Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 04, Issue: 02 (MAR-APR, 2024)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Recent Approaches for Mitigation of Climate Change

(*Abhishek Singh Yadav, Pradeep Kumar, Kapil Kumar Yadav, Tapasya Tiwari and Shubha Tripathi)
Chandra Shekhar Azad University of Agriculture & Technology, Kanpur -208002
*Corresponding Author's email: singhyadava555@gmail.com

The term "climate change" refers to a change in climate patterns that is mostly brought about by greenhouse gas emissions. The fundamental factor causing global warming has been the earth's atmosphere retaining more heat due to greenhouse gas emissions. Such emissions primarily originate from human activity and natural processes. The reduction of heat-trapping greenhouse gas emissions into the atmosphere is the key to mitigating climate change. This is reducing greenhouse gas emissions from primary sources, including companies, farms, vehicles, and power plants. A major component of the answer is soil, forests, and oceans, which all absorb and store these gasses. All of our activities, including how we travel and power our economy and produce food, must be changed in order to reduce and avoid emissions.

Reducing the net release of greenhouse gas emissions that warm our planet is known as climate change mitigation. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report emphasizes the urgency of the required climate action: in order to stay within the safety limits, set by the Paris Agreement, global emissions must drop by 43% from 2019 by 2030 and rapidly to net-zero by 2050. The United Nations Framework Convention on Climate Change (UNFCCC) Secretariat's 2023 NDC Synthesis Report, however, demonstrates that although nations have stepped up their individual ambitions to cut emissions, the overall effect still falls short of the emission reductions required to meet the objectives of the Paris Agreement. More aggressive targets have also been established, such as a net 55% decrease below 1990 levels by 2030 and an aim of achieving climate neutrality by 2050. It will need considerably greater emission reductions from the switch from fossil fuels to clean, renewable energy sources to meet these targets. In order to achieve a balance between the emission of greenhouse gases into the atmosphere and their uptake and storage in our soil, seas, and forests, we must also stop deforestation, manage land responsibly, and restore nature. With only 6% of global emissions, the EU is powerless to act alone. All approaches of mitigation of climate change require global collaboration. Additionally, the EU met its goal for renewable energy. By 2022, 40% of our energy was produced, and 22.5% came from renewable sources. After a sluggish start, the EU-27 exceeded the goal for energy efficiency in the last year. The European Green Deal addresses the problem of climate change while simultaneously fostering economic growth and preserving human welfare, providing the general framework for the EU to become carbon neutral by 2050. The EU established an interim objective of a net 55% emission reduction by 2030 and is working on determining the 2040 target. The EU made climate neutrality by 2050 a legally obligatory goal via the European Climate Law. The Fit for 55 initiative seeks to align EU laws with the 2030 objective.

The impacts of the 2022 gas and energy security crisis highlighted the importance of transitioning faster towards a clean and secure EU energy system.

- Due to decreased activity during the COVID-19 pandemic, transport emissions from the EU's transportation industry significantly decreased in 2020 after six years of continuous development. According to preliminary predictions, transportation-related emissions will increase by 8.6% in 2021 and then by 2.7% in 2022.
- Between 2005 and 2021, greenhouse gas emissions from agriculture were constant. By 2040, it is anticipated that national policies and initiatives implemented throughout the EU will only result in another 1.5% reductions.

Under the wider umbrella of the European Green Deal, Europe's 2030 policy ambitions include:

- Reducing net greenhouse gas emissions to at least 55% below 1990 levels by 2030;
- Improving the share of renewable energy use;
- Increasing energy efficiency;
- Setting a more ambitious and cost-effective path to achieving climate neutrality by 2050;
- Stimulating green job creation and continuing the EU's track record of cutting greenhouse gas emissions while growing its economy;
- Providing more opportunities to recharge or fuel vehicles with alternative fuels, and providing alternative power supply for ships and planes;
- Encouraging international partners to increase their ambition to limit the rise in global temperature to 1.5°C and avoid the most severe consequences of climate change;
- Introducing a waste hierarchy for proper waste management that includes prevention, reuse, recycling, recovery, and disposal.

Conventional mitigation technologies

As previously discussed, energy-related emissions are the main driver behind the increased greenhouse gas concentration levels in the atmosphere; hence, conventional mitigation technologies and efforts should be focused on both the supply and demand sides of energy. Mitigation efforts primarily discussed in the literature cover technologies and techniques that are deployed in four main sectors, power on the supply side and industry, transportation and buildings on the demand side. Within the power sector, decarbonization can be achieved through the introduction of renewable energy, nuclear power, carbon capture and storage as well as supply-side fuel switch to low-carbon fuels such as natural gas and renewable fuels.

Renewable energy

According to a recent global status report on renewables, the share of renewable energy from the total final energy consumption globally has been estimated at 18.1% in 2017 (REN21 2019). An array of modern renewable energy technologies is discussed throughout the literature. The most prominent technologies include photovoltaic solar power, concentrated solar power, solar thermal power for heating and cooling applications, onshore and offshore wind power, hydropower, marine power, geothermal power, biomass power and biofuels. In terms of power production, as of 2018, renewable energy accounted for approximately 26.2% of global electricity production. Hydropower accounted for 15.8%, while wind power's share was 5.5%, photovoltaic solar power 2.4%, biopower 2.2% and geothermal, concentrated solar power and marine power accounted for 0.46% of the generated electricity (REN21 2019). While large-scale hydropower leads in terms of generation capacity as well as production, there has been a significant capacity increase in photovoltaic solar power and onshore wind power over the past decade.

Nuclear power

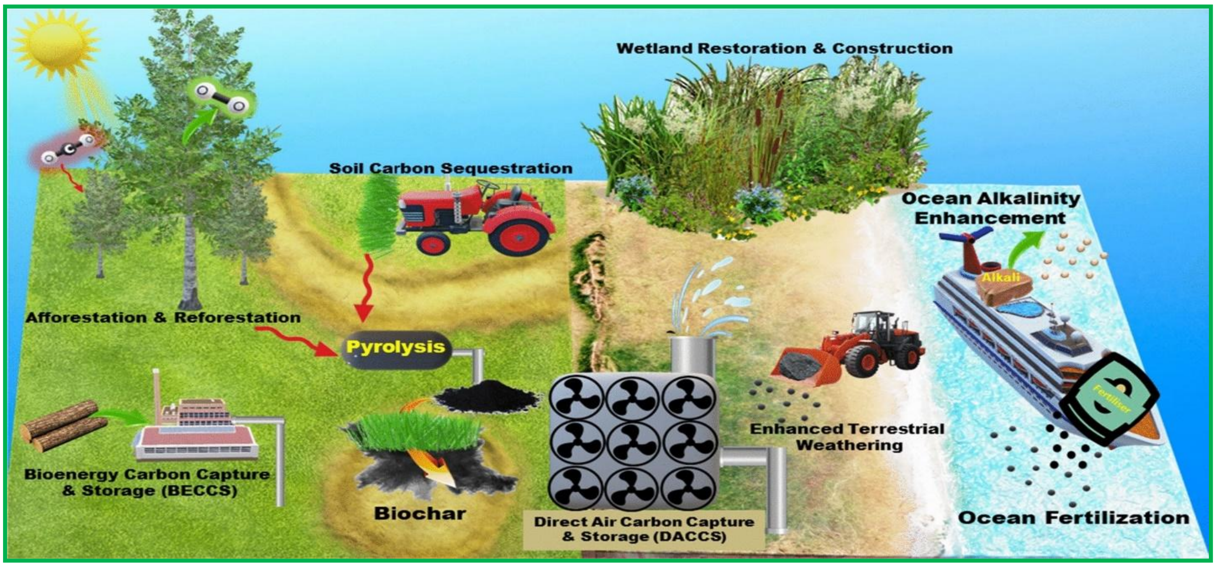
The International Atomic Energy Agency (IAEA) has released its most recent report, which states that as of 2018, there were 450 nuclear power reactors operating worldwide with an installed capacity of 396.4 GW. By 2030, installed capacity is expected to have increased by 30% (from a base assumption of 392 GW in 2017). Based on the 2017 data, a 10% decline might be reached by 2030 as a low case projection scenario. Long-term projections indicate that, in a best-case scenario, worldwide capacity might reach 748 GW by 2050 (IAEA 2018).

Carbon capture, storage and utilization

An intriguing technique that has been explored in the literature as a possible decarbonization strategy for the industrial and electricity sectors is carbon capture and storage. The method involves extracting and storing CO2 emissions from operations that use fossil fuels like coal, oil, or gas. After then, the collected CO2 is moved and kept for a very long time in geological reserves. Reducing emissions while still using fossil fuels is the primary goal. The literature discusses three capture technologies: oxyfuel combustion, post-combustion, and pre-combustion. Every technology has a unique method for removing and storing CO2. However, post-combustion collection systems offer the most potential for use and are best suited for retrofit projects. After CO2 is effectively caught, it is liquefied and sent to appropriate storage locations via pipelines or ships. The research suggests that depleted oil and gas Felds, coal beds, and subterranean saline aquifers not utilized for drinking water are among the storage choices.

Bioenergy carbon capture and storage

Bioenergy carbon capture and storage, also referred to as BECCS, is one of the prominent negative emissions technologies discussed widely in the literature. The Intergovernmental Panel on Climate Change (IPCC) heavily relied on bioenergy carbon capture and storage within their assessments as a potential route to meet temperature goals (IPCC 2018). The technology is simply an integration of biopower, and carbon capture and storage technologies discussed earlier. The basic principle behind the technology is quite straightforward. Biomass biologically captures atmospheric CO2 through photosynthesis during growth, which is then utilized for energy production through combustion. The CO2 emissions realized upon combustion are then captured and stored in suitable geological reservoirs (Pires 2019; Royal Society 2018). This technology can significantly reduce greenhouse gas concentration levels by removing CO2 from the atmosphere.



Afforestation and reforestation

During tree growth, CO2 is captured from the atmosphere and stored in living biomass, dead organic matter and soils. Forestation is thus a biogenic negative emissions technology that plays an important role within climate change abatement efforts. Forestation can be deployed by either establishing new forests, referred to as afforestation, or re-establishing previous forest areas that have undergone deforestation or degradation, which is referred to as reforestation. Depending on tree species, once forests are established CO2 uptake may span 20–100 years until trees reach maturity and then sequestration rates slow down significantly. At that stage, forest products can be harvested and utilized. It is argued that forest management activities and practices have an environmental impact and should be carefully planned (Royal Society 2018). Harper et al. discuss several advantages and co-benefits that are associated with forest-based mitigation which include biodiversity, food control as well as quality improvement for soil, water and air (Harper *et al.* 2018).

Biochar

As a potential method for carbon capture and permanent storage, biochar has attracted a lot of attention lately and is regarded as one of the most promising negative emissions technologies. Through a thermochemical conversion process, biomass—such as devoted crops, agricultural residues, and forestry residues—is converted into biochar. It is made by gasification, hydrothermal carbonization, and pyrolysis, which involves heating without the presence of oxygen. Afterwards, the carbon that biomass absorbs from CO2 during plant development is converted into char, which may be left in soil for a long time. Carbon from biomass is stored during the conversion process in a very stable and non-decomposable state. Perhaps the most significant characteristic of biochar that distinguishes it as a reliable carbon removal technique is its stability in soils.

Conclusion

The three main components of CCS, a method for mitigating climate change, are the extraction of CO2 from a sizable stationary source (such as a coal-fired power plant), transportation of the CO2 to a storage location (such as a pipeline), and storage (such as injection into a saline aquifer). By burying CO2 underground rather than releasing it into the atmosphere, CCS aims to lower human carbon emissions. In order to collect CO2 for CO2-EOR, CO2 collection effectively uses current technology in industrial settings. The primary component of capture systems are scrubbers (such as absorption by amine-based solutions), which need a lot of energy to run but are quite simple to integrate into already-existing power plants. Because CO_2 sources and storage locations don't always match, captured CO_2 may need to be transported across long distances for storage. Due to the expertise gained from CO_2-EOR, pipeline transportation of CO_2 over long distances is a proven technology; nevertheless, building extensive networks of CO_2 pipelines may require substantial government financing. Although all of the components of carbon capture and storage (CCS) are established technologies, the implementation of CCS is far behind scenarios that aim to keep global temperature rise to 1.5 or 2°C. This lack of deployment is mostly due to industry's lack of motivation to bear the expenses of CCS as long as CO_2 emissions into the atmosphere are free of charge. Another problem is that some of the nations with the highest levels of human CO_2 emissions, including China and India, lack the manpower and subsurface understanding necessary to construct and run CCS facilities.