Alternative Energy Sources

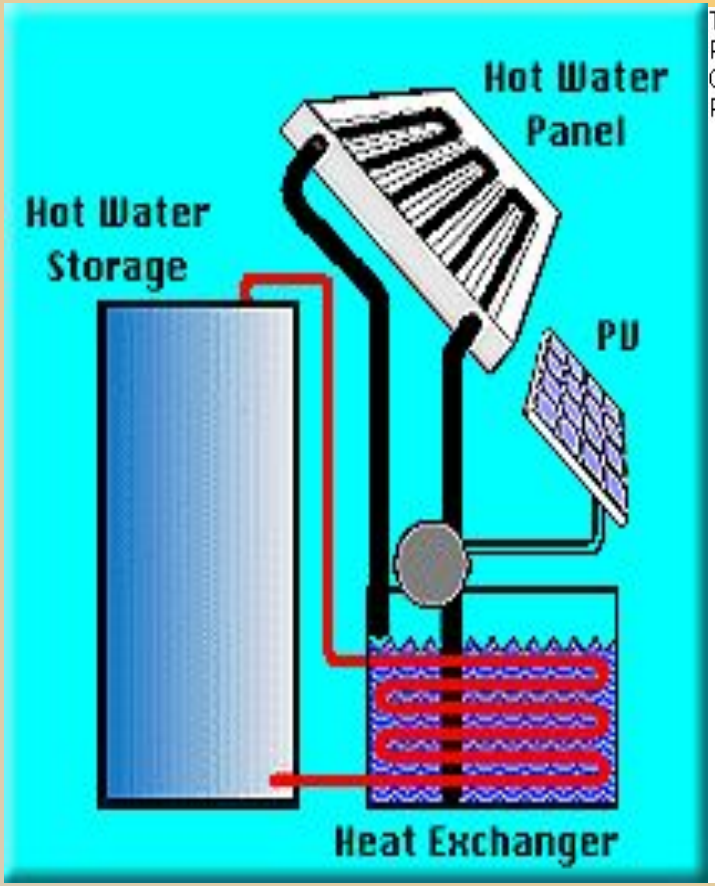
Alternative Energy Sources

- Solar
- Wind
- Hydropower
- Tidal Power
- Biomass
- Geothermal

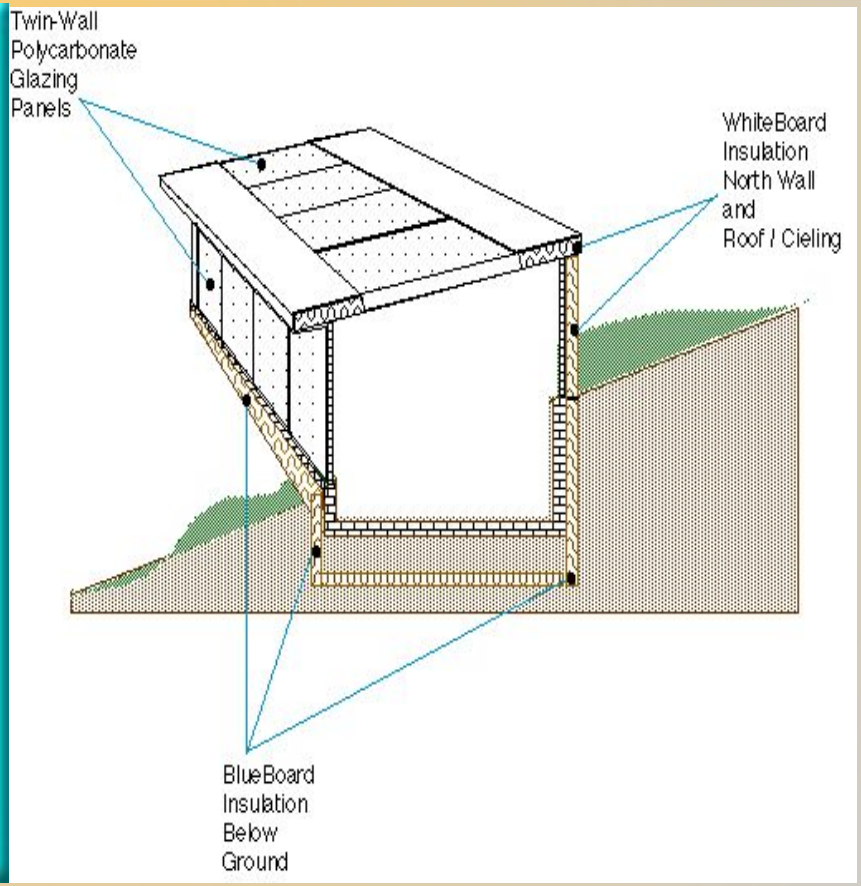
Solar Power

Types of Solar Power

- Active



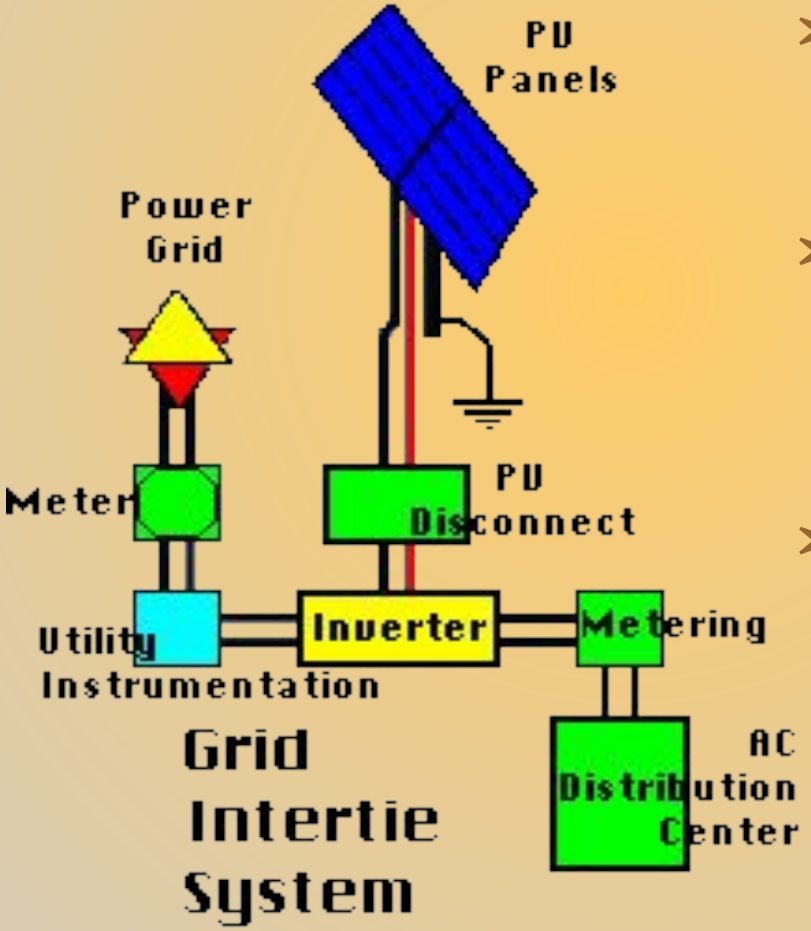
- Passive



Active Solar Power

- Energy from sun is stored in a “thermal mass”
- When needed, heat from thermal mass is then pumped throughout structure

Active Solar Power



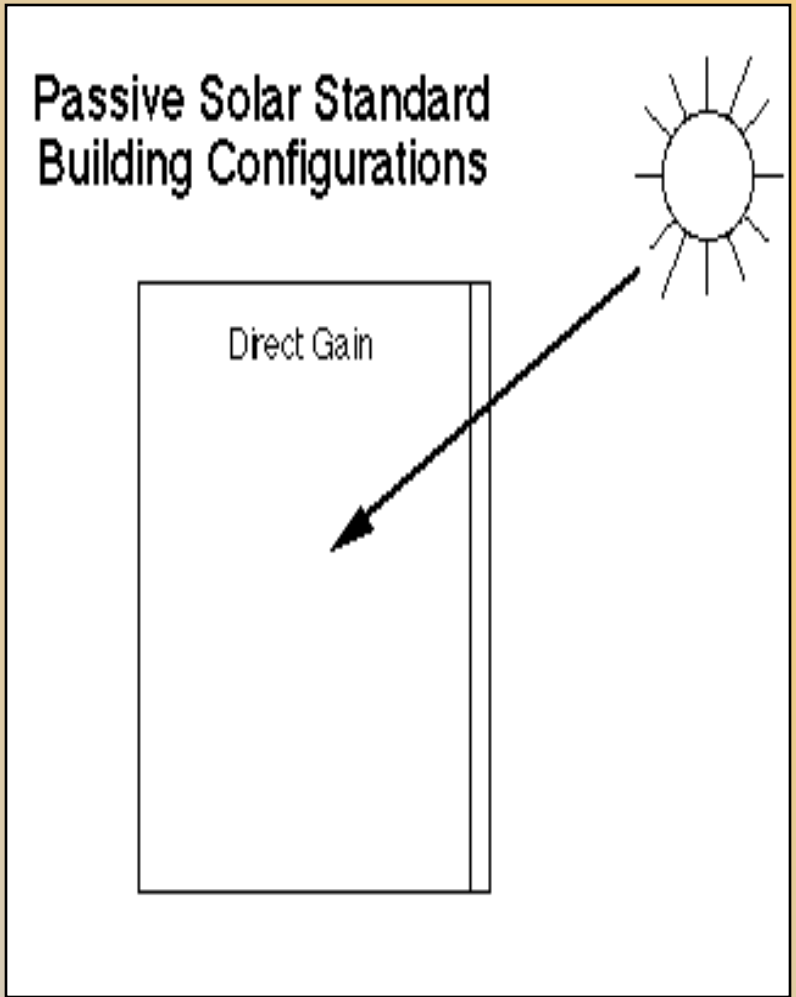
- This also refers to electrical generation using solar power
- Two ways to do this are photovoltaic cells and huge commercial electric facilities
- This shows the diagram for the house seen in the previous slide. The PV panels are on the roof

Large-scale Solar Electric Site

Large-scale Solar Electric Site

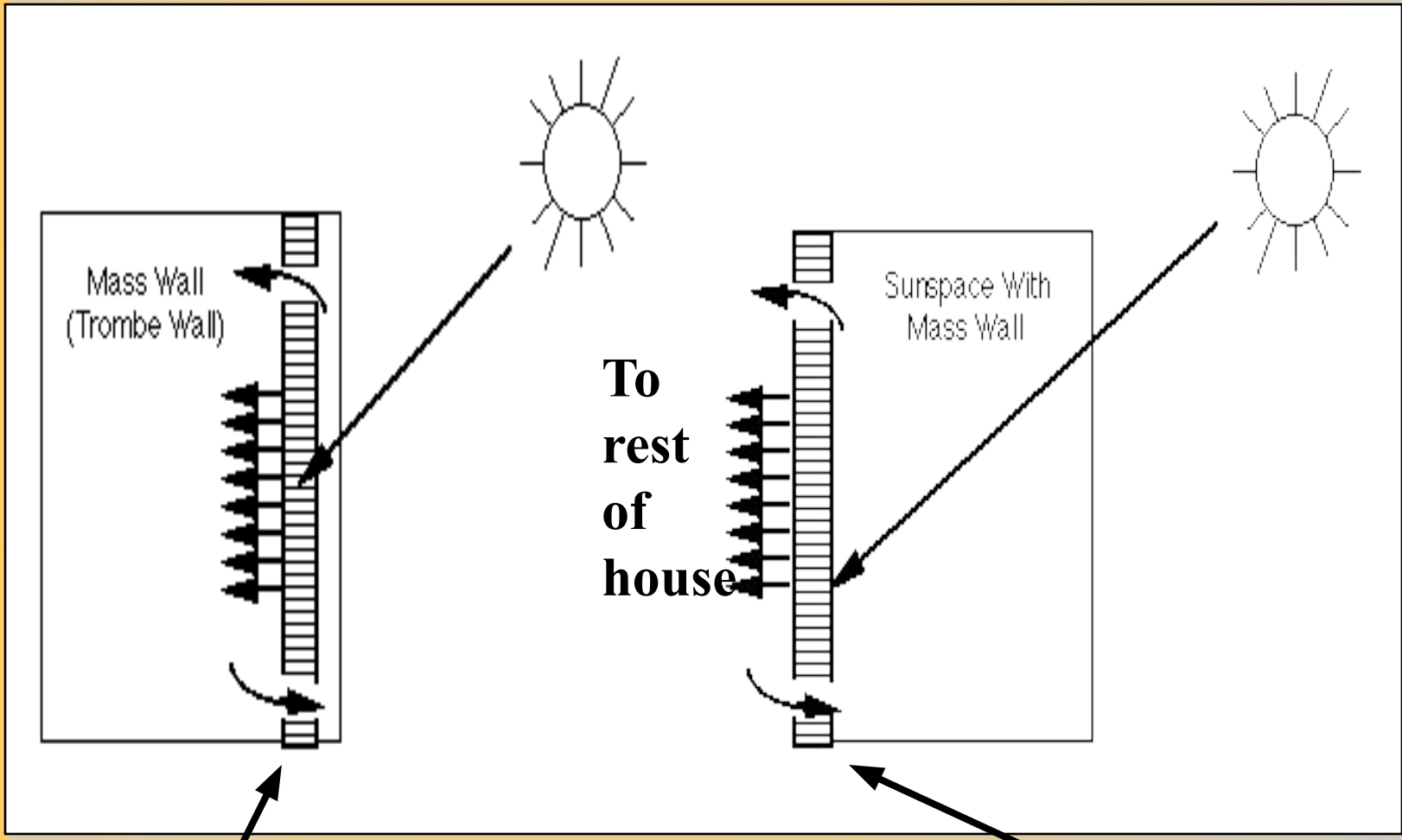
- These facilities use solar power to heat water to form steam. The steam goes to generate electricity just as in fossil fuel or nuclear electric plants.
- No release of air pollutants
- No electricity generated at night
- They *do* work on cloudy days, though.

Passive Solar Power



- Works on the principle that hot air rises and cool air sinks (convection)
- Solar heats air and it moves through convection through the structure or to thermal mass

Passive Solar Power



Mass wall or "Trombe Wall

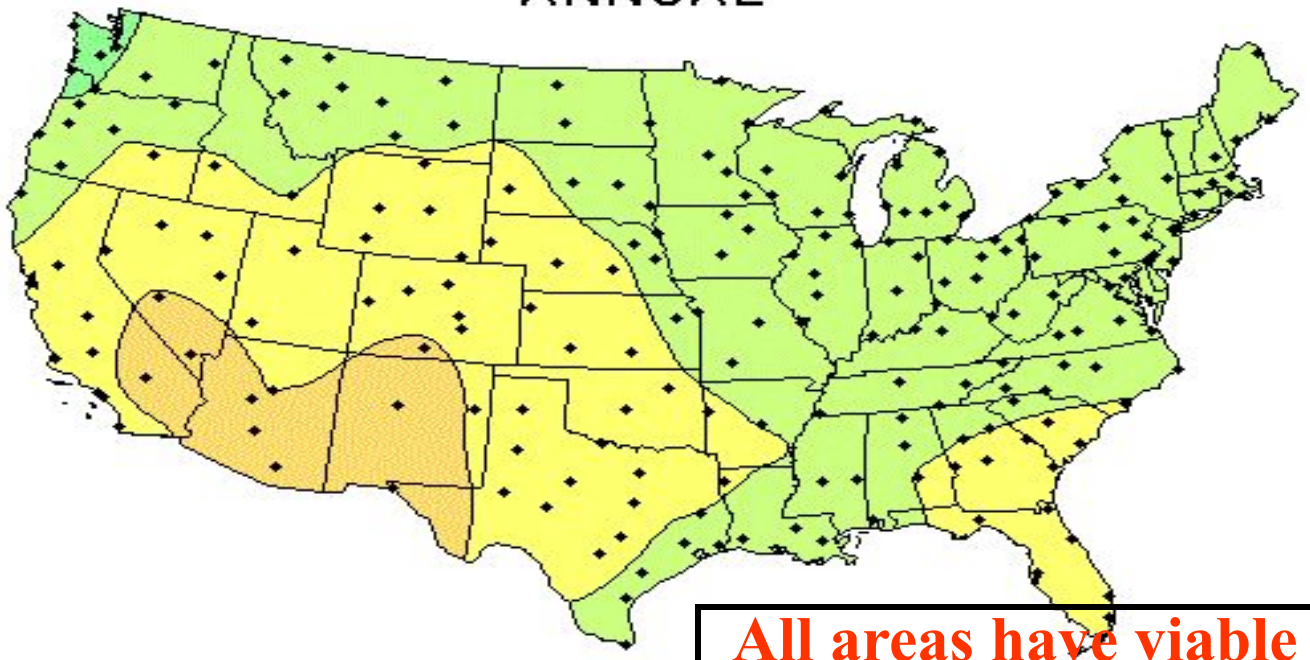
Using back wall as "mass"

Solar Power

- Benefits
  - **Abundant**
  - **No greenhouse gases, few other pollutants**
  - **Simple, minimal repair needed**
  - **Cheap over the long term**
- **Detriments**
  - **Retrofitting needed if structure is not already designed as passive solar**
  - **Has limitations, night, some locations better such as south rather than north facing slopes**
  - **Initial capital outlay can be high**

Average Daily Solar Radiation Per Month

ANNUAL



All areas have viable amounts of solar energy

Flat Plate Tilted South at Latitude

This map shows the general trends in the amount of solar radiation received in the United States and its territories. It is a spatial interpolation of solar radiation values derived from the 1961-1990 National Solar Radiation Data Base (NSRDB). The dots on the map represent the 239 sites of the NSRDB.

Maps of average values are produced by averaging all 30 years of data for each site. Maps of maximum and minimum values are composites of specific months and years for which each site achieved its maximum or minimum amounts of solar radiation.

Though useful for identifying general trends, this map should be used with caution for site-specific resource evaluations because variations in solar radiation not reflected in the maps can exist, introducing uncertainty into resource estimates.

Maps are not drawn to scale.

NREL

National Renewable Energy Laboratory
Resource Assessment Program

kWh/m^2/day

	10 to 14
	8 to 10
	7 to 8
	6 to 7
	5 to 6
	4 to 5
	3 to 4
	2 to 3
	0 to 2
	none

FLATA13-2

Some solar power history

- Solar power furnace was used by Lavoisier to discover elements, particularly nitrogen
- Solar power water distillation used by French Foreign Legion and still used today!

Wind Power

Wind power

- Can be used for mechanical tasks, e.g. pumping water
- Can be used for generation of electricity for direct use or storage in batteries

Mechanical Power Windmills

- High torque, low-speed to pump water, grind grain, saw wood

Electrical Power Windmills

- High speed, low torque machines
- Will turn themselves off if wind speed exceeds their limits

Effects of windpower

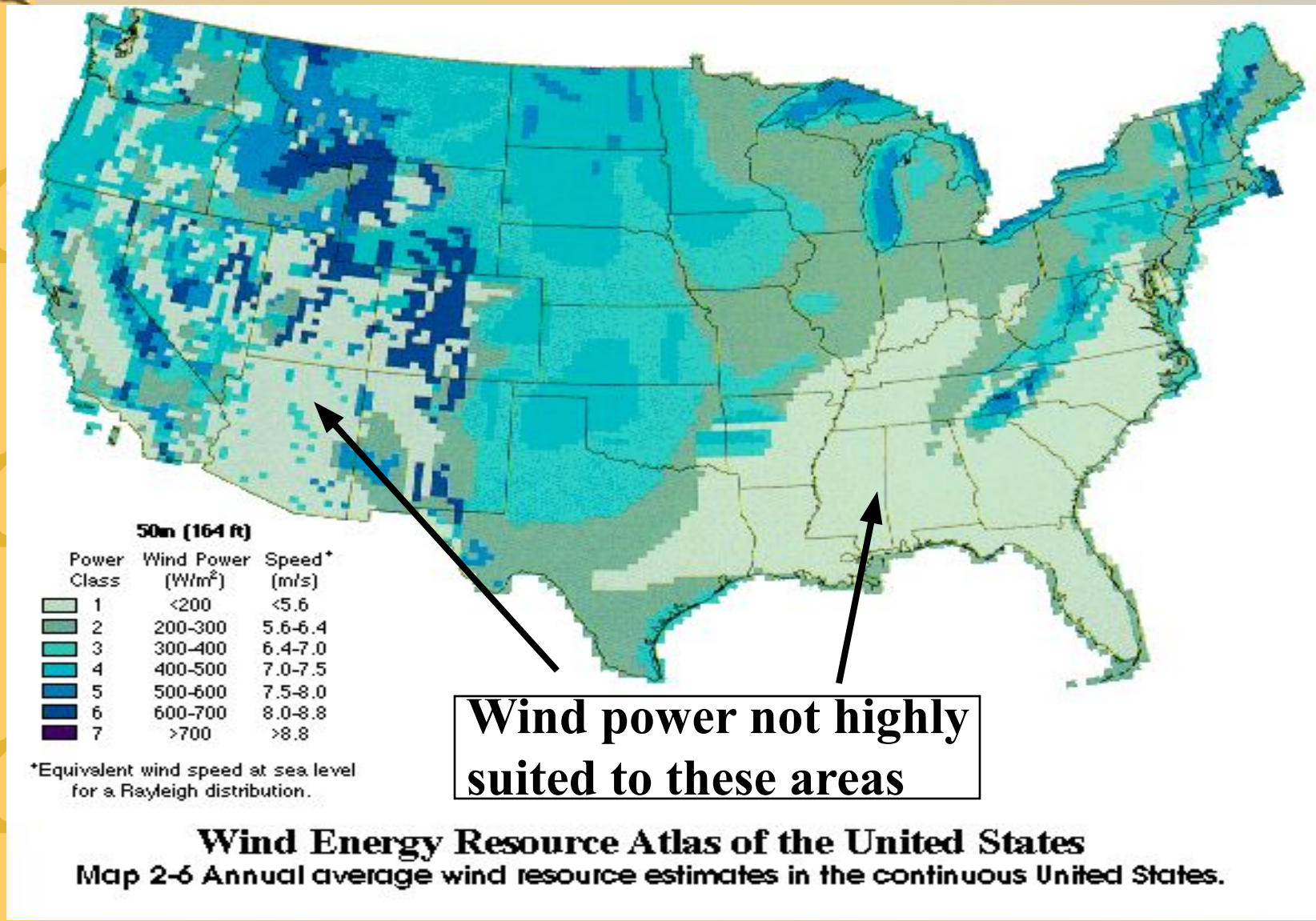
Positive

- No greenhouse gases
- Few other pollutants
- Cheap
- Abundant
- Simple

Negative

- Some noise pollution
- Metal blades interfere with TV & radio reception
- Aesthetic pollution
- No evidence for bird death, but can kill bats

Where is wind power available?



Wind Energy Resource Atlas of the United States

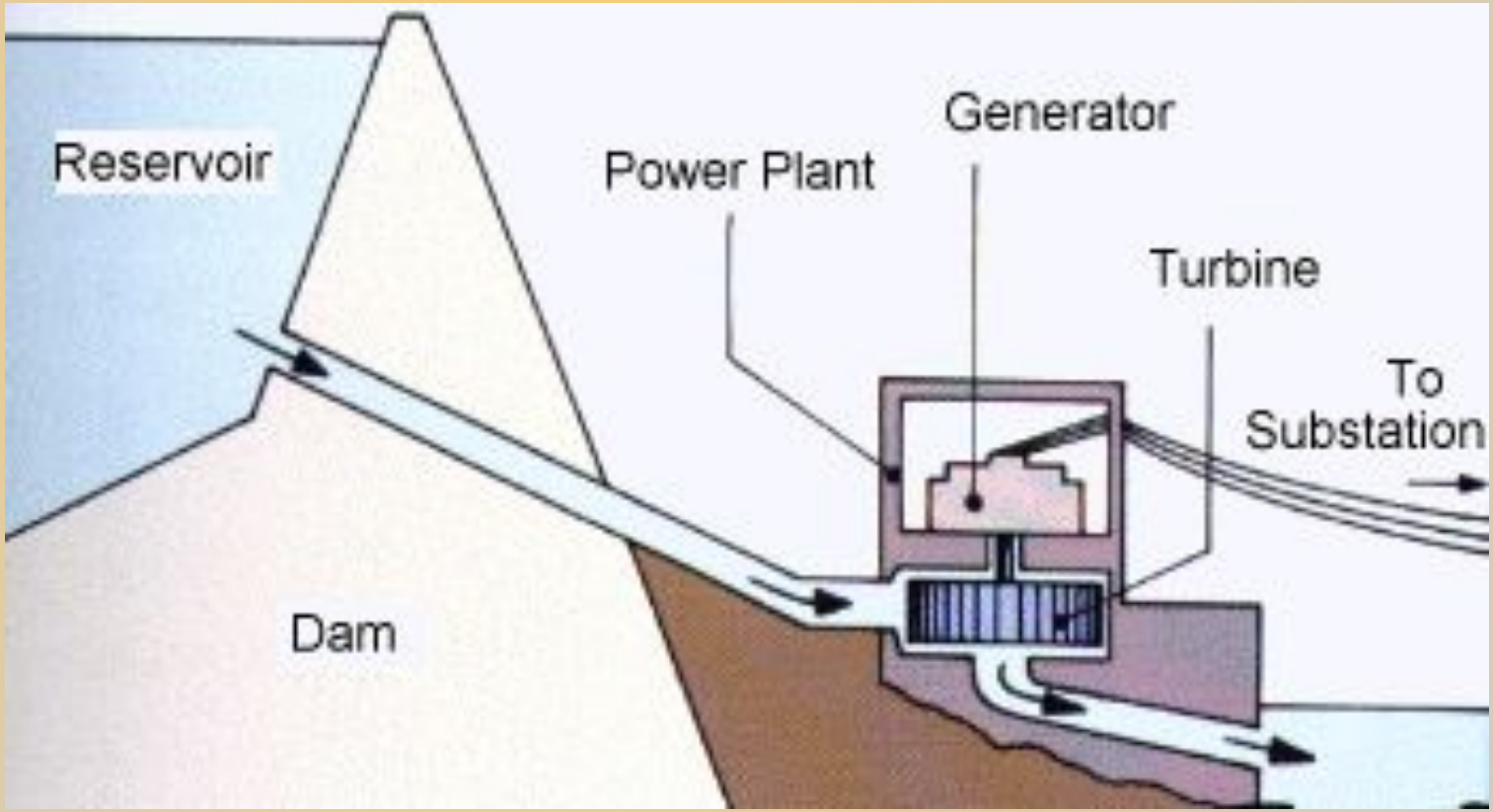
Map 2-6 Annual average wind resource estimates in the continuous United States.

Hydropower

Electric

Mechanical

How hydropower works



Negative effects of Hydropower

- Flooding the land
- Displacement of local inhabitants
- Local climatic changes
- Tectonic activities (Earthquakes)
- Loss of species (aquatic & terrestrial)
- Loss of normal nutrient flow down river
- Changes temperature of water, too

Positive Effects of Hydropower

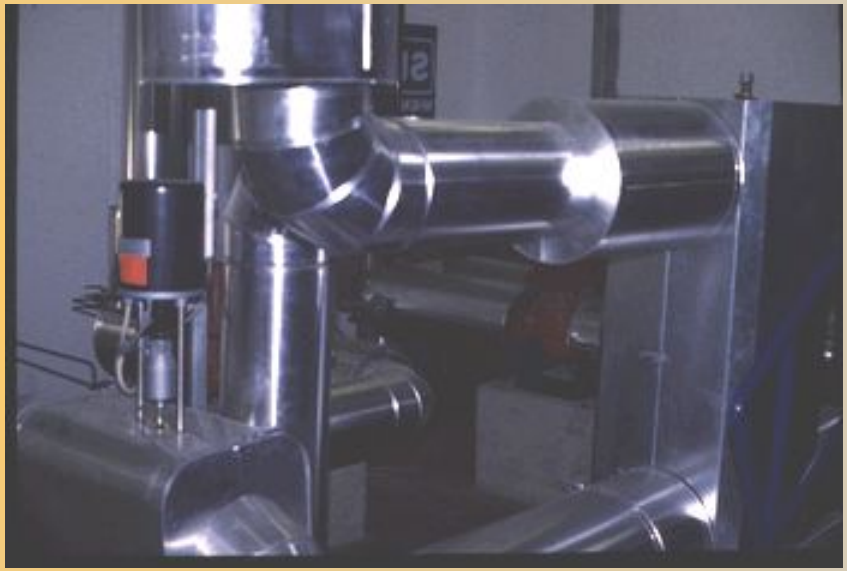
- Can generate electricity
- Can do mechanical work, e.g. grind grain
- No greenhouse gases
- Initial construction provides jobs

Tidal Power

Tidal Power

- Essentially entails placing a dam across an ocean inlet and harnessing the energy as water moves in and out with the tides
- Positive & negative effects are same as hydropower

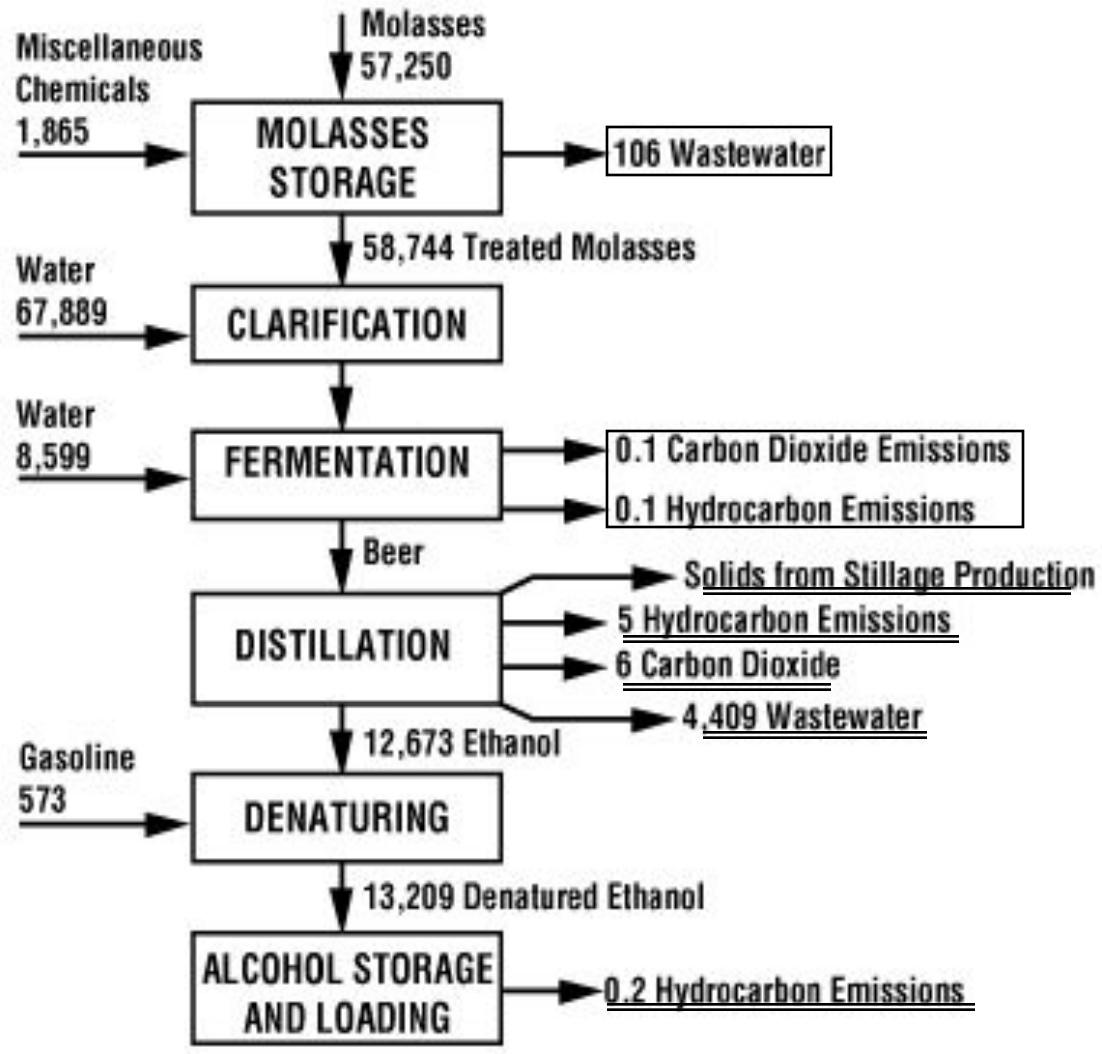
Biomass Energy



Biomass Pros & Cons

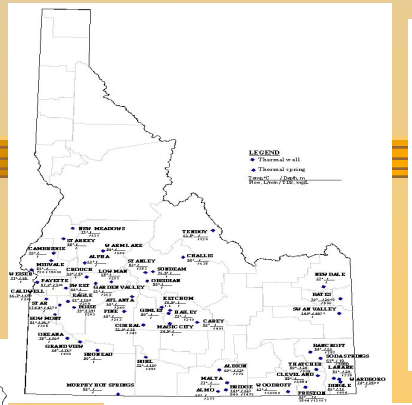
- Burning biomass gets rid of solid waste
- Creates energy
- Creates new markets for crops
- Burning biomass releases CO_2 and other gases associated with combustion
- Creates solid waste from ash
- May cause more grasslands to be planted to corn

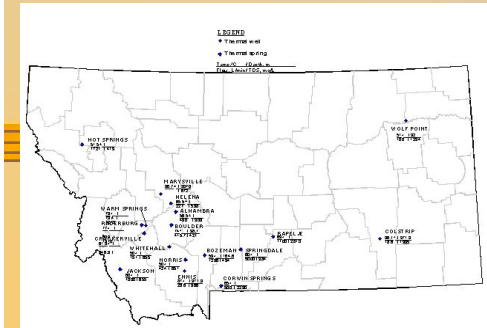
Ethanol production: not environmentally benign

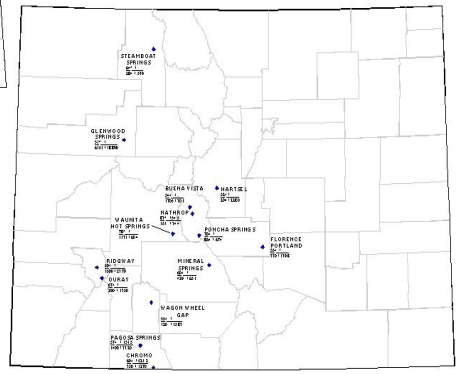


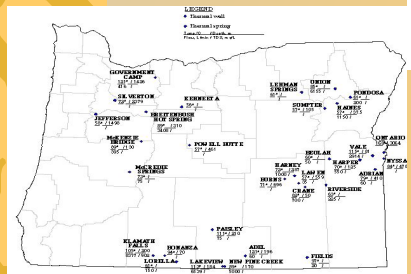
Geothermal Energy

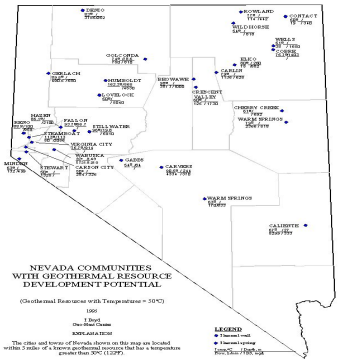
Where is Geothermal in the U.S.?

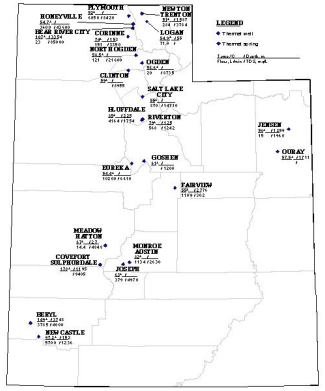


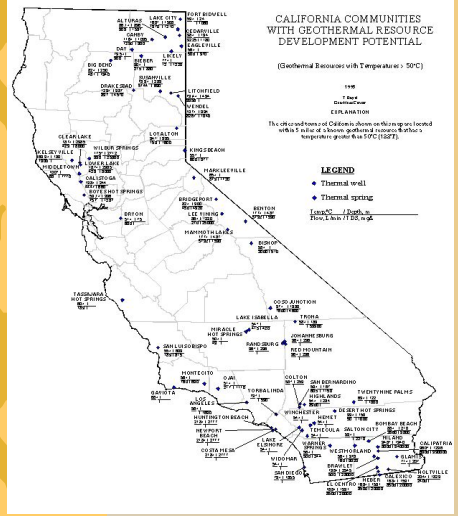


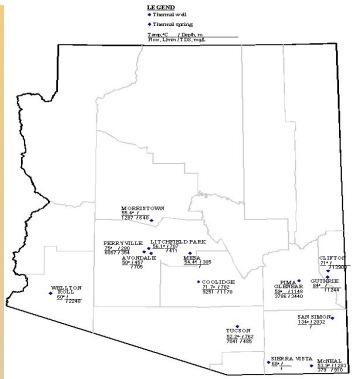


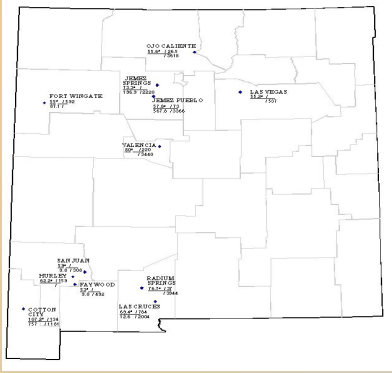












Primarily in western U.S.

- Pros – Can be used for electricity generation, space heating, cooking & low temperature industrial
- Pros – Inexpensive after initial outlay
- Pros – No greenhouse gas emission
- Cons – same problems as we see with oil drilling
- Cons – Localized distribution

How does it work?

- Drill to deep, hot rock
  - Either wet system where heated water belowground is used
  - Dry system sends aboveground water belowground to get heated
- Resulting steam can be used for a number of purposes

An energy mix

- Using more than one form of energy to meet needs is an important way to ensure long-term energy needs will be met
- Just as in ecosystem ecology, we find that Diversity = Stability
- Depending on only one form of energy leaves nation vulnerable to all sorts of problems