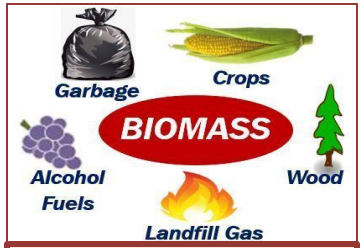
Renewable Resources

Solar Energy

Wind Energy



Biomass Energy

Thermal Energy

COMSATS UNIVERSITY ISLAMABAD

ARCHITECTURE DEPARTMENT
CUI Lahore

ENVIRONMENT IMPACT ANALYSIS (ARC-555)

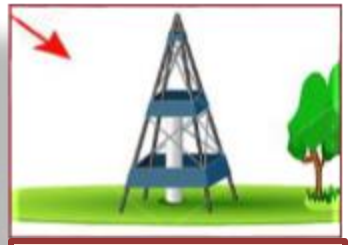
ENVIRONMENT& ITS SPHERES

Presented by:
Dr. Bilal Ahmad Zafar Amin

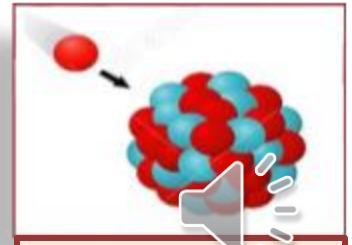
Non-Renewable Resources

Oil

Coal



Natural Gas



Nuclear

The environment is the totality of all the external conditions affecting the life, development and survival of an organism.

- **The naturally produced physical surroundings** on which humanity is entirely dependent in all its activities. The various uses to which these surroundings are put for economic ends are called environmental functions.

- **The circumstances, objects, or conditions by which one is surrounded**: the complex of physical, chemical, and biotic factors (such as climate, soil, and living things) that act upon an organism or an ecological community and ultimately determine its form and survival.

- **Ecology** is the study of the relationships between living organisms, including humans, and their physical environment. Ecology considers organisms at the individual, population, community, ecosystems, and biosphere level.

- **"Ecosystem"** includes the interaction between the organism and its surroundings.

Different branches of science are interested in studying the environment, its components, and the interaction between living organisms and their environment. For example, **Environmental science** is interested in studying and investigating the interaction of organisms with their environment and its outcomes. A branch of environmental science is **ecology,** which deals with the ecological interactions within ecosystems.

Internal and external

An **internal environment** would be the internal milieu of a multicellular organism. Maintaining the internal environment of an organism through homeostasis is crucial to the organism's survival. An external environment refers to the environment outside of the organism.

Natural and Built

Environments may be *natural* or *built*. A **natural environment** is a type of environment found in nature. It includes all naturally occurring things, both living and nonliving. It, therefore, involves the complex relationships of weather, climate, living species, and natural resources.

Built environments, unlike natural environments, are made by humans, such as agricultural conversions or urban settings. With the current breadth of human interventions and conversions, many natural environments have acquired some degree or level of being *"built"*.

The term "habitat" has several meanings. In ecology it **means either the area and resources used by a particular species (the habitat of a species)** or an assemblage of animals and plants together with their abiotic environment. ... and secondarily by the species of plants and animals that live there".

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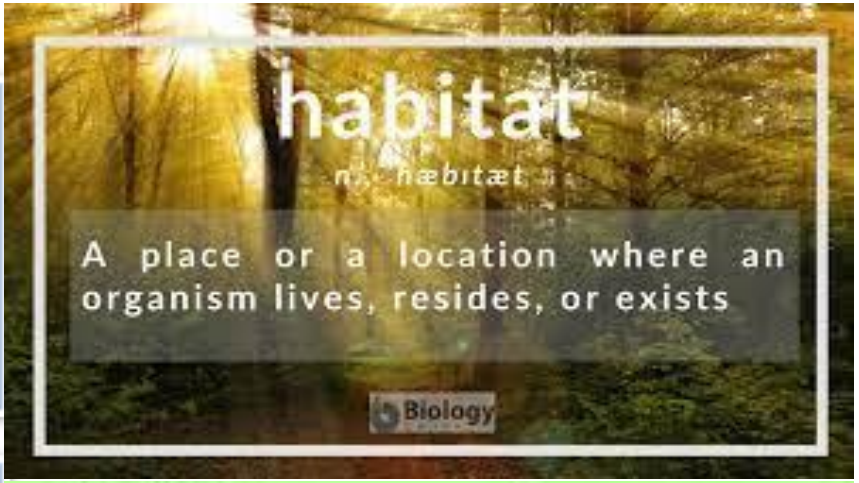
There are five different types of habitats found on the earth;

- Forest.
- Desert.
- Polar Regions and Mountains.
- Ocean.
- Freshwater.



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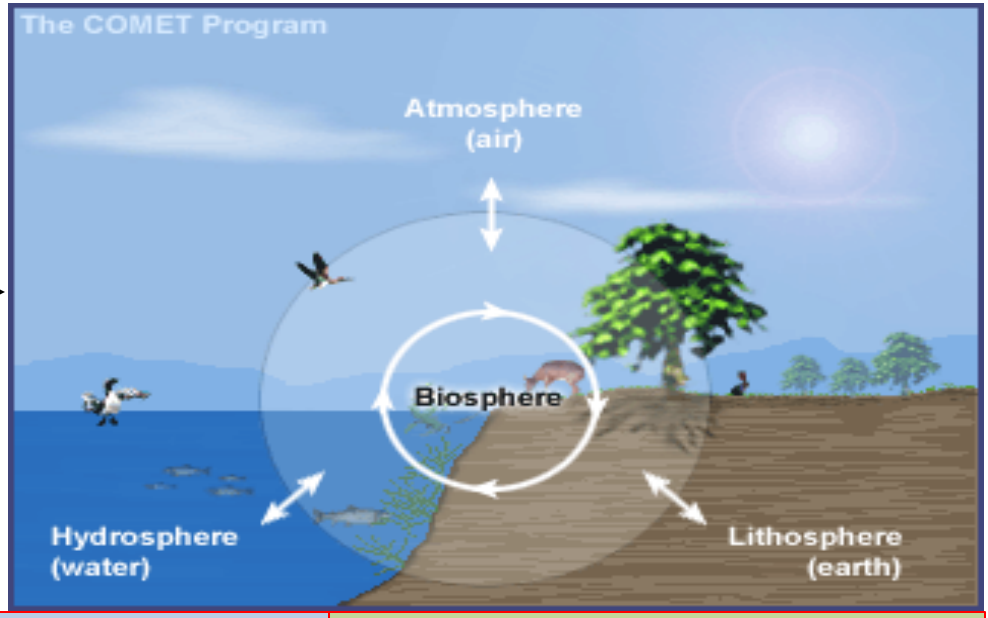
Spheres



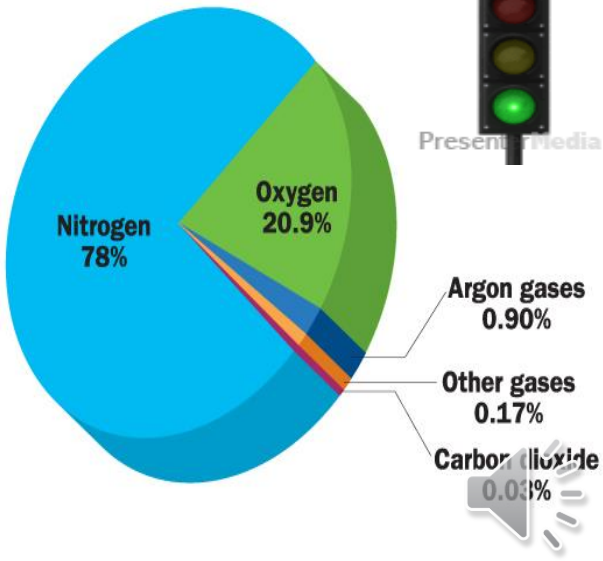
Lithosphere

- ✓ Human
- ✓ Animal
- ✓ Plants

Anthropogenic activities

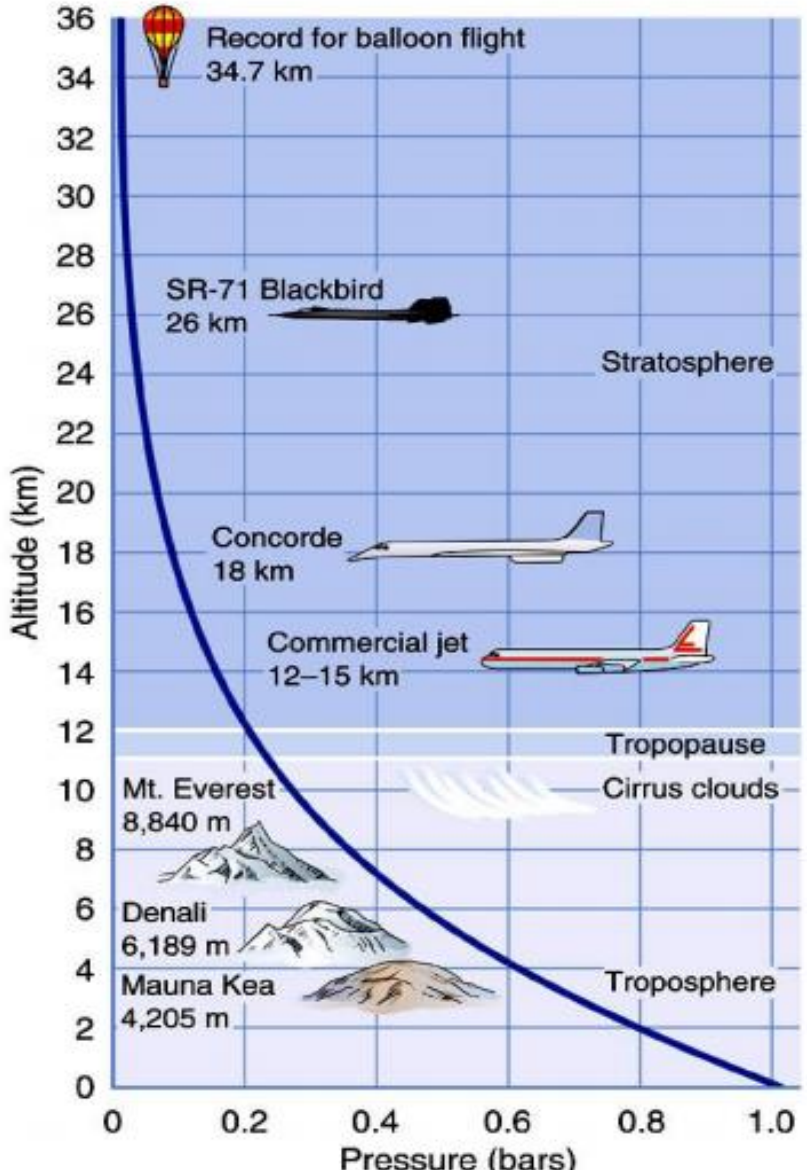
Hydrosphere

Atmosphere

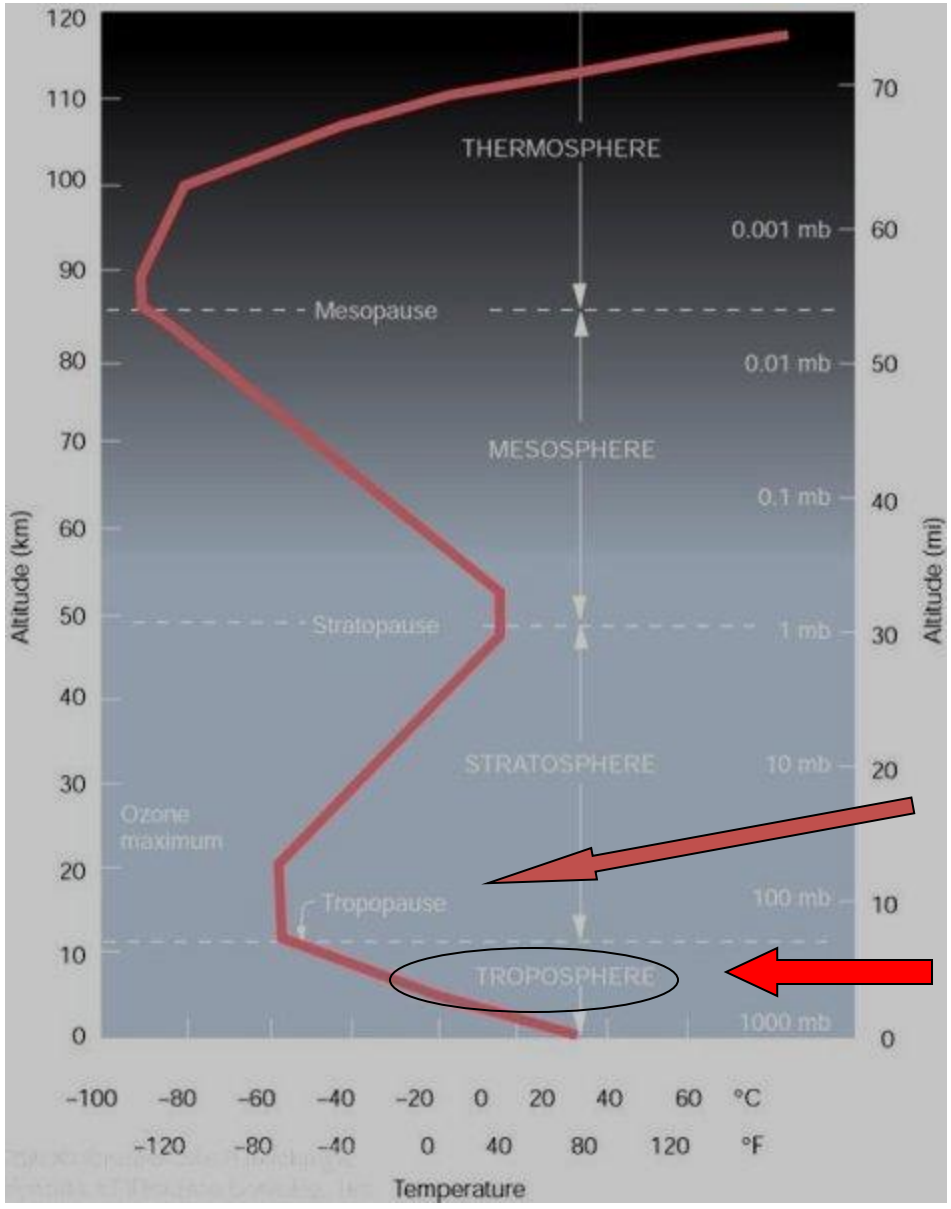


Earth's Atmosphere

- **Earth's Atmosphere is divided into distinct layers based on altitude**
  - Exosphere (very thin ~500 km)
    - Atmosphere merges with space
  - Thermosphere (>90 km)
    - Where space shuttles orbit
  - Mesosphere (50-90 km)
    - Meteors burn up here
  - Stratosphere (12-50 km)
    - Stable air; good for jets
  - Tropopause (11-12 km)
  - Troposphere (0-11 km)
    - Mixing layer
    - All weather is limited to this layer
    - "Tropo" = Greek for "turning"



Atmospheric Layers

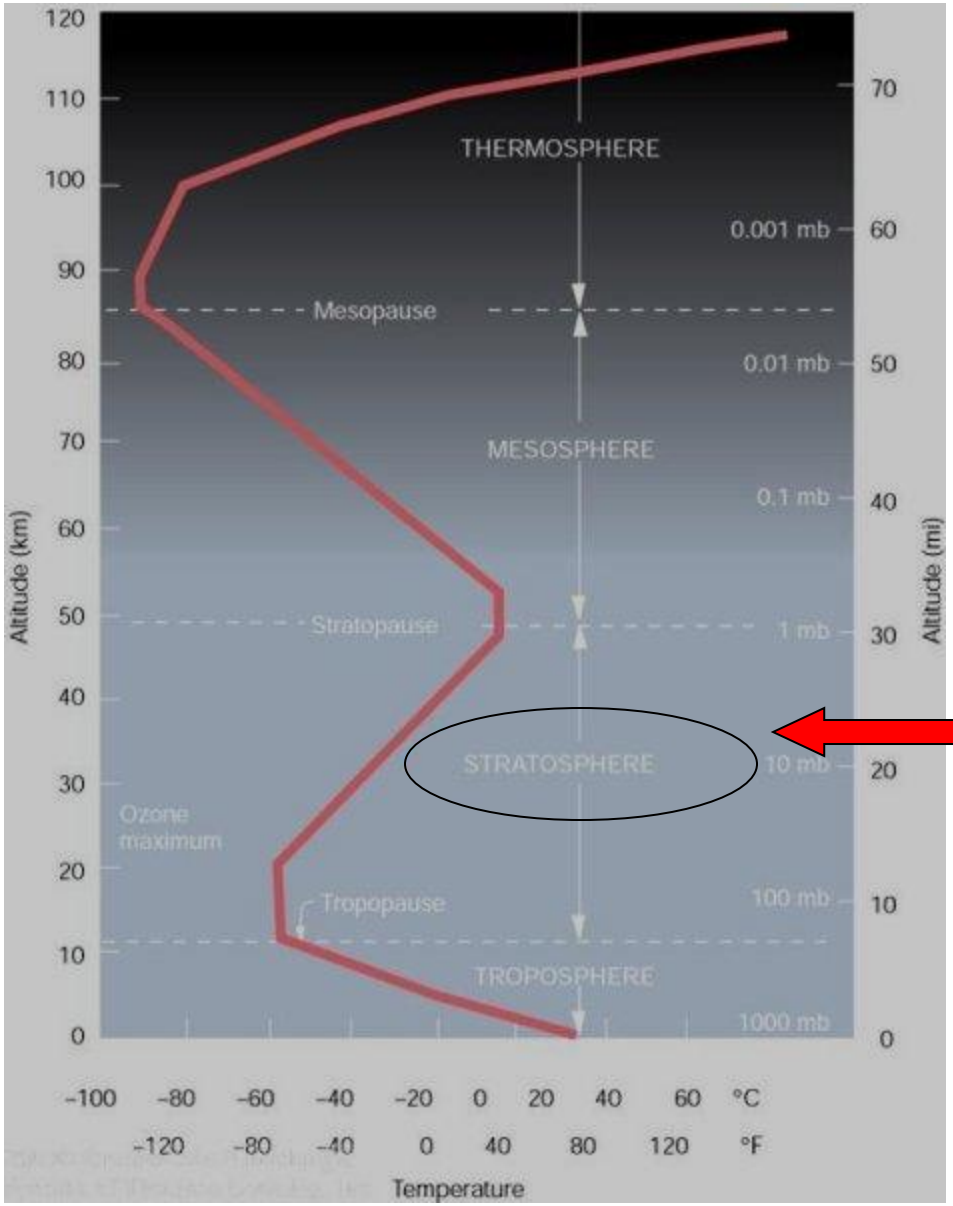


- Temperature decreases with altitude – called the environmental lapse rate
  - 6.5˚C per kilometer (average)
  - 3.5˚F per 1000 feet (average)
- Thickness varies – average height is about 12 km

Tropopause separates Troposphere from Stratosphere. Generally higher in summer Lower in winter.

Troposphere – Temp decrease w/ height
Most of our weather occurs in this layer
Varies in height around the globe

Atmospheric Layers



- Extends from about 16 Km to about 56 Km above the sea level
- Boundary b/w troposphere and stratosphere is called tropopause
- Once material injected into remain for years e.g. ammonium sulfate aerosols at 20 Km
- Important feature is presence of a thin layer ozone
- Solar UV rays absorbed and converted into heat

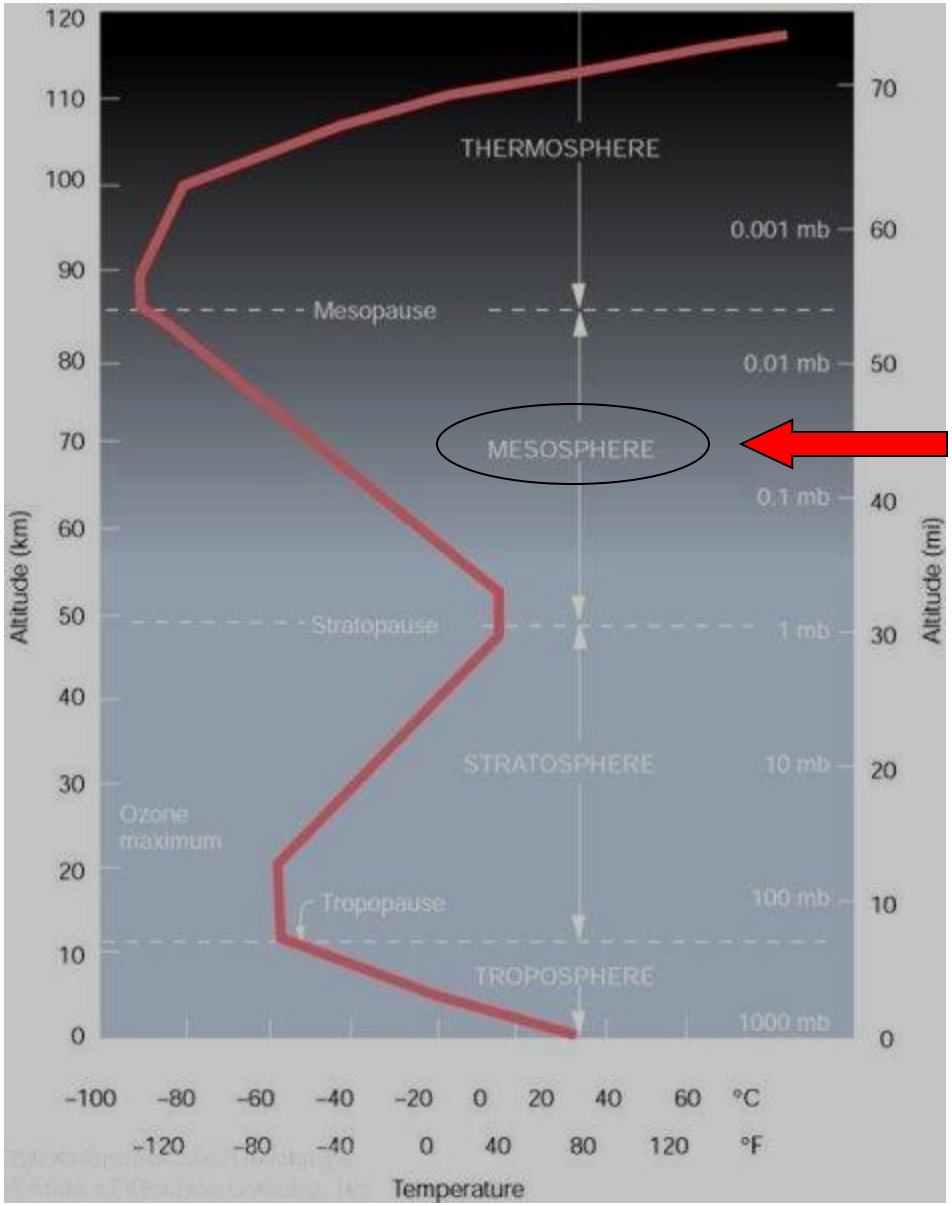
Stratosphere

Temperature inversion in stratosphere

Ozone plays a major part in heating the air

At this altitude

Atmospheric Layers



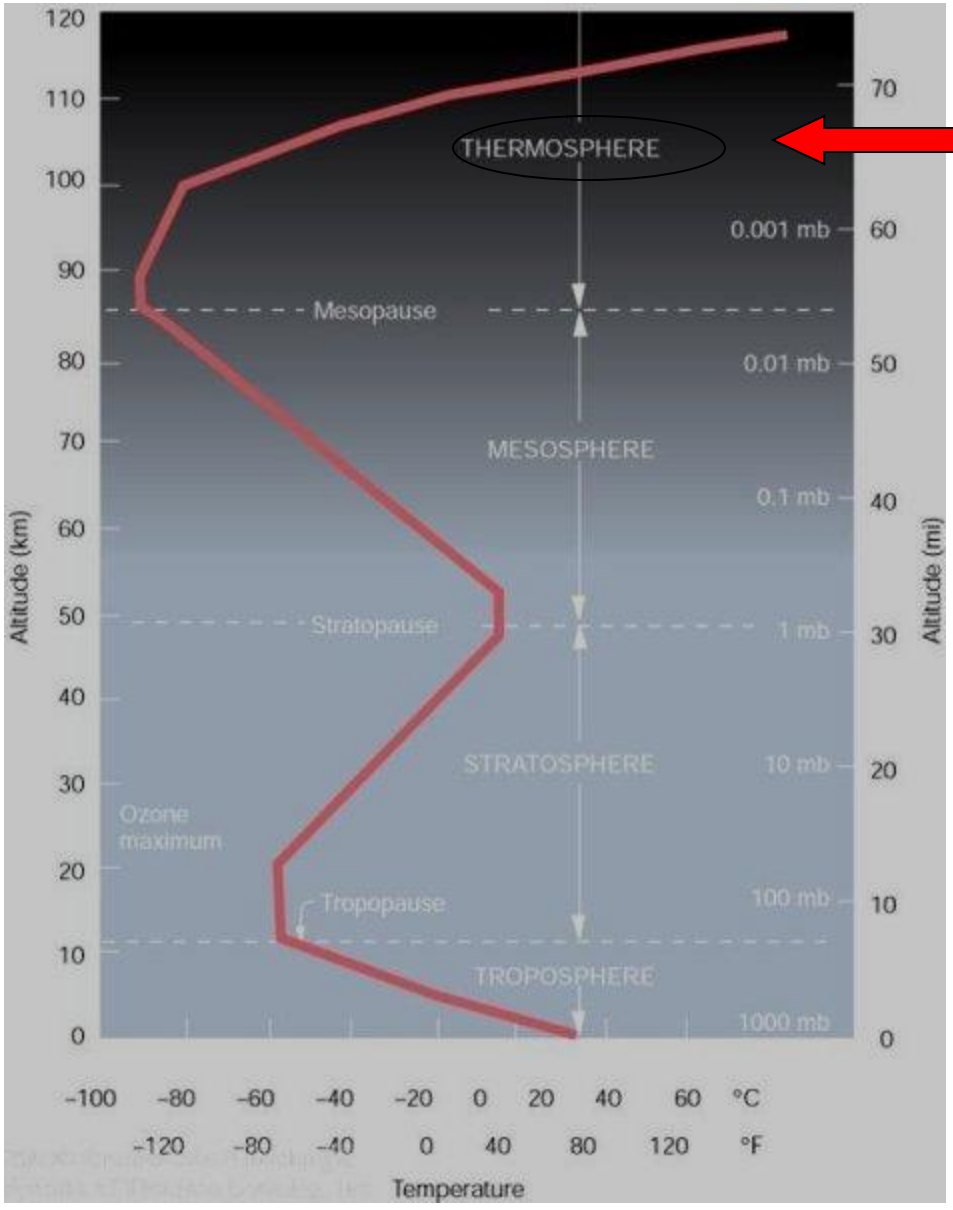
- Extends from 56 Km to about 90 Km
- Boundary b/w stratosphere and mesosphere is called stratopause
- Very low concentration of O_2 and N_2
- Symmetrical structure they possess little capacity to absorb solar radiation
- Temperature decreases with elevation

Mesosphere

Middle atmosphere – Air thin, pressure low,

Need oxygen to live in this region. Air quite Cold -90°C (-130°F) near the top of mesosphere

Atmospheric Layers

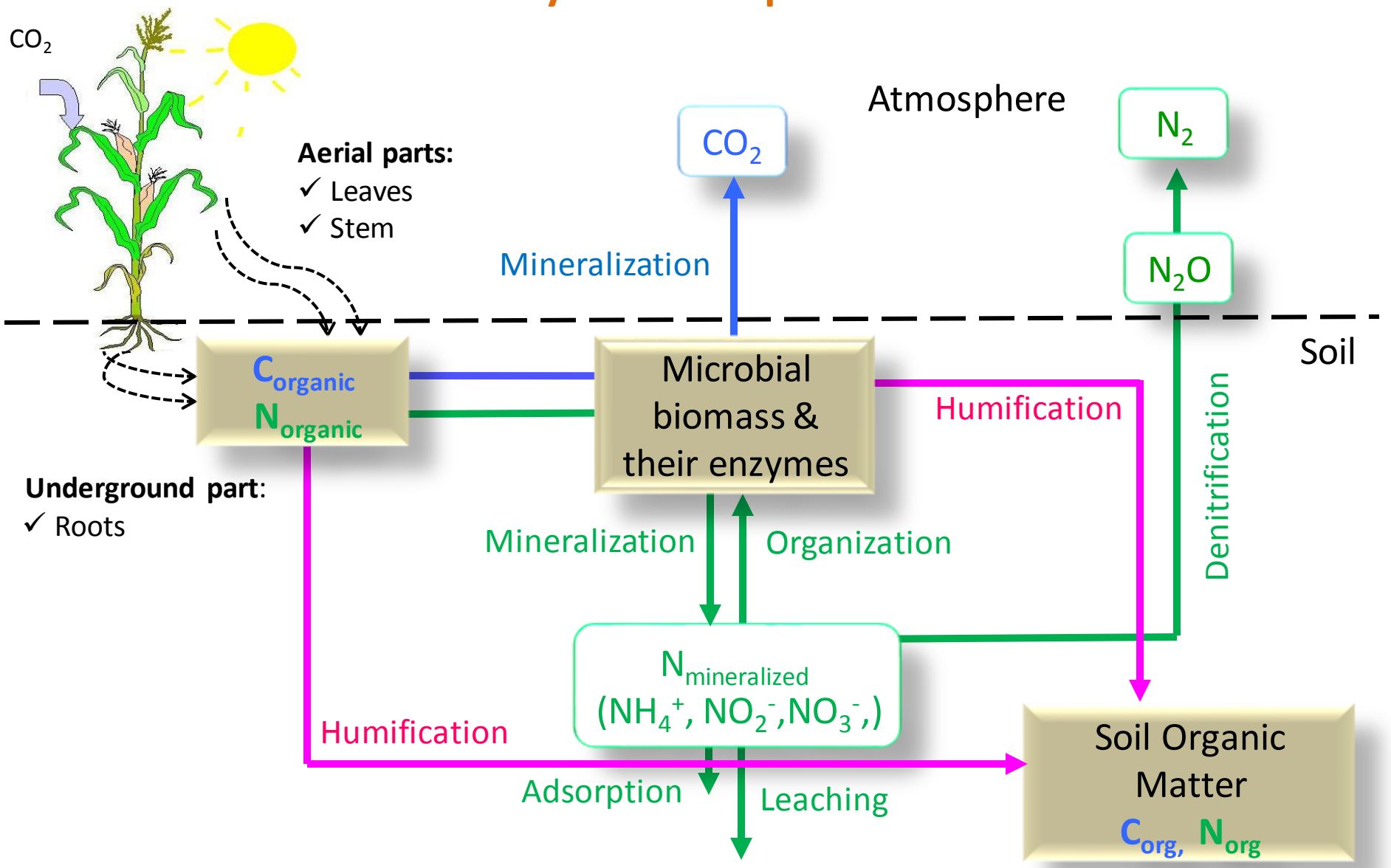


Thermosphere

"Hot layer" – oxygen molecules absorb energy from solar Rays warming the air. Very few atoms and molecules in this Region.

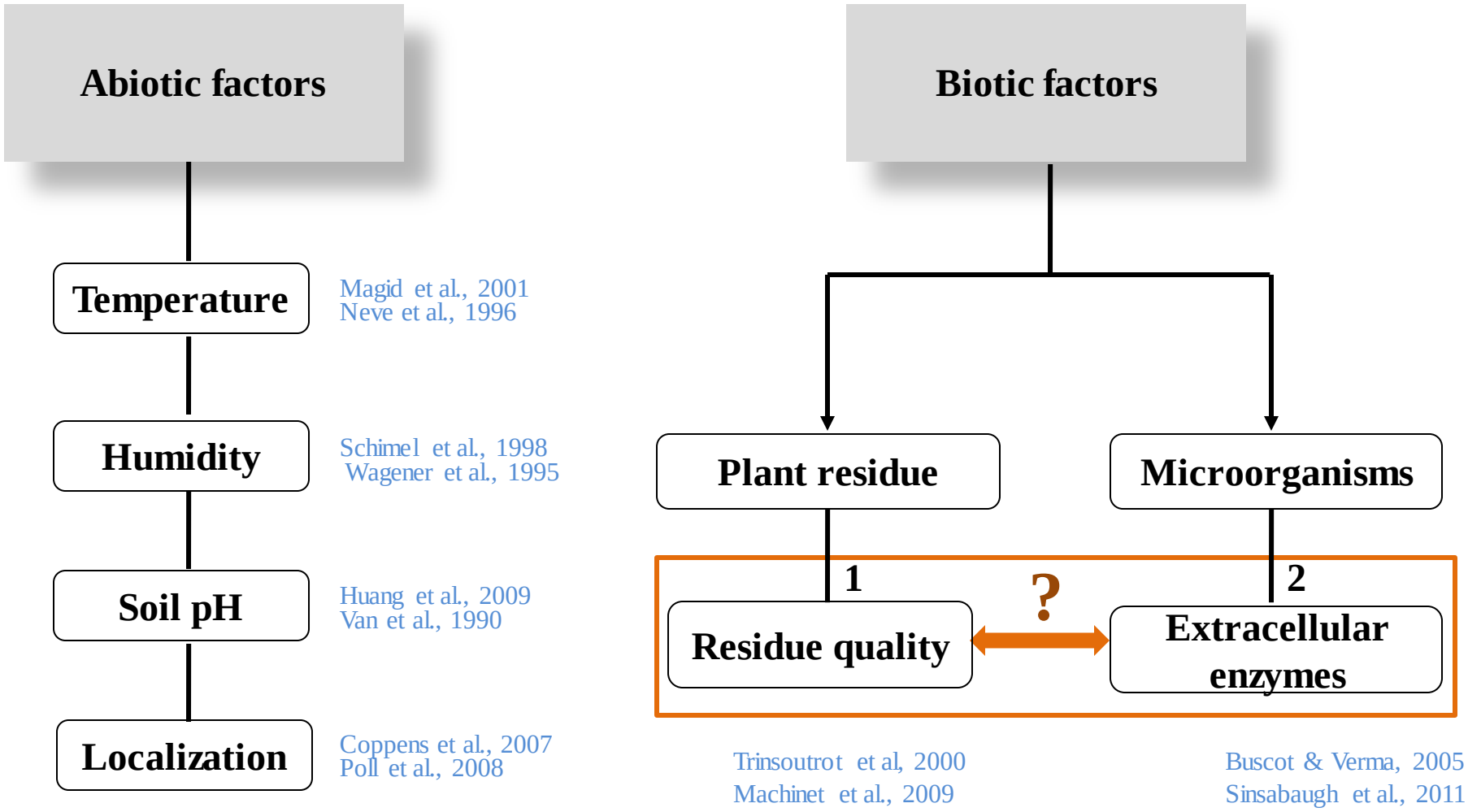
- Above mesopause zone of atmosphere is called thermosphere
- Boundary b/w mesosphere and thermosphere is called mesopause
- Contain oxygen ions (O^+), molecular oxygen ions (O_2^+), and molecular nitrogen ions (N_2^+)
- These ions absorb invisible short wave solar radiation

C & N dynamics of plant residues



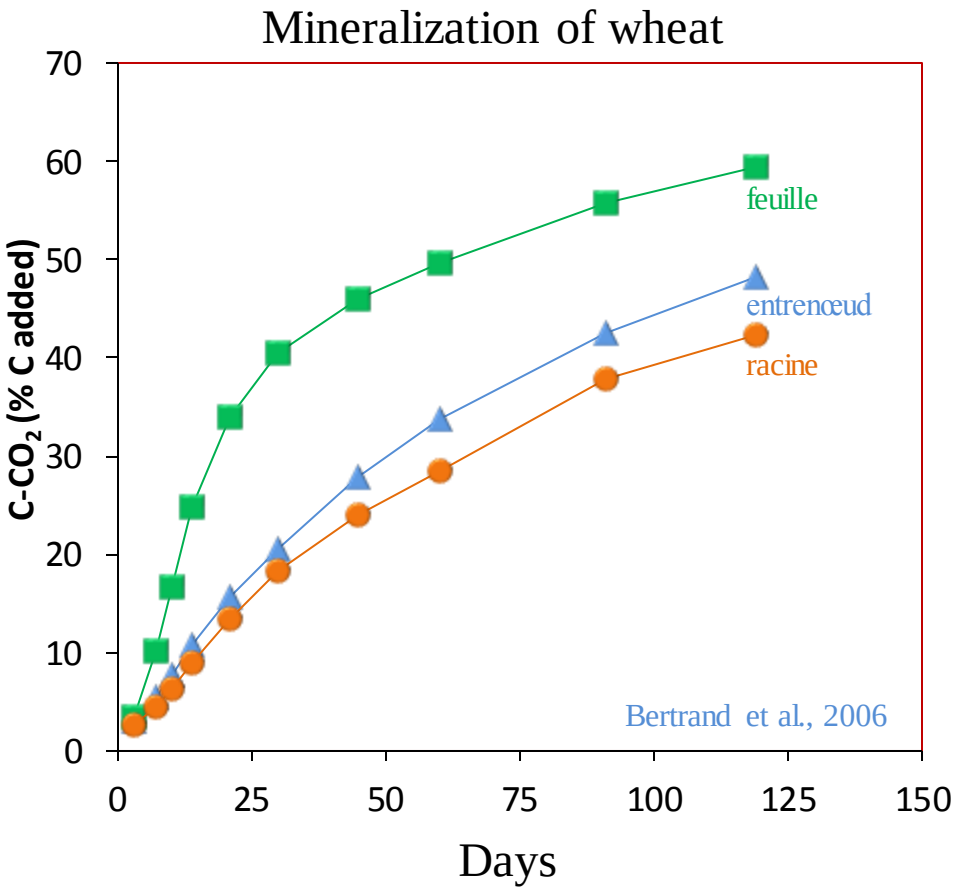
➢ **Plant residue decomposition: important role in C & N cycles**

Factors affecting process of decomposition



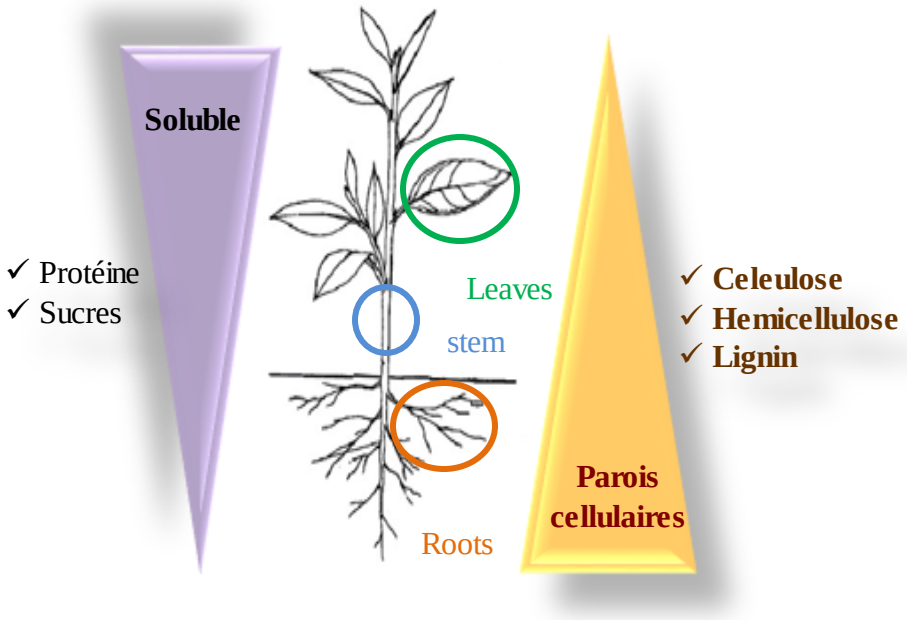
The effect of plant residue quality on enzyme dynamics and their interaction is less studied as compared to other factors

Effect of chemical composition of plant residue of C mineralization



➢ **Nature of residue**

- ✓ Species
- ✓ Type of organ
- ✓ Degee of maturity



➢ Chemical composition of plant residue determines the rate of decomposition

➢ Proportion soluble- cell wall play an important role in the processes of decomposition

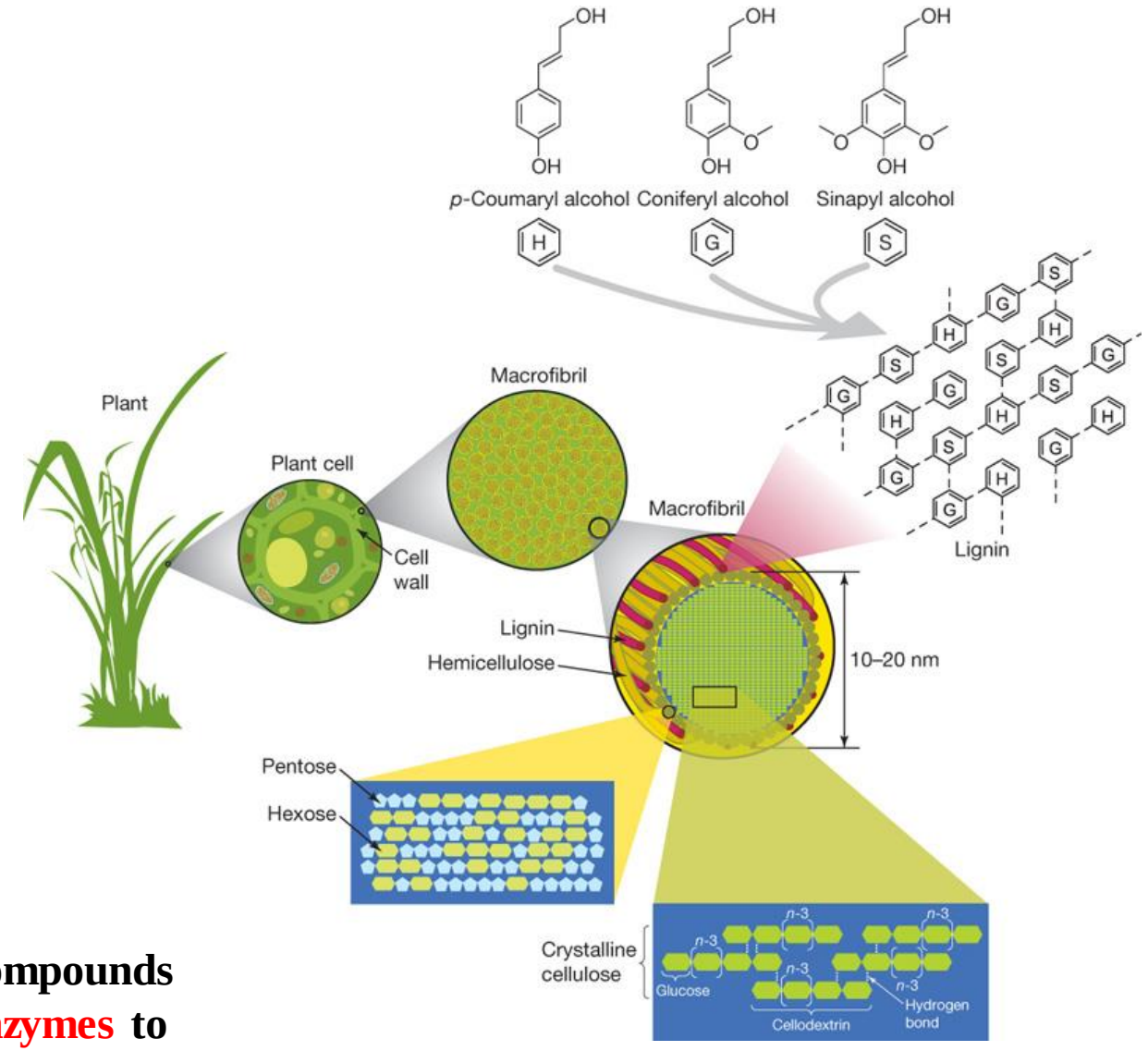
Composition plant cell wall

Cell wall: Heterogeneous composition

Cellulose, hemicellulose, lignin

Interaction of plant cell wall compounds form complex architecture

The organization of cell wall compounds influence the accessibility of enzymes to polymers (Chesson et al., 1988)



(Rubin, 2008)

Enzymes → Protéines, biocatalyseurs qui ont la propriété de catalyser des réactions biochimiques spécifiques

$$E + S \xrightarrow[H_2O]{\text{Hydrolase}} E + P$$

Enzymes categories:

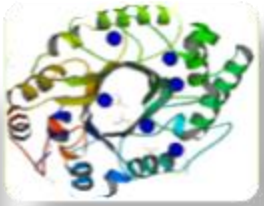
Extracellular enzymes

- Fungal or bacterial origin
- Secreted actively in the environment
- Metabolic functions in the biogeochemical cycles of soil
- ex. xylanase, laccase

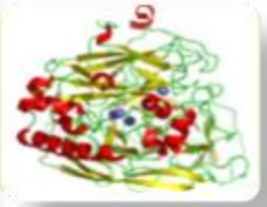
Intercellular enzymes

- Microbial origin(plant, animal)
- Located in the cells of organisms
- Metabolic functions of the microorganisms which produce them.
- ex. deshydrogénases

Deshydrogenase



Xylanase

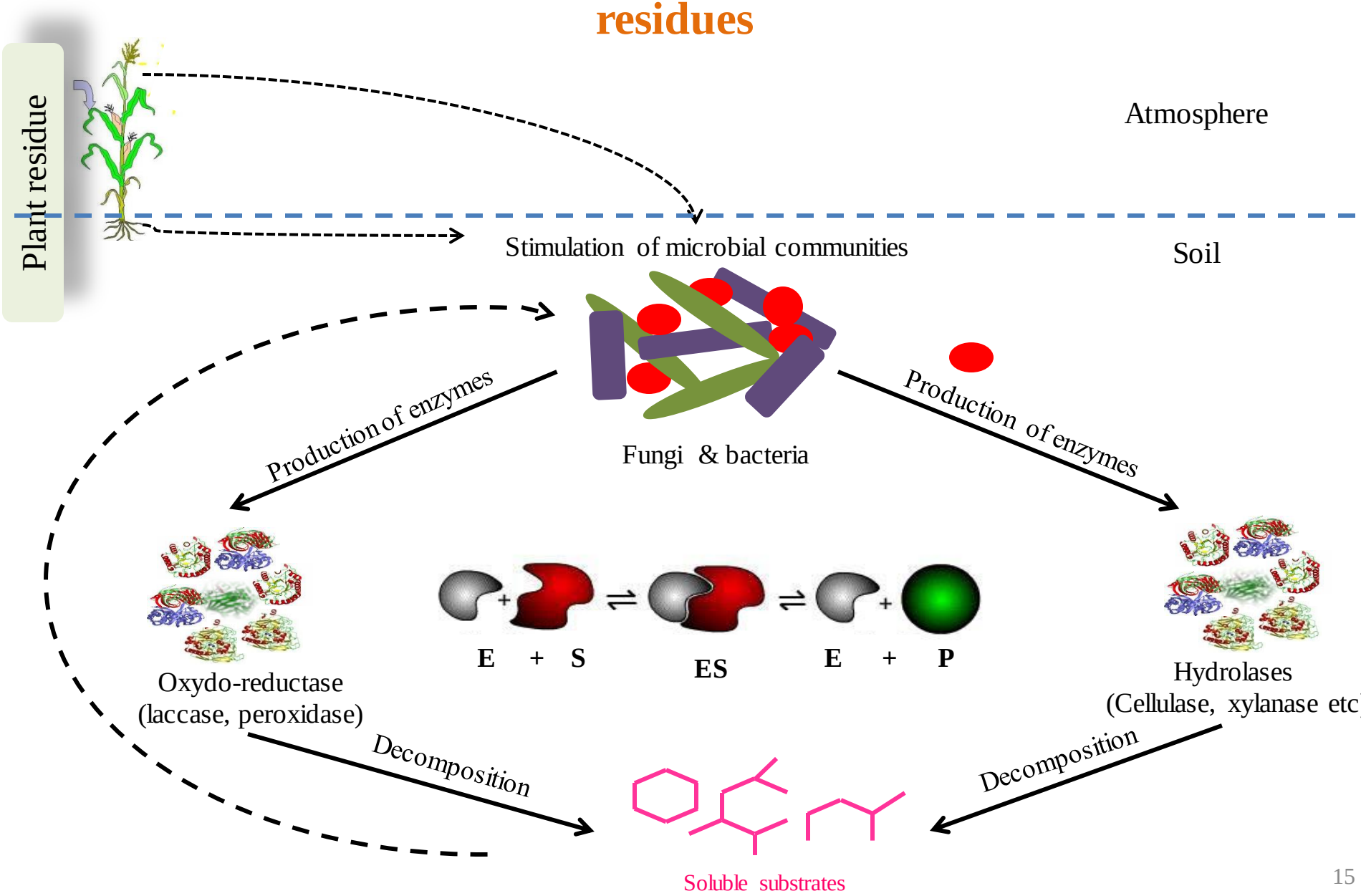


Laccase

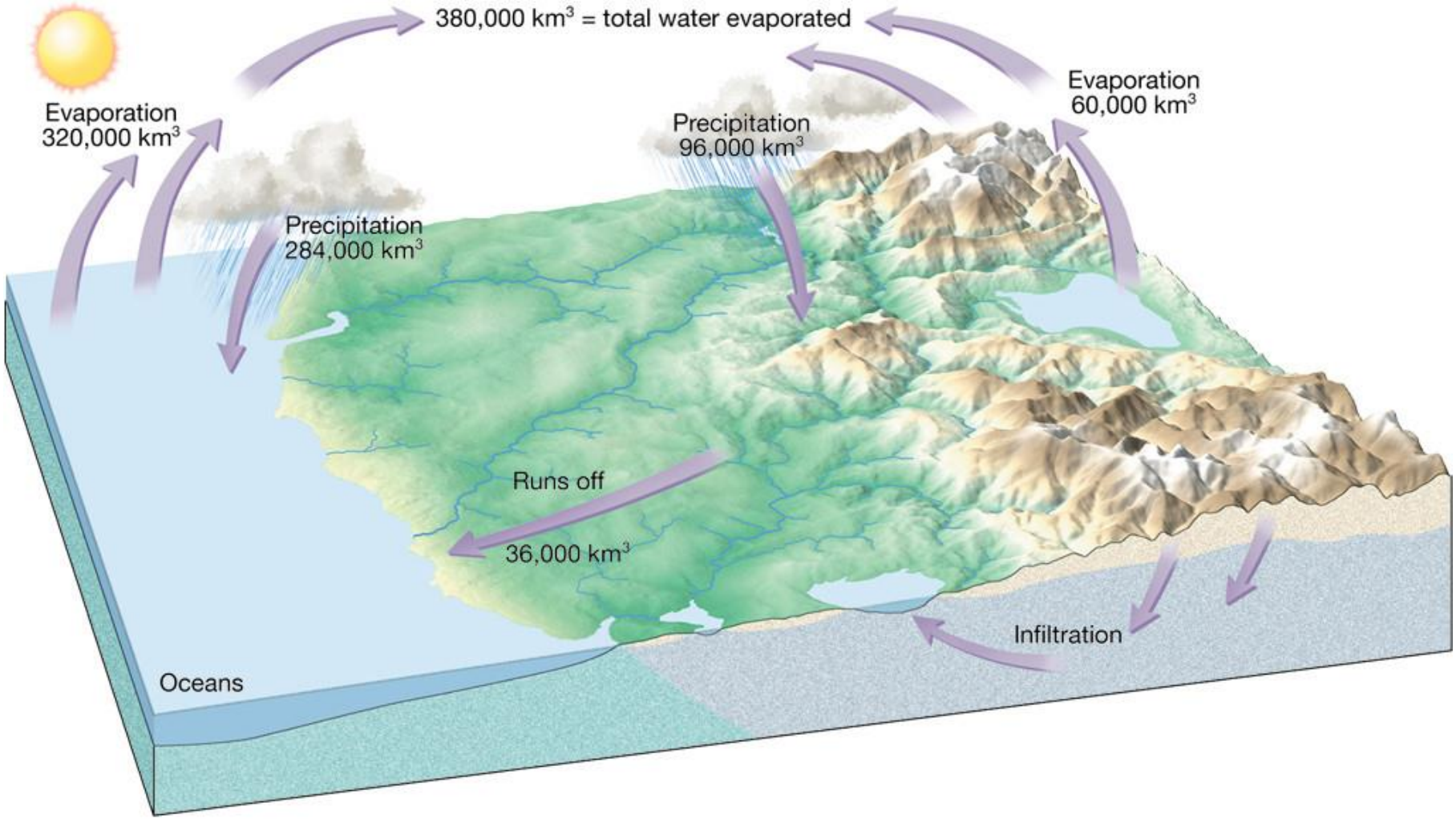
Enzyme families:

Oxido-reductase (EC 1): To catalyze oxidation/reduction reaction
Transferase (EC 2): Transfer functional group from one substance to another
Hydrolase (EC 3): Formation of two products from a substrate by hydrolysis
Lyase (EC 4): Non-hydolytic addition/removal of groups from substrates
Isomerase (EC 5): Isomerization changes within a molecule
Ligase (EC 6): Join together two molecules with breakdown of ATP

Role and mode of action of enzymes in the degradation of plant residues



The Hydrologic Cycle



Average reservoir residence times

Reservoir	Average residence time
Antarctica	20,000 years
Oceans	3,200 years
Glaciers	20 to 100 years
Seasonal snow cover	2 to 6 months
Soil moisture	1 to 2 months
Groundwater: shallow	100 to 200 years
Groundwater: deep	10,000 years
Lakes	50 to 100 years
Rivers	2 to 6 months
Atmosphere	9 days

How can calculate residencial time?

1) Principle of conservation of mass

Assumes the amount of water in a given reservoir is roughly constant.

With this method, residence times are estimated by dividing the volume of the reservoir by the rate by which water either enters or exits the reservoir. Conceptually, this is equivalent to timing how long it would take the reservoir to become filled from empty if no water were to leave

2) Isotope hydrology is a field of hydrology that uses isotopic dating to estimate the age and origins of water and of movement within the hydrologic cycle.

Water molecules carry unique fingerprints, based in part on differing proportions of the oxygen and hydrogen isotopes that constitute all water

Air, soil and water contain mostly oxygen 16 (^{16}O). Oxygen 18 (^{18}O) occurs in approximately one oxygen atom in every five hundred and is a bit heavier than oxygen 16, as it has two extra neutrons. From a simple energy standpoint this results in a preference for evaporating the lighter ^{16}O containing water and leaving more of the ^{18}O water behind in the liquid state (called fractionation). Thus seawater tends to be richer in ^{18}O and rain and snow relatively depleted in ^{18}O.

Human activities that alter the water cycle include:

- agriculture
- industry
- alteration of the chemical composition of the atmosphere
- construction of dams
- deforestation and afforestation
- removal of groundwater from wells
- water abstraction from rivers
- urbanization

Impact of hydrological cycle

86% of the global evaporation occurs from the oceans, reducing their temperature by evaporative cooling . Without the cooling, the effect of evaporation on the greenhouse effect would lead to a much higher surface temperature of 67 °C (153 °F), and a warmer planet

Runoff is responsible for almost all of the transport of eroded sediment and phosphorus from land to waterbodies.

The salinity of the oceans is derived from erosion and transport of dissolved salts from the land.

Cultural eutrophication of lakes is primarily due to phosphorus, applied in excess to agricultural fields in fertilizers, and then transported overland and down rivers.

Both runoff and groundwater flow play significant roles in transporting nitrogen from the land to waterbodies.

Increased population growth, urbanization and industrialization accelerates environmental pollution via fossil fuel burning.

Natural Ecosystems

Anthropogenic Influence

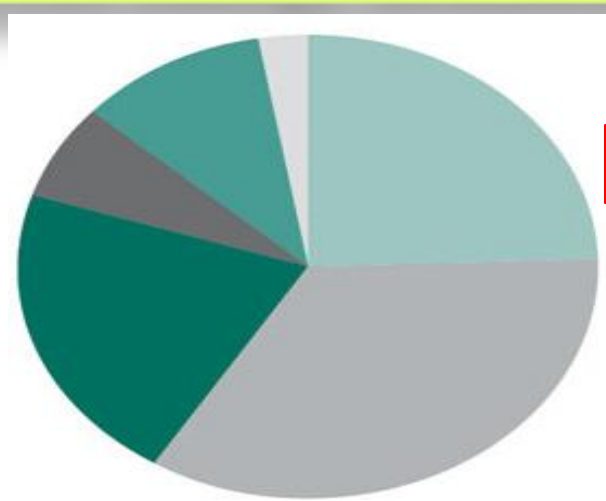
urbanization

Industrialization

Municipal Solid Wastes (MSW)

Alternative is required !!!!!

Current energy demands:



Non-renewable

Coal	24.4
Oil	34.4
Gas	21.2
Nuclear	6.5

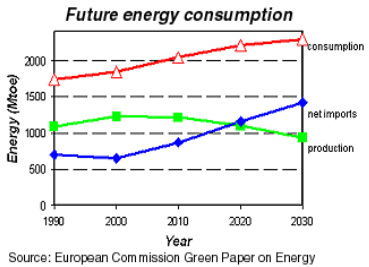
Renewable

Biofuels	10.6
Other renewables	2.7

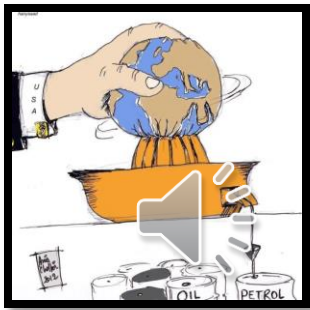
Future energy scenario….

Factors determining future energy choices:

- Oil price
- Depletion of oil reserves
- Greenhouse gas emissions
- Energy dependence



Source: European Commission Green Paper on Energy

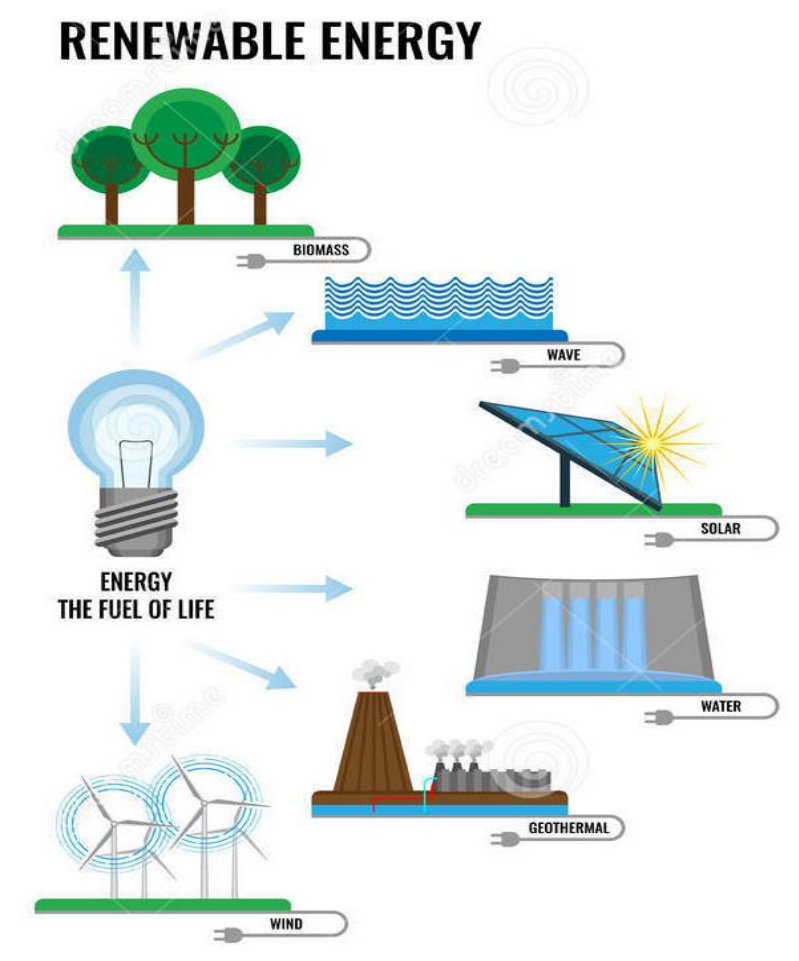


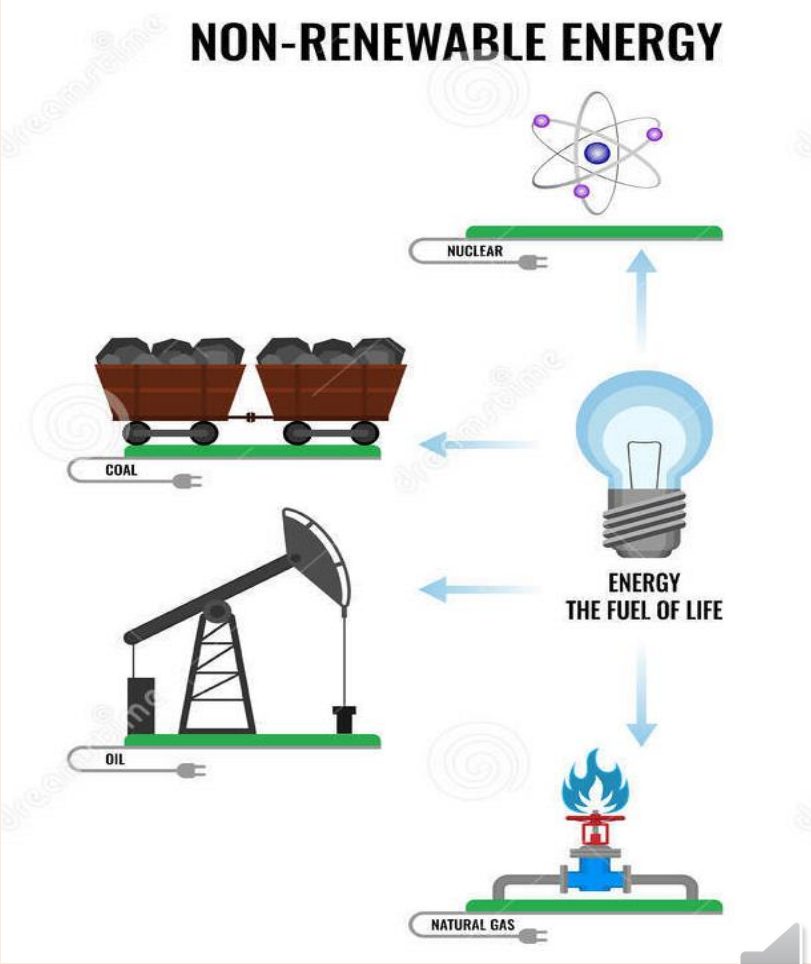
Renewable Energy Resources vs Non-Renewable Energy Resource

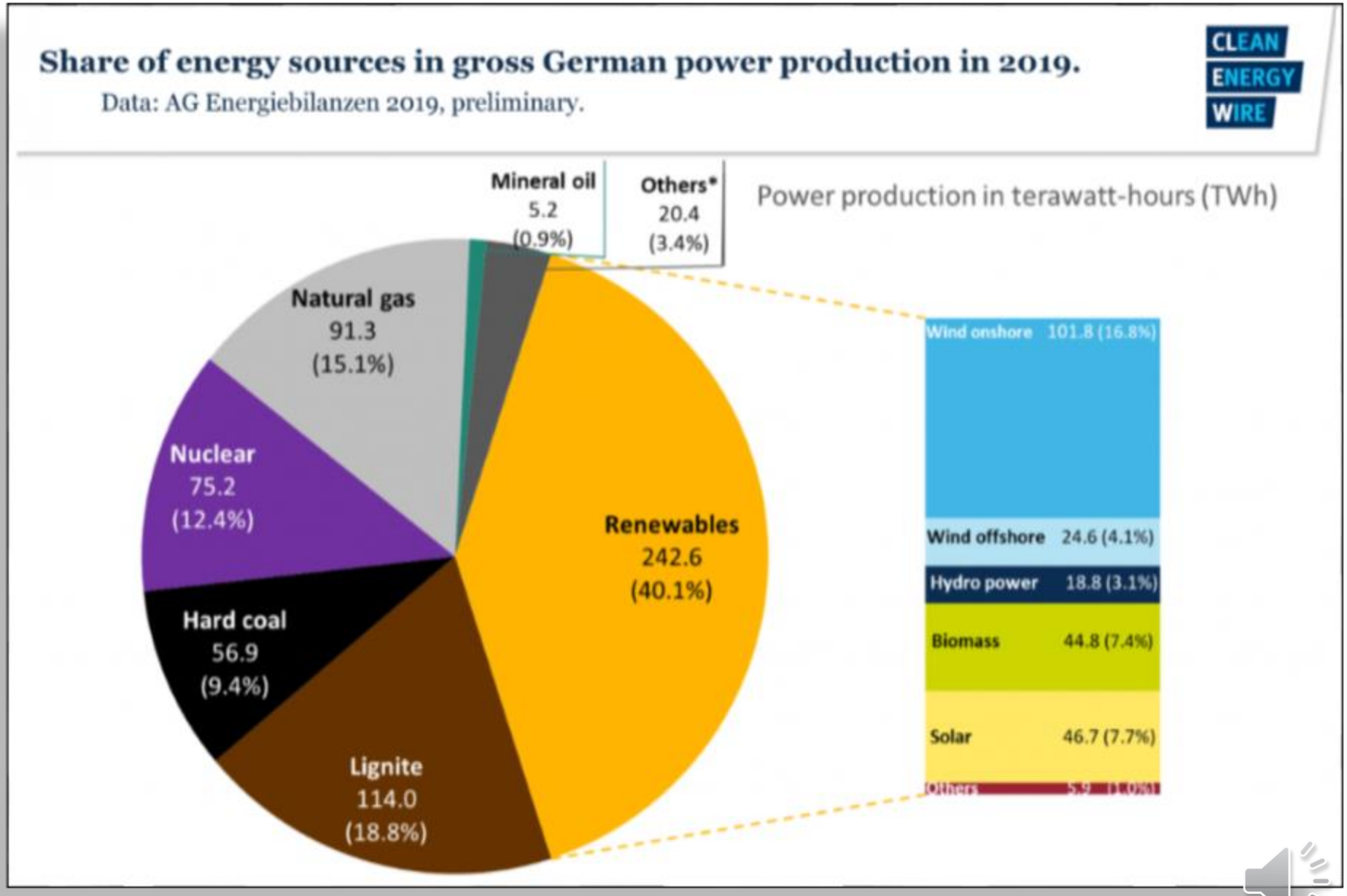
- Renewable energy is energy obtained from sources that are essentially inexhaustible. Examples of renewable resources include wind power, solar power, geothermal energy, tidal power and hydroelectric power. The most important features of renewable energy is that it can be harnessed without the release of harmful pollutants.

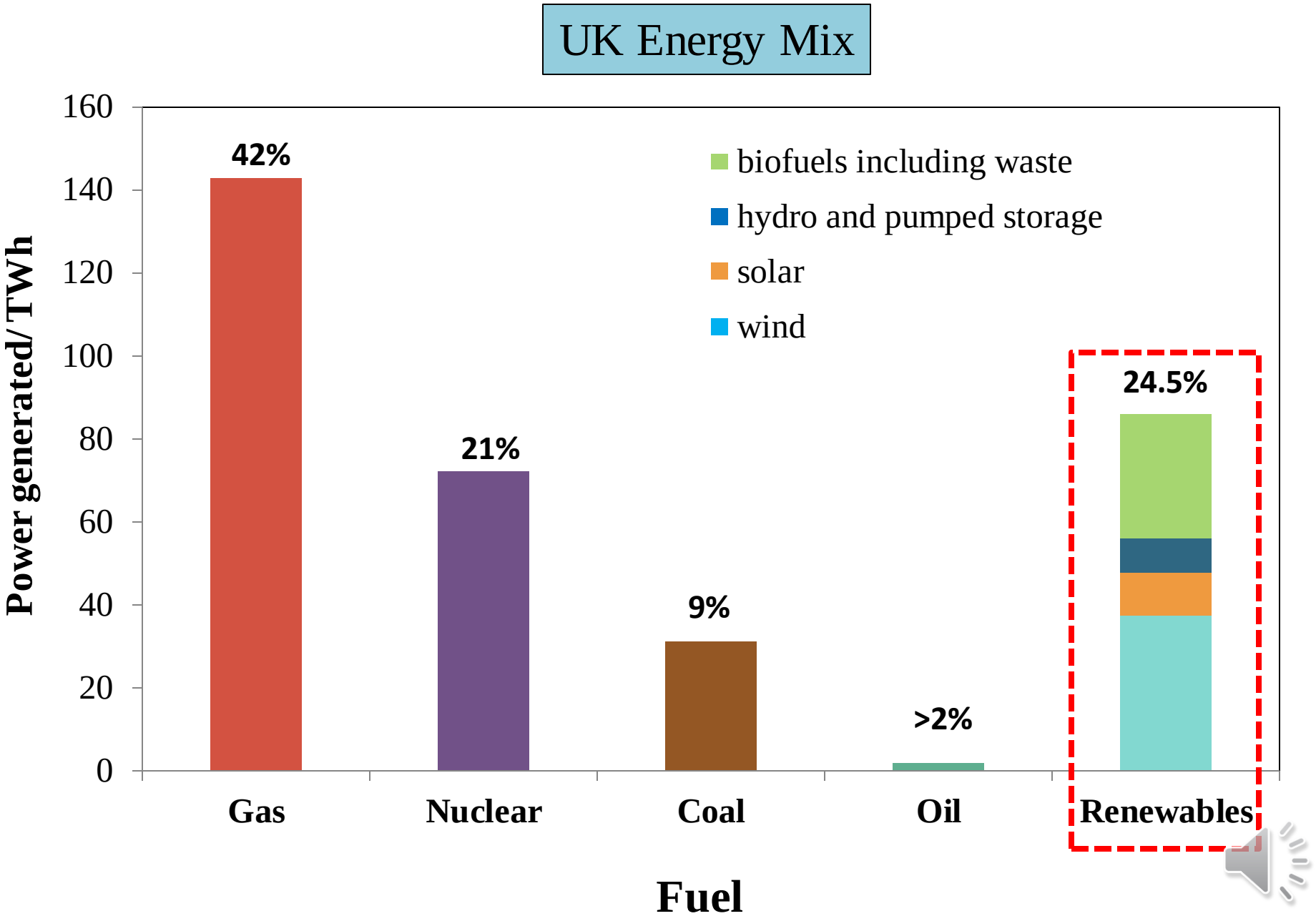
- Non-renewable energy is the conventional fossil fuels such as coal, oil and gas, which are likely to deplete with time.

Renewable Energy Resources vs Non-Renewable Energy Resource






Share of energy sources in gross German power production in 2019.
Data: AG Energiebilanzen 2019, preliminary.
CLEAN ENERGY WIRE
Mineral oil 5.2 (0.9%)
Others* 20.4 (3.4%)
Power production in terawatt-hours (TWh)
Natural gas 91.3 (15.1%)
Nuclear 75.2 (12.4%)
Renewables 242.6 (40.1%)
Hard coal 56.9 (9.4%)
Lignite 114.0 (18.8%)
Wind onshore 101.8 (16.8%)
Wind offshore 24.6 (4.1%)
Hydro power 18.8 (3.1%)
Biomass 44.8 (7.4%)
Solar 46.7 (7.7%)


UK Energy Mix
Power generated/ TWh
160
140
120
100
80
60
40
20
0
42%
21%
9%
>2%
24.5%
biofuels including waste
hydro and pumped storage
solar
wind
Gas
Nuclear
Coal
Oil
Renewables
Fuel

Renewable energy, the ultimate need!

- Renewable energy is energy that is collected from natural sources that can't be depleted such as **biomass, sunlight, wind**, and **hydropower**.
- Since these natural sources aren't going anywhere anytime soon, using them to generate power is not only **reliable** but is **eco-friendly**, too.
- Plus, these **types of alternative energy** don't typically produce any negative byproducts like those produced when burning fossil fuels for energy, which causes serious harm to the environment.
- Of course, we've all heard that renewable energy is important and that we should be using it **instead of fossil fuels, but why?**

Renewable energy vs. fossil fuels

Fortunately, renewable energy usage is on the rise. It's predicted clean energy will make up 20% of energy usage by the end of 2025, and that number will only continue to increase.

We've already covered many of the advantages of using renewable energy, so let's do a quick recap:

- **Renewable energy isn't going anywhere** – unlike fossil fuels, wind, solar, hydro, and geothermal energy will always exist.
- **Minimize greenhouse gasses** – though manufacturing of a wind turbine has an environmental impact, it is able to cancel out its own carbon footprint after just 6 months of use. Then it's pure, clean energy forever.
- **Minimize pollutants** – renewable energy sources don't produce smog, acid rain, or other byproducts that can become trapped in the atmosphere and cause respiratory disease.
- **Low cost** – once a renewable energy farm has been built, it requires almost no maintenance for at least 20 years. That means costs stay low and this will in turn lower the cost of power over the long term.
- **Creates jobs** – over 12,000 jobs were created in the US by wind power in 2019.

Why is the development of renewable energy sources so important?

- According to experts, we may only have **until 2040** to reverse the effects of **climate change** before irreparable damage is done. Here's why:
- **Fossil fuels will run out** – experts believe we have between 53 and 110 years before non-renewable sources will be scarce and therefore unable to power our world.
- **Sustainable energy sources are much more affordable** – they pay for themselves over time (both financially and environmentally!), and that means cheaper electricity for the consumer.
- **Air pollutants and smog** hanging over our cities cause allergies, symptoms of asthma, and even lung disease.
- **Climate change, acid rain**, and physical damage to the environment are also major negative impacts caused by our continued reliance on fossil fuels.
- Plus, **clean energy reduces the risk of respiratory health problem**s. According to the World Health Organization, household and ambient air pollution caused 7 million deaths globally in 2016.

Fossil fuel burning as major precursor of Air pollution

Air pollutants occur either as gases or particulate matter

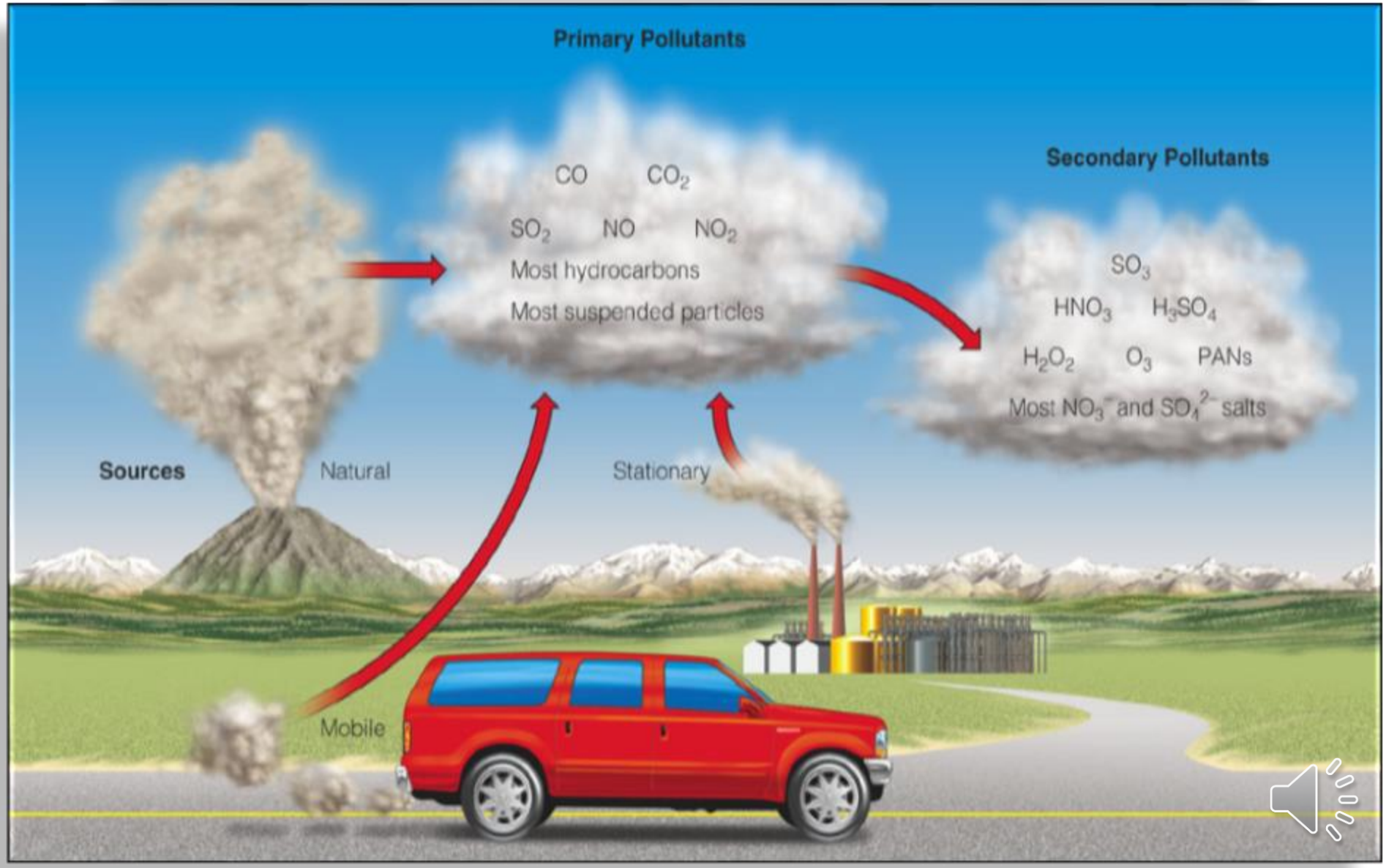
- **Primary air pollutants**
- **Secondary air pollutants**
- **Particulates**

Primary - Released directly into the air from point sources (stationary/ mobile). For example: CO_2, SOx, NOx etc

Secondary - Formed when primary pollutants react or combine with one another, or basic elements. For example: H_2SO_4, HNO_3, SO_3 etc

Particulates - small pieces of solid materials and liquid droplets (2.5 mm and 10 mm). For example: ash from fires, asbestos from brakes and insulation, dust etc

Fossil fuel burning as major precursor of air pollution



Nitrogen Oxides-NO_X

- Produced from burning of fossil fuels
- Contributes to acid rain, smog
- Automobile engine main source
- New engine technology has helped to reduce, but still harmful emissions in air

Sulphur Dioxide-SO_x

- Produced by burning sulfur containing fossil fuels (coal, oil)
- Coal-burning power plants major source
- Reacts in atmosphere to produce acids major components of acid rain
- When inhaled, can be very corrosive to lung tissue

Carbon Monoxide-CO

- Produced by burning of organic material (coal, gas, wood, trash, etc.)
- Automobiles biggest source (80%)
- Cigarette smoke another major source
- Toxic because binds to hemoglobin, reduces oxygen in blood
- Not a persistent pollutant, combines with oxygen to form CO_2

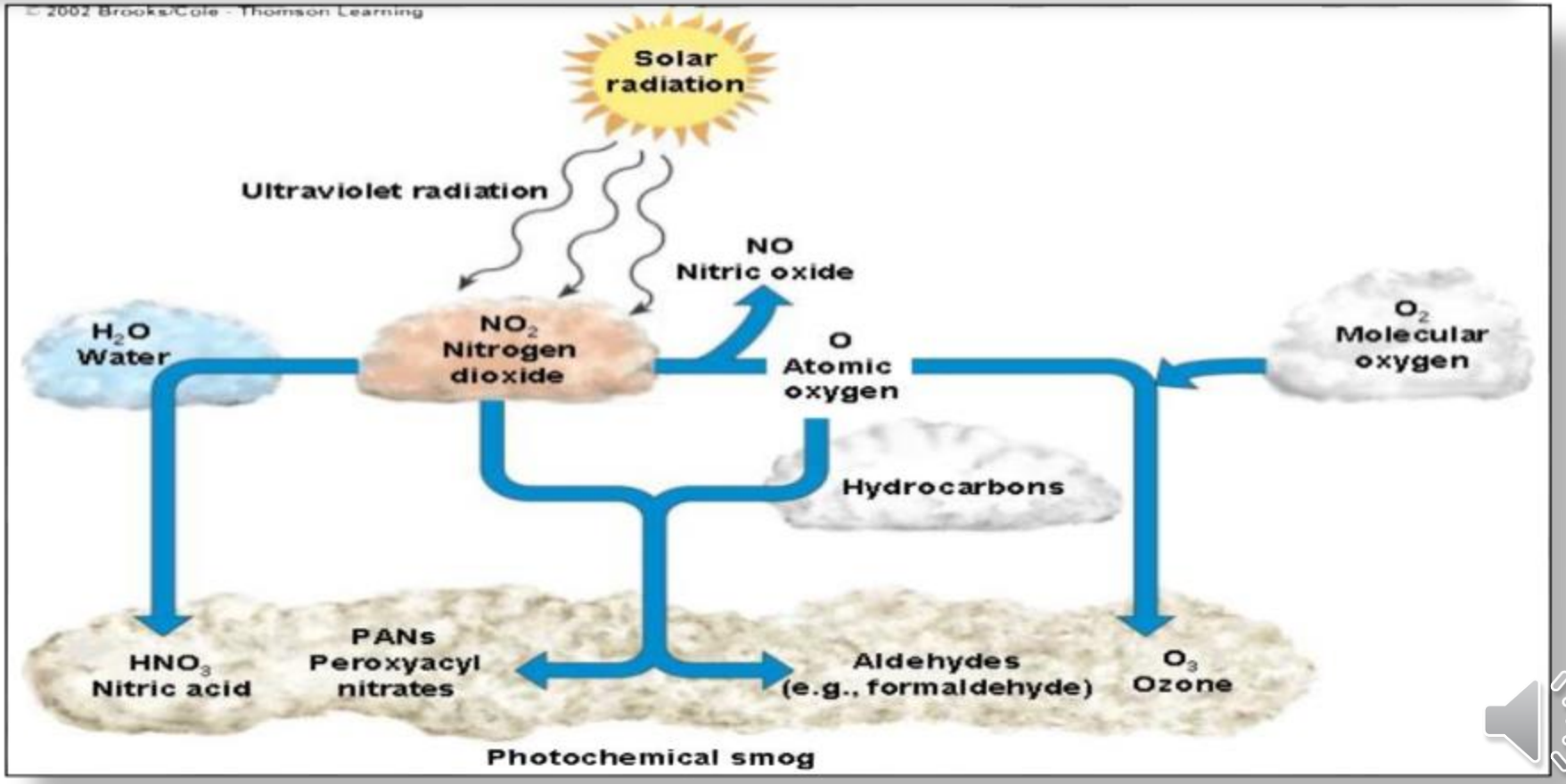
Hydrocarbons-CH

- Hydrocarbons - organic compounds with hydrogen, carbon
- From incomplete burning or evaporated from fuel supplies
- Major source is automobiles, but some from industry
- Contribute to smog
- Improvements in engine design have helped reduce its emission into the air

Photochemical Smog

Smog = Smoke + Fog

Some primary pollutants (NO_x) react under the influence of sunlight (photochemical reaction), to produce secondary pollutants like O_3, HNO_3, aldehydes and PANs.



Source	Necessary conditions	Reactions take place in atmosphere	Products
Primarily automobiles	volatile organic compounds (VOC) present	$VOC + O^* \text{ or } O_3 \rightarrow$ highly reactive organic radicals $+ NO_2 \rightarrow$ Peroxyacetyl nitrates; Aldehydes	
Primarily automobiles	Nitrogen monoxide (NO) present	$NO +$ organic radicals $\rightarrow NO_2$	
From automobiles and formed from NO	Nitrogen dioxide (NO_2) present	$O^* + O_2 \rightarrow O_3$ (ozone) $\rightarrow$ Ozone; $NO_2 \rightarrow NO + O^*$ (atomic oxygen); sunlight	
Sun	Sunlight		
Sun (summer temperatures)	Heat	Reactions take place more rapidly at higher temperatures.	

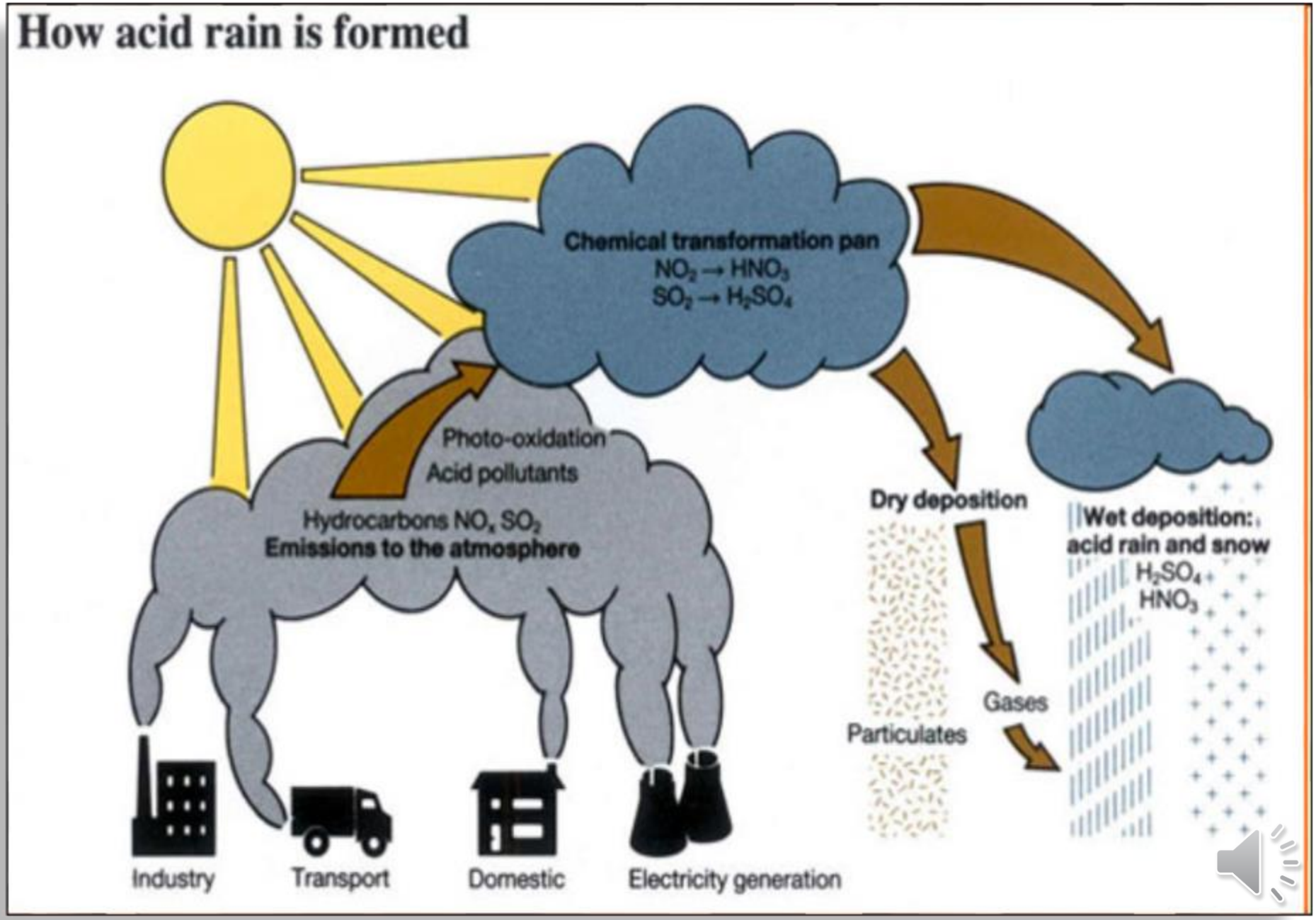
What is Acid rain?

Acid rain is rain that is more acidic than normal.

Sulfur dioxide and nitrogen oxides, the major sources of acid rain

Causes of Acid Rain

- ✓ Burning coal, Oil and natural gas, in power stations makes electricity, giving off sulphur dioxide gas.
- ✓ Burning petrol and oil in vehicle engines gives off nitrogen oxides as gases.
- ✓ These gases mix with water vapour and rainwater in the atmosphere producing weak solutions of sulphuric and nitric acids – which fall as acid rain.


How acid rain is formed
Chemical transformation pan
$NO_2 \rightarrow HNO_3$
$SO_2 \rightarrow H_2SO_4$
Photo-oxidation
Acid pollutants
Hydrocarbons NO_x, SO_2
Emissions to the atmosphere
Dry deposition
Wet deposition:
acid rain and snow
H_2SO_4
HNO_3
Gases
Particulates
Industry
Transport
Domestic
Electricity generation

Types of Acid Rain

Dry Deposition

- Dry deposition refers to acidic gases and particles.
- About half of the acidity in the atmosphere falls back to earth through dry deposition

Wet Deposition

- Wet deposition refers to acidic rain, fog, and snow.
- As this acidic water flows over and through the ground, it affects a variety of plants and animals.

Effects Of Acid Rain

Non-living

- ✓ The Taj Mahal in Agra, suffering from sulphur dioxide, sulphuric acid and other fumes pollutants released from Mathura Refinery.
- ✓ Acid Rain causes extensive damage to building, statues, bridges, & structural materials of marble, lime stone, etc.

Living organism

- Respiratory diseases
- Toxic metal leaching
- Damage to structures, especially containing calcium carbonate
- Decreased visibility
- Decreased productivity and profitability of fisheries, forests, and farms

Plant & Soil

- Acid Rain dissolves all the nutrients and the useful minerals for the tree to grow.
- Weakens the process of photosynthesis.
- Acid Rain leaches potassium, calcium, magnesium, etc essential elements from the top of soil & When soil is contaminated, cereal (arable) production crops.
- Acids activate aluminium from the soil which leaches into water and fish die. Drinking water is contaminated.

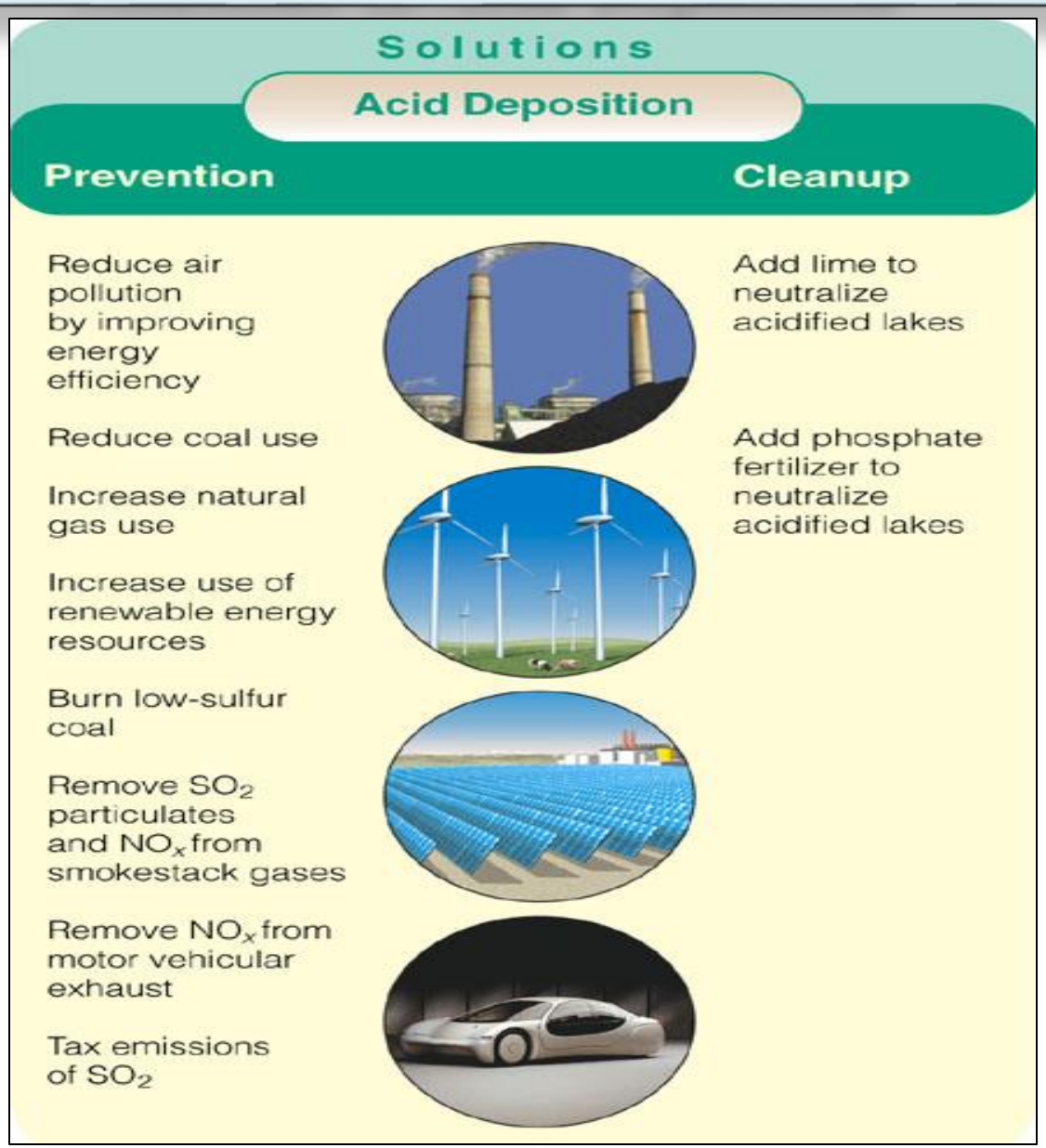
Air Pollution Control

Early approach:

"Dilution is the solution to pollution"

- Particulate removal - air filters
- Sulfur removal - scrubbers
- Nitrogen oxide reduction - catalytic converters
- Hydrocarbon controls - afterburners

Solutions to Acid Deposition



CLEAN AIR LEGISLATION

- Clean Air Act (1963) - First national air pollution control.

- Clean Air Act (1970) rewrote original Act.
  - Identified critical pollutants
  - Established ambient air quality standards.
    - Primary Standards - Human health
    - Secondary Standards - Materials, environment

Thanks for your Attention