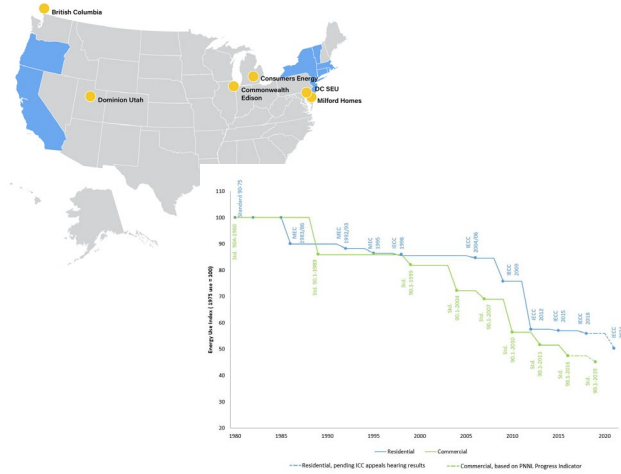


# Buildings Decarbonization

Steven Nadel, Executive Director  
Presentation to DOE Buildings Code  
Conference  
July 2021



# ACEEE



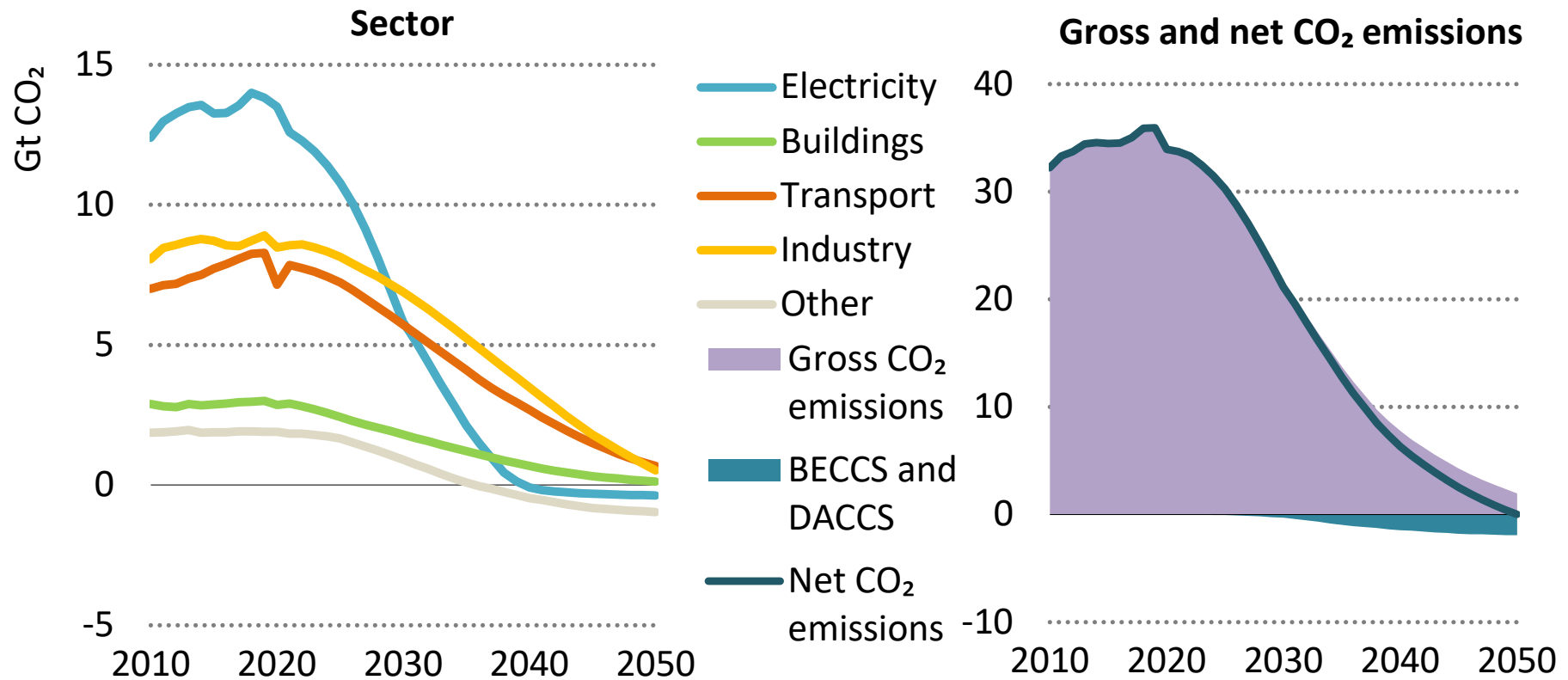
Research

Program and policy  
TA and advocacy



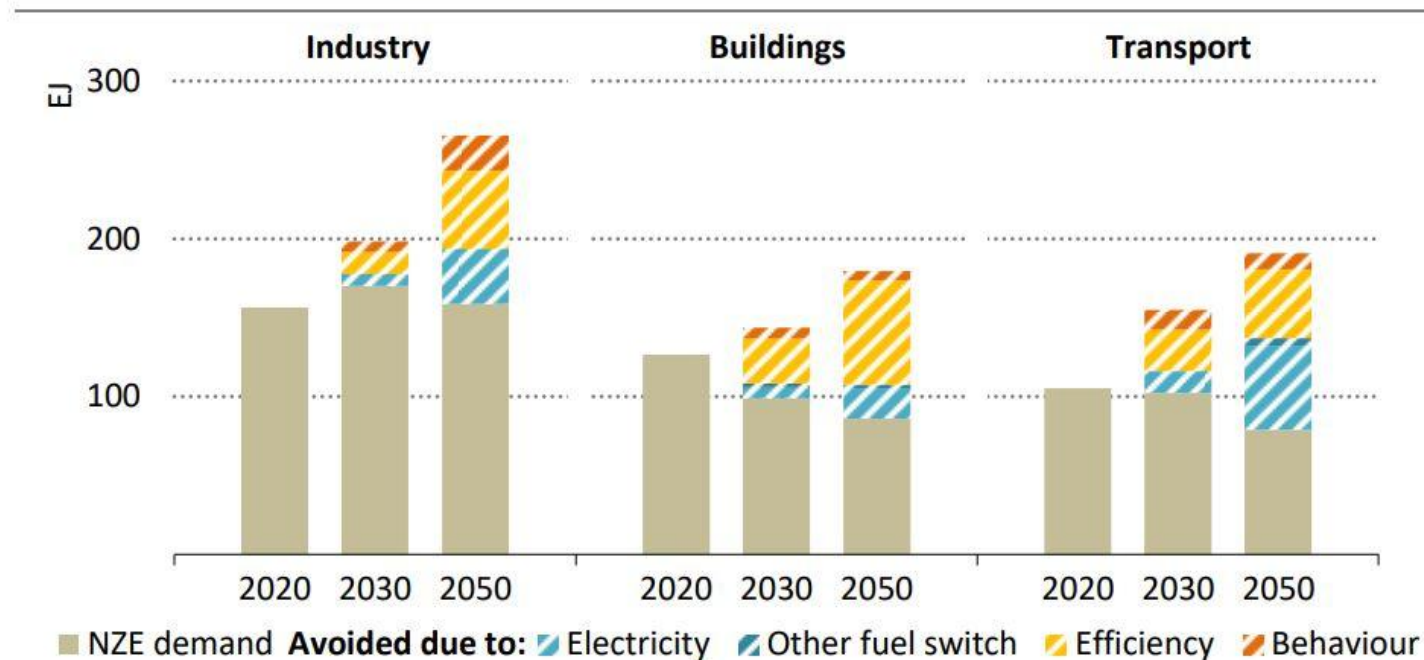
Education

# IEA Net Zero Emissions Scenario



# IEA Net Zero Emissions Scenario

**Figure 2.13** ▶ Total final consumption and demand avoided by mitigation measure in the NZE

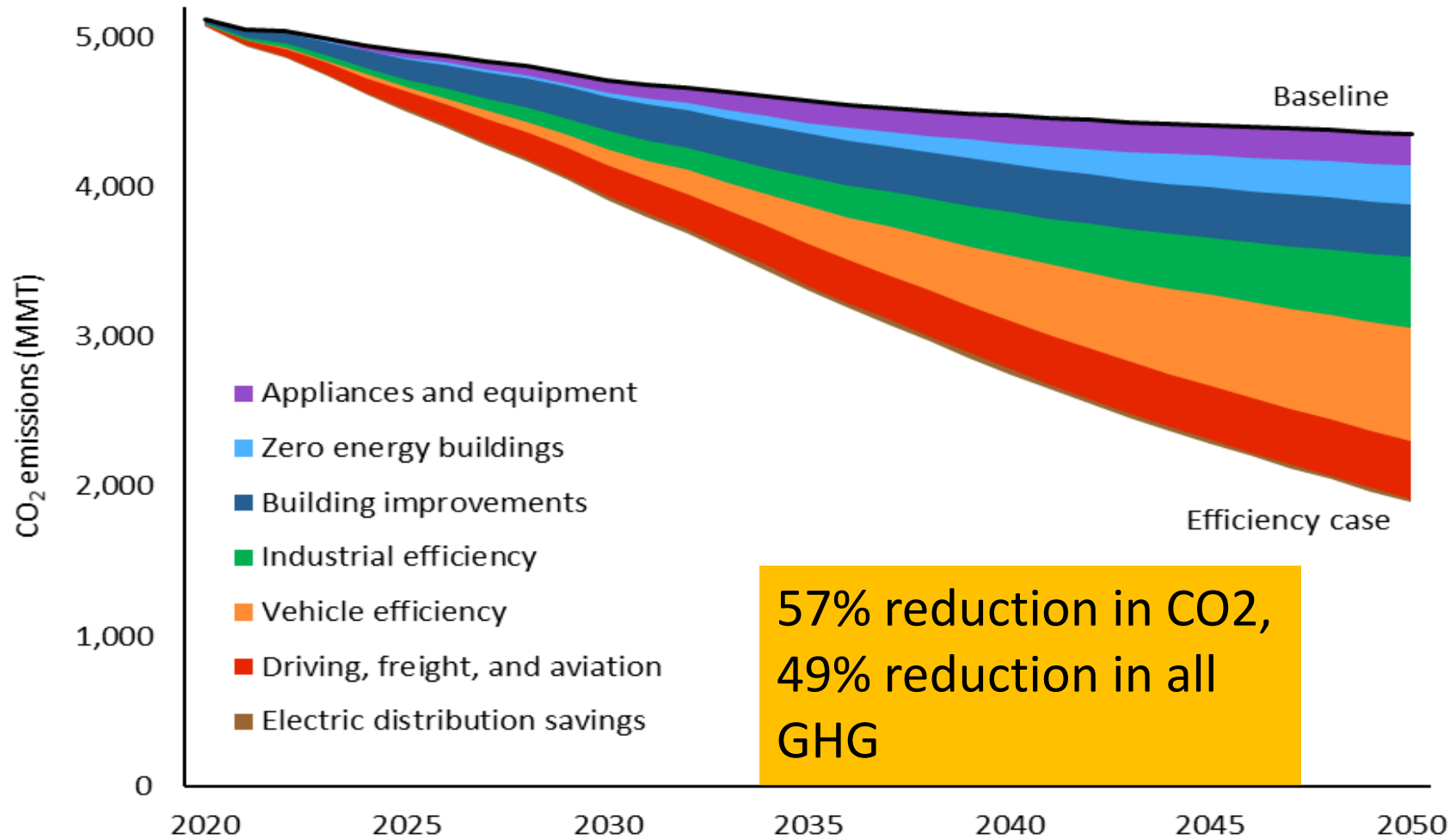


IEA. All rights reserved.

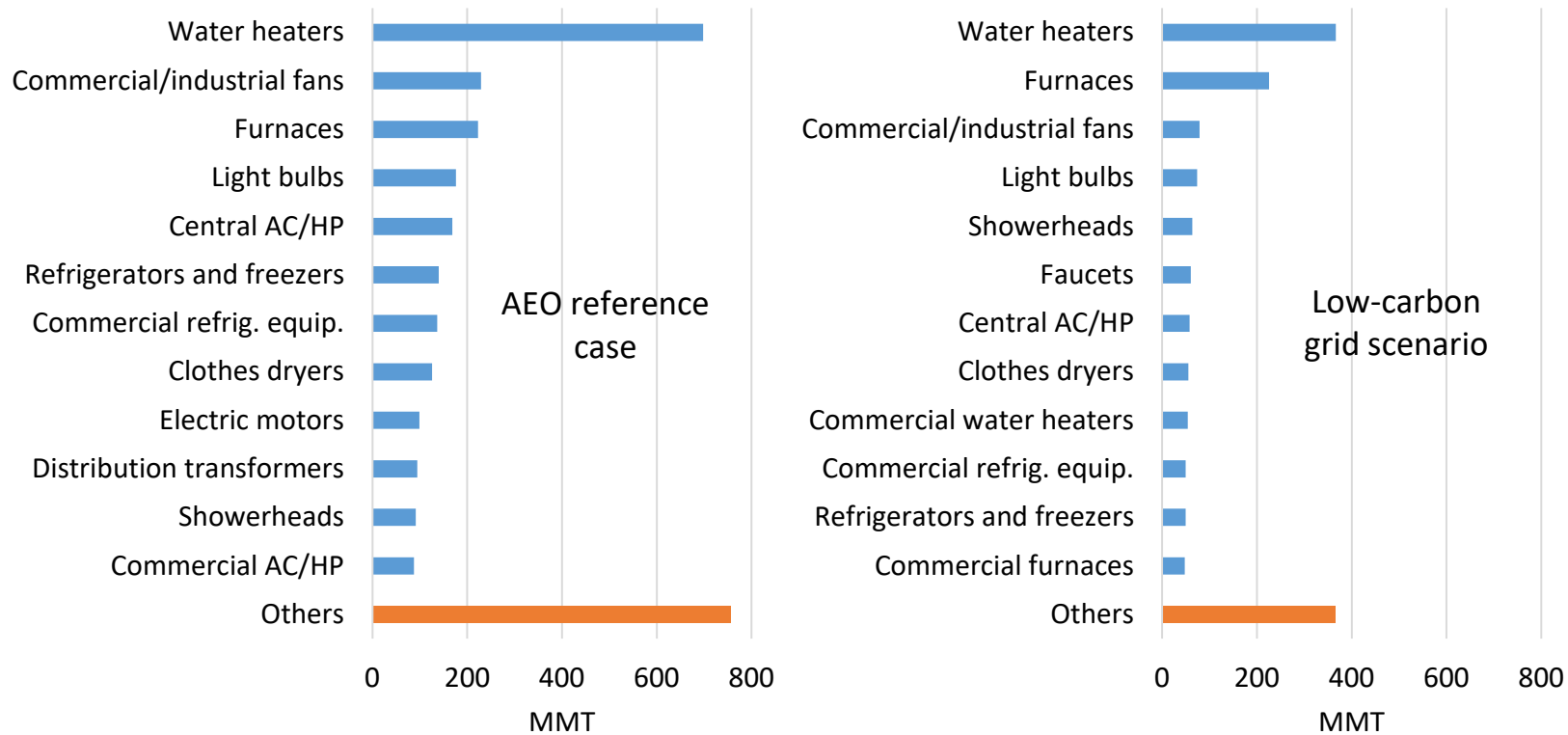
*Energy efficiency plays a key role in reducing energy consumption across end-use sectors*

Notes: CCUS = carbon capture utilisation and storage. Other fuel switch includes switching to hydrogen-related fuels, bioenergy, solar thermal, geothermal, or district heat.

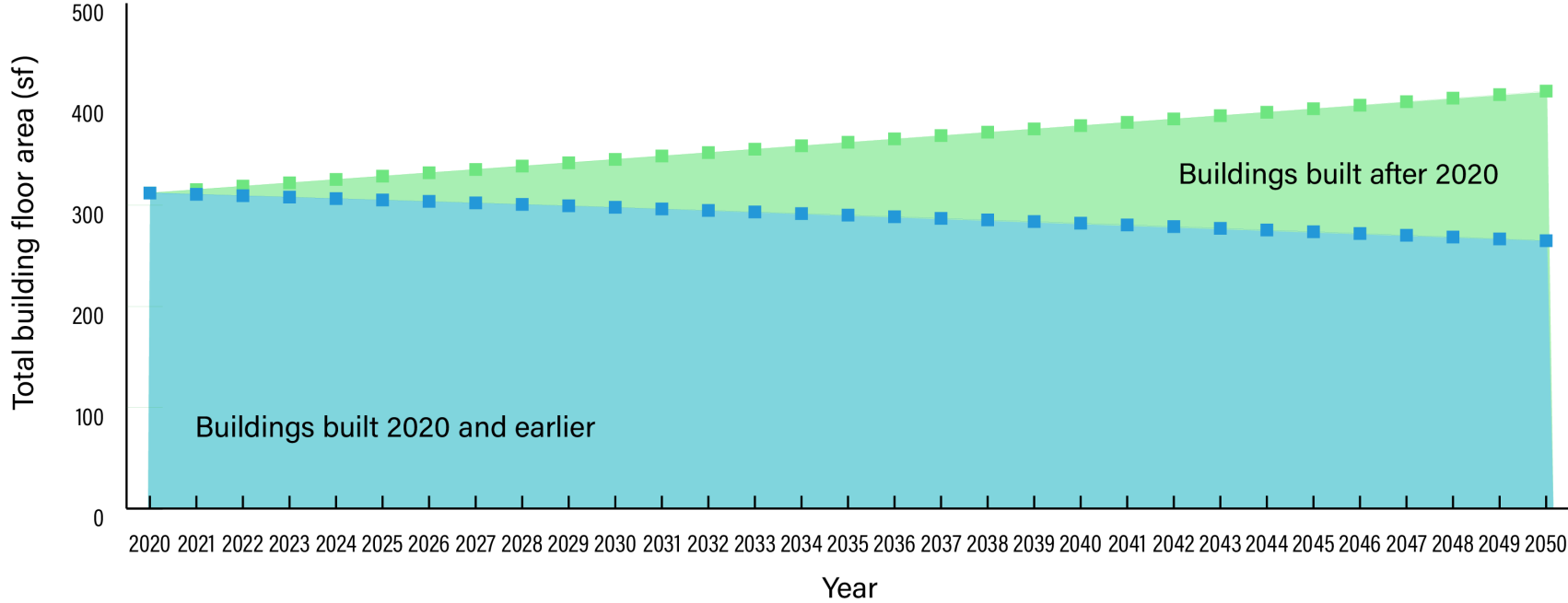
# Energy efficiency can get us halfway to decarbonization...



# Appliances and Equipment: Potential Savings from Updated Standards

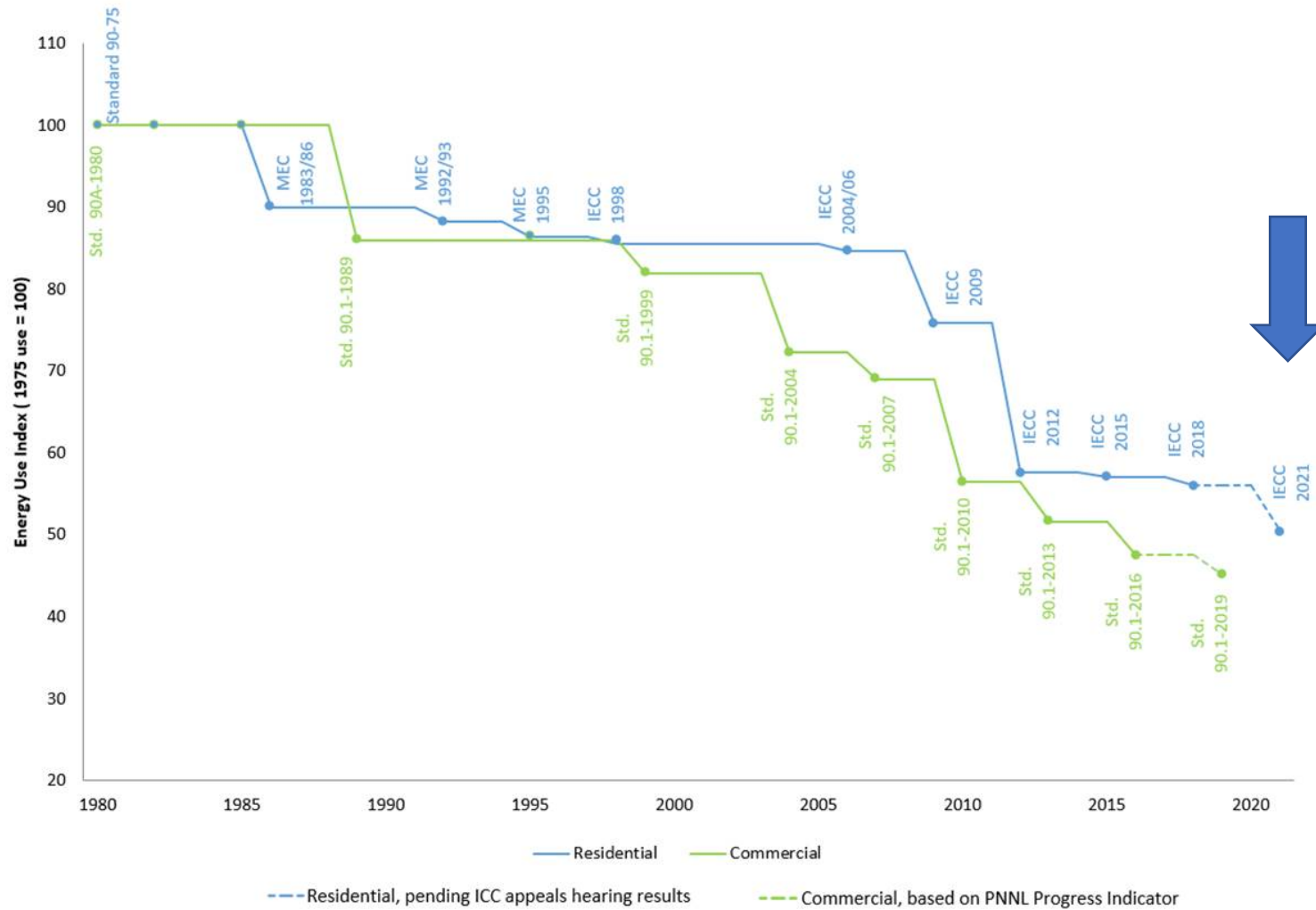


# New and Existing Buildings as Share of Building Floor Area (Residential + Commercial)



Source: ACEEE calculations based on data in EIA AEO 2020.

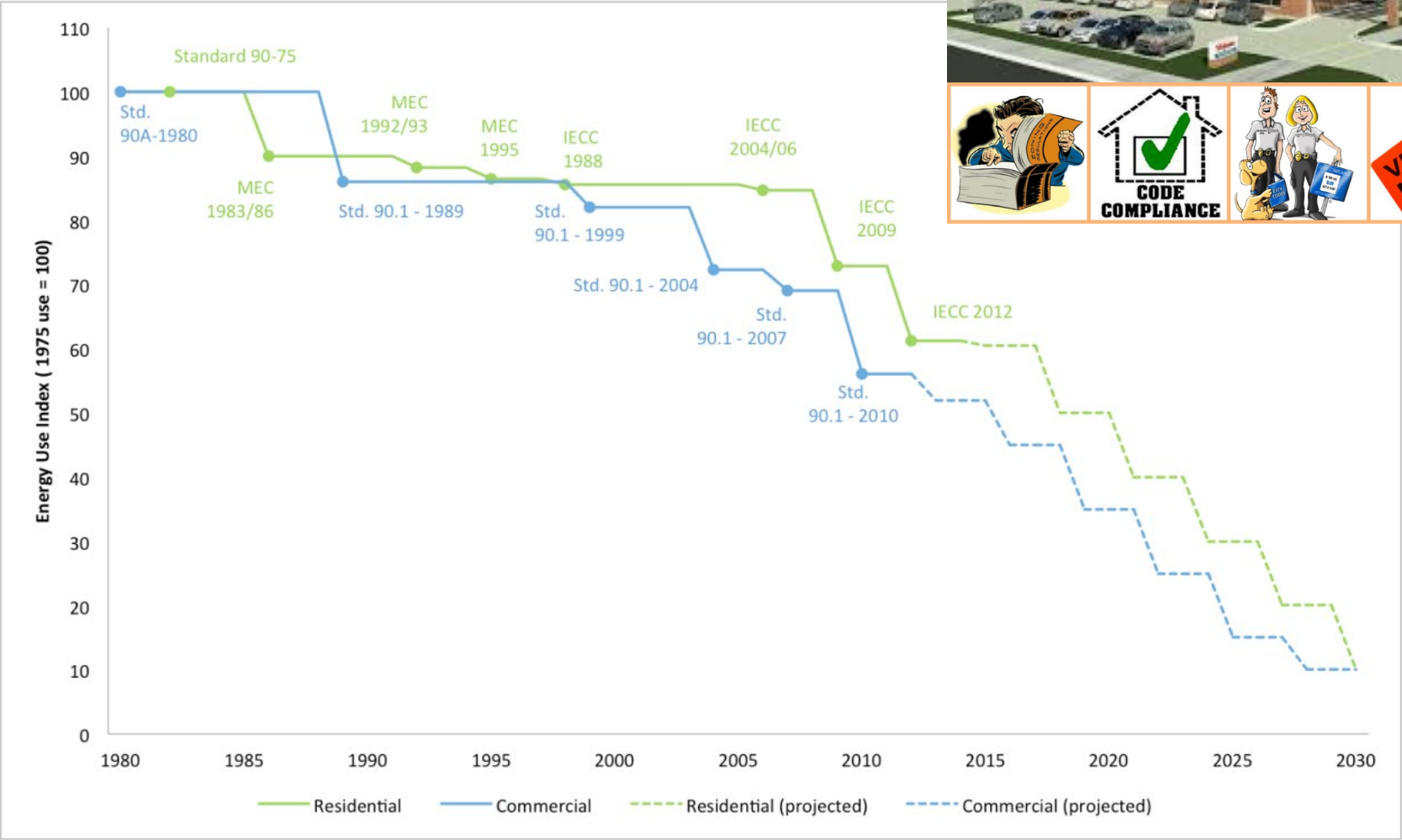
# Building Energy Code Progress



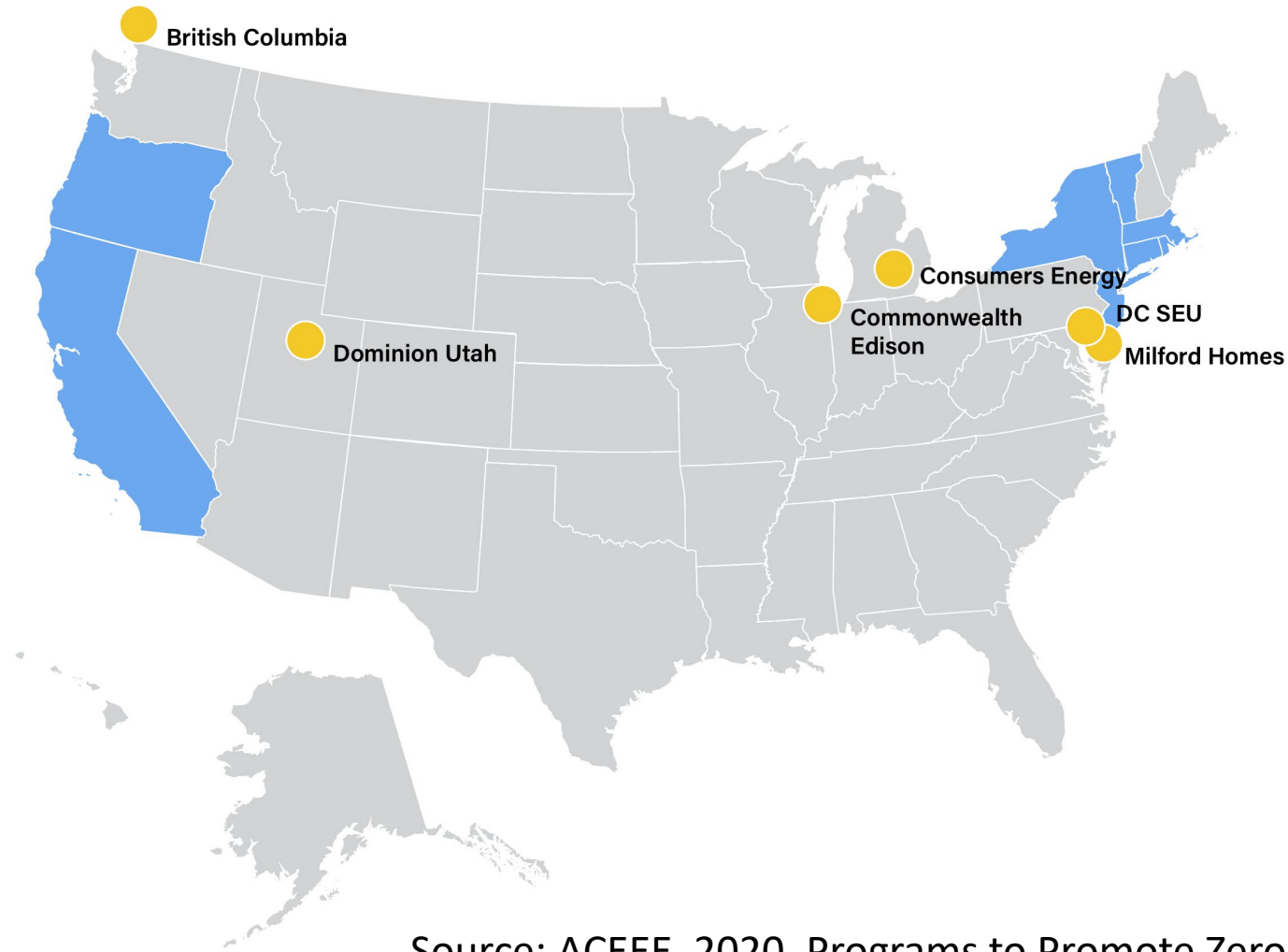
Source: Data from Pacific Northwest National Laboratory & U.S. DOE Building Codes Program, except 2021 which are ACEEE estimates



# Code Goal



# Zero Energy Home and Building Programs



Source: ACEEE, 2020, Programs to Promote Zero Energy Homes and Buildings

# Estimated Retrofit Rates

Residential



HPwES: 87k/yr

WAP (all sources):  
85k/yr

Together 0.1%/yr of  
homes

Other efforts double  
this??

Commercial



CBECS: 14% received  
HVAC retrofits over 18 yrs

If add lighting and other  
retrofits and assume no  
overlap, 39% over 18 yrs

This is 0.8-2.2%/yr of the  
existing building stock

# Residential Retrofits

- Hope for Homes retrofit incentives now before Congress
- Need improved retrofit techniques



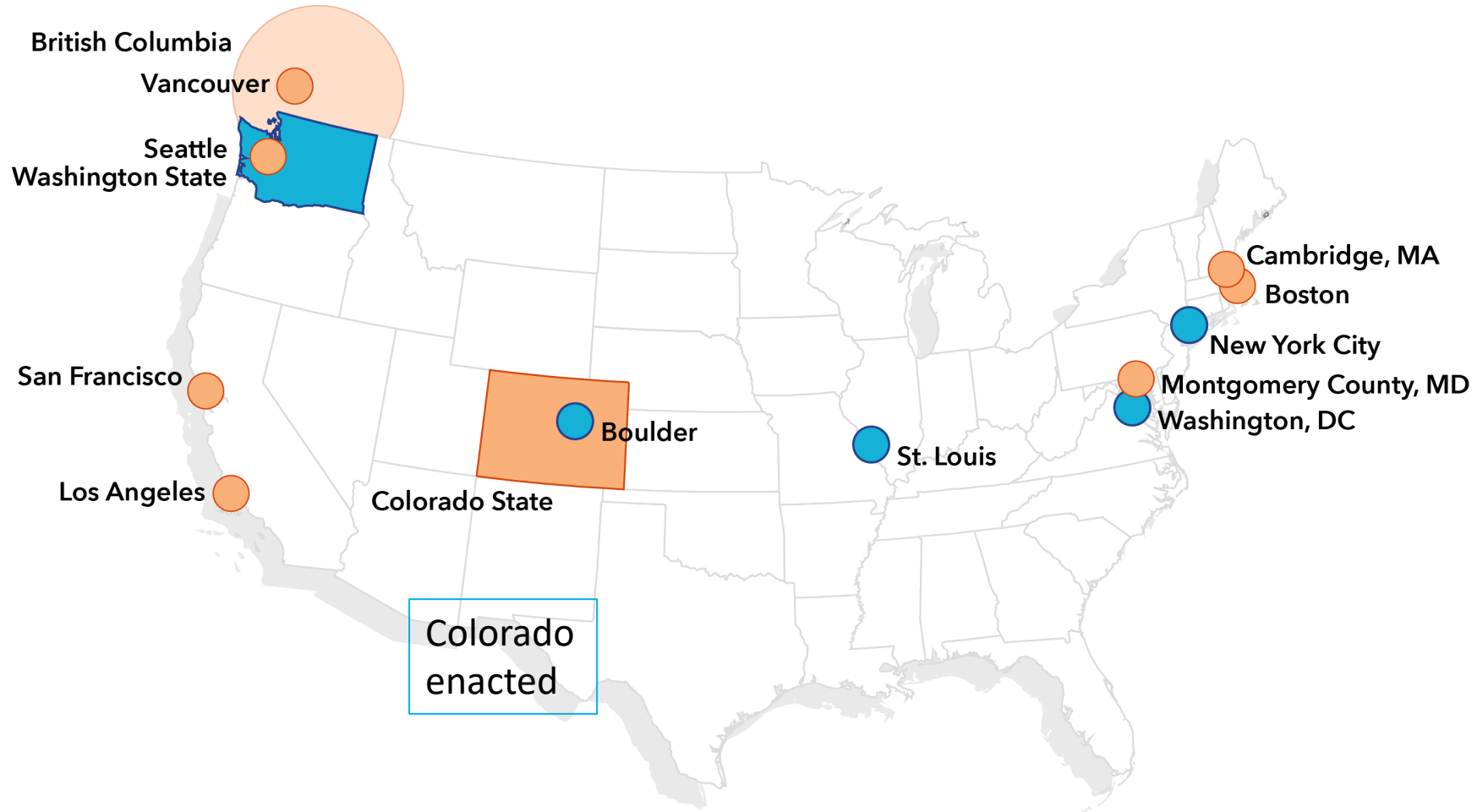
# Commercial Retrofit Programs

- Moving beyond lighting
  - Intelligent efficiency/GEB
  - Whole building retrofits
  - HVAC including ventilation
- Deep retrofits at time of building renovation
- ACEEE will be doing a study on commercial retrofit programs in 2021



GAO Deep Retrofit Project

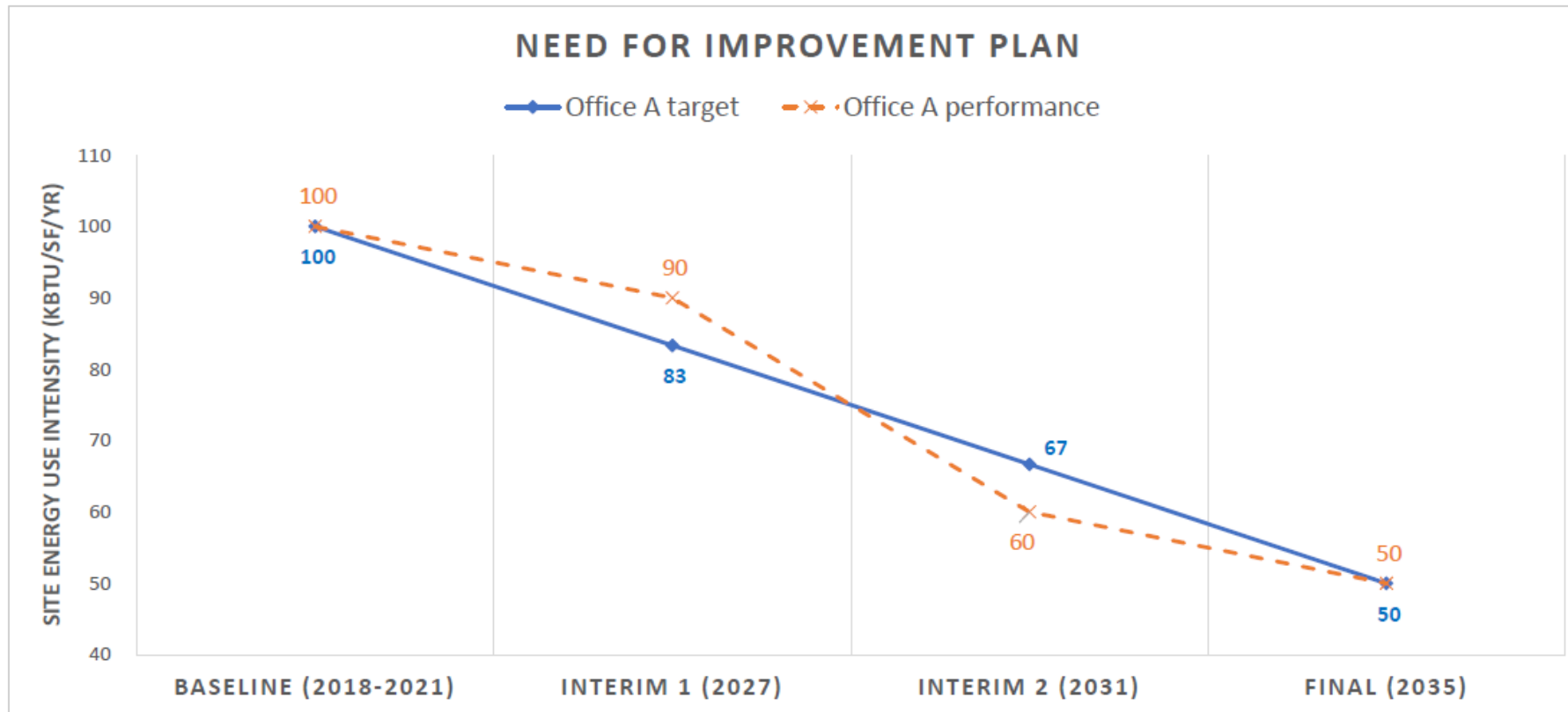
# Building Performance Standards



Source: ACEEE, *Mandatory Building Performance Standards*, 2020

 Enacted  
 Under Consideration

# Proposed Montgomery County MD Building Performance Standard



Note: This is an illustration; values not determined yet

# Other State and Local Policies to Promote Retrofits

- Building and home benchmarking and labeling (e.g. time-of-sale home energy reports in Portland, Berkeley, Minneapolis and Austin).
- Energy audit, retrocommissioning and lighting upgrade requirements.
- Job training, weatherization programs



**PORTLAND HOME ENERGY SCORE**  
Know the score. Outsmart energy waste.

U.S. DEPARTMENT OF ENERGY  
**THIS HOME'S SCORE** 3 OUT OF 10

THIS HOME'S ESTIMATED ENERGY COSTS  
**\$1,233** PER YEAR

**Better Buildings** Home Energy Score

**HOME PROFILE**  
LOCATION: 123 Main St  
Portland, OR 97201  
YEAR BUILT: 1924  
HEATED FLOOR AREA: 1,500 sq. ft.  
NUMBER OF BEDROOMS: 3

**ASSESSMENT**  
ASSESSMENT DATE: 12/22/2016  
EXPIRATION DATE: 12/22/2021  
ASSESSOR: Maria Gomez  
Gomez Energy Partners  
PHONE: 503-555-1211  
EMAIL: maria@gomezenergy.com  
CCB LICENSE #: 1234567890

*Flip over to learn how to improve this score and use less energy!*

**HOW MUCH ENERGY IS THIS HOME LIKELY TO USE?**  
Electric: 10,000 kWh/yr.....\$600  
Natural Gas: 700 therms/yr.....\$633  
Other: \_\_\_\_\_ gal/yr.....\$0  
**TOTAL ENERGY COSTS PER YEAR \$1,233**

**THIS HOME'S CARBON FOOTPRINT:**  
35 tons/year WORSE  
15.5 tons/year This Home  
0 tons/year BEST  
Estimated average carbon footprint for a similar sized home: 3.8 tons of CO<sub>2</sub> equivalent emissions per year.

**Official Assessment [ID#1234567]**  
The Home Energy Score is a national rating system developed by the U.S. Department of Energy. The Score reflects the energy efficiency of a home based on the home's structure and heating, cooling, and hot water systems. The average score is a 5. Learn more at HomeEnergyScore.gov.

**How much renewable energy does this home generate?**  
3,000 kWh/yr

Actual energy use and costs may vary based on occupant behavior and other factors.  
• Estimated energy costs were calculated based on current utility prices (\$0.11/kwh for electricity; \$0.89/therm for natural gas; \$2.50/gal for heating oil; \$3.50/gal for propane).  
• Carbon footprint is based only on estimated building energy use.  
• Carbon emissions are estimated based on utility- and fuel specific emissions factors provided by the Oregon Department of Energy.  
• This report meets Oregon's Home Energy Performance Score Standard and complies with Portland City Code Chapter 17.308.



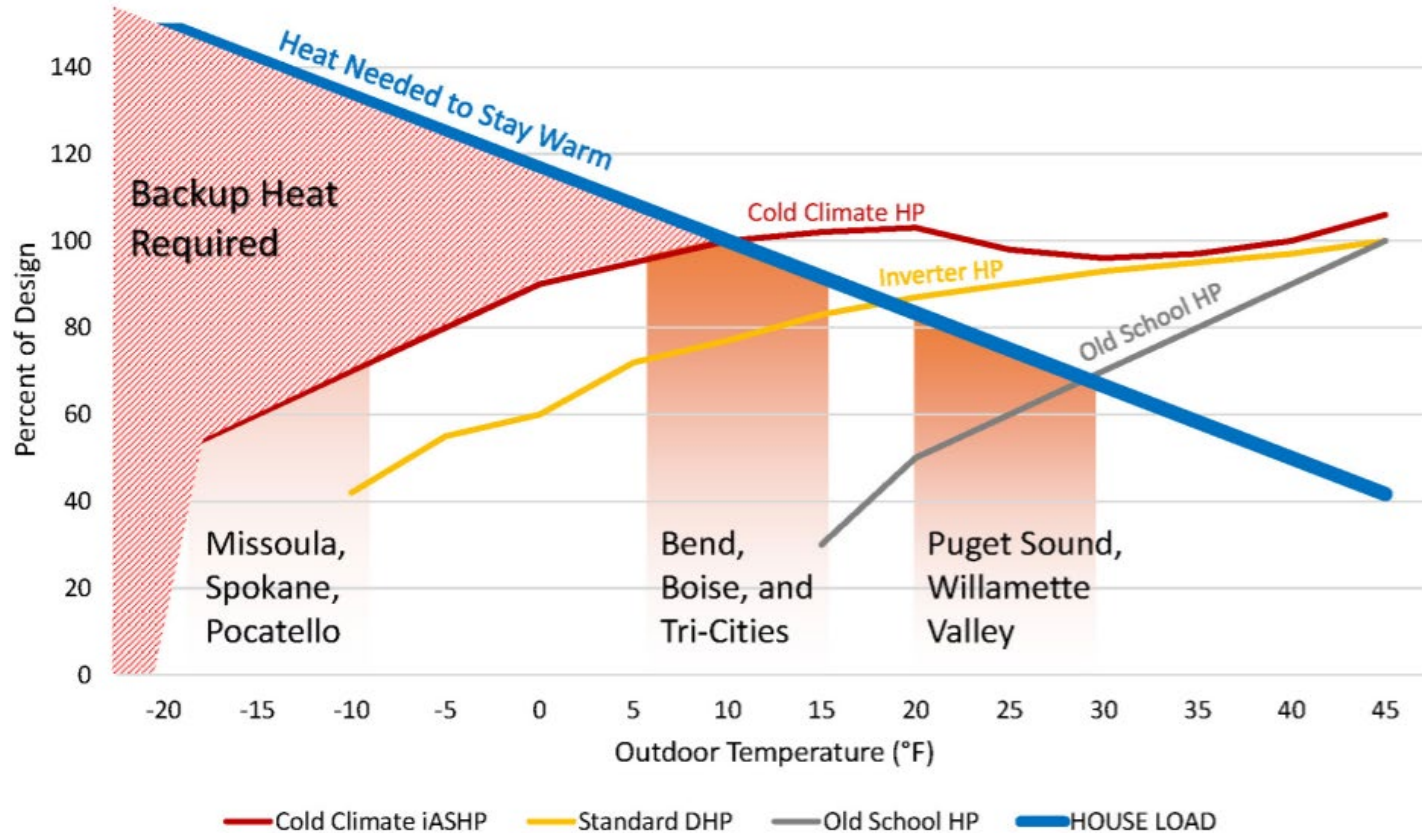
# Replacing Furnaces & Boilers with Heat Pumps

Table ES1. Representative average simple payback period for installing a heat pump at the time an existing oil or propane system needs to be replaced

Comparison	Average simple payback period (years)				
	US	West	Midwest	Northeast	Southeast
Oil furnace (83% AFUE) vs. HP (8.5 HSPF), includes AC savings	0.9	1.4	1.3 in MO; no savings in Upper MW	1.9	0.8
Propane furnace (80% AFUE) vs. HP (8.5 HSPF), includes AC savings	1.5	1.7	3.4 in MO; no savings in Upper MW	2.0	1.3
Oil boiler (86% AFUE) vs. ductless HP, without AC	4.4	7.3	18.8	6.2	5.1
Propane boiler (84% AFUE) vs. ductless HP, without AC	16.1	12.1	19.8	8.5	9.1
Std. oil water heater to HPWH (2.0 rated EF)	Immediate	Examined only at a national level			
Std. propane water heater to HPWH (2.0 rated EF)	3.9				



# Heat Pump Heat Output as a Function of Outdoor Temperature



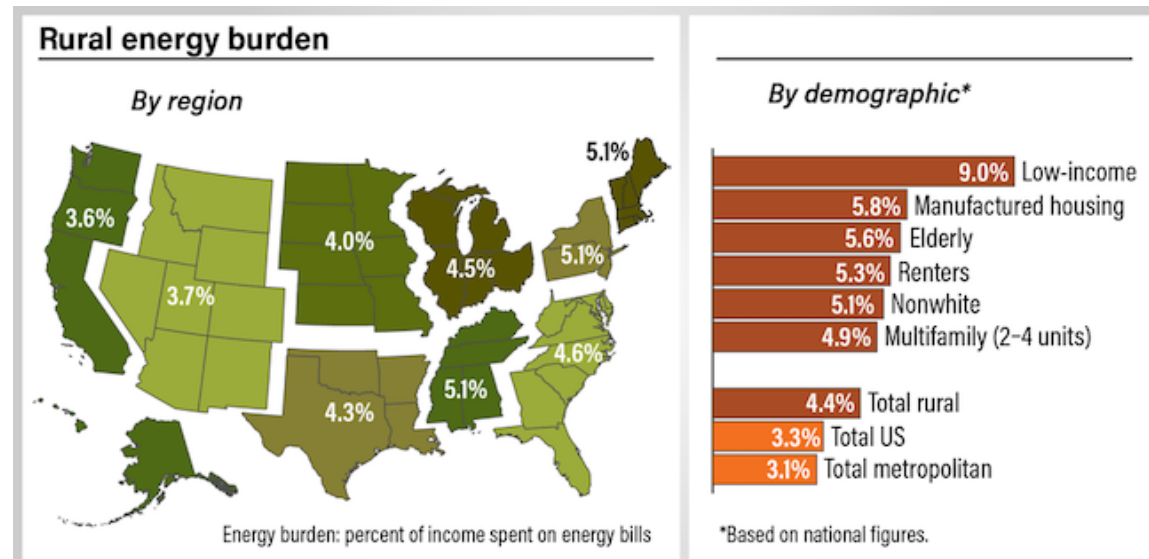
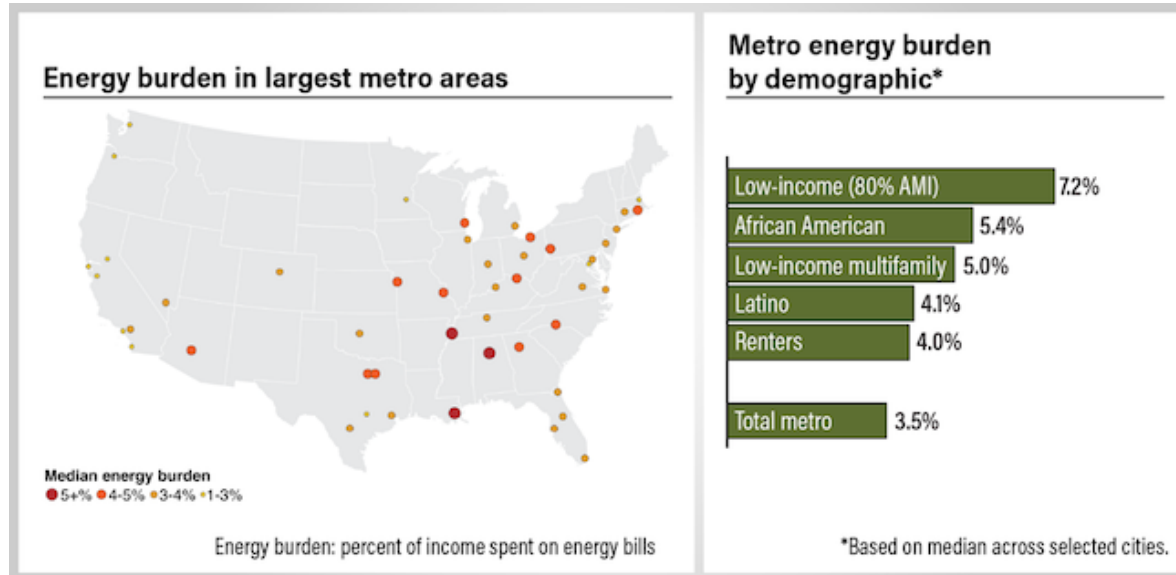
Source: Bruce Harley Energy Consulting

# Efficiency Critical; Will be Challenging to Hit Climate Goals without Efficiency

- Efficiency lowers total cost
  - Consumers
  - The grid
- Efficiency can help reduce peak demand
- Efficiency has additional benefits beyond energy and climate
  - Comfort
  - Health
  - Productivity
  - Resilience



# Addressing Equity Critically Important



**When you find  
yourself  
in a hole,**

carbon



**stop digging.**

- Will Rogers

m. skurado.com

# Contact Information

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