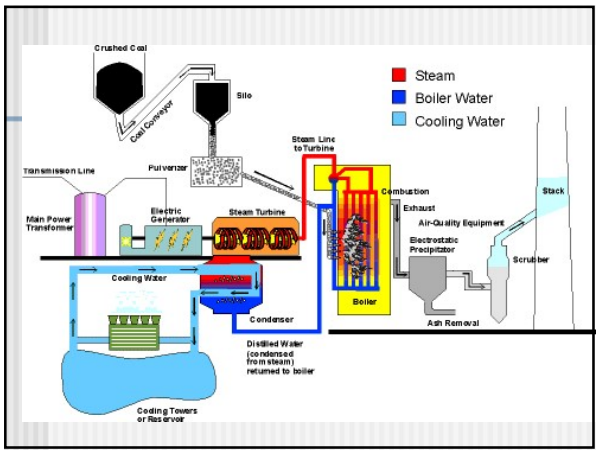
Nuclear Power

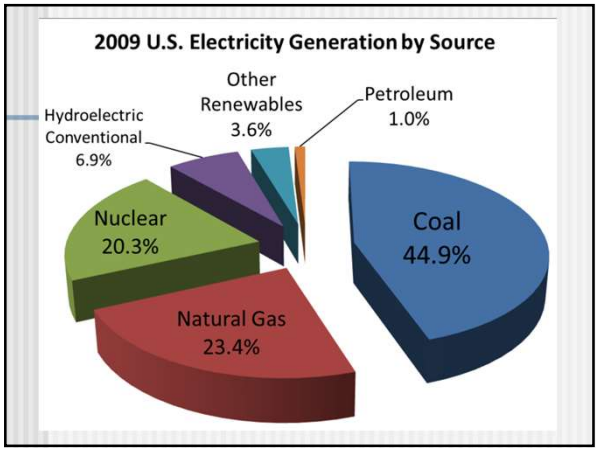
Generators

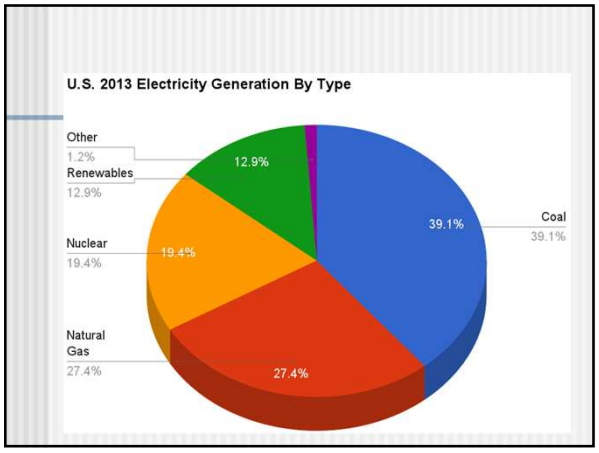
- Generators produce electricity by spinning a coil of wire (solenoid) in front of permanent magnets.
- The part of a generator that spins is referred to as a turbine.
- Most power plants just try to spin a turbine.

Coal Power Plant

- The most common type of power plant (the place where electricity is produced) in the United States is a coal plant.
- In a coal plant, coal is burned to heat up water. The steam is forced through a pipe and spins a turbine to create electricity.
- Natural Gas plants are the 2nd most common, and work the same way.


Crushed Coal
Silo
Coal Conveyor
Steam
Boiler Water
Cooling Water
Steam Line to Turbine
Transmission Line
Pulverizer
Combustion
Stack
Exhaust
Main Power Transformer
Electric Generator
Steam Turbine
Air-Quality Equipment
Electrostatic Precipitator
Scrubber
Cooling Water
Boiler
Condenser
Ash Removal
Distilled Water (condensed from steam) returned to boiler
Cooling Towers or Reservoir


2009 U.S. Electricity Generation by Source
Other Renewables 3.6%
Petroleum 1.0%
Hydroelectric Conventional 6.9%
Nuclear 20.3%
Coal 44.9%
Natural Gas 23.4%


U.S. 2013 Electricity Generation By Type
Other 1.2%
Renewables 12.9%
Nuclear 19.4%
Natural Gas 27.4%
Coal 39.1%
12.9%
39.1%
19.4%
27.4%

Advantages

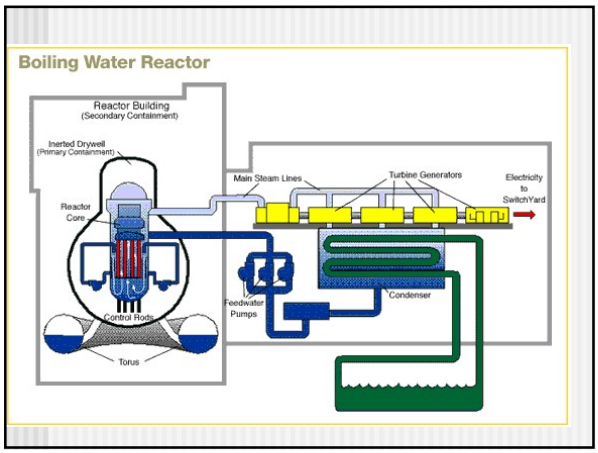
- The main reason for the popularity of these plants are you can put them anywhere.
- All you need to do is ship in the coal or pipe in the natural gas.
- They don't require a relatively large amount of space to produce enough electricity for a city.

Disadvantages

- Both release smoke into the surrounding area.
- Higher rates of asthma have been recorded as the number of power plants grow.
- Both release carbon dioxide, a greenhouse gas, which may be the largest threat to our survival on this planet.

Nuclear Power

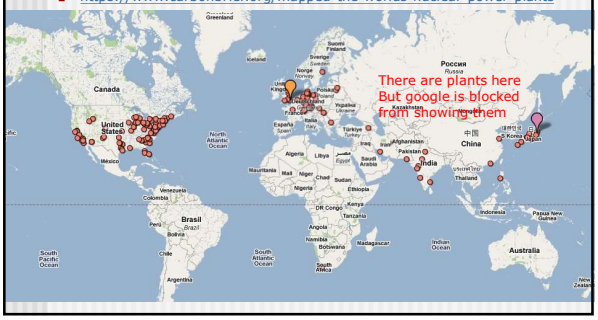
- Nuclear power is using a nuclear reaction heat up water instead of a fossil fuel.
- It works the exact same as a coal or natural gas plant.
- The first nuclear power plant was the Obninisk Plant in the USSR in 1954.
- The first in the United States was the Shipping Port Reactor in 1957



Google Earth US Map of nuclear power plants

Google Earth World Map of nuclear power plants

- https://www.carbonbrief.org/mapped-the-worlds-nuclear-power-plants



Why put them next to population centers?

- That's where the power is needed!
- Electricity is lost as you send it across power lines.
- The further is it sent, the more you lose.
- Research is being done that shows as some materials are cooled to near absolute zero, they become super conductive losing no electricity.

Super cool

- That is not practical to keep power lines near absolute zero though.
- At least not at the moment.
- Even if it was practical, a city would have to form near the power station.

Can a nuclear power plant explode like a nuclear bomb?

- No
- There is not enough U-235 being reacted.
- Nuclear plants use a fission reaction to boil water. Steam rises forcing a turbine to spin producing electricity (same way a coal plant works).
- The Uranium they are using is not as pure as weapons grade, so it can't react as quickly.

Meltdown

- The danger in a power plant is a meltdown of a reactor.
- It is an explosion, but not an explosion like a nuclear bomb (no mushroom cloud, or knocking down giant buildings).
- A meltdown is a reactor cracking and leaking radiation and/or radioactive material into the surrounding area.
- This actually can release more radiation and radioactive material into the surrounding area than a bomb.

Meltdowns

- There have been three major accidental releases of radiation from nuclear power plants.
- Three Mile Island, Chernobyl, and Fukushima.

Three Mile Island

- Located in PA
- The accident occurred in 1979.
- A small amount of radiation escaped The problem was controlled before it got really bad.
- The average person within 10 miles received the radiation of about a chest x-ray.
- No deaths or injuries occurred on site.

Chernobyl

- Located in modern day Ukraine (was the USSR at the time)
- Occurred in 1986
- A much worse accident (full meltdown)
- 31 workers and firefighters died right away, 130 suffered acute radiation sickness.
- hundreds of thousands of people were hit with a high level of radiation
- The long term effects are still being studied.

Fukushima

- Located in Japan, north of Tokyo.
- The accident occurred in 2011
- Caused by a massive earthquake (9.0) and ensuing tsunami.
- This wiped out the cooling system, controls and left the surrounding area without power for weeks.
- Unlike the others, this slowly continued as onlookers were unable to contain it.

Fukushima cont.

- Workers died from the Earthquake/Tsunami, however no one died directly from radiation.
- The area around the plant was evacuated and will be unlivable for years.
- This accident released 1/5 the radiation that was released during Chernobyl.

Why use nuclear power?

- Taking everything into consideration, it is safer and cleaner than other forms of power.
- The accidents were horrible, but they were few.
- Nothing is completely safe. People die **each year** from accidents at other types of plants.
- Coal plants also pour smoke and other pollutants into the air, nuclear plants do not.
- Coal plants also produce carbon dioxide.

New nuclear power plants

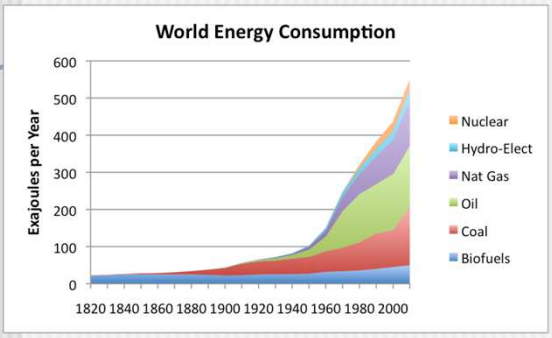
- There was a "freeze" on nuclear power plants in the United States for a long time given the concerns.
- President Obama signed off on the construction of 3 new reactors in Alabama in 2010.

Nuclear Phase Out

- Germany announced it will be shutting down all 17 nuclear power plants by 2022.
- Italy is the only country to have ever shut down all nuclear plants and not built new ones, however, they import power from neighboring countries that is nuclear
- Several countries has released proclamations to reduce their dependence on nuclear power.

Overall effect

- Globally more nuclear power plants have closed in recent years than have opened, but the overall capacity has increased.
- That is the new ones that opened are bigger than the older smaller ones that closed.



- http://www.census.gov/popclock/

Other places nuclear power is used

- Submarines- nuclear powered ships can stay at sea for 25 years without refueling. Compare that to the few weeks a diesel ship could stay at sea.
- Space ships commonly use nuclear generators as well.

Sunken nuclear subs

- 8 nuclear ships have sunk.
- 2 from the US, 6 from USSR/Russia
- 5 are in Atlantic Ocean
- 3 are in Artic Ocean