























Buildings Sector EESI February 26, 2021

Buildings Contribution to GHG Emissions

- Significant: 12% direct combustion, 38% including power use
- Drivers include building age, code/efficiency, size
- Buildings have carbon impact beyond energy: waste, water, transportation, materials
- Both Construction phase + Operations phase matter



Buildings as End Use Sector

Carbon dioxide emissions by end-use sectors, 2019



million metric tons of carbon dioxide

nonelectric emissions



Note: nonelectric emissions are from primary energy consumption; electric emissions are from generation of electricity purchased from the electric power sector.

Source: U.S. Energy Information Administration, Monthly Energy Review, Tables 11.1 to 11.6, July 2020, preliminary data

U.S. energy consumption by source and sector, 2019

(Quadrillion Btu)



Where is the energy demand?

FUEL TYPE



Figure 4: Flow of Fuel Types to End Use (LL84 and LL87 data) 14

Electricity represents more than half of the audited source energy, while space heating, fueled mainly by natural gas, represents the largest end use. (Urban Green Council)

END USE

As grids get cleaner, scope 3 emissions become more significant



Building Life Cycle Carbon Footprint



Source: Onat et al, Scope-based carbon footprint analysis of U.S. residential and commercial buildings (2013).

Building Carbon footprint from construction to end of life



* B. Lippke et al "Life-Cycle Environmental Performance of Renewable Building Materials" June 2004 Journal of Forest Products





Materials Embodied Impact Operational energy impact



Buildings are more efficient, but footprint is growing



Notes: EJ = exajoules; kWh/m2 = kilowatt-hours per square metre: RTS = Reference Technology Scenario. Source: IEA (2017), Energy Technology Perspectives 2017, IEA/OECD, Paris www.iea.org/etp/

Floor area additions to 2060 by key regions 3



D Pacific includes Australia, New Zealand, Japan and Korea; ASEAN = Association of Southeast Asian Nations. (2017), Energy Technology Perspectives 2017, IEA/OECD, Paris, www.iea.org/etp

Floor area addition =2017-302030-40 2040-50 2050-60

Buildings aren't getting younger



- About half of buildings in 2012 were built before 1980
- Pre-1980/1990 buildings less impacted by energy codes
- Poor insulation, envelopes, inefficient systems



nbi new buildings

2020 Getting to Zero Buildings L

Growth and trends for zero energy and zero carbon buildings.



zero

The good news: We can do better



Existing buildings achieving LEED O+M contributed:

50% less GHGs from water use 48% less GHGs from solid waste 5% less GHGs from transportation

Source: UC Berkeley-California Air Resources Board





Policy Approaches to Decarbonizing Buildings

- New construction
- Retrofits
- Workforce
- RD&D, technology

Administration goal: retrofit 6 million buildings



Federal Buildings: Opportunity to Lead by Example

- health
- Appropriations & funding including supplemental, stimulus
- Establish buildings goals and direction e.g. GREEN Building Jobs Act (116-S.5001)
 - Energy and water efficiency, GHG intensity
 - Net Zero, deep retrofits, incorporate ZEV charging
- Leverage private sector finance e.g., Open Back Better (116-H.R. 7303/S. 4060) using AFFECT program

Invest in cost-effective energy improvements, boost resilience &



Commercial Buildings (including public)

- Appropriations & funding including supplemental, stimulus • Use DOE programs to advance on all fronts:
- - workforce, RD&D, deployment, energy codes, Better Buildings
- Tax incentives e.g., GREEN Act (H.R. 848)
- Leverage private sector finance e.g., Open Back Better (H.R. 7303/S. 4060) through State Energy Program
- Invest in public buildings improvement e.g., Energy Efficiency Conservation Block Grants program
- State Energy Program numerous activities, proposals



Schools



Boost U.S. Dept. Education ability to support healthy, green, low-carbon schools

- Appropriations & funding including supplemental, stimulus – e.g., *Reopen & Rebuild America's Schools Act (H.R. 604/S.* 96)
- Energy Efficiency grants e.g., 116-H.R. 2-Sec. 33222
- Leverage private finance e.g., Open Back Better
- Technical assistance on school facilities improvements through DOE, EPA, State Energy Offices, State Departments of Education



Residential Buildings

- Appropriations & funding including supplemental, stimulus e.g., Housing is Infrastructure Act (in 116-H.R. 2)
- Use DOE programs to advance on all fronts: • workforce, RD&D, deployment, energy codes, Better Buildings
- Use HUD, USDA programs impacting housing e.g., Energy Efficient Neighborhoods Act
 - Establish minimum code
 - Above-code incentive or requirement
- Weatherization Assistance Program (WAP)
- Workforce training e.g., HOPE for HOMES
- Tax incentives e.g., GREEN Act
- Rebates e.g., HOMES Act



Specific technologies, approaches

- Beneficial electrification
- Heat pumps
- Solar water heating
- Thermal storage
- Battery storage with renewable energy generation
- LED lighting
- Integrating ZEV needs
- Reducing construction phase GHG impacts
- Reducing embodied carbon in materials
- Many more

RD&D Example: Grid-Interactive Efficient Buildings

- Buildings that work with the grid
- Smart, connected technology
- Flexible demand, reduced peak
- Integration
- GridOptimal emerging standard



Buildings ARE Infrastructure

• Part of the system – with huge opportunities to improve resilience, health, and quality of life while reducing GHGs





Buildings Sector

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