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Building Decarbonization Efforts

California Energy Commission

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California Energy Commission
CEC Efforts on Building Decarbonization

This presentation summarizes:

- Updates to Long-standing Regulations
- Implementation of New Legislation
- Key Assumptions for Electricity GHG Intensities
- Ongoing Research & Development
CEC Regulations & Building Decarbonization

- **Building Energy Efficiency Standards (Title-24)**
  - Working towards a performance compliance path for all-electric systems
  - New source energy metric proposed for 2022 title-24 Update

- **Appliance Energy Efficiency Standards (Title-20)**
  - AB 49 (Skinner, 2019) adds demand flexibility to scope of future regulations

- **Load Management Standards (Title-20)**
  - Adopted an Order Instituting Rulemaking in November 2019
  - Focus will be on strategies and technologies to shift electric loads for GHG reductions & cost savings
  - Regulations apply to all Load Serving Entities in California
New Legislation & Building Decarbonization

- **SB 350** (De Leon, 2015)
  - Assess potential to double Energy Efficiency by 2030
  - Increases Renewable Portfolio Standard to 60% by 2030

- **SB 1477** (Stern, 2018)
  - Provides $200M over 4 years for low emission residential new construction & existing residential heating

- **AB 3232** (Friedman, 2018)
  - Assess potential to reduce Building GHGs 40% below 1990 by 2030

- **SB 100** (De Leon, 2018)
  - 100% Zero Carbon Resources for Electricity Retail Sales by 2045
Decarbonization Policy Overview

Sector Scope of Policy Instrument

- SB 100
- AB 3232
- SB 1477
- SB 350
- Load Management Standards
- Building Standards
- Appliance Standards (w/ AB 49)
- Research & Development

Residential | Commercial | Industrial & Agriculture | Transportation
Decarbonization Policy Overview

Planning Horizon of Policy Instrument

- SB 1477
- SB 350
- AB 3232
- SB 100

Years: 2020, 2025, 2030, 2035, 2040, 2045
Assumptions for Current Electricity
GHG Emission Intensities

Electricity Demand:
- 2030 natural gas consumption = 40% below 1990
- Electric heat pumps replace gas space and water heating
- No building envelope efficiency improvements
- No load shifting

Electricity Supply:
- 60% RPS by 2030
- 1200 MW battery storage to maintain traditional levels of resource margin
- Out of state renewables: 80% GHG free, 20% default (0.43 tCO2/MWh)
- Long-term marginal emission intensities: reflects the change in generation resources needed to meet demand change
Electricity GHG Emission Intensities Relative to Natural Gas
Electricity GHG Emission Intensities Relative to Natural Gas

2030 Average Hourly Long Term Marginal Electricity Emission Intensity (tCO2/MW)
Ongoing Research & Building Decarbonization

Building End Use Efficiency Research

Energy-Related Environmental Research
Advancing Low-Carbon Building Research

**Challenges:**
- Cost of equipment and installation
- Consumer acceptance
- Concern about future bill increase

**Goals:**
- Advance emerging technologies
- Document technical and economic performance
- Reduce installation, capital and operating costs
- Obtain real world feedback from consumers
- Ensure benefits to low income or disadvantaged communities

Diagram:
- Improvement in Space Conditioning Systems
- Integrated approaches
- Renewable energy use in buildings
- Building envelopes
- Building Decarb
- Alternative refrigerants
- Improving efficiency of natural gas using appliances
Advancements in Space Conditioning and Alternative Refrigerants

Commercial Building Space Conditioning (EPC-15-004)

- Develop and demonstrate climate appropriate air conditioning system that optimizes occupant comfort and reduce energy use and peak demand
- Includes a combination of variable refrigerant flow technology with indirect evaporative cooling
- Evaluate applicability of low GWP refrigerants
- Initial test results show electric savings of about 33%.

Residential Space Conditioning (EPC-14-021)

- Design and test an advanced residential heat pump space-conditioning system
- Includes variable-capacity compressor and variable speed fans, zonal ventilation control, and other efficient components
- Evaluated applicability and use of low GWP R-32 refrigerants
- Integrated HVAC system showed 22 to 32% cooling energy savings
Integrated Approaches and Reducing Natural Gas Use

**Integrated approaches**: Customer-Centric Approach to Scaling Integrated demand side management (IDSM) Retrofits (EPC-15-053)

- Develop and demonstrate an approach to scale multifamily retrofits in disadvantaged communities that focus on customer needs with minimal disruption to occupants
- Demonstration sites: Ontario and Fresno

**Improvements in Natural Gas Use**: Demonstrating Natural Gas Heat Pumps for Integrated Hot Water and Air-Conditioning in Restaurants (PIR-16-001)

- Goal is to demonstrate a 40% reduction in natural gas usage and offset 20% of the air conditioning cost.
- Pilot sites: two full-service restaurants in Southern California
- Preliminary data shows gas heat pumps able to meet 80% of the hot water demand for the restaurants. M&V to continue for 12 months
Improve Building Envelopes (EPC-16-067)
- Develop thermal building insulation material with high R-value at a cost commensurate with conventional insulation materials
- Includes packed nanoparticle bed to reduce the cost of manufacturing and lead to high mechanical strength.
- The goal is to develop insulation with a R/inch value of at least 9

Increase Renewable Energy Use (500-15-006)
- Demonstrate aluminum mini-channel solar water heating collectors on residential buildings in the Los Angeles Basin
- Potential to reduce the upfront cost of solar water heating by 30%
Research on Methane Leaks from California’s Natural Gas System

- Traditionally, analyses of natural gas sector emissions only considered sources inside the black rectangle.
- CEC’s research program has expanded this limited view to include other potential sources of emissions.
- Official GHG inventories do not include most of these “downstream of the meter” emissions.

Adapted from:
California Statewide Methane Survey for Point Sources

Led by JPL and recently published in *Nature*, a large field study funded by ARB, NASA/JPL, and CEC characterized point sources from multiple sectors based on airborne survey.\(^1\)

**Highlights:**

- **Point sources** (>~ 10 kg/hr of methane) **emit** an equivalent to 34-46% of the state’s 2016 methane inventory.
- Methane emissions from **associated wells** in the southern part of the SJ Valley are equivalent to about 4% of natural gas production.
- Results in all sectors investigated, including landfills and dairy farms, generally show **discrepancies from results based on standard estimation methods.**

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Available online at: [https://www.nature.com/articles/s41586-019-1720-3](https://www.nature.com/articles/s41586-019-1720-3)
- A CEC-sponsored field study conducted measurements of residential behind-the-meter emissions in ~75 homes using blower door test.¹
- Results suggest that leaked natural gas is ~0.5% of total residential consumption, valued at approximately $30,000,000 per year.
- CARB used results as basis for inclusion of residential post-meter natural gas leaks in the most recent GHG inventory (published 2019).²
- The PIER natural gas R&D funding request for FY 2019-2020³ includes support for further characterization of methane emissions from the residential sector.


Source: LBNL. Provided in support of CEC grant 500-13-006.
Additional, Ongoing Research on Methane Emissions Beyond the Residential Sector

- Field measurements in non-residential buildings, including hospitals and restaurants. (PIR-15-003, PIR-15-017)
- Field measurements in industrial sector, including: natural gas power plants, CNG fueling stations, etc. (PIR-16-014)
- Development of blueprint design for cost-effective continuous measurement of methane leaks across the entire NG system, including residential, commercial, and industrial sectors, as well as production fields. (PIR-17-015)