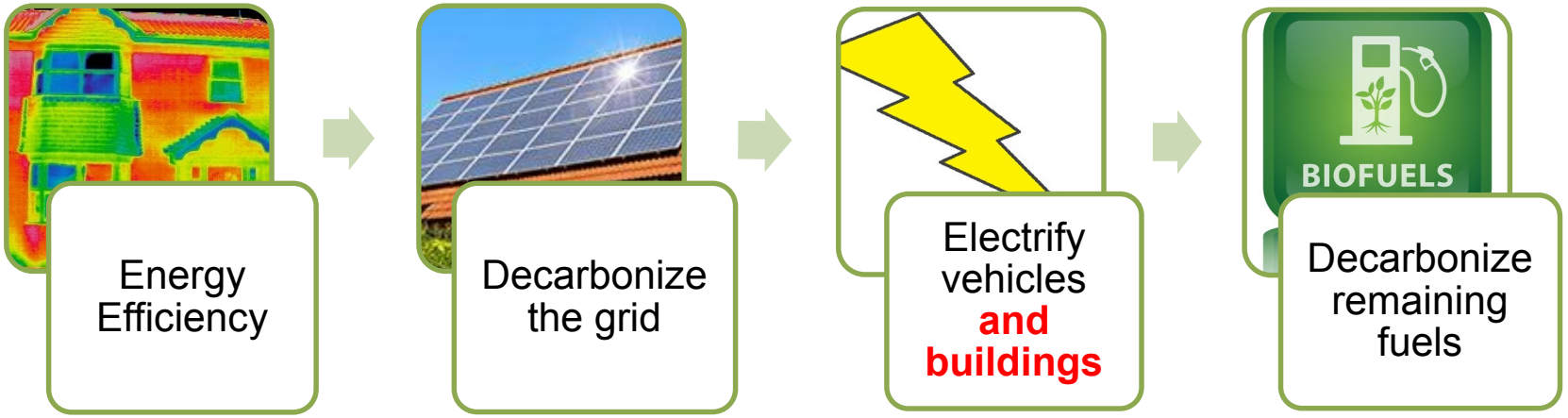
Policy Pathways for Building Decarbonization

Pierre Delforge, pdelforge@nrdc.org, October 17, 2018

Electrification of buildings in context

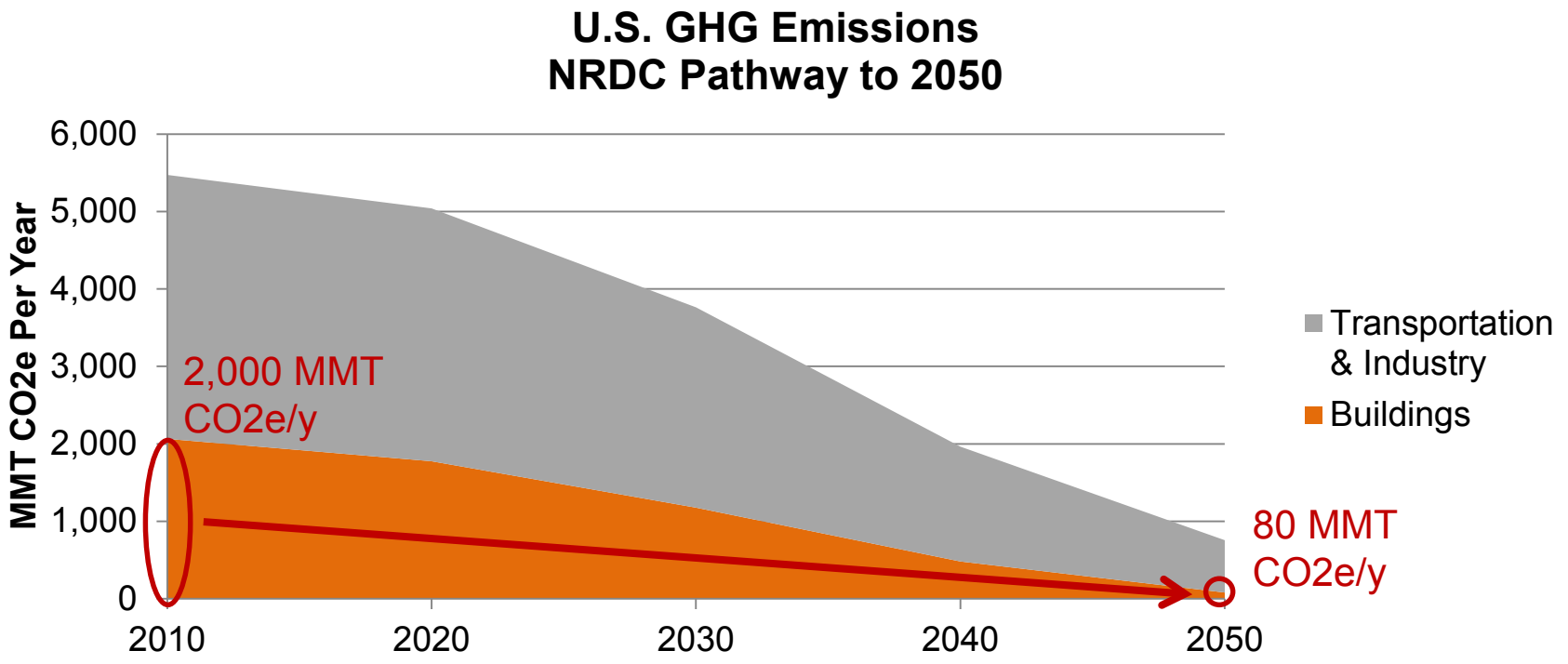
To minimize climate change impacts, we need to reduce GHG emissions by 80% by 2050 (below 1990)

80/50 Decarbonization Framework



Why decarbonize heat in buildings?

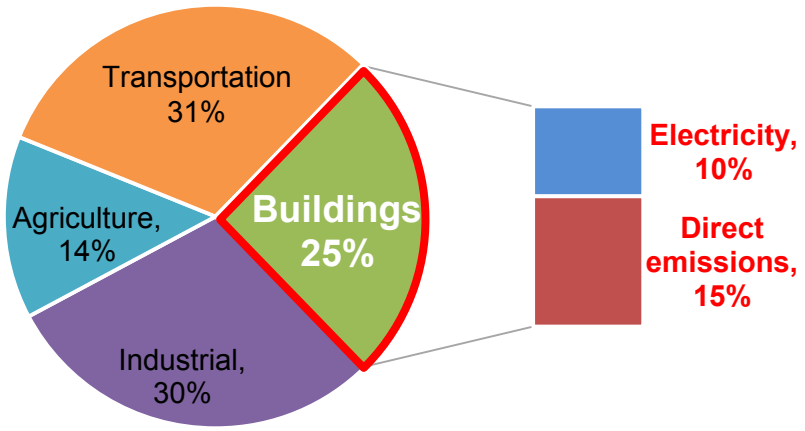
- Buildings ≅ **40%** of U.S. GHG emissions
- Need **95%** building GHGs reduction from EIA baseline by 2050*



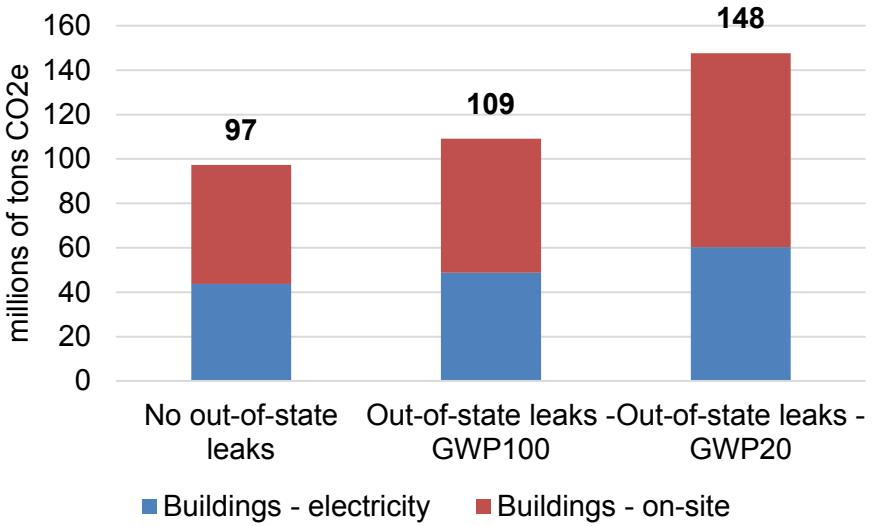
*NRDC, "America's Clean Energy Frontier: The Pathway to a Safer Climate Future", Sept. 2017

Building emissions in CA

CA 2016 Emissions, Demand-Side



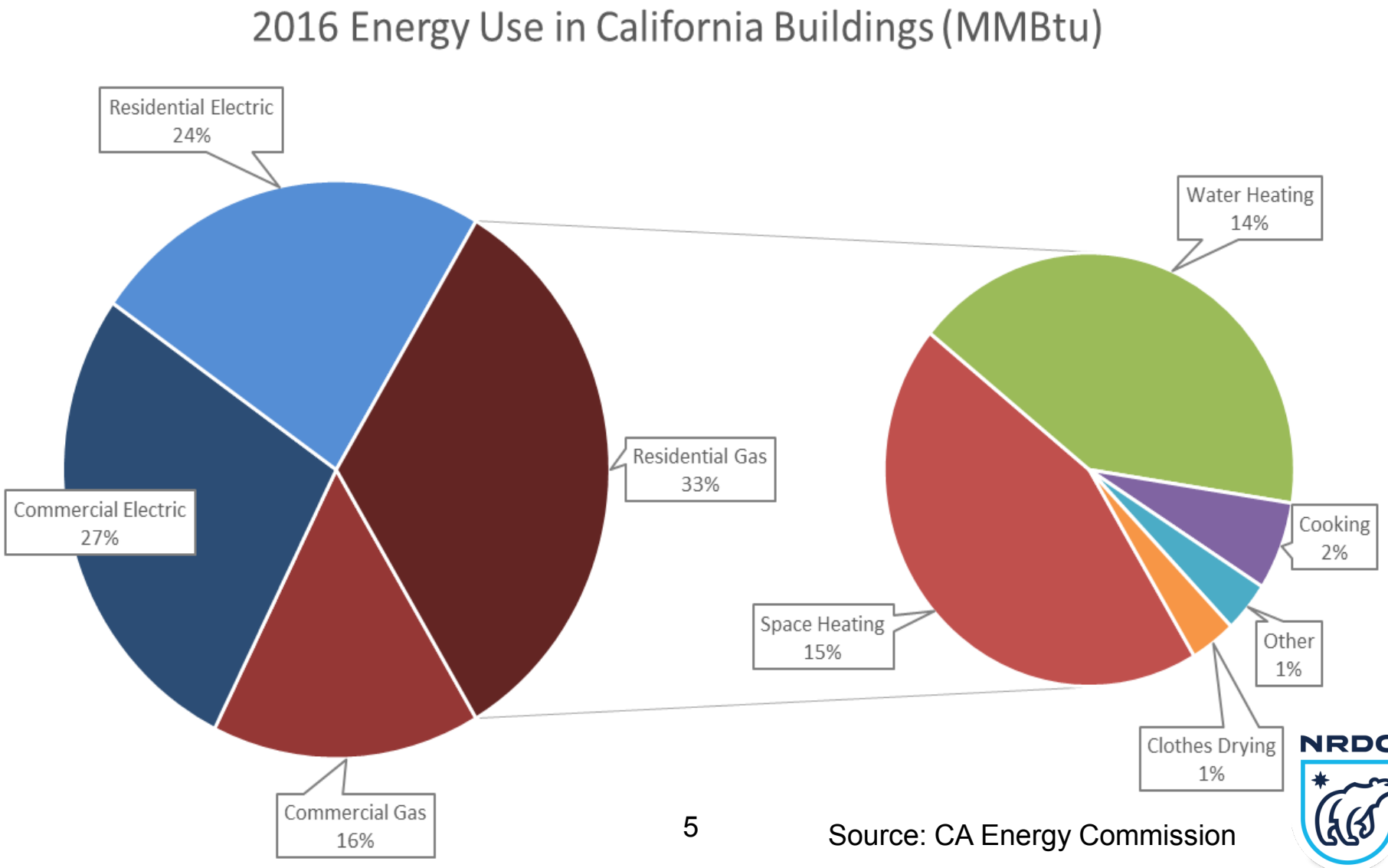
CA 2016 Building Emissions



- Demand-side view of building emissions, including:
  - ☑ Direct onsite emissions
  - ☑ Electricity generation emissions
  - ☑ fugitive methane from extraction, distribution, use

Source: Vukovich, Delforge, NRDC blog, The Real Climate Impact of California's Buildings, 9/18/2018

Gas fuels ≅ half of CA site energy use
Space heating and DHW top two residential uses



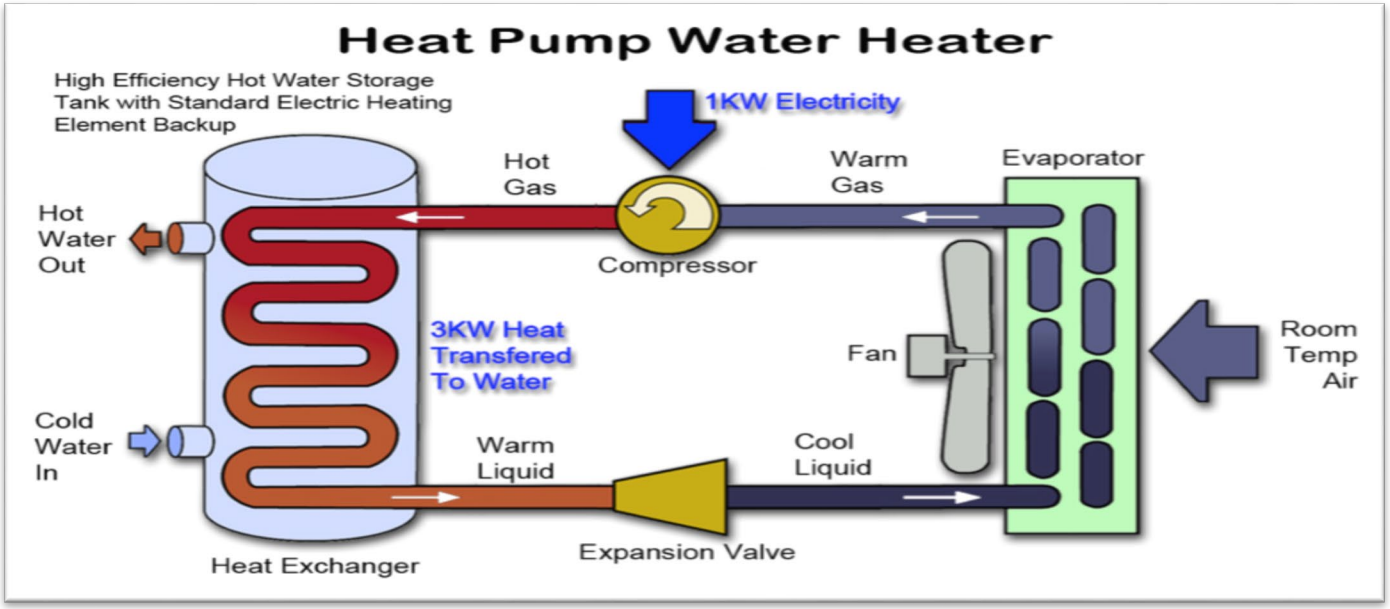
Source: CA Energy Commission

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

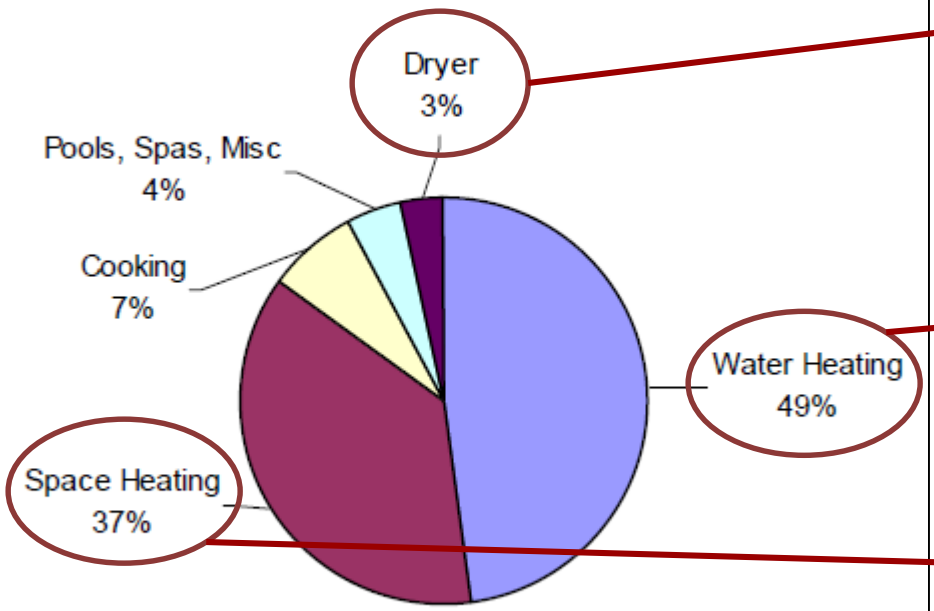
200% to 300% efficient!



Heat pump technology can electrify 90% of thermal energy use in homes

Figure ES-6: Statewide Natural Gas Energy Consumption

354 therms per household



Source: *2010 California Residential Appliance Saturation Survey*

Heat-pump clothes dryer

Heat-pump water heater

Heat pump space heating

Toward Zero Net Energy (ZNE/NZE) 2.0

Zero Annual Energy ➔ Zero Hourly Emissions
(or Zero Emissions Buildings/ZEB)

2 key differences:

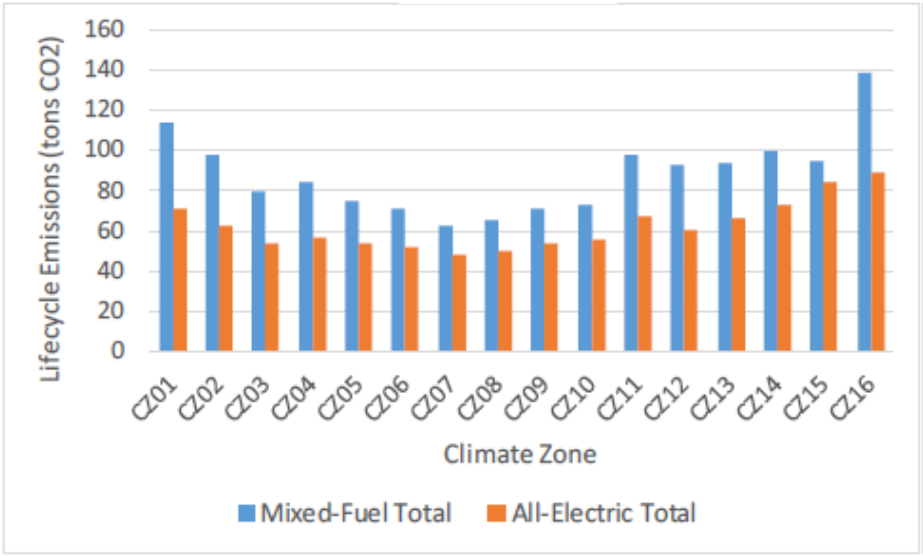
1. Energy ➔ Emissions

2. Annual ➔ Hourly Netting

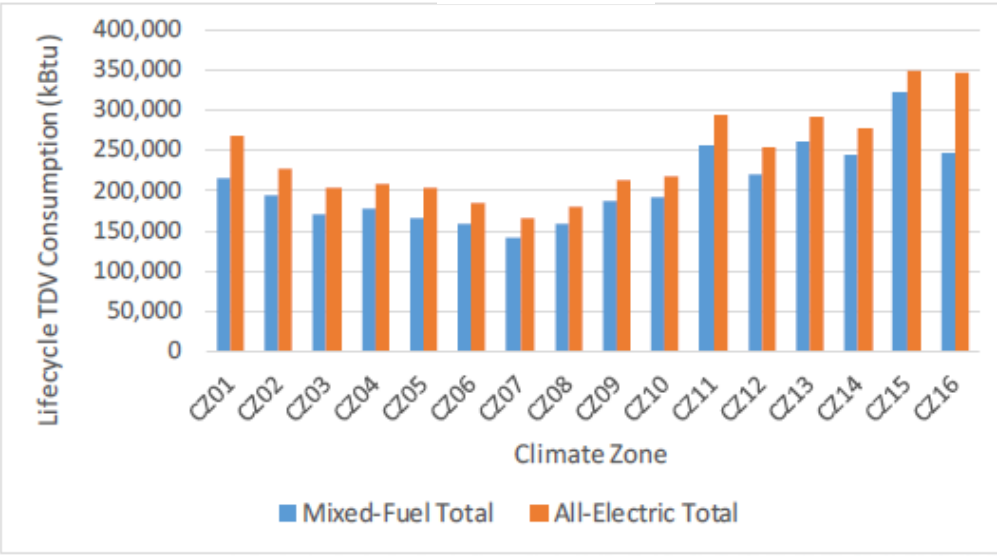
1. Energy ➔ Emissions

All-electric buildings have 30-40% lower GHGs,
but 10-15% higher TDV* scores than mixed-fuel buildings

GHGs



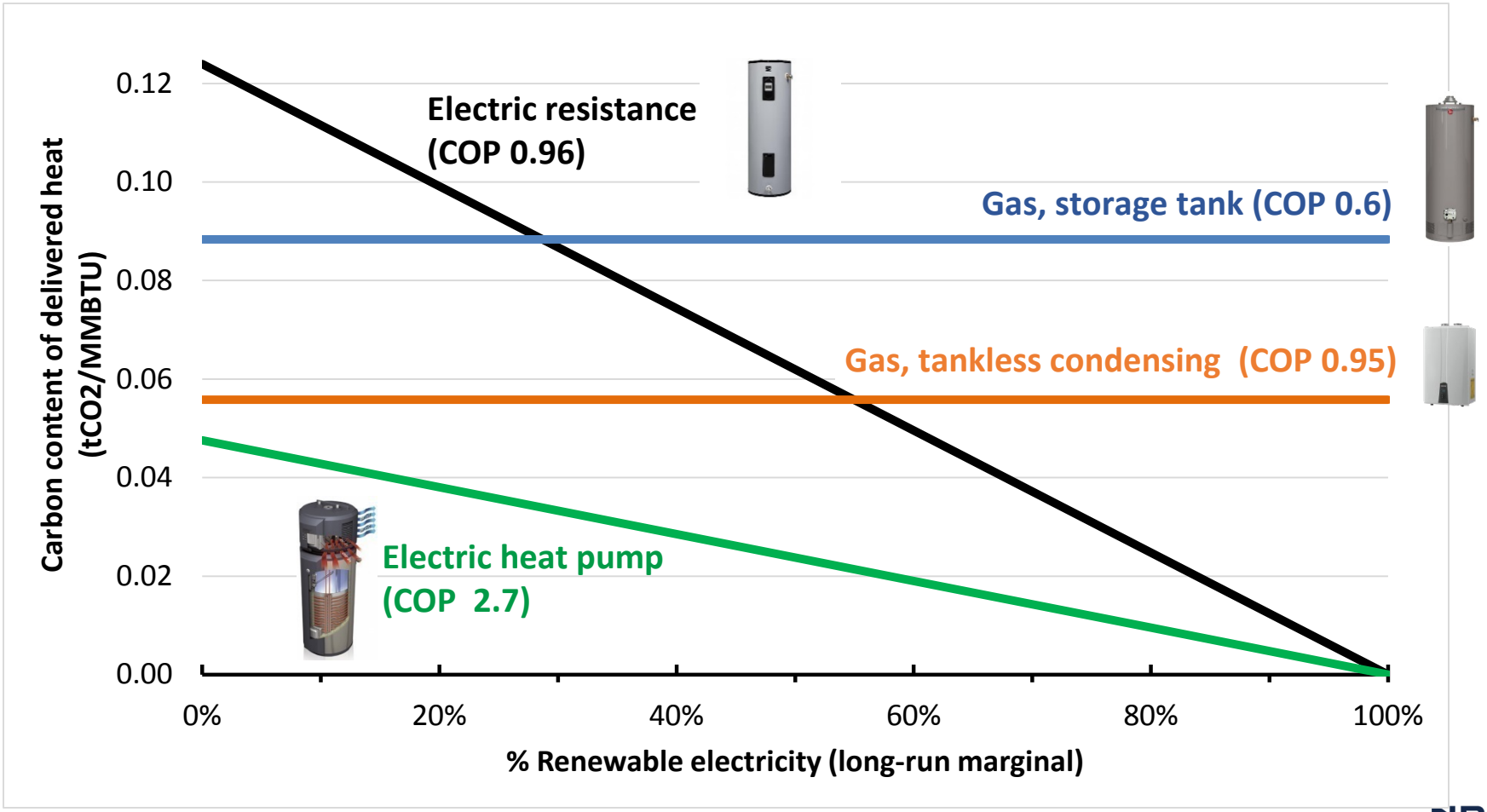
TDV



Source: E3, 2019 TDV Update, July 2016
* Time Dependent Valuation

Emissions: fuels matter!

Electrification offers pathway to emissions-free heat as CA grid gets cleaner



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

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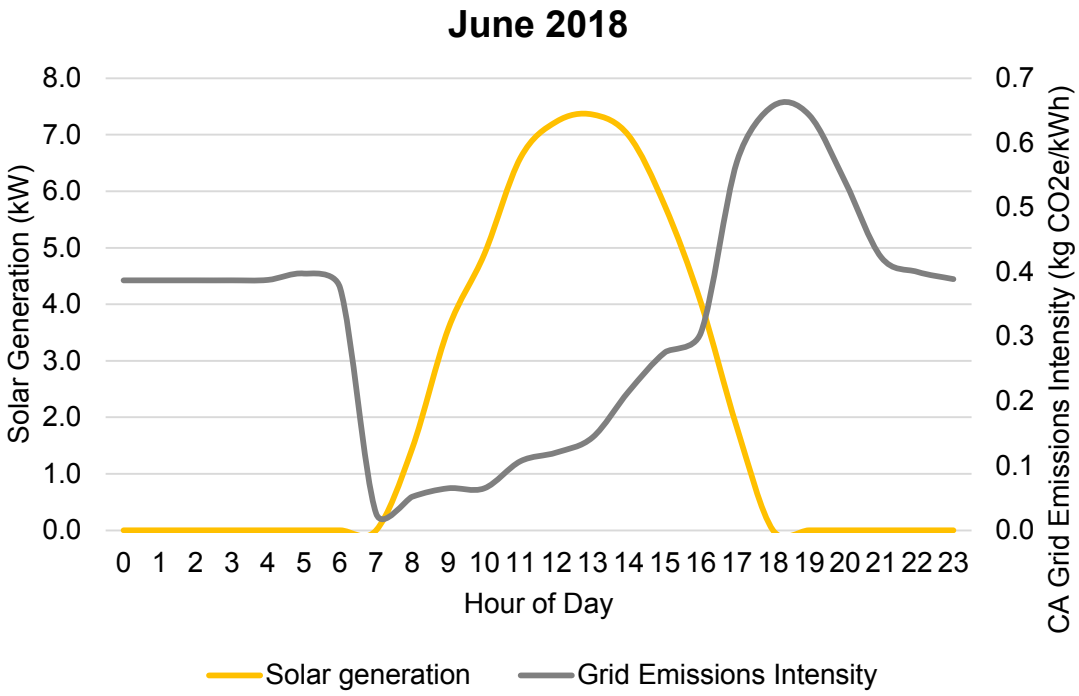
2. Annual ➔ Hourly Netting



- Must count emissions at the time they occur (hourly)
- The grid isn't an emissions "bank" (annual netting)

Source: CPUC Avoided Cost Calculator 2018

How to account for emissions from electrification?

- System view: avoided emissions
- Emissions factors: average ➔ marginal
- Marginal accounting methodologies:

Short-run ("dispatch") marginal	Behavior (small-scale impact)
Long-run ("build") marginal	Policy (large-scale impact)

- Why it matters:
  - From long-run marginal perspective, efficient and flexible electrification already beneficial in most/all U.S. regions, even in coal-dominated grids
  - Will become more so as new generation becomes increasingly renewable

Reference: Hawkes 2014, "Long-run marginal CO2 emissions factors in national electricity systems"

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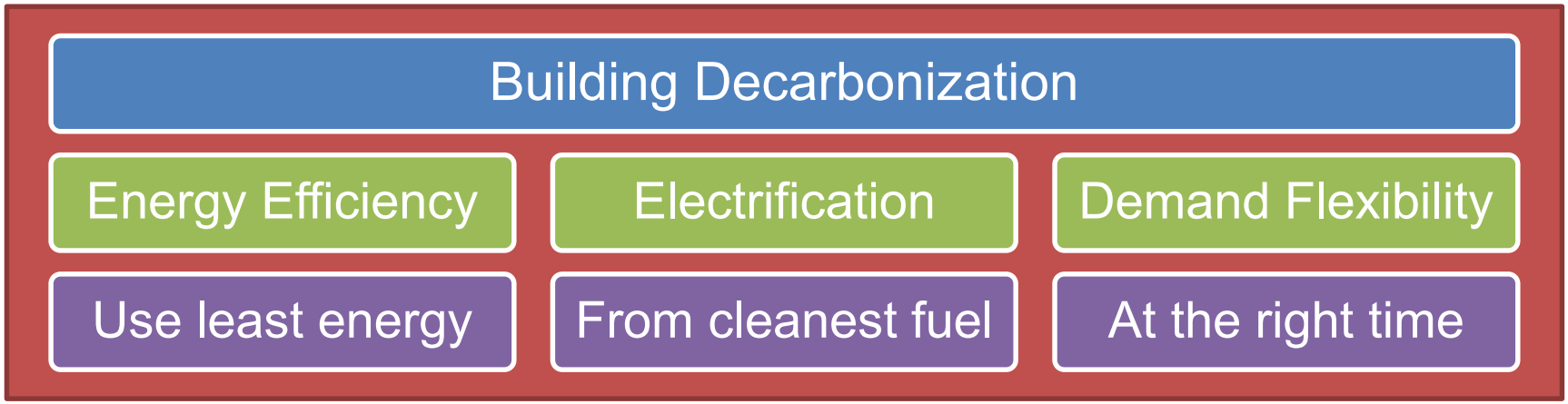
Getting building decarbonization right

Electrification is key… but not sufficient

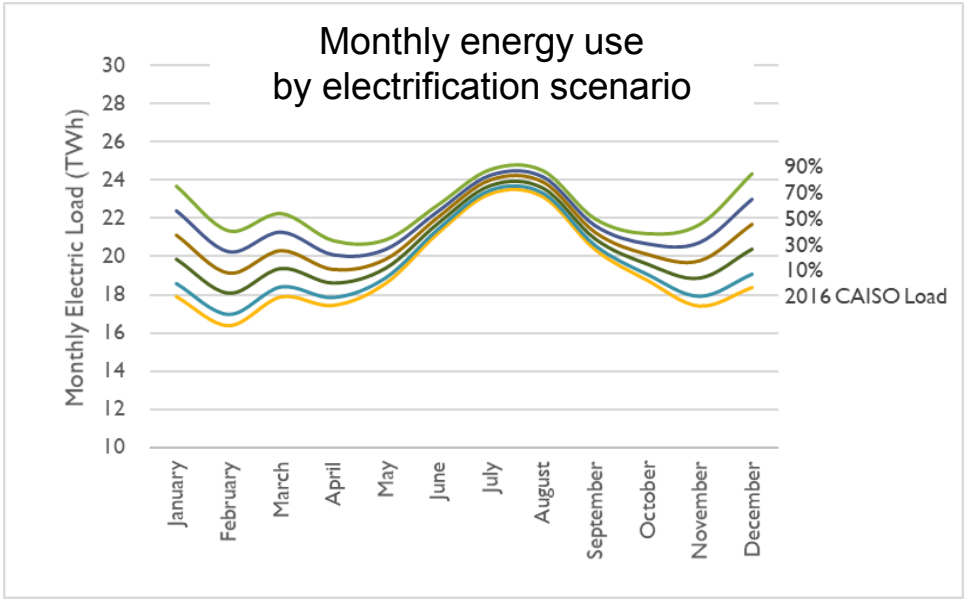


Energy efficiency remains essential…

1. To avoid increasing grid system peak

   (and costs and emissions)

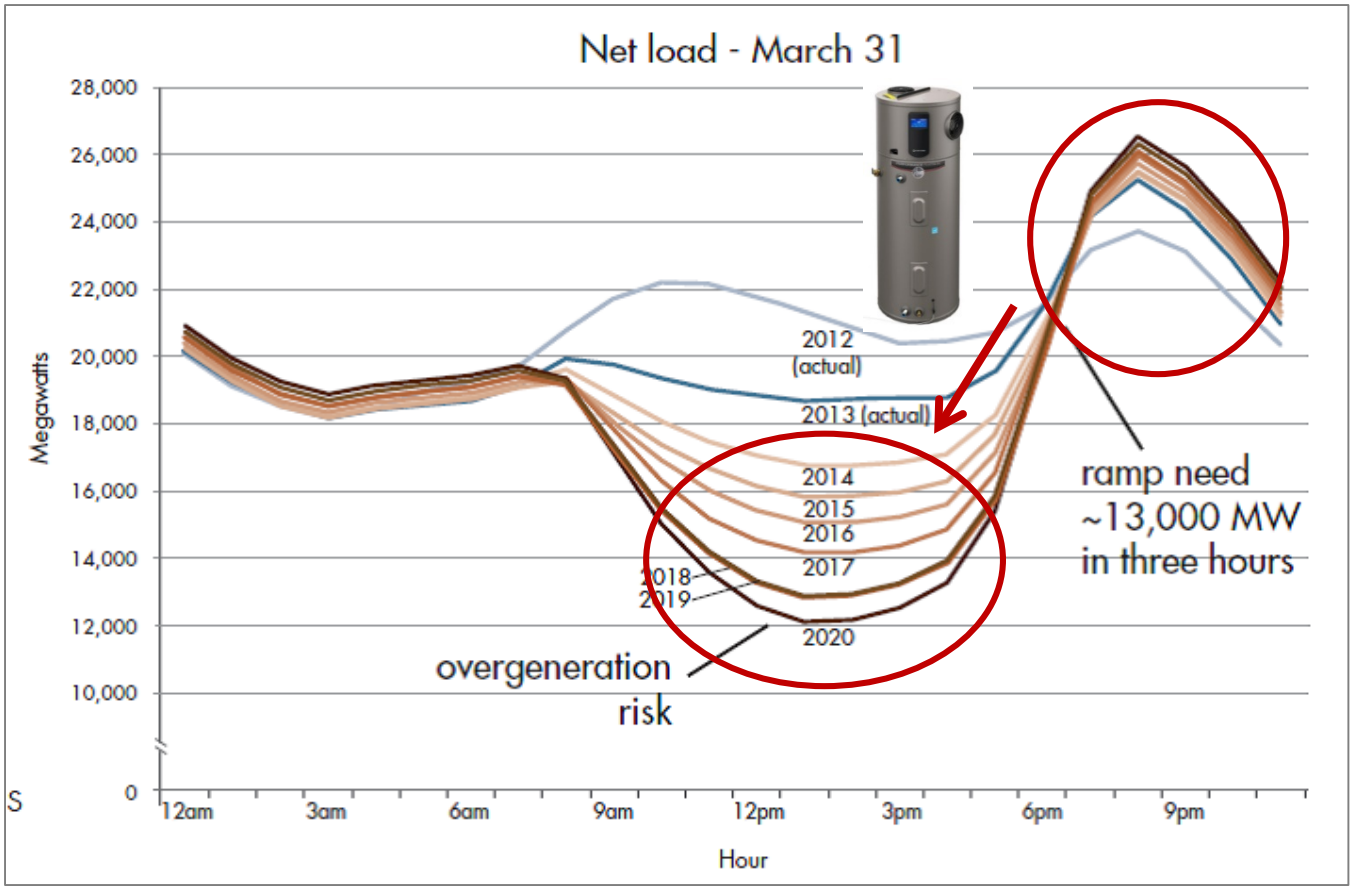
2. To deliver compelling customer bill savings



Synapse: Decarbonization of Heating Energy Use in California Buildings, Oct. 2018

- Potential Shift to Winter Peak Under High Electrification Scenario

And demand flexibility: soak up abundant low-carbon electricity off peak, without adding load on peak



Barriers: What's hindering adoption?

Awareness/perception

- "Heat what?"
- "Clean natural gas"…
- Cooking

Costs

- Equipment: capital cost
- Installation: circuit, panel
- Operation: compelling savings

Access

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

Technology

- Installation cost reduction
- Controls
- Cold temperature performance

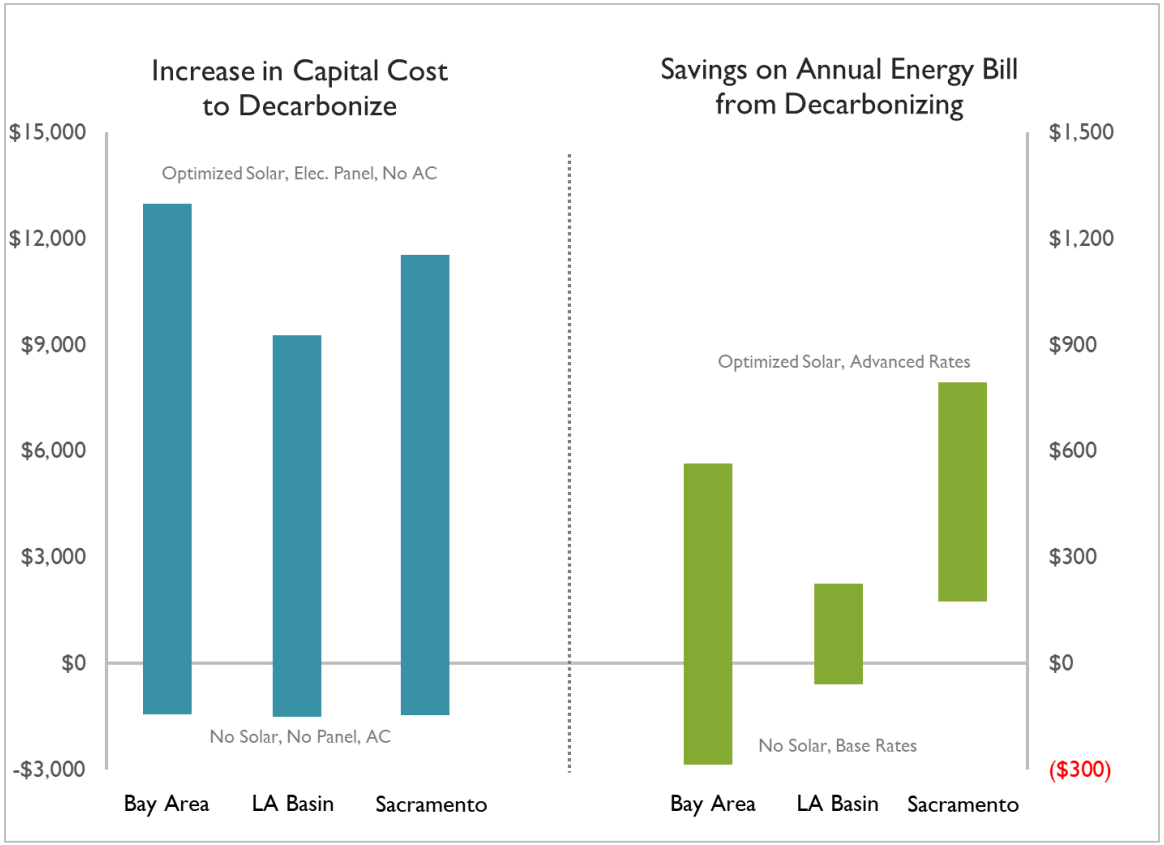
Regulatory

- CEC: Building code
- CPUC: Incentives, rates…
- ARB: Scoping Plan

Economics of electrification

It depends… Already cost-effective in some situations, but not yet all

Customer economics of electrification for retrofit of a single-family home



Source: Decarbonization of Heating Energy Use in California Buildings, Oct. 2018

Improving the economics of electrification

Mass adoption will require more compelling economics vs. gas

Key levers:

Equipment	Installation	Operation
✓ Sales volume	✓ Sales volume	✓ Better product performance
✓ Supply chain capacity	✓ Supply chain capacity	✓ Rate design
✓ Innovation	✓ Products easier to install, e.g. “retrofit-ready”	✓ Carbon pricing
		✓ Load management
		✓ Virtuous cycle on electric rates

Building decarbonization policy landscape

- 40% GHG reduction by 2030

SB 32 (2016)

- Electric secto
- 60% RPS/2030
- 100% carbon-free / 2045

NEW!

SB 100 (2018)

- Carbon neutrality by 2045

NEW!

Gov. Exec Order (2018)

- 40% GHG reductions in buildings / 2030

NEW!

AB 3232

- $50M/y incentives for building decarb

NEW!

SB 1477

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Strategies

Raise awareness

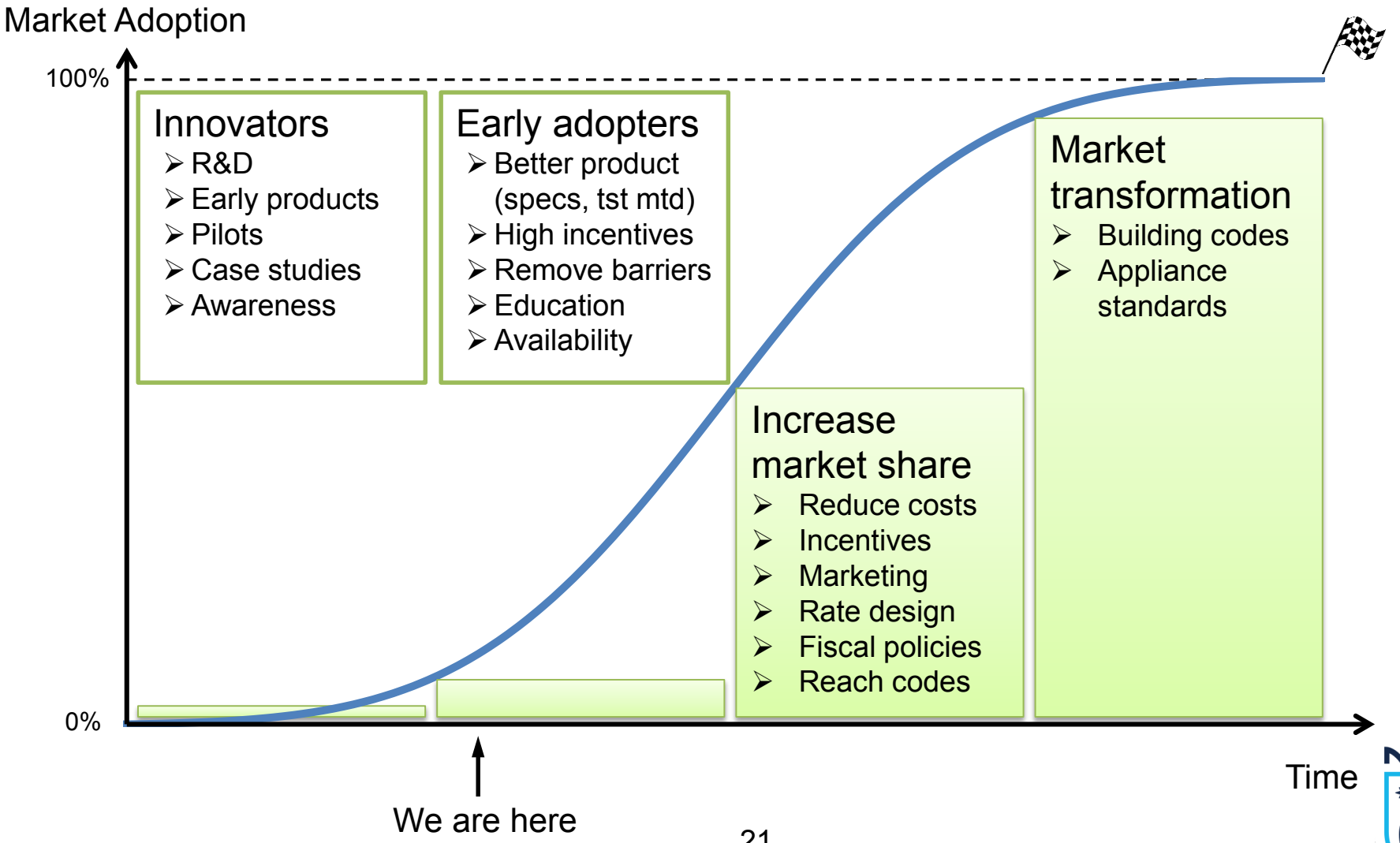
Set targets and plan

Remove barriers

Develop market

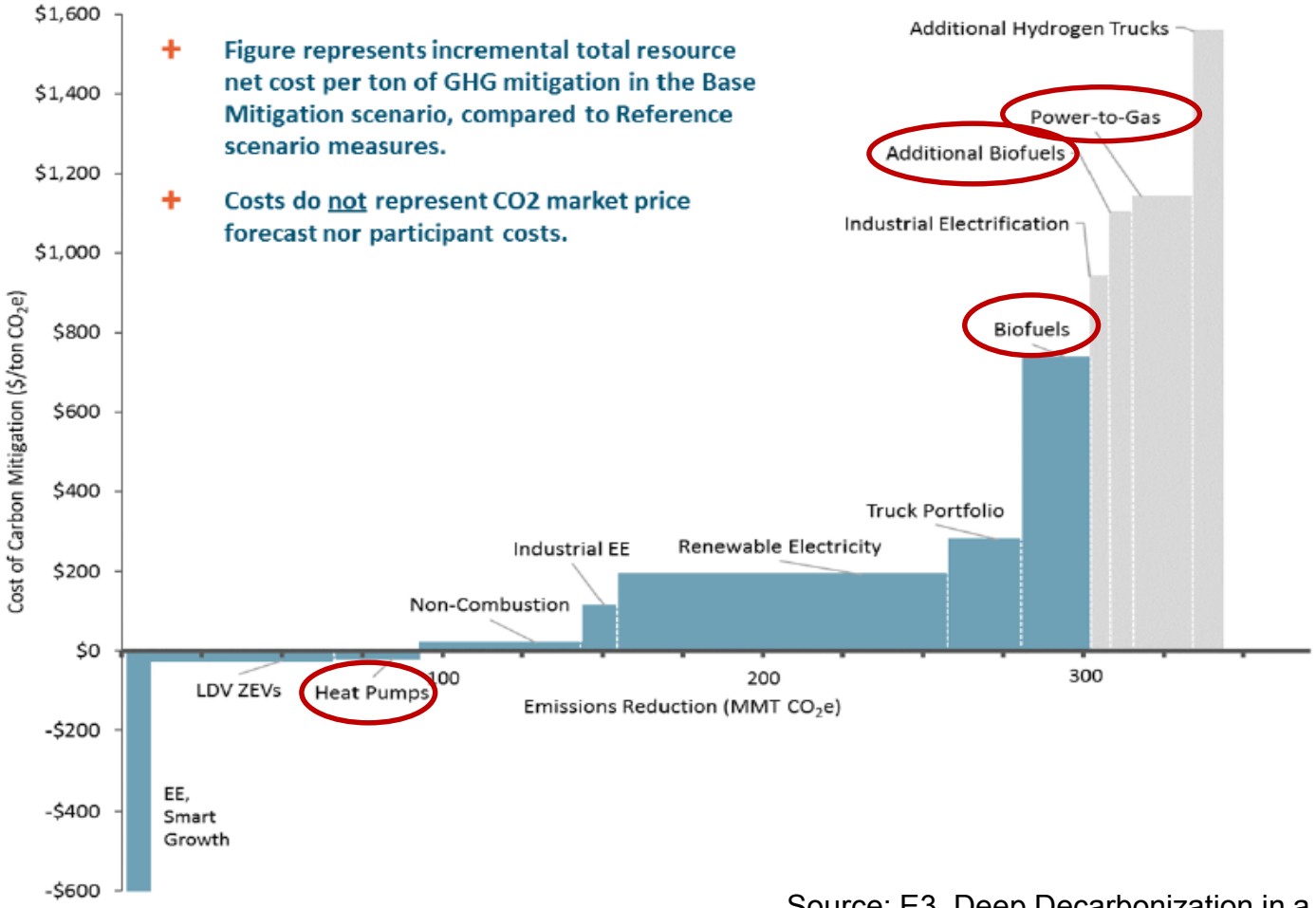
State and City Policy

Policy roadmap

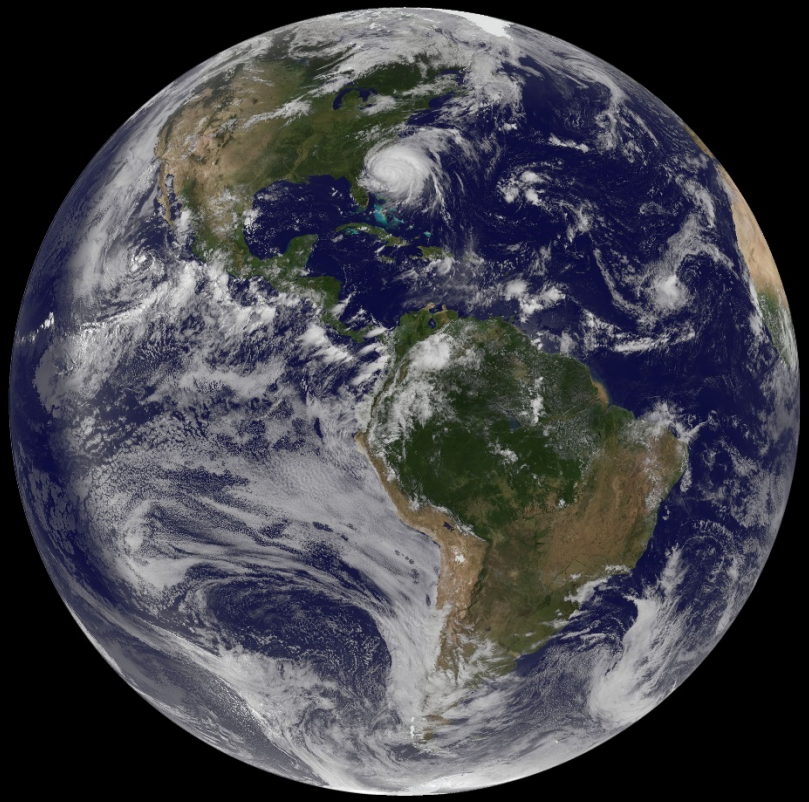


Other building decarbonization strategies

2030 Incremental Carbon Abatement Cost Curve in High Electrification Scenario



Source: E3, Deep Decarbonization in a High Renewables Future, June 2018



Thank you!

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