CLIMATE DEFENDERS

Category-1 Guidebook

For Students in Grades Preschool to 3

Green Living Association

About the Guidebooks

Climate Change is no longer a distant concern—it is the reality we live with every day. From intense monsoon rains and cloudbursts to heatwaves and floods, Pakistan is already among the most climate-vulnerable countries in the world. Our classrooms are filled with students whose families, communities, and futures are directly impacted by these changes. This makes climate education not just a subject, but a **lifeline for resilience, awareness, and action.**

As educators, we are entrusted with preparing the next generation not only to excel academically but also to become responsible citizens who can face global challenges with courage and knowledge. By guiding students through understanding the causes, impacts, and solutions, we help them **connect science with everyday life and empower them to be part of the solution**.

A central theme in the guidebooks is the **green energy transition**—shifting from fossil fuels to renewable sources such as solar, wind, and hydropower. This transition is one of the most powerful tools we have to **mitigate climate change** by reducing harmful emissions. At the same time, it offers Pakistan new opportunities for innovation, green jobs, and sustainable development. Students must see themselves not only as victims of climate change but as **leaders of change**, capable of shaping a cleaner and brighter future for their communities and their nation.

The ***Climate Defenders*** guidebooks are created to present these vital concepts in simple, age-appropriate language, enriched with real-life examples from Pakistan. Each section is carefully structured to build students' understanding—starting from the fundamentals of climate science and moving toward practical actions they can take at home, in school, and within society. Through these lessons, we aim not only to **expand participants' knowledge** but also to nurture their **skills, values, and sense of responsibility** to actively respond to the climate crisis.

Developing the comprehensive project *'**Climate Defenders**'* for Green Ambassadors and their families has been a true challenge, given the need to accommodate students of different educational levels, diverse subjects, and varied institutions. Thanks to the dedicated efforts of **GLA's technical team, our global partners**, and **volunteer associates**, this vision has been successfully realized.

The implementation of this project would not have been possible without the active support of the committed management teams of our **Green Partner Schools and Campuses**, along with the enthusiastic participation of Green Ambassadors and their families. We sincerely thank you for your contribution and look forward to your continued partnership in shaping a **sustainable and dynamic society**, safeguarded against environmental threats.

This guidebook has been established under the ‘Green Studies’ approach, without using the booklet or any of its part as printed material.

Green Living Association

A Atmosphere (Artwork)

For Supporters

In the context of **Climate Change**, the atmosphere is the layer of gases that traps heat and moderates Earth's temperature, but it's also the primary medium for the buildup of **human-emitted greenhouse gases** like carbon dioxide and methane. This excess of gases intensifies the greenhouse effect, trapping more heat and causing **global warming**, a phenomenon that drives climate change through increased global temperatures, more intense storms, and altered weather patterns.

The main greenhouse gases that are causing climate change include **carbon dioxide and methane**. These come from using gasoline for driving a car or coal for heating a building, for example. **Clearing land and cutting down forests** can also release carbon dioxide. Agriculture, oil and gas operations are major sources of methane emissions. **Energy, industry, transport, buildings, agriculture and land use** are among the main sectors causing greenhouse gases.

B Biofuel

For Supporters

A type of fuel produced from plants or other forms of biomass. **Examples of biofuels include ethanol, biodiesel, and biogas**.

Biofuels, derived from renewable organic material, are viewed as a crucial tool in the fight against climate change due to their potential to **displace fossil fuels, thus reducing greenhouse gas (GHG) emissions and supporting net-zero goals**. However, their role is complex; while offering environmental benefits like carbon neutrality and energy security, the production of many biofuels raises sustainability concerns, including links to land-use change, competition with food production, and indirect GHG emissions.

Biofuels offer a way to reduce GHG emissions from sectors that are difficult to electrify, such as aviation and shipping, helping countries achieve net-zero emission targets.

Advanced biofuels and sustainable production methods are key to realizing their full climate mitigation potential and ensuring they contribute to a **greener energy future**.

C Coal

For Supporters

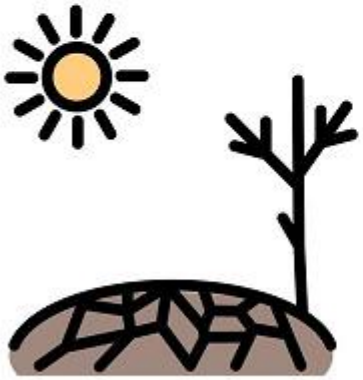
A dark-coloured solid fossil fuel that can be mined from the Earth. Coal is the **most abundant fossil fuel** produced in the world, including Pakistan.

Coal is a primary driver of **Climate Change** because its combustion releases large amounts of greenhouse gases, particularly carbon dioxide (CO_2) and methane. These gases **trap heat in the Earth's atmosphere**, causing global temperatures to rise and altering weather patterns. To combat climate change and achieve international temperature targets, a global phase-out of coal in favour of **renewable energy sources like solar and wind power** is considered essential, with the United Nations recommending a rapid transition away from coal.

The burning of coal for energy production is a major source of **greenhouse gas emissions**. Coal mining also releases **methane, a powerful greenhouse gas** that is significantly more potent than carbon dioxide.

Drought

D



For Supporters

Drought is a period of **unusually dry weather lasting long enough** to cause serious **shortages of water** for ecosystems and human use (such as drinking water and agriculture) in the affected area.

Climate Change worsens droughts by increasing temperatures, leading to higher evaporation rates that dry out soil and reduce water availability. This results in **more frequent, intense, and longer-lasting droughts**, particularly in vulnerable regions, with significant economic, social, and environmental impacts such as **agricultural failure, food insecurity, increased wildfire risk, and potential geopolitical tensions**. Societies must reduce carbon emissions and improve water management to mitigate these effects.

Higher global temperatures accelerate the rate at which water evaporates from the land and water bodies, leading to drier conditions. **Less snow and earlier snowmelt impact water availability**, as reduced snowpack means less water stored for longer periods.

Energy

E

For Supporters

Energy means ability to do work. Energy comes in many forms, such as **heat, light, motion, and electricity**. Most of the world's energy comes from **burning fossil fuels** to produce heat, which can then be converted into other forms of energy, such as motion (for example, driving a car) or electricity.

Energy production and consumption are the primary drivers of **Climate Change**, as the burning of fossil fuels for electricity, heat, and transportation releases vast amounts of **greenhouse gases** that trap heat and warm the planet. Conversely, climate change, through events like **heatwaves, droughts,** and **floods**, also puts stress on energy infrastructure, affecting fuel supplies and power generation. The solution involves a **global energy transition to renewable sources, improvements in energy efficiency,** and a **transformation of the entire energy sector** to reduce emissions and avoid the most severe impacts of climate change.

Fossil fuel

F

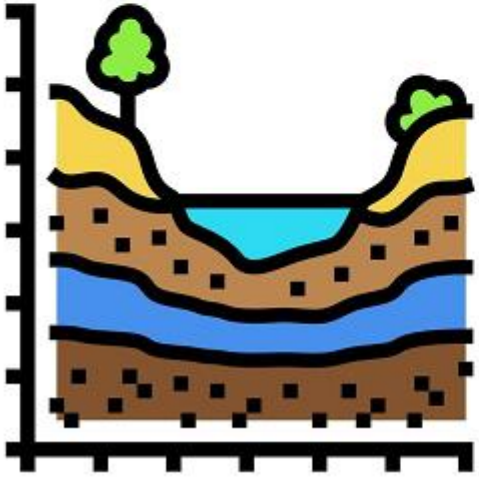
For Supporters

Fossil fuel is a type of fuel that forms deep within the Earth. Examples of fossil fuels include **coal, oil, and natural gas**. Fossil fuels are created over millions of years as dead plant and animal material becomes trapped and buried in layers of rock, and heat and pressure transform this material into a fuel. **All fossil fuels contain carbon**, and when people burn these fuels to produce energy, they create **carbon dioxide**.

Fossil fuels (coal, oil, and gas) are the primary driver of **Climate Change**, as burning them releases large amounts of heat-trapping **greenhouse gases** like carbon dioxide into the atmosphere. This phenomenon is causing **global warming**, **disrupting weather patterns**, and leading to **sea-level rise** and **extreme weather events**. To mitigate climate change, the world needs to rapidly **transition from fossil fuels to clean, renewable energy sources** to reduce greenhouse gas emissions and achieve net-zero emissions by 2050.

Ground water

G



For Supporters

Water that occurs below the surface of the Earth, where it occupies spaces in soil or layers of rock. When rain falls to the ground, some of it sinks into the ground and becomes ground water.

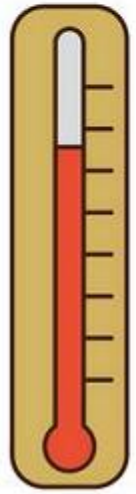
Climate Change affects groundwater by altering precipitation patterns and increasing temperatures, which can reduce aquifer recharge, diminish storage, and **degrade quality through factors like saltwater intrusion** in coastal areas. Despite these threats, **groundwater is vital for climate adaptation**, offering a reliable water source when surface water is scarce and supporting ecosystems. However, its sustainability is at risk, requiring better management and protection to ensure its **availability for future generations** facing increased climate variability and extremes.

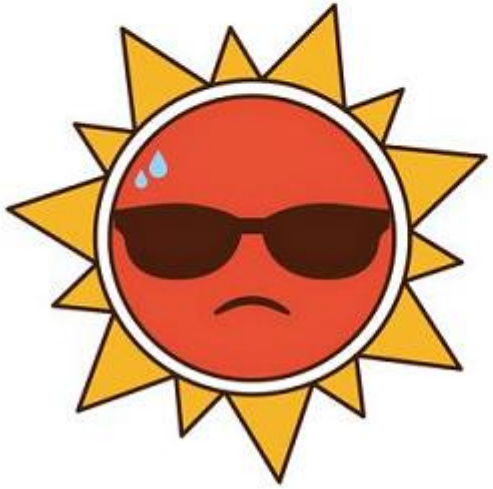
Changes in precipitation frequency, intensity, and seasonality, coupled with increased evaporation due to higher temperatures, disrupt **natural groundwater recharge**, reducing the amount of water stored in aquifers.

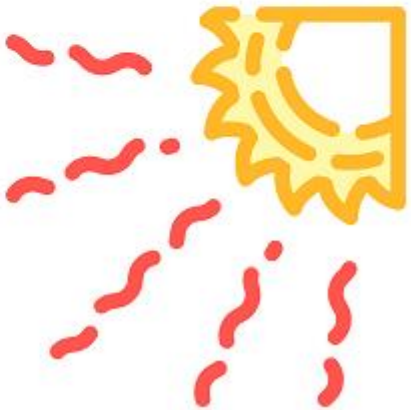
Heatwave

(Artwork)

H







For Supporters

A long period of abnormally hot weather, typically lasting for several days.

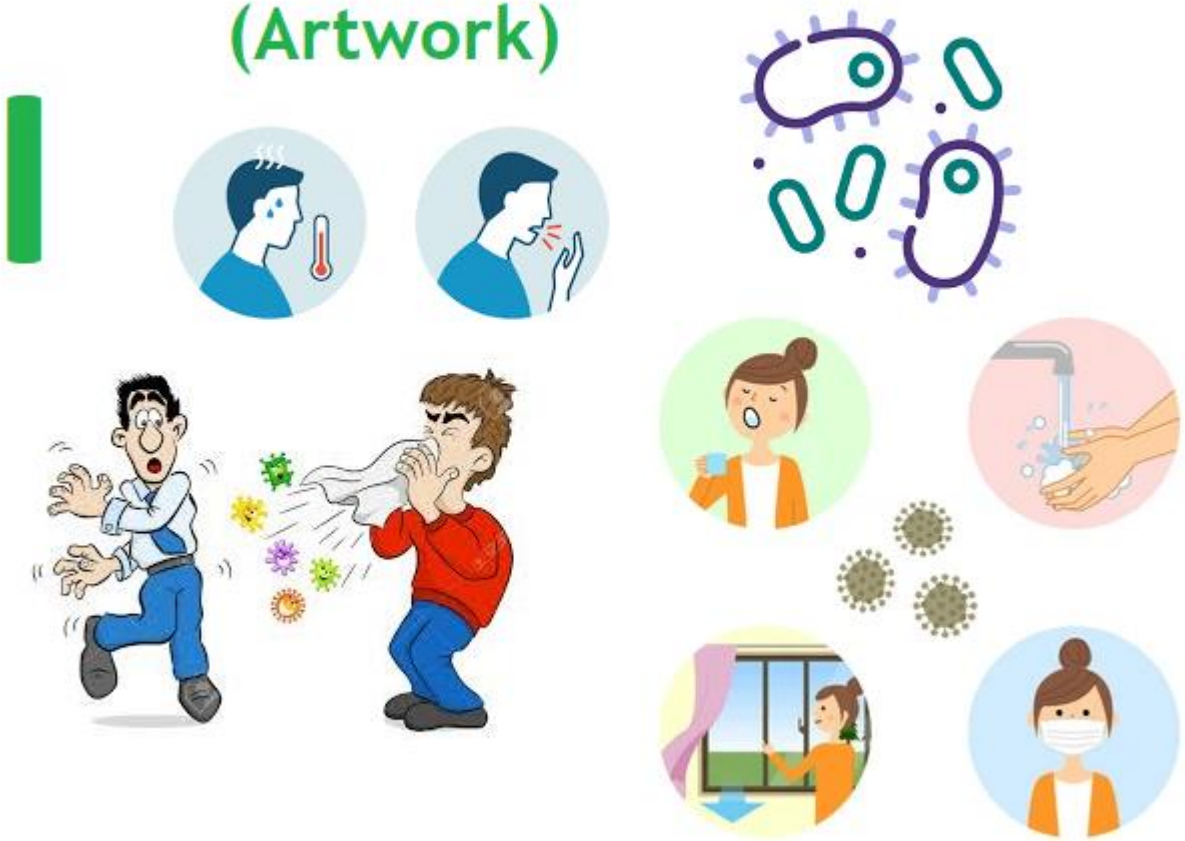
Climate Change increases the frequency, duration, and intensity of heatwaves by **trapping more heat in the atmosphere** due to greenhouse gas emissions. These extreme heat events, which are periods of **unusually high temperatures lasting several days**, stress human bodies, infrastructure, and ecosystems, leading to cascading health and socioeconomic impacts. Heatwaves are now **more likely and severe than in the past**, with some attributing human activity to making them significantly more frequent.

Human-induced Climate Change, driven by **greenhouse gas emissions**, leads to warmer global temperatures.

A heat wave occurs when the daily maximum temperature of more than five consecutive days **exceeds the average maximum temperature** by 5 °C (9 °F), the normal period being 1961–1990.

Infectious disease

(Artwork)



For Supporters

A disease caused by bacteria, a virus, or other organisms. **Climate Change** increases infectious disease risk by expanding the range and activity of disease vectors like mosquitoes and ticks, altering pathogen survival and reproduction, and contributing to **extreme weather events** that disrupt sanitation and spread waterborne and foodborne illnesses. Diseases such as **malaria, dengue fever, Lyme disease, and Vibrio infections** are becoming more prevalent and moving into new geographic areas as **warming temperatures, increased precipitation, and other environmental shifts** favour the spread of these pathogens and their hosts.

Warmer temperatures allow mosquitoes, ticks, and other vectors to survive and reproduce in previously unsuitable regions. **Climate Change** can accelerate the life cycle of mosquitoes and ticks, leading to higher population densities and more frequent feeding on humans.

Jute

(Artwork)

J

For Supporters

Jute is a **biodegradable and renewable resource**. This means it can break down naturally over time, reducing its environmental impact. Additionally, the jute plant requires **minimal pesticides and fertilisers**. This makes it a sustainable choice.

Jute fibre's primary use is in fabrics for packaging a wide range of agricultural and industrial commodities that require bags, sacks, packs, and wrappings. Wherever bulky, strong fabrics and twines resistant to stretching are required, jute is widely used because of its low cost.

In the campaign of saving the planet, everyone prefers to use **jute bags over plastic**. Plastic adversely affects the environment. On the contrary, jute not only comes from a **natural source** but also has **many benefits of usage**. Other than bags, it's used in manufacturing carpets, rugs, baskets, mats and many more useful items.

Kerosene

(Artwork)

K

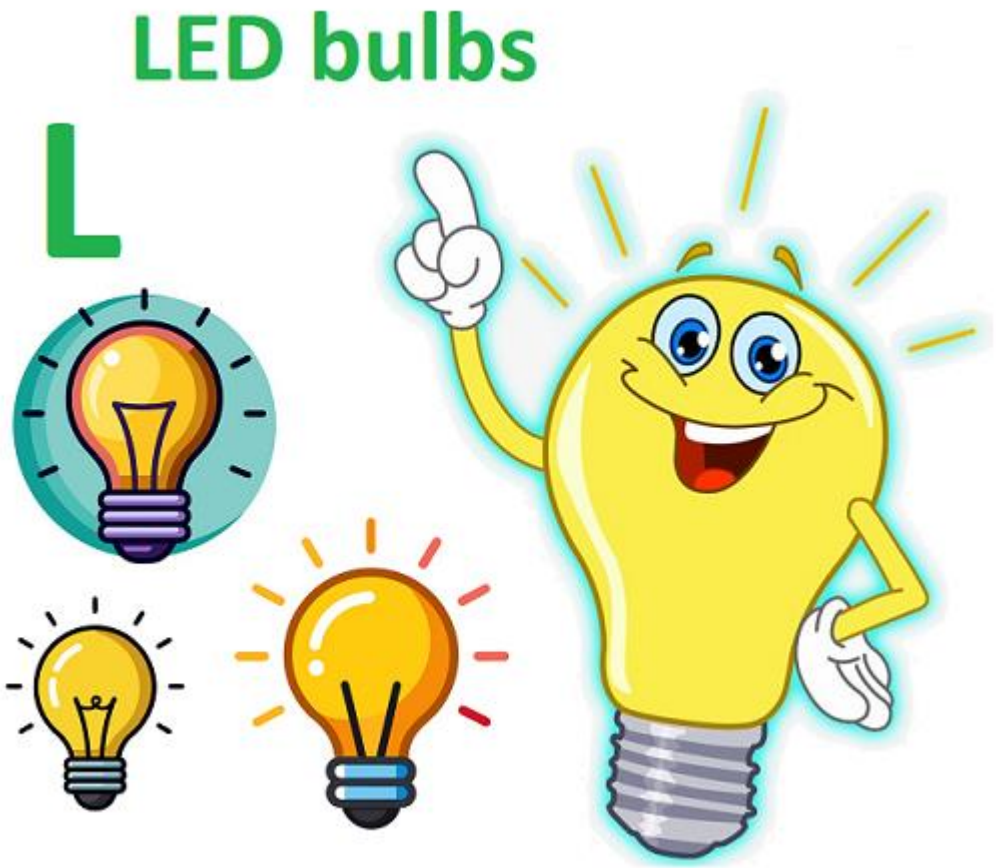
For Supporters

Kerosene, or paraffin, **is a combustible hydrocarbon liquid** which is derived from petroleum. It is widely used as a fuel in aviation as well as households.

Kerosene is typically pale yellow or colourless and has a not-unpleasant characteristic odour. It is obtained from petroleum and is used for burning in kerosene lamps and domestic heaters or furnaces, as a fuel or fuel component for jet engines, and as a solvent for greases and insecticides.

All fossil fuels, including kerosene, release 'greenhouse gases' like carbon monoxide. This is directly attributed to global warming. However, if you still rely on fossil fuels for home heating, kerosene is one of the most environmentally-friendly options.

Therefore, kerosene has certain advantages as well. It can be used as a synthetic kerosene flue gas, which is energy-saving and environmentally friendly, reducing accidents and black smoke during combustion.



For Supporters

LEDs address Climate Change by significantly cutting **greenhouse gas emissions** through superior energy efficiency and longer life spans compared to older technologies, **reducing demand for electricity generation from fossil fuels**. Their efficiency also lessens the impact of heat output, further reducing cooling needs and energy consumption. Additionally, the absence of toxic materials like mercury in LEDs **prevents soil and water contamination**, and their durability reduces waste and the environmental impact associated with manufacturing new bulbs.

LEDs use considerably less energy (up to 80% less) than incandescent and even CFL bulbs, directly lowering the electricity required for lighting. This reduced energy demand translates to **lower greenhouse gas emissions** from power plants, which are often fuelled by coal and other fossil fuels.

A global switch to LEDs could **save over 1,400 million tons of CO_2 annually**, a significant impact on fighting **Climate Change**.

M Methane

For Supporters

Methane is a **colourless, odourless greenhouse gas**. It occurs both naturally and as a result of people's activities. Methane is produced by the decay of plants, animals, and waste, as well as other processes. It is also the **main ingredient in natural gas**.

Methane is a potent, short-lived greenhouse gas and **a significant driver of Climate Change**, responsible for a substantial portion of observed global warming. Its ability to trap heat is much higher than carbon dioxide on a 20-year timescale, but it also breaks down more quickly, meaning **cuts to methane emissions can have a rapid impact on slowing the rate of global temperature increase**. Methane contributes to **Climate Change** through both human-influenced sources, such as agriculture, fossil fuel activities, and landfills, and natural sources like wetlands.

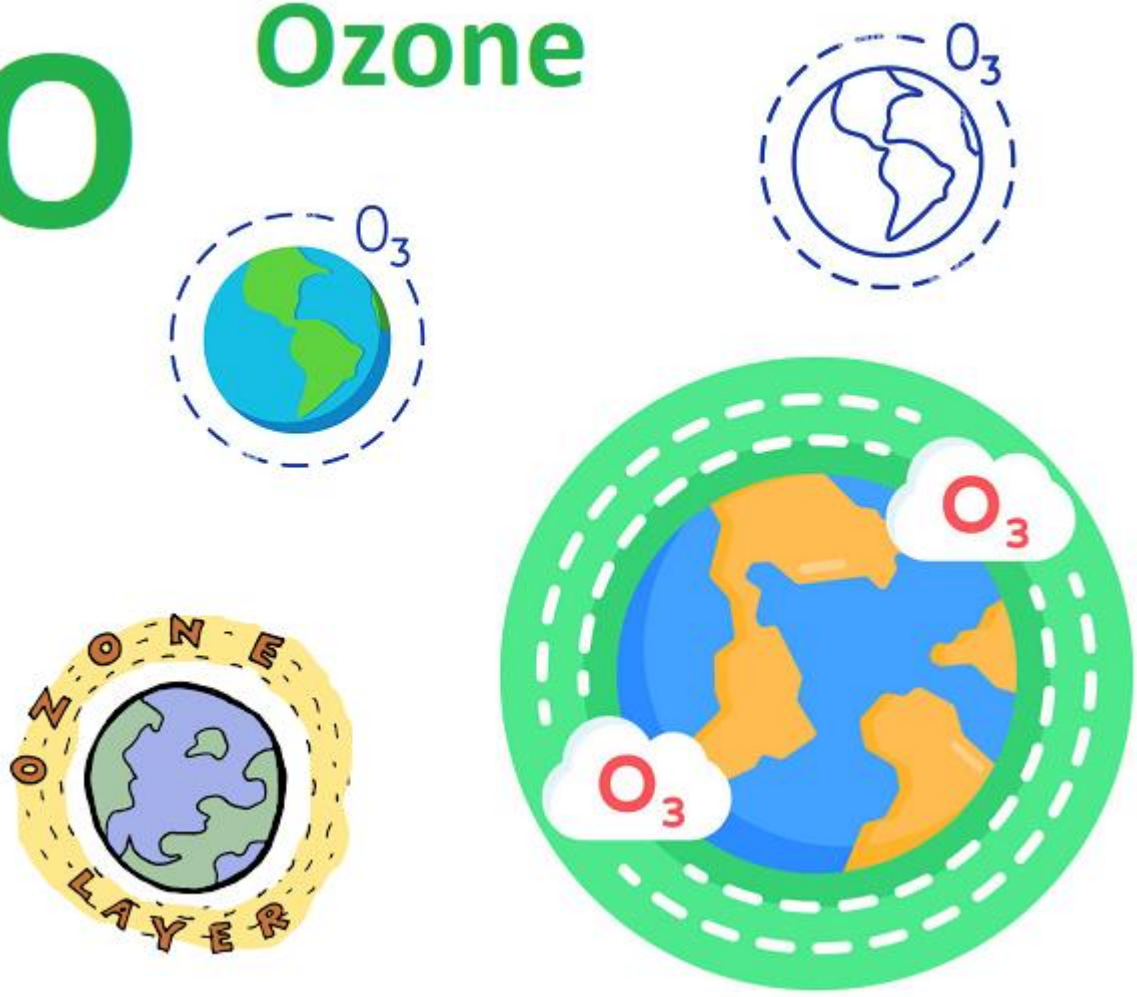
It has accounted for a large percentage of the global warming observed since the **Industrial Revolution** and is the second-largest contributor to human-caused warming after CO_2.

For Supporters

In the context of **Climate Change**, net zero is the point where **human-caused greenhouse gas (GHG) emissions into the atmosphere are balanced** by the removal of an equivalent amount of GHGs, either through natural processes or technological solutions. **Achieving net zero is the key to halting global warming** and meeting climate goals, such as those outlined in the Paris Agreement to limit temperature rise to 1.5°C. This balance involves **drastic reductions in emissions from sources** like fossil fuels and an increase in carbon removal methods such as reforestation and carbon capture technologies.

Net zero is essential for stopping the increase in global average temperatures caused by rising **greenhouse gas concentrations** in the atmosphere. Once net zero is achieved, the concentration of GHGs in the atmosphere begins to stabilize, slowing the pace of **Climate Change**. Critics express concern that overreliance on removals can weaken efforts to cut emissions at the source. Therefore, it's crucial to have ambitious targets for gross (absolute) emission reductions.

O Ozone

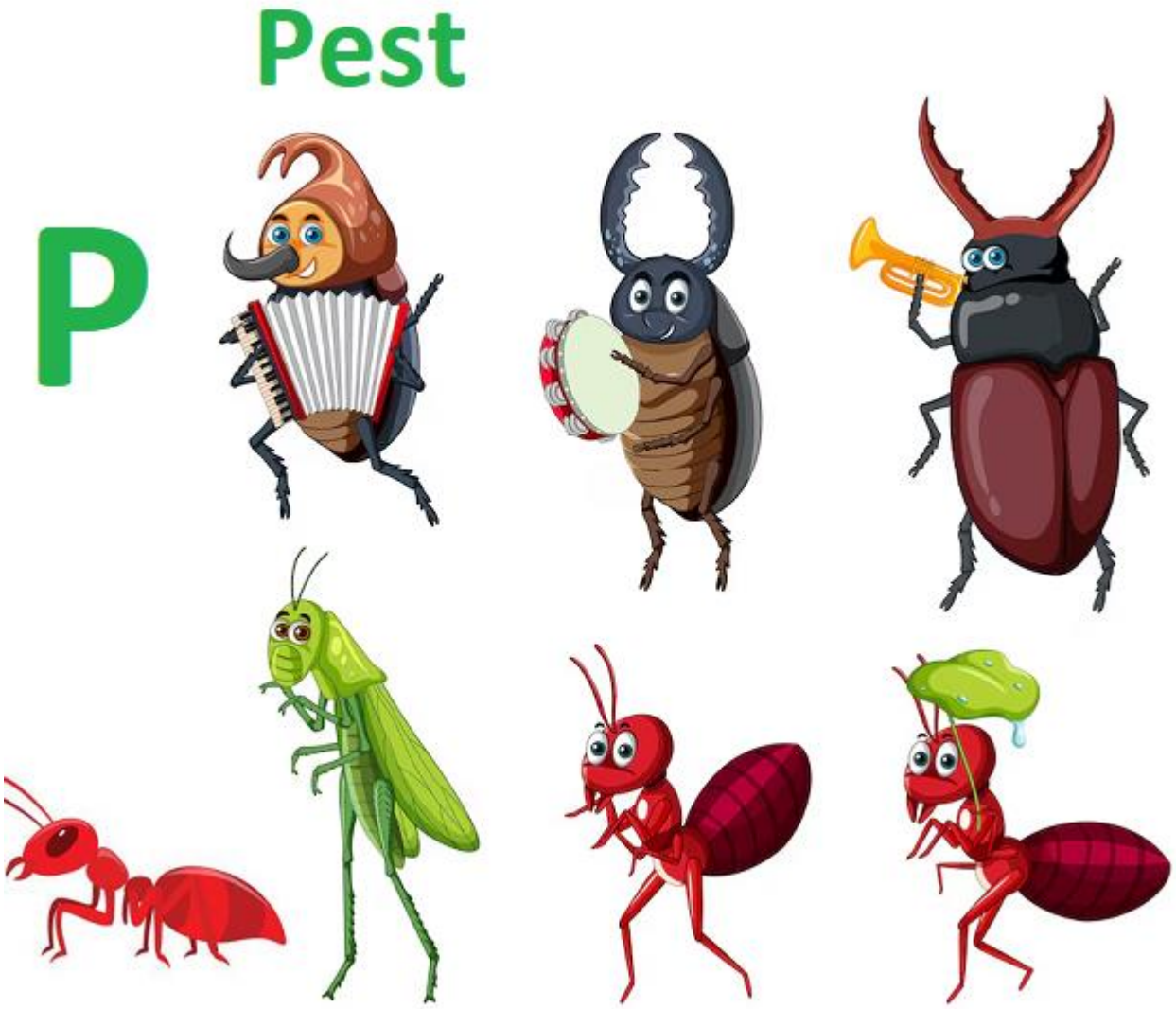


For Supporters

Ozone impacts **Climate Change** in two key ways, depending on its altitude: tropospheric ozone (ground-level) is a **greenhouse gas that causes warming** and contributes to air pollution, while stratospheric ozone depletion (part of the "good" ozone layer) causes cooling but was primarily addressed by the Montreal Protocol. **Climate Change** itself can **affect the stratospheric ozone layer**, potentially hindering its recovery, and influences the formation of tropospheric ozone.

This "bad" ozone is a powerful greenhouse gas that **absorbs infrared radiation**, trapping heat in the lower atmosphere and contributing to **global warming**. High levels of tropospheric ozone are a health concern, causing **premature deaths** and **damaging agricultural crops** and **ecosystems**.

It forms from pollutants like **nitrogen oxides** (NOx) and **volatile organic compounds** (VOCs) reacting in sunlight. **Climate Change** can influence the rate of ozone formation and transport.



For Supporters

Pest is any organism—such as a plant, animal, insect, or microbe—that causes harm or is considered **a nuisance to humans**, their interests, food, or living conditions.

In the context of **Climate Change**, pest activity increases as warmer temperatures and shifting weather patterns promote faster reproduction, extended lifespans, wider geographical ranges, and more generations per year for many insect pests. This leads to **increased pest outbreaks** and greater crop damage, posing significant threats to global food security, especially in temperate regions. Consequently, there is a critical need for new, **climate-smart pest management strategies** that focus on resilience and ecological approaches rather than solely relying on conventional pesticides.

Warmer temperatures increase pest reproduction rates and accelerate their development, leading to more generations per year and shorter generation times.

As temperatures rise, pests expand their habitable territories, moving into new regions, particularly at higher latitudes and altitudes.

Q Quality of life

For Supporters

Quality of life is the **overall well-being of individuals and communities**, which is affected by environmental factors such as access to clean air and water, and a healthy ecosystem.

Climate Change deteriorates quality of life by increasing extreme weather events, disrupting food and water systems, spreading diseases, and threatening housing and infrastructure, leading to **poor health, mental health issues, displacement, and economic hardship**. These negative impacts are felt disproportionately by vulnerable populations, affecting health, safety, livelihoods, and overall well-being, undermining the social determinants of health. **Climate Change** contributes to death and illness from extreme weather, increased infectious diseases (food-, water-, and vector-borne), and impacts on food systems.

Psychological tolls like **stress, anxiety, and depression** arise from natural disasters, loss of livelihoods, and uncertainty about the future, **particularly affecting children and the elderly**.

For Supporters

Recycling is **to collect and reprocess a material so it can be used again to make a new product**. An example is collecting aluminium cans, melting them, and using the aluminium to make new cans or other products.

In the context of **Climate Change, recycling helps by reducing the need to extract new raw materials** and by saving energy in manufacturing, which significantly lowers greenhouse gas emissions. It also diverts waste from landfills, preventing the creation of methane, a potent greenhouse gas, and reduces air and water pollution. **Recycling supports a circular economy**, where materials are reused, thereby minimizing the environmental destruction associated with resource extraction and creating a more sustainable approach to waste.

Producing goods from recycled materials **uses less energy** than manufacturing from virgin resources, leading to lower emissions.

Solar energy

S

For Supporters

Solar energy is heat and radiant light from the Sun that can be harnessed with technologies such as **solar power** (which is used to generate electricity) and **solar thermal energy** (which is used for applications such as water heating).

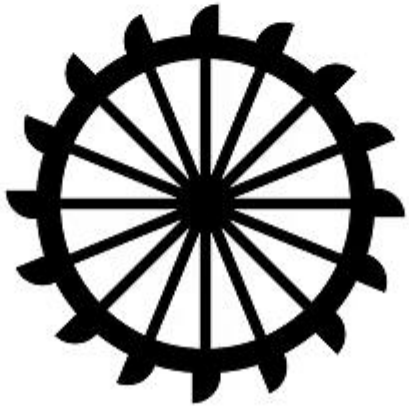
Solar energy fights Climate Change by replacing high-emission fossil fuels with clean, renewable power, drastically cutting greenhouse gases and reducing the planet's carbon footprint. While it's a key solution for mitigating global warming and achieving **net-zero goals**, the solar industry also faces challenges from **Climate Change** itself, such as altered weather patterns affecting energy output. Addressing these impacts through climate modeling and adaptive strategies is vital for ensuring the long-term effectiveness and reliability of solar energy in the **fight against Climate Change**.

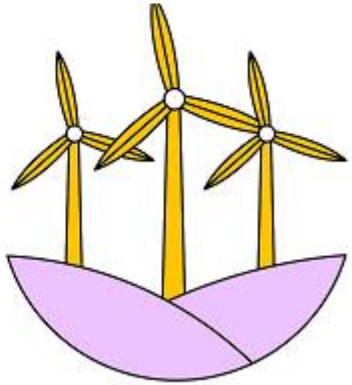
Solar panels generate electricity without emitting harmful greenhouse gases like carbon dioxide, which are released by burning coal and natural gas and contribute to global warming. By switching from fossil fuels to solar power, businesses and communities **reduce their carbon footprint** and contribute to a more sustainable future, directly impacting climate change mitigation efforts.

Turbine

(Artwork)

T





For Supporters

Turbine is a device with blades that can be turned by a force such as **wind, water, or high pressure steam**. The energy of a spinning turbine is converted into electricity by a generator.

In the context of **Climate Change**, wind turbines are primary tools for generating renewable energy, mitigating the effects of climate change by producing carbon-free electricity without burning fuel. While their operation is emissions-free, a life-cycle assessment of the entire process from manufacturing to decommissioning shows that they have **significantly lower global warming potential (emissions)** compared to fossil fuel-generated electricity. However, their effectiveness can be influenced by changing climate conditions, which necessitates the development of **more resilient and advanced turbine designs**, such as floating offshore turbines and airborne systems, to capture wind energy efficiently and sustainably.

Wind turbines harness mechanical energy from the wind to generate electricity, a process that does not require fuel combustion or **release greenhouse gases into the atmosphere**.

Urbanization

U

For Supporters

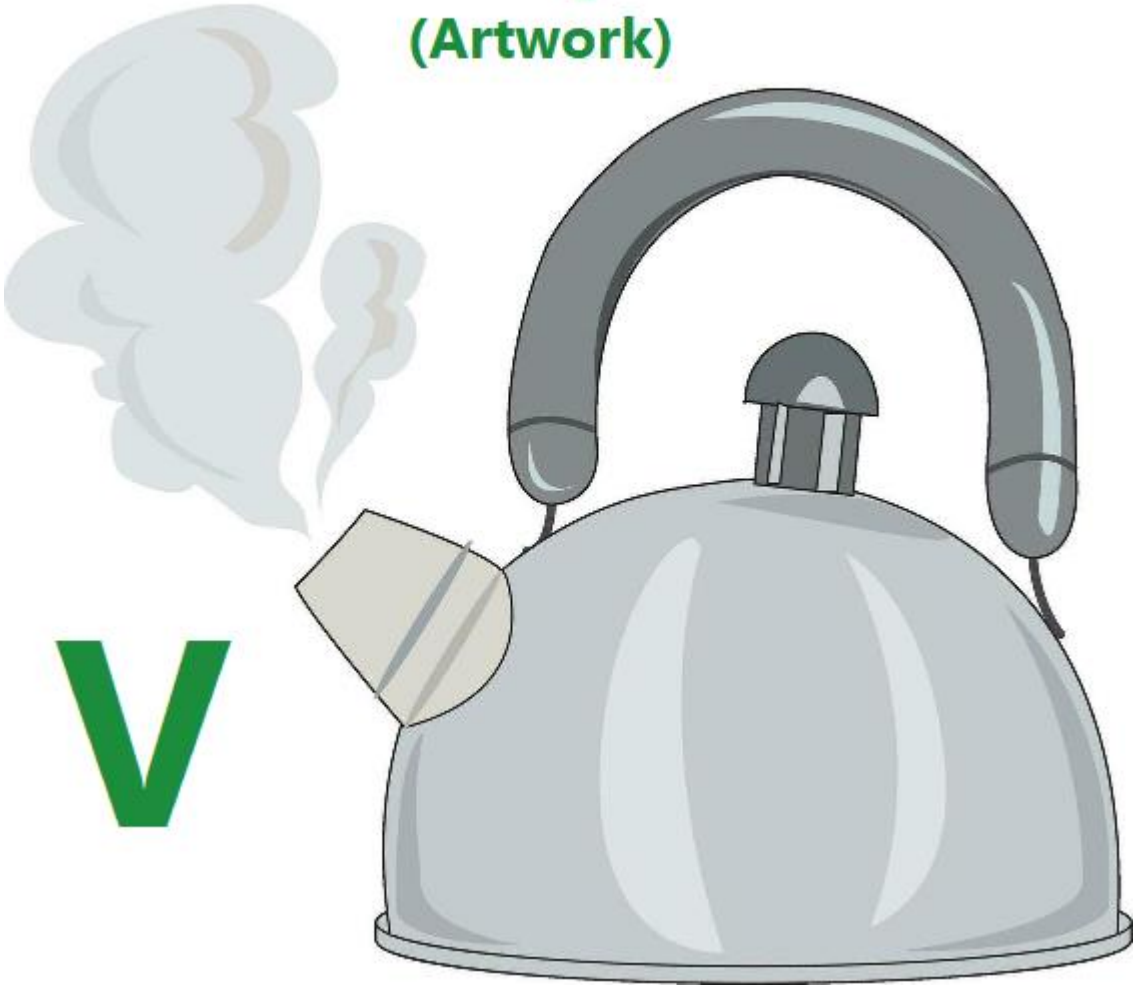
Urbanization is the process of **urban growth**, which can lead to **habitat loss, pollution, and other environmental issues**.

Urbanization is both a **cause and victim of Climate Change**, with growing cities contributing to **Climate Change** by increasing energy consumption, waste, and emissions, while also intensifying localized impacts like the **Urban Heat Island (UHI)** effect and water scarcity. Cities are increasingly vulnerable to extreme weather, heatwaves, and other climate-related disasters, especially in their poorer communities **lacking green spaces and cooling infrastructure**. Addressing these challenges requires sustainable urban planning to reduce emissions and adapt to changing conditions, **transforming cities into resilient, inclusive communities**.

Dense populations, high demand for transportation, energy-hungry buildings, and industrial activities in cities contribute significantly to **global greenhouse gas emissions.** Cities consume a large portion of global energy, with air conditioning in the face of rising temperatures creating a self-reinforcing cycle of heat and emissions.

Vapour

(Artwork)



V

For Supporters

In the context of **Climate Change**, water vapour is Earth's most abundant and powerful **natural greenhouse gas** that traps heat in the atmosphere, amplifying **global warming**. As human-caused increases in other greenhouse gases, like carbon dioxide (CO_2), warm the planet, the atmosphere can hold more water vapour. This creates a positive feedback loop where the increased **water vapour traps even more heat**, further intensifying warming and influencing **extreme weather events** such as floods, droughts, and hurricanes.

Like other greenhouse gases, water vapour absorbs and re-emits heat radiated from Earth's surface, preventing it from escaping into space. The amount of water vapour the atmosphere can hold is directly related to its temperature. **Warmer air holds more moisture**.

Human activities, such as **burning fossil fuels**, increase concentrations of gases like carbon dioxide. **This initial warming increases global temperatures**.

Weather
(Artwork)

W

For Supporters

Weather is the **condition of the atmosphere at a particular place and time**. Some familiar characteristics of the weather include wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation. Weather can change from hour to hour, day to day, and season to season.

In the context of **Climate Change, "weather" refers to short-term atmospheric conditions** that are becoming more extreme and frequent due to rising global temperatures, while **"climate" describes the long-term average weather patterns** over extended periods. Human activities, primarily the burning of fossil fuels, have increased greenhouse gases, causing a planet-wide warming that alters the water cycle and fuels **more intense storms, heatwaves, droughts, and wildfires**.

The number of hot days is increasing, leading to **more frequent and intense heatwaves, such as those seen Pakistan**. Warmer ocean temperatures and increased water vapour in the atmosphere are fuelling more powerful storms, including **tropical cyclones and heavy rainfall**.

For Supporters

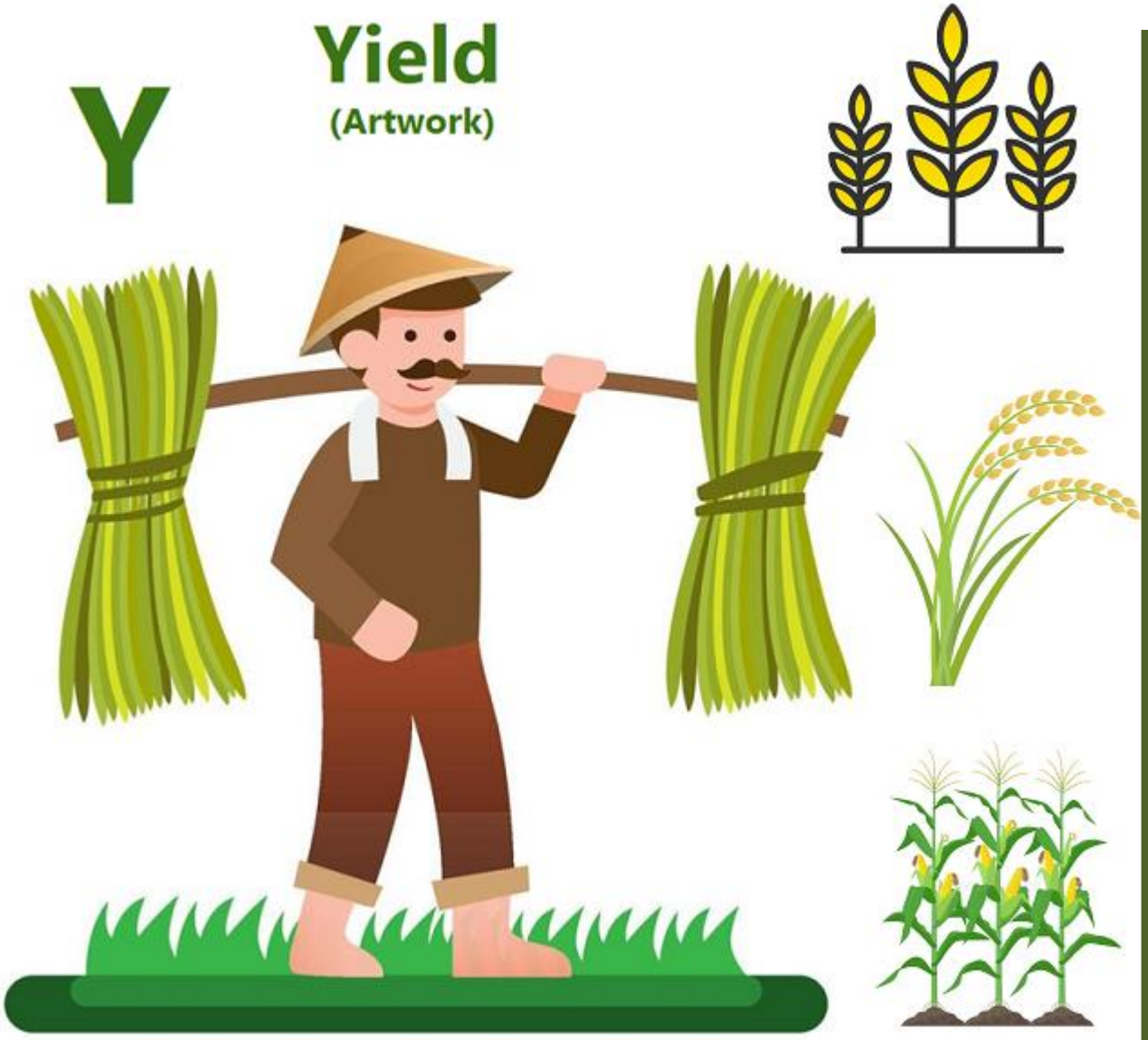
Xenobiotics are foreign chemical compounds, such as **pesticides and plastics, whose persistence and toxicity are amplified by Climate Change** through altered temperatures, salinity, and precipitation, leading to enhanced degradation, increased environmental concentrations, and disruption of food webs, nutrient cycles, and human health. **Climate Change also alters environmental parameters** like aeration rates, affecting xenobiotic uptake and toxicity in organisms. Strategies to mitigate these combined threats include improving waste management, **developing eco-friendly alternatives**, using bioremediation techniques, and implementing stricter chemical usage regulations.

Rising temperatures can enhance the metabolism and degradation of some xenobiotics, but also increase their uptake by organisms due to **changes in aeration rates**, thus intensifying their toxic effects.

Climate Change modifies key environmental factors like temperature, salinity, and precipitation, which in turn influence the distribution, persistence, and overall impact of xenobiotics in the environment.

Y

Yield
(Artwork)



For Supporters

In agriculture, the yield is a measurement of the amount of a crop grown, or product such as **wool, meat or milk produced, per unit area of land**. The seed ratio is another way of calculating yields.

In the context of **Climate Change**, "yield" refers to the amount of a crop produced per unit of land, and **climate change is generally negatively impacting crop yields globally** due to increased temperatures, altered rainfall patterns, and intensifying natural disasters, leading to **food insecurity**. However, there are regional and crop-specific exceptions, with some high-latitude regions potentially seeing increased yields due to longer growing seasons, while others, like the **coastal regions of Pakistan, face crop destruction from sea-level rise and flooding**.

Higher temperatures can reduce crop production and increase water stress, leading to faster crop development but also increased risk of yield failure. Altered rainfall patterns, including **more intense droughts and floods, can negatively affect crop growth**, while the role of precipitation in yield is complex and region-specific.

For Supporters

Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them.

Zero waste, or waste minimization, is a set of principles focused on waste prevention that encourages redesigning resource life cycles so that all products are repurposed (i.e. "up-cycled") and/or reused. The goal of the movement is to avoid sending trash to landfills, incinerators, oceans, or any other part of the environment. Currently 9% of global plastic is recycled. In a zero-waste system, all materials are reused until the optimum level of consumption is reached.

Zero waste refers to waste prevention as opposed to end-of-pipe waste management. It is a "whole systems" approach that aims for a massive change in the way materials flow through society, resulting in no waste.

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