تشريعات الطاقة والواقع البيئي

المستوى الرابع

قسم علوم الطاقة المتجددة

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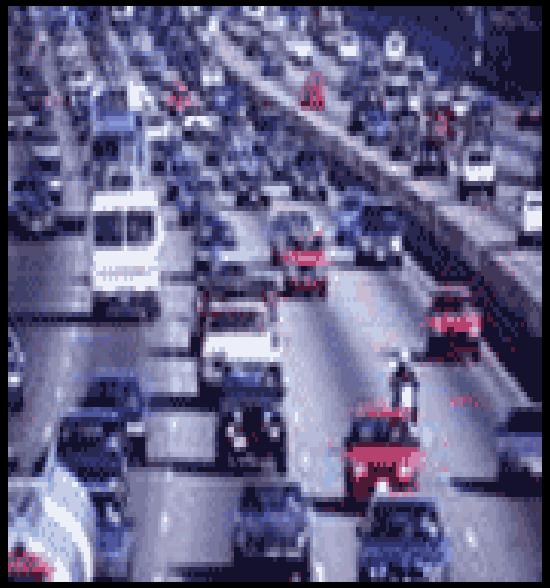
Introduction

EGEE 102 – Energy Conservation And Environmental Protection

Course Objectives

- The objective of the course is to apply energy efficiency concept in day to day life in order to save Money and Energy and thereby protect the Environment.
  - By obtaining necessary knowledge and information on the main operating principles of devices/appliances that are in common use and information on which to make the right decision in selecting the most energy efficient and economical choice

Day-to-Day Energy Use

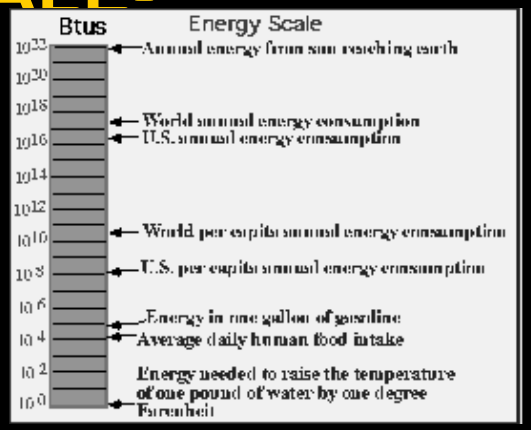


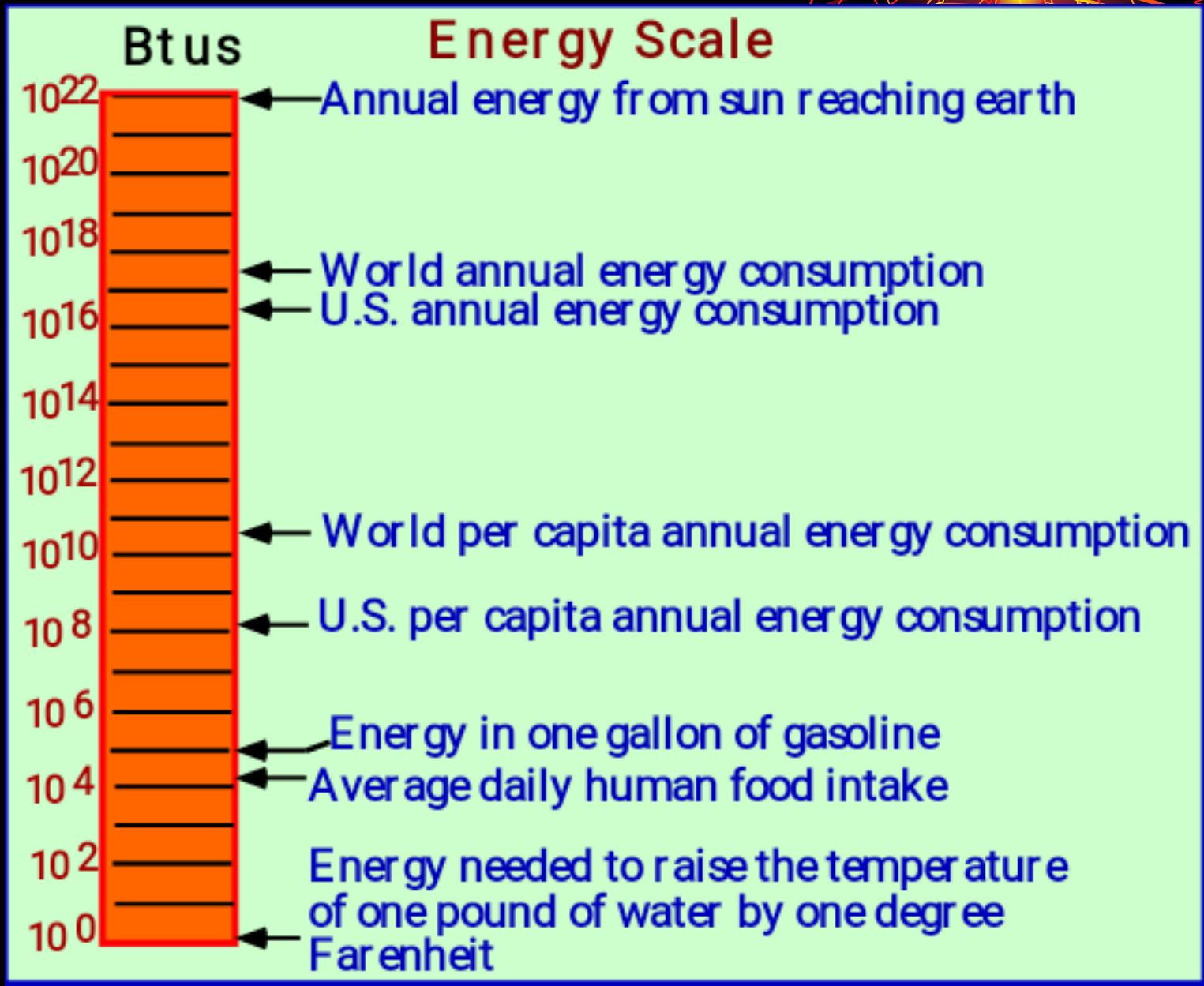
What is Energy?

- "Energy is a property of matter that can be converted into work, heat or radiation.

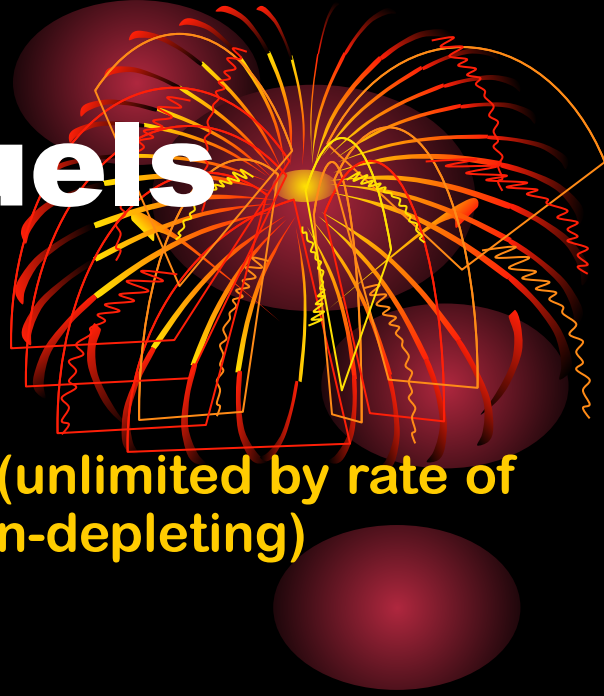
Energy Scale

- BTU-One BTU is the equivalent to the energy required to raise the temperature of one pound of water by one degree Fahrenheit.
- ENERGY SCALE-




Energy Scale
Btus
10^{22}
10^{20}
10^{18}
10^{16}
10^{14}
10^{12}
10^{10}
10^{8}
10^{6}
10^{4}
10^{2}
10^{0}
Annual energy from sun reaching earth
World annual energy consumption
U.S. annual energy consumption
World per capita annual energy consumption
U.S. per capita annual energy consumption
Energy in one gallon of gasoline
Average daily human food intake
Energy needed to raise the temperature of one pound of water by one degree Farenheit

Energy Source-Fuels Classification



Non renewable (limited in quantity or depleting)

Fossil Fuels

Coal

Natural Gas

Petroleum

Oil Shale

Tar Sands

Nuclear Fission

Renewable (unlimited by rate of use or non-depleting)

Solar

Hydro

Wind

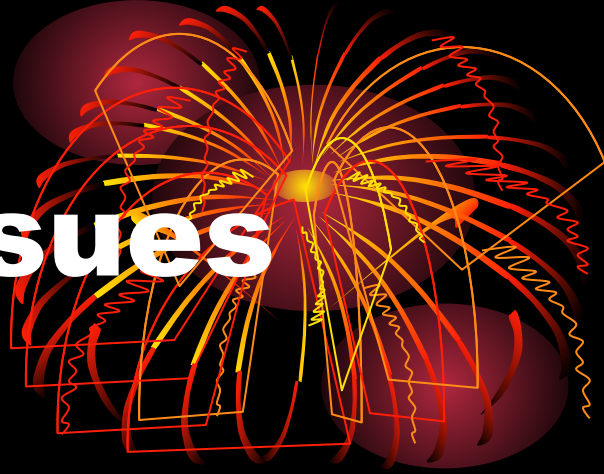
Tidal

Biomass

Nuclear Fusion

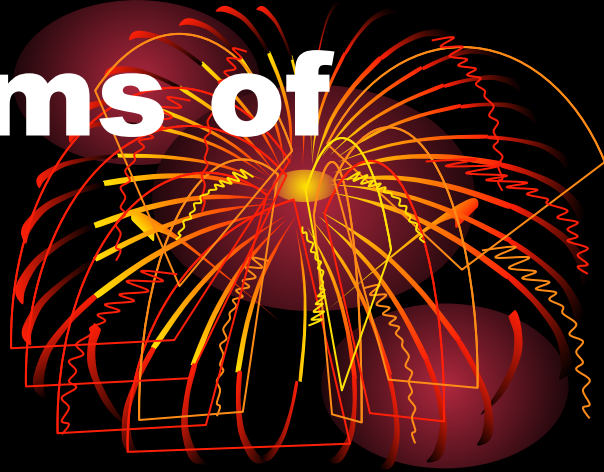
World Fossil Fuel Distribution

Environmental Issues



- Energy and Environment
  - Greenhouse effect and global warming
  - Ozone Layer Destruction
  - Acid Rain Formation
  - Radiation and Health

Fundamental Forms of Energy



- Mechanical Potential and kinetic
- Heat
- Radiant - Sun Light
- Electrical
- Chemical - Food we eat and a tank of gasoline
- Nuclear - Nuclear Reactor, Bombs used in war

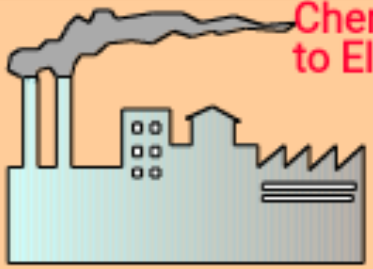
Energy Measurement

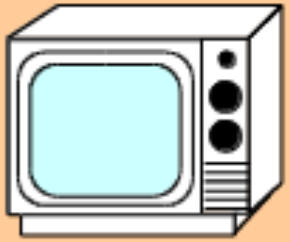
- Units
  - BTUs
  - Calories
  - calories
  - kWh
  - Joules
- One can be converted to another if the conversion factor is known

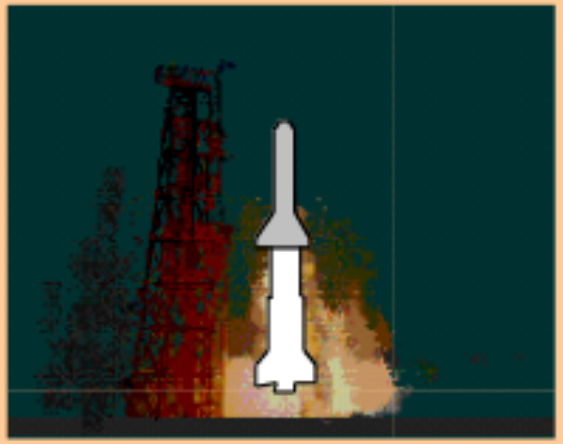
Conversion Factors

- 1055 Joules = 1 Btu
- 1 Calorie = 1,000 calories
- 1kWh = 3,412 Btus

Energy Transformations



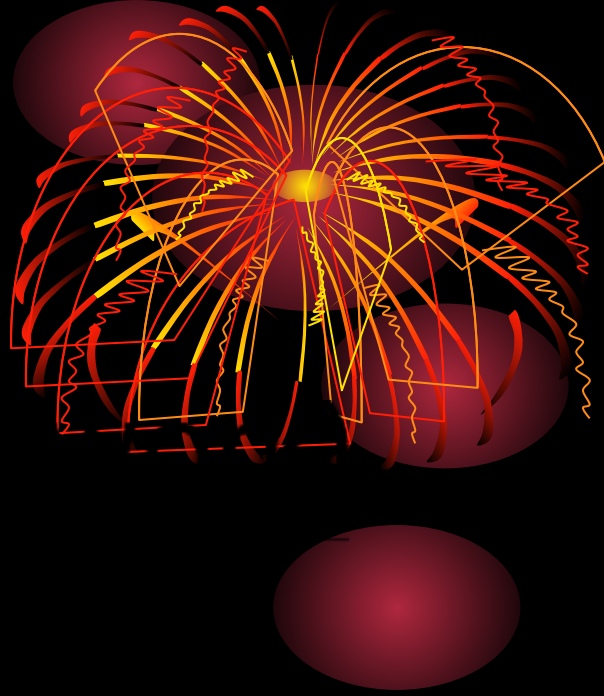




Energy Conversion Devices

Energy Input	Energy Output
	Hair Dryer
	Lawn Mover
	Trees
	Solar
	Automobile

Power



- Energy is the capacity to do work
- Power is the rate at which work is done
- Unit 1 watt= 1 J/s = 3.412 Btu/h

Unit of Power is watt (W) defined as

$$1 \text{ Watt} = 1 \frac{\text{J}}{\text{s}}$$

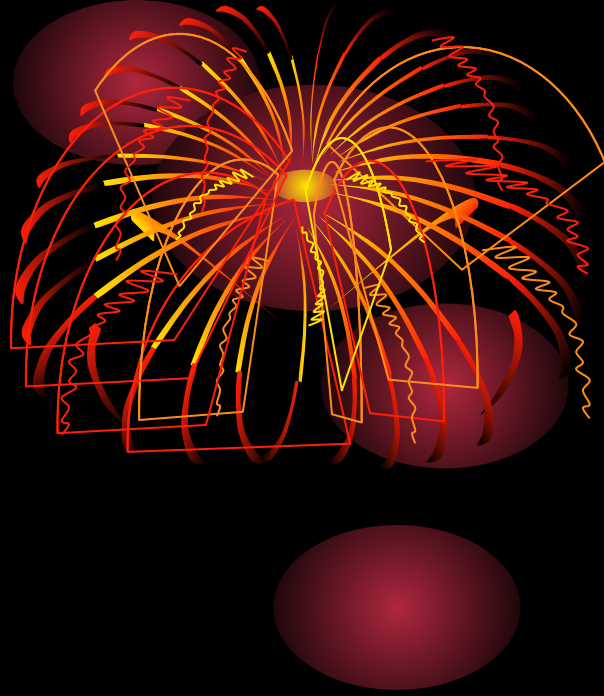
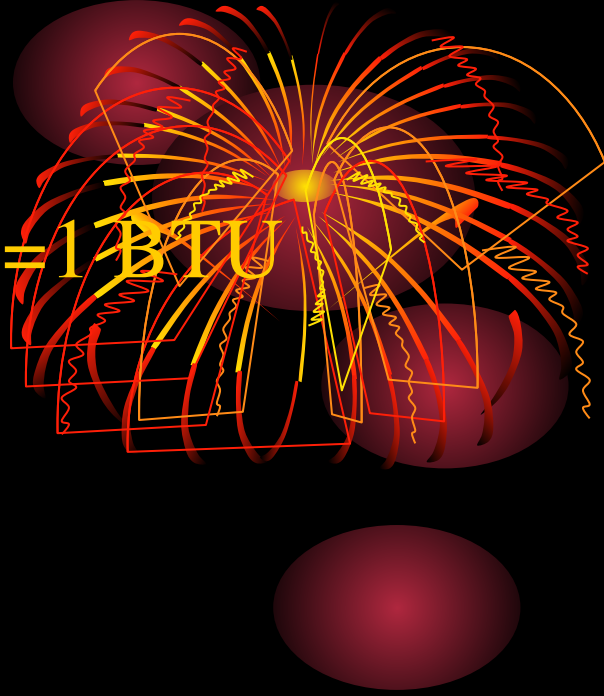


Illustration-1

On a winter day a home needs 1 x 10^9 BTU of fuel energy every 24 hours to maintain the interior at 65ºF. At what rate is the energy being consumed in watts?

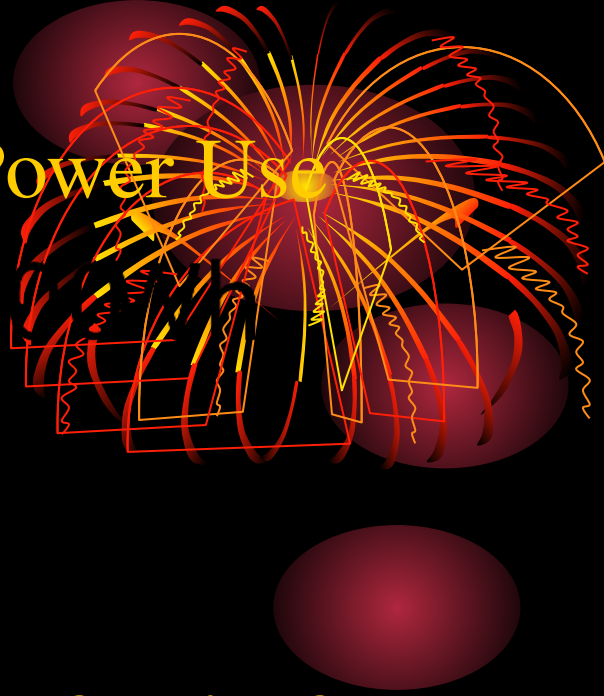
Recall that Watt=J/s and 1,055J=1 BTU



Illustration

- A 100W light bulb is left accidentally on overnight (8 hours). How much energy does it consume ?
- And how much money does this cost, if electricity cost 10 cents per Kilowatt hour?

Energy Use = Power x Time of Power Use



Cost of the Energy = Energy Used x Cost of Unit of Energy

Calculation of Money Made

Person	Wage Rate (power)	Hours Worked (time)	Total Amount (Energy)
A	$7/h	10	$70
B	$20/h	10	$200
C	$50/h	20	$

Calculation of Your Energy Consumption

- List the appliances that you use at home. Note down their power consumption and estimating the time of usage, calculate approximate energy consumption for a month.
  - Electric bulbs (number of bulbs)
  - Refrigerator
  - Washer
  - Dryer
  - Dishwasher etc.

ENERGY RESOURCES (NON – RENEWABLES)

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CONTENTS

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NATURAL RESOURCES

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What are natural resources?

What are some examples of natural resources and what are they used for?

What can nations try to do if they don't have all the natural resources they need?

NATURAL RESOURCES

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Natural resources – natural substances required by humans for different needs.

Natural resources

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Natural resources are any kind of natural substance which is required (or desired) by humans. Different natural resources are not equally spread out across the Earth, as a result, countries must trade their natural resources to ensure that their needs can be met.

Discuss why different types of natural resource are important e.g. minerals and metals like iron, gold, copper, silicon, cobalt etc. are used as building materials and in technology such as computers, smartphones and cars, forests and rainforests are used for timber and medicines as well as being important habitats for thousands of species of animals, plants and fungi, crops like wheat, vegetables and fruits are grown for food, water is used for drinking, washing, and generating energy, animals such as fish are caught for eating, fossil fuels like coal, oil and gas are burnt for energy.

ENERGY RESOURCES

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What are energy resources?

What are some of the different types of energy resource?

ENERGY RESOURCES

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Wind

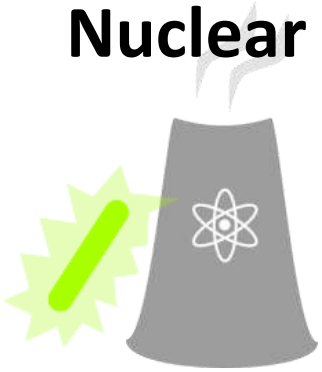
Biofuel

Coal

Solar

Natural gas

Nuclear



Biomass

Geothermal

Hydroelectric

Energy resources

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- Energy resources such as oil, gas, coal, wood, wind, waves, sunlight, heat from the ground (geothermal) are all types of natural resources. They can be used to produce heat and electricity.

- A country's energy mix is the specific combination of different energy sources a country uses to meet its energy consumption needs. At present in the UK we use a mixture of non-renewable and renewable energies. Non-renewable energy resources are finite and cannot be easily replaced, we as a planet are using them up faster than they are being made so they will inevitably run out.
- Renewable energy resources will not run out or can be easily replaced, so economies are trying to move towards greater reliance on renewable energy sources.

NON-RENEWABLE & RENEWABLE

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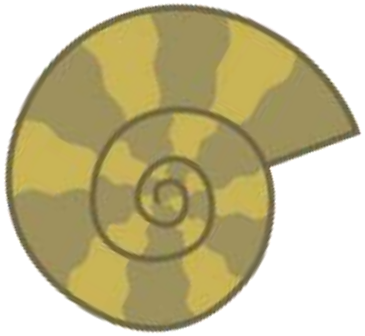
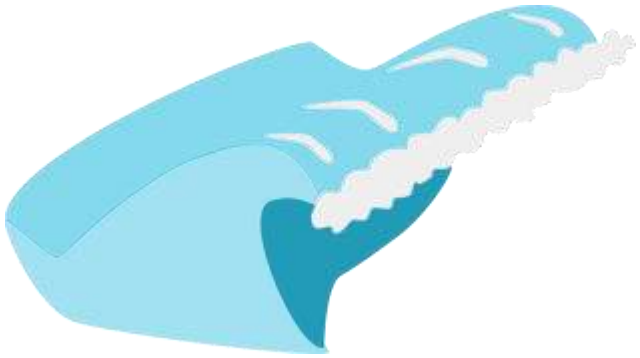
What is a <u>renewable energy</u> resource?



What is a <u>non-renewable</u> energy resource?



NON-RENEWABLE & RENEWABLE

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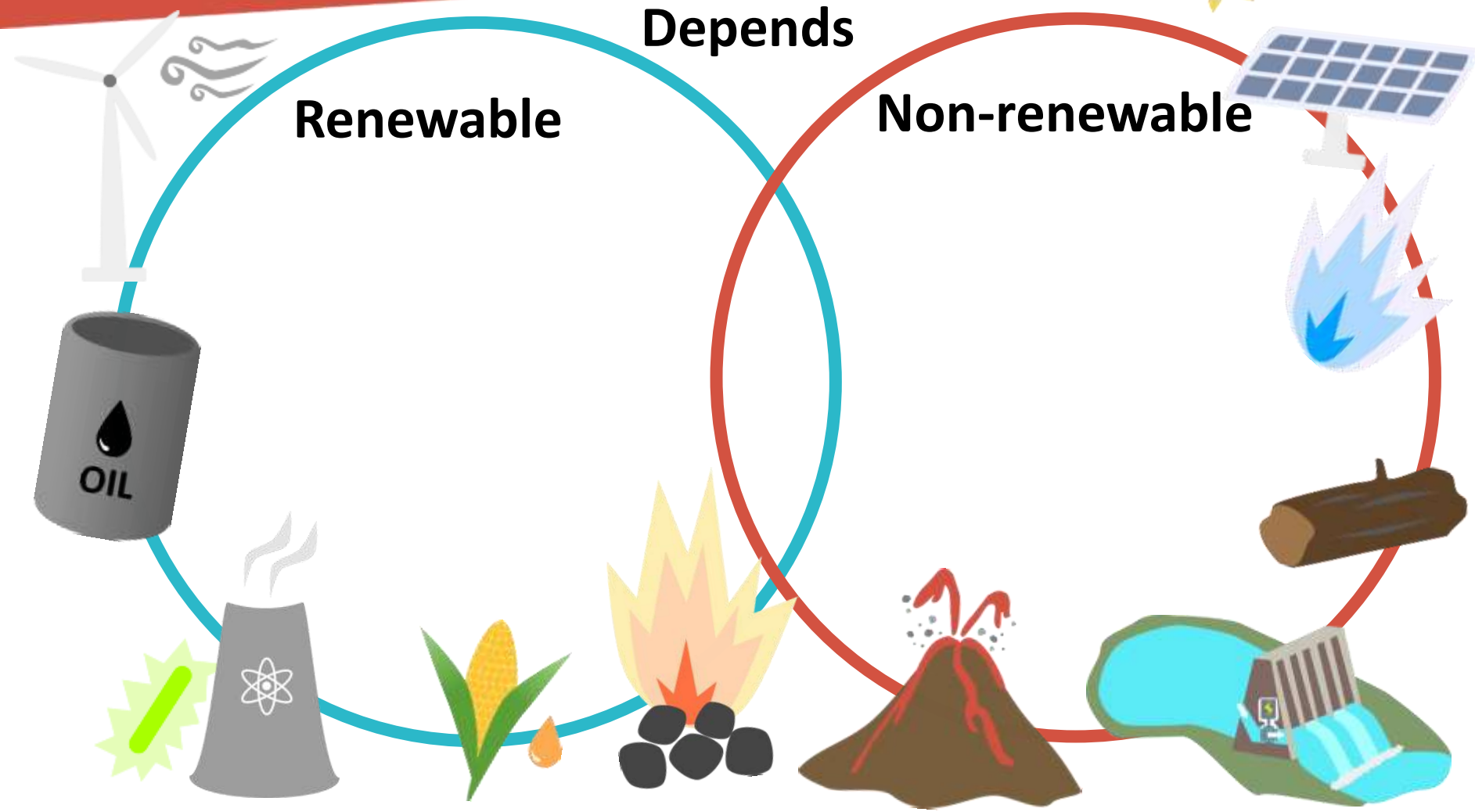

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- Discuss which of the resources are renewable and non-renewable. Is wood (biomass) a renewable or non-renewable resource? Yes and no - wood can be a renewable resource but only if all the trees that are chopped down are replanted otherwise it is non-renewable. Note that renewable doesn't necessarily mean no carbon dioxide emissions – burning biofuel and wood releases CO_2 (but these plants also take CO_2 when they are growing though photosynthesis), in the process of building hydroelectric dams and wind turbines non-renewable energy sources must be used (at present). Can students think of any other energy resources not on this slide? (wave power, tidal power, hydrogen fuel, tar sands, shale gas)

ENERGY CONSUMPTION BY FUEL (WORLD)

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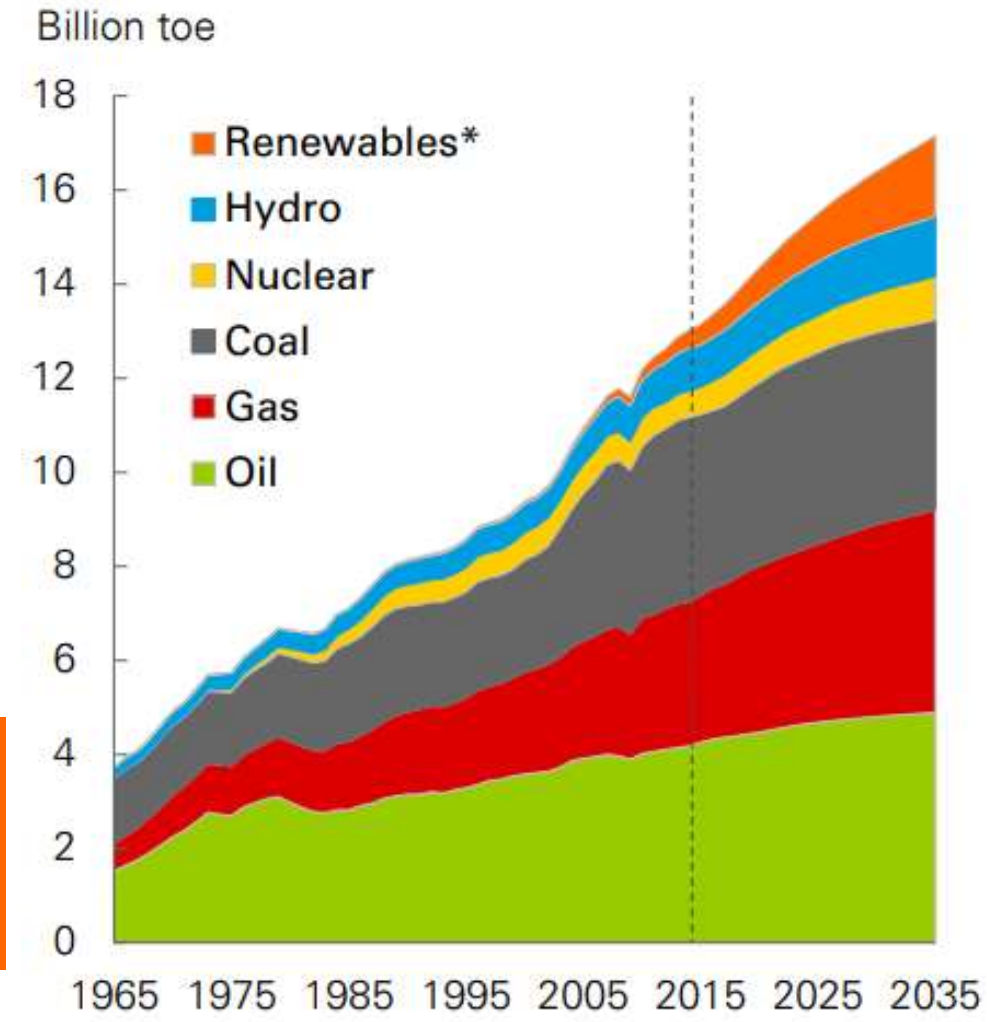

***renewables includes wind, solar, geothermal, biomass and biofuels**

Billion toe = billion tonnes of oil equivalent

BP 2017 Energy Outlook

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- Graph of global energy consumption from BP 2017 Energy Outlook. Renewables in orange includes wind, solar, geothermal, biomass and biofuels.

- Discuss what the current dominant sources of energy are and how this are projected to change in the near future - in 2035 oil, gas and coal are still predicted to account for more than 75% of total energy supplies, however hydroelectric power, nuclear and renewables are predicted to increase.

- There is a dip in the graph for energy consumption in 2009 why might this be? - global recession caused demand for energy to shrink – for the world as a whole, primary energy consumption fell by 1.1% in 2009 (BP Statistical Review of World Energy).

NON- RENWABLES

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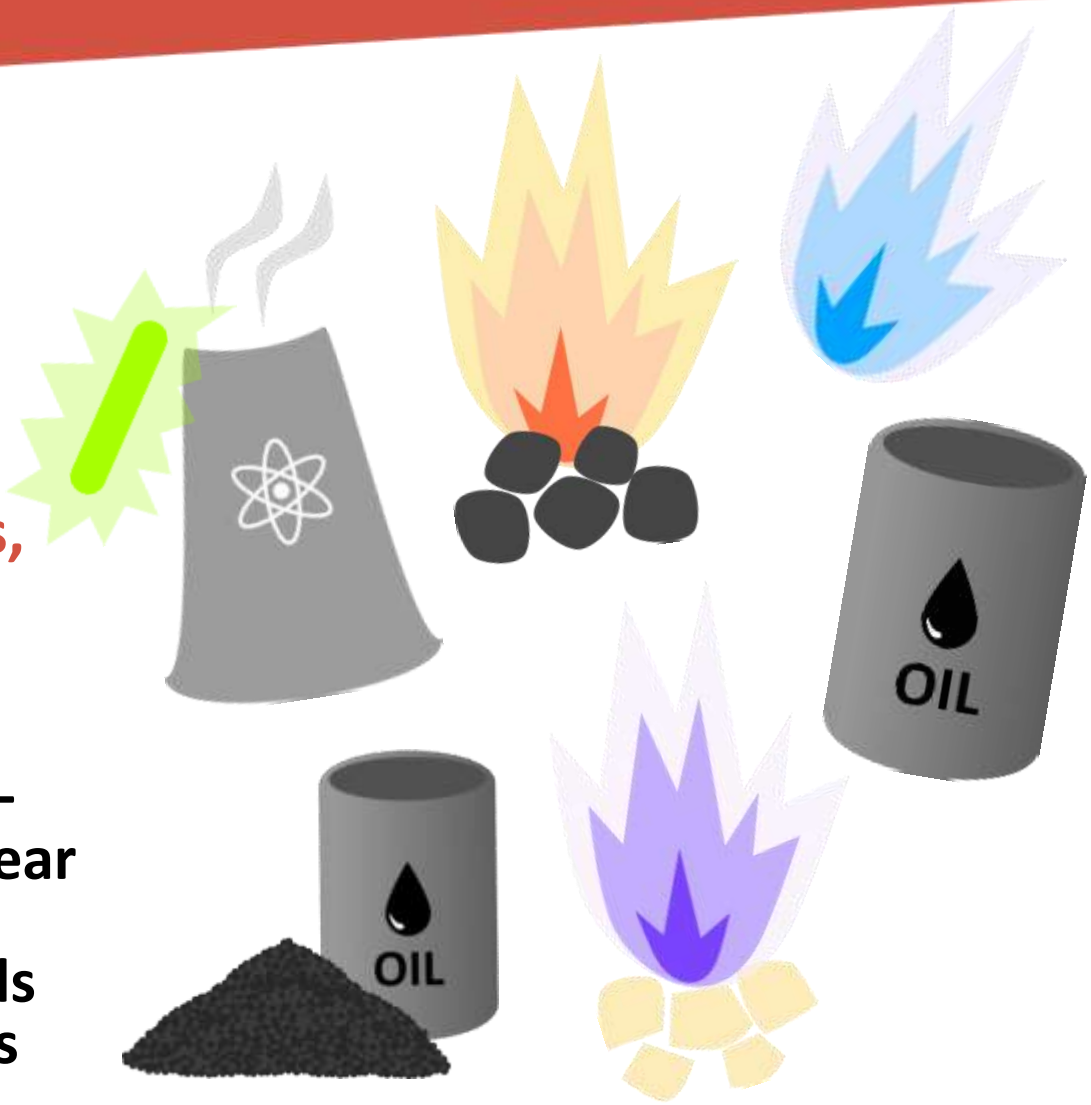
- Oil
- Natural gas
- Coal
- Nuclear
- Unconventional non-renewables: tar sands, methane hydrates.



Non-renewable energy sources include the conventional fossil fuels – coal oil and gas, and nuclear energy. It also includes unconventional fossil fuels such as methane hydrates and tar sands.

OIL & GAS FORMATION

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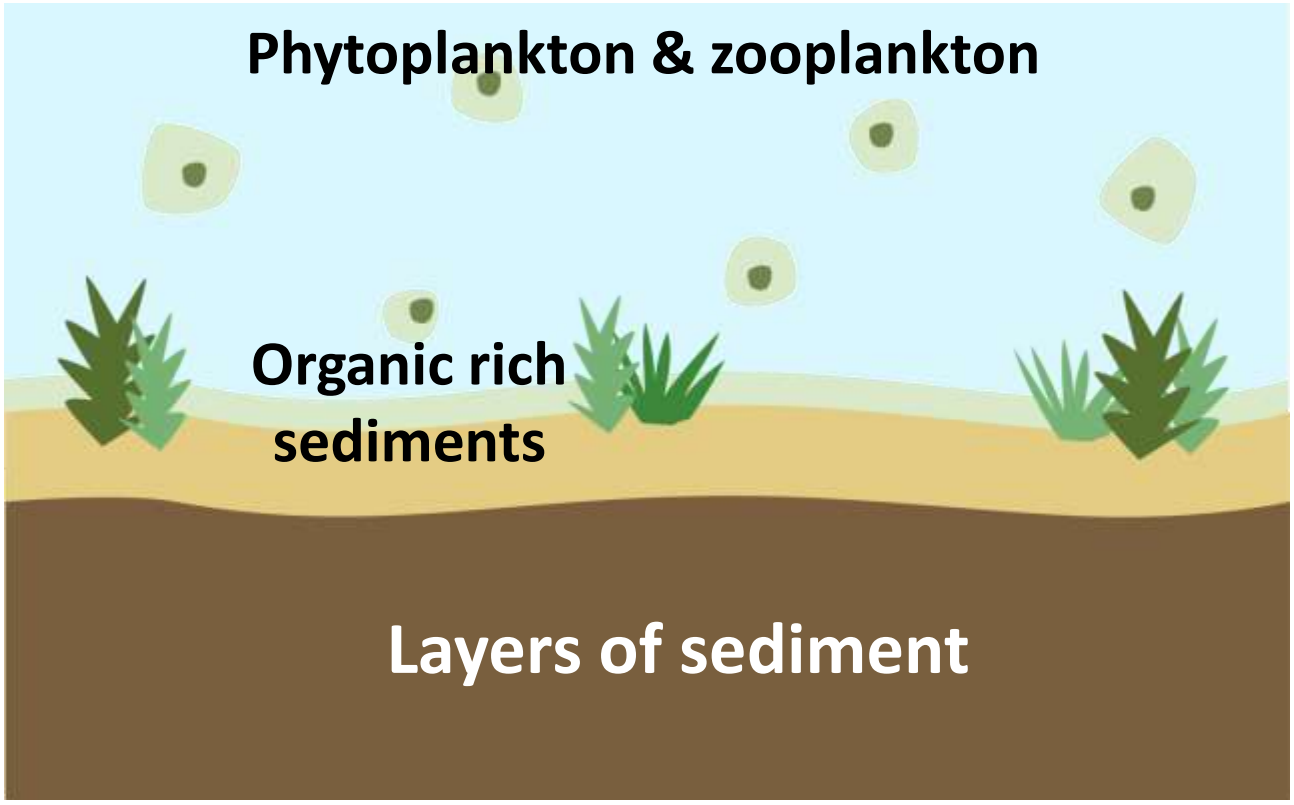

- **Crude oil** and **natural gas** are formed from **phytoplankton** and **zooplankton**
- Microorganisms sink to the bottom of the ocean when they die forming layers of **organic rich sediment**
- High primary production, stagnant, stratified water column, lack of sea floor decomposers, low oxygen (anoxic) = good conditions for forming oil and gas source rocks

Crude oil and natural gas are hydrocarbons formed from organic matter – phytoplankton (plant plankton) and zooplankton (animal plankton).

Oil and gas formation: microorganisms sink to the bottom of the ocean creating layers of organic rich sediment. Environments with high primary productivity, low hydrodynamics (stagnant water), stratified water column (no mixing between layers of the water column), poor benthic (sea floor) fauna, and anoxic (low oxygen) conditions prevailing at the bottom, are the best prospects for the development of organic rich source rocks as these conditions prevent the organic matter from decomposing.

OIL & GAS FORMATION

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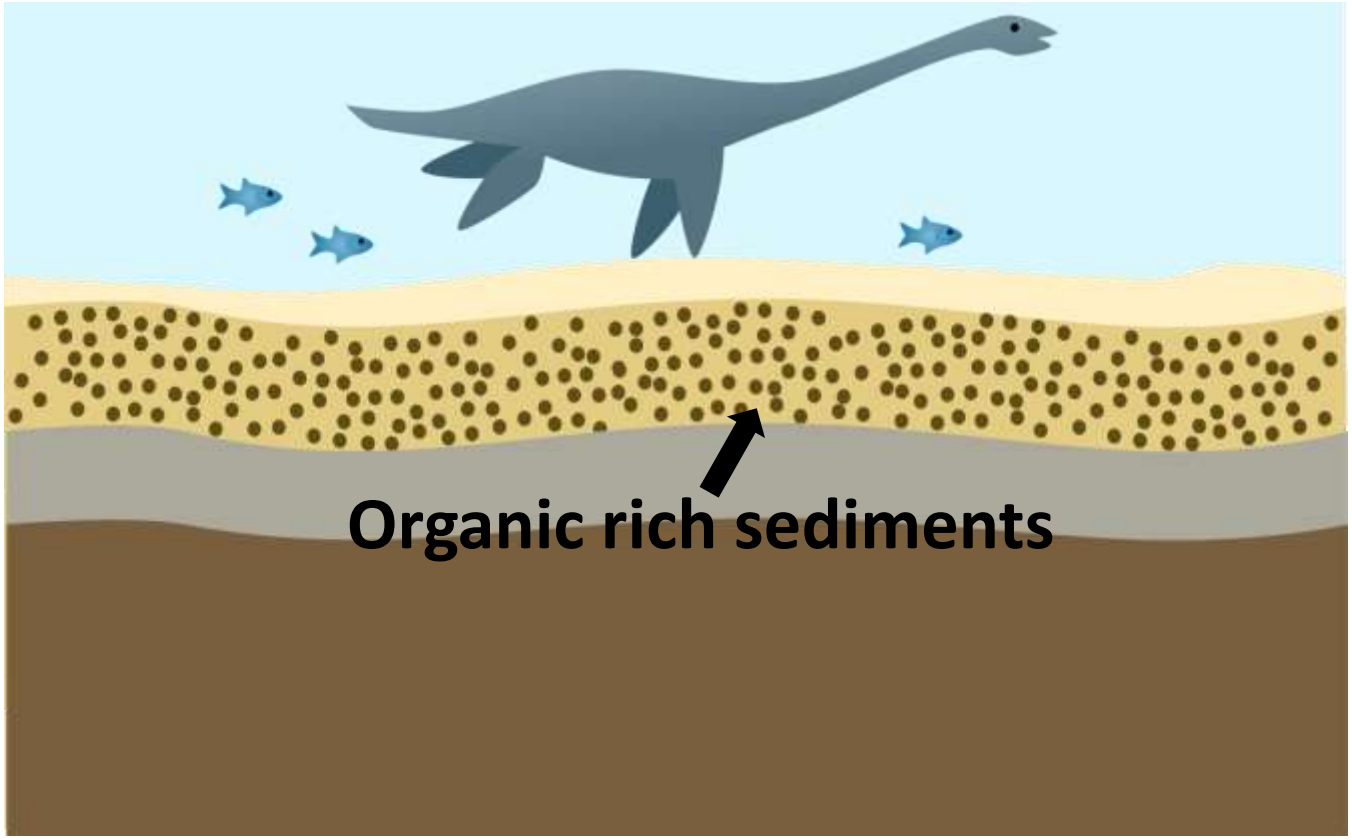

- **Organic rich sediments** are buried by layers and layers of sediment
- Increased and sustained **heat and pressure** 'cooks' the organic matter in the source rock into **petroleum**
- **Temperature** and **burial depth** determine which **hydrocarbons** are produced

As the phytoplankton and zooplankton are buried over thousands and millions of years the heat and pressure rises and the organic matter in the sediment is turned into petroleum (oil and gas). Temperature and burial depth determine whether oil, gas or other hydrocarbons are produced – graph on next slide

OIL & GAS FORMATION

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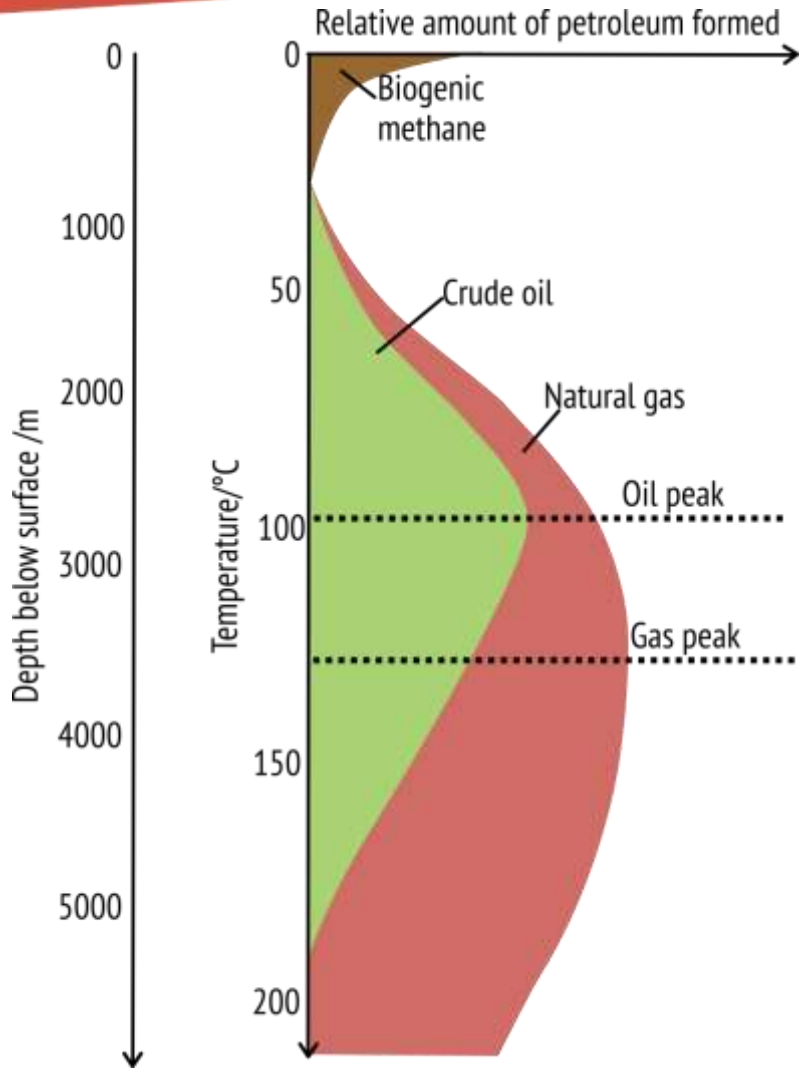

Temperature and burial depth determine whether you get oil or gas and how much is formed.

OIL & GAS FORMATION

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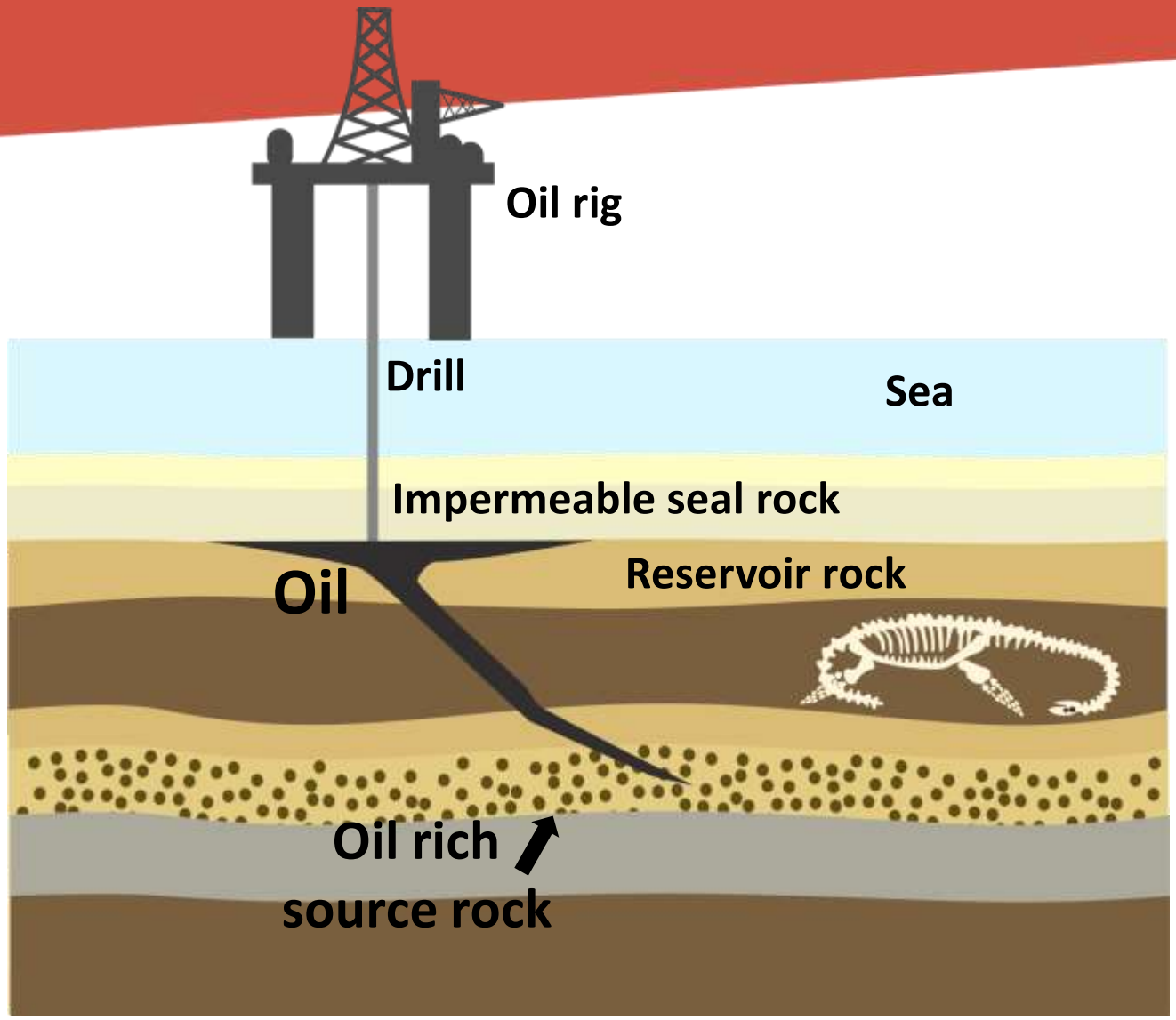

- Oil and gas **migrate** upwards form the **source rock** into **reservoir rocks** capped by **impermeable seals**
- Can sometimes migrate all the way to the surface e.g. La Brae tarpits
- Trapped deposits are **drilled** to release oil and gas
- **Hydraulic fracking** can also be used to extract gas

- Oil and natural gas is less dense than the surrounding rock so migrates upwards through tiny pores and fractures in the surrounding rock. Some oil and natural gas manages to get all way to the surface and escapes through vents into the atmosphere e.g. La Brae tarpits in California. Other oil and natural gas get trapped in reservoirs under impermeable layers of rock – known as seals or cap rocks. These trapped deposits are then drilled (after extensive exploration and testing) to release the oil and gas e.g. in the North Sea oil fields.

- Natural gas can be also extracted using hydraulic fracking. This process uses high-pressure water to split apart the rocks underground, releasing the natural gas that is trapped in rock formations.

OIL & GAS

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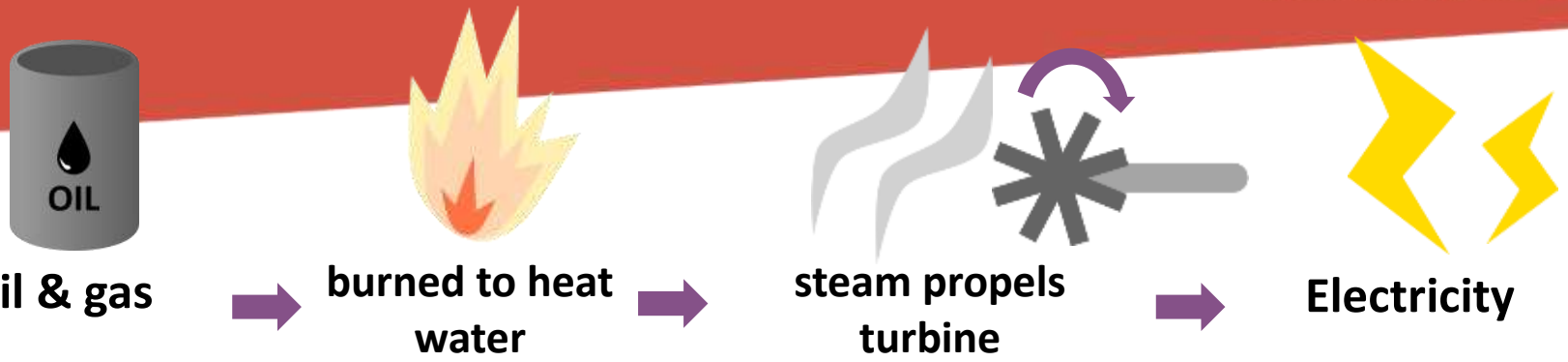

- **Crude oil** is **refined** by **fractional distillation** into kerosene, petrol, diesel etc. before it is used as a fuel.
- Relatively **inexpensive** to extract.
- **Reliable** and **dependable** source of energy and **income** for local community e.g. in Aberdeen, Scotland.
- **Natural gas** can be converted into **liquid** form
- When oil and gas are burnt they release gas into the atmosphere. **carbon dioxide**
- **Oil spills** are environmental disasters – e.g. BP Mexico oil spill 2010

Oil and gas can be burnt to produce electricity, to do this oil/ gas (chemical energy) is burned in power plants to heat water and produce steam. The kinetic energy of the steam then propels the blades of a turbine. The turbine is attached to a generator and when it spins it produces electricity.

Oil is also used as fuel in cars, planes, buses and trains (chemical energy mechanical energy kinetic energy). Before it can be put into cars and planes or used as wax etc. crude oil extracted from the Earth must be refined in an oil refinery by fractional distillation to turn it into different fuels like petrol, diesel and jet engine fuel (diagram on next slide).

Oil can also be turned into various different types of plastic and chemical products so it is an extremely valuable natural resource.

Natural gas is mostly made from methane and can be used for heating and cooking as well as generating electricity. Natural gas can be condensed into a liquid - liquid natural gas (LNG) which is much cleaner than any other fossil fuel and takes up less space so can be it transported and stored easily.

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Pros

Oil and natural gas are relatively inexpensive to extract. They are relatively reliable and dependable sources of energy and provide jobs and income money for the local community e.g. Aberdeen. Natural gas is a much cleaner fossil fuel than coal.

Cons

When oil and gas are burnt they release carbon dioxide gas into the atmosphere. CO2 is a greenhouse gas and contributes to global warming. Oil spills are environmental disasters, oil penetrates bird feathers and mammal fur reducing insulation, buoyancy and flight ability. Oil and gas are often geopolitical issues

FRACTIONAL DISTILLATION

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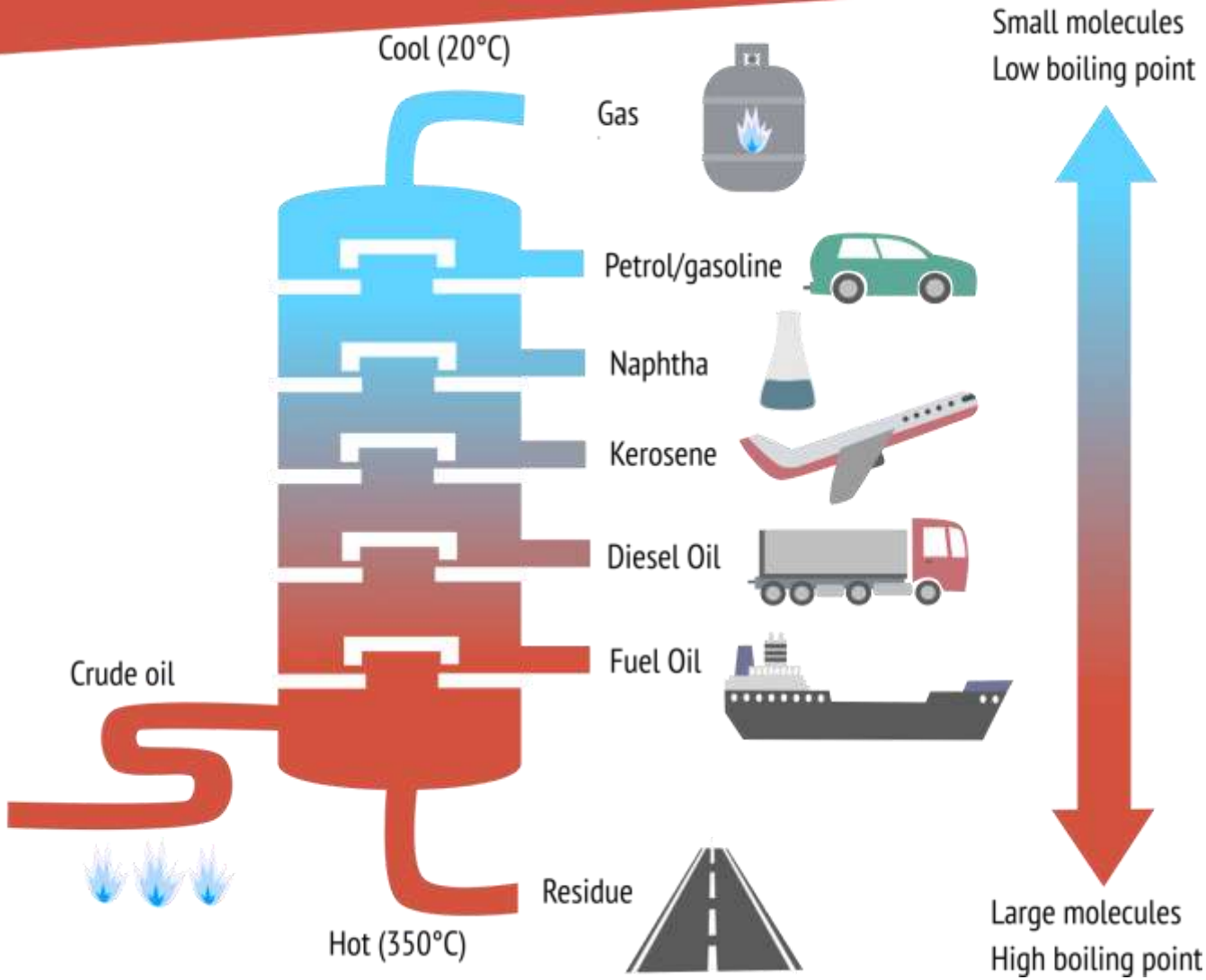

Fractional distillation diagram - because they have different boiling points, the substances in crude oil can be separated using fractional distillation. Crude oil is evaporated and hydrocarbons condense at different temperatures in the fractionating column. Each fraction contains hydrocarbon molecules with a similar number of carbon atoms. Larger molecules have higher boiling points and do not ignite as easily so they condense low in the fractionation column e.g. bitumen used in roads and fuel oil for ships. The smaller molecules have lower boiling points so condense high up in the fractionation column, these hydrocarbons such as bottled gas and gasoline ignite more easily which means they make better fuels.

COAL FORMATION

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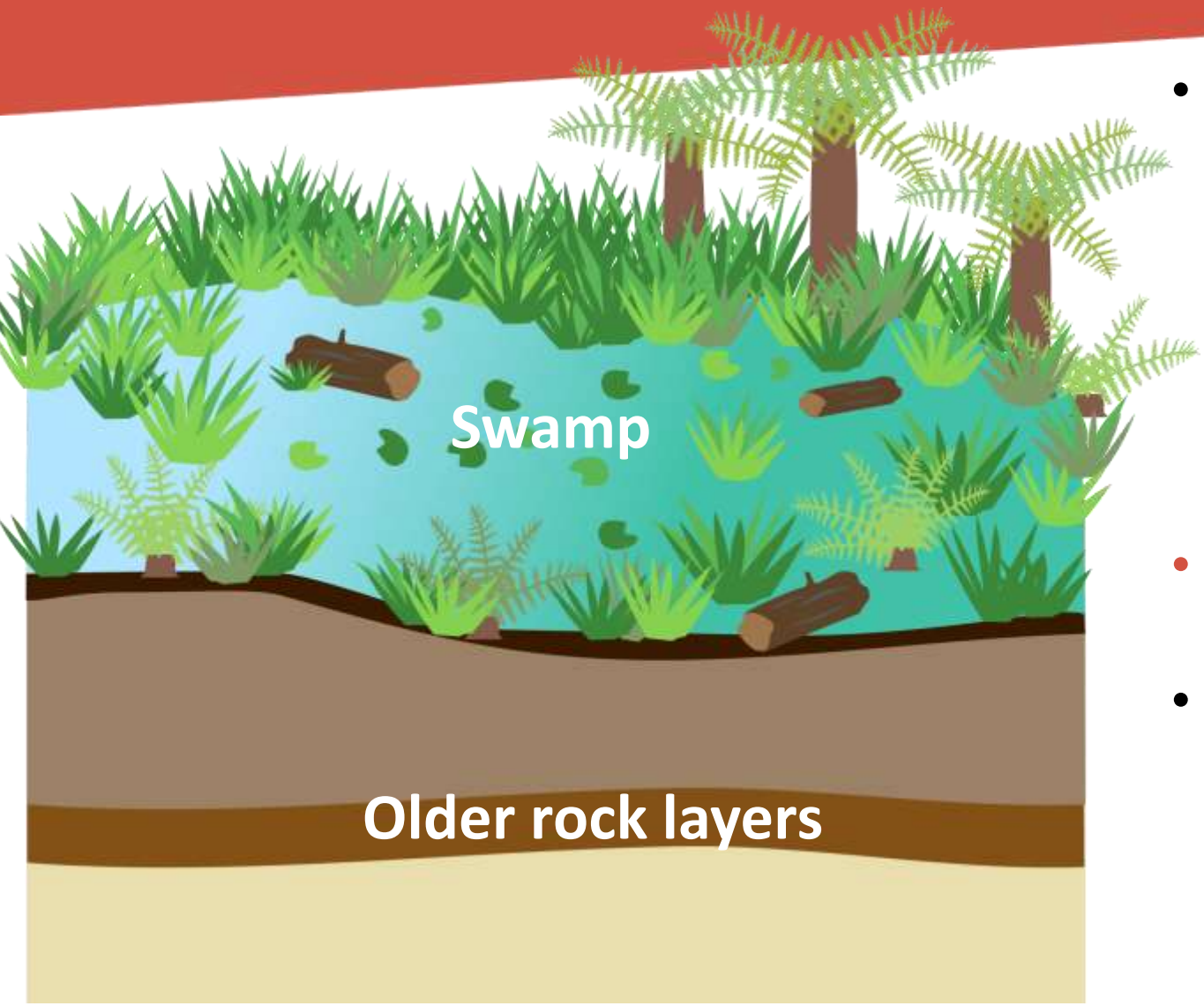

- Most of the **coal** we have on Earth today was formed in the **Carboniferous period** 360 – 299 million years ago
- **Tropical, swampy climate**
- Plants die and over time form layers of squashed plant material

COAL FORMATION

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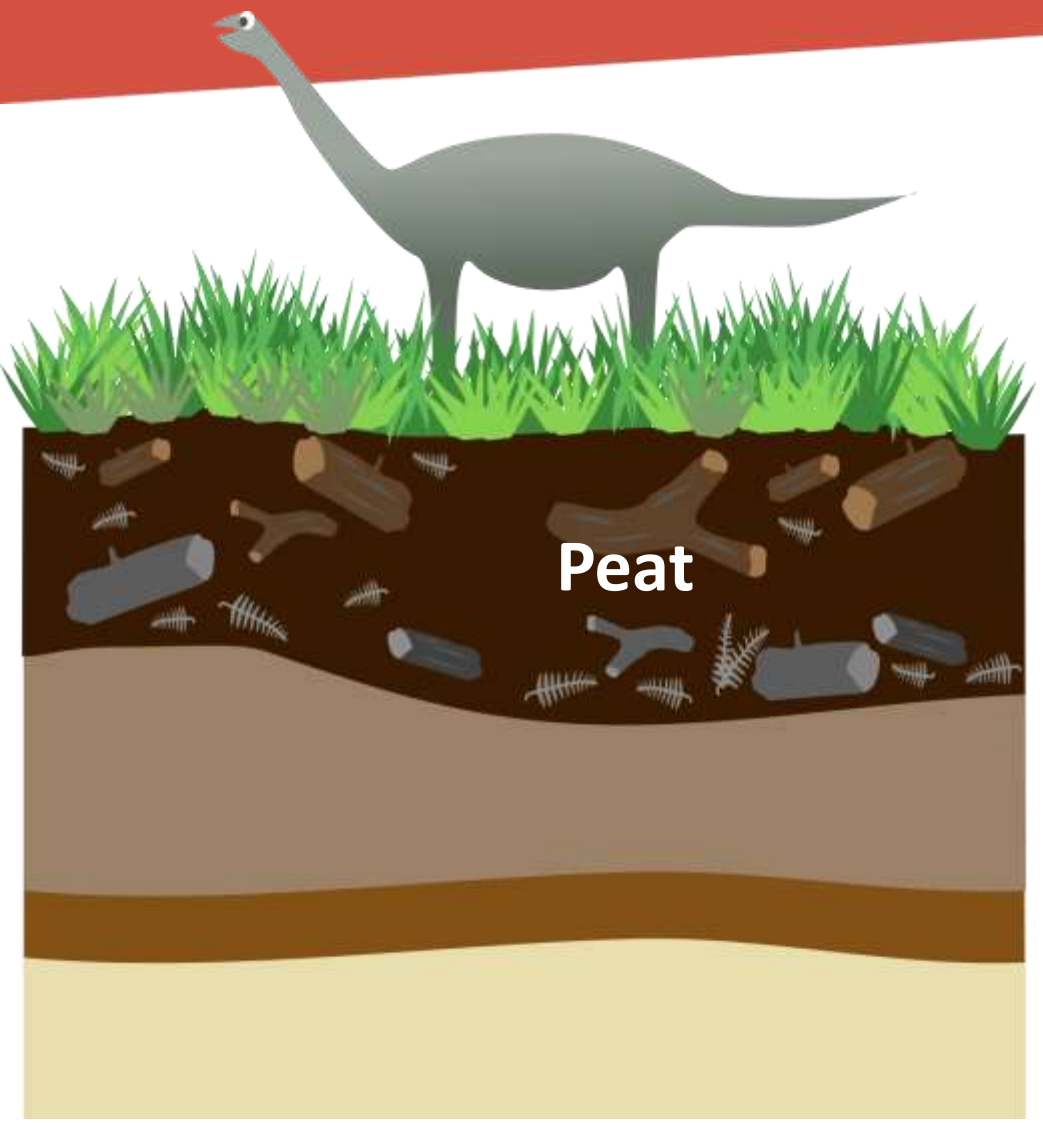

- Squashed **plant material** accumulates over thousands of years.
- Plant material turns into **peat.**
- Peat is used for fuel Ireland, Scotland and Finland

The thick layers of plant material eventually turned into a brown spongy material called peat. Peat is the lowest rank of coal (i.e. the least efficient) but it is an important fuel in places like Ireland, Scotland and Finland.

COAL FORMATION

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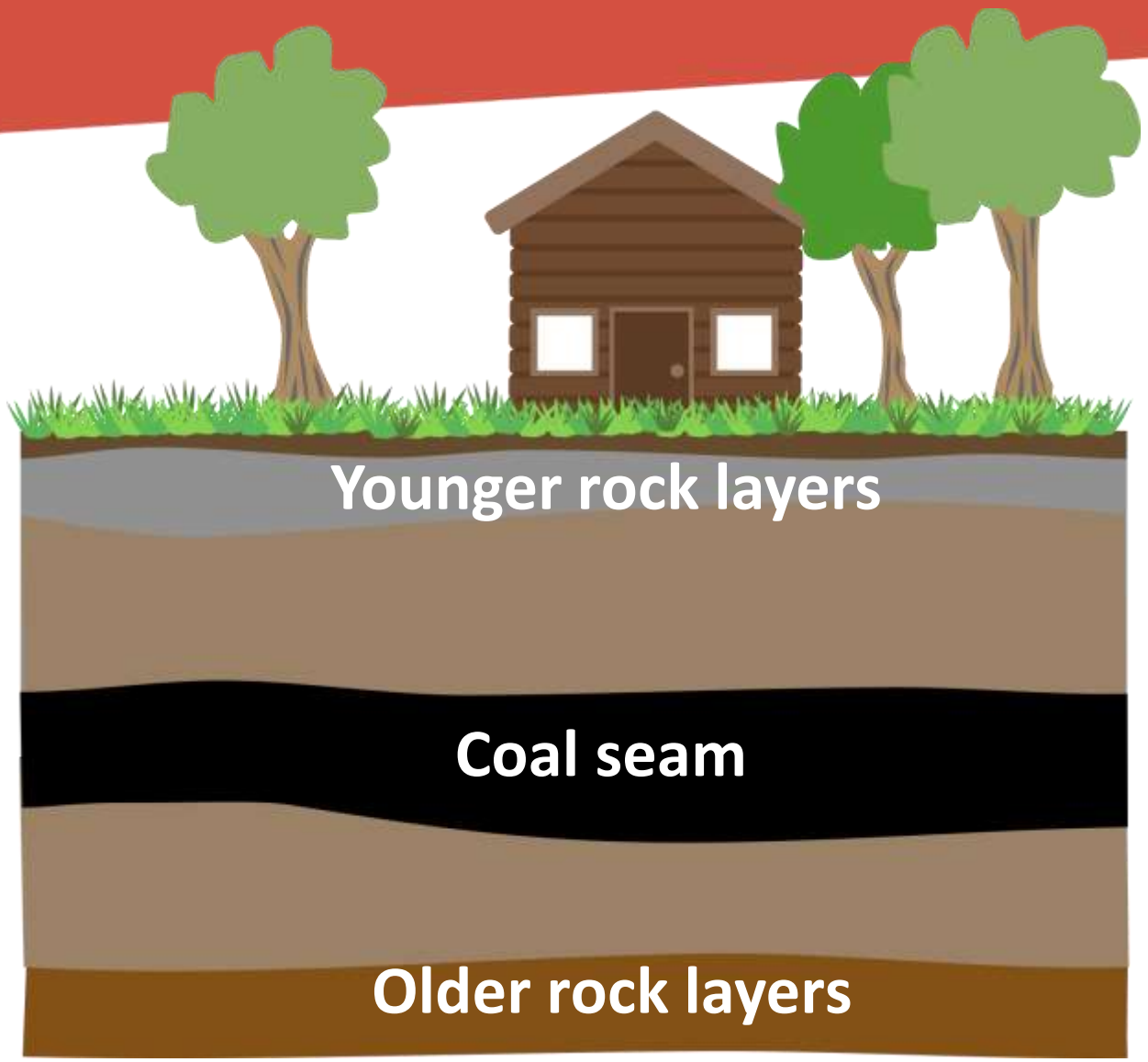

- Peat is buried by layers of sediment and subjected to increased **heat** and **pressure**
- 'Cooked' into **coal**
- The type of coal you get depends on how long it was buried, how deep and how hot it got.

TYPES OF COAL

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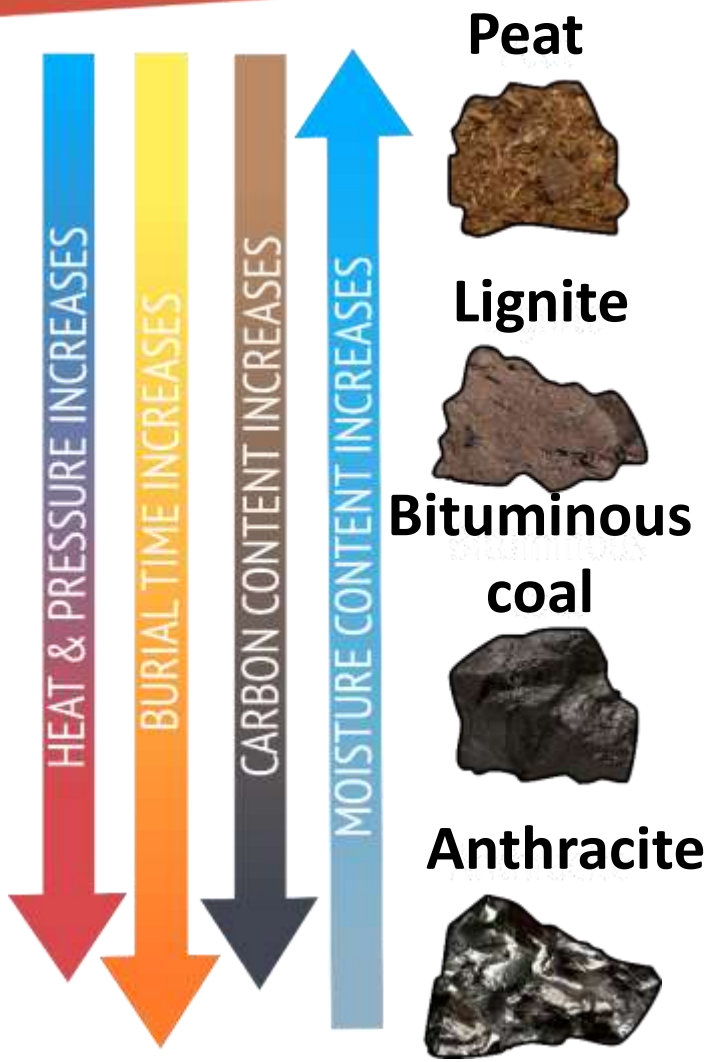

The hotter the **temperature**, the **deeper** the coal is buried, and the longer the amount of **time** the coal is buried, the more **efficient** coal you get.

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The hotter the temperature, the deeper the coal is buried, and the longer the amount of time the coal is buried, the better (more efficient) coal you get – lignite, brown coal is the first type of coal (peat isn't technically coal) it has a low carbon content and a high moisture and volatiles content which means it doesn't burn very efficiently. Anthracite is the most efficient coal it has a high carbon content, very low moisture and volatiles content and burns with a short pale blue flame (complete combustion). Most of the coal we use is bituminous coal in between lignite and anthracite in terms of carbon and moisture content.

NON-RENEWABLE: COAL

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Coal →  **burned to heat water** →  **steam propels turbine** →  **Electricity**

↓

burned for heat

- Coal is **cheap** and there is **lots of it**!
- When coal is are burnt it releases **carbon dioxide, sulphur dioxide** and **nitrogen dioxide** into the atmosphere contributing to global warming and acid rain.
- Coal mining is harmful to the environment and mine workers – toxic dust, cave-ins and explosions.

NON-RENEWABLE: NUCELAR

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- **Uranium** and **plutonium** are nuclear fuels – **fission reactions**
- Nuclear fuels do not produce harmful greenhouse gases
- Nuclear power is very **efficient**
- Produces **radioactive waste** which is dangerous and has to be sealed in containers and buried for thousands of years.
- Nuclear cores can **melt down** releasing **harmful radiation** e.g. Fukushima Daiichi plant in 2011
- Safety is **expensive**

The main nuclear fuels are uranium and plutonium these are radioactive chemical elements. Nuclear fuels are not burnt to release energy, they are involved in nuclear reactions where atoms are split to release large amounts of energy as heat in a chain reaction (nuclear fission). The rest of the process of generating electricity is then the same as in coal, oil and gas, the heat energy released by the nuclear reactions causes the reactor vessel to heat to about 300 ºC. This heat is used to boil water generating steam that spins turbines ad drives generators to produce electricity.

Pros

Nuclear fuels do not release harmful greenhouse gases. The vast majority of carbon dioxide emissions associated with nuclear power stations arise during construction and fuel processing, not during electricity generation.

They are very efficient, a tiny amount of nuclear fuel produces a lot of energy

Cons

Nuclear power produces radioactive waste, which is very dangerous. When animals (including humans) and plants are exposed to large amounts of radiation, it can be very harmful to their survival. Radioactive waste must be removed and disposed of from power plants it has to be sealed in containers and buried for thousands of years until it is no longer radioactive.

Nuclear accidents can occur releasing harmful radiation into the environment when e.g. the Fukushima Daachi nuclear plant melt down in 2011 as a result of the Tohoku tsunami

Nuclear power is reliable but a lot of money has to be spent on safety so it is expensive.

UK NUCLEAR POWER

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- Nuclear power currently generates **21% total UK electricity** (2018 Department of Business, Energy & Industrial Strategy)
- **15 operational reactors** across the UK (2018)
- **Hinkley Point C** in Somerset estimated to cost £20.3 billion
- Scotland have banned any future nuclear plants

MATCH-UP (1)

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Energy resource formed from ancient plants	Fractional distillation
Natural substances required by humans for different needs	Crude oil & natural gas
How the different components of crude oil are separated	Nuclear power
The specific combination of different energy sources a country uses to meet its energy consumption needs	Coal
Uses uranium and plutonium to generate heat in fission reactions	Energy Mix
Energy resources formed from marine organisms	Natural resources

MATCH-UP (2)

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Generates 21% of UK electricity (2018)	Temperature and burial depth
Time period when most of the world's coal was made	Carbon dioxide
Released in the combustion of fossil fuels (hydrocarbons)	Radioactive waste
Brown spongey precursor to coal	Carboniferous
Determines which hydrocarbons are produced	Peat
By product of using nuclear power	Nuclear power

MATCH-UP ANSWERS (1)

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Energy resource formed from ancient plants	Coal
Natural substances required by humans for different needs	Natural resources
How the different components of crude oil are separated	Fractional distillation
The specific combination of different energy sources a country uses to meet its energy consumption needs	Energy Mix
Uses uranium and plutonium to generate heat in fission reactions	Nuclear power
Energy resources formed from marine organisms	Crude oil & natural gas

MATCH-UP ANSWERS (2)

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Generates 21% of UK electricity (2018)	Nuclear power
Time period when most of the world's coal was made	Carboniferous
Released in the combustion of fossil fuels (hydrocarbons)	Carbon dioxide
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Determines which hydrocarbons are produced	Temperature and burial depth
By product of using nuclear power	Radioactive waste

UNCONVENTIONAL NON-RENEWABLES

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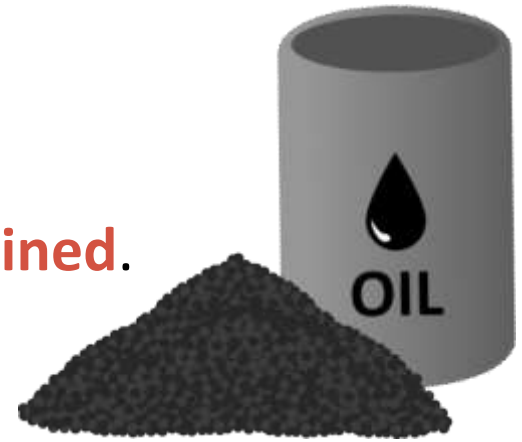

- **Tar sands** - mixtures of clay, sand, water, and **bitumen**
- Bitumen can't be pumped so tar sands are **mined**.
- **Vast reserve** of untapped oil.
- Provided a massive **economic growth** and thousands of jobs in Alberta.
- Uses large amounts of land, water, and energy, when compared to other oil resources
- Carbon dioxide emissions are **~15% higher** compared with standard crude oil extraction
- **Open-pit mining** produces a lot of waste - leftover sand, clays, and contaminants

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Pros – we only have a finite amount of oil reserves left to use, tar sands represent a vast reserve of oil.

Tar sands have provided a massive economic growth in Alberta, generating huge profits and providing thousands of jobs.

Cons - oil production from tar sands uses large amounts of land (for open-pit mining), water, and energy, when compared to other oil resources.

Carbon dioxide emissions are on average 15% higher when extracting bitumen from tar sands compared with standard crude oil extraction.

Open-pit mining also produces a lot of waste (leftover sand, clays, and contaminants contained within the tar sands) that may pose a risk to nearby water supplies.

The Athabasca Delta, where the Canadian tar sands are located, is a breeding ground for hundreds of species of birds.

UNCONVENTIONAL NON-RENEWABLES

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- **Methane hydrates** are methane (natural gas) trapped lattices of ice.
- **Arctic permafrost** and **sea floor sediments** at 300-500m depth
- Untapped **reserve** of fossil fuel
- **Warming** or **depressurising** → turns into water + natural gas
- **Global warming** is likely to liberate methane hydrates
- Past climate warming events in geological history are linked with methane hydrate
- CH4 is 20x more **potent** than CO_2 – accelerate global warming

- Methane hydrate is a cage-like lattice of ice inside of which are trapped molecules of methane. If methane hydrate is either warmed or depressurized, it will revert back to water and natural gas.

- Originally they were thought to occur only in the outer regions of the Solar System, where temperatures are low and water ice is common, but significant deposits of methane hydrate have been found under the Arctic permafrost and beneath the ocean floor. They form either from biological matter or from heat processes deep within the Earth.

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Pros

Methane hydrates represent an untapped reserve of fossils fuels which could provide the world with greater energy security. Countries including India, Japan and the US are currently developing mining techniques in order to be able to use methane hydrates as a source of energy in the future.

Cons

CH_4 is 20x more potent than CO_2 which means that is has a much greater warming affect on the atmosphere.

As methane hydrates are temperature sensitive global warming may liberate methane hydrates from the Arctic permafrost and sea floor sediments.

Previous climate warming events in geological history – e.g. the Paleocene-Eocene Thermal Maximum ~55 million years ago have been linked with the release of methane hydrates

Discuss – should we be burning methane hydrates?

SUMMARY

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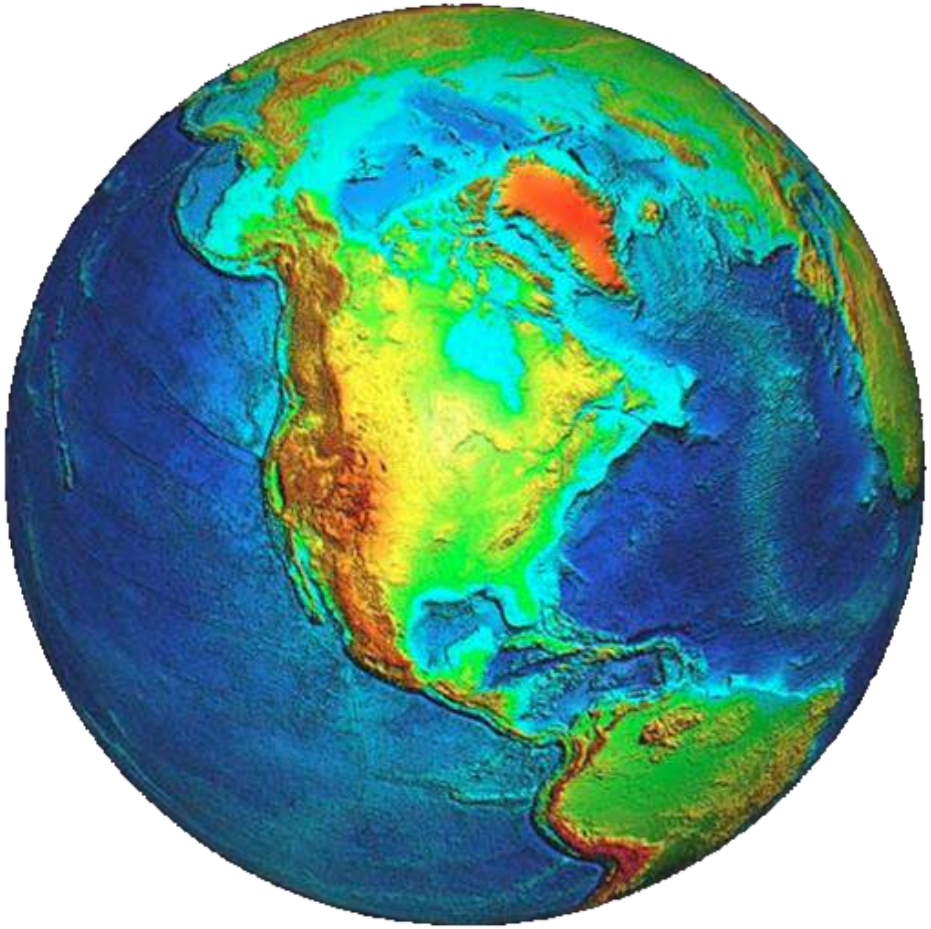
- **Energy resources** are **natural resources** - **non-renewable** or **renewable**
- Oil, gas and coal are **fossil fuels** formed from marine **plankton** (oil and gas) and land plants in swampy conditions (coal).
- Fossils fuels can be burned directly for heat or used to generate electricity through heating water.
- Nuclear power is generated from the radioactive elements uranium ad plutonium. No **greenhouse gases** but issues with **radioactive waste** disposal.
- **Unconventional fossil fuels** include methane hydrates and tar sands.

Environmental Laws

Presentation Roadmap (contin…)

Part I:

Structural Overview of Environmental Laws



Sources of Environmental Law

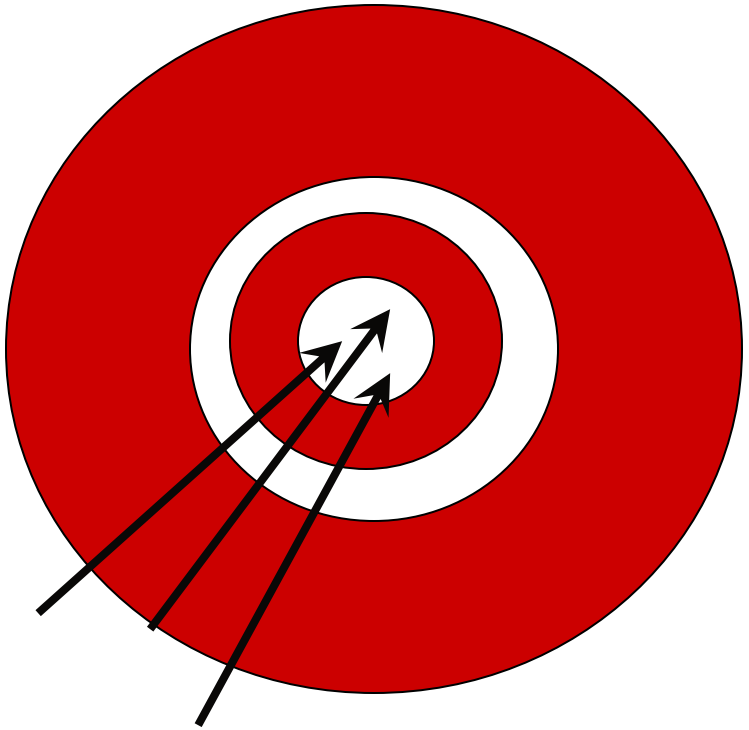
- Legislation (federal, state, local)
- Regulations (federal, state, local)
- Court decisions (interpreting statutes and regulations)
- Common law
- Constitutions (United States, state)
- International treaties
- Foreign regulations

- **Legislation:** relevant environmental statutes are passed on the federal, state, and local levels
- **Regulations:** federal, state, and local agencies pass regulations in order to implement the mandates of federal, state, and local statutes
- **Court decisions:** environmental law can be developed by the way that courts interpret the meaning of various environmental statutes and regulations
- **Common law:** common law is the creation of general principles and rules relating to persons and property from court decisions that have recognized customs and usages over time -- not derived from express legislative authority.
- **Constitutions:** another example of the dual influence of federal and state law
- **International treaties:** international treaties can effect United States regulations by committing the United States to reduce pollutant emissions (e.g. the Kyoto Protocol, if ratified, would commit the U.S. to reduce carbon dioxide emissions by 7% below 1990 levels)
- **Foreign regulations:** regulations in other countries can influence engineering in the United States if American products are produced in foreign countries or exported to foreign countries with more stringent environmenta regulations than the United States.

Targets of Environmental Laws:

Who or what gets regulated?

- Products
- Pollutants
- Industrial Facilities
- Government Agencies
- Individuals
- Land uses



Products: Legislation targeted at products can be broad like the Toxic Substances Control Act (TSCA), which regulates any chemical substance or mixture. Or, legislation can be more specific like the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), which only governs pesticide chemicals.

Pollutants: Virtually every pollutant resulting from industrial, commercial, or domestic activities fall within the scope of a federal environmental statute.

Industrial Facilities: Federal regulation targeted at industrial facilities is the most popular and perhaps the easiest form of regulation to enforce because facilities are fewer in number than individuals. For example, the EPA can more easily impose requirements for emissions reductions against car manufacturers rather than individual car owners.

Government Agencies: Governmental entities may be regulated if they own certain kinds of facilities that are part of the pollution problem, e.g. public water supply systems.

Individuals: Regulation of individual conduct is less popular than regulation of facilities for both political and practical reasons.

Land Uses: While most private land use decisions are regulated only at the local level, some of the federal environmental laws contain provisions that effect land use. **Decisions**: The Clean Water Act, for example, requires individuals to obtain permits before dredge and fill operations are conducted on wetlands.

Regulatory Objectives:
What is the desirable level of protection?

- Health or Environmental Based Standards
  - E.g., under the Clean Air Act, ambient air quality standards must protect human health
- Technology or Feasibility Based Standards
  - E.g., under the Clean Air Act, emission limits for new sources is determined by the limits achievable using the best control technology demonstrated by that industry
- Balancing Standards
  - E.g., the Toxic Substances Control Act requires the EPA to balance the environmental and health effects of chemicals with the economic consequences of regulation

Regulatory Obligations

How will regulations achieve their objectives?

- Design Standards
- Performance Standards
- Ambient or Harm Based Standards
- Product Bans or Use Limitations
- Planning or Analysis Requirements
- Information Disclosure Requirements

Translating Statutes into Regulations

Federal Environmental Statutes:
Enacted through the legislative process.
Provide the regulatory framework.
Authorize the agencies to adopt regulations.
Reported in the United States Code.

Federal Environmental Regulations:
Adopted by federal agencies.
Set forth implementation details, such as emission standards or procedures for submitting permit applications.
Reported in the Code of Federal Regulations (CFR)

Part II:
Environmental Laws

Federal Statutes

International Treaties

Common Law

Federal Environmental Statutes

Clean Air Act
Clean Water Act
Pollution Prevention Act
Toxic Substances Control Act
National Environmental Policy Act
Occupational Safety and Health Act
Resource Conservation and Recovery Act
Federal Insecticide, Fungicide, and Rodenticide Act
Emergency Planning and Community-Right-to-Know Act
Comprehensive Environmental Response, Compensation, and Liability Act

Clean Air Act

- What is the purpose?
  - To control air pollution by instituting point source controls and establishing maximum pollutant levels for the ambient air.
- What is the scope?
  - The main focus is stationary sources of air pollution but the Act also provides some regulation for mobile sources.
- Who implements the program?
  - The EPA must establish national ambient air quality standards (NAAQS) for criteria pollutants: total suspended particulates, sulfur dioxide, nitrogen oxides, carbon monoxide, ozone, and lead.
  - Each state is required to determine how to attain and maintain NAAQS by developing a State Implementation Plan (SIP).
  - For state areas that exceed the NAAQS, the states must implement a program to prevent the significant deterioration of air quality in those areas that exceed the NAAQS.

CAA. . .

- What are the major provisions?
  - Stationary source permits : Different standards are imposed on existing verses new or modified facilities. New or modified sources are subject to new source performance standards (NSPSs) and must obtain preconstruction permits. If the new or modified source is located in a nonattainment area, the source must obtain a non-attainment area permit and offset emissions so that the nonattainment can further its progress toward becoming an attainment area.
  - Hazardous air pollutants: The 1990 amendments list 189 hazardous air pollutants for which the EPA requires the installation of technology that will result in the maximum achievable reductions.
  - Phase-outs: With the enactment of the 1990 Amendments, implements the *Montreal Protocol* by phasing out substances like CFCs, halons, carbon tetrachloride, methyl chloroform.

Clean Water Act

- What is the purpose?
  - The stated objective of the Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.
- What is the scope?
  - All point sources that discharge any pollutants into the waters of the United States must first obtain a permit under the Act.
- Who implements the program?
  - the EPA
  - With EPA approval, states can issue NPDES permits within the state. The EPA can revoke a state's permitting authority if the program is not as stringent as the federal program.

CWA

- What are the major provisions?
  - National Pollution Discharge Elimination System Permit: End-of-pipe pollution from point source dischargers is controlled through permits that specify effluent limitations for each discharger.
  - Water Quality Standards: Each water body of every state must meet certain ambient water quality standards consisting of numerical and narrative criteria. Water quality standards vary depending on the state's designated use of the water body.
  - TMDLs: When point source effluent limitations are not stringent enough to meet water quality standards, states must develop total maximum daily load (TMDL) calculations for that water body to help identify and reduce pollution inputs from both point and nonpoint sources.

Resource Conservation and Recovery Act

- What is the purpose?
  - to provide a “cradle to grave” framework for managing solid and hazardous waste from generation to final disposal
- Who must comply?
  - Any party that generates, transports, stores or disposes of solid and hazardous waste.
- Who implements the program?
  - the EPA
  - States: with EPA approval, some states implement and manage solid and hazardous waste management programs in lieu of the federal RCRA program

RCRA ….

- What are the Major Provisions?
  - Permits : Requires generators, transporters, and treatment/storage/disposal facilities to obtain permits before handling solid or hazardous waste.
  - Uniform Hazardous Waste Manifest : Requires preparation and maintenance of Waste Manifest to track origin of waste, who is transporting the waste, and destination of waste.
  - Sanitary Landfills : Addresses the management of nonhazardous waste and exempt hazardous solid waste. This title mainly pertains to the design and monitoring of wastes that are disposed of in sanitary landfills.
  - Leaking Underground Storage Tanks : Addresses problems associated with regulated substances entering the soil and groundwater due to leaking underground storage tanks.

Comprehensive Environmental Response, Compensation, and Liability Act

- What is the purpose?
  - To provide a mechanism to clean up contaminated sites and hold potentially responsible parties accountable for clean up costs.
- What is the scope?
  - Parties may be liable for cleanup costs if they contributed any amount of hazardous substance to a contaminated site, e.g. anyone who disposed of hazardous substances found at the site.
- How is the Act enforced?
  - The EPA can conduct a short-term removal action at any site requiring emergency action or conduct a long-term remedial action at any site on the National Priorities List.
  - The EPA can compel private parties to cleanup a site when release or threatened release of hazardous substances present an imminent endangerment to the public health or welfare of the environment.

CERCLA. . .

- What are the major provisions?
  - Contaminated Site Cleanup: CERLCA authorizes the EPA to force parties that were responsible for the release of hazardous substances to finance cleanups on the contaminated site.
  - Superfund: Where the responsible party cannot be identified or has gone bankrupt, CERCLA established a $1.6 billion Trust Fund, known as Superfund. The Superfund Amendments and Reauthorization Act of 1986 (SARA) appropriated another $8.5 billion.
  - National Priorities List: The EPA can only conduct long term remediation actions at sites that are on the National Priorities List, which ranks the sites eligible for Superfund clean up.

Toxic Substances Control Act

- What is the purpose?
  - To regulate toxic chemicals and mixtures that present an "unreasonable risk of injury to health or the environment"
- What is the scope?
  - TSCA places the burden on manufacturers to supply the EPA with information on environmental and health effects of chemical substances and mixtures. The EPA then has broad power to regulate the manufacture, use, distribution, and disposal of chemical substances and mixtures. However, the EPA must balance the economic and social benefits of a chemical against the risks when setting forth regulations.
- Who implements the program?
  - the EPA
  - Unlike other programs, states do not implement TSCA

TSCA . . .

- What are the major provisions?
  - Premanufacture Notice : Any person who manufactures or processes new chemicals for commercial purposes must submit a premanufacture notice (PMN) to the EPA at least 90 days before they begin manufacturing or processing. The PMN lists the intended uses of the substance, the information required to develop test data, and the nature of the test data that was developed.

  - Existing Chemicals : TSCA requires manufacturers, importers, and processors of TSCA-related chemical substances to submit data to the EPA on existing chemicals when they may present an unreasonable risk to health and environment or when they are produced in such quantities that there is a potential for a substantial release into the environment or human exposure.

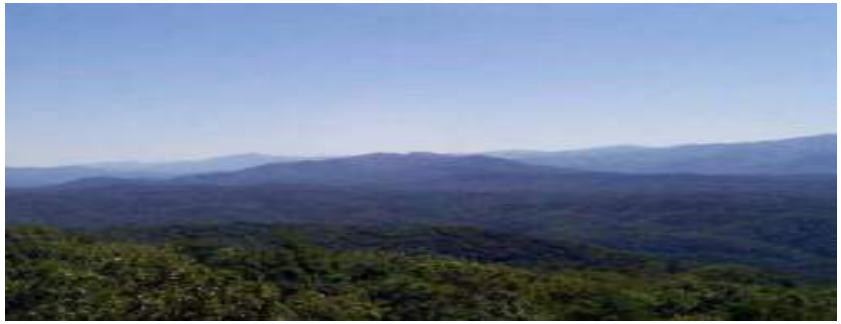
Federal Insecticide, Fungicide, and Rodenticide Act

- What is the purpose?
  - To protect the public health and environment against the misuse of pesticides.
- What is the scope?
  - All pesticide manufacturers must submit data regarding the safety and efficacy of their pesticides.
- Who implements the program?
  - The EPA
  - Where a state has a federally approved pesticide program, the state is the primary enforcement authority.

FIFRA . . .

- What are the major provisions?
  - Registration requirements : Based on the data submitted by the manufacturer on its registration application, the EPA decides whether the pesticide poses unreasonable adverse effects to the environment. The EPA takes into account the economic, social, and environmental costs and benefits of the pesticide's use.
  - Suspension or cancellation of pesticides : The EPA may suspend, cancel, or restrict the use of a pesticide that poses unreasonable adverse effects or imminent hazards to the environment.
  - Labeling requirements: All registered pesticides must be properly labeled for lawful sale. The label must specify the pesticide's active ingredients, how to use the pesticide on particular crops, and limitations on how or when it may be used.

National Environmental Policy Act



- What is the purpose?
  - Section 2 of NEPA declares that the purpose of the Act is to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; and to enrich the understanding of the ecological systems and natural resources important to the Nation.
- What is the scope?
  - NEPA applies to all major federal actions -- therefore it affects all federal agencies.
- Who implements the Act?
  - The Council on Environmental Quality, as an Executive Office of the President to implement NEPA
  - States do not implement NEPA

NEPA. . .

- Substantive NEPA : Pronounces national environmental policy goals.

- Procedural NEPA :
  - Purpose to guarantee that no federal agency will undertake projects without first considering the adverse environmental consequences of its action
  - Requires an environmental impact statement (EIS) to be prepared for all major Federal actions that significantly impact the environment.
    - Agency prepares environmental assessment (EA) to determine whether a full-blown EIS is necessary (whether the project will significantly affect the environment), posted on the Federal Register
    - If no EIS is necessary, the agency issues a finding of no significant impact statement (FONSI), posted on the Federal Register
    - If EIS is necessary, the agency issues a notice of intent, posted on the Federal Register
  - Once the first version of the EIS (the Draft EIS) is available on the Federal Register, there is a public comment period; the agency will respond to the public comments in the Final EIS.

Emergency Planning and Community Right-to-Know Act

- What is the purpose?
  - To create emergency response plans to prepare for accidental chemical releases.
  - To create an information database so that the public can know what types of chemical are being released by manufacturing facilities in their communities.
- What is the scope?
  - Any facility that produces, uses, or stores any of the substances listed on the EPA's List of Extremely Hazardous Substances.
- Who implements the Act?
  - The State Emergency Response Commission, which are created in each state under the Act, implement the emergency planning requirements.
  - The EPA receives submissions of the Toxic Release Inventory (TRI) reports with the authority to inspect and verify the reports.

EPCRA

- What are the major provisions?
  - Planning Provisions:
    - Require states to create local emergency units that must establish plans for responding to chemical release emergencies
    - Requires facilities to report any release of a chemical substance that exceeds the reportable quantity established for that substance to the state and local emergency planning commissions
  - Community Right to Know Provisions:
    - Toxic Release Inventory – requires the facilities producing more than a threshold amount of listed chemicals to report the maximum amount of the chemicals at the facility and released from the facility to the EPA
    - Toxic Release Inventory – data submitted to the EPA is compiled in a computerized database that is available to the people to view chemical releases from facilities in their communities

Occupational Safety and Health Act

- What is the purpose?
  - To ensure that “no employee will suffer material impairment of health or functional capacity” from a lifetime of occupational exposure.
- What is the scope of the Act?
  - The Act extends to all employers and their employees in all fifty states, except workplaces with fewer than ten workers and federal or state employees.
- Who implements the Act?
  - The Occupational Safety and Health Administration (OSHA)

OSHA

- What are the major provisions?
  - General Duty Clause
    - Imposes a generic duty on employers to keep their workplaces safe. Even where specific standards do exist, the general duty clause is triggered if those standards are outdated or otherwise not sufficient to ensure worker safety.
  - Refusal to Work/ Whistle blowing Provisions
    - If a worker refuses to work because of unsafe working conditions, the OSHA regulations protect workers from discrimination
    - If a worker reports an OSHA violation, the Act also protects the employee from being fired because of the whistle blowing
  - Hazard Communication Regulations
    - Requires employers to provide employees with information concerning hazardous chemicals through labels, material safety data sheets, training and education, and lists of hazardous chemicals in each work area.

Pollution Prevention Act

- What is the purpose?
  - Establishes Pollution Prevention as the nation's preferred pollution control strategy, as opposed to end of pipe pollution control.
  - Pollution Prevention is the attempt to reduce the amount of generated waste through more efficient use of resources at the input and production levels.
- What is the scope of the Act?
  - Moves facilities beyond compliance on a **voluntary** basis
- Who implements the Act?
  - The EPA

Pollution Prevention Act

- What are the major provisions?
  - Amendment to the TRI reporting requirement under EPCRA:
    - Facilities subject to EPCRA's reporting requirements must also report information on the pollution prevention and recycling activities at the facility for each chemical.
  - Voluntary Programs to Implement Pollution Prevention Strategies:
    - Environmental Leadership Program: Participating companies develop and implement pollution prevention management practices and set environmental goals beyond regulatory compliance.
    - Common Sense Initiative: The EPA takes an industry-by-industry approach to environmental protection by giving facilities more opportunity to reduce waste streams generally instead of targeting particular pollutants
    - Excellence in Leadership (XL) Program: Participating companies have the flexibility to meet regulatory requirements in exchange for an enforceable commitment to moving beyond compliance.


Common Law Liabilities

Common Law v. Statutory Law

Common Law

- Rules are created by judges through court decisions.
- Because common law is continuously shaped by court decisions, common law can vary between different jurisdictions.
- Liabilities stem from personal injuries or property damage caused by environmental conditions.

Statutory Law

- Rules are created through legislative procedures.
- Statutes provide uniform, national frameworks for pollution control, e.g. Clean Water Act.
- Liabilities stem from national pollution control policies.

Common Law:
Trespass

- *Definition*: unauthorized invasion of a person's land
- *Application in environmental law:* a defendant was held liable for trespass when defendant's sludge seeped on to plaintiff's land and yet defendant did nothing to stop it.

Common Law:

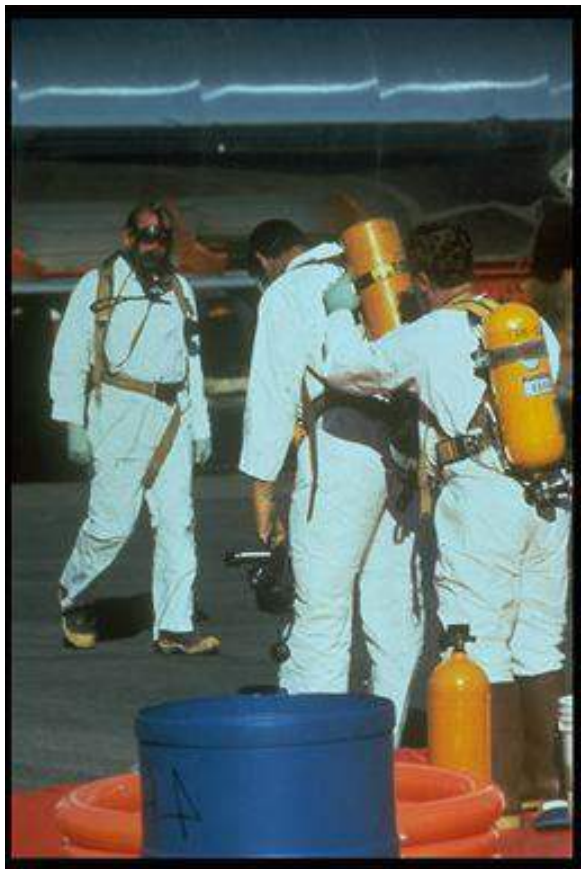
Strict Liability for Ultra Hazardous Activities

- *Definition of Strict Liability*: the defendant can be liable if he was engaged in the activity that caused injury, without proof that defendant actually did anything wrong.
- *Application in environmental law:* the owners of a toxic waste dump were held strictly liable for harm caused to others even though the situation looked like a CERCLA issue.

Common Law:
Nuisance

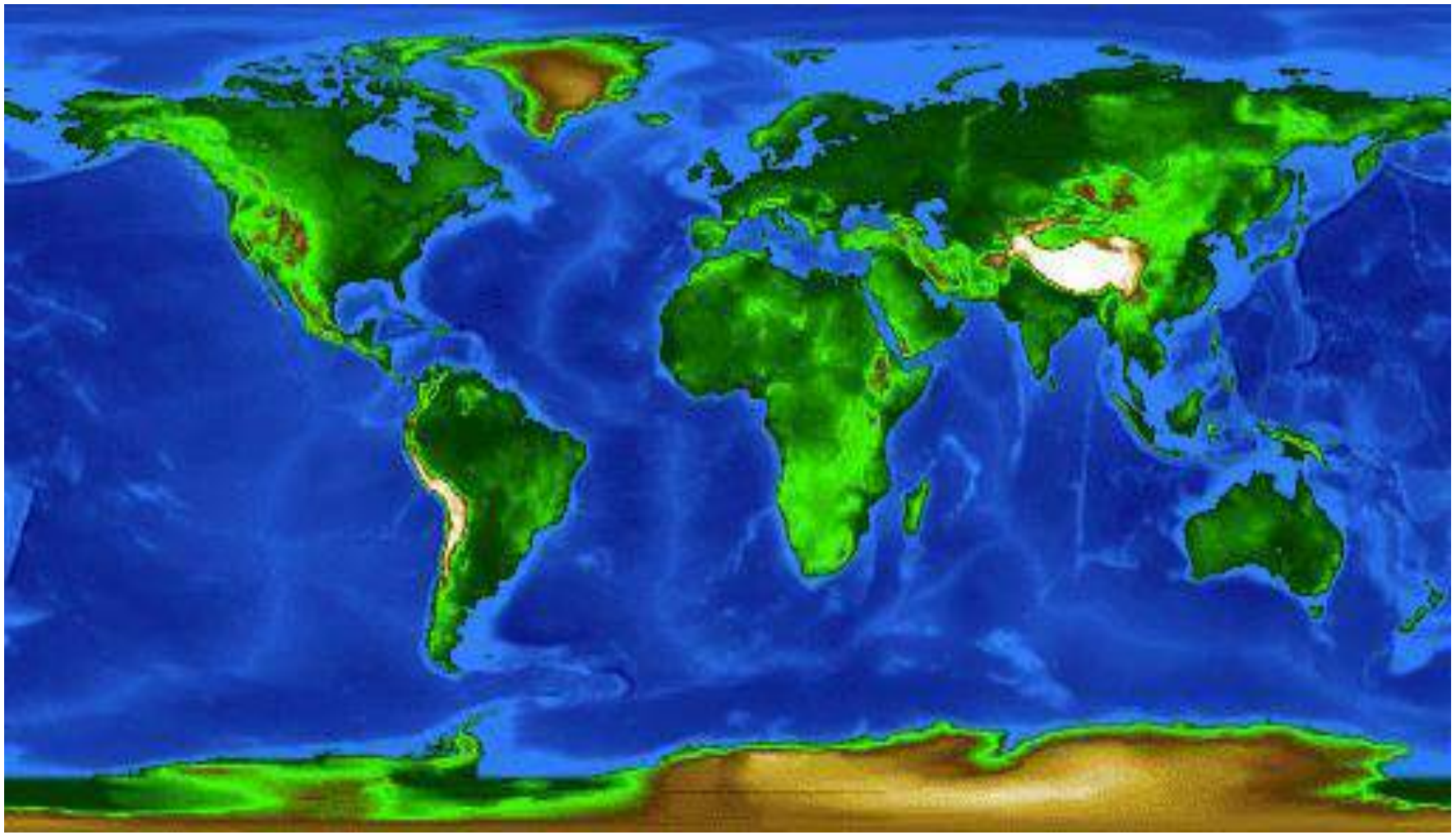
- *Definition*: An action brought against somebody for interfering with one's use and enjoyment of property
- *Application in environmental law*: In Florida, a court ruled that an oil company unreasonably interfered with the ability of neighboring land owners to peacefully occupy their land because of noise, vibrations, and emissions from the plant.

Common Law:
Toxic Torts



- *Definition*: A claim for damages arising from exposure to a harmful chemical or substance.
- *Application in environmental law:* Environmental torts are increasingly related to injuries caused by exposure to pesticides, PCBs, benzene, heavy metals, and other contaminants.

International Treaties



International Treaties:
Great Lakes Water Quality Agreement of 1978

- Agreement between the U.S. and Canada
- Created an international joint commission to draft regulations and make recommendations on all actions affecting the Great Lakes, their tributaries, and adjacent riparian areas

International Treaties: The Kyoto Protocol

- Addresses greenhouse gas emissions
- Signed by the former President Clinton in 1998, but not yet submitted to the Senate for ratification
- If ratified, the U.S. would have to:
  - Reduce greenhouse gas emissions (CO_2, NO_x, and CH_4) 7% below 1990 levels
  - Reduce HCFC, CFC, and HFC 7% below 1995 levels over the period from 2008 to 2012
- The Protocol also contains provisions whereby credits for greenhouse gas emissions can be earned by carbon reducing activities, e.g. reforestation.

International Treaties: The Montreal Protocol

- Addresses ozone depletion
- 1987 Protocol Requirements:
  - 50% reduction in the 1986 CFC productions levels by 1999
  - Freeze on the 1986 halon production and consumption levels
- London Amendment of 1990:
  - Phase out CFCs entirely by 2000
- Amendments of 1992:
  - Accelerated timetable for reducing ozone depleting substances
- Implementation in the U.S. through Title VI of the Clean Air Act Amendments of 1990:
  - Production of all Class I substances (CFCs, halons, carbon tetrachloride, and methyl chloroform) phased out by 2000
  - Production of Class II substances (HCFCs) phased out by 2030

International Treaties:
International Organization for Standards

- International Organization for Standards (ISO) is a private sector non-governmental organization founded in Switzerland in 1947.
- Promotes international harmonization and development of manufacturing, product, and communications standards.
- ISO 14000 series – environmental management standards:
  - Voluntary
  - Standards and guidance documents on environmental management, eco-labeling, auditing, life-cycle assessment, and environmental performance evaluation.
  - Calls for environmental policies that represent a commitment to environmental compliance and pollution prevention