Improving Energy Efficiency in the Buildings Sector

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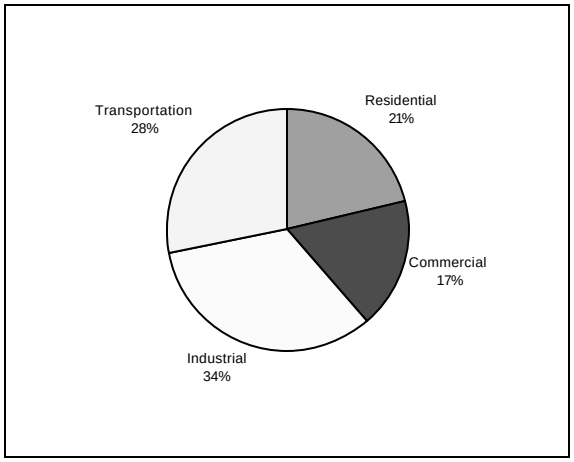
Outline

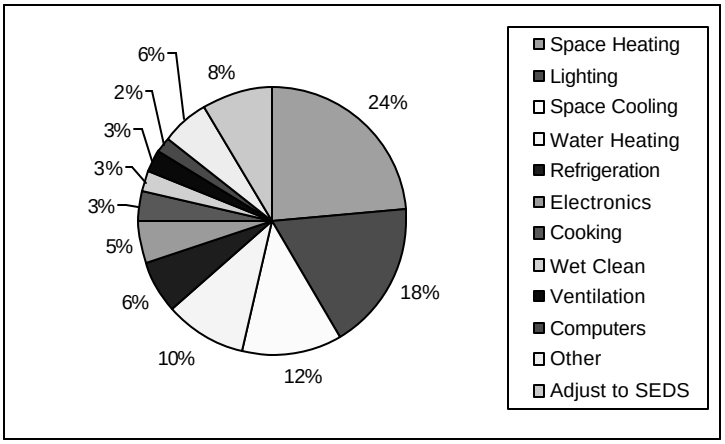
- Buildings energy use
- Opportunities for savings
- Policies
  - Market transformation -- Utility programs
  - Standards and labels -- Tax incentives
  - Building codes -- Retrofit codes
  - Public building policies
- Conclusion

Buildings as a Proportion of U.S. Energy Use



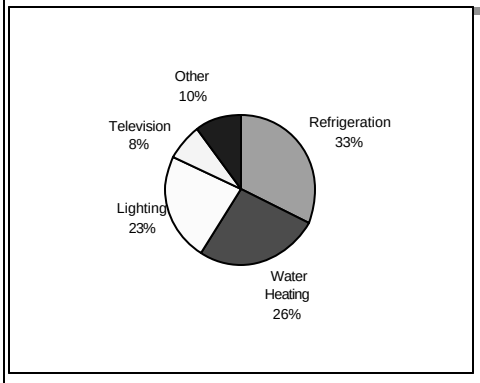
Source: EIA, AEO 2006

U.S. Buildings Energy Use by End-Use

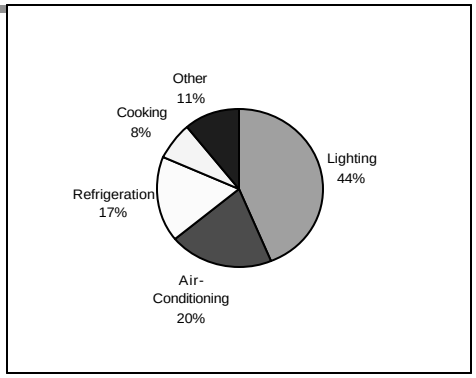


Source: DOE, *Buildings Energy Databook*, 2004

Electricity Use in Brazil by End-Use (1988)



Residential (41 TWh)



Commercial & Public Buildings (28 TWh)

Source: Geller, 1990, "Efficient Electricity Use, A Development Strategy for Brazil".

Summary of Studies of Savings Potential in the U.S.

				Residential			Commercial			Industrial		
Region	**Year**	**Fuel**	**# Yrs**	**Tech**	**Econ**	**Ach**	**Tech**	**Econ**	**Ach**	**Tech**	**Econ**	**Ach**
California	2003	Elec	10	21%	15%	10%	17%	13%	10%	18%	12%	11%
Mass.	2001	Elec	5	NA	31%	NA	NA	21%	NA	Included in comm.		
New York	2003	Elec	20	40%	32%	NA	46%	40%	NA	21%	18%	NA
Oregon	2003	Elec	10	28%	NA	NA	32%	NA	NA	35%	NA	NA
Puget	2003	Elec	20	35%	19%	12%	39%	16%	12%	NA	NA	10%
Southwest	2002	Elec	17	NA	NA	26%	NA	NA	37%	NA	NA	33%
U.S.	2000	Elec	20	NA	NA	27%	NA	NA	22%	NA	NA	17%
Vermont	2003	Elec	10	NA	NA	30%	NA	NA	32%	Included in comm.		
Median				32%	25%	26%	36%	19%	22%	21%	15%	14%
California	2003	Gas	10	NA	NA	NA	NA	21%	10%	NA	NA	NA
Oregon	2003	Gas	10	69%	54%	NA	16%	8%	NA	NA	NA	NA
Puget	2003	Gas	20	48%	19%	10%	20%	16%	8%	NA	NA	9%
U.S.	2000	Gas	20	NA	NA	8%	NA	NA	8%	NA	NA	8%
Utah	2004	Gas	10	46%	27%	NA	29%	11%	NA	NA	NA	NA
Median				48%	27%	9%	20%	14%	8%	NA	NA	9%

Source: Nadel et al. 2004.

Savings Opportunities in Brazil

Table 38. Electricity Conservation Supply Curve in 2010, Improved-Technology Scenario

Sector		Efficiency measure	Cost of saved energy[a] ($/kWh)	Savings potential (TWh/yr)	Cumulative savings[b] (TWh/yr)
COM	1	More efficient refrigeration	0.004	3.0	3.0
IND	2	More efficient furnaces/boilers	0.011	7.5	10.5
COM	3	More efficient air-conditioning	0.012	5.6	16.1
RES	4	Heat pump for water-heating	0.013	3.4	19.5
IND	5	More efficient motors	0.014	5.8	25.3
IND	6	Low-cost measures	0.015	15.6	40.9
IND	7	More efficient electrochem. processes	0.016	2.8	43.7
PI	8	Replacing incandescent lamps	0.016	0.3	44.0
COM	9	More efficient fluorescent fixtures	0.019	9.3	53.3
IND	10	More efficient lighting	0.024	2.7	56.0
PI	11	Replacing self-ballast lamps	0.025	2.6	58.6
RES	12	Energy-saving incandescent lamps	0.027	1.1	59.7
RES	13	More efficient air conditioners	0.027	2.4	62.1
RES	14	More efficient refrigerators	0.029	13.1	75.2
RES	15	More efficient freezers	0.029	2.8	78.0
PI	16	Replacing mercury vapor lamps	0.030	3.4	81.4
RES	17	Power control for electric shower	0.031	4.0	85.4
COM	18	Conversion to fluorescent lamps[c]	0.036	9.3	94.7
IND	19	Motor-speed controls	0.042	9.9	104.6
RES	20	Conversion to fluorescent lamps[c]	0.044	6.5	111.1

Notes:
[a] The cost of saved energy is calculated using a 10% real discount rate (see appendix for further details).
[b] For reference, 204 TWh of electricity were consumed in Brazil in 1988 and 469 TWh of electricity consumption is projected in 2010 in the base case.
[c] Cost of saved energy based on half of savings from standard and half from compact fluorescent lamps.

Source: Geller, 1990

Overall Savings Available in Brazil

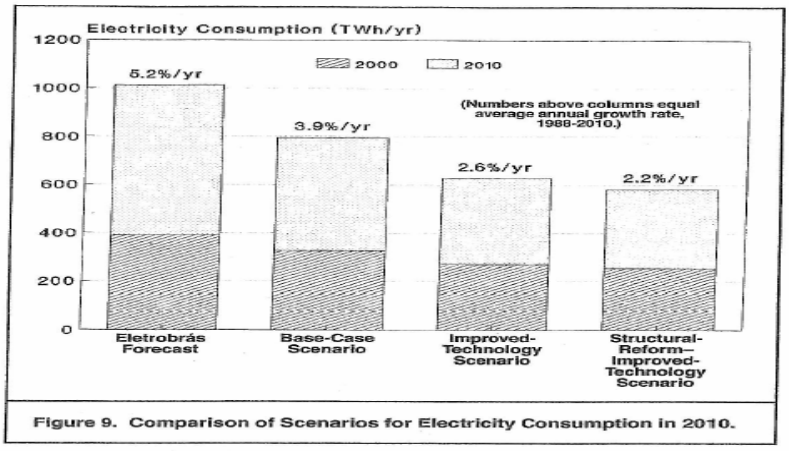


Figure 9. Comparison of Scenarios for Electricity Consumption in 2010.

Source: Geller, 1990

Policies to Achieve Savings

- Market transformation
- Appliance/equipment standards and labels
  - Discussed previously
- Building codes
- Public building policies
- Utility programs and incentives
- Tax incentives
- Retrofit codes

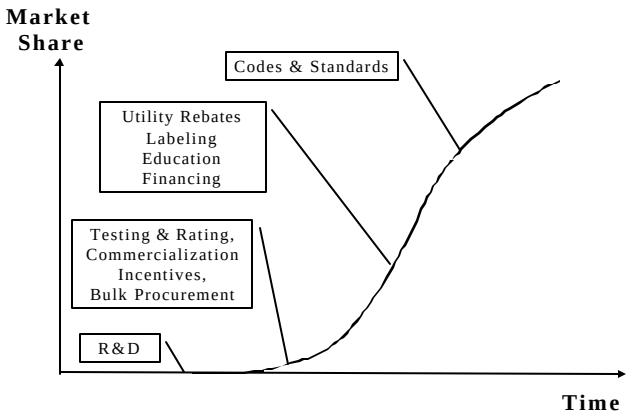
Market Transformation

- "[a strategic effort] by utility and other organisations to intervene in the market, causing beneficial, lasting changes in the structure or function of the market…, leading to increases in the adoption of energy-efficient products, services and/or practices" (Schlegel et al. 1997)

Market Transformation Initiatives

- Designed to understand and address market barriers
- Employ multiple coordinated activities
- Generally multiple organisations
- Activities evolve as the market development of a measure progresses (evaluations key)
- Include transition plan or exit strategy

Diffusion Curve



Residential Clothes Washers

- Promote horizontal-axis and other high-efficiency washers
- Original promotions built around sales staff training and incentives
- Now emphasize Energy Star and broad array of benefits
- National market share 27% in 2004; 2007 standard will mandate current Energy Star
- DOE just updated specification for 2007

Condensing Furnaces

- Technology developed by Lennox and others in 1970s
- Wisconsin effort in 1980s/1990s helped to bring into mainstream:
  - Utility rebates
  - Purchases through low-income weatherization
  - Raised market share to nearly 90%
- Other cold weather states have gradually promoted
- Market share nationally now above 30%
- Some discussion of mandating condensing furnaces in cold states

Building Codes

- Regulate aspects of new homes and new commercial buildings
  - Focus on new buildings since much more can be done cost-effectively to improve their efficiency
  - Gradually, new buildings account for growing portion of building stock
- Can regulate:
  - Insulation levels in walls, ceilings, floors
  - Thermal resistance and solar heat gain of windows
  - Equipment efficiencies (e.g. heating and cooling)
  - Lighting power density (e.g. W/sq. meter)
  - Heating, cooling and lighting controls

Building Codes (continued)

- Can be set at:
  - National level (Canada to a large degree)
  - Regional level (e.g. China)
  - State level (e.g. most of U.S.)
  - Local level (parts of U.S.)
- Typically set to reduce energy use 10-15%
- Periodically tightened
  - Use voluntary programs to promote beyond code performance, then tighten code

Public Building Policies

- Special efficiency policies for government buildings and equipment
  - Exceed building codes by x% (or "LEED certified")
  - Buy only Energy Star or best-in-class equipment
  - Implement retrofit measures with <10 year payback
- Advantages
  - Saves government money
  - To set an example

Utility Programs and Incentives

- Utilities (or sometimes government) can offer efficiency programs finances through electric and gas rates
- Programs can include:
  - Education
  - Technical assistance
  - Financial incentives
  - Direct installation

Utility Programs (2)

- Commonly comprehensive set of programs developed to serve all customer classes
- Good set of programs can save:
  - 1% of load for each year of operation
  - More of peak demand
  - Additional savings during crises (e.g. CA saved 6-11% in 2001)

Utility Programs (3)

- Three general approaches
  - Least-cost planning (examine demand- and supply-side options and select least-cost mix)
  - Public benefit fund (small charge on bills)
  - Energy-efficiency resource standard (utilities must meet specific savings targets)

Tax Incentives

- Can provide reductions in taxes for efficient equipment or practices
  - Income tax credits or deductions
  - Reduce/waive import duty, sales tax, VAT, etc.
- Examples:
  - Thailand has reduced import duty for a list of efficient products
  - Several U.S. states waive sales tax on specific Energy Star products

U.S. Energy Efficiency Tax Incentives

- New homes (50% better than code)
- Commercial buildings (50% > code)
- High-efficiency refrigerators, clothes washers, dishwashers, residential furnaces, heat pumps and central AC
- Improvements to existing homes – insulation, windows, sealing
- Hybrid, fuel cell and lean-burn diesel vehicles (credit increases with fuel economy)
- Building fuel cells and microturbines

U.S. Tax Incentives (continued)

- Mostly target highest efficiency levels so "free riders" low
- Generally run for two years
  - But some likely to be extended
  - Cost roughly $1 billion/year

Retrofit Codes

- Require existing buildings to meet new code performance levels
  - Typically subject to a cost cap (e.g. 2% of sales price)
  - Commonly applied at time of building sale
- Can achieve large savings
- Can be difficult politically as unpopular with realtors, sellers and often buyers
- Been used in some small U.S. cites

Conclusions

- Can generally reduce energy use in buildings by at least 30% cost-effectively
- Variety of policies can be employed
- Often several strategies work well in tandem as part of a “market transformation” initiative