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California Energy Commission

STAFF PAPER

Introduction to Flexible Demand Appliance Standards

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ABSTRACT

Senate Bill 49 (SB 49, Skinner, Chapter 697, Statutes of 2019) gives the California Energy Commission (CEC) the authority to set flexible demand appliance standards and labeling requirements.

This staff paper introduces the statutory requirements for flexible demand appliance standards within the context of a broader statewide energy policy framework that enables progress toward a 100 percent clean electricity supply. Flexible demand appliance standards will promote technologies to schedule, shift, and curtail appliance operations to support grid reliability, benefit consumers, and reduce greenhouse gas emissions associated with electricity generation. While a small number of other flexible demand appliance initiatives do exist internationally, to date no federal or state regulations have mandated the robust flexible demand appliance standards consistent with those envisioned by SB 49.

This report also describes staff knowledge of current potential approaches to flexible demand appliance standards and requests stakeholders provide information to inform staff as they develop and evaluate proposals for these appliances.

Keywords: Flexible demand, appliance standards, load management, Senate Bill 49, cost-effectiveness, cybersecurity, grid reliability

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EXECUTIVE SUMMARY

Introduction

Since 1976, the California Energy Commission (CEC) has adopted cost-effective and technically feasible appliance standards that set a minimum level of energy or water efficiency as part of the CEC's mandate to reduce the wasteful, uneconomic, inefficient, or unnecessary consumption of energy. Senate Bill 49 (SB 49, Skinner, Chapter 697, Statutes of 2019) creates a new authority for the CEC to adopt flexible demand appliance standards and labeling requirements to improve grid reliability, minimize electrical grid greenhouse gas emissions, and benefit California consumers. Flexible demand technologies provide the capability to shift timing of when appliances consume electricity to better match energy demand and supply, as well as enable excess renewable electricity production to be used rather than curtailed. Policies and appliance regulations that increase the flexible demand resources available to the grid will allow a more reliable, affordable, and clean electricity grid as the share of intermittent renewable wind and solar power grows.

SB 49 requires the development of standards that promote flexible demand technologies centered around consumer interests and benefits, mandating opt-in for participation in any load flexibility programs while prioritizing open source standards that maintain privacy and security. Eventual standards will also provide savings to household and business energy bills, which are increasingly important to low-income households and small businesses. Flexible demand appliance standards will help to minimize the use of fossil fuels for electricity generation at the least overall costs and reduce disproportionate impacts of fossil fuel power plants on disadvantaged communities within California.

Framework for Flexible Demand Appliance Standards

SB 49 requires the CEC to evaluate any proposed flexible demand appliance standards for technical feasibility, cost-effectiveness, cybersecurity, grid reliability, consumer consent, and ease of use. Staff must also propose regulations that provide the necessary process to comply with and enforce the flexible demand appliance standards, including potential labeling requirements.

Staff is aware of a range of candidate flexible demand appliance standards at different stages of maturity that could be considered based on an initial literature review. Each of these potential standards, as well as any other proposed by stakeholders, will need to be evaluated according to the criteria listed above and prioritized based on projected bill savings, greenhouse gas emissions reductions, and technical readiness.

Recognizing the important contributions these standards will make to supporting grid reliability and reducing GHG emissions, the CEC seeks to accelerate development of an initial rulemaking covering a first set of appliance technologies. At the same time, staff will be building a body of knowledge and filling technology gaps related to the range of further candidate appliances that could be addressed in subsequent rulemakings.

CEC Seeks Proposals From Stakeholders

Staff seeks information to identify proposals for flexible demand appliance standards and assist with the performance of cost-effectiveness analyses. Staff also seeks to identify cybersecurity requirements and approaches to compliance and enforcement of these new standards.

CHAPTER 1:
Introduction to Flexible Demand Appliance Standards

Introduction

In October 2019, Governor Gavin Newsom signed Senate Bill 49 (SB 49, Skinner, Chapter 697, Statutes of 2019), giving the CEC the authority to set flexible demand appliance standards and labeling requirements. The law is part of a broader energy and environmental policy focus to address climate change, reduce dependence on fossil fuels, and drive innovation within the California economy.

California Energy and Environmental Policy

The State of California has set ambitious energy and environmental goals to reduce the impacts of climate change caused by greenhouse gas (GHG) emissions. The burning of fossil fuels in the electricity generation, buildings, transportation, industrial, and agricultural sectors all drive changes in the Earth's climate. California government has passed Senate Bill 32 (SB 32, Pavley, Chapter 249, Statutes of 2016) and Senate Bill 100 (SB 100, De León, Chapter 312, Statutes of 2018) to guide state policy. SB 32 requires greenhouse gas emissions be reduced to 1990 levels by 2020 and 40 percent below 1990 levels by 2030. Assembly Bill 3232 (AB 3232, Friedman, Chapter 373, Statutes of 2018) further requires the CEC to assess strategies to achieve this same target and timeframe with equivalent GHG reductions in the California building sector. SB 100 requires 100 percent of retail sales of electricity to be from renewable resources by 2045. California must implement strategies including building decarbonization, load management standards, and flexible demand appliance standards to achieve the climate goals while maintaining a reliable, low-cost energy system.[1]

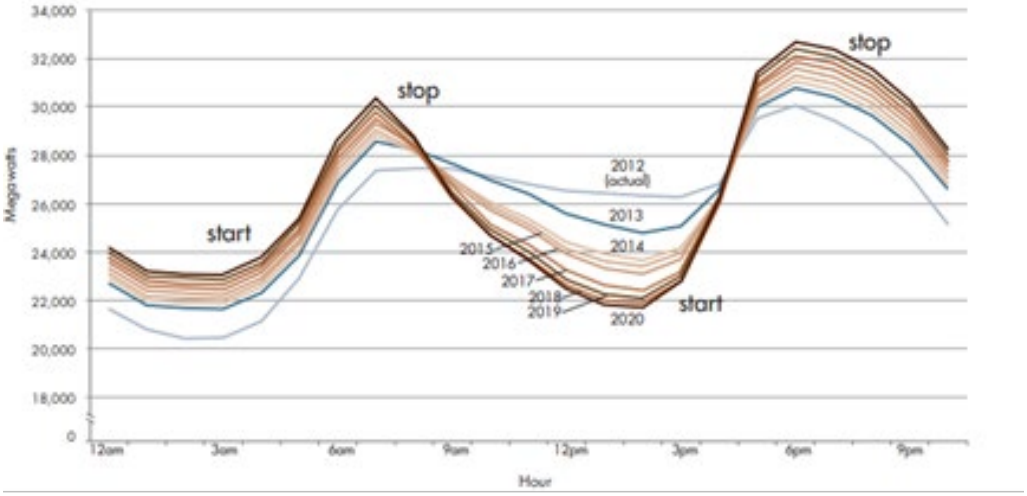
Decarbonization of the electricity sector requires significant increases in the use of renewable resources such as solar and wind. Net load or demand on the grid has been described as the "Duck Curve" and represents the difference between renewable electricity production and demand on the system. Net load varies by time of day, as shown in **Figure 1**. Conventional fossil fuel gas power plants must ramp up or down electricity production in response to

1 Building decarbonization refers to a variety of activities that reduce GHG emissions from buildings including a more renewable energy supply, implementing deep energy efficiency, and installing flexible demand technology. Load management standards are programs to encourage use of electrical energy at off-peak hours or assist with control of the daily electrical load.

changes in electrical demand and solar or wind production. When the electrical demand is low and solar or wind production is high, there can be a significant overabundance of renewable energy that cannot be compensated for by reducing conventional electricity generation. As a result, curtailment of renewable resources occurs. Renewable curtailments are rising as more solar electricity is introduced as a resource in California. **Figure 2** shows recent increases in the curtailment of renewable resources.

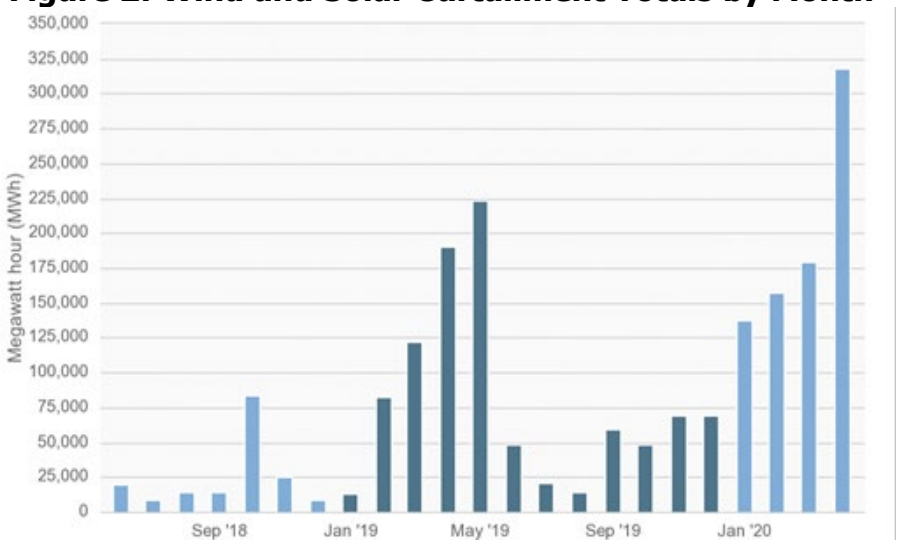
Flexible demand technologies that create the ability to shift when appliances consume electricity will enable excess solar and wind production to be used rather than curtailed. Implementing policies and regulations to increase the flexible demand resources available to the grid will allow a reliable, affordable, and clean grid as the share of intermittent renewable resources grows.

Figure 1: Net Load on the Electrical Grid (Duck Curve)



Source: California Independent System Operator

Figure 2: Wind and Solar Curtailment Totals by Month



Source: California ISO

Increasing Flexible Demand Through Appliance Standards

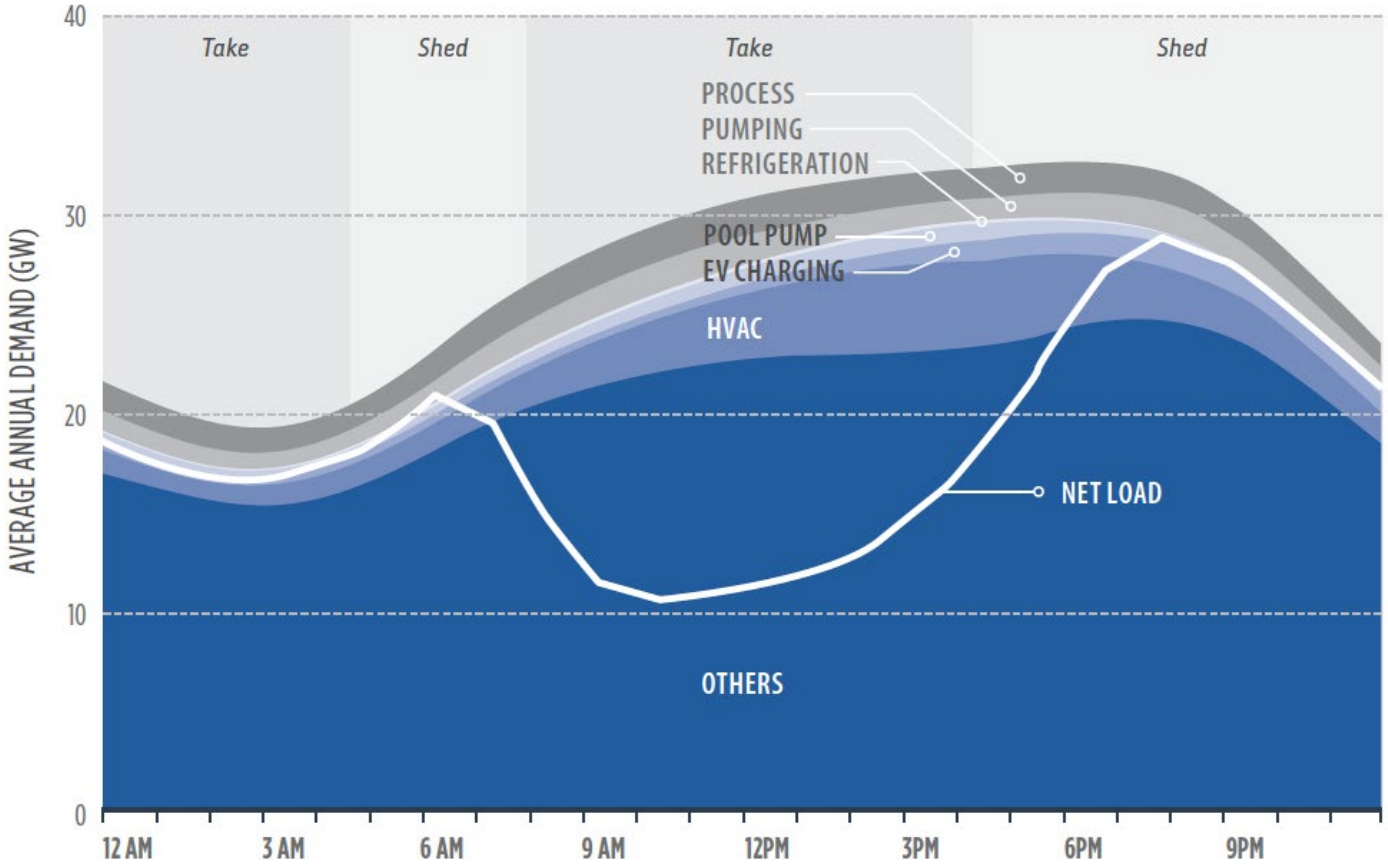
Flexible demand is a load-management strategy that allows a shift in the timing of electricity consumption through market price signals and appliance automation. Flexible demand contrasts with demand response in that the former may be implemented more frequently, across many customers and in a way that would save customers money without any inconvenience to consumers. Flexible demand in appliances will shift electricity use to maintain a reliable and affordable supply of electricity.

Flexible demand may be implemented through already existing technology and infrastructure. Automated metering infrastructure (AMI) is widely available within California. When AMI is paired with time-varying rate structures, customers would receive benefits by shifting appliance loads to off-peak times. There are many examples of appliances that may be shifted to avoid peak load prices including pool pumps, space heating, ventilation and air-conditioning equipment, refrigeration, electric vehicle service equipment, electric clothes dryers, dishwashers, and electric hot water storage tank heaters.

The Legislature and Governor have granted the CEC authority under SB 49 to establish flexible demand appliance standards across a range of appliances within the residential, commercial and industrial sectors. The flexible demand appliance standards may include communication protocol requirements so that appliances can respond to grid conditions, price signals, or GHG emissions content of electricity supplies or a combination. The standards may also include minimum load-shift performance requirements to ensure that appliances react in a way that yields benefits to the grid and the consumer.

Lawrence Berkley National Lab under contract to the CPUC determine that by 2025 California could shift between 2% and 5% of the daily load. The shifting of load could lead to savings of 200-600 million dollars in costs associated with curtailment of renewable generation. **Figure 3** shows the average annual daily load shape in 2025 with several of the analyzed shift able load uses highlighted.

Figure 3: Average Annual Load Shape with Shift able Load Uses



Source: CPUC Working Group on Load Shift January 31, 2019

Load management slows rising electricity costs and improves grid reliability by improving time-of-use efficiency of electricity consumption. Load management standards (LMS) support these goals by encouraging increased demand flexibility of the energy system - minimizing cost, improving reliability, and promoting renewable energy resources. Flexible demand appliances standards will be complimentary to Load Management Rulemakings to increase demand flexibility in California's energy systems, while ensuring that cost and benefits are equitable.

Framework for Flexible Demand Appliance Standards

SB 49 provides a framework for the CEC to set flexible demand appliance standards. Staff will consider technical feasibility, cost-effectiveness, cybersecurity, reliability, consumer consent, and ease of use when evaluating proposals. Staff will coordinate with the California Public Utilities Commission, load serving-entities, and the California Independent System Operator to align flexible demand appliance standards with other demand response programs administered by the State and load-serving entities.

Technical Feasibility

CEC staff must show that proposed standards will promote the capability to shift a significant amount of statewide electricity load. Staff will gather information on the load shape of appliance types, an analysis of when the appliance is used during the day and throughout the year. An appliance with greater use during periods of higher grid GHG emissions would provide

more desired load-shift potential. Staff will also use size of the appliance load, annual energy consumption, statewide stock, and rate of turnover to estimate the load-shift potential.

Staff must show that proposed standards are achievable by the effective date of new regulations. The evidence staff uses can include descriptions of products in the marketplace or test data from appliances demonstrating compliance with the proposed standards.

Cost-Effectiveness

Staff must show that the proposed standards are cost-effective. Staff shall consider the cost of flexible demand technologies in appliances compared to nonflexible demand appliances, the value of increased or decreased GHG emissions associated with the timing of appliance use, the life-cycle cost to the consumer from using a product that complies with the standard, and the life-cycle costs and benefits to consumers, including the ability to better align consumer demand and electric system supply. Grid reliability benefits will result from improved alignment of electricity demand and supply.

Cybersecurity and Reliability

The SB 49 statutes require the CEC to consider the National Institute of Standards and Technology's reliability and cybersecurity protocols, or other cybersecurity protocols that are equally or more protective. The CEC shall adopt, at a minimum, the North American Electric Reliability Corporation's Critical Infrastructure Protection standards. The CEC will review approaches taken by industry and government in developing cybersecurity standards for flexible demand technologies and appliances.

Consumer Consent and Ease of Use

Statute requires consumer consent. The CEC is required to prioritize approaches with user-friendly interfaces, a straightforward setup and connection process, and options that follow simple standards for third-party direct operation. The CEC shall also prioritize approaches where load-management technology is readily available and that are interoperable and open source to maximize collaboration among manufacturers, utilities, and third-party aggregators.

Other Key Requirements

The CEC may propose labeling standards to promote the use of appliances with flexible demand capabilities. The effective date for flexible demand appliance standards shall be at least one year after adoption by the CEC.

Compliance Assistance and Enforcement

The Legislature and Governor provided the CEC with the authority to create regulations that include a process to enforce compliance with the standards. This authority is identical to the appliance efficiency enforcement authority under Title 20. CEC staff anticipates proposing flexible demand regulations for appliance certification to a CEC database, mandatory product marking, and enforcement procedures as established with appliance efficiency regulations.

CEC Seeks Proposals From Stakeholders

Staff seeks proposals for flexible demand appliance standards from stakeholders. Staff is committed to working closely with stakeholders to understand the issues and potential

solutions. Staff has a goal to put forward proposals with broad appeal that significantly address climate change and provide benefits to California consumers and improved reliability of the statewide electric grid.

Table 1 summarizes various frameworks developed by others identified through initial staff research. Staff seeks additional proposals to evaluate.

Table 1: Flexible Demand Appliance Frameworks

Organization	Appliances Within Scope	Description of Standards	Voluntary or Mandatory
States of Washington[2] and Oregon[3]	Electric resistance water heater Heat pump water heater	Modular demand response port	Mandatory
U.S. Environmental Protection Agency — ENERGY STAR®[4]	Heat pump water heater Dishwasher Clothes washer and dryer Pool pump Electric vehicle service equipment Central air conditioner Room air conditioner Refrigerator and freezer Thermostat	Connected functionality for grid communications and demand management responses	Voluntary

2 Washington State Revised Code of Washington, Title 19, Chapter 19.260, Section 19.260.080, available at https://app.leg.wa.gov/RCW/default.aspx?cite=19.260.080.

3 Oregon Department of Energy, Energy Efficiency Standards Rulemaking, available at: https://www.oregon.gov/energy/Get-Involved/Pages/EE-Standards-Rulemaking.aspx.

4 U.S. EPA Energy Star Program, Connected Criteria for ENERGY STAR Products, available at, https://www.energystar.gov/products/spec/connected_criteria_energy_star_products_pd.

Organization	Appliances Within Scope	Description of Standards	Voluntary or Mandatory
Air-Conditioning Heating, & Refrigeration Institute[5]	Central air conditioner Heat pump water heater	Test procedures to verify communication and demand response	Voluntary
Association of Home Appliance Manufacturers[6]	Home appliances	Communications and security requirements	Voluntary
Australia and New Zealand[7]	Central air conditioner Pool pump Electric vehicle service equipment Electric resistance water heater Heat pump water heater	Modular demand response port and demand management response	Mandatory

5 Air-Conditioning Heating, & Refrigeration Institute, State Advocacy, available at: http://www.ahrinet.org/policy/state-advocacy.

6 Association of Home Appliance Manufacturers, Connectivity: New Levels of Convenience, available at: https://www.aham.org/AHAM/Innovation/Connectivity/AHAM/Innovation/Connectivity.aspx?hkey=12ff39f3-ebad-4594-959b-3812ffdfff93.

7 Australia and New Zealand Government, Regulation Impact Statement for Decision: 'Smart' Demand Response Capabilities for Selected Appliances, https://www.energyrating.gov.au/document/regulation-impact-statement-decision-smart-demand-response-capabilities-selected-appliances.

Organization	Appliances Within Scope	Description of Standards	Voluntary or Mandatory
CEC Title 24 Building Standards[8]	Heat pump water heater Energy storage systems	Modular demand response port and demand management response	Voluntary
CPUC[9]	Heat pump water heater	Modular demand response port	Voluntary (rebate)

Source: CEC

CEC Seeks Information on the Following Topics

Provide comments on a range of candidate appliance types, examples include:

- electric water heaters;
- electric heating, ventilation, and air conditioning;
- pool pumps;
- electric vehicle service equipment;
- and home appliances.

8 California Energy Codes and Standards, 2022 Code Cycle Single Family Grid Integration, available at: https://title24stakeholders.com/measures/cycle-2022/single-family-grid-integration/.

9 CPUC, Demand Response, available at: https://www.cpuc.ca.gov/general.aspx?id=5924.

Flexible Appliance Demand Response Modes

- What demand response mode signals are accepted by flexible appliances? And why should this standard be considered as a priority?
- What responses are provided by the flexible appliance?
- Can an appliance react to a price or a GHG signal to modify its operation? If so, describe the modification to the operation.
- Identify communication and load control requirements to enable flexible demand in appliances.
- Describe the benefits and costs to the consumer, and to the manufacturer, of an internal vs. an external communications module that accepts signals for flexible demand modes.

Flexible Demand Appliance Standards

- What flexible demand appliance standards would you propose?
- Would the standard proposed rely on appliance design or performance criteria?
- What flexible demand compliance or test procedures for appliances would you propose for design standards criteria?
- What flexible demand appliance test procedures would you propose for performance criteria?

Cost-Effectiveness and Avoided Greenhouse Gas Emissions

- Identify framework and cost-effectiveness studies on flexible demand appliance standards.
- Identify costs of a flexible demand appliance compared to a standard appliance including purchase price, installation, operation, and communications technology costs.
- Identify benefits of participating in flexible demand appliance programs including rebates, utility bill savings, and environmental and health impacts.
- Identify needs of disadvantaged communities and how proposals may affect these communities.
- Identify types of flexible demand programs offered by government, utilities, and third parties.
- Benefits related to improved resiliency of California's electric grid including better response to extreme weather events and wildfire, and lower rates to consumers.

Cybersecurity

- What minimum cybersecurity protocols should be required?
- What cybersecurity standards would you propose?

Compliance Assistance and Enforcement

- Staff believes the current Appliance Efficiency Enforcement regulations provide a good template for the Flexible Demand Appliance Standards (Title 20, Sections 1608 and 1609) and seeks comments on approach to enforcement of new flexible demand appliance standards.
- What unique considerations should be given for enforcement of flexible demand appliance standards as compared to the existing appliance efficiency enforcement approach?

Rulemaking Process

Schedule

The Flexible Demand Appliance Standards rulemaking will use the following projected schedule. As workshop topics and dates are finalized, the CEC will post notices on the docket and website.

Table 2: Estimated Timeline of 2022 Flexible Demand Appliances Rulemaking

Activity	Date
Lead Commissioner Workshop	December 14, 2020
Close of public comment period for workshop	January 4, 2021
Staff Report	3rd Quarter 2021
Initiate Formal Rulemaking	4th Quarter 2021
Public Comment Period Ends	2nd Quarter 2022
Public Hearing	2nd Quarter 2022
Adoption Hearing at CEC of Initial Standards	3rd Quarter 2022
Effective Date of Initial Standards	3rd Quarter 2023

Source: CEC

Participating in the Flexible Demand Appliance Standards

Flexible Demand Appliance Standards will be based on the proceeding record, which may include data and technical analyses by CEC staff and stakeholders. Analysis and information developed in other proceedings at the CEC and by other agencies will be incorporated as appropriate. Participants should use docket number **20-FDAS-01** when submitting information.

Active participation is encouraged because public input is essential to ensure a complete and thorough record. The Lead Commissioner recognizes that close coordination with federal, state, local, and other agencies is critical to identifying and addressing energy infrastructure and related environmental challenges. The Lead Commissioner directs staff to continue working with these agencies to ensure their participation in this proceeding.

The process will include a Lead Commissioner Workshop, to be held on December 14, 2020. Written comments must be submitted to the Docket Unit by **5:00 p.m. on January 4, 2021**. One or more public hearings, and public input periods will follow on the draft text of regulations. All records for the process will be accessible in the Flexible Demand Appliance Standards docket (20-FDAS-01).

CEC staff will notice workshop dates in the docket. When new information is posted, an email will be sent to those on the Load Management list server. To receive these notices, subscribe at the Flexible Demand Appliance webpage, https://www.energy.ca.gov/proceedings/energy-commission-proceedings/flexible-demand- appliances.