Sustainable Energy Alternatives

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China Total Primary Energy Supply
Global Energy Use
Energy Consumption and Affluence are Linked

Source: Energy Information Administration, International Energy Annual 1998 Tables E1, B1, B2; Mike Grillot, 5/17/00
Global installed power generation capacity by energy source

Four ways of to reduce GHG emissions and provide more Sustainable Energy Use

• Fuel switching
  – Shift to fuels with lower CO2 for given energy
    • Example: coal to gas for electricity

• Improve efficiency
  – Use fuels more efficiently to produce lighting, heating, etc.
    • Example: better lights

• Renewable Energy Sources
  – Wind, solar, biomass and hydro

• Reduce energy services
  – Use less lighting, heating, etc.
    • Example: turn lights off
Average Retail Price of Electricity by State, 2006

The U.S. average residential retail price of electricity was 10.64 cents per kilowatthour in 2007.

Source: Energy Information Administration, Form EIA-826, “Monthly Electric Sales and Revenue with State Distributions Report.”
New York is ranked 10th cleanest in nation.
Lazard Estimates of Energy Costs

![Chart showing levelized costs for various energy sources: Solar PV - Crystalline, Fuel Cell, Solar PV - Thin Film, Solar Thermal, Biomass Direct, Landfill Gas, Wind, Geothermal, Biomass Co-firing, Energy Efficiency, Gas Peaking, IGCC, Nuclear, Coal, Gas Combined Cycle. The chart compares costs across conventional and alternative energy sources, with levelized costs ranging from $0 to $350 per MWh. Key sources include Solar PV - Crystalline at $19, Fuel Cell at $115, Solar PV - Thin Film at $79, Solar Thermal at $90, Biomass Direct at $50, Landfill Gas at $50, Wind at $44, Geothermal at $42, Biomass Co-firing at $37, Energy Efficiency at $3, Gas Peaking at $221, IGCC at $104, Nuclear at $98, Coal at $74, and Gas Combined Cycle at $73.](chart.png)
SUNY ESF Gateway building – Targeting LEED Platinum

New “zero net energy” showcase building for campus. Design includes biomass combined heat and power, PV, green roof, passive solar and rain gardens.
Annual Utility Cost Comparison

Designed to achieve a 64 percent reduction in energy costs

Legend:
- Chilled Water
- Natural Gas
- Steam
- Electricity

Annual Utility Costs

ASHRAE 90.1–2007
(standard building built to code)

Gateway Building

64 Percent Reduction
Gateway Energy System

- 8,000 MBtu CHP Wood Pellet Steam Boiler
- 8,000 MBtu CHP Natural Gas Steam Boiler
- 200 kW Back-pressure steam turbine
- Three 65 kW CHP Natural Gas Micro-turbines
- Solar Thermal for hot water needs
- 100 kW Solar PV array
Overall Before the Gateway Energy System

Delivered Energy Required  Conversion Efficiency  Energy Input  Losses  Delivered Energy

49,575 MMBTU  52%  95,030 MMBTU  45,455 MMBTU  49,575 MMBTU

48% of all energy input is wasted as losses

Overall With the Gateway Energy System

Delivered Energy Required  Conversion Efficiency  Energy Input  Losses  Delivered Energy

49,575 MMBTU  76%  65,486 MMBTU  15,911 MMBTU  49,575 MMBTU

Input energy has been cut in half  Wasted energy has been cut in half  Energy is now 55% renewable