Efficiency and Intensity in the AEO 2010

Session 9
Energy Efficiency: Measuring Gains and Quantifying Opportunities

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Overview

- What are the sources of efficiency in the AEO 2010?
- What is the contribution of energy efficiency to projected U.S. energy intensity?
- How do AEO scenarios relate to technical potential?

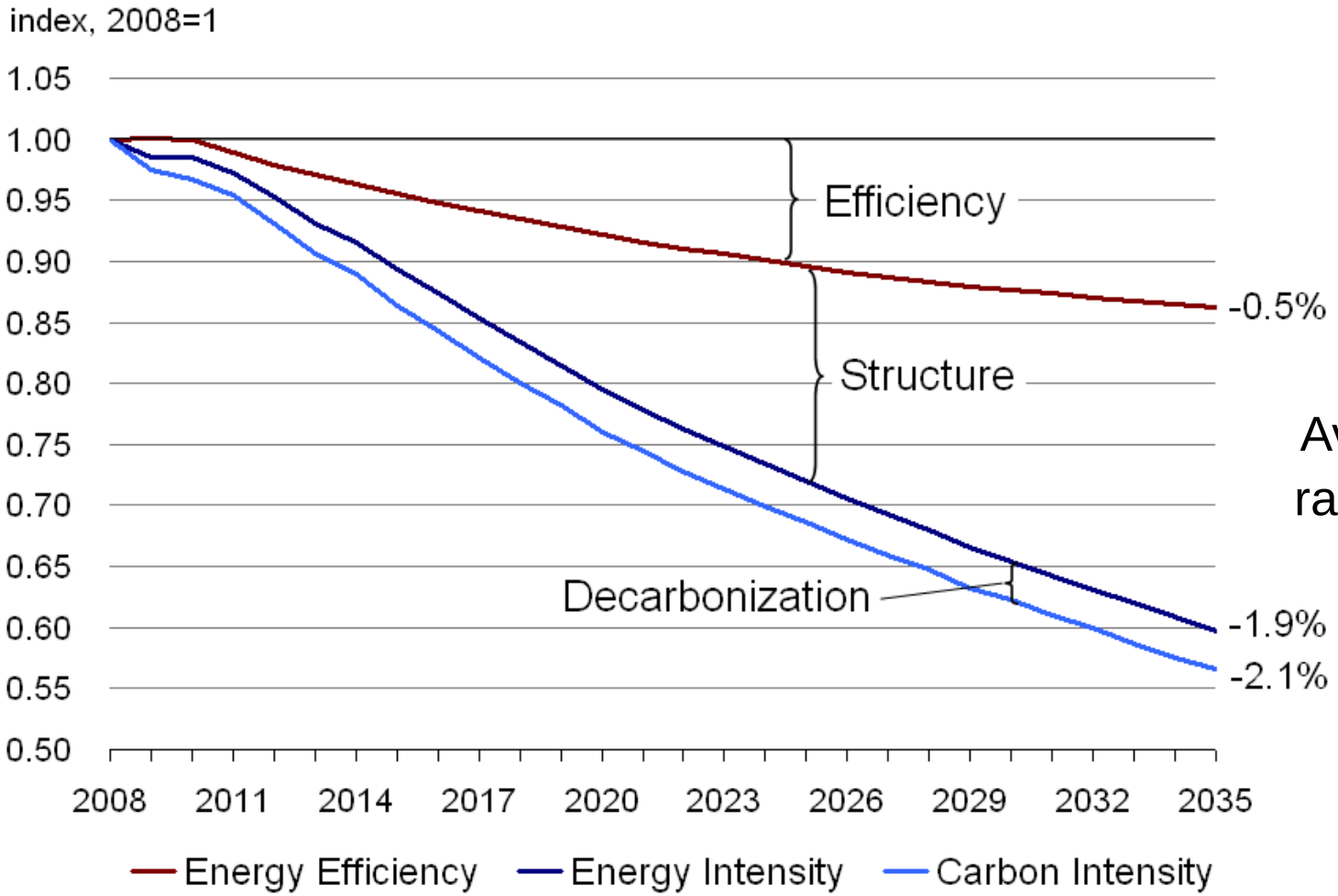
Sources of efficiency

- Technology
  - Stock turnover
  - Progress and learning
- Mandates
  - CAFÉ, efficiency standards (NAECA, EPACT), building codes…
  - Renewable fuel standards
- Incentives
  - Tax credits, loan guarantees, grants, …
    - Energy efficiency and renewables - ACESA, ARRA (stimulus bill) …
    - Investment tax credits
    - Production tax credits for renewable generation
  - Voluntary programs like Energy Star, Rebuild America

Key Concepts

- Energy Efficiency
  - Primary energy consumption per energy services provided
  - Driven by technology improvements
- Energy Intensity
  - Primary energy consumption per real GDP
  - Efficiency + structural changes
- Carbon Intensity
  - Carbon emissions per real GDP
  - Efficiency + structural changes + decarbonization

Decomposition of carbon intensity



Average annual rate of decrease

De-carbonization: 2035 Carbon/Energy ratio is 95% of its 2008 value in Reference case

Source: EIA, National Energy Modeling System run AEO2010r.d111809a.

Examples of structural changes

- Conservation
  - Changes in energy use that reduce consumption by reducing services provided
- Buildings
  - Migration to moderate climates
  - Housing type shifts / commercial building mix
- Industry
  - Shifts to less energy-intensive industries
  - Growth of service sector relative to industry
- Transportation
  - Vehicle type shifts (cars, mini-vans, SUVs, and light trucks)
  - Urbanization, shifts to mass transit, biking / walking…

Structural drivers grow slower than GDP

	CAGR: 2008 - 2035
Macroeconomic	
Real Gross Domestic Product	2.4%
Population	0.9%
NEMS Sectoral Drivers	
Buildings	
Households	1.0%
Commercial Floorspace	1.3%
Industrial (Real Value Shipments)	
Non-Manufacuring	0.9%
Energy Intensive Manufacturing	0.8%
Non-Energy Intensive Manufacturing	1.8%
Transportation	
Light Duty Vehicle-Miles Traveled	1.7%
Freight Truck Vehicle-Miles Traveled	1.7%
Air Seat Miles	1.3%
Rail Ton-Miles	0.8%

Source: EIA, National Energy Modeling System run AEO2010r.d111809a.

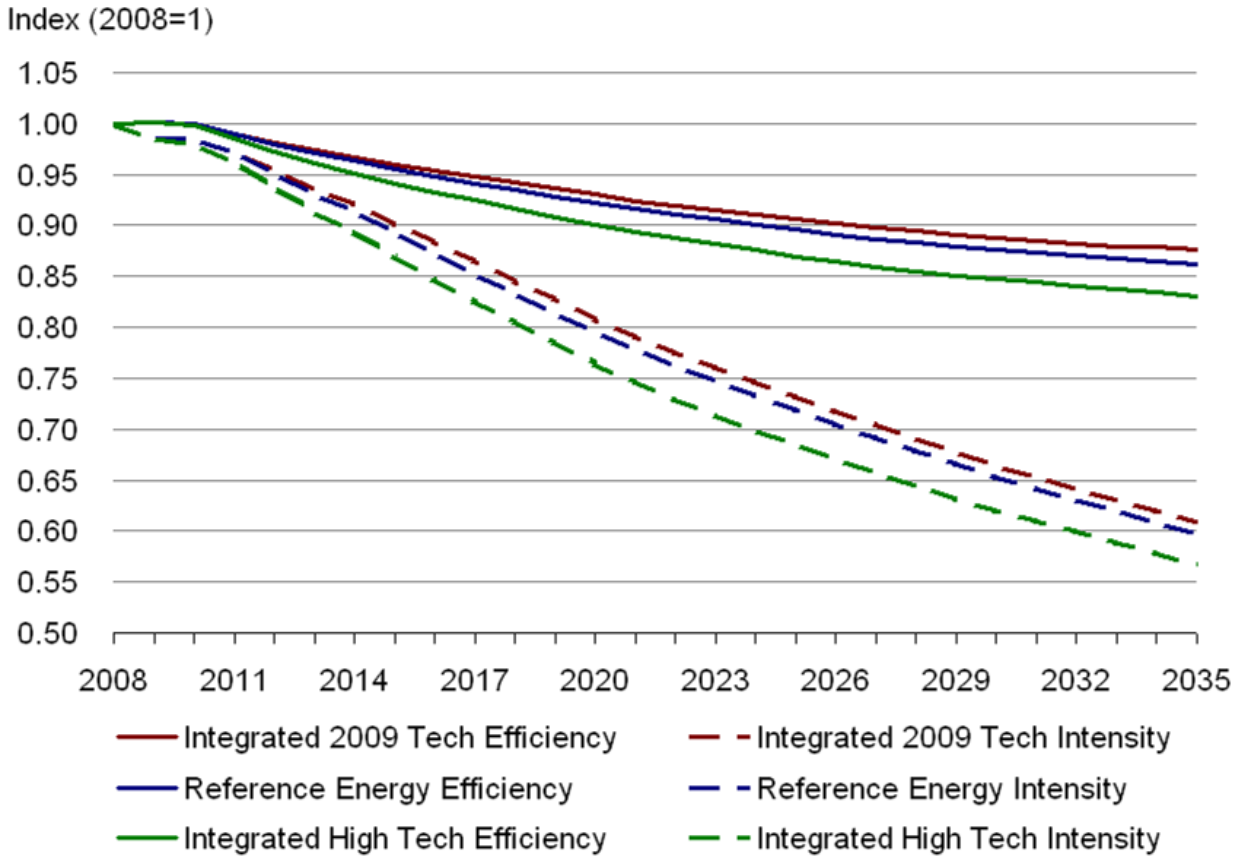
Contribution of technology improvements

- Low technology integrated case
  - No future technology advances
    - Equipment and shells limited to what was available in 2009
    - Equipment stocks improve through turnover
- Reference case
  - Future technology improvements
  - Equipment purchases calibrated to observed behavior
- High technology integrated case
  - Advanced equipment available earlier at lower cost
  - Purchases based on reduced discount rates
  - Building shells get more efficient than Reference

Note: All cases have same stock turnover rate

- *No aggressive retrofitting*

Energy efficiency and intensity across technology cases



Primary Energy Consumption difference from Reference Case, 2035

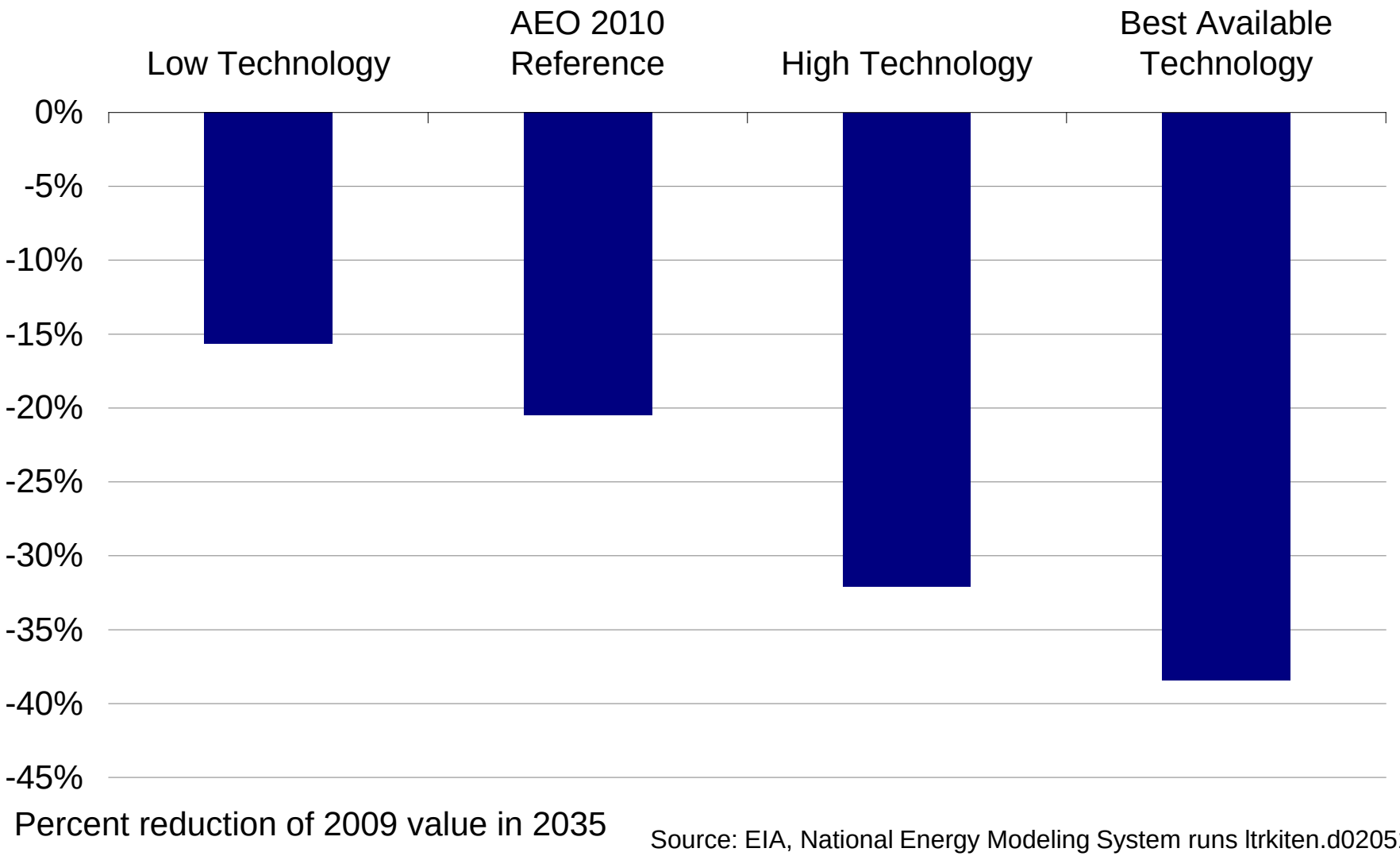
2009 Technology = 2.4 quad Btu increase High Technology = 5.7 quad Btu decrease

Source: EIA, National Energy Modeling System runs ltrkiten.d020510a, AEO2010r.d111809a, and htrkiten.d020510a.

Approaching technology potential: buildings best case

- Buildings case only
  - Residential and commercial sectors
  - Not integrated with other modules
- Best technology case
  - Equipment costs ignored
  - Only the most efficient technologies are allowed
  - Shells even better than High technology case
- Reference assumptions on stock turnover
  - *No aggressive retrofitting*

Buildings delivered energy use per square foot



Source: EIA, National Energy Modeling System runs ltrkiten.d020510a, AEO2010r.d111809a, htrkiten.d020510a, and bldbest.d012010a.

Approaching technical potential: buildings best case

- Best case still not maximum technical potential
- Long-lived, rapidly advancing technologies do not fully penetrate by 2035
  - LED lighting
  - Geothermal heat pumps
  - Miscellaneous buildings equipment
  - Building shells
- Technical Potential
  - Post-2035 intensity could ultimately fall to 43 percent lower than 2009 (from 38 percent in 2035)

For more information

- EIA, *Annual Energy Outlook 2010*, DOE/EIA-0383(2010) (Washington, DC, forthcoming), **www.eia.doe.gov/oiaf/aeo/index.html**

- EIA, *An Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook,* SR/OIAF/2009-03 (Washington, DC, April 2009), **www.eia.doe.gov/oiaf/servicerpt/stimulus/index.html**

- Wade, S.H., *Measuring Changes in Energy Efficiency for the AEO 2002,* **www.eia.doe.gov/oiaf/analysispaper/efficiency/index.html**

Thank you

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