Building Decarbonization: Opportunities and Policy
Electrification of buildings in context

To minimize climate change impacts, we need to reduce GHG emissions by **80% by 2050** (below 1990)

80/50 Decarbonization Framework

- Energy Efficiency
- Decarbonize the grid
- Electrify vehicles and buildings
- Decarbonize remaining fuels
Buildings ≈ 2nd largest source of GHGs in CA (including emissions from gas + electricity use)

**Emissions by Economic Sector**

- Combustion emissions ≈ all in-state power plants
- Not including fugitive methane ≈ 60% combustion GHG impacts

2015 Total CA Emissions: 440.4 MMTCO2e

Source: [www.arb.ca.gov/cc/inventory/data/data.htm](http://www.arb.ca.gov/cc/inventory/data/data.htm)

(1) For a 2% leakage rate and 20-year GWP
Electricity use still the majority of GHG emissions from buildings, but as the grid gets cleaner, natural gas becoming a major contributor.

Average Household CO2 emissions from energy use

- Note including emissions from methane and other high global warming potential gases
Heat pump technology can electrify over 90% of thermal end uses

Figure ES-6: Statewide Natural Gas Energy Consumption
354 therms per household

- **Space Heating**: 37%
- **Water Heating**: 49%
- **Cooking**: 7%
- **Pools, Spas, Misc**: 4%
- **Dryer**: 3%

Source: 2010 California Residential Appliance Saturation Survey

NRDC
Heat pumps 101

Extracts, concentrates, and moves (or “pumps”) heat from surrounding air into tank or building
Like a fridge or A/C in reverse

250 to 400% efficient!
Hybrid heat pumps

Many heat pumps are “hybrids”, they have both a heat pump, and a backup resistive element for:

- high demand periods
- very cold periods

Like plug-in hybrid cars (e.g. Chevy Volt)

But new technologies can work down to -20F in heat pump only mode
Heat pumps value benefits: Much more than GHGs!

- **Superior comfort (air source heat pumps)**
- **Air quality and health**
- **Safety and resiliency**
- **Save energy and lower bills***
  * Depends on electricity tariffs and local conditions
- **New jobs to retrofit buildings, install heat pumps**
- **Slashes GHGs, path to Zero Emissions Buildings**
Water heater CO2 emissions
As CA grid gets cleaner, HPWH offer pathway to near zero-GHG hot water

1) Not including fugitive methane emissions, which may roughly double GHG emissions from gas
2) With 45%-efficient combined cycle gas plant as long-run marginal resource
Grid-interactive heat pump water heaters can help deep integration of renewable energy

- NRDC et. al. study in-progress to quantify the load shifting capacity and value of HPWH, report planned June 2018

![Diagram showing load shedding and charge during off-peak hours.](image)
Barriers: What’s hindering adoption?

Awareness/perception
- “Heat what?”
- “Clean natural gas”...
- Gas cooking

Costs
- Equipment: capital cost
- Installation: circuit, panel
- Operation: rate design

Access
- On-truck
- In-store
- Supply-chain

Technology
- Installation cost reduction
- Controls
- Cold temperature performance

Regulatory
- CEC: Building code compliance
- CPUC: incentives, rates...
- ARB: Scoping Plan
Accelerate the transition of the building sector to clean energy

2018
- Jump start space and water heating market transformation to clean heating technology

2030
- Most replacements and new buildings use clean heating technology

2050
- Most buildings have transitioned to clean heating
- Building sector GHGs 90% lower than 1990
Theory of Change

Raise awareness

Remove regulatory barriers

Develop market

Policy
Key policy opportunities

Local Gov’t, Air Districts
- Public education
- Workforce development
- Clean heating rebates
- Bulk buy programs

Utilities
- Pilot programs
- Incentive programs
- Electrification-friendly rates

CPUC
- Incentive programs
- Electrification-friendly rates
- San Joaquin Valley

CEC
- Building Code
- IEPR
- SB 350 Double EE Savings
- AB 758 Existing Building

CARB
- Scoping Plan
- Cap and trade funding
- Leakage emissions
- Health impacts of fossil fuel combustion in buildings

Legislation
- GHG targets in buildings
- Remove regulatory barriers
- Allocate funding
- Assess leakage emissions
Building Decarbonization Policy Action
Supporters (as of 4/6/2018)

And the following organizations: Beyond Efficiency; Design Avenues; EHDD; Guttman Blaevot; Integral; Interface Engineers; Leddy Mayton Stacy Brown and Green Architects; Menlo Spark; Mogavero Architects; Point Energy Innovations; Redwood Energy; SEA; Siegel & Strain Architects
Thank you!

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