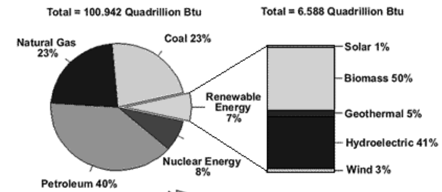
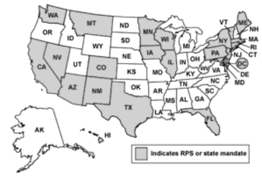
Summary: Renewables v. Fossil Fuels

Introduction to Renewables





What Are We Looking For?

- Current Problems We Need To Address
  - exponential growth in demand
  - limited supplies
  - pollution
  - climate change
- How Does Nature Provide Energy?
  - *mechanical kinetic energy*
  - *mechanical potential energy*
  - *thermal energy (microscopic ke)*
  - *chemical and nuclear bonds (microscopic pe)*
  - *radiant energy*
- We've Only Just Begun To Tap The Potentital!

Estimating Available Energy

- Total Energy Available is relatively easy to estimate
  - most of the main renewables have a total energy available equal to or greatly in excess of our energy requirements!
- Technical Potential is always much less
  - usually comparable to or less than our total energy requirements
  - e.g. temperature or velocity *difference* required
  - only land area suitable
  - some of the energy must be saved for other things (e.g. food production; atmospheric sinks; etc.)
- Practical/Economic Potential is generally much less
  - current ideas for extracting energy are maybe not optimal
  - investment required can never be justified
  - other unacceptable impacts

Power v. Energy

- Total Energy Content is not necessarily the critical parameter
  - unless we can "save" energy through fuels, reservoirs, etc
  - energy is typically distributed in low density over large area
- Power = Energy / time;   Energy = Power integrated over time
  - Electricity, Engines, etc. require power (energy now!)
  - Peak Power Capacity v. Average Power Production
  - MW_{peak} v. $MW_{thermal}$ v. $MW_{electric}$
  - Efficiency and Down Time and Duty Cycle
  - a 1 GW_e plant doesn't produce 24x7x365 GWh per year!
  - and it may take 3 GW_t to produce it's peak output
- Power not always available when it is needed
  - no sunlight during the night
  - wind doesn't always blow
  - tides follow their own cycle

Current Paradigm

- Before Fossil Fuels and the Grid
  - energy production was colocated with energy use
  - renewables were used wherever possible and practical
  - industry was centralized where power was available
  - efficiency was very important (but the machines were typically very low efficiency compared to today's)
- Conservation/efficiency is and always will be cheaper than producing new energy, but there is no free lunch
- Fossil Fuels and the Grid have led to
  - a distributed population and industry
  - high capital cost, large-scale, fairly efficient power plants
  - energy production is out of sight and out of mind

Paradigm Shift

- Renewables are not very good at meeting the “base load”
  - intermittent, variable, linked to natural cycles, not societal demand for electricity
  - resources are vast and widespread, but exploitable resources are limited
  - no single source can completely replace fossil fuels
- Renewables + Efficiency cannot replace our current electrical power (or transportation fuel) infrastructure
- But they can meet growth and gradually diminish our need for fossil fuels
- To reduce enviro. impact, we must reduce fossil fuel use

- A robust grid enables renewables, but realities of the grid also limit renewables
- Long-term contracts limit restructuring
- Renewables can be further enabled with improvements in energy storage technology and with “total energy” applications that can use power whenever it is available in any amount (e.g. production of H_2; water pumps)
- Energetically, it is always favorable to use energy near the point of production
- So we must undergo another paradigm transition
  - energy production co-located with energy use
  - energy production centralized; electric and fuel grids
  - mixed; co-locate when possible + efficient grid

How Can You Help?

-
-
-
-
-
-
-
-
-
-