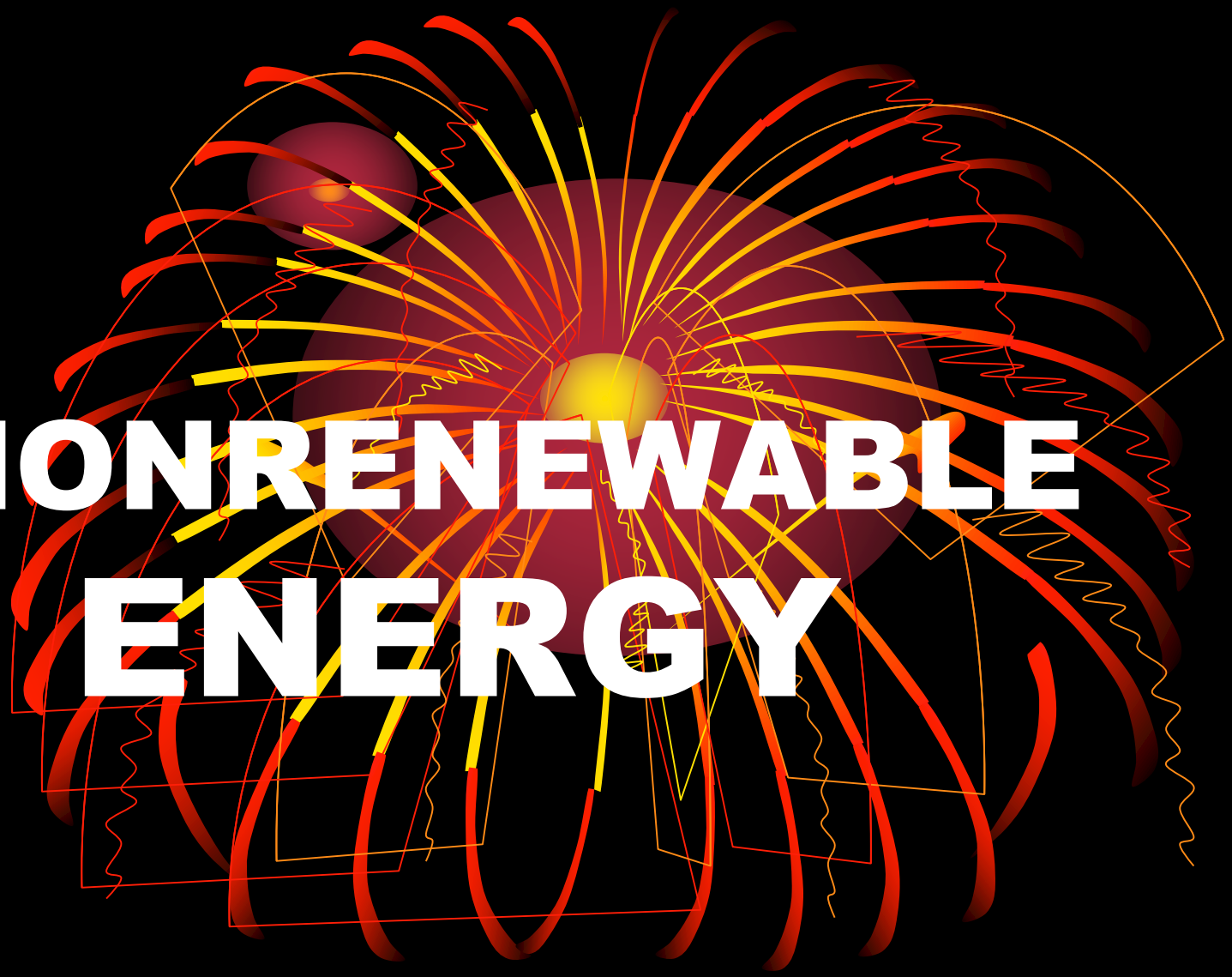
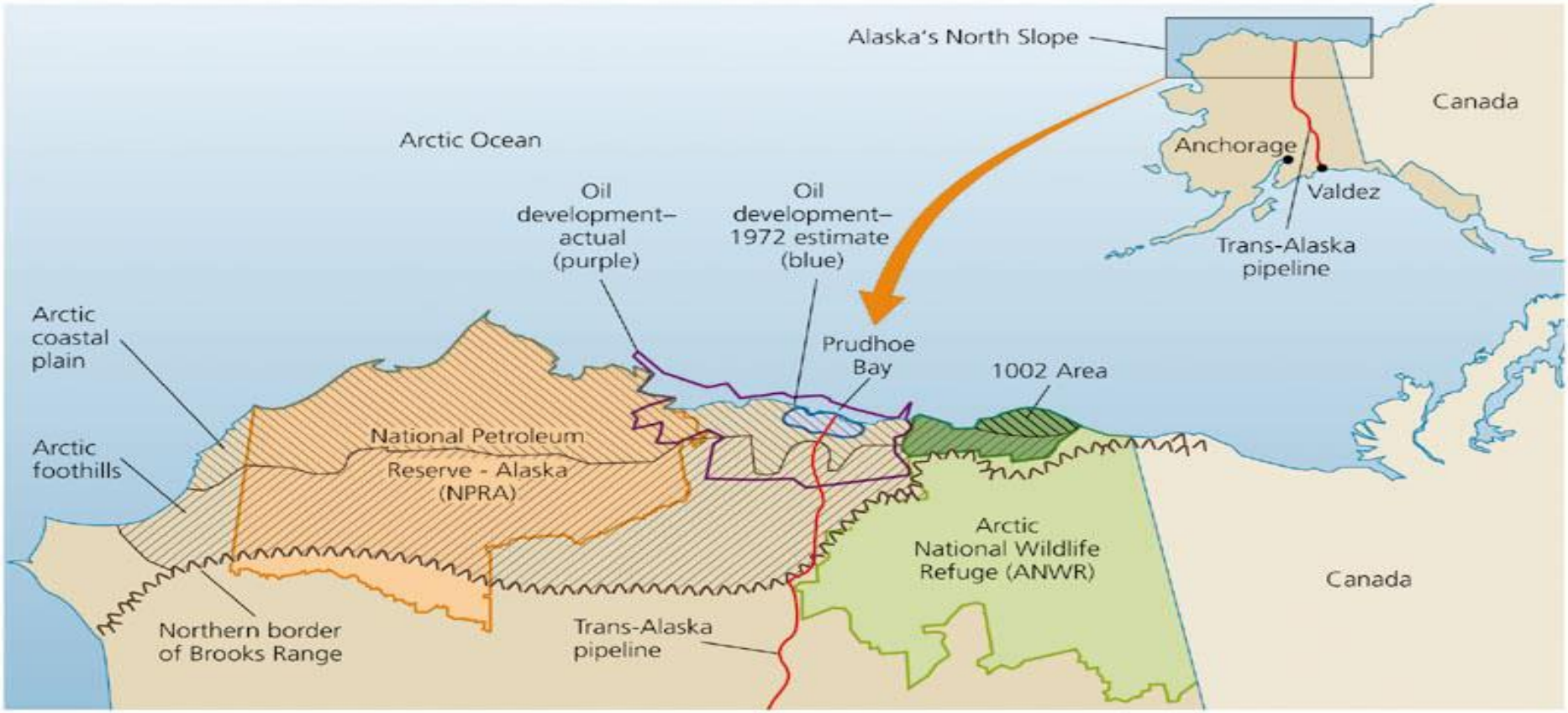
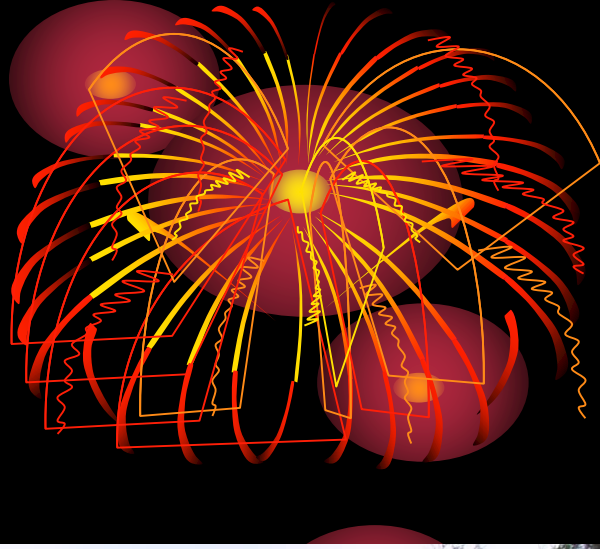


NONRENEWABLE ENERGY

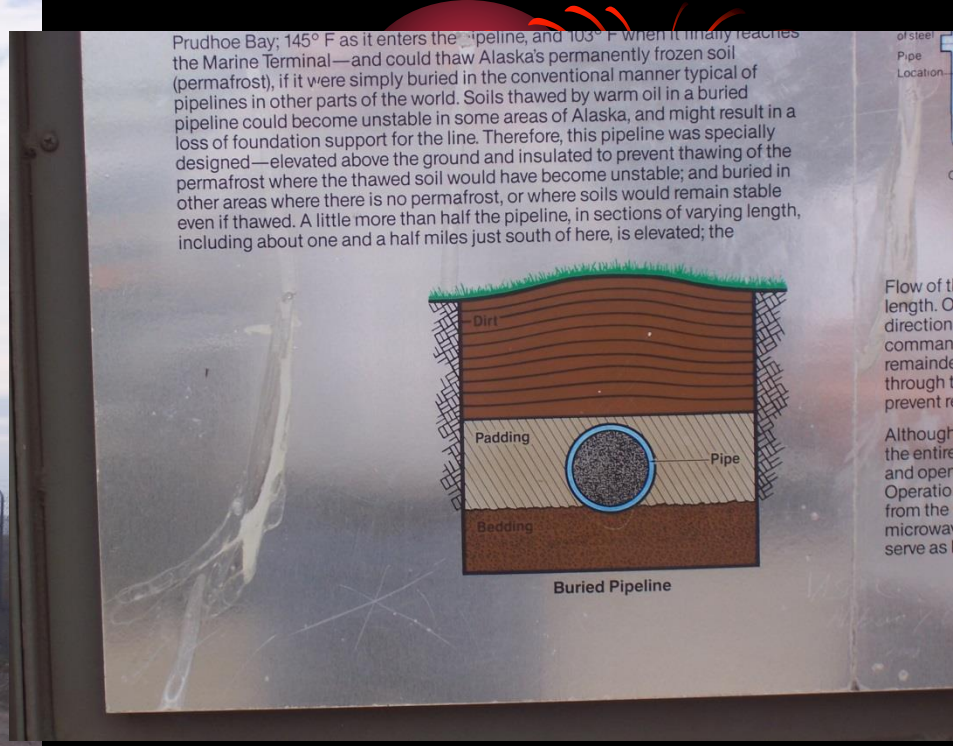
Can Alaska Help Relieve Our Energy Crisis?



https://www.youtube.com/watch?v=_OrAmGOFOEk

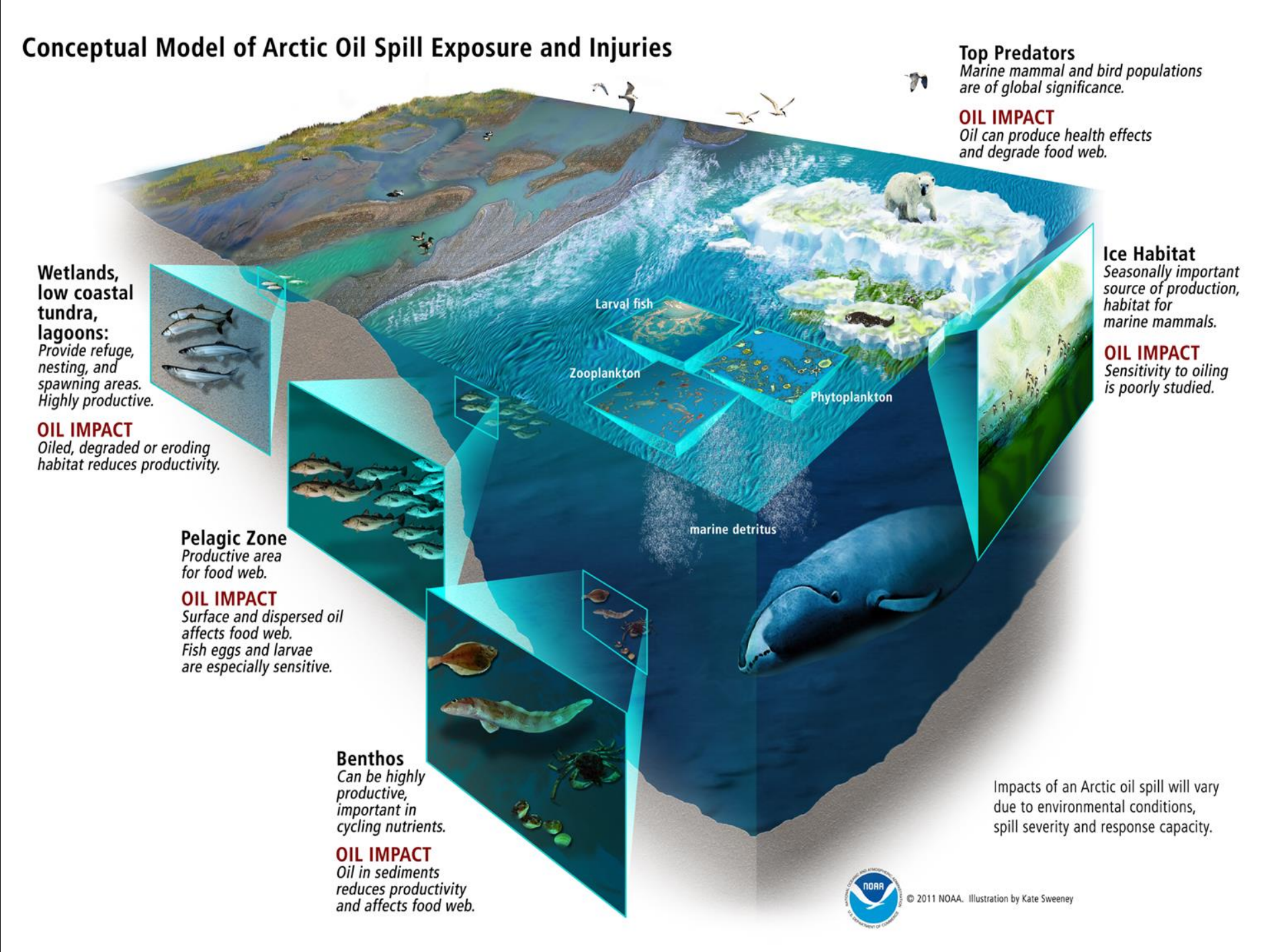


View of the Alaskan Pipeline



- **Parts of the pipeline are buried to protect the tundra, permafrost and wildlife.**

Conceptual Model of Arctic Oil Spill Exposure and Injuries



The Exxon Valdez Oil Spill Assignment

Directions for Project

In the assigned perspective, create a single page newspaper spread (8.5”x11”) of your perspective of what occurred. Use newspaper articles from that time to see what the experience may have been like. This should be in a time period of no more than 1 year after the spill of 1989. Consider what you would want an audience reading your newspaper article to believe occurred. Some things to consider, though this is not a be all, end all list of questions: Who was at fault? How is the cleanup being managed? Is the cleanup successul? How are the locals handling the problem? What has the company done to mitigate environmental damage?

Remember to keep this in the perspective you are writing from.

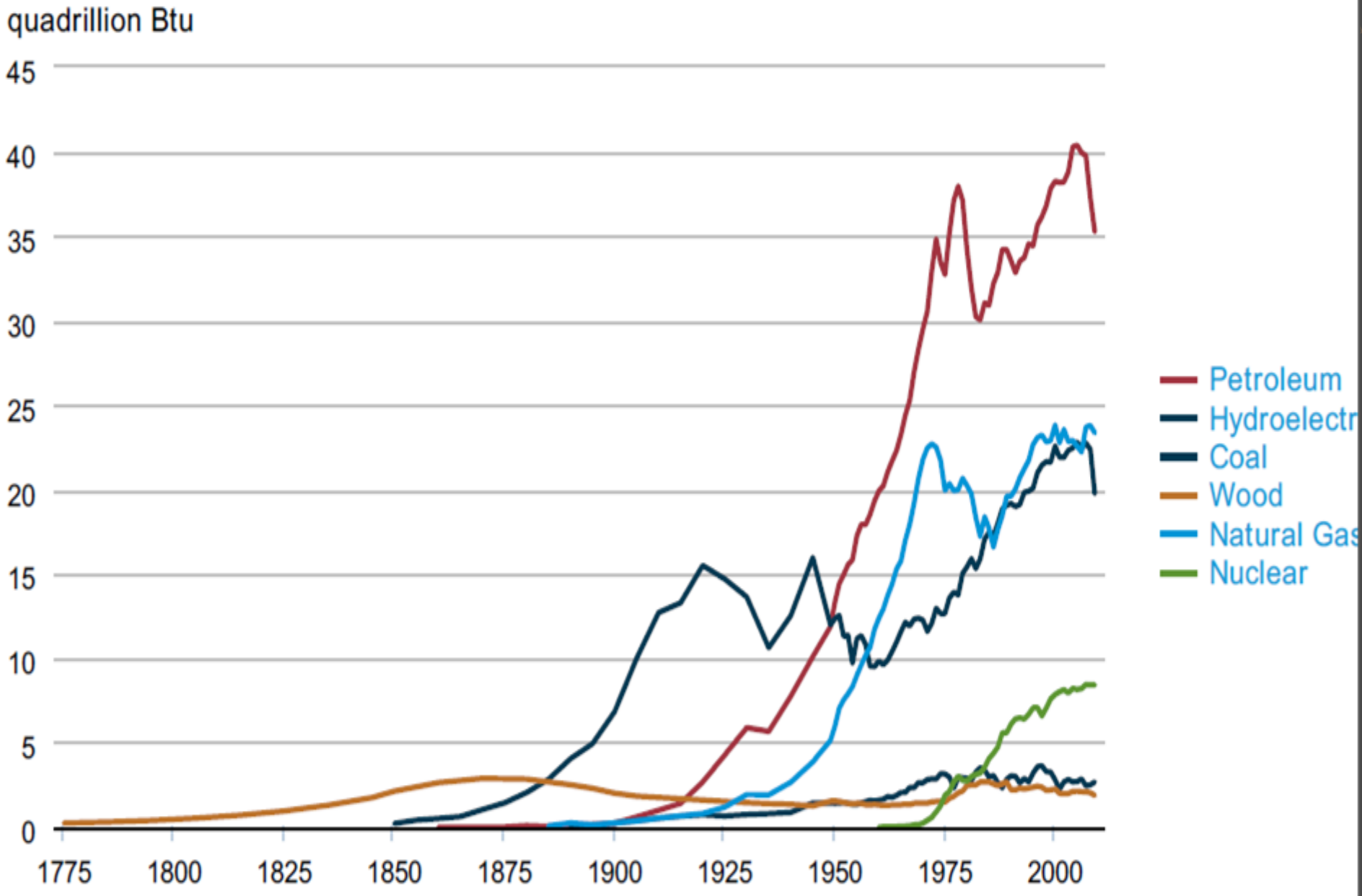
Future Perspective: What do you expect to see in the next 5-10 years? What will the animal/plant biodiversity look like? How will the fishermen be coping? What will the water look like? Use newspaper articles from 5-10 years after the spill to determine what is occurring at that time.

Include at least one picture and one video in your spread.

History of Energy

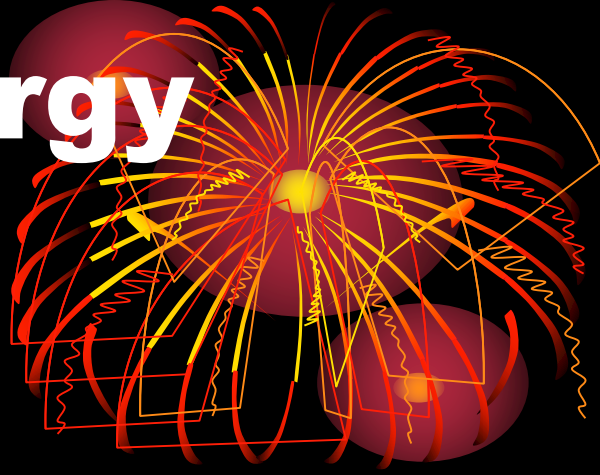
- Energy has been used, and fought over, for all of our history
- Only in the past 150 years has energy and wilderness been a topic to discuss at the same time

History of energy consumption in the United States, 1775-2009



Source: U.S. Energy Information Administration - Annual Energy Review 2009

History of Energy



http://science.howstuffworks.com/environmental/energy/timeline-energy-history.htmhttp://science.howstuffworks.com/environmental/energy/timeline-energy-history.htm

- **Wood and wood products were the first sources of energy for light and heat**
- **Animal, wind and water were the first energy sources for mechanical work in fields, mills, etc.**

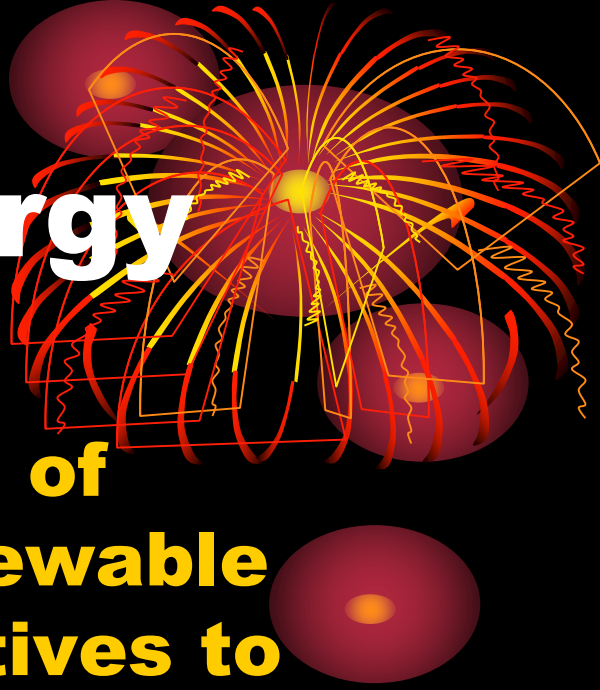
History of Energy

- 18th century – development of the steam engine using coal, allowed for industrialization
- Continued use of wood for other means caused deforestation, incentive to shift to sources other than wood

History of Energy

- 20th century – use of fossil fuels (coal, oil, natural gas). Used to generate electricity for a variety of uses
- Oil is the most used fossil fuel because of efficiency to burn, ship and store.

History of Energy



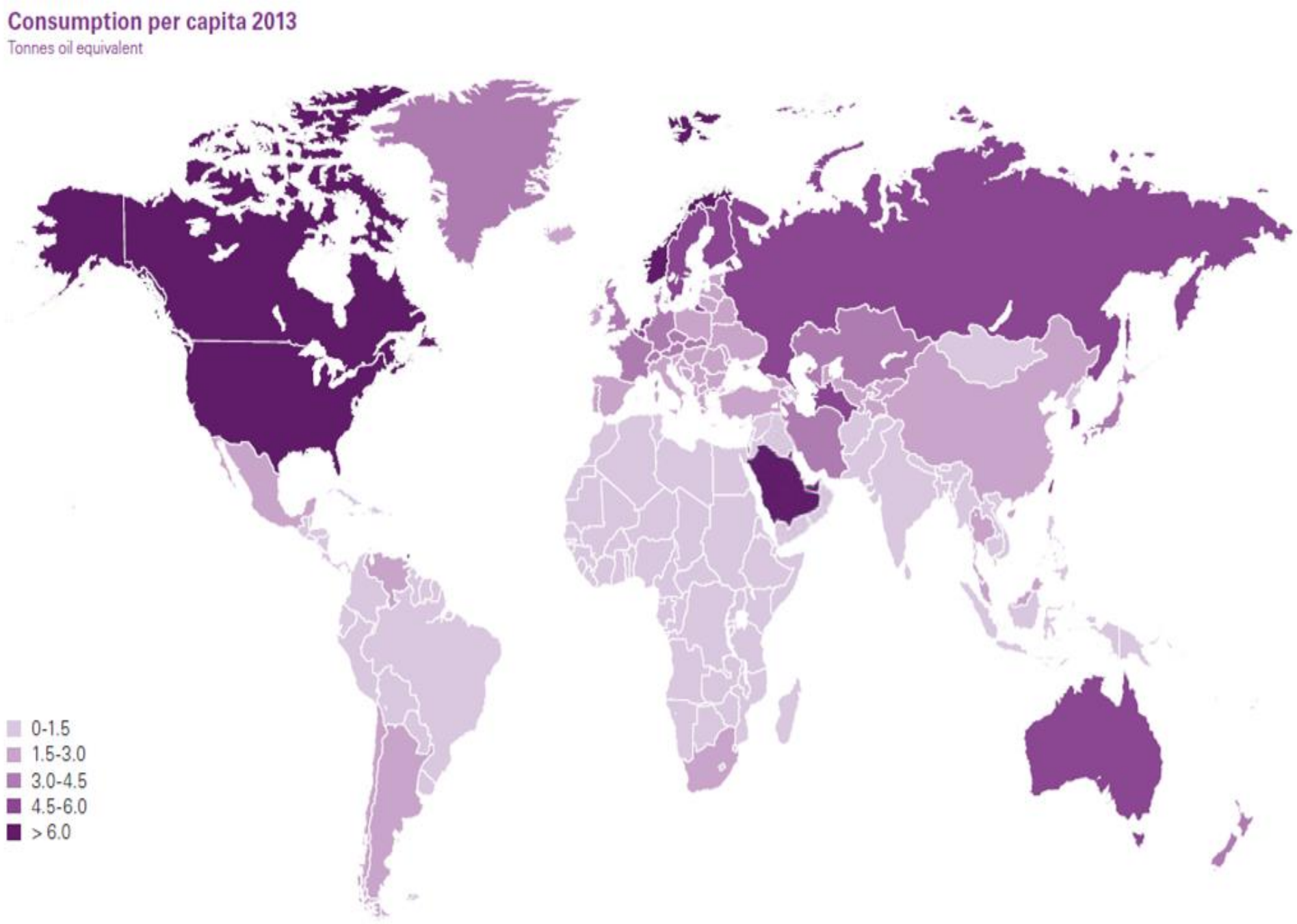
- 21st century – continuation of searching for efficient renewable energy sources as alternatives to nonrenewable sources.
- Available today: heat from center of Earth, gravitational pull (tidal power), nuclear power, sun, organic sources, wind, hydroelectric power

Table 17.1 Energy Sources We Use Today

Energy source	Description	Type of en
Crude oil	Fossil fuel extracted from ground	Nonrenew
Natural gas	Fossil fuel extracted from ground	Nonrenew
Coal	Fossil fuel extracted from ground	Nonrenew
Nuclear energy	Energy from atomic nuclei of processed uranium mined from ground	Nonrenew
Hydropower	Energy from running water	Renewabl
Solar energy	Energy from sunlight directly	Renewabl
Wind energy	Energy from the power of wind	Renewabl
Geothermal energy	Earth's internal heat rising from core	Renewabl
Biomass energy	Chemical energy stored in plant matter from photosynthesis	Renewabl
Tidal and wave energy	Energy from tidal forces and ocean waves	Renewabl
Electricity	Energy generated from use of primary energy sources	Secondary
Hydrogen	Stored energy from primary energy sources can be stored in fuel cells	Secondary

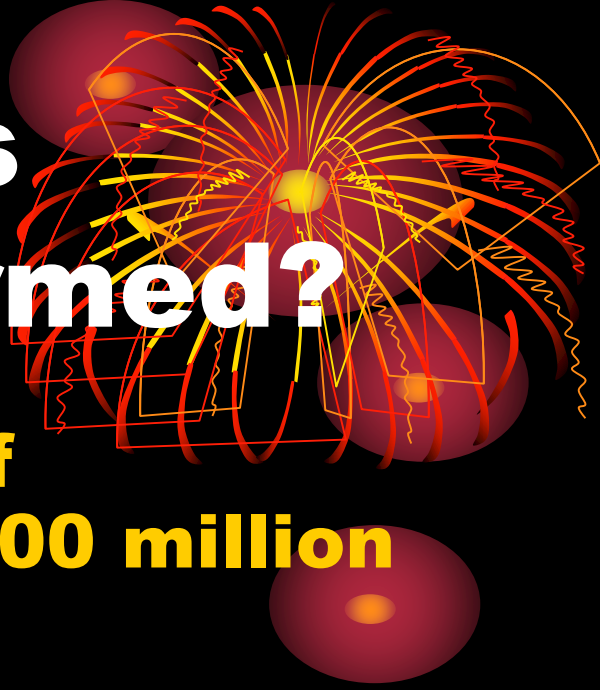
Use of energy throughout the world

- Characteristically MDCs use more energy than LDCs
- The most developed nations use 100x as much energy per capita as the least developed countries
- North America consumes more than 5x the world average in energy per capita
- Developing nations use energy for food preparation, heating, food growing, developed countries use energy for transportation and industry

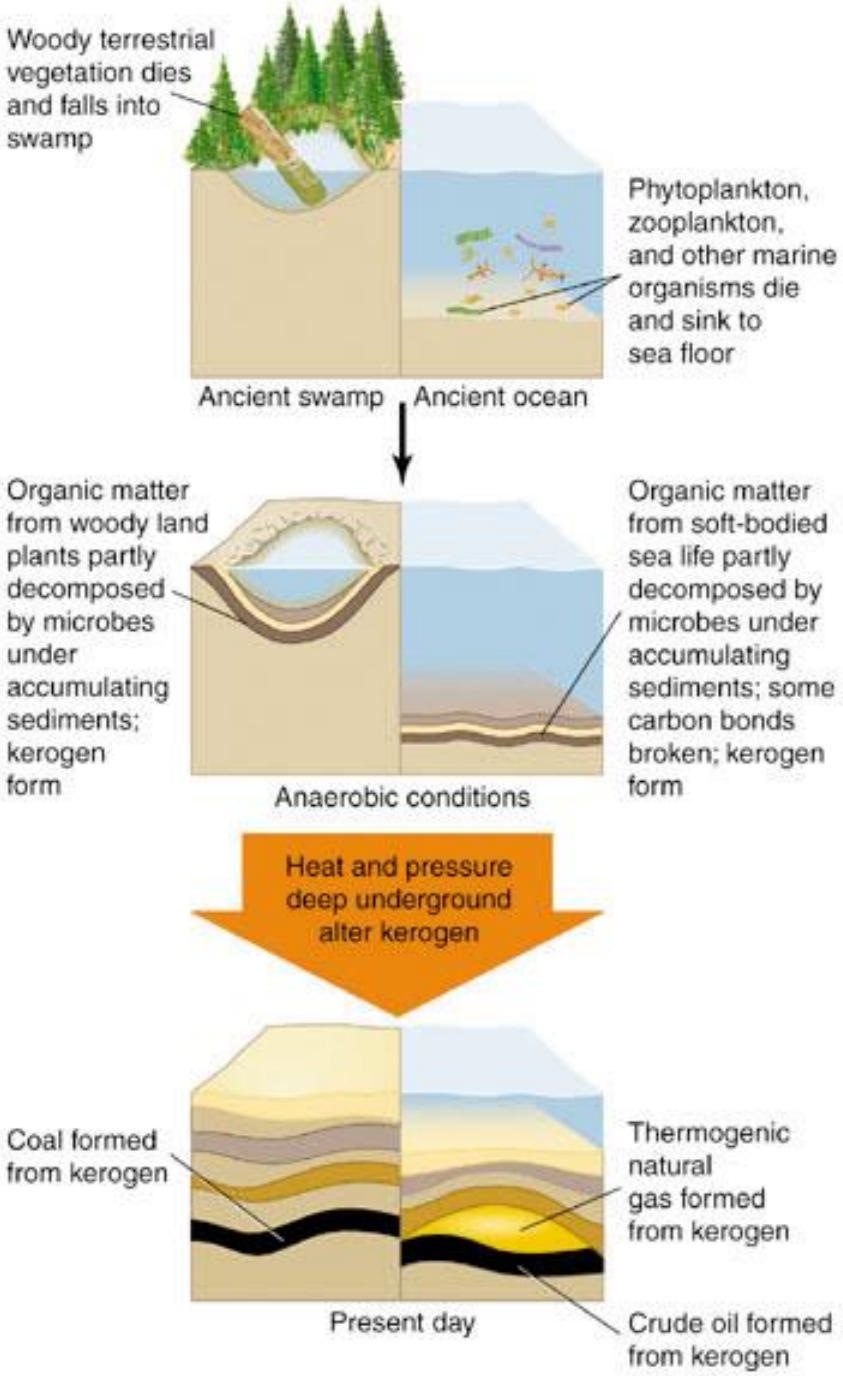


Source: BP Statistical review of world energy 2014 – full report

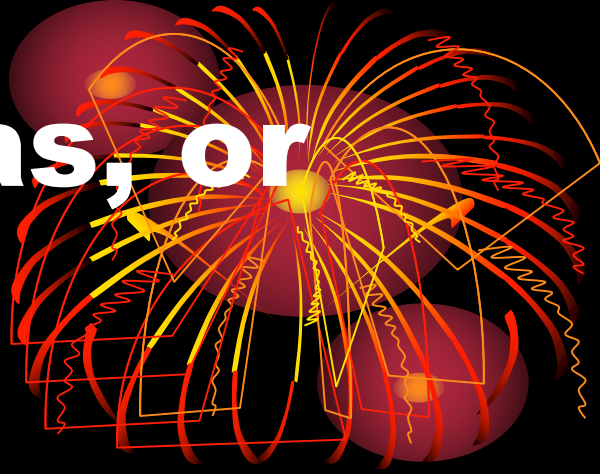
Fossil Fuels
How are they formed?



- Formed from the tissues of organisms that lived 100-500 million years ago
- Energy from the sun converted to chemical energy (photosynthesis), chemical energy concentrated as tissues decomposed and hydrocarbons altered and compressed
- Only occurs in anaerobic conditions



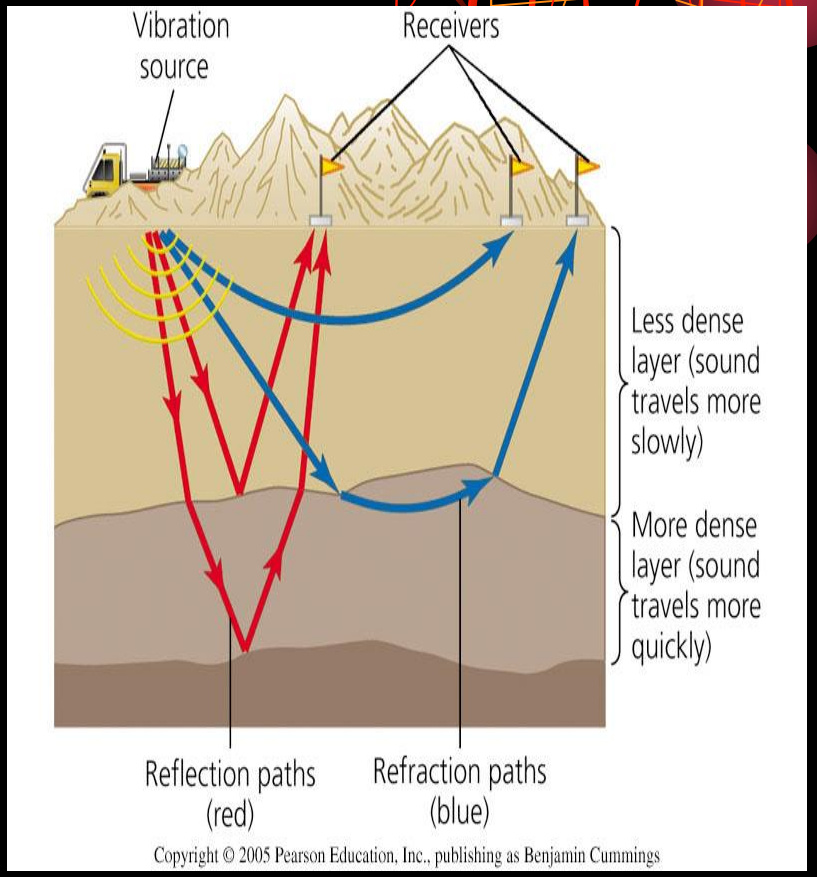
Coal, Natural Gas, or Oil?



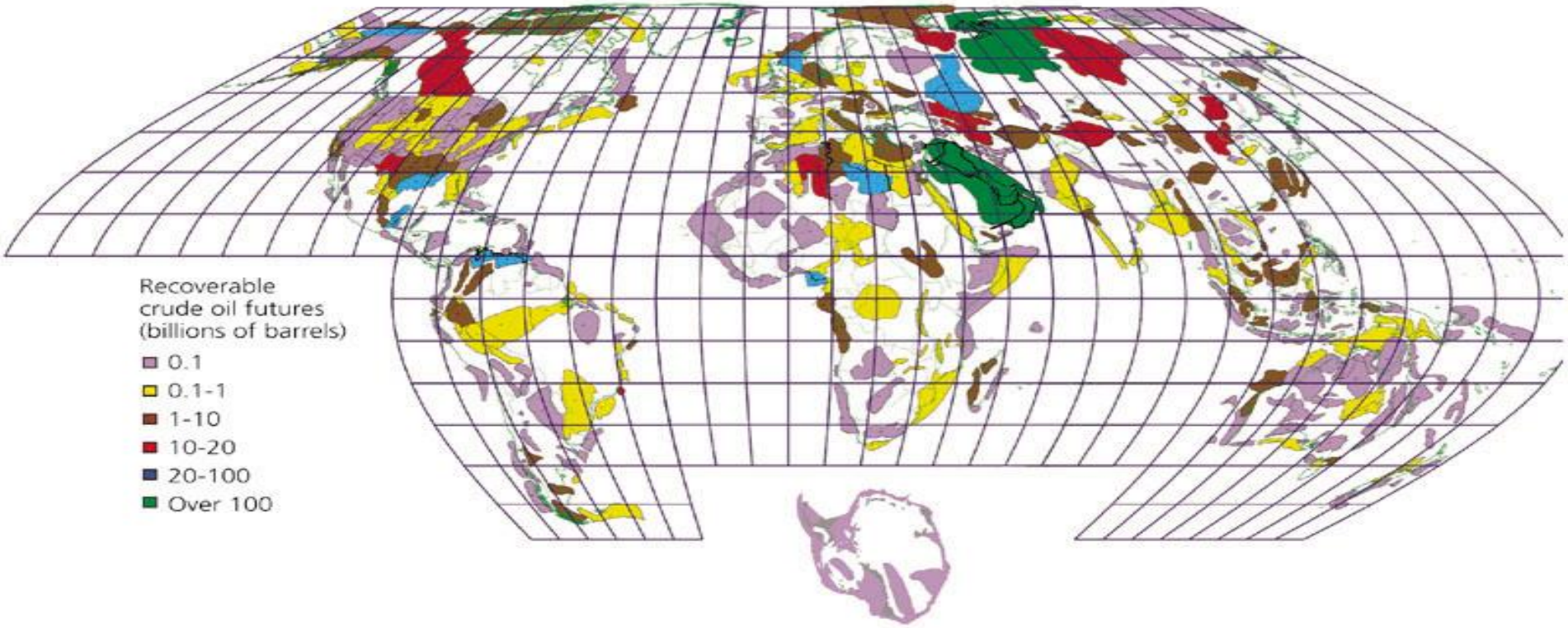
- Coal forms when little decomposition occurs because decomposers are not present. Compressed under very high pressure
- Natural gas forms as a by-product of bacterial action on organic material under anaerobic conditions or from compression and heat deep below ground forming kerogen. If very high temps and pressure, kerogen forms natural gas
- Oil (crude oil, petroleum) forms just as natural gas under a specific temperature and pressure range
- https://www.youtube.com/watch?v=8YHsxXEVB1M

How do we find fossil fuel deposits?

- **Petroleum geologists**
- **Ground surveys, air surveys, drilling of rock cores, or seismic surveys, exploratory well drilling**



Where are these reserves?



Oil

Proved reserves

	At end 1993 Thousand million barrels	At end 2003 Thousand million barrels	At end 2012 Thousand million barrels	
US	30.2	29.4	44.2	2.6%
Canada	39.5	180.4	174.3	10.3%
Mexico	50.8	16.0	11.4	0.7%
Total North America	120.5	225.8	229.9	13.6%
Venezuela	64.4	77.2	297.6	17.6%
Total S. & Cent. America	80.7	100.4	328.6	19.5%
Kazakhstan	n/a	9.0	30.0	1.8%
Russian Federation	n/a	79.0	92.1	5.5%
Turkmenistan	n/a	0.5	0.6	.04%
Total Europe & Eurasia	78.3	115.5	147.4	8.7%
Iran	92.9	133.3	157.0	9.3%
Iraq	100.0	115.0	150.0	8.9%
Kuwait	96.5	99.0	101.5	6.0%
Qatar	3.1	27.0	25.2	1.5%
Saudi Arabia	261.4	262.7	265.9	15.8%
United Arab Emirates	98.1	97.8	97.8	5.6%
Total Middle East	661.9	745.7	808.7	47.9%
Libya	22.8	39.1	48.5	2.9%
Nigeria	21.0	35.3	37.1	2.2%
Total Africa	61.2	106.2	130.6	7.7%
China	16.4	15.5	18.1	1.1%
Total Asia Pacific	38.8	40.5	42.1	2.5%
Total World	**1041.4**	**1334.1**	**1687.3**	**100%**
of which: OECD	140.8	247.5	249.6	14.7%
Non-OECD	900.6	1086.6	1437.7	85.2%
European Union#	8.1	8.0	6.8	0.4%
Former Soviet Union	60.1	96.8	130.9	7.8%
OPEC	774.9	912.1	1213.8	71.9%
Non-OPEC#	206.3	325.2	342.6	20.3%

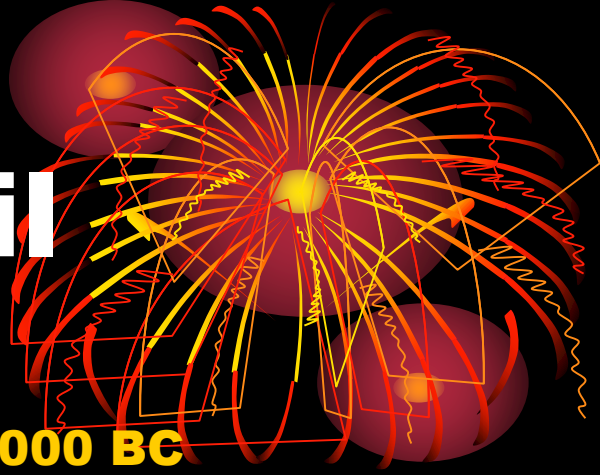
Natural gas

Proved reserves

	At end 1993 Trillion cubic metres	At end 2003 Trillion cubic metres	At end 2012 Trillion cubic metres	
US	4.6	5.4	8.7	4.7%
Canada	2.2	1.6	2.0	1.1%
Mexico	2.0	0.4	0.4	0.2%
Total North America	8.8	7.4	11.1	6.0%
Venezuela	3.7	4.2	5.6	3.0%
Total S. & Cent. America	5.4	6.8	7.7	4.2%
Kazakhstan	n/a	1.3	1.5	0.8%
Russian Federation	n/a	30.4	31.0	16.7%
Turkmenistan	n/a	2.3	17.5	9.4%
Total Europe & Eurasia	40.5	42.7	56.5	30.5%
Iran	20.7	27.6	33.6	18.1%
Iraq	3.1	3.2	3.6	1.9%
Kuwait	1.5	1.6	1.8	1.0%
Qatar	7.1	25.3	24.9	13.4%
Saudi Arabia	5.2	6.8	8.2	4.4%
United Arab Emirates	5.8	6.0	6.1	3.3%
Total Middle East	44.4	72.4	80.3	43.3%
Libya	1.3	1.5	1.5	0.8%
Nigeria	3.7	5.1	5.1	2.8%
Total Africa	10.0	13.9	14.4	7.8%
China	1.7	1.3	3.3	1.8%
Total Asia Pacific	9.3	12.7	15.2	8.2%
Total World	**118.4**	**155.7**	**185.3**	**100%**
of which: OECD	14.6	15.3	18.7	10.1%
Non-OECD	103.8	140.4	166.6	89.9%
European Union	3.7	3.2	1.6	0.9%
Former Soviet Union	35.3	36.9	52.8	28.5%

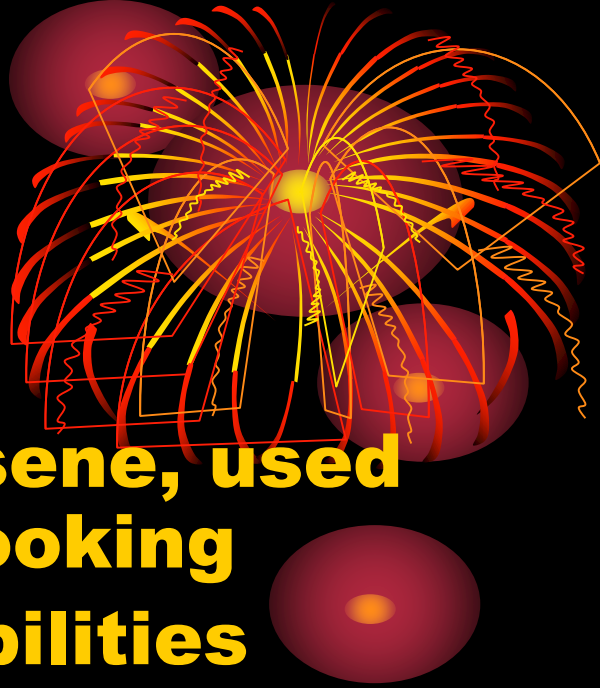
Source: BP Statistical review of world energy 2014 – full report

History of Oil



- Used as tar and asphalt as long ago as 4,000 BC
- Modern uses began in the 1850s
- Found by miners drilled for salt, sold as a healing aid. George Bissell used oil for lighting lamps and lubricating machinery, started Pennsylvania Rock Oil Company but left before credited for discovery. Edwin Drake credited with drilling the first oil well in Titusville, PA in 1859
- https://www.youtube.com/watch?v=-1gaOoLoCbU

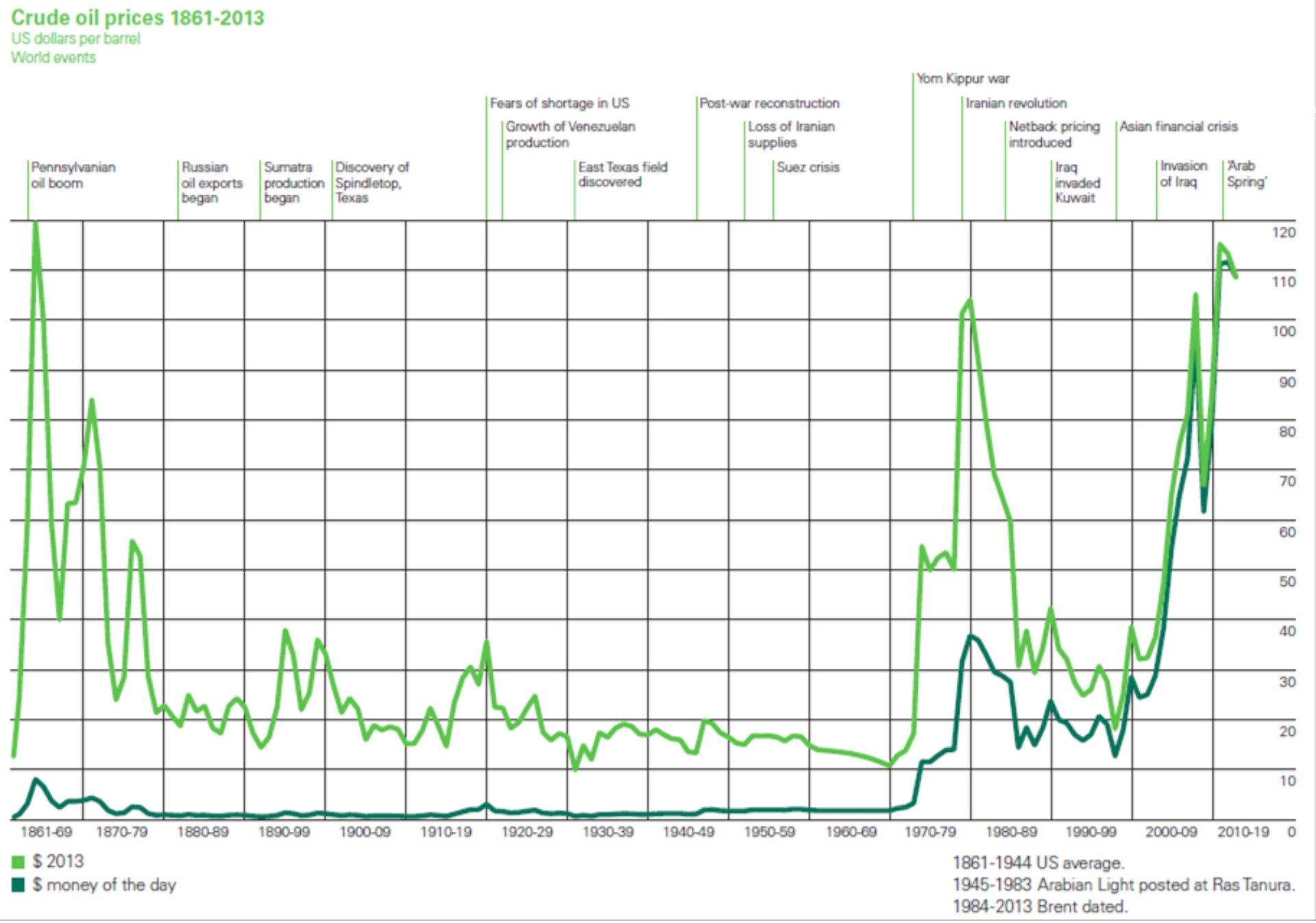
Use of oil



- Primary oil product – kerosene, used for lighting, heating and cooking
- Since 1920s refining capabilities grew, use of petroleum products grew
- Use of gasoline and diesel
- Lubricants, plastics, pharmaceuticals, fertilizers all made using the power of oil

The economy and oil

- The oil trade can control governmental policies
- Energy crisis of 1973-1974 – US importing lots of oil. OPEC (Organization of Petroleum Exporting Countries) stopped selling oil to the US to raise prices by restricting supply, and because US was supporting Israel in the Yom Kippur War. Oil prices skyrocketed, and was in high demand

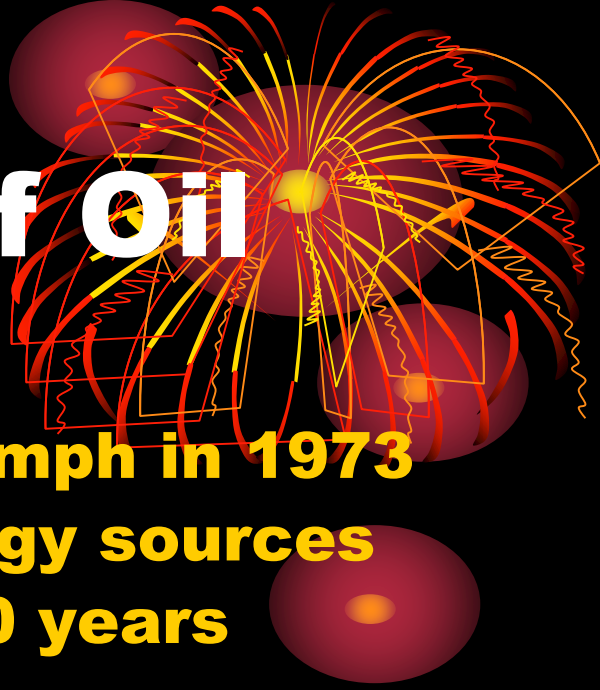


Source: BP Statistical review of world energy 2014 – full report

The economy and oil

- The United States government enacted a series of policies to reduce reliance on oil – increasing domestic sources, reopening closed sites, capping the price that domestic producers could charge, import oil from other sources

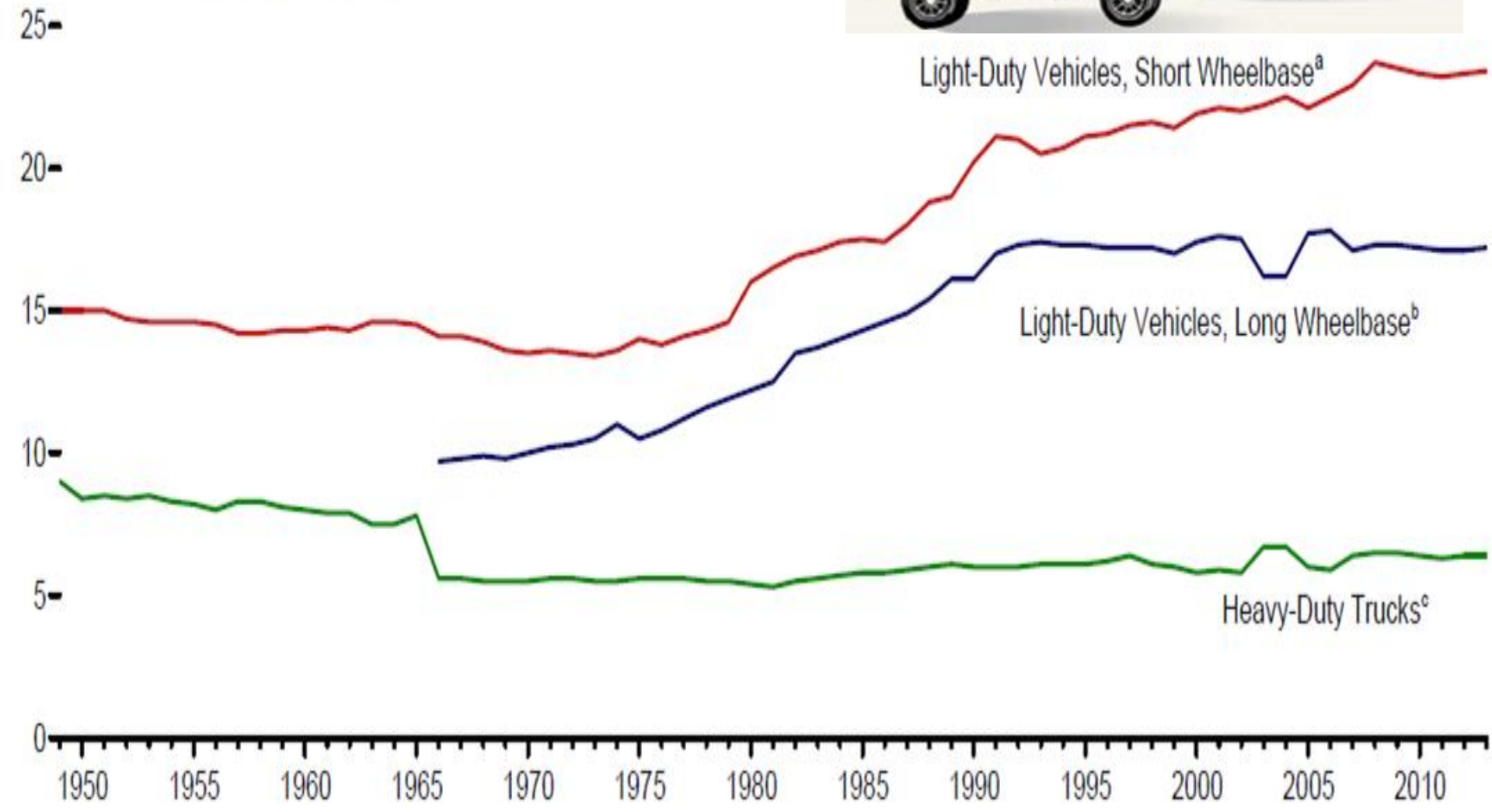
Conservation of Oil



- Reduction of speed limit to 55 mph in 1973
- Research in non-oil based energy sources
- Conservation policies in last 30 years have greatly decreased
- Decrease in funding for alternative energy sources
- Bill failed in Congress to make average mpg of cars 35
- Average fuel efficiency decreased by 2 mpg from 1988-2003 due to SUVs
- Newest changes?

Figure 1.8 Motor Vehicle Fuel Economy, 1949–2013

(Miles per Gallon)



Web Page: http://www.eia.gov/totalenergy/data/monthly/#summary.

Source: Table 1.8.

[a] Through 1989, data are for passenger cars and motorcycles. For 1990–2006, data are for passenger cars only. Beginning in 2007, data are for light-duty vehicles (passenger cars, light trucks, vans, and sport utility vehicles) with a wheelbase less than or equal to 121 inches.

[b] For 1966–2006, data are for vans, pickup trucks, and sport utility vehicles. Beginning in 2007, data are for light-duty vehicles (passenger cars, light trucks, vans, and sport utility vehicles) with a wheelbase greater than 121 inches.

[c] For 1949–1965, data are for single-unit trucks with 2 axles and 6 or more tires, combination trucks, and other vehicles with 2 axles and 4 tires that are not passenger cars. For 1965–2006, data are for single-unit trucks with 2 axles and 6 or more tires, and combination trucks. Beginning in 2007, data are for single-unit trucks with 2 axles and 6 or more tires (or a gross vehicle weight rating exceeding 10,000 pounds), and combination trucks.

How much is left?

- Always difficult to say for sure.
- Calculations suggest we are more than half way through world oil reserves (with current consumption levels).
- If we continue with current use of oil, there may be 40 years worth of oil left.
- But, proven reserves keep rising due to better technology; no way to take into account future discoveries/market forces.
- It may be hundreds/thousands of years before reserves start to run low.

Should we be concerned with using oil?

Constuction of roads and infrastructure fragment habitats. Vegetation and wildlife are damaged

Waste must be stored somewhere – what do you do with the sludge that is produced?

Animals are displaced and reproductive rates decrease.

What about oil spills, fires, trash build up, permafrost melts, off-road vehicle trails, and dust from roads?

Political, Social, and Economic Impacts on Fossil Fuels

- Foreign dependence means national economies vulnerable to supplies becoming unavailable or costly. Seller nations have great control over buying nations.

- Those that live in oil rich countries do not necessary benefit from that oil. The rich get richer and the poor get poorer

Spills: Deepwater Horizon

https://www.youtube.com/watch?v=mA3LLf5rp8M

Coal

- Most abundant fossil fuel.
- ¼ of the world's coal is located in the U.S.
- Has been used for thousands of years: fire pottery, cook food, and to heat homes.
- Commercial mining began in the 1700s and coal began to be widely used as a heating source.

Coal

- Expanded to the next growing market – steam engines. It was used to boil water to produce steam.
- The birth of the steel industry in 1875 increased demand even further because coal fueled the furnaces used to make steel.
- In the 1880s, people began to put coal to use in generating electricity. The coal combustion converts the water to steam, which turns a turbine to create electricity. Coal provided over half the electrical generating capacity in the U.S. in 2000 and supplied 43% of electrical power plants.

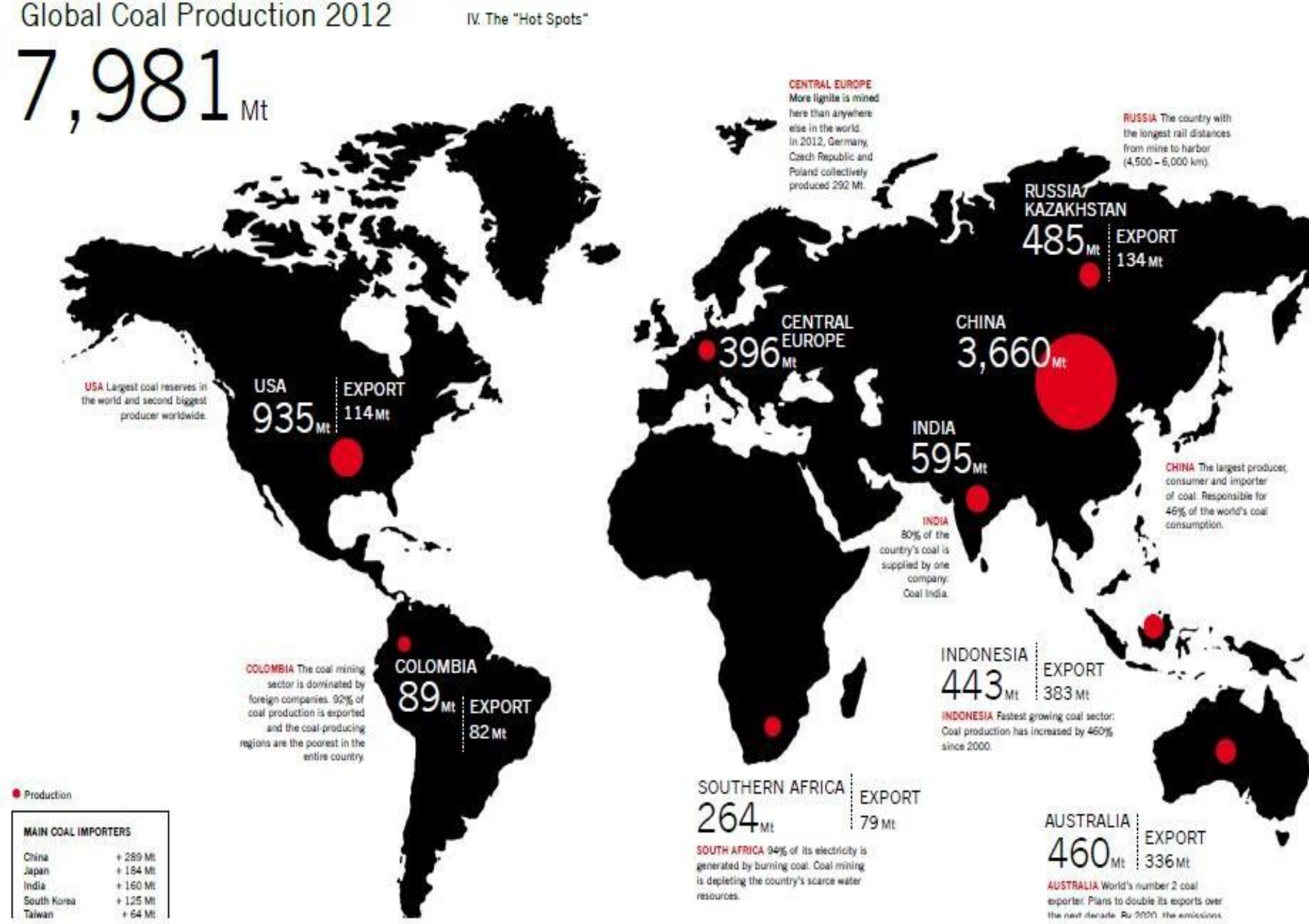
Table 17.4 Top Producers and Consumers of Coal

Production (% world production)	Consumption (% world consumption)
China, 29.5	China, 27.7
United States, 24.0	United States, 23.1
Australia, 7.7	India, 7.5
India, 7.1	Japan, 4.4
South Africa, 5.3	Russian Federation, 4.1
Russian Federation, 4.8	Germany, 3.5
Poland, 3.0	Poland, 2.4
Indonesia, 2.7	Australia, 2.1
Germany, 2.3	South Korea, 2.0
Ukraine, 1.8	Ukraine, 1.6

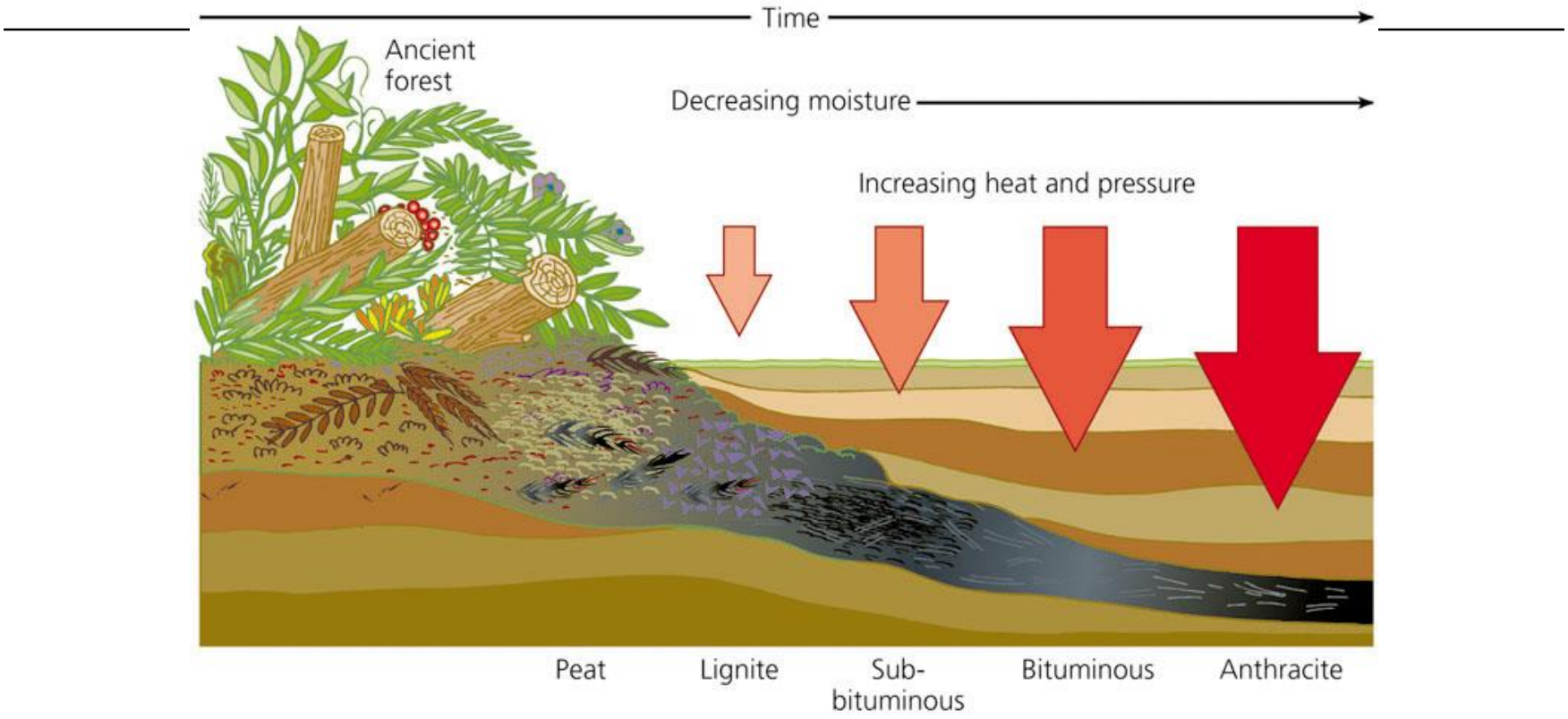
Data from British Petroleum, Statistical review of world energy, 2003.

Global Coal Production 2012

IV. The "Hot Spots"



How is it formed?

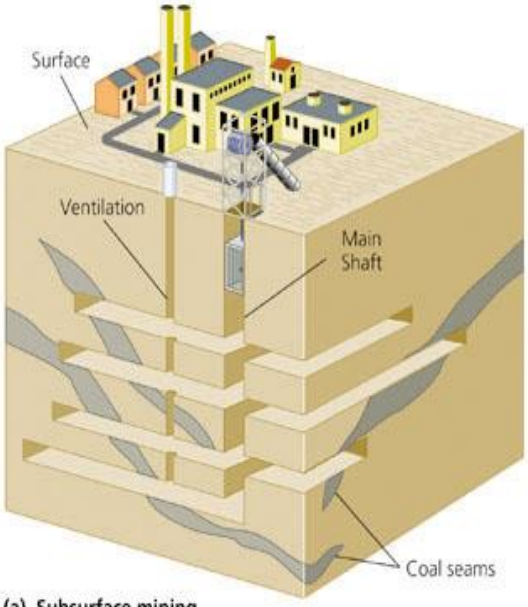


- Coal is formed as ancient plant matter is compacted below the ground. Scientists categorize coal into several different types, depending on the amount of heat, pressure, and moisture involved in its formation.

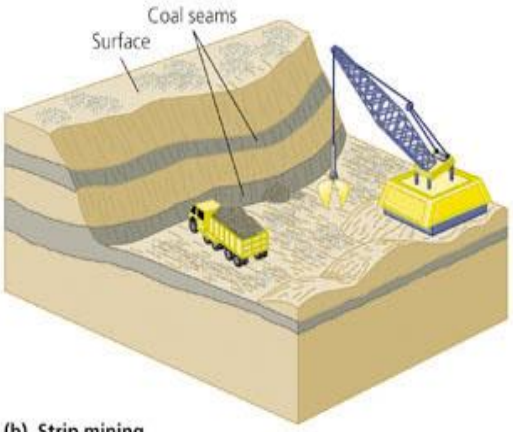
Types of Coal

- Coal is classified into four types; from least to most energy-rich: lignite, sub-bituminous, bituminous, and anthracite.
- The peat that makes up bogs in parts of the world represents plant matter that is minimally compacted.
- As peat further decomposes, as it becomes buried more deeply under sediments, as pressure and heat increase, and as time passes, water is squeezed out of the material, and carbon compounds are packed more tightly together, forming coal.
- Lignite is the least-compressed type of coal, and anthracite is the most-compressed.
- The greater the compression, the greater is the energy content per unit volume.

How do we get coal?



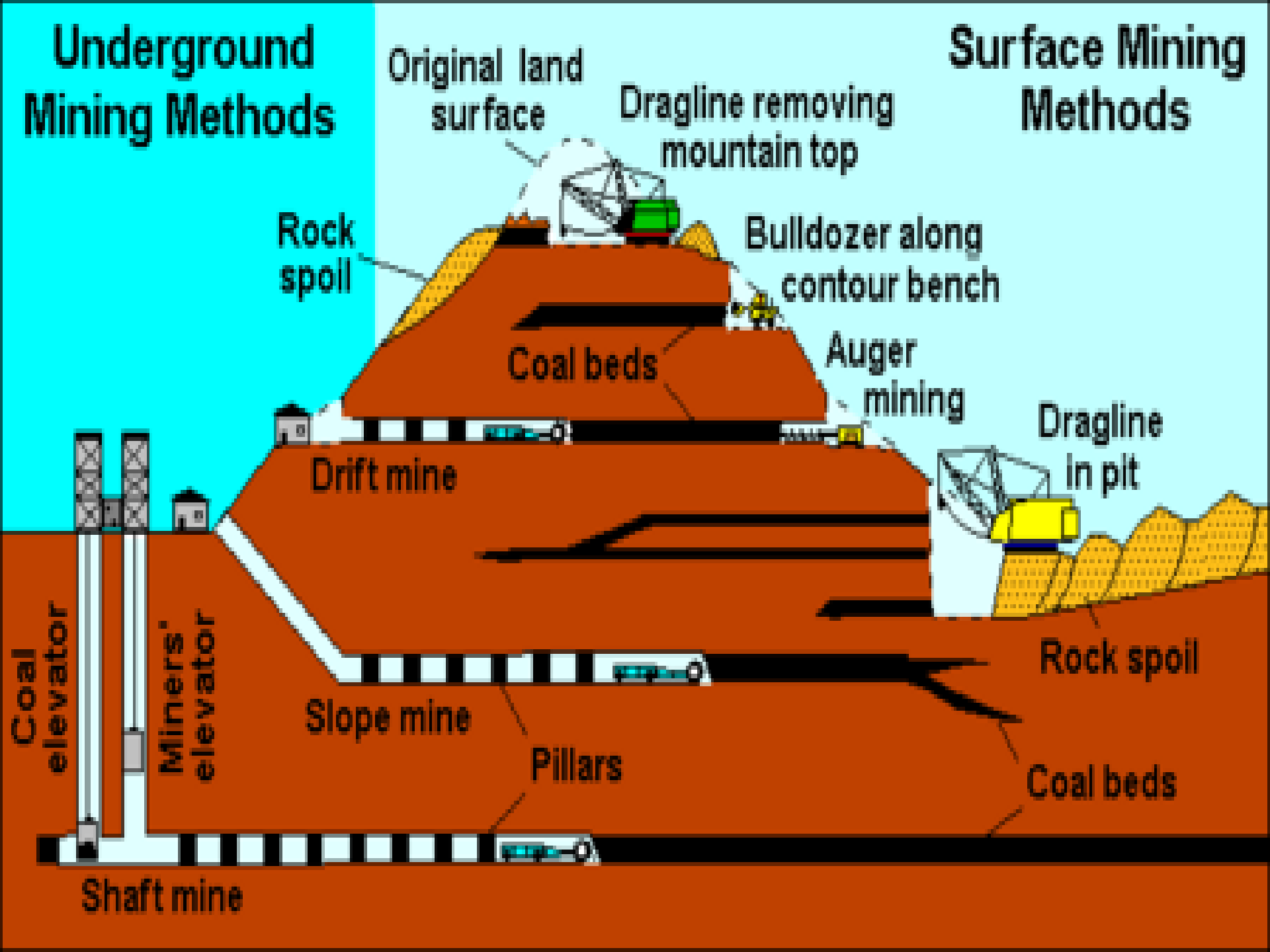
(a) Subsurface mining



(b) Strip mining

https://www.youtube.com/watch?v=ylkdUuNOJzw

https://www.youtube.com/watch?v=cWs3FzDIgUA


Underground Mining Methods
Original land surface
Dragline removing mountain top
Surface Mining Methods
Rock spoil
Bulldozer along contour bench
Coal beds
Auger mining
Dragline in pit
Drift mine
Rock spoil
Coal elevator
Miners' elevator
Slope mine
Pillars
Coal beds
Shaft mine

Concerns with Coal

Subsurface causes damage to land above, but strip mining is even more destructive to ground. Soil erosion and runoff into waterways occurs.

Mining is one of the most dangerous jobs in the US. Collapsing shafts is a huge concern, and inhaling the dust can lead to black lung disease.

https://www.youtube.com/watch?v=MCsAI6ItU60https://www.youtube.com/watch?v=MCsAI6ItU60

Natural Gas

- The fastest growing fossil fuel.
- It now provides for ¼ of global commercial energy consumption.
- Has been long known, but used in homes just recently.
- The first commercial extraction of natural gas took place in 1821, but during much of the 19th century it was localized because technology did not exist to pipe gas safely.

Natural Gas

- It was used to fuel lamps along city streets, but when electric lights replaced most gas lamps in the 1890s, gas companies began marketing gas for heating and cooking.
- The first long distance pipeline was built in 1891 to carry gas from deposits in Indiana to homes 120 miles away in Chicago.
- Natural Gas did not replace coal until after WWII, when wartime improvements in welding and pipe-building made the transport of gas safer and more economical.
- During the 1950s and 1960s, thousands of miles of underground pipelines were laid throughout the U.S.

How is it formed?

- Biogenic gas is created at shallow depths by the anaerobic decomposition of organic matter by bacteria. (pure methane) An example is the “swamp gas” you can sometimes smell when stepping in the muck of a swamp.
- Thermogenic gas is formed at deep depths as geothermal heating separates hydrocarbons from organic material. (methane and other hydrocarbons) Thermogenic gas may be formed directly, along with crude oil, or may be formed from crude oil that is altered by heating.

Table 17.5 Top Producers and Consumers of Natural Gas

Production (% world production)	Consumption (% world consumption)
Russian Federation, 22.0	United States, 26.3
United States, 21.7	Russian Federation, 15.3
Canada, 7.3	Great Britain, 3.7
Great Britain, 4.1	Germany, 3.3
Algeria, 3.2	Canada, 3.2
Indonesia, 2.8	Japan, 3.1
Norway, 2.6	Ukraine, 2.8
Iran, 2.6	Iran, 2.7
Netherlands, 2.4	Italy, 2.5
Saudi Arabia, 2.2	Saudi Arabia, 2.2

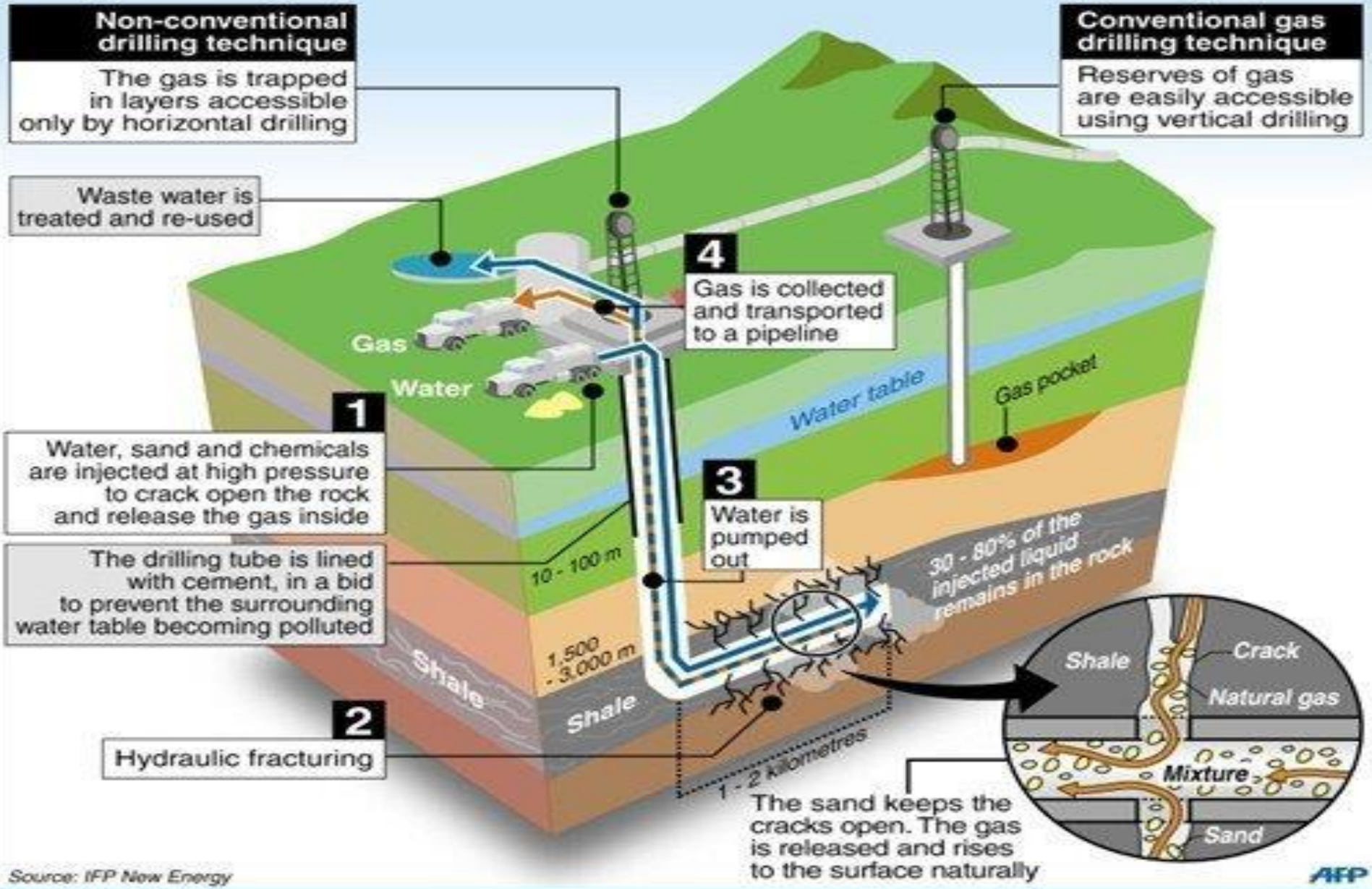
Data from British Petroleum, Statistical review of world energy, 2003.

Challenging Extraction

- To access natural gas you need to drill only an opening to allow the gas to flow to the surface.
- Most fields remaining today have to be pumped to Earth's surface.
- Many of the reserves are already exhausted, so they have to come up with other means of extracting the gas.
- Sophisticated techniques to break into gas containing rock formations and pump gas to the surface. One such technique is to pump salt water under high pressure into the rocks to crack them (ie fracking)

Shale gas extraction

Hydraulic fracturing uses high-pressure injections to crack open rock and release oil and gas. Opponents say it may pollute ground water and trigger earthquakes. It is banned in several countries.



Source: IFP New Energy

AFP

What is fracking?

Hydraulic fracturing, or fracking, is a method of forcing natural gas or oil from rock layer deep below the Earth's surface.

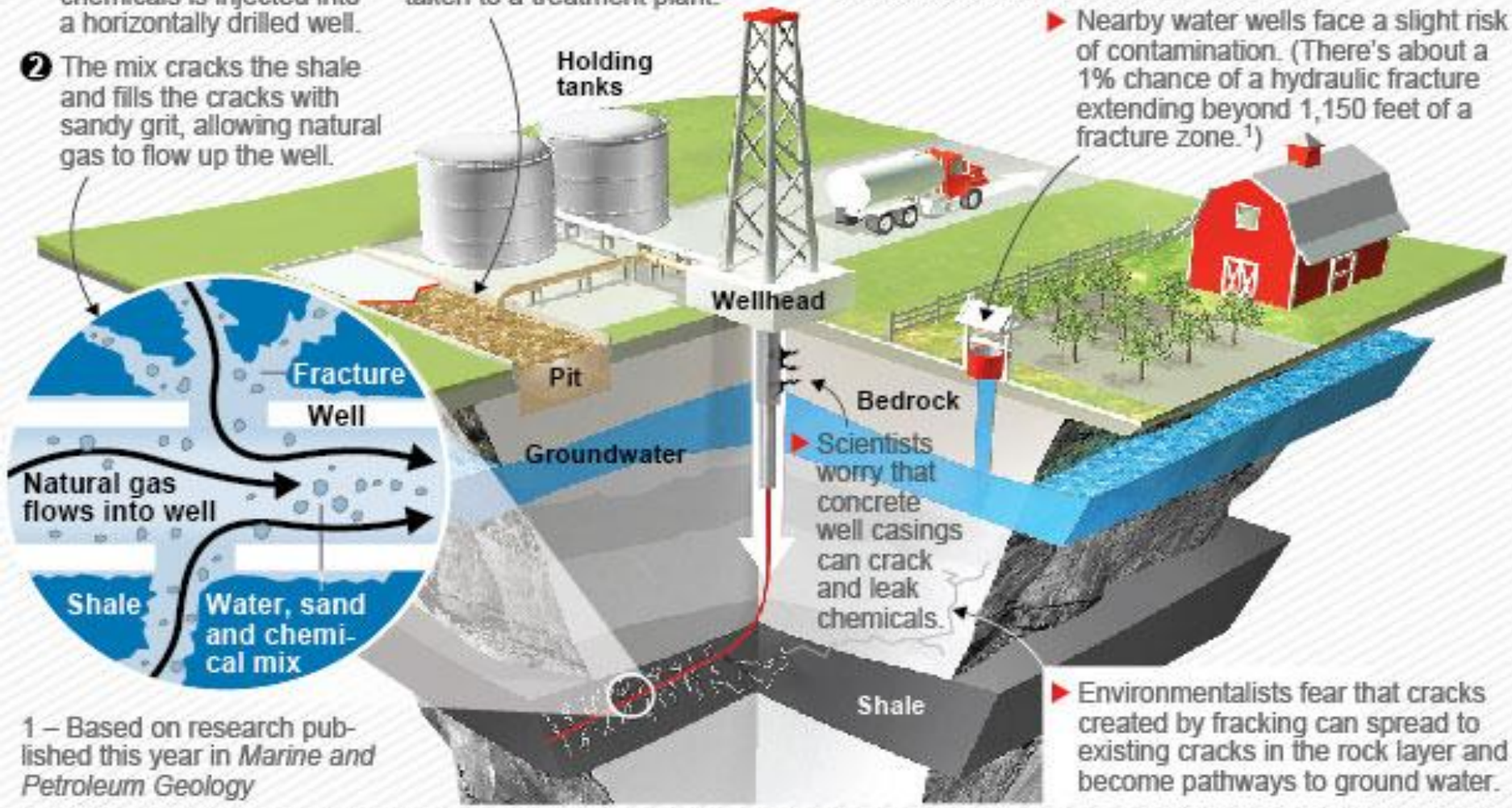
How fracking works ...

1. A pressurized mixture of sand, water and chemicals is injected into a horizontally drilled well.
2. The mix cracks the shale and fills the cracks with sandy grit, allowing natural gas to flow up the well.
3. The recovered water is stored in lined pits or taken to a treatment plant.

... and why it's controversial

Much of the water used in fracking is collected from the well and processed, but some communities have raised concerns that potentially carcinogenic chemicals can escape into drinking water.

- Nearby water wells face a slight risk of contamination. (There's about a 1% chance of a hydraulic fracture extending beyond 1,150 feet of a fracture zone.[1])
- Scientists worry that concrete well casings can crack and leak chemicals.
- Environmentalists fear that cracks created by fracking can spread to existing cracks in the rock layer and become pathways to ground water.



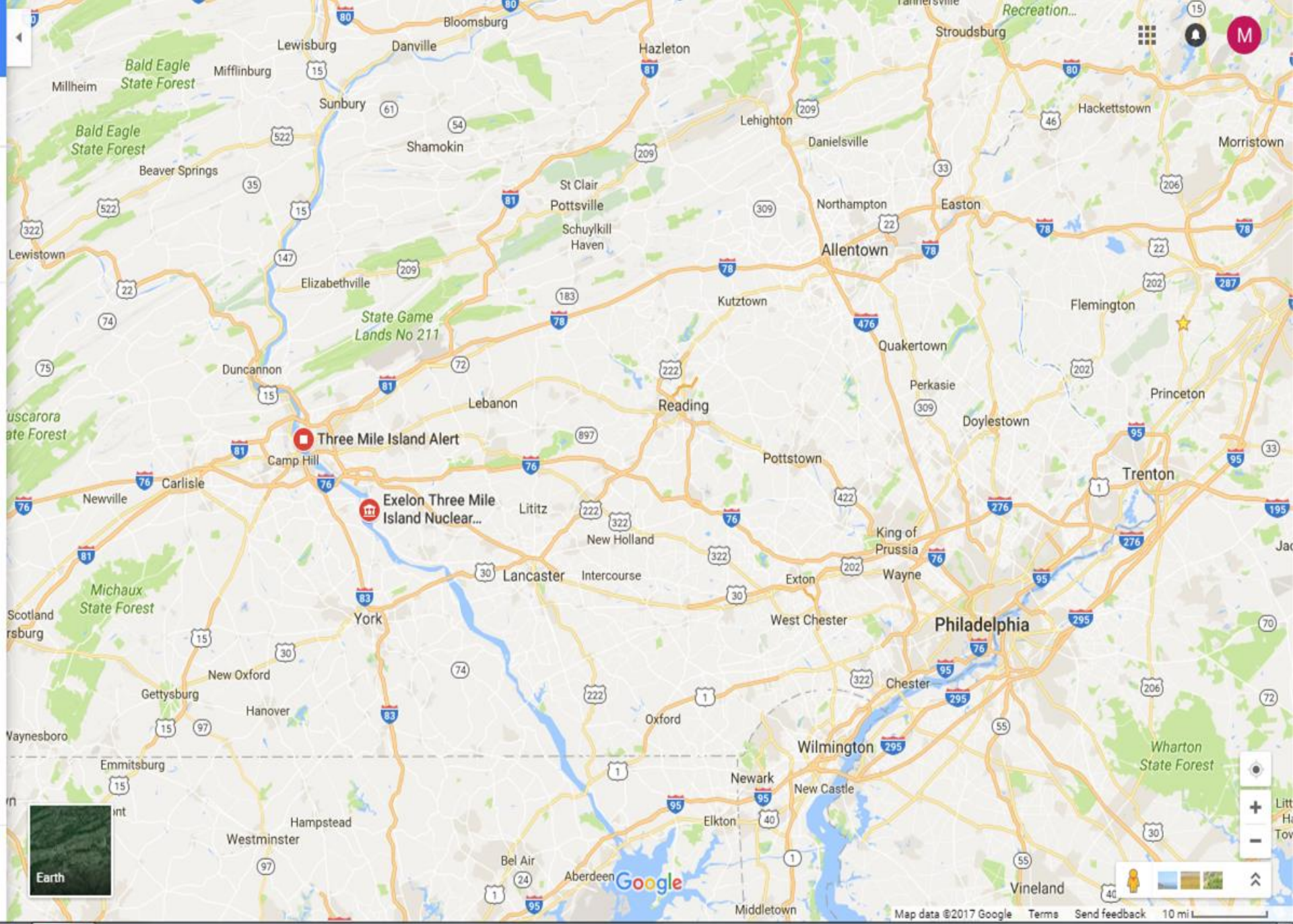
1 – Based on research published this year in *Marine and Petroleum Geology*

Sources: Duke University; U.S. Energy Information Administration; National Research Council; *Marine and Petroleum Geology*

By Dan Vergano and Karl Gelles, USA TODAY

Nuclear Problems

- The possibility of catastrophic accidents has created a great deal of public anxiety about nuclear power.
- In 1979 a partial meltdown at the Three Mile Island nuclear power plant in PA released radiation into the environment, necessitating evacuation of area residents and causing public harm.
- Then in 1986 an explosion at Chernobyl plant in Ukraine caused the most severe nuclear accident yet recorded. Many thousands of area residents died or became ill from radiation poisoning, several hundred thousand people were evacuated from their homes, and radioactive contamination spread over Ukraine, Russia, eastern and northern Europe, and beyond. The region around Chernobyl remains contaminated today.



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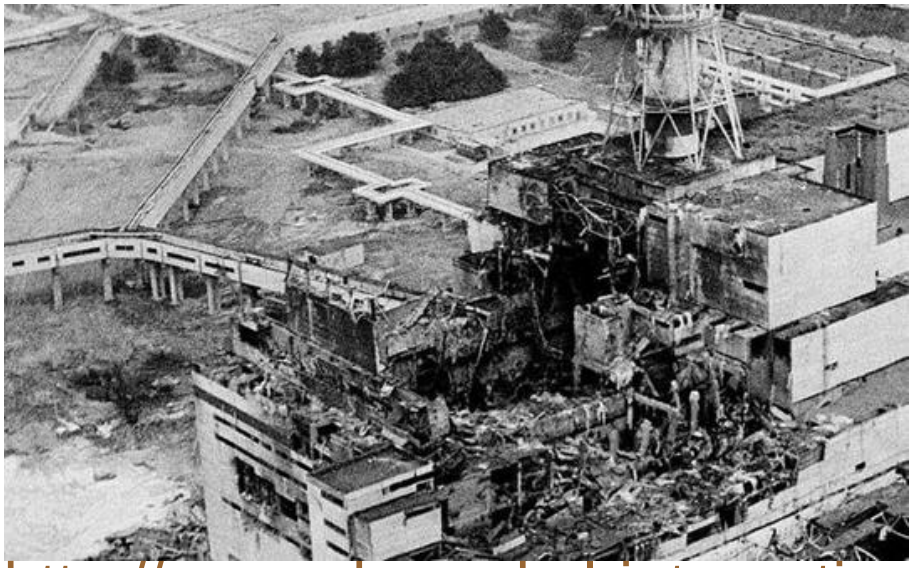
NUCLEAR ACCIDENT AT THREE MILE ISLAND
On March 28, 1979, and for several days thereafter -- as a result of technical malfunctions and human error -- Three Mile Island's Unit 2 Nuclear Generating Station was the scene of the nation's worst commercial nuclear accident. Radiation was released, a part of the nuclear core was damaged, and thousands of residents evacuated the area. Events here would cause basic changes throughout the world's nuclear power industry.
PENNSYLVANIA HISTORICAL AND MUSEUM COMMISSION
1999

Chernobyl Incident, Ukraine, 1986

https://www.youtube.com/watch?v=XJAIIiq2G-o&t=5s



http://www.chernobyl-international.com/about-chernobyl/

Concerns continue...

Fukushima Accident, March 11, 2011

- 9.0 earthquake, tsunami followed.
- No power and no cooling of reactors, 4 reactors damaged/leaked into water
- No immediate deaths, but concern continues about future cancer related deaths
- Company admitted fault in lack of evacuation plans, preparation for events