

# Decarbonization Targets and Building-Related Technical Issues to Reach the Goals



Donald Colliver, PhD, PE, FASHRAE, Presidential Member ASHRAE ('02-'03)  
Co-Chair – ASHRAE Task Force for Building Decarbonization

# Introduction

- Climate change is a global problem
- CO<sub>2</sub> emissions from buildings are a major contributor
- Many reduction goals have been made
- How to reach those goals is uncertain
- It requires technical firepower
- It requires international cooperation and coordination

# Objectives

- To introduce and describe decarbonization
- To identify the major sources of GHGs
- To identify some of the policy goals & targets set by governmental groups
- To identify some of the major building technical issues that must be addressed
- To suggest ASHRAE's part of the solution

# What is Building Decarbonization?

**Decarbonization:** The *process of reduction or elimination* of greenhouse gas emissions using the standard metric of carbon dioxide

**Building Decarbonization:** The *process of reducing the carbon or CO<sub>2</sub>e* that is attributable to buildings.

The **pathway** to building decarbonization involves:

- building design & construction,
- building operation, and
- building occupancy.

# Why Is It Important?

- Global human-caused emissions must reach net zero by approximately midcentury to limit climate change to substantially less than 2C (IPCC, 2018)<sup>1</sup>
- Climate stabilization requires full decarbonization of our energy systems and zero net greenhouse-gas emissions by around 2070 (World Economic Forum)<sup>2</sup>
- Many nations, states, cities, and companies have committed to replacing our current energy system by midcentury with a system that would emit zero net human-caused greenhouse gases (GHGs) (CDP, 2019; U.S. Climate Alliance, 2020; We Are Still In, 2020). (NAS, 2021)<sup>3</sup>

1. NAS.2021. Accelerating Decarbonization of the US Energy System. Pg 25.

2. <https://www.weforum.org/agenda/2015/12/whats-the-path-to-deep-decarbonization/>

3. NAS. 2021. Accelerating Decarbonization of the US Energy System. Pg 25.

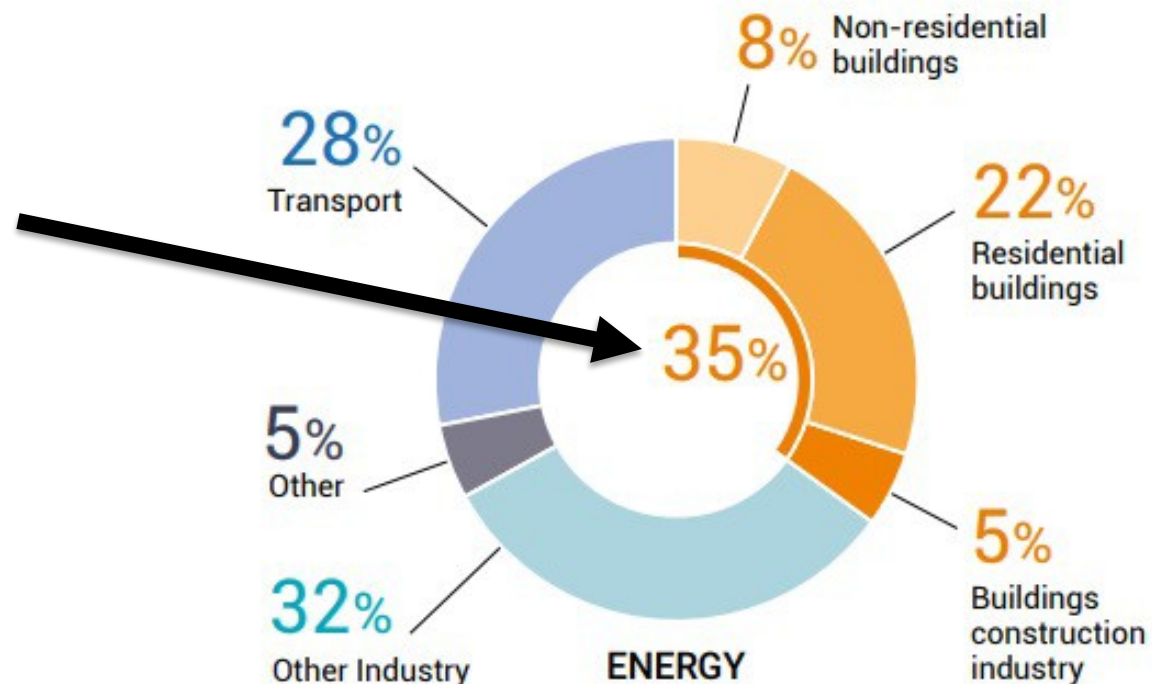


# Why Is It Important to ASHRAE?

- Direct building CO<sub>2</sub> emissions need to be cut in half by 2030 to get on track for net zero carbon building stock by 2050
- Buildings remain a major area that lacks specific mitigation policies, despite its importance to global CO<sub>2</sub> emissions.
- Of those who have submitted Nationally Determined Contributions (NDCs), **136** countries mention buildings, **53** countries mention building energy efficiency, and **38** specifically call out building energy codes.

# Do buildings make a difference?

Global share of buildings and construction final energy and emissions, 2019



Notes: Buildings construction industry is the portion (estimated) of overall industry devoted to manufacturing building construction materials such as steel, cement and glass. Indirect emissions are emissions from power generation for electricity and commercial heat.

Sources: (IEA 2020d; IEA 2020b). All rights reserved. Adapted from "IEA World Energy Statistics and Balances" and "Energy Technology Perspectives".



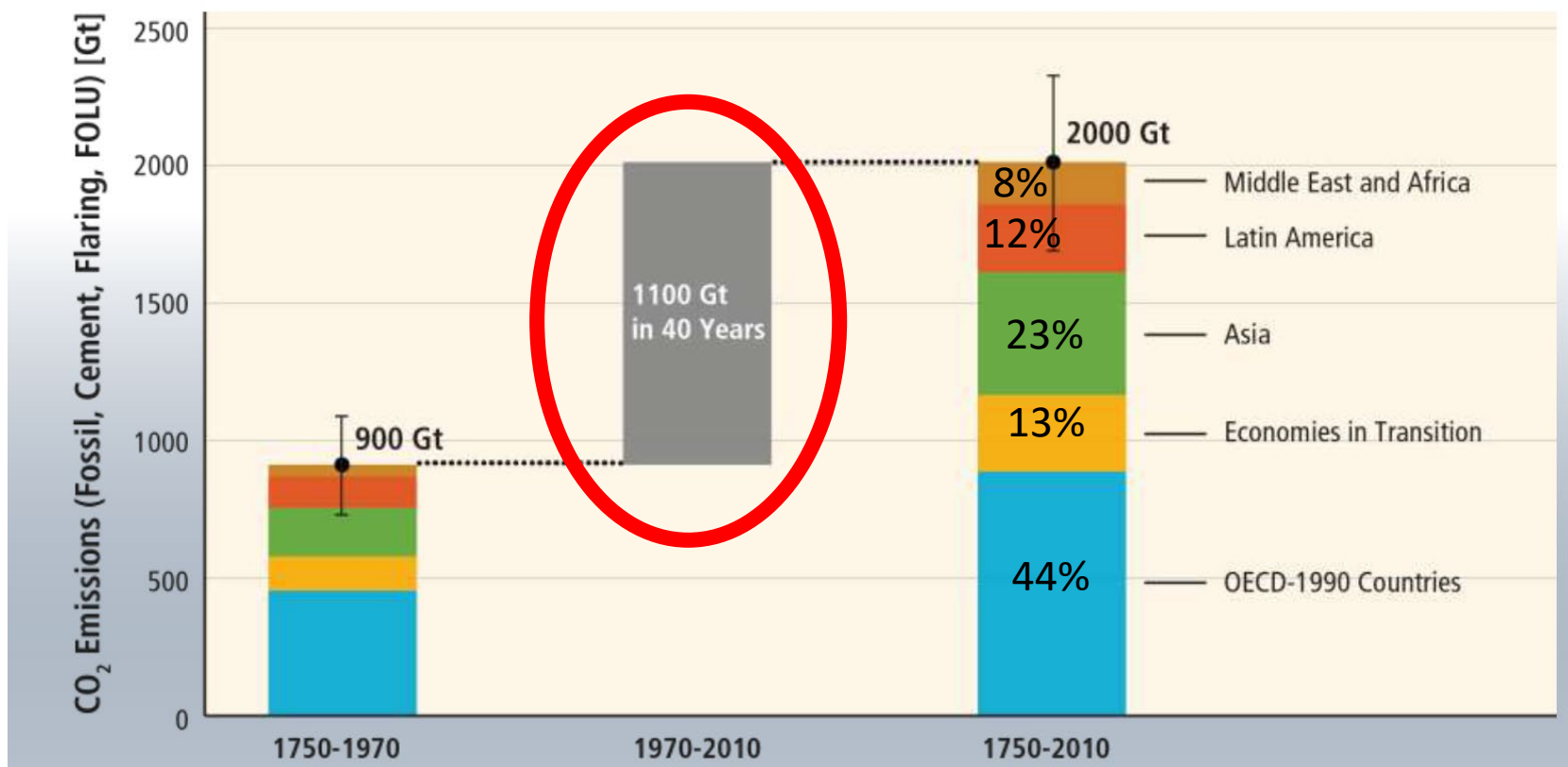
# Why ASHRAE?

- ASHRAE is the standards authority for energy usage and efficiency in buildings
- ASHRAE has an international presence – Chapters in over 130 countries



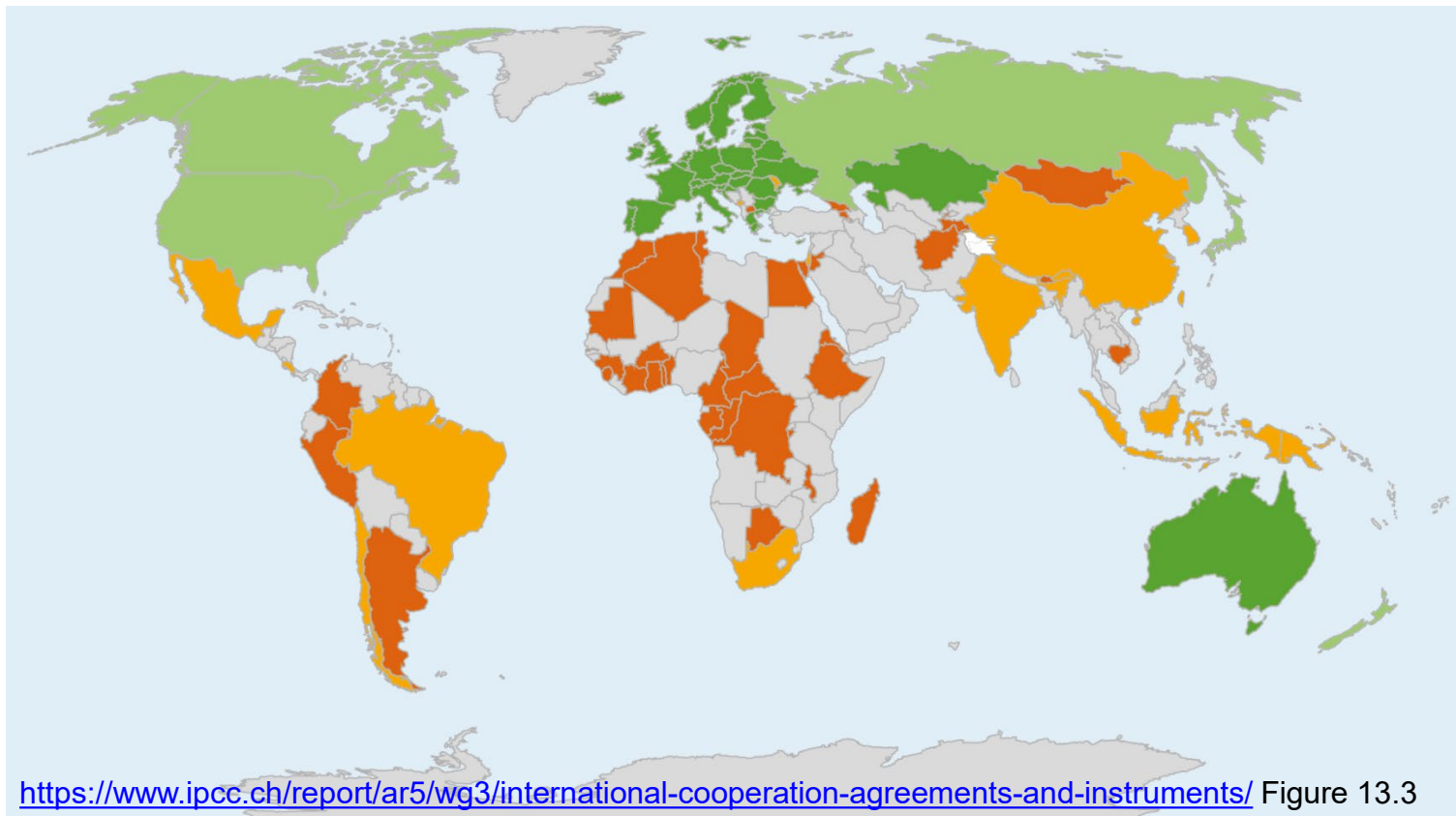
# Where are GHG's Being Produced?

About ½ of the cumulative man-made CO<sub>2</sub> emissions between 1750 and 2010 have occurred in the last 40 years.



Source: Intergovernmental Panel on Climate Change, Working Group III - IPCC Fifth Assessment Report Figure 5.3

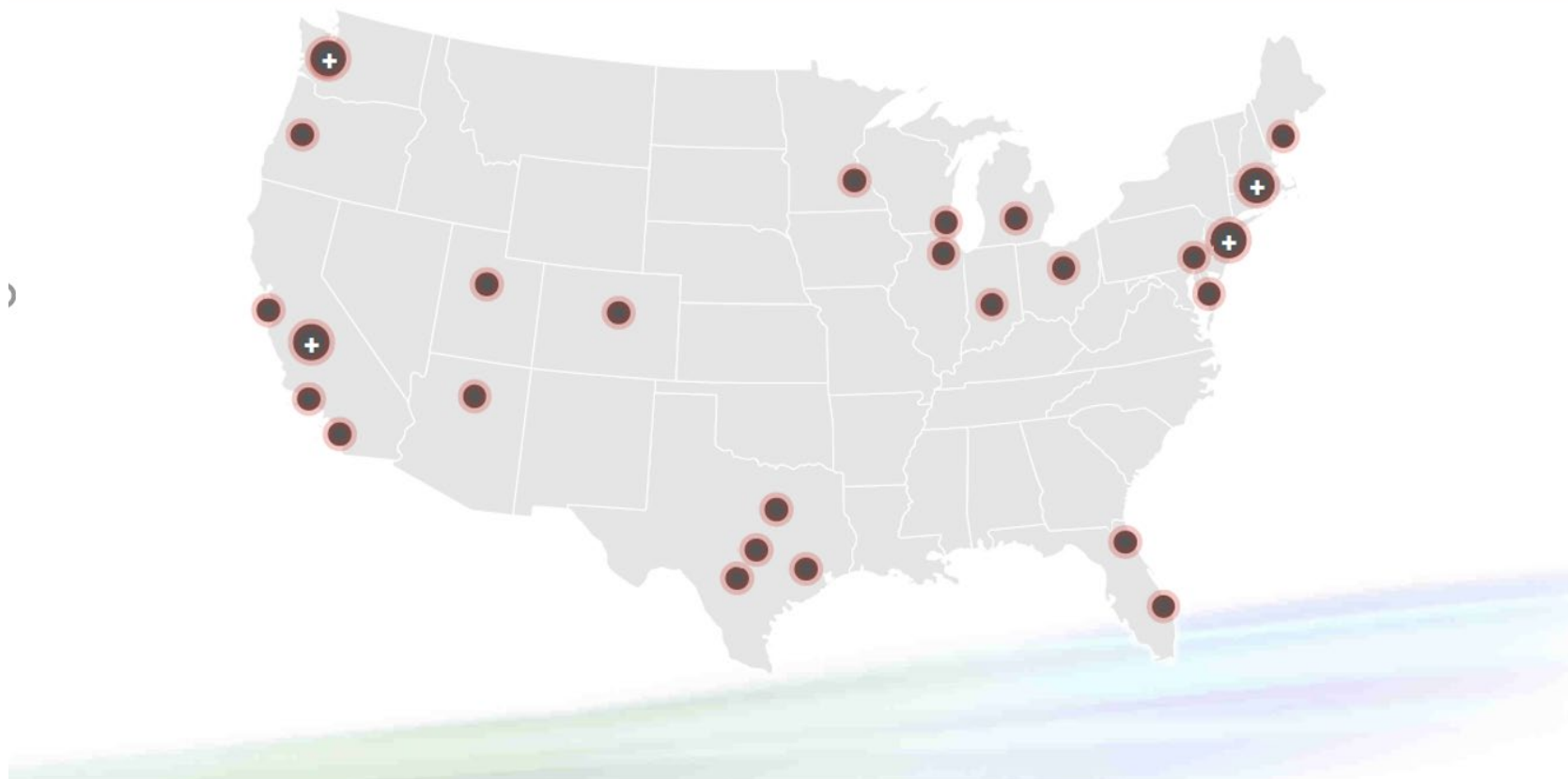
# Decarbonization Targets



- Developed countries with Quantified Emission Limitation or Reduction Commitments (QELROs) under the Kyoto Protocol and Cancún agreements
- Developed countries with Quantified Economy-Wide Emission Reduction Targets (QEERTs) under Cancún agreements
- Developing countries with Nationally Appropriate Mitigation Actions stating their impact on greenhouse gas emissions (Reduction relative to BAU; Reduction in carbon intensity of GDP, compared to 2005 levels)
- Developing countries with Nationally Appropriate Mitigation Actions, termed as policy-, sectoral-, and project-level actions
- Countries with no pledges

# US Locations with Targets

## U.S. Decarb Policies – 2021-03



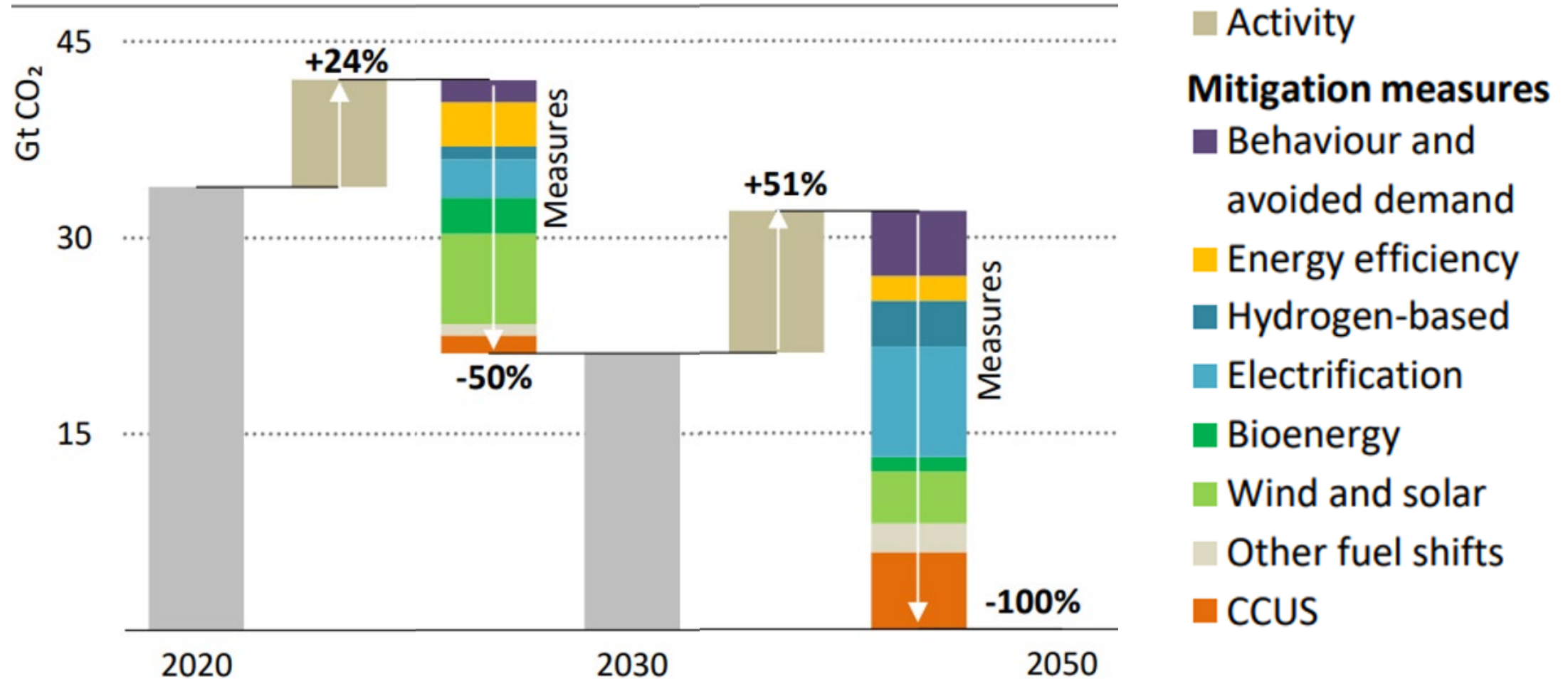
Source: Mick Schwedler, *Decarbonization: Reducing Operating Emissions*, ASHRAE DL Talk, 2021

# General Approach to Hitting the Targets

- Energy efficiency
- Switching to cleaner energy sources
- Shifting to electricity produced with low-carbon energy sources

# IEA's Key Pillars of Decarbonization

## Net Zero by 2050 Roadmap

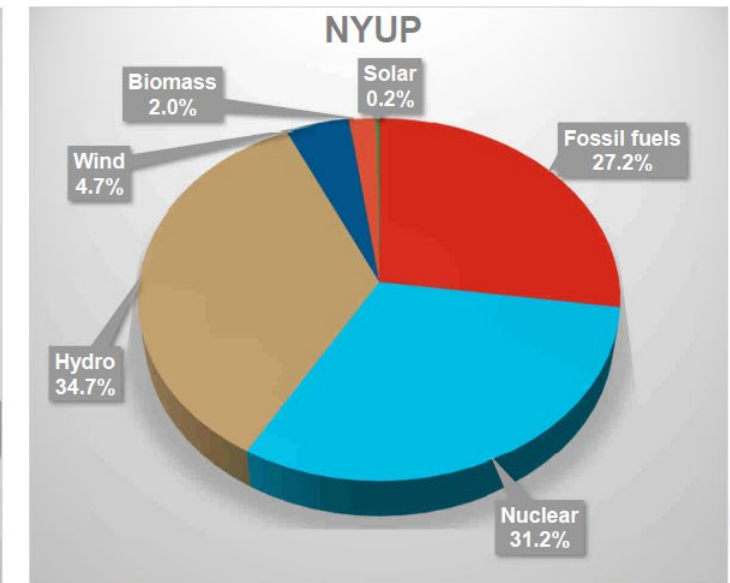
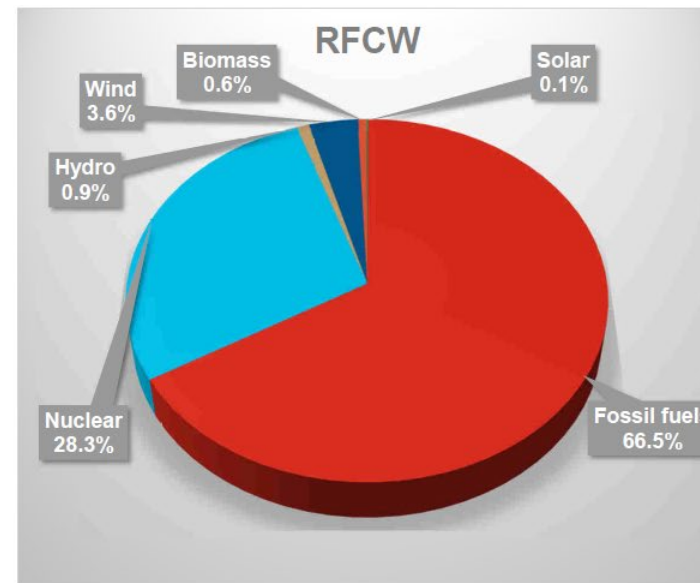
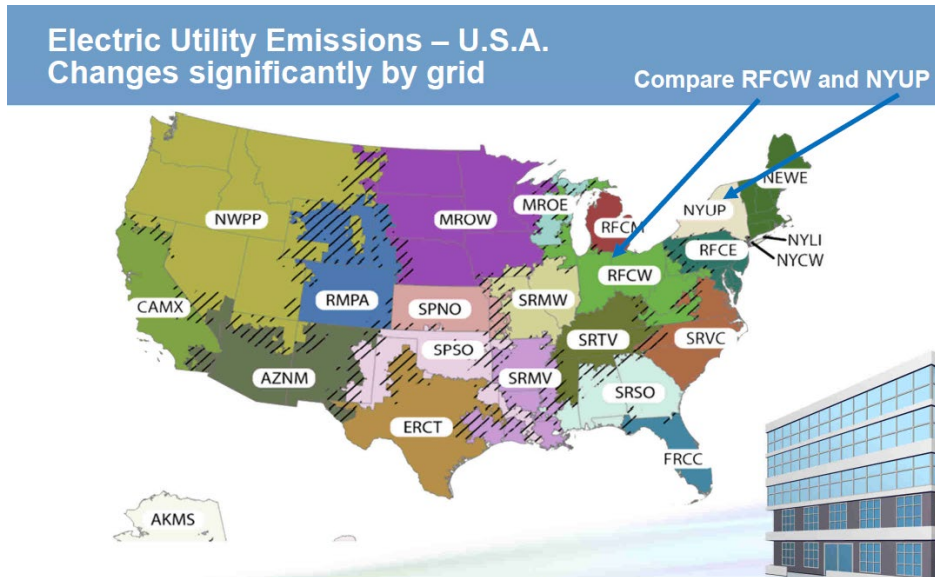


IEA. All rights reserved.

IEA, May 2021, Figure 2.12 Net Zero by 2050 – A Roadmap for the Global Energy Sector, <https://www.iea.org/reports/net-zero-by-2050>

# Building Decarbonization Issues

1. One-size does not fit all
  - a) Residential – commercial - industrial
  - b) New – retrofit
  - c) Spectrum of existing generation fuel mix



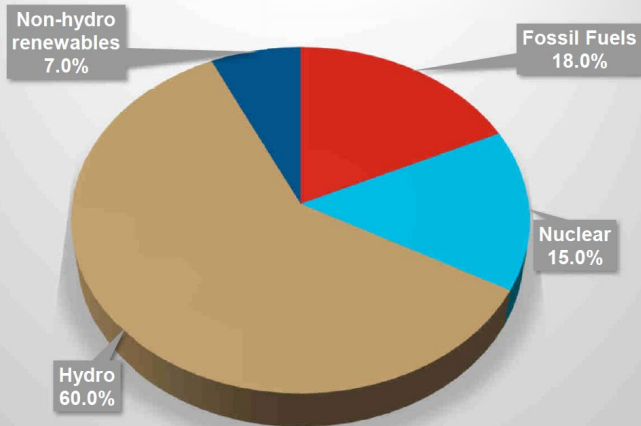
Source: Mick Schwedler, *Decarbonization: Reducing Operating Emissions*, ASHRAE DL Talk, 2021



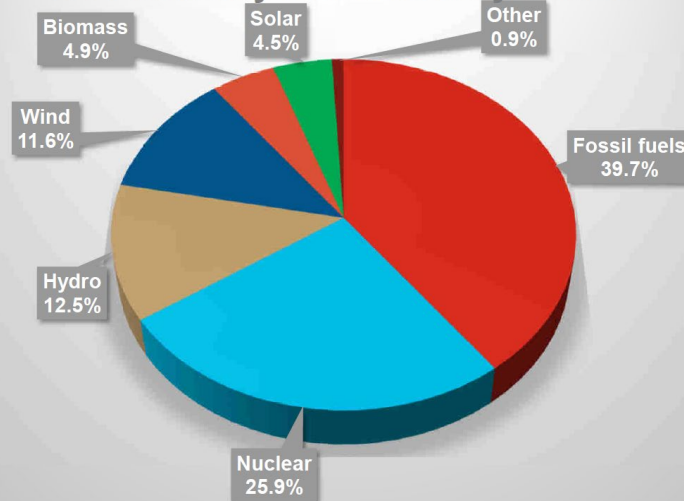
# Building Decarbonization Issues

1. One-size does not fit all
  - a) Residential – commercial - industrial
  - b) New – retrofit
  - c) Spectrum of existing generation fuel mix
  - d) Developed vs underdeveloped countries

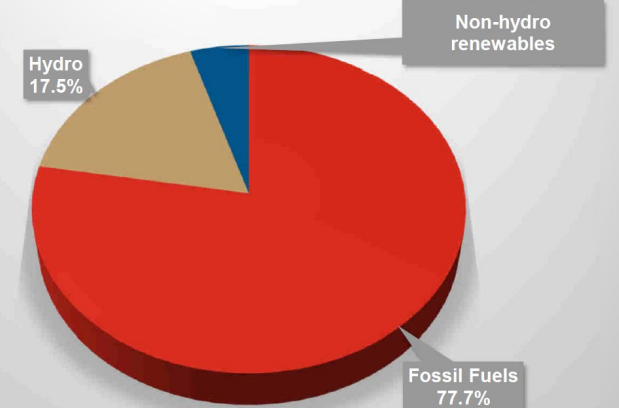
Canada Electricity Production by Source



EU Electricity Production by Source



Southeast Asia Electricity Production by Source



Source: Mick Schwedler, *Decarbonization: Reducing Operating Emissions*, ASHRAE DL Talk, 2021

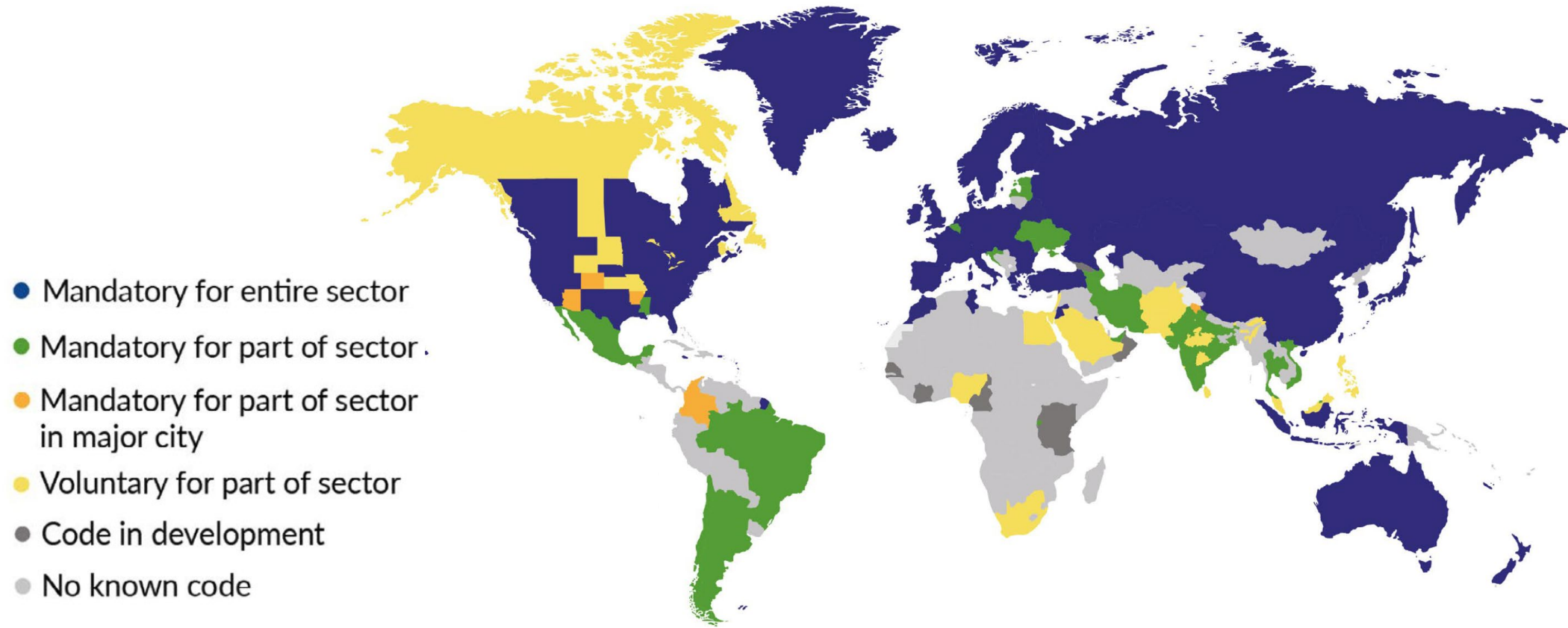
## 2. Definitions

- a) Net zero
  - b) Net zero carbon
  - c) Operational carbon
  - d) Embodied Carbon
  - e) Whole life carbon
  - f) Upfront carbon
- (See CIBSE TM65)



## 3. Standards and codes – scope is not uniform

Figure 9 - Building energy codes by jurisdiction, 2018-19



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

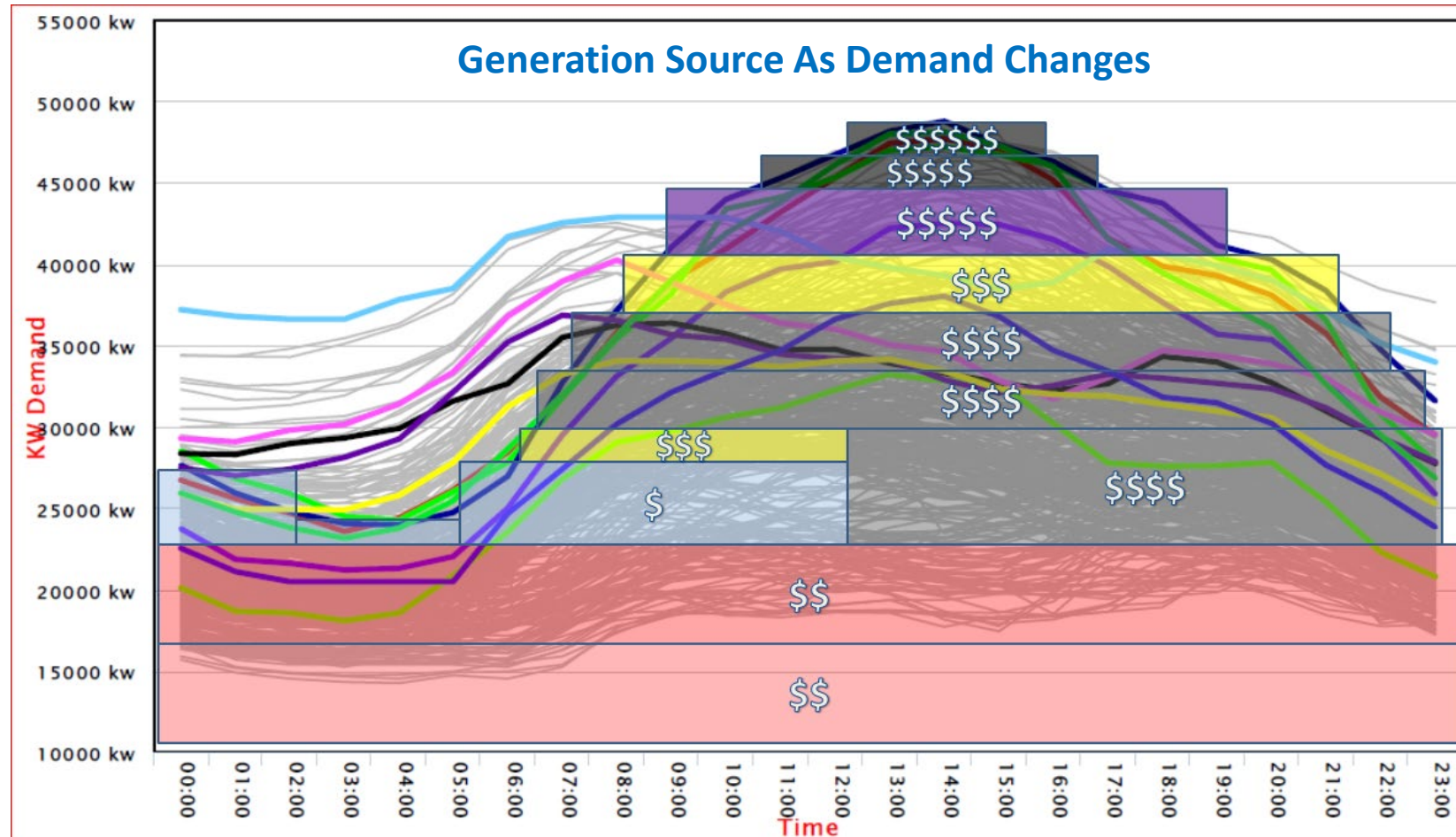
Source: GlobalABC/IEA/UNEP (2019). All rights reserved. Adapted from "Energy efficiency policies: Buildings".

- 3. Standards and codes
  - a) Scope of Standards
  - b) Metrics – transition from energy-based vs carbon-based
  - c) Prescriptive vs performance based
  - d) Boundaries –
    - i. Site vs source EUI
    - ii. Carbon emission and other metrics as a benchmark or base
  - e) Need for global harmonization on labeling and reporting on equipment

## 4. Metrics

- a) Energy use or carbon (embodied and operational)
- b) Offsets – example – allowed in CIBSE but not ASHRAE 228P
- c) Benchmarks – need common measurement scale
  - a) Inclusion of plug loads or just thermal
- d) Embedded carbon / LCA – availability of data and geographically differences

## 5. Generation Source Changes Over Time





# Building Decarbonization Issues

6. Refrigerants
7. Energy Storage – thermal and electrical
8. Controls & communication – internal and with the grid  
(more than load controllers)
9. Maintenance and operation complexities
10. Commissioning and retro-commissioning

- 11. Transportation – electric vehicle energy
- 12. Grid security and capacity
- 13. Linkage between guides, standards, codes, AHJs
- 14. Value / Economics
  - i. Cost of carbon
  - ii. Energy



# Solutions from ASHRAE

- Web Presence
- Best Practices
- Guides / Guidelines
- Standards – Building Performance Standard
- Benchmarking & Existing Stock Assessment
- Training and Education
- International Cooperation



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**dcolliver@uky.edu**





Thanks for your time!