Energy End-Use: Buildings

Final Building Heating and Cooling Energy Demand Scenarios until 2050
Energy End-Use: Buildings

Total Annual Final Energy Use In The Residential and Commercial/Public Sectors

- OECD North America
- EU-27
- Former USSR
- China
- Latin America
- Middle East
- Africa
- Asia excluding China
- OECD Pacific

- Residential sector
- Commercial & Public sectors
Final Heating and Cooling Specific Energy Consumption by Region and Building Type

- North America
- Latin America
- Western Europe
- Eastern Europe
- Middle East
- South Asia
- Former Soviet Union
- Centrally Planned Asia
- Pacific Asia
- Pacific OECD
- North America
- Latin America
- Western Europe
- Eastern Europe
- Middle East
- South Asia
- Former Soviet Union
- Centrally Planned Asia
- Pacific Asia
- Pacific OECD

- Single family
- Multi family
- Commercial and public
Primary Energy Use in US Commercial and Residential Buildings

- Residential: 21%
  - Space Heating: 26.4%
  - Water Heating: 12.5%
  - Lighting: 11.6%
  - Electronics: 8.1%
  - Refrigeration: 7.2%
  - Wet Clean: 6.2%
  - Cooking: 4.7%
  - Other: 9.3%

- Commercial: 18%
  - Space Heating: 12.1%
  - Space Cooling: 12.6%
  - Electronics: 7.5%
  - Ventilation: 6.7%
  - Water Heating: 6.3%
  - Refrigeration: 4.1%
  - Computers: 3.8%
  - Cooking: 2.0%
  - Other: 20.0%

- Buildings: 39%
- Computers: 33%
- Transportation: 28%

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Energy End-Use: Buildings

Share of End-Uses by Appliance in Electricity Consumption in Delhi, India

**Summer**
- Cooking: 1%
- Lighting: 4%
- Ceiling fans: 9%
- Coolers: 5%
- Air conditioner: 15%
- Refrigerator: 28%
- Television: 28%
- Pumps: 1%
- Others: 1%

**Winter**
- Cooking: 6%
- Lighting: 14%
- Room heater: 8%
- Geyser: 18%
- Refrigerator: 44%
- Television: 2%
- Pumps: 7%
- Others: 1%
Residential Energy Use in Different Developed Countries

The chart shows the residential energy use per capita in different countries, normalized to 2700 HDD. The energy use is categorized into five main components: Appliances, Lighting, Cooking, Water heating, and Space heating. The energy use ranges from the highest in the US to the lowest in Japan.
Electricity Consumption of Air-Conditioning in 25 Flats of a Residential Building in Beijing

average = 2.4 kwh/(m²yr)
Trend of Total Building Final Energy Use per m² in USA and Japan as Compared to China
Energy End-Use: Buildings

World Total Final Energy Consumption by Fuel in the Residential (left) and Commercial and Public (right) Sectors

- **Combustible Renewables & Waste**: 31.7%
- **Electricity**: 16.1%
- **Natural Gas**: 17.9%
- **Renewables**: 0.3%
- **Petroleum Products**: 9.2%
- **Coal & Heat**: 3.9%
- **Combustible Renewables & Waste**: 0.04%
- **Electricity**: 0.6%
- **Renewables**: 0.04%
- **Petroleum Products**: 4.2%
- **Coal & Heat**: 1.2
Energy End-Use: Buildings

Direct and Indirect Primary Energy Use of the Average US Citizen

Direct and Indirect Energy Use

- Education
- Health
- Communications
- Clothing/Footwear
- Miscellaneous Goods and Services
- Recreation, Culture
- Utilities
- Furniture, Equipment, Maintenance
- Building construction
- Private Transport
- Alcohol, Tobacco
- Restaurants, Hotels
- Food & Beverages

GJ per capita and year

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Primary Embodied and Operating Energy of Buildings

- Residential Buildings
- Commercial Buildings
Annualized Operational Energy Use vs. Annualized Embodied Energy Use for Polystyrene Insulation of Differing Thickness

- **Base Case**: NER = 5.8
- **UP 1 (Base case + 50 mm polystyrene)**: NER = 3.1
- **UP 2 (UP1 + 50 mm polystyrene)**: NER = 1.6
- **UP 3 (UP2 + 50 mm polystyrene)**: NER = 0.9
- **UP 4 (UP3 + 50 mm polystyrene)**

AEU (Annual Energy Use, kWh primary energy) vs. AEE (Annualised Embodied Energy, kWh primary energy)
GHG Emissions Associated with the Purchase, Use and Disposal of Electric and Electronic Equipment in Norwegian Households

Energy End-Use: Buildings
A Biolite Stove
Energy Base Building

Energy Base Building

Energy End-Use: Buildings

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Learning Curve Showing the Progressive Decrease in the Incremental Cost of Meeting the Passive House Standard for the Central Unit of Row Houses

- 1991 Prototype: experimental house, 4 dwellings in Kranichstein using handicraft batch production
- PH in Groß-Umstadt: Reduced costs by simplification
- Settlement in Wiesbaden: Serially produced windows & structural elements
- Settlements in Wuppertal, Stuttgart, Hanover
- Row houses in Darmstadt, 80 €/m²
- Profitability with contemporary interest rates & energy prices
Energy End-Use: Buildings

World Space Heating and Cooling Final Energy Use

PWh/year

- 32.5%
- 79%
- 46.4%

Sub-Optimal  State of the Art
Space Heating and Cooling Final Energy Use

State of the art scenario

Sub-optimal scenario

PWh/year

2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

OECD90  ASIA  REF  LAC  AFR

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Comparison of the Two GEA Building Scenarios – OECD90

Energy End-Use: Buildings

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Comparison of the Two GEA Building Scenarios – ASIA

Energy End-Use: Buildings
Comparison of the Two GEA Building Scenarios – REF

Energy End-Use: Buildings

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Comparison of the Two GEA Building Scenarios – MEA, LAC and AFR

Energy End-Use: Buildings

Middle East and Africa
State of the Art Scenario

Adv New
New
Adv Ret
Retrofit
Standard

PWh/year

2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4

0

Middle East and Africa
Sub-Optimal Scenario

New
Retrofit
Standard

PWh/year

2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4

0

Latin America
State of the Art Scenario

Adv New
New
Adv Ret
Retrofit
Standard

PWh/year

2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8

0

Latin America
Sub-Optimal Scenario

New
Retrofit
Standard

PWh/year

2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8

0

AFRica
State of the Art Scenario

Adv New
New
Adv Ret
Retrofit
Standard

PWh/year

2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8

0

AFRica
Sub-Optimal Scenario

New
Retrofit
Standard

PWh/year

2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8

0
Energy End-Use: Buildings

Cumulative Undiscounted Investment Costs and Energy Cost Savings

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Appliance Electricity Demand in Base Case and High Efficiency Scenario

- Television
- Standby
- Refrigeration
- Oven
- Washing Machine
- Fan
- Efficiency Scenario
Average Values of Total Costs by Quality Of Fittings

- **Overall costs**
  - Low: 5.7%
  - Medium: 5.8%
  - High: 4.9%

- **Energy cost**