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## SSC2030: Module 3, Primary energy forms and uses, overview

### 3. Primary energy forms and uses

#### 3.1: Primary energy consumption (conservation!)

- Energy is transferred and transformed (conserved) rather than consumed
- We transform primary energy (often chemical fuel source) into secondary energy (heat, steam, liquid fuel), tertiary energy (often electricity) and then useful energy (light, heat, motion)
- Energy transformation is very inefficient with as little as 10% of primary energy consumed. Waste heat is a huge loss of energy.
- Energy use has increased over time and is still increasing.

#### 3.2: Units of energy and energy data

- Be aware that energy has many different units and prefixes
- Be aware that W is a rate and kWh is an amount

#### 3.3: Energy density (aka heat content)

- Energy dense fuels are convenient and conventional
- Nuclear > fossil fuel > others
- Condensing steam increases efficiency

#### 3.4: Global and regional sources of energy

- 14% of the world's population uses 41% of global energy
- Consumption of renewable energy is growing but still small

#### 3.5: UK energy use today

- 145 GJ/person
- Inefficient, though industry has made gains
- Transportation is a big user

#### 3.6: Primary energy: UK vs. Denmark vs. US

- UK historically coal but depleted
  - Now largely oil and NG
  - Used North Sea oil fairly quickly to avoid increased taxes
- Denmark had fewer FF resources and chose a different path (143 GJ/person)
  - Extreme energy conservation; no increase in use
  - Focus on district heat, CHP, RE (esp. wind and biomass)
  - Energy self-sufficient
- US still FF dependent, though has switched from coal to NG
  - Exporter of LNG and oil
  - Energy use still increasing (306 GJ/person)



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### 3.7: Primary energy: France vs. India vs. China

- France has virtually no FF; reliant on nuclear for 75%
  - High energy use
  - Imports oil and NG for transportation and heating
- India has low energy use that is rising rapidly; and population expanding
  - Inefficient production of energy
  - Many Indians don't have energy
  - 25% primary energy is biomass; energy imports
- China also has low energy use, but increasing use and population
  - Have increased efficiency
  - Great increases in RE, but still using huge amounts of coal
  - Global manufacturing leader

### 3.8: Trends in US energy use

- Gains in efficiency have been made but energy use is still increasing
- No national plan
- Transportation is a big challenge

### 3.9: Vermont energy statistics

- RE accounts for ~25% of primary energy
- Most electricity supply is RE
- Transportation and heating are FF dependent
- Energy production and consumption are low.
- Energy costs are high
- Vermont's Comprehensive Energy Plan is aggressive