

Moving Toward Optimizing Energy Efficiency and Renewables Using Smart Grid Technologies and Policies

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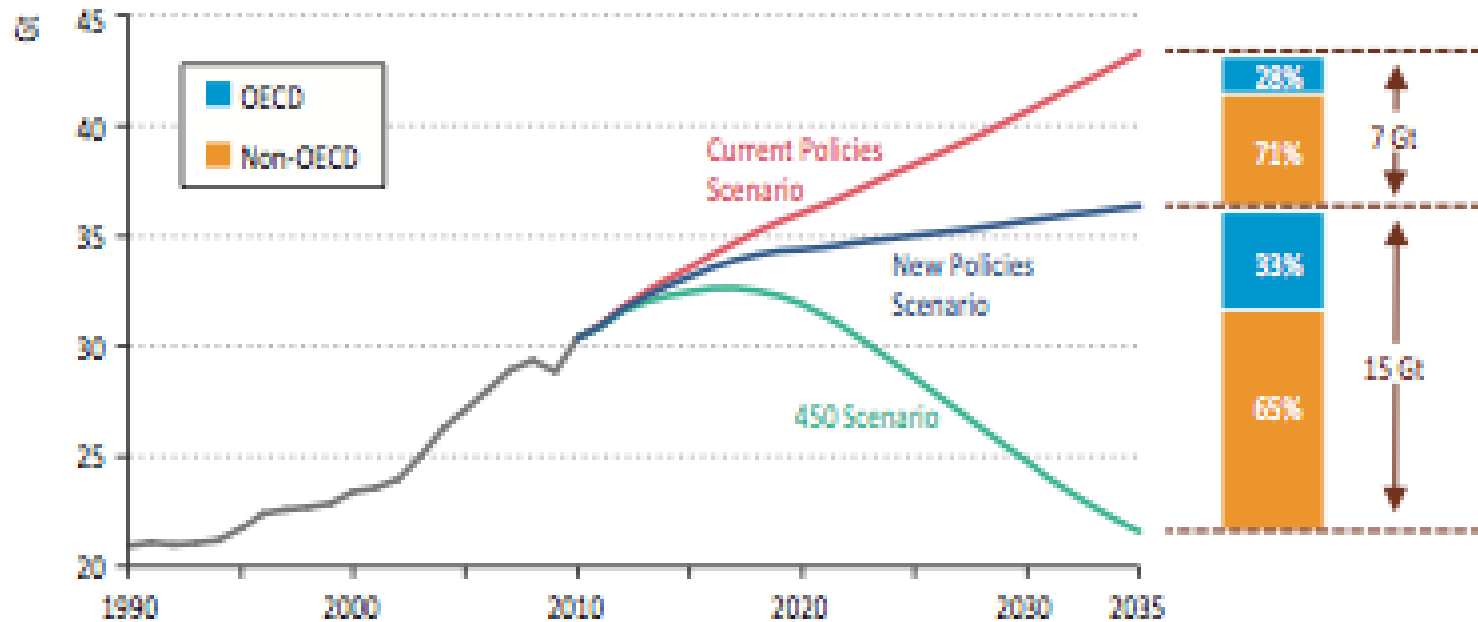
**Visions of Sustainable Economic Growth:
A Transatlantic Dialogue on Energy, Water, & Innovation**

September 11, 2012 Woodrow Wilson Center, Washington, DC

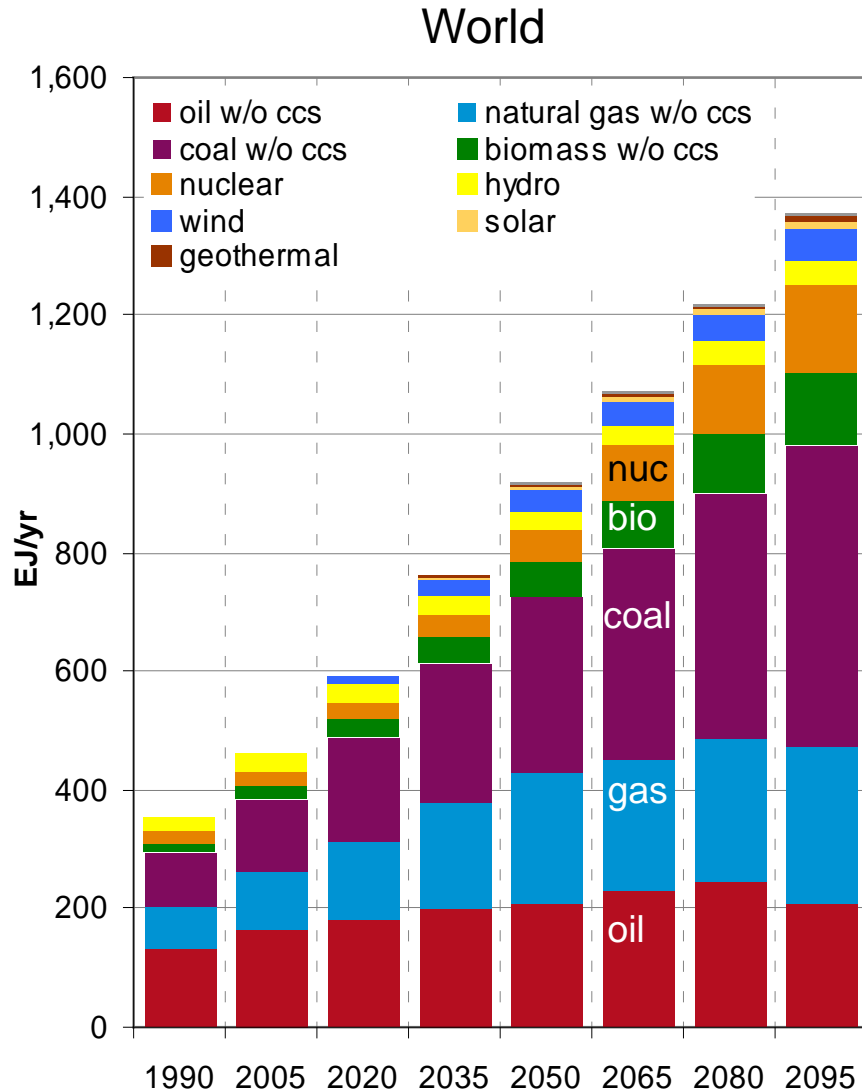
Door is Closing on 450 ppm CO₂ (or 2° C Rise in Global Temperatures)

- Four-fifths of the total energy-related CO₂ emissions “permissible” by 2035 is already “locked-in” by our existing capital stock

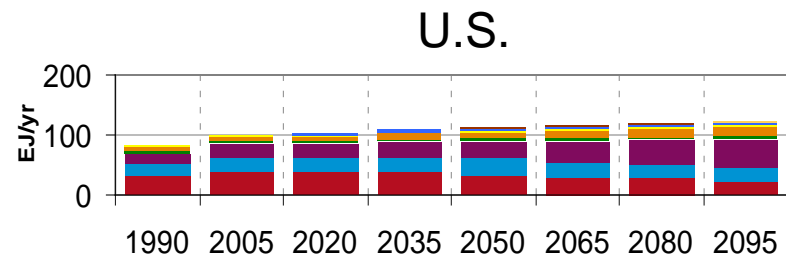
Figure 6.2 • World energy-related CO₂ emissions by scenario²



Global Trends: Where the Action Is



- U.S. energy demand is growing much more slowly than the rest of the world
- Today we consume almost 25% of the world's energy production; in 2100 the U.S. will consume less than 10%

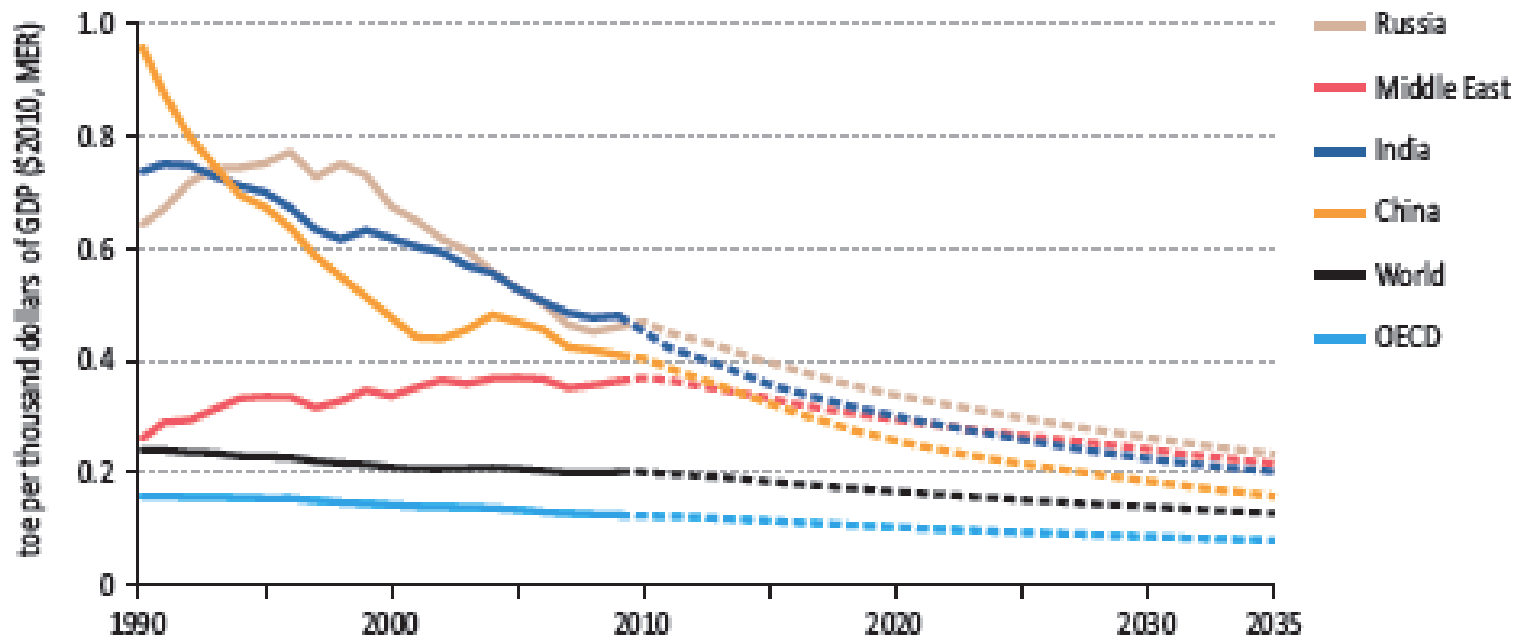


Source: Brown and Sovacool. 2011. Climate Change and Global Energy Security (MIT Press)

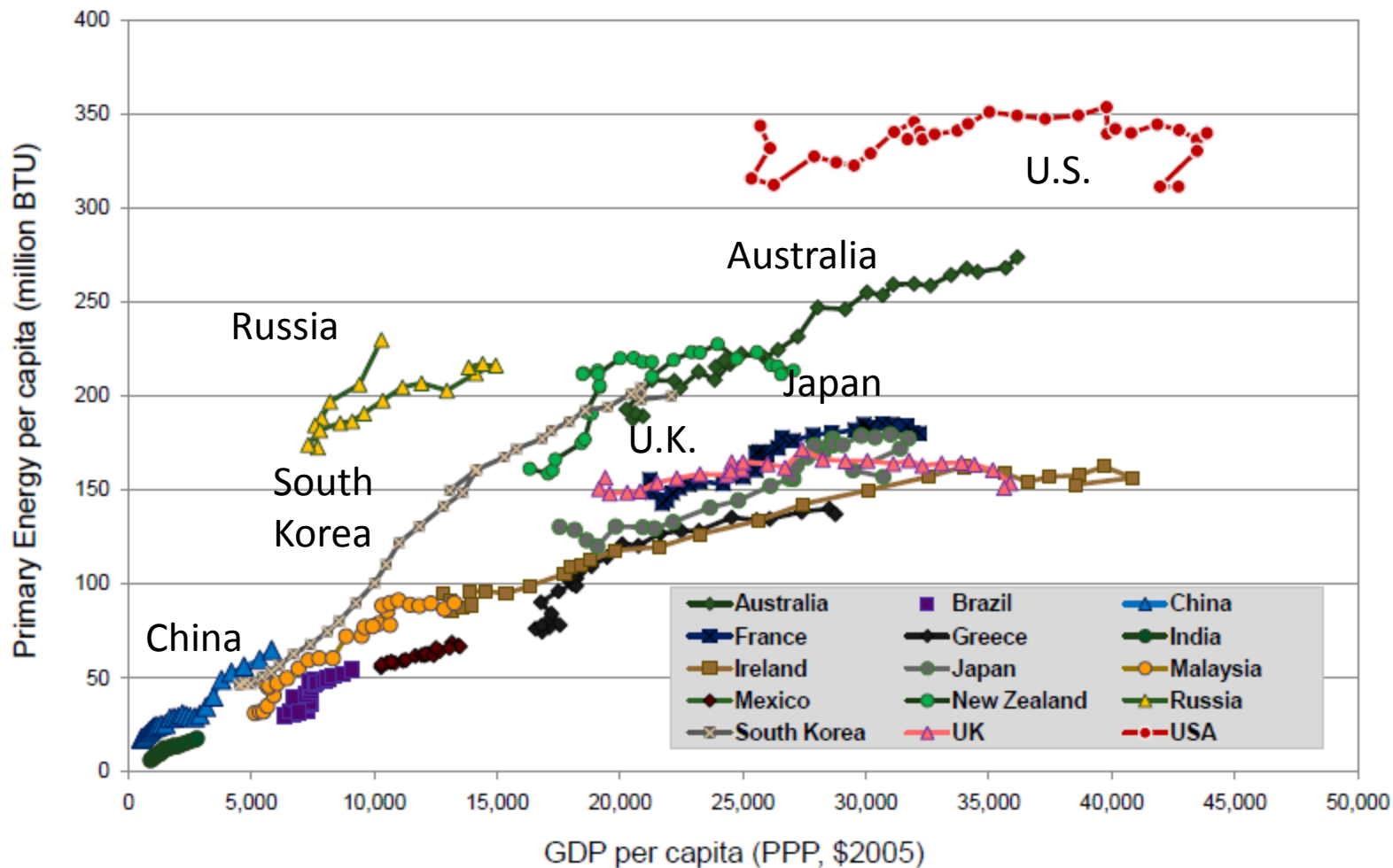
Energy Efficiency: Making a Difference, But More is Needed

- Global primary energy demand rebounded by a remarkable 5% in 2010.
- Energy efficiency improves at a rate twice as high as that seen over the last two-and-a-half decades, stimulated by tighter standards across all sectors and a partial phase-out of subsidies to fossil fuels.

Figure 2.9 ● Energy intensity in selected countries and regions in the New Policies Scenario, 1990-2035

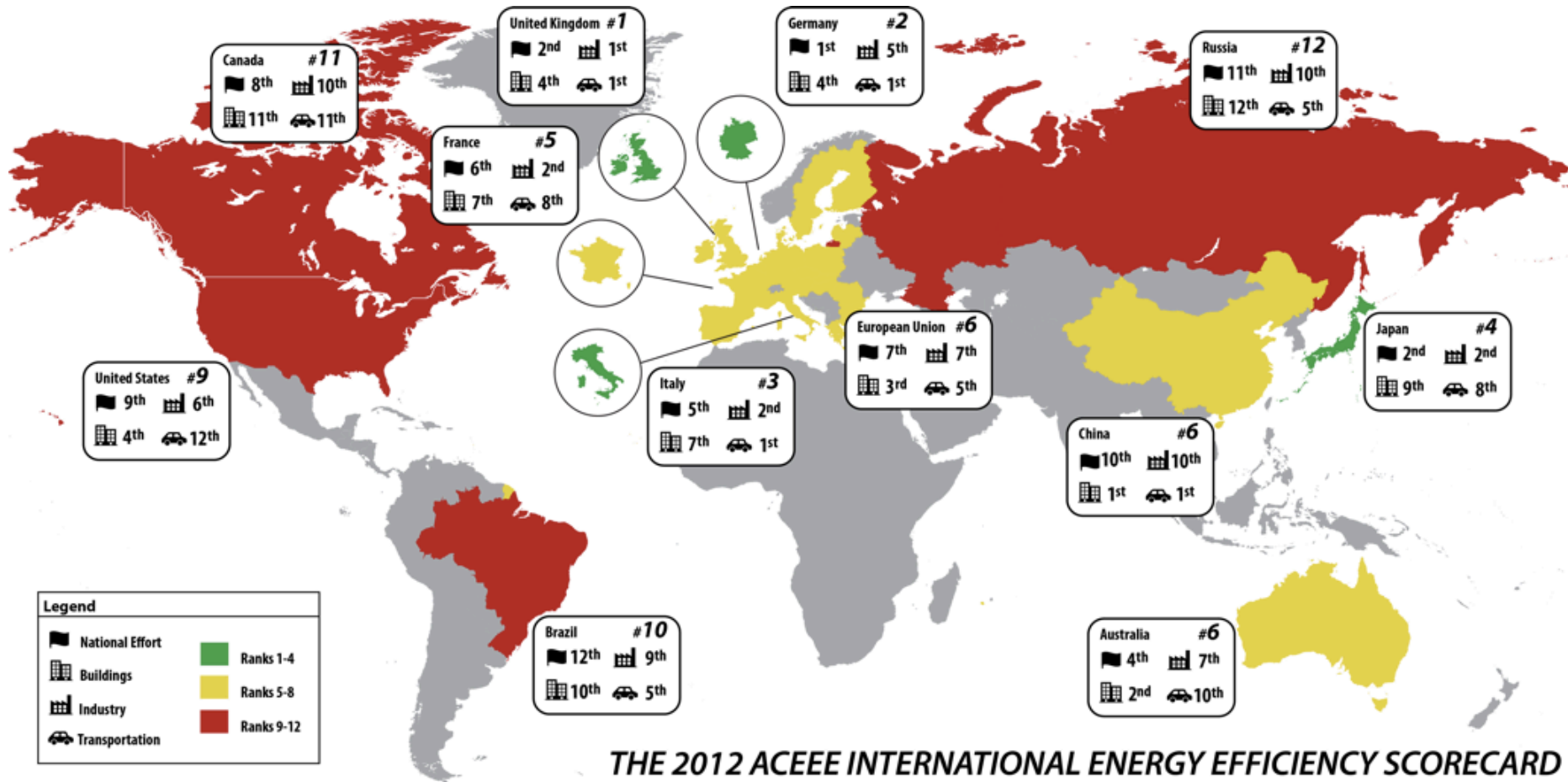


Per Capita Energy Use and Gross Domestic Product (GDP): 1980-2010



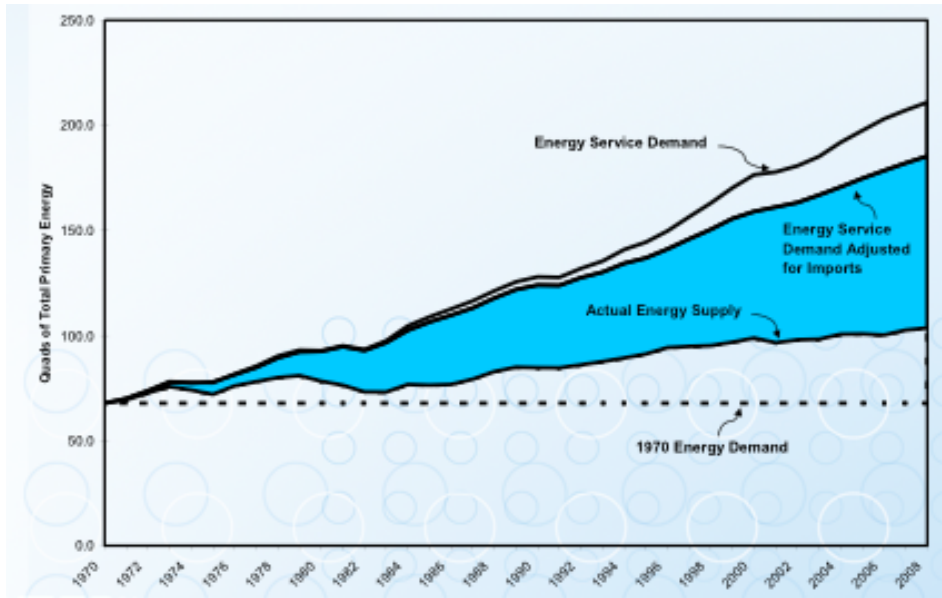
Source: Energy Information Administration (EIA)

The U.S. is Ninth in the World in Energy Efficiency



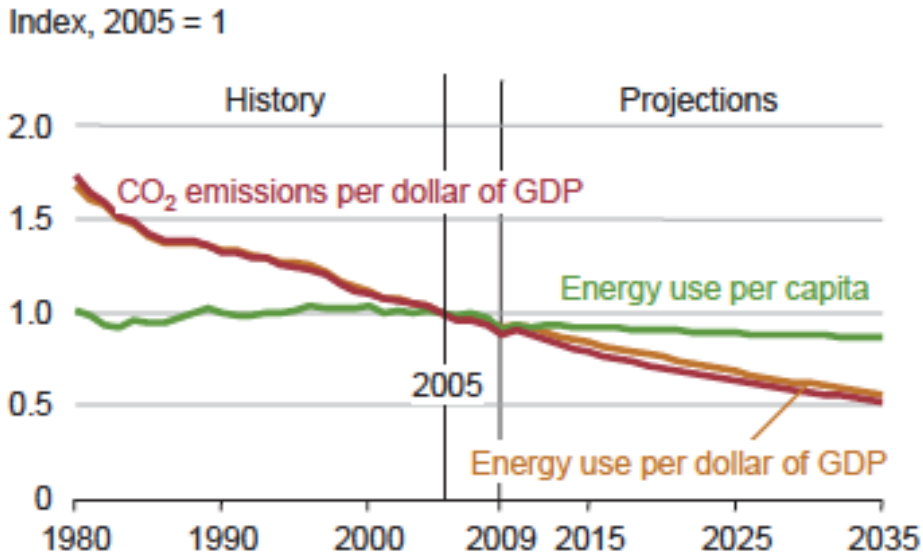
Source: Sara Hayes, Rachel Young, and Michael Sciortino. 2012. *The ACEEE 2012 International Energy Efficiency Scorecard*.

Energy Efficiency: The Largest Energy Resource & More is Available

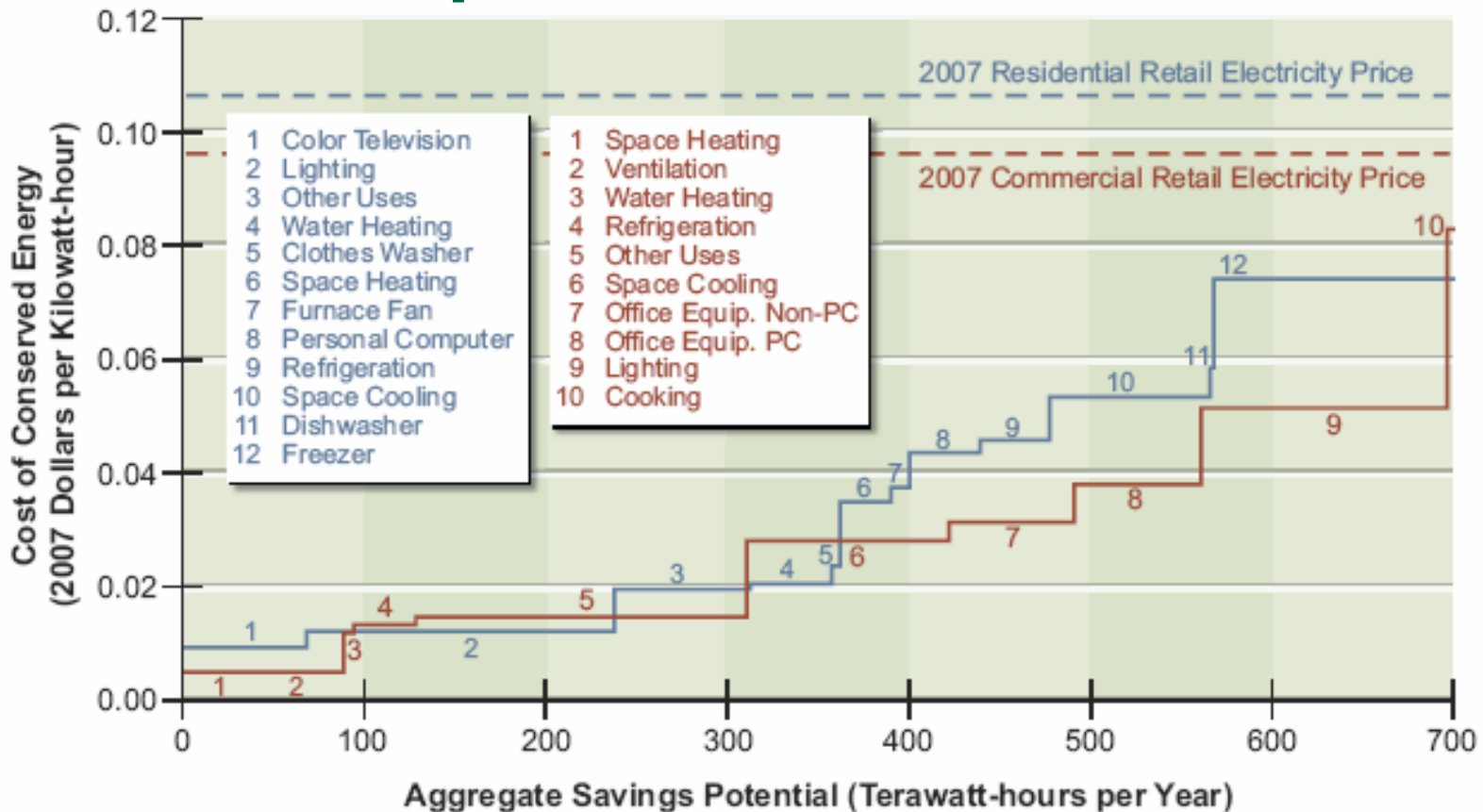


Source: Steven Nadel, ACEEE, 2011.

Figure 8. Energy use per capita and per 2005 dollar of gross domestic product, 1980-2035

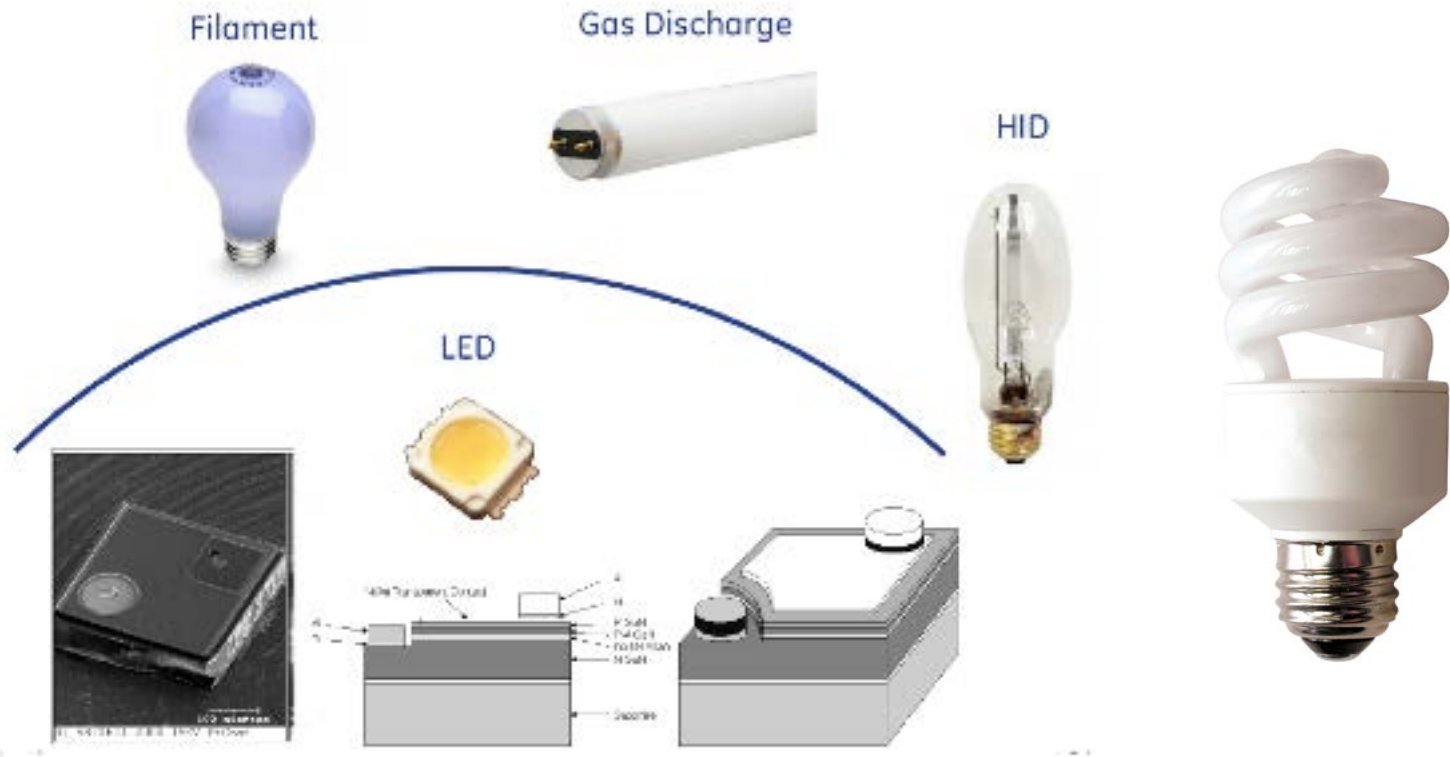


Opportunities for Energy Efficiency Improvements Abound



Cost of Conserved Energy= the additional cost that must be invested in order to implement an energy-saving strategy or feature.

Light Source Efficiency Trends



Systems Integration Offers Future Savings (e.g., Climate Master Launches Trilogy™)

- ~ 65% energy savings vs. minimum efficiency (SEER 13) equipment
- ~ 33% savings vs. state-of-the-art two-stage GHP with the super heater



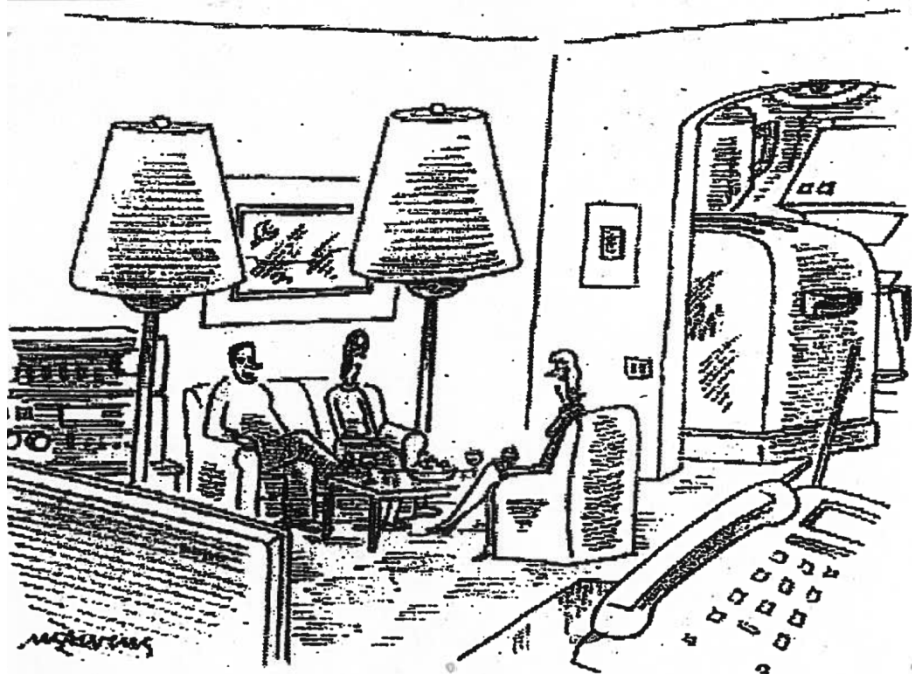
**Integrated Unit: Water Heating and
Space Heating/Cooling**



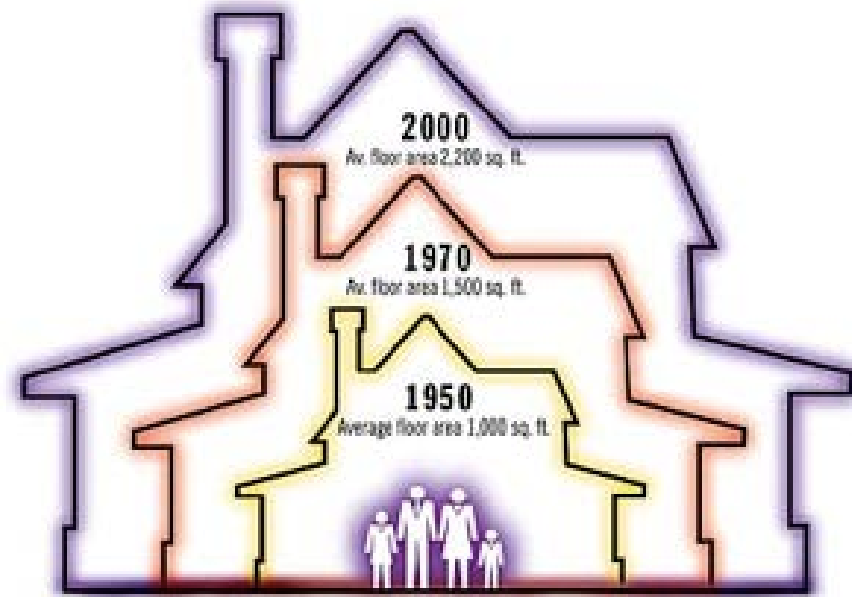
**Separate Units: Water Heating and
Space Heating/Cooling**

The Impact of Affluence and Cheap Energy: A Rebound Effect?

“Now that we have a heat pump, we can afford a plasma TV and lots of lighting.”

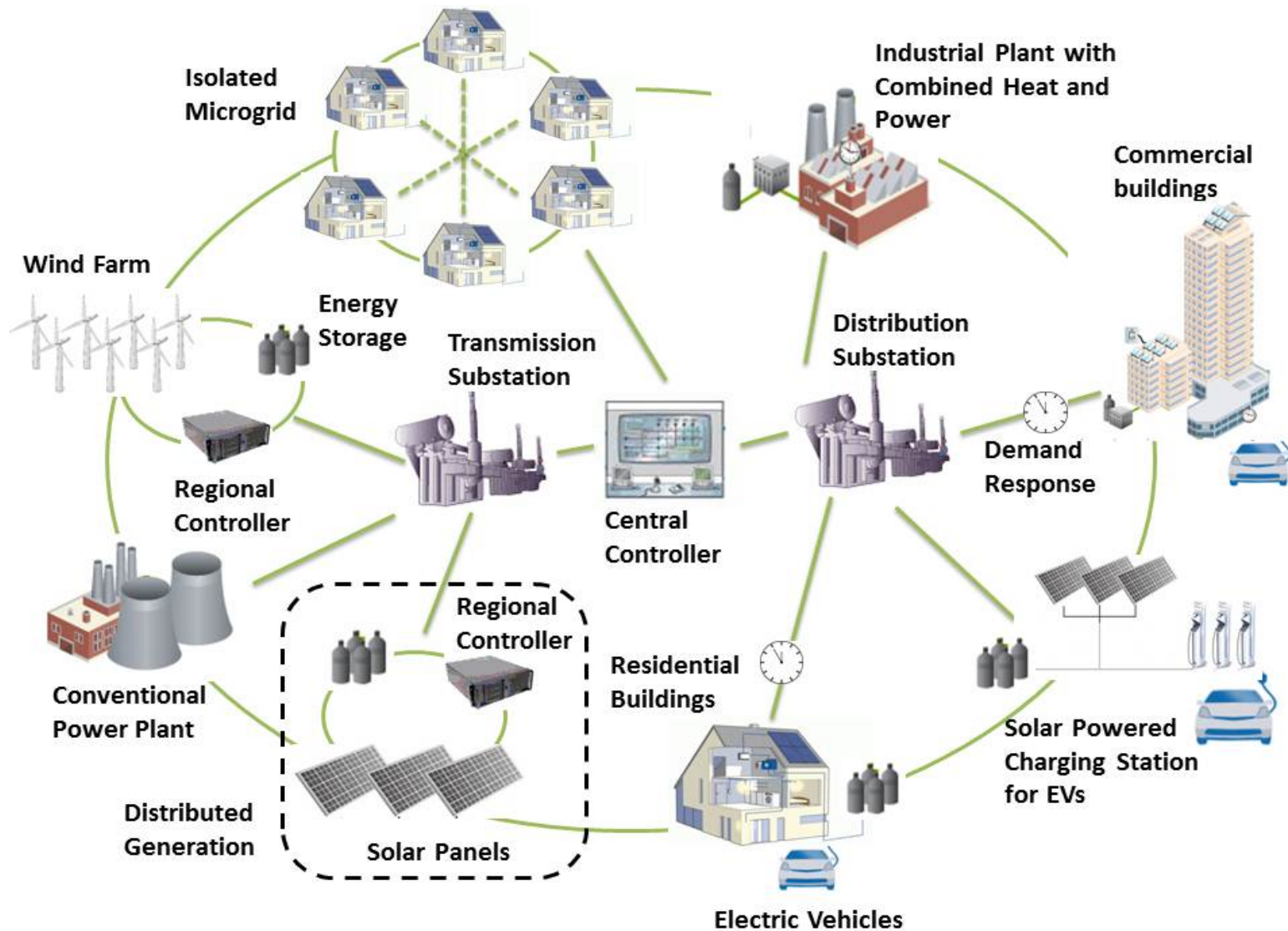


Average U.S. Home Size



From: U.S. Census Bureau, National Association of Home Builders

Smart Grid: A Vision for the Future



Source: Brown, Marilyn A. and Shan Zhou. In press. "Smart-Grid Policies: An International Review," *Wiley Interdisciplinary Reviews: Energy and Environment*.

Smart-Grid Policies in the US

- Net Metering Policies
- Interconnection Standards and Rules
- Smart Metering Targets
- Demand Response and Dynamic Pricing Policies
 - Time-of-Use Pricing (TOU)
 - Critical Peak Pricing (CPP)
 - Real-Time Pricing (RTP)
- Data Security & Privacy



Smart-Grid Policies – U.S.

Status

- **Metric tons of CO₂ per Capita: 18.1**
- **Percent Renewable Generation: 11%**

Targets

- **CO₂ emissions 17% below 2005 level by 2020**
- **None (80% clean energy by 2035)**

Financial Incentives

- **In 2009: \$4.5 billion for smart grid investment grants**

Key Legislation

- **Energy Policy Act of 2005 and FERC Order 1000**
- **Stimulus Bill**

Smart-Grid Policy Emphases

- **Improving distribution and transmission infrastructure to enhance system reliability and efficiency and to better integrate renewable generation**
- **Smart meter deployment**

Smart-Grid Policies – UK

Status

- **Metric tons of CO₂ per Capita: 8.5**
- **Percent Renewable Generation: 7%**

Targets

- **Carbon emissions reduction by at least 34% by 2020 and 80% by 2050 –below the 1990 baseline**
- **15% of total energy consumption from renewables by 2020**

Financial Incentives

- **A £500 million Low Carbon Networks (LCN) Fund**
- **A £6 million Smart Grid Demonstration Fund**
- **Feed-in-tariffs available**

Key Legislation

- **The 2008 Energy Act**
- **Energy Bill 2010-11**
- **Smart Metering Implementation Programme**

Smart-Grid Policy Emphases

- **Distribution network modernization**
- **Smart meter deployment**

Smart-Grid Policies – Italy

Status

- **Metric tons of CO₂ per Capita: 7.2**
- **Percent Renewable Generation: 27%**

Targets

- **17% of total energy consumption from renewables by 2020**

Financial Incentives

- **Feed-in-tariffs available**

Key Legislation

- **Regulatory orders**
- **National action plan for renewable energies of Italy**

Smart-Grid Policy Emphases

- **Improving distribution and transmission infrastructure to better integrate renewable generation**
- **Smart meter deployment**

Smart-Grid Policies – Japan

Status

- **Metric tons of CO₂ per Capita: 9.2**
- **Percent Renewable Generation: 10%**

Targets

- **Reducing carbon Emissions by 30% below 1990 by 2030**
- **Raising zero-emission power source ratio to 70%**

Financial Incentives

- **\$73 million investment on community grid system**
- **\$1.1 billion on four smart grid technology pilot projects**
- **Feed-in-tariffs available**

Key Legislation

- **The Strategic Energy Plan of Japan**

Smart-Grid Policy Emphases

- **Smart grid and smart communities demonstration programs**
- **Smart meter deployment**

Smart-Grid Policies – South Korea

Status

- **Metric tons of CO₂ per Capita: 11.9**
- **Percent Renewable Generation: 1%**

Targets

- **Carbon emission reduced by 30% below BAU by 2020**
- **11% of total energy consumption from renewables by 2030**

Financial Incentives

- **\$25.85 billion allocated for smart grid technology and infrastructure development**

Key Legislation

- **Smart Grid Road Map 2030**
- **Korea's National Strategy for Green Growth**

Smart-Grid Policy Emphases

- **Smart power grid; Smart consumers; Smart transportation; Smart renewables; Smart electricity services**

Smart-Grid Policies – China

Status

- **Metric tons of CO₂ per Capita: 6.3**
- **Percent Renewable Generation: 19%**

Targets

- **Carbon intensity reduced by 17% below the 2011 level by 2015**
- **11% of total primary energy consumption from renewables by 2015**

Financial Incentives

- **\$45 billion investment in smart grid between 2011 and 2015**

Key Legislation

- **The Amendment of the Renewable Energy Law (2009)**
- **The 12th Five-year Plan**
- **The Special Planning of 12th Five-Year Plan on Smart Grid**

Smart-Grid Policy Emphases

- **Increasing transmission and distribution capacity**
- **Integration of distributed renewable generation**

Moving toward Optimization: Some Recommended Policy Directions



- International and domestic collaboration to share smart-grid technology policy experiences
- A policy framework that attracts diverse funding sources for smart-grid deployment
- Regulatory changes that promote competitive electricity markets
- Policy-making that considers social as well as private costs and benefits and an understanding of consumers as well as markets

FOR MORE INFORMATION

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