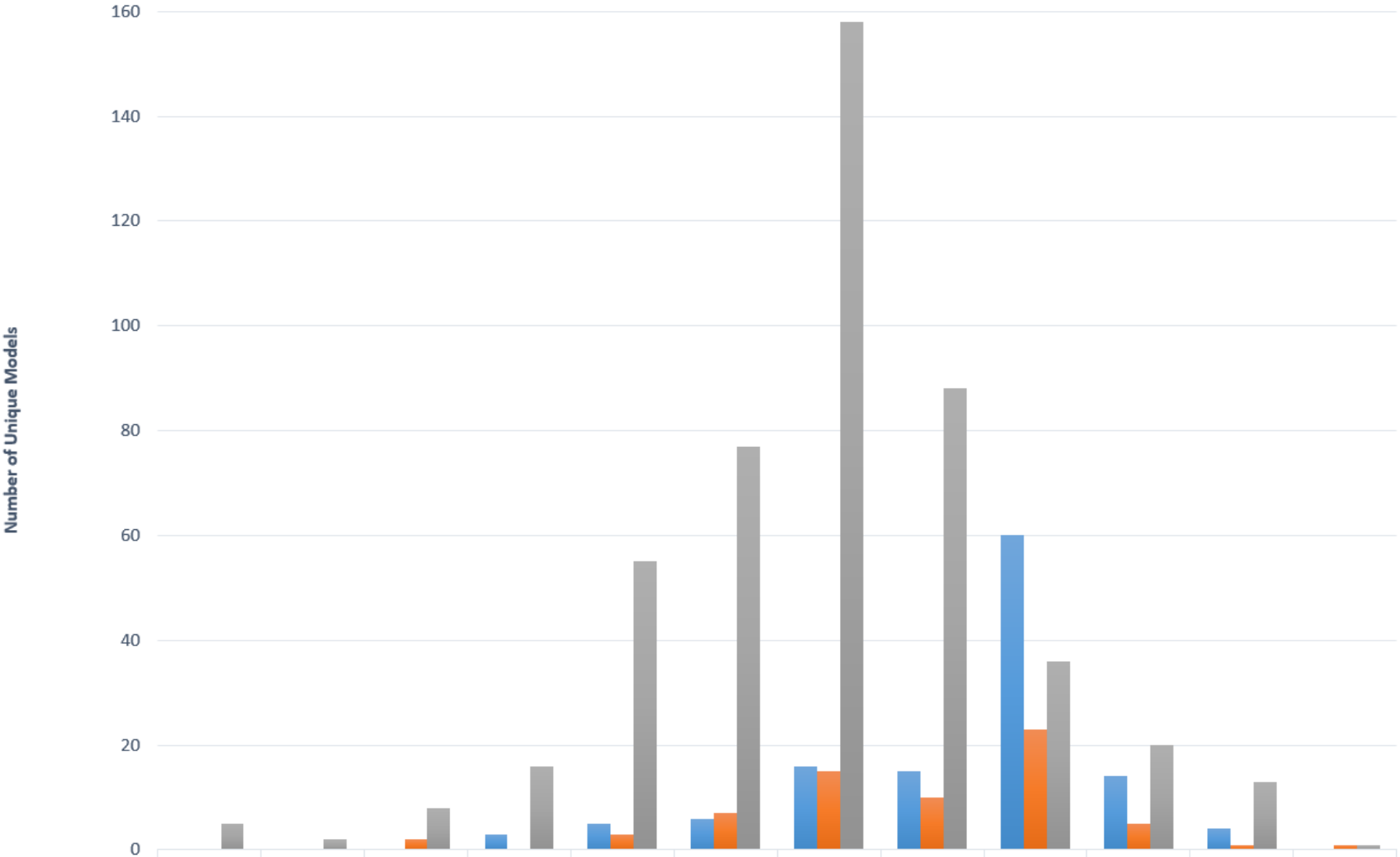
Figure C-5: Propane Gas Heating Fireplaces – Fireplace Efficiency vs. Pilot Type



	0-4	20-24	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89
Continuous			3	10	17	17	50	22	22	8	3	2
Intermittent + Continuous	1	0	0	0	10	23	69	63	38	30	11	1
Intermittent	4	1	7	6	11	30	16	19	23	7	7	1
Intermittent + On-Demand	0	0	0	0	1	3	8	7	4	3	1	0
On-Demand				1	2	4	7	27	17			

Source: Energy Commission staff calculation

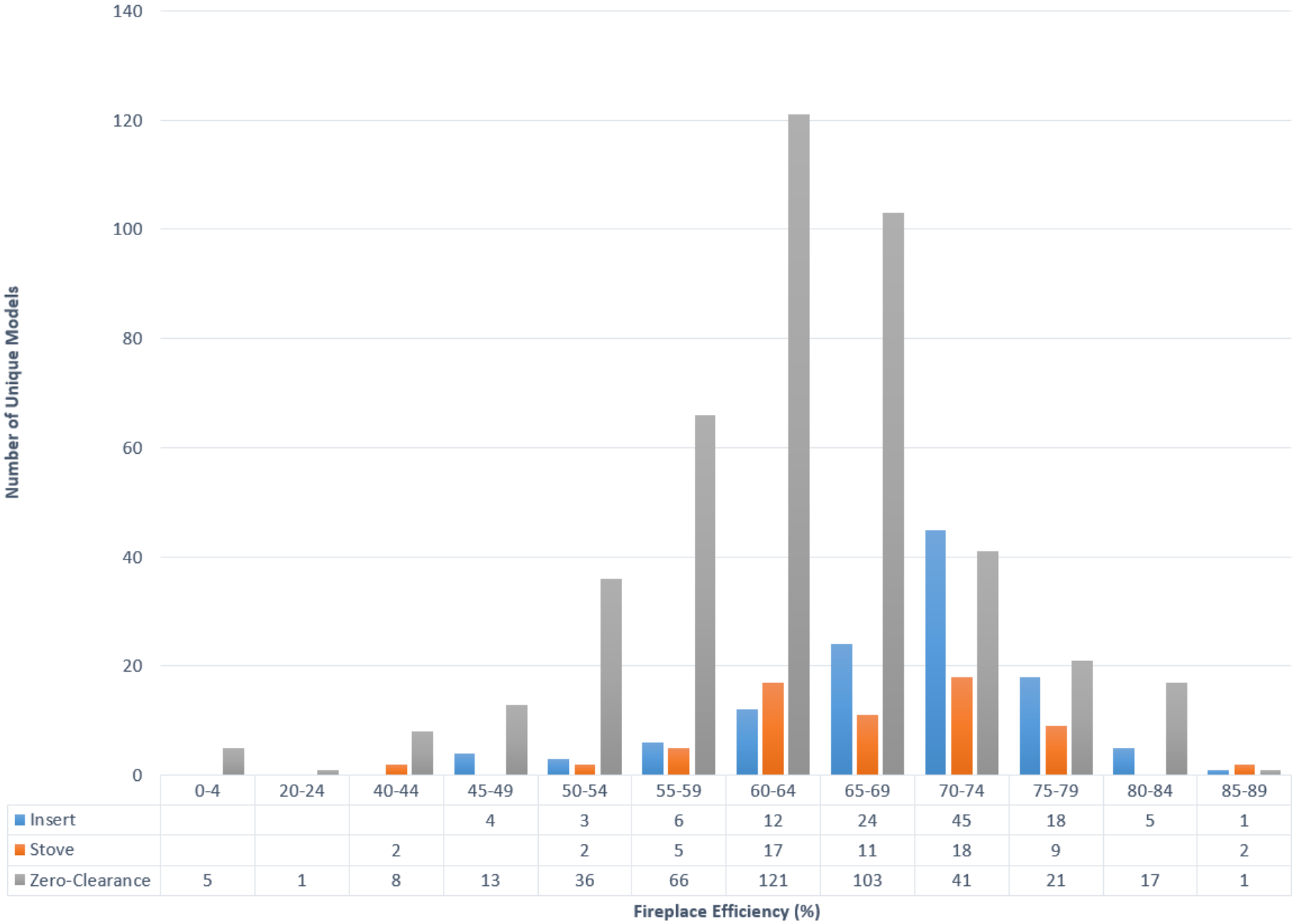
Figure C-6: Natural Gas Heating Fireplaces – Fireplace Efficiency vs. Fireplace Configuration



	0-4	20-24	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89
Insert				3	5	6	16	15	60	14	4	
Stove			2		3	7	15	10	23	5	1	1
Zero-Clearance	5	2	8	16	55	77	158	88	36	20	13	1

Source: Energy Commission staff calculation

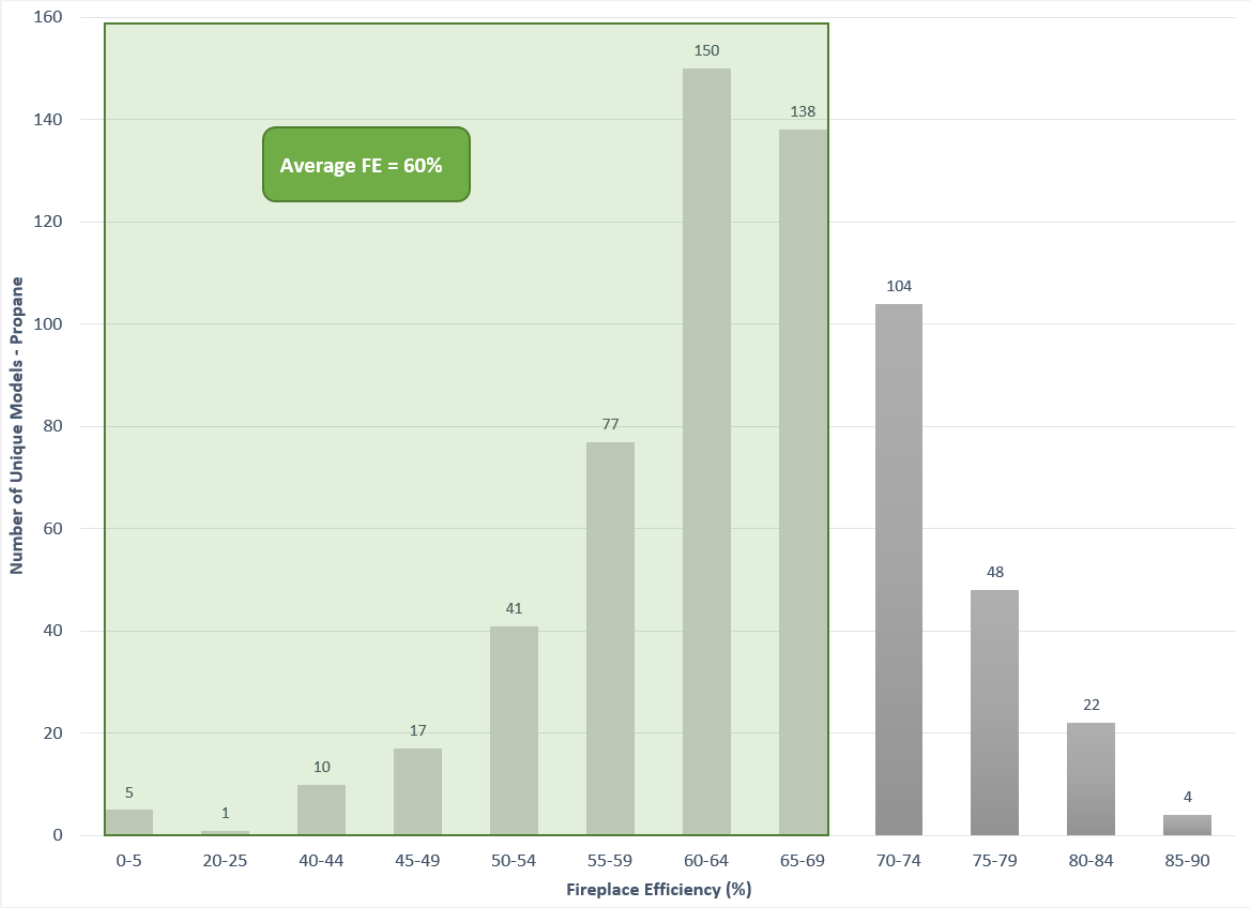
Figure C-7: Propane Gas Heating Fireplaces – Fireplace Efficiency vs. Fireplace Configuration



	0-4	20-24	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89
Insert				4	3	6	12	24	45	18	5	1
Stove			2		2	5	17	11	18	9		2
Zero-Clearance	5	1	8	13	36	66	121	103	41	21	17	1

Source: Energy Commission staff calculation

Figure C-8: Propane Baseline Fireplace Efficiency Ratings Distribution



Source: Energy Commission staff research

Tables

Table C-1: Baseline First-Year Natural Gas-Fueled Hearth Products Stock

Pilot Type	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces
Continuous Pilot	140,552	2,396	34,701	15,420
Intermittent Pilot	103,297	21,565	3,253	23,644
On-Demand Pilot	54,189	7,188	553	4,112
Intermittent + On-Demand Pilot	22,183	1,438	11,929	617
Intermittent + Continuous	199,651	12,939	553	5,551
Total Units	**519,872**	**45,526**	**50,989**	**49,344**
†Stock for gas logs includes vented and outdoor types.				

Source: Energy Commission staff calculation

Table C-2: Baseline First-Year Propane-Fueled Hearth Products Stock

Pilot Type	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces
Continuous Pilot	6,200	106	1,531	680
Intermittent Pilot	4,557	951	144	1,043
On-Demand Pilot	2,390	317	24	181
Intermittent + On-Demand Pilot	979	63	526	27
Intermittent + Continuous	8,807	571	24	245
Total Units	**22,934**	**2,008**	**2,249**	**2,177**
†Stock for gas logs includes vented and outdoor types.				

Source: Energy Commission staff calculation

Table C-3: Baseline Full Stock-Turnover Year Natural Gas-Fueled Hearth Products Stock

Pilot Type	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces
Continuous Pilot	159,777	2,724	39,448	17,529
Intermittent Pilot	117,427	24,514	3,698	26,878
On-Demand Pilot	61,601	8,171	629	4,674
Intermittent + On-Demand Pilot	25,218	1,634	13,560	701
Intermittent + Continuous	226,960	14,709	629	6,310
Total Units	**590,983**	**51,753**	**57,964**	**56,093**
†Stock for gas logs includes vented and outdoor types.				

Source: Energy Commission staff calculation

Table C-4: Baseline Full Stock-Turnover Year Propane-Fueled Hearth Products Stock

Pilot Type	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces
Continuous Pilot	7,048	120	1,740	773
Intermittent Pilot	5,180	1,081	163	1,186
On-Demand Pilot	2,717	360	28	206
Intermittent + On-Demand Pilot	1,112	72	598	31
Intermittent + Continuous	10,012	649	28	278
Total Units	**26,070**	**2,283**	**2,557**	**2,474**
†Stock for gas logs includes vented and outdoor types.				

Source: Energy Commission staff calculation

Table C-5: Compliant First-Year Natural Gas-Fueled Hearth Products Stock

Pilot Type	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces
Continuous Pilot	133,939	2,189	33,236	14,249
Intermittent Pilot	112,499	22,513	3,561	24,970
On-Demand Pilot	59,016	7,504	605	4,343
Intermittent + On-Demand Pilot	24,160	1,501	13,057	651
Intermittent + Continuous	190,258	11,819	530	5,130
Total Units	**519,872**	**45,526**	**50,989**	**49,344**
†Stock for gas logs includes vented and outdoor types.				

Source: Energy Commission staff calculation

Table C-6: Compliant First-Year Propane-Fueled Hearth Products Stock

Pilot Type	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces
Continuous Pilot	5,909	97	1,466	629
Intermittent Pilot	4,963	993	157	1,102
On-Demand Pilot	2,603	331	27	192
Intermittent + On-Demand Pilot	1,066	66	576	29
Intermittent + Continuous	8,393	521	23	226
Total Units	**22,934**	**2,008**	**2,249**	**2,177**
†Stock for gas logs includes vented and outdoor types.				

Source: Energy Commission staff calculation

Table C-7: Compliant Full Stock-Turnover Year Natural Gas-Fueled Hearth Products Stock

Pilot Type	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces
Continuous Pilot	0	0	0	0
Intermittent Pilot	339,773	36,966	11,984	46,744
On-Demand Pilot	178,242	12,322	2,037	8,129
Intermittent + On-Demand Pilot	72,968	2,464	43,942	1,219
Intermittent + Continuous	0	0	0	0
Total Units	**590,983**	**51,753**	**57,964**	**56,093**
†Stock for gas logs includes vented and outdoor types.				

Source: Energy Commission staff calculation

Table C-8: Compliant Full Stock-Turnover Year Propane-Fueled Hearth Products Stock

Pilot Type	Heating Fireplaces	Decorative Fireplaces	Gas Logs†	Outdoor Fireplaces
Continuous Pilot	0	0	0	0
Intermittent Pilot	14,989	1,631	529	2,062
On-Demand Pilot	7,863	544	90	359
Intermittent + On-Demand Pilot	3,219	109	1,938	54
Intermittent + Continuous	0	0	0	0
Total Units	**26,070**	**2,283**	**2,557**	**2,474**
†Stock for gas logs includes vented and outdoor types.				

Source: Energy Commission staff calculation

Table C-9: Detailed Determination of Pilot Secondary Effects

Pilot Secondary Effects	Heating Fireplace	Decorative Fireplace	Gas Log
Continuous Pilot Impact on Main Cooling System (Btu/yr)	80,478	34,924	22,942
Continuous Pilot Impact on Main Heating System (Btu/yr.)	1,374,891	596,646	391,947
Secondary Effects - Standing Pilot (Btu/yr.)	**-1,294,413**	**-561,722**	**-369,005**
Intermittent Pilot Impact on Main Cooling System (Btu/yr.)	6,526	1,585	1,616
Intermittent Pilot Impact on Main Heating System (Btu/yr.)	111,488	27,080	27,611
Secondary Effects - Intermittent Pilot (Btu/yr.)	**-104,962**	**-25,495**	**-25,995**
On-Demand Pilot Impact on Main Cooling System (Btu/yr.)	51,016	14,667	11,838
On-Demand Pilot Impact on Main Heating System (Btu/yr.)	871,565	250,576	202,242
Secondary Effects - On-Demand Pilot (Btu/yr.)	**-820,549**	**-235,909**	**-190,404**
Intermittent + On-Demand Pilot Impact on Main Cooling System (Btu/yr.)	53,567	15,401	12,627
Intermittent + On-Demand Pilot Impact on Main Heating System (Btu/yr.)	915,144	263,105	215,725
Secondary Effects - Intermittent + On-Demand Pilot (Btu/yr.)	**-861,577**	**-247,704**	**-203,098**
Intermittent + Continuous Pilot Impact on Main Cooling System (Btu/yr.)	80,478	36,670	24,472
Intermittent + Continuous Pilot Impact on Main Heating System (Btu/yr.)	1,374,891	596,646	391,947
Secondary Effects - Intermittent + Continuous Pilot (Btu/yr.)	**-1,294,413**	**-559,976**	**-367,475**

Source: Energy Commission staff calculation