ACEEE 30
30 Years of Energizing Efficiency

Outlook for Energy Efficiency in 2050—Industry & the Built Environment

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The Built Environment: Energy Trends over Past 40 Years

- Dramatic Improvements in Appliance & Equipment Efficiency—But things are getting bigger offsetting much of the improvements
- “Drive until you can afford it” has lead to larger homes that increase energy use
- Improved building practices mean shell losses are decreasing as a relative portion of building energy load—plug loads & hot water up
- So, EE has slowed but not reversed the increase in energy consumption.

Industry:
Energy Trends over Past 40 Years

- Manufacturing energy use steady while sector output has grown significantly—intensity declining steadily
- Intensity change due to:
  - Energy efficiency including equipment, process & feedstock changes
  - Structural change—*what we make*
  - Dematerialization—*making with less stuff*
- Increasingly see system optimization, sensors & control as key EE elements

Energy Efficiency in Industry & the Built Environment: the Next 40 Years

Shared Trends:

- Shift in focus from component efficiency to system efficiency—reaching point of diminishing return from equipment efficiency
- Information & Communications Technologies will play a transformative role: optimizing use & anticipating needs.
- Potential to transform: where we live & work; what we use; and how everything works together

Building Energy Efficiency over the Next 40 Years

- Where we live and work will define energy use
- Internal building energy use could be ≈ shell loads, so cooling may dominate
- Plug & equipment loads fastest growing segment—our gadgets & appliances drive energy use
- Likely need to change how we build—manufactured buildings are site-assembled
- What do we do with existing stock?

Building EE over the Next 40 years: Where we live & work

- Continuing population shift toward urban?
- Urban dwellings smaller than suburban
- Greater opportunities for multi-use building & development that allow for load leveling
- Greater access to transport
- Greater opportunities for distributed generation & district energy systems

Building EE over the Next 40 years: Technology Trends

- Greater emphasis on building systems
- Improving building methods probably has the greatest potential for savings
- Continued focus on improving energy efficiency of appliances & equipment—particularly electronics
- Building *intelligence*—smart buildings & equipment – will be part of solutions

Industrial Energy Efficiency over the Next 40 Years

Energy use will be about:

- What we will consume
- Where it will be produced
- What we will make it from

Understand the elements of Industry:

- Agriculture
- Mining
- Construction
- Manufacturing

Industrial EE over the Next 40 Years: Agriculture

- Chemical & fertilizers ½ of energy input with water next—transport secondary input
- Need changes in Ag practices to reduce energy inputs
- Waste over 40% of production in the consumer chain— reduce waste to save energy & free up capacity for other uses

Industrial EE over the Next 40 Years: Mining

- Energy intensity *increasing* due to lower quality resources—need to reduce demand for virgin materials
- Redesign product to use less material or less energy intensive products
- Shift to greater recycled feedstocks is important energy saving opportunity
- Pursue alternative feedstocks—bio & agricultural feedstocks

Industrial EE over the Next 40 Years: Construction

Mainly about *what* we build things from:

- Shift to products that use recycled and reusable materials—rubberized asphalt
- Shift to longer-lasting materials
- Shift to stronger materials—use less

Industrial EE over the Next 40 Years: Manufacturing

- Demand driven by other sectors & products required
- Sensors & controls currently account for half of savings—future potential even greater
- Opportunities about supply chains—most energy imbedded is upstream
- Energy management system key to controlling energy use

Industrial EE over the Next 40 Years: Manufacturing (continued)

- Integration of CHP & energy recovery into manufacturing—manufacturing as a source of new electric generation capacity
- Manufacturing shifting to clusters—improves quality, reduces waste, and reduces transport *time* & energy
- Focus on manufacturing energy/carbon footprinting—designing products for reuse & recycling

Summary & Conclusions

- Last 40 years have seen dramatic changes in EE, markets & technologies
- Next 40 likely the same
- Biggest opportunities are:
  - Changes in structure of society & economy
  - Changes in where & how we live & work
  - Role of greater intelligence in optimizing & changing how we do thing

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