

BUILDING TECHNOLOGIES PROGRAM

U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy



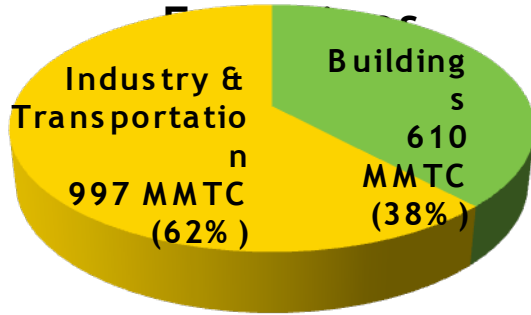
Market Transformation Symposium

• March
17

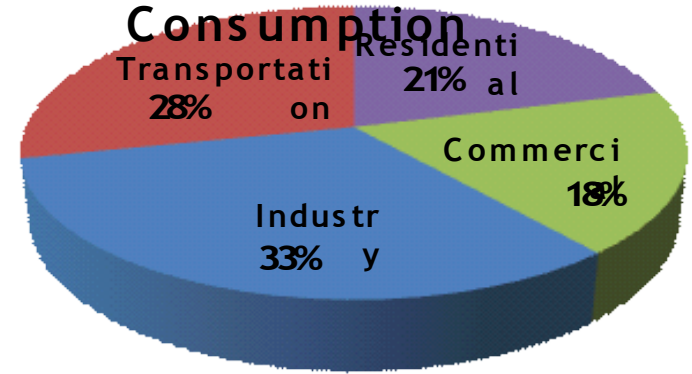
• Paul A.
• National
Renewable
Energy
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Background: Building Energy Use

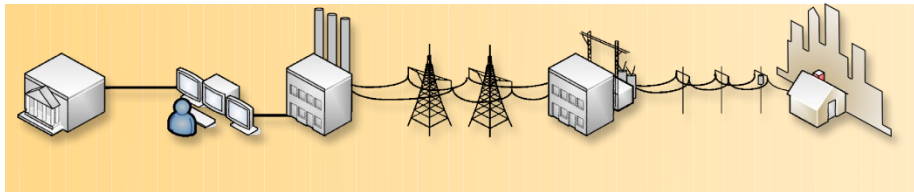
38% of U.S. Carbon



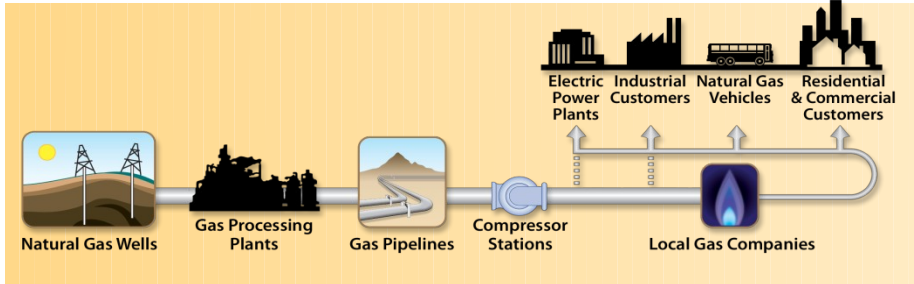
39% of U.S. Primary Energy



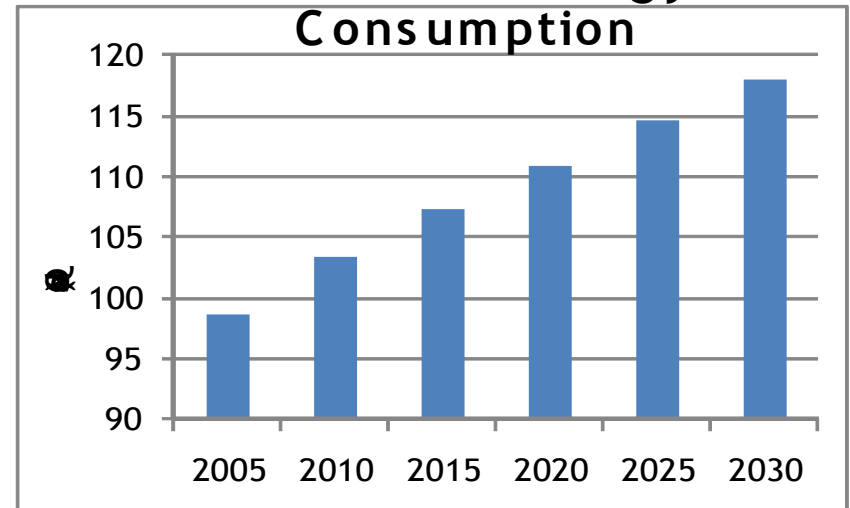
72% of U.S. Electricity Consumption



54% of U.S. Natural Gas Consumption

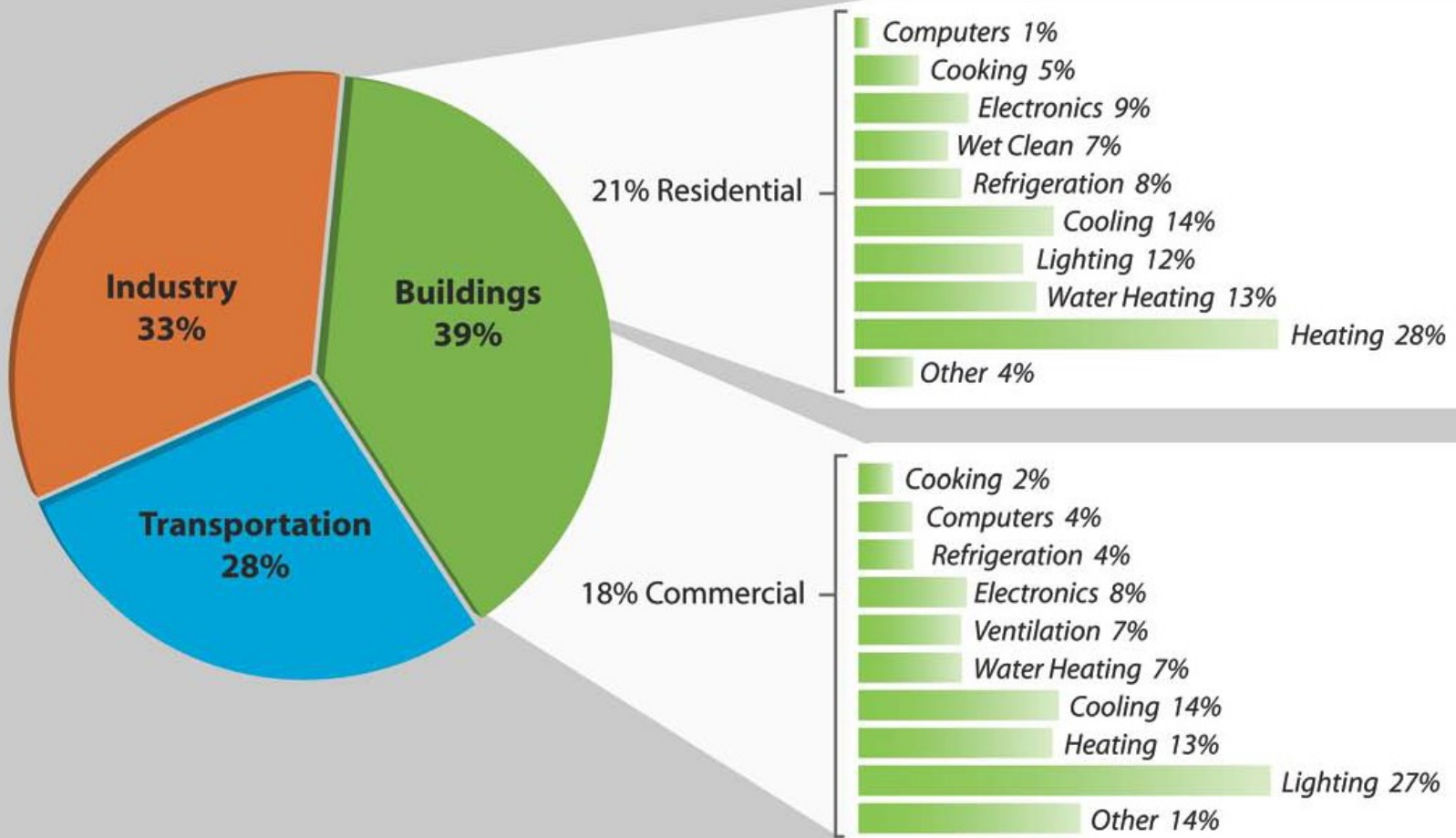


Total U.S. Energy Consumption



Sources: BED 2009; AEO 2010

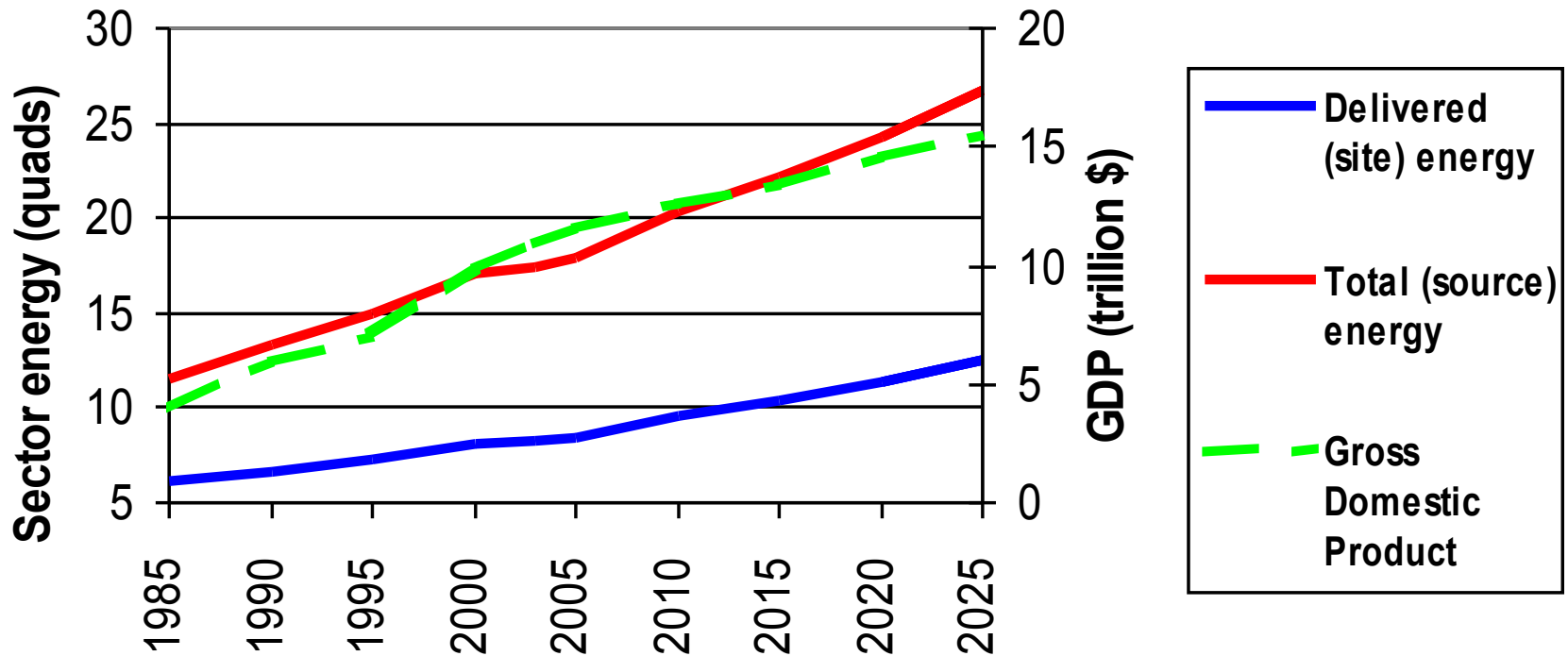
2006 Buildings Share of U.S. Primary Energy Consumption End-Uses



Source: Buildings Energy Data Book <http://buildingsdatabook.eren.doe.gov/>
Tables 1.1.3, 2.1.5, 3.1.4

Note: The "Adjust to SEDS" percentages for the residential and commercial end-use splits were distributed among the other categories.

Trends of Commercial Sector



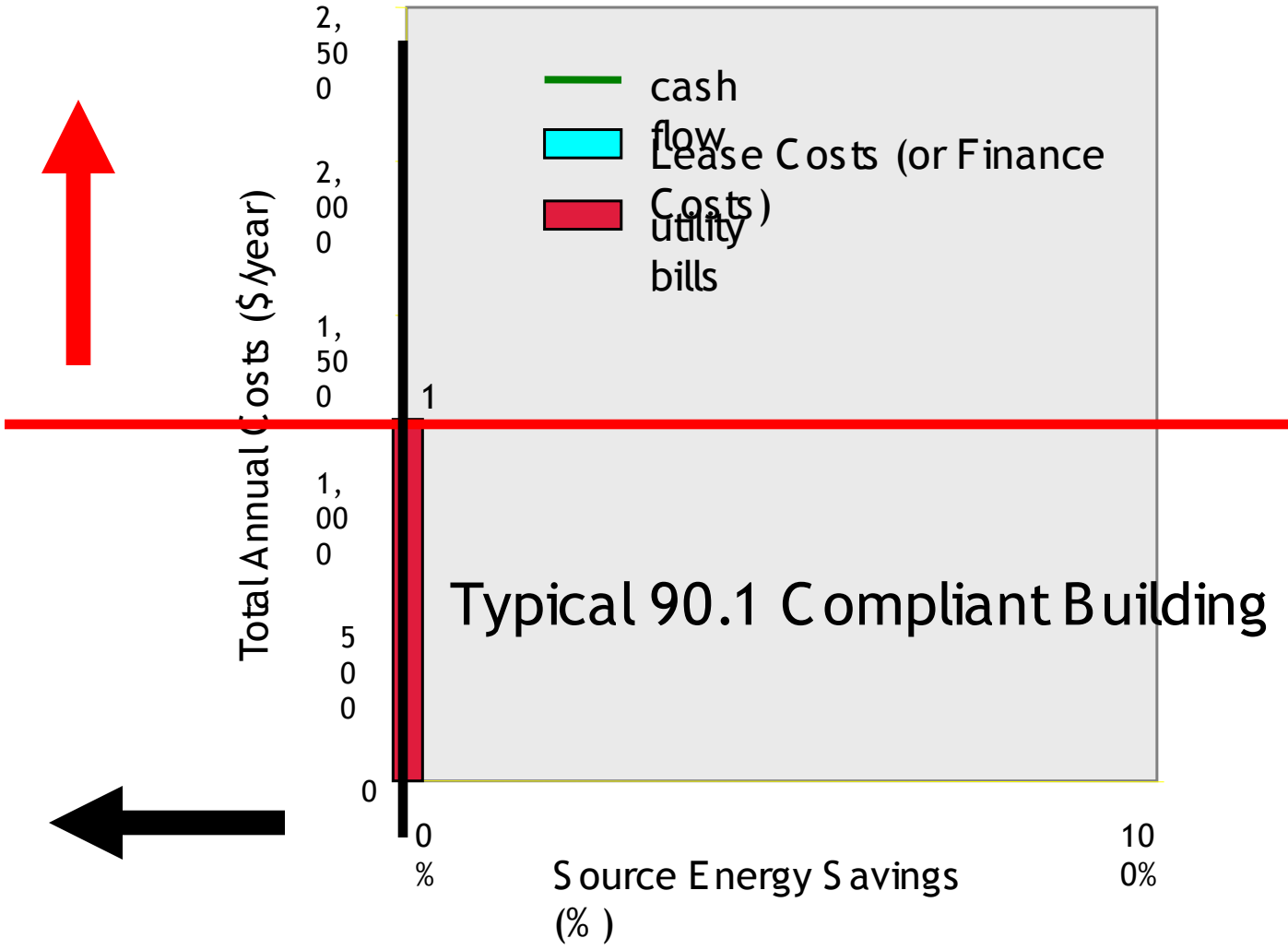
- Commercial Sector Energy Use is Growing at 1.6% per year
- Growth is faster than energy efficiency

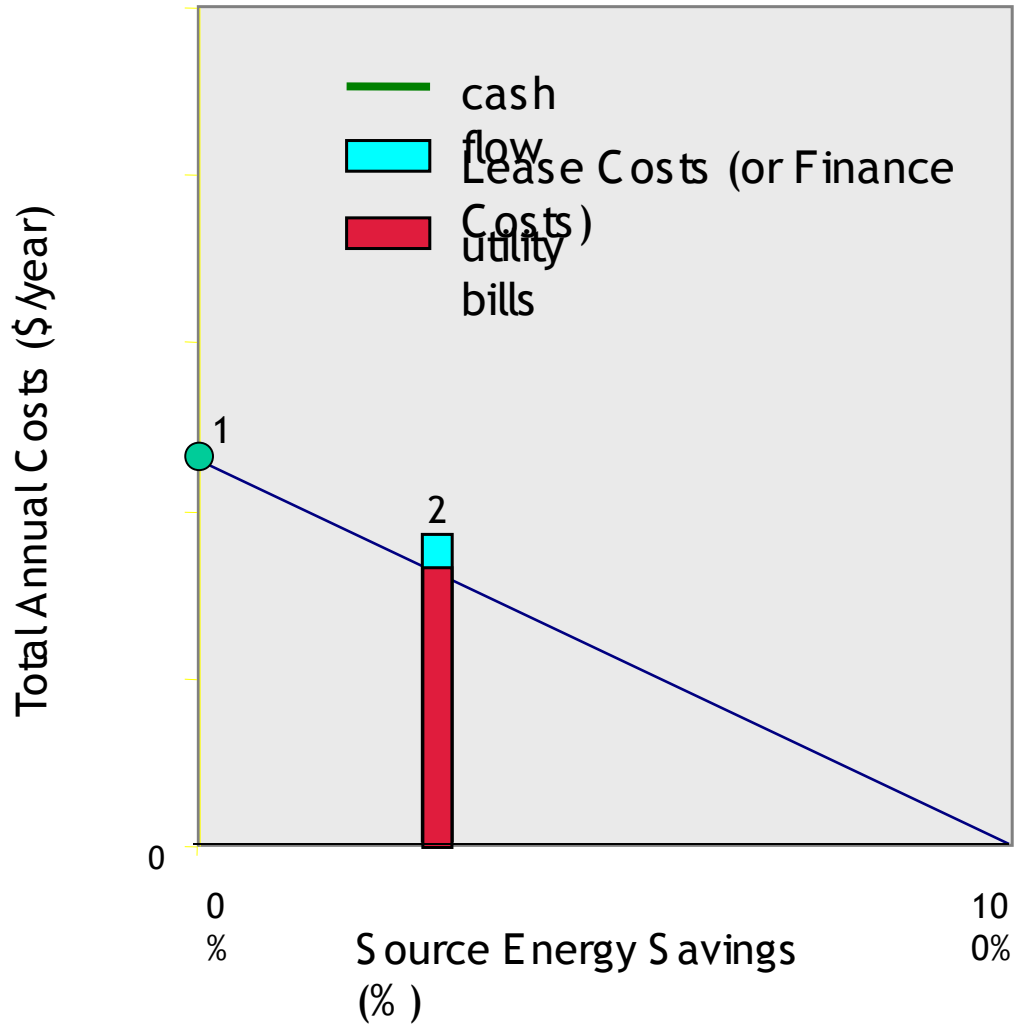
Many Pieces

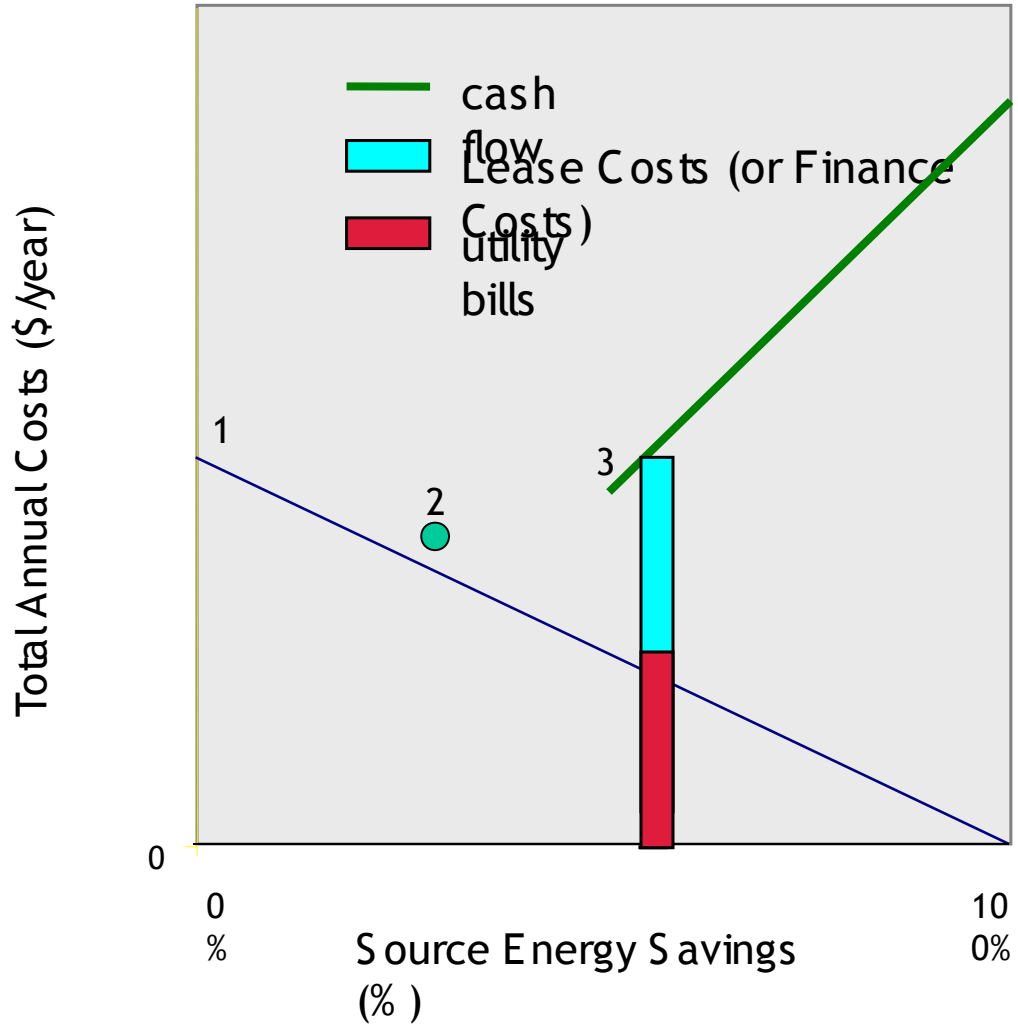
- So many ways to assemble the pieces
- Design is about making decisions - need motivation to make the right decisions
- Need to work with decision makers



Decision Making Process







Site EUI
kBtu/ft²·yr
(MJ/m²·yr)

100.0
(1,135)

90 (1020)

Existing commercial buildings (2003 CBECS)

79.2 (900)

Models of existing stock (Griffith et al. 2007)

75.0
(852)

70.7 (803)

New buildings
Base scenario (Standard 90.1-2004)

Case Study Buildings:
CBF 40 (457)

Where we are if all buildings were built to code

Oberlin 30 (338)

40.3 (458)

Max Tech energy efficient scenario

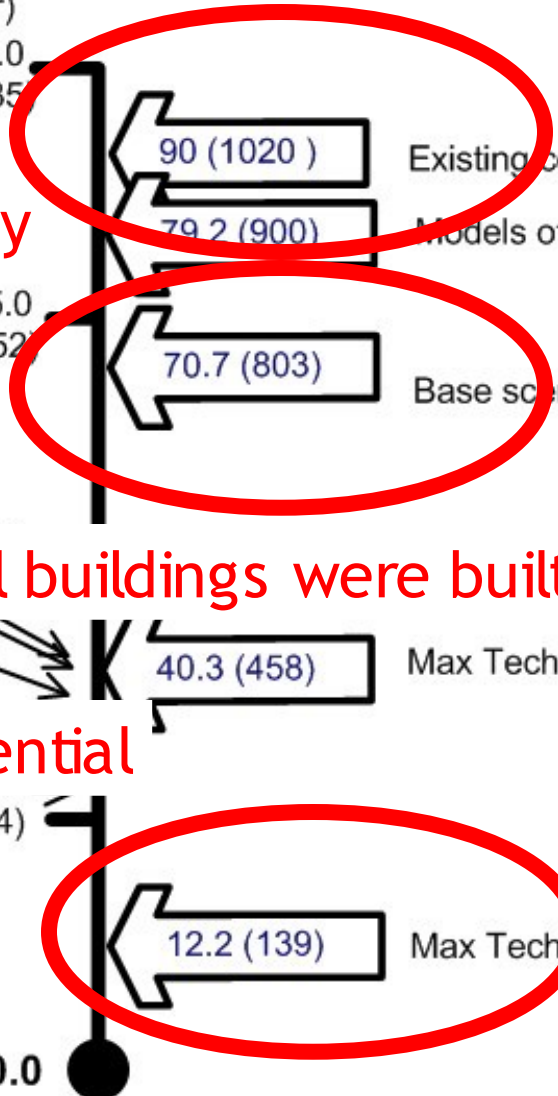
Assessment potential

(284)

12.2 (139)

Max Tech energy efficient scenario w/ PV

0.0




Program Focus: Develop and deploy technologies, tools, and standards for making residential and commercial buildings more energy-efficient, affordable, and better performing.

- Existing Buildings
 - 115 million households (est. 275 billion sqft) in the US, 2/3 of which were built before modern building codes took effect
 - There are 5.5 million commercial buildings, with more than 81 billion sqft of floor space
 - Existing buildings are more challenging than new construction, and require new approaches
- New Construction
- Appliance standards and building codes
- Component R & D
 - roadmaps, cost goals, and metrics



Lighting Overview

Lighting represents 19% of commercial building energy use (14% of total energy) and is projected to consume nearly 10 quads of primary energy by 2012.



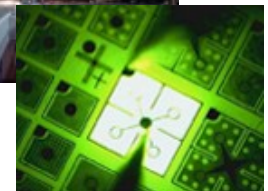
Commercial Building Energy by End Use (2010)

(Source: *Building Energy Data Book 2009*)

Research Planning: Lighting R&D

Lighting R&D conducts R&D of Solid-State Lighting (SSL) devices and technologies, both inorganic light emitting diodes (LEDs) and organic light emitting diodes (OLEDs)

- The SSL R&D agenda is established through an annual consultative process with general lighting industry, compound semi-conductor industry, universities, research institutions, National Laboratories, trade organizations, other industry consortia, and the Next Generation Lighting Industry Alliance.
- Includes Cost and Performance Targets



Space Conditioning, Appliances, and MELS

Space Conditioning & Refrigeration R&D focuses on Heating, Ventilation, Air Conditioning (HVAC) systems, Water Heaters, Appliances, and Miscellaneous Electric Loads (MELS) R&D

- HVAC (space heating, cooling, and ventilation) is the largest end use for residential and commercial buildings, consuming approximately 35% of total energy used in buildings.
- Water heating is the third largest end use in buildings, using approximately 10% of primary energy.
- Air-conditioning is a key driver of peak electricity demand.

Research Planning: Space Conditioning & Refrigeration Research & Development

- Air-Source and Ground-Source Integrated Heat Pump (IHP)
- HVAC Research
 - Solar-Assisted Heat Pump Systems
 - High Performance Cold Climate Heat Pumps
- Heat Pump Water Heater (HPWH)
- Appliances
 - Improved User Interface of Residential Thermostats
 - Defining next generation of appliances: technology options, cost curves, and technical innovations for ultra-high efficiency appliances and energy service systems
 - Evaluation and comparison of real world energy consumption and DOE test procedures



Envelope Overview

Envelope (Roof, Walls, Foundations, and Windows) affect similar end uses as Space Conditioning but also includes lighting.

- Focus: walls, roofs, and foundations, which includes envelope materials and envelope systems; and windows and doors.
- A large fraction of the energy used to heat and cool buildings each year is lost through the building envelope
- Continued R&D is key to success of high efficiency whole building design and construction

- **Highly Insulating Near Term (R5 Windows)**
 - Production engineering with industry and volume purchase
- **Highly Insulating Long Term (R10)**
 - Goal U value 0.10 with possible vacuum glazings
- **Dynamic solar control and Daylighting**
 - Passive heating and dramatic peak cooling reduction
 - Control strategies
- **Enabling research to support efficient products**



- Research impacts , education

Prototype - Concept Window
 Highly Insulating and Dynamic
 R 5.6 (U Value 0.18)
 SHGC 0.04 - 0.34

- Advanced walls to reach R20 in 3.5” cavity, R30 total wall exterior insulation systems
- Next Generation of Attic/Roof System to save 50 Percent Energy
- New Material Development
- Test procedure development and performance impacts in association with industry & standard organizations
- Cool Roofs Research and Deployment



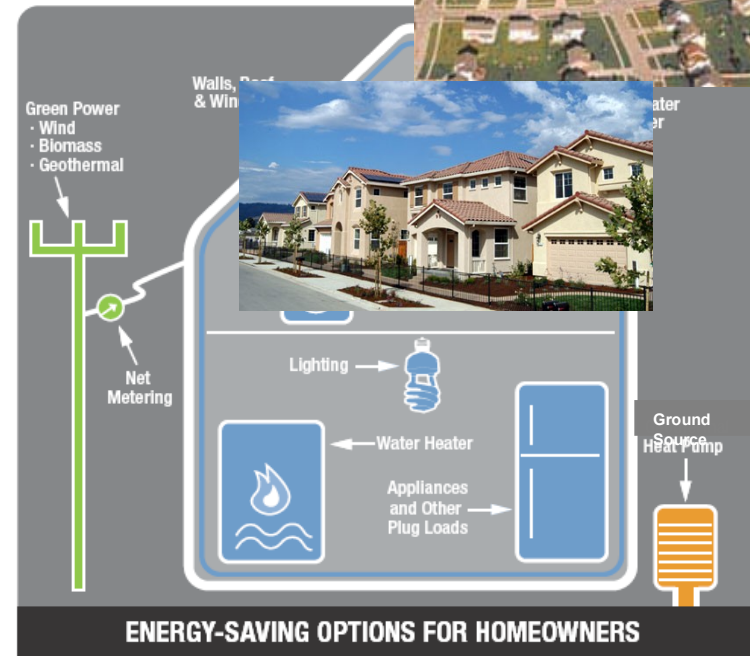
Research Planning: New R&D Areas, Sensors & Controls

- Advanced Controls with Better Interfaces
- Optimization Algorithms
- Interface with Utilities
- Integration of New Technologies with Building
- Whole Building Systems

- Savings Potential Huge— Makes investment in other technologies more effective
- Savings is between 2.3 and 6.5 Quads per year in Commercial

Residential

- New
 - Whole Building Integration
 - HVAC, Envelope, Controls, Sensors, Hot Water
- Analysis Tools
- Existing
 - Streamlined auditing
 - Economic packaging
 - 30% savings; deep retrofit to 50%
- Community and Prototype

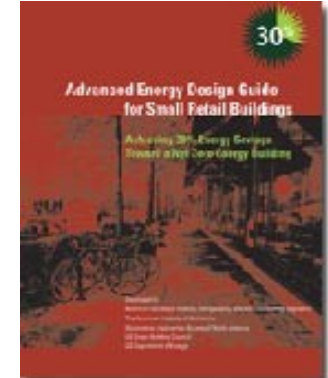
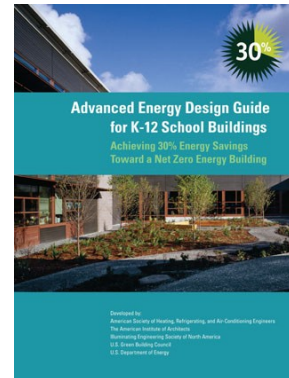


Commercial Buildings

- Market Engagement Activities
 - Commercial Building Partnerships
 - Commercial Building Alliances
- Building Design Package Research and Development
 - Advanced Energy Design Guides
- Analysis Tools



National Accounts commit to accomplishing 50% and 30% energy savings, in a new and existing building, respectively.

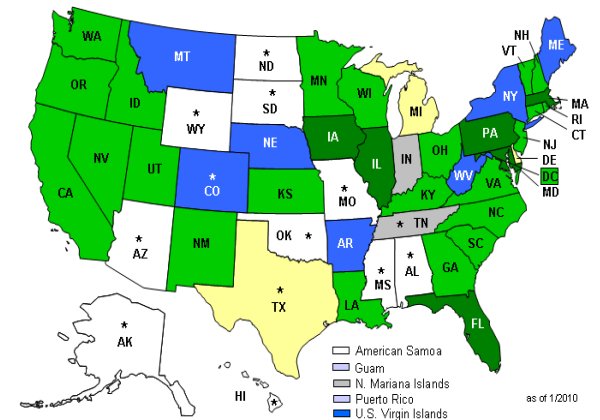
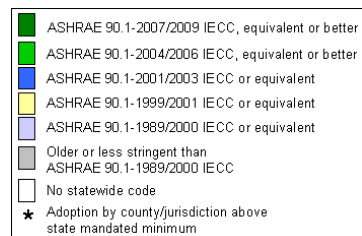


Getting Innovations into the Market: Building Energy Codes

- DOE is preparing a major effort to seek out suggestions on how the Department and others might best support states in their effort to:
 - Upgrade their codes to Standard 90.1-2007 for commercial buildings and the 2009 IECC for residential buildings, or equivalents
 - Develop and implement a plan to achieve compliance with their codes by 2017
- Plan will be based on broad stakeholder input, will be available for public review, and will be used to gauge and report progress

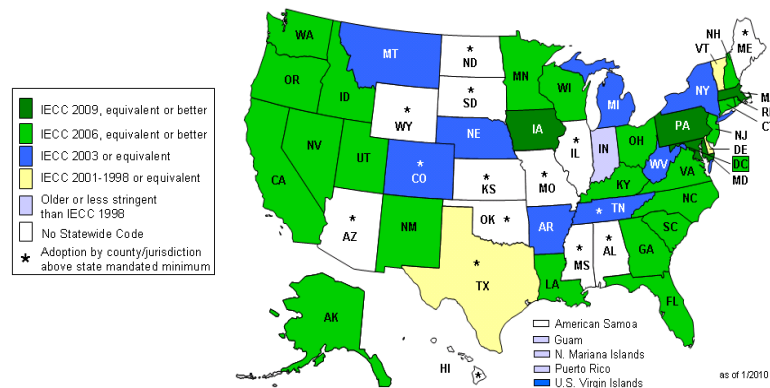
Getting Innovations into the Market: Building Energy Codes

- Commercial model code goal
 - DOE goal is for Standard 90.1-2010 to be 30% more energy efficient than 90.1-2004
 - DRAFT Determination: Standard 90.1-2007 is 5.2% more efficient on site energy basis and 4.1% better on source energy than Standard 90.1-2004
 - Joint effort with ASHRAE /IES /ANSI



Getting Innovations into Market: Building Energy Codes

- Residential low-rise model code goal
 - DOE goal is for 2010 IECC to be 30% more energy efficient than 2006 IECC
 - DRAFT Determination: IECC 2009 is 12% to 15% better than 2006 IECC
 - Multi-stakeholder effort



Getting Innovations into the Market: Commercial Equipment & Appliance Standards

- **Schedule for Equipment and Appliance Standards**
- **Comprehensive Set**

Ending Thoughts...

- Will take lots of efforts from many different directions to change how buildings use energy
- Use performance based metrics whenever possible (avoid specific technology solutions)
- Make decisions that have a positive energy impact— we all need to play a part.

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- www.eere.energy.gov/buildings
- www.nrel.gov