



## Action to combat climate change: Pathways for a sustainable future

Sutapa Roy<sup>1</sup>, Anushka Mishra<sup>2</sup>, Arya Dubey<sup>3</sup>

<sup>1</sup> HOD, Department of Chemistry, St. Aloysius' College, Jabalpur, Madhya Pradesh, India

<sup>2</sup> Assistant professor, Department of Chemistry, St. Aloysius' College, Jabalpur, Madhya Pradesh, India

<sup>3</sup> Department of Chemistry, St. Aloysius' College, Jabalpur, Madhya Pradesh, India

### Abstract

The idea of health as a constantly changing process influenced by many different factors started to become clearer as knowledge grew. Along with this growing understanding, the world created a plan called Sustainable Development Goal 3 (SDG 3) to work towards "healthy lives and well-being for all at all ages" by the year 2030. Climate change is one of the greatest threats to global stability, impacting ecosystems, economies, and human well-being. Rising greenhouse gas emissions, extreme weather patterns, biodiversity loss, and sea-level rise demonstrate the urgency of immediate action. This paper emphasizes the need for integrated strategies that combine mitigation and adaptation approaches. Key solutions include expanding renewable energy, promoting sustainable agriculture and urban planning, advancing green technologies, and strengthening global climate governance. Special attention is given to the socio-economic consequences of climate change, particularly for vulnerable communities, and the importance of inclusive policies that ensure equity and resilience. By uniting scientific innovation, policy reforms, and collective global responsibility, humanity can move towards a climate-conscious and sustainable future. The installation of solar panels at the college reduces dependence on fossil fuels, lowers greenhouse gas emissions, and contributes to mitigating climate change by promoting renewable energy usage.

**Keywords:** Sustainable, climate change, action, renewable, planning

### Introduction

#### The Anthropocene and Climate Change

Industrial Revolution (1760-1820) became the breakpoint in human history, causing transformative changes to earth system functions. These changes have been so profound that several authors have proposed a recognition of a new geological epoch –the Anthropocene –characterised by human domination of climate and ecosystems (Steffen *et al.*, 2011). The mid-20th century, a period known as the "great acceleration," saw population numbers, industry, resource consumption and energy use skyrocket. Such dynamics have led to economic development, but has also driven GHG emissions which exacerbated global warming and environmental stresses (Rockström *et al.*, 2009). As of today, the average global temperature has increased by roughly 1.09°C from preindustrial levels and predictions deem that overshooting beyond a tipping point of 1.5–2°C could have catastrophic consequences such as extreme weather conditions, mass extinction in biodiversity, instability of food and water supply systems and massive socioeconomic perturbations (IPCC, 2021).

#### Health Implications of Climate Change

The health implications of climate change are just as alarming. Associated direct impacts include heat-related illnesses, as well as the cardiovascular and respiratory effects of air pollution and injuries resulting from climate-driven disasters.

The indirect impacts include agricultural disruption with food insecurity and malnutrition, water scarcity contributing to depletion of freshwater resources, as well as the spread of diseases like malaria, dengue or Zika into non-endemic areas (Watts *et al.*, 2021). Climbing temperatures and recurring disasters also are found to stress human behavior

and well-being: disturbed sleep, less exercise, emotional disturbances, climate-stressed trauma all undercut individual health in the long run (Clayton, 2020). For this reason, the specialty of behavioral medicine needs to expand its focus beyond disease and mortality rates, instead exploring how climate change influences daily habits that contribute to health and community resiliency.

#### Global Response and Planetary Health

Despite a mountain of evidence, the global response has been somewhat underwhelming. The Intergovernmental Panel on Climate Change (IPCC) has indicated that the 1.5°C target will likely be unattainable by 2040 without significant alterations (IPCC, 2021). This underscores the critical importance of the upcoming decade for our planet's well-being. In this context, the Planetary Health concept (Whitmee *et al.*, 2015) underscores the interdependence between human health and societal prosperity, both of which are closely tied to the Earth's health. Excessive environmental degradation isn't just an ecological concern; it also poses a direct risk to human health. This perspective advocates for transformative changes centered around environmental stewardship, social equity, and long-term sustainability.

#### Climate Change as an Opportunity

Climate change, while undeniably a threat, also presents a pivotal opening. The World Health Organization (WHO, 2017) has framed tackling climate change as "the greatest global health opportunity of the century," a viewpoint echoed by The Lancet Countdown, which perceives it as a chance to reshape the variables influencing both our health and our surroundings (Watts *et al.*, 2018). Policies crafted with an eye towards equity can mitigate dangers, bridge

disparities, and fortify communities. Simultaneously, grassroots endeavours, such as ecovillages, provide compelling examples of individuals pioneering novel solutions to lessen their environmental footprint and cultivate healthier, more sustainable existences (Kunze, 2012). These community-driven projects act in concert with international accords like the Paris Agreement and the Sustainable Development Goals (UN, 2015; UNFCCC, 2015), demonstrating that genuine transformation can be spurred by collaboration on both a global and a local scale. In essence, the Anthropocene epoch delivers a mix of formidable risks and opportunities for transformation. Climate change, arguably the preeminent health and development challenge of our time, paradoxically offers humanity a chance to alter its trajectory. The choices we make today will ultimately chart the course, determining whether we descend into an irreversible environmental downturn or ascend towards a resilient, low-carbon, and just future. Addressing climate change, therefore, transcends mere environmentalism; it constitutes a fundamental ethical and health imperative, poised to influence the welfare of generations to come.

### Methods for Tackling Climate Change

- **Green Hydrogen Advancement:** India is highlighting hydrogen as a crucial element in its pathway to reduce carbon emissions from energy-intensive industries and the transport sector. Under the National Green Hydrogen Mission, the country aspires to become a prominent global hub for the production, deployment, and export of green hydrogen, although this initiative is still at an initial stage.
- **Growth of Renewable Energy Capacity:** Over the past decade, India's renewable energy capacity has expanded by nearly 165%, rising from 76.38 GW in 2014 to 203.1 GW in 2024. This growth positions the country as the world's fourth-largest in terms of installed renewable power capacity.
- **Promotion of Electric Vehicles (EVs):** To make electric vehicles more financially viable, the Government of India has introduced a Battery Swapping Policy along with a Production-Linked Incentive (PLI) program for Advanced Chemistry Cells (ACC). These measures are intended to cut down battery expenses, which represent nearly 40% of the total vehicle cost.

## Climate Change in the Context of Developed and Developing Countries: A Case Study Approach

### 1. Developed Countries: Japan – Innovation in Carbon Capture and Storage (CCS)

Japan is admired globally for its technological advancement, efficiency, and ability to adapt innovation to pressing challenges. As a nation with limited natural resources but strong industrial growth, Japan has committed itself to leading in sustainable development. One of its landmark innovations is the Tomakomai Carbon Capture and Storage (CCS) project. Between 2016 and 2019, Japan successfully captured and stored about 0.3 MtCO<sub>2</sub> annually in offshore saline aquifers beneath Hokkaido (METI, 2019) [12]. Advanced monitoring and verification systems ensured

safety, even in seismic conditions. This innovation reflects Japan's determination to achieve carbon neutrality by 2050 and its responsibility under the Paris Agreement. The project has created expertise in CCS technology, provided industrial decarbonization pathways, and strengthened Japan's role as a climate technology leader, though high costs and public acceptance remain hurdles (IEA, 2021) [8].

#### 1.1 Outcomes and Advantages

The project successfully proved the technical feasibility of offshore CCS in a seismically active region, providing confidence for broader deployment. It gave Japan a technological edge in Asia, created expertise in MRV, and offered a clear pathway to decarbonize heavy industries.

### 2. Developed Countries: Germany – Innovation in the Energiewende (Energy Transition)

Germany is recognized as Europe's economic powerhouse and a leader in environmental policy. Known for engineering excellence and industrial innovation, Germany has taken bold steps in climate leadership through its Energiewende strategy. This energy transition aims to replace nuclear and fossil fuel power with renewables. Supported by the Renewable Energy Act (2000), Germany massively scaled up solar, wind, and biomass energy (BMWK, 2020) [2]. After the Fukushima disaster in 2011, it decided to phase out nuclear energy, with a coal exit planned by 2038. By 2020, renewables provided over 40% of electricity, cutting emissions significantly while creating thousands of green jobs (Agora Energiewende, 2021) [1]. Germany's innovation not only supports its domestic sustainability but also provides clean-tech expertise to the world. Challenges such as rising electricity prices and grid bottlenecks remain, but the positive climate impact is undeniable.

#### 2.1 Outcomes and Advantages

By 2020, renewables provided more than 40% of Germany's electricity. The country successfully cut emissions compared to its 1990 baseline while fostering an advanced clean-technology industry. Green jobs, technological leadership, and enhanced global reputation are among the key benefits.

### 2.2 Developing Countries: India – Innovation in Solar Power and Cooling Efficiency

A dynamic and rapidly expanding economy, India showcases considerable diversity alongside its strengths. Despite the challenges of development, the country has emerged as a global leader in renewable energy. The National Solar Mission, launched in 2010, aimed to make solar power accessible and economical for a broad audience. Significant projects like the Bhadla Solar Park in Rajasthan and the Rewa Solar Park in Madhya Pradesh are prime examples of this endeavor (MNRE, 2020) [13]. Reverse auctions played a crucial role, making solar energy more cost-effective than coal in numerous regions. Furthermore, India has spearheaded innovations in cooling efficiency, including cool roofs, more efficient appliances, and district cooling systems, designed to mitigate urban heat stress (IEA, 2018) [4]. These initiatives have led to an increase in rural electrification, reduced reliance on fossil fuels, and generated new employment opportunities in the green

sector. While integration difficulties persist, India's innovations have a positive impact on the climate, serving as a model for other developing countries.

### 2.3 Outcomes and Advantages

India has quickly become one of the world's fastest-growing solar markets, with substantial cost reductions benefiting both consumers and businesses alike. Rural electrification has improved markedly, and cooling efficiency programs have lessened peak energy demand, leading to more reliable electricity supply. The health and environmental benefits, such as decreased air pollution, represent noteworthy achievements.

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### 2.4 Developing Countries: Brazil – Innovation in Biofuels and Deforestation Control

Brazil, the largest country in South America, is celebrated for its rich biodiversity, agricultural strength, and global role in climate discussions. As a pioneer in biofuels, Brazil launched the Proálcool program in the 1970s, promoting sugarcane ethanol as a clean transport fuel (Goldemberg, 2008)<sup>[3]</sup>. Today, flex-fuel vehicles dominate the Brazilian market, allowing consumers to use ethanol, gasoline, or blends, thereby reducing transport emissions and oil dependence. In addition, Brazil developed advanced satellite monitoring systems to control Amazon deforestation, complemented by REDD+ projects (Nepstad *et al.*, 2014)<sup>[14]</sup>. These innovations brought global recognition by significantly lowering deforestation between 2004 and 2012. Brazil's biofuel program supports rural economies while reducing greenhouse gases, and its forest-monitoring systems highlight the importance of conservation. Though renewed deforestation poses challenges, these innovations have delivered lasting positive impacts on climate and development.

### 2.5 Outcomes and Advantages

Brazil became one of the largest producers of bioethanol, reducing its dependency on fossil fuels and lowering transport sector emissions. The adoption of flex-fuel vehicles created consumer flexibility and reduced greenhouse gases. Between 2004 and 2012, deforestation rates dropped substantially due to satellite monitoring and enforcement, earning Brazil international recognition.

## Global Corporations as Catalysts for Climate Action and Sustainability

### 1. Ford Motor Company – A Leader in Sustainable Innovation

Ford Motor Company has changed how they deal with being environmentally responsible. They're now using some pretty cool sustainable habits.

Vehicles, such as the Focus and Escape, are made with lots of recyclable stuff, like 80% of the parts can be recycled. Also, these cars have fuel-efficient transmissions, plus you can get them with clean diesel engines.

At their factories in Michigan, something interesting is happening with the paint fumes. They're not going to waste; instead, they are turned into fuel. Geothermal cooling assists in lowering energy use. Which is efficient.

The Crown Victoria Interceptor uses ethanol or gasoline, which helps lower how much pollution is released. Also, Ford has the biggest green roof on Earth. That's pretty cool. They even got the EPA Energy Star Award two times in a row.

Ford shows they care about the environment in a lot of ways through their actions. By doing these things, Ford is making a sustainability plan that others all over the world can try to follow. Showing how being new, not wasting, also protecting environment can work together well. It's a good example for everyone.

### 2. Nike: Leading Through Sustainable Innovation

Nike shows how serious it is about protecting the environment. They do this by mixing new green ideas with ads that get people's attention. For example, Nike sells eco-friendly items like Air shoes. These shoes are made using old polyester. They also make Flyleather sneakers that have at least half of their material coming from recycled leather bits. A big part of what they do is sustainable design. Nike also uses clean energy in the places where they make their products. It helps lower the amount of carbon emissions they release into the air. It's all part of their plan.

Nike has also pushed more than 650 suppliers in 52 countries to get environmental policies in place. It's not only about what Nike does itself. Doing so helps make sure things are sustainable across their whole worldwide operation.

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## Results & Discussion

The review points out apparent differences in climate action. It also demonstrates the strengths between developed countries and those still developing.

Nations that are developed, take Japan and Germany, show off some pretty advanced tech fixes. Carbon capture plus storage, also known as CCS, that energy transition called Energiewende are some examples. This is proving that getting rid of carbon in big industries and switching to using lots of renewable energy can actually happen. It can!

These endeavour's demonstrate progress in new ideas, but things like price, available systems, plus how people feel about it, could be issues.

Countries that are still growing, for instance, India and Brazil, are more concerned with answers that don't cost too much, that can grow to be big, such as putting up more solar panels. There are also cooling programs to make them more efficient, biofuel usage, along with stopping deforestation from space. These strategies mix trying to fix the climate, also helping the country get better by helping bring power to the countryside, making sure there's enough food, moreover giving people a chance to make a living.

Corporate case studies help to highlight the importance of sector in worldwide climate action. While Nike uses sustainable product design, renewable energy, and supply chain responsibility, Ford has embraced recycled materials,

fuel-efficient technologies, and green infrastructure. Together they show how innovation and responsibility enable companies to support national plans.

## Conclusion

The results show that addressing climate change calls for a multi-level, cooperative effort. While developing nations present scalable and inclusive models, developed countries provide technological leadership; businesses show how sustainability may match profit and brand leadership. Each has a particular way of helping to move along world climate objectives. The general lesson is that mitigating climate change is not only an ecological need but also a one of innovation, equity, and economic resilience. By connecting science, policy, and business activity, societies can progress toward a low-carbon, sustainable, and fair future. Though the way ahead is difficult, the examined examples show that answers now exist—and scaling them is both doable and vital for human and planetary well-being.

The Industrial Revolution (1760-1820) became the breakpoint in human history, causing transformative changes to earth system functions. These changes have been so profound that several authors have proposed a recognition of a new geological epoch—the Anthropocene—characterized by human domination of climate and ecosystems (Steffen *et al.*, 2011). The mid-20<sup>th</sup> century, a period known as the “great acceleration,” saw population numbers, industry, resource consumption, and energy use skyrocket. Such dynamics have led to economic development but have also driven GHG emissions, which exacerbated global warming and environmental stresses (Rockström *et al.*, 2009). As of today, the average global temperature has increased by roughly 1.09°C from preindustrial levels, and predictions deem that overshooting beyond a tipping point of 1.5–2°C could have catastrophic consequences such as extreme weather conditions, mass extinction of biodiversity, instability of food and water supply systems, and massive socioeconomic perturbations (IPCC, 2021).

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concept (Whitmee *et al.*, 2015) underscores the interdependence between human health and societal prosperity, both of which are closely tied to the Earth’s health. Excessive environmental degradation isn’t just an ecological concern; it also poses a direct risk to human health. This perspective advocates for transformative changes centered around environmental stewardship, social equity, and long-term sustainability.

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In essence, the Anthropocene epoch delivers a mix of formidable risks and opportunities for transformation. Climate change, arguably the preeminent health and development challenge of our time, paradoxically offers humanity a chance to alter its trajectory. The choices we make today will ultimately chart the course, determining whether we descend into an irreversible environmental downturn or ascend towards a resilient, low-carbon, and just future. Addressing climate change, therefore, transcends mere environmentalism; it constitutes a fundamental ethical and health imperative, poised to influence the welfare of generations to come.

Japan frequently receives global accolades for its technological prowess, operational effectiveness, and ability to incorporate novel concepts when tackling significant issues. Given its limited natural resources alongside a robust industrial sector, the country has prioritized spearheading advancements in sustainable development. A prime illustration of this is the Tomakomai Carbon Capture and Storage (CCS) initiative. Between 2016 and 2019, Japan successfully captured and stored approximately 0.3 MtCO<sub>2</sub> annually in subsea saltwater formations beneath Hokkaido (METI, 2019) <sup>[12]</sup>. The project’s safety was maintained via sophisticated monitoring and verification systems, even in seismically active zones. This ground breaking endeavor underscores Japan’s dedication to carbon neutrality by 2050 while also fulfilling its commitments under the Paris Agreement. Although challenges such as considerable costs and public acceptance persist (IEA, 2021) <sup>[8]</sup>, the project has fostered expertise in CCS technology, provided avenues for industrial carbon emission reductions, and elevated Japan’s standing as a climate technology leader.

The success of this project confirmed that offshore carbon capture and storage (CCS) could work, even where there’s a lot of seismic activity, which makes its use in other places more likely. Not only did this put Japan ahead in technology in Asia, but it also helped develop special expertise in keeping track of things, reporting, and checking the results

(MRV). Plus, it created a clear plan for cutting down carbon emissions in some important industries.

Germany distinguishes itself as a pivotal force in both European economics and environmental stewardship. Celebrated for its world-class engineering and industrial innovation, the nation has demonstrated a strong commitment to climate action, most notably through its 'Energiewende' strategy. This ambitious undertaking is centered on transitioning away from nuclear and fossil fuels and embracing renewable energy alternatives. Supported by the Renewable Energy Act of 2000, Germany significantly expanded its utilization of solar, wind, and biomass energy, as documented by the BMWK in 2020 [2]. In the wake of the Fukushima disaster in 2011, Germany made the decision to phase out nuclear power, with an eye toward ceasing coal consumption by 2038. By the year 2020, over 40% of its electricity was sourced from renewable resources, resulting in substantial emission reductions and the creation of a multitude of green jobs, as highlighted by Agora Energiewende in 2021 [1]. Germany's advancements not only bolster its own sustainability initiatives but also provide other nations with valuable insights into clean-tech solutions. While there are challenges, such as rising electricity costs and grid constraints, the positive impact on the climate is undeniable.

By 2020, Germany's power grid had already begun to draw more than 40% of its electricity from renewable sources, a move that, in turn, helped the country lower its emissions from what they were back in 1990. In tandem with this, Germany has been cultivating a very advanced clean-technology sector. Among the many upsides of this significant shift have been the creation of environmentally friendly jobs, a prominent position in the tech sphere, and an improved international reputation.

In India, a dynamic and rapidly expanding economy, India showcases considerable diversity alongside its strengths. Despite the challenges of development, the country has emerged as a global leader in renewable energy. The National Solar Mission, launched in 2010, aimed to make solar power accessible and economical for a broad audience. Significant projects like the Bhadla Solar Park in Rajasthan and the Rewa Solar Park in Madhya Pradesh are prime examples of this endeavor (MNRE, 2020) [13]. Reverse auctions played a crucial role, making solar energy more cost-effective than coal in numerous regions. Furthermore, India has spearheaded innovations in cooling efficiency, including cool roofs, more efficient appliances, and district cooling systems, designed to mitigate urban heat stress (IEA, 2018) [4]. These initiatives have led to an increase in rural electrification, reduced reliance on fossil fuels, and generated new employment opportunities in the green sector. While integration difficulties persist, India's innovations have a positive impact on the climate, serving as a model for other developing countries.

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systems to control deforestation in the Amazon, supported by REDD+ projects (Nepstad *et al.*, 2014) [14]. These innovations earned global recognition by significantly reducing deforestation between 2004 and 2012. Brazil's biofuel program supports rural economies while decreasing greenhouse gas emissions, and its forest-monitoring systems highlight the importance of conservation. Despite renewed deforestation posing ongoing challenges, these innovations have produced lasting positive effects on both climate and development.

Brazil turned into a major bioethanol producer, cutting down its reliance on fossil fuels and decreasing emissions from transportation. The introduction of flex fuel cars gives consumers more choices & lowers greenhouse gas emissions. From 2004 to 2012, deforestation rates significantly declined thanks to satellite monitoring and regulations, bringing Brazil global praise.

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