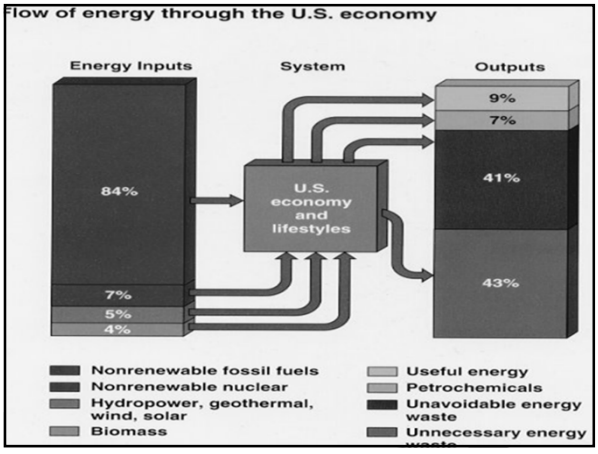
Energy

How work is performed,
kinetic and potential

Evaluating Energy Resources

- 99% of the energy used to heat the earth comes from the sun



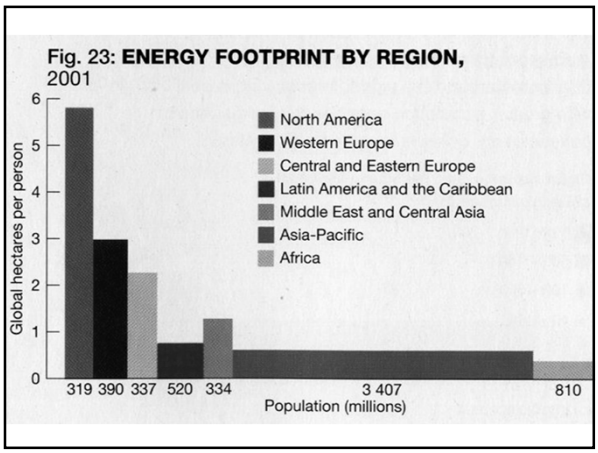
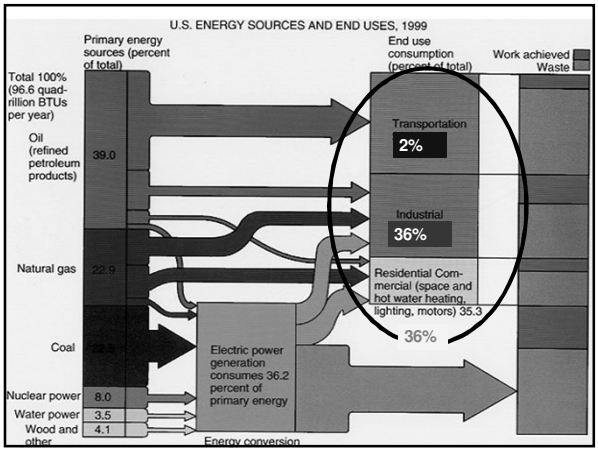
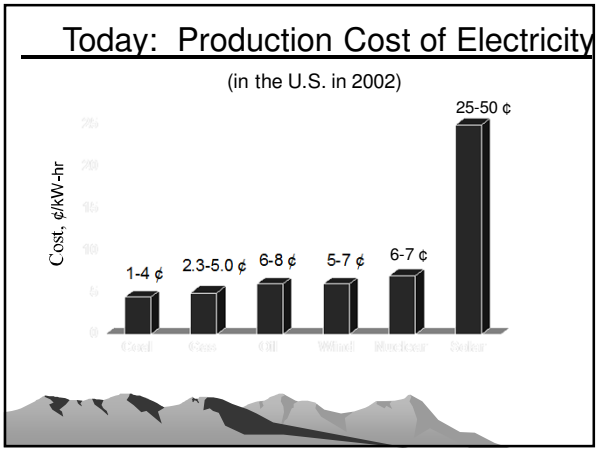


Fig. 23: ENERGY FOOTPRINT BY REGION, 2001
Global hectares per person
0
1
2
3
4
5
6
North America
Western Europe
Central and Eastern Europe
Latin America and the Caribbean
Middle East and Central Asia
Asia-Pacific
Africa
319 390 337 520 334
3 407
810
Population (millions)


U.S. ENERGY SOURCES AND END USES, 1999
Primary energy sources (percent of total)
End use consumption (percent of total)
Work achieved
Waste
Total 100% (96.6 quadrillion BTUs per year)
Oil (refined petroleum products)
39.0
Natural gas
22.9
Coal
22.5
Nuclear power
8.0
Water power
3.5
Wood and other
4.1
Transportation
2%
Industrial
36%
Residential Commercial (space and hot water heating, lighting, motors) 35.3
36%
Electric power generation consumes 36.2 percent of primary energy
Energy conversion


Today: Production Cost of Electricity
(in the U.S. in 2002)
Cost, ¢/kW-hr
1-4 ¢
2.3-5.0 ¢
6-8 ¢
5-7 ¢
6-7 ¢
25-50 ¢

Energy Units

- Watt= 3.413 Btu/hr = 14.34 calorie/min = joule per second
- Btu = British thermal unit
- Joule = force of 1 Newton applied over a distance of 1 meter
- Kilowatt-hours kWh = 3413 Btus = 860,421 calories = 3.6 million joules

Things to remember

- **First Law of Thermodynamics-** energy is never created nor destroyed, only transformed from one kind to another
- **Second Law of Thermodynamics-** high quality energy is transformed into low quality energy (entropy)

First-Law Efficiency

Energy delivered/Energy supplied X 100= %

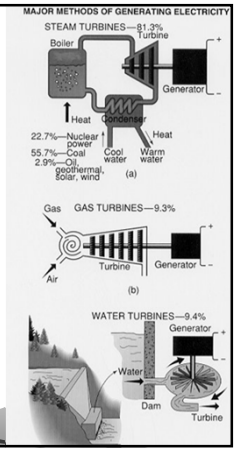
Energy-end use	First-Law % Efficiency	**% Waste Heat**
Incandescent light bulb		
Fluorescent light		
Automobile		
Power plants-electric Fossil fuel and nuclear		
Burning fossil fuels directly for heat		

Net Energy ratio

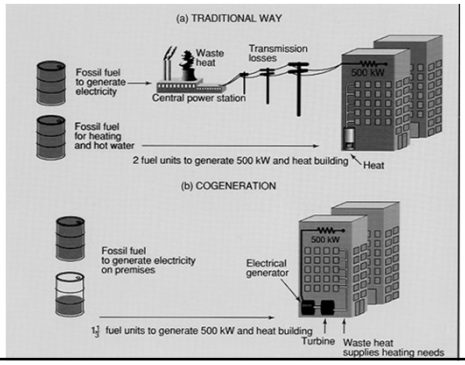
higher ratio equals greater energy yield

- **For space heating it is**
- **For industrial heat it is**
- **For transportation it is**

How do we increase energy efficiency?

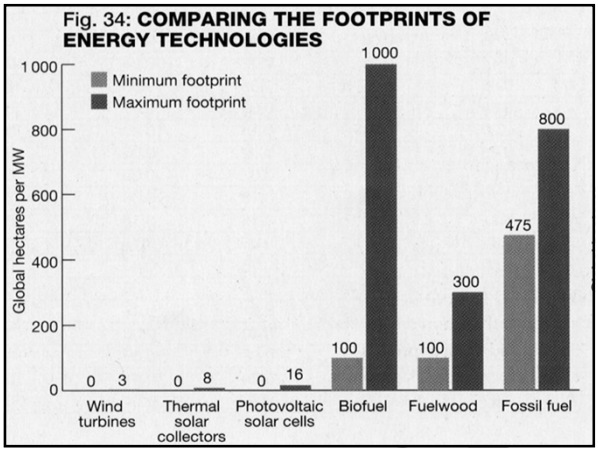


Cogeneration-



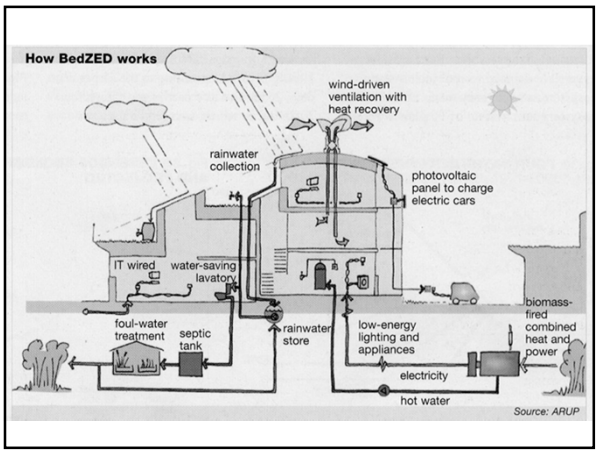
It takes

Isn't it about time our Economy looks at this issue?



Beddington Zero Fossil Energy Development- BedZED London

- Consumes 90% less heating energy than average UK housing
- Uses half of the water
- Designed so that all energy is renewably generated
- ONE PLANET LIVING


How BedZED works
wind-driven ventilation with heat recovery
rainwater collection
photovoltaic panel to charge electric cars
IT wired
water-saving lavatory
foul-water treatment
septic tank
rainwater store
low-energy lighting and appliances
biomass-fired combined heat and power
electricity
hot water
Source: ARUP