Microbial Solutions for Climate Change

AMERICAN SOCIETY FOR MICROBIOLOGY

As climate change accelerates, innovative and scalable solutions are crucial. Microorganisms have long been overlooked as climate solutions, yet their unique abilities make them powerful tools for tackling the climate crisis. The American Society for Microbiology and the International Union for Microbiological Societies released *Microbial Solutions for Climate Change,* a report developed by their scientific advisory group of experts (SAG). The report outlines the top 3 microbe-based solutions that can help mitigate climate change and underscores the urgent need for coordinated cross-sector global action.

Economics and Application of Microbial-based Climate Change Solutions

The report highlights major scientifically sound microbial solutions that could help humans adapt to and mitigate the negative impacts of climate change. The solutions are not substitutes for other strategies, but another powerful tool that contributes to a comprehensive climate strategy. The SAG assessed both the technical and economic feasibility of microbial innovations, highlighting solutions that prioritize human health, safety and wellbeing. The solutions must either generate enough revenue to cover implementation costs (commercial feasibility) or provide broader societal benefits—such as improved public health or reduced environmental damage—that outweigh their implementation costs (societal feasibility). By assessing both aspects, the SAG identified scalable microbial solutions that are effective and practical for real-world implementation, ensuring they can contribute meaningfully to global climate strategies.

Non-fossil Carbon Economy

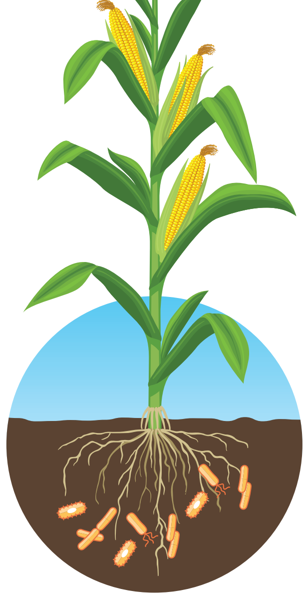
Microbes can transform sustainable and renewable carbon sources into valuable resources, offering an alternative to fossil fuels. The goal is to develop scalable microbe-based solutions that replace fossil-derived products and reduce greenhouse gas emissions. By feeding on greenhouse gases, food waste, crops and industrial byproducts, microbes can generate energy, biofuels and high-value chemicals.

Case Study: Microalgae-based Biofuels

Microalgae-based biofuels offer a promising alternative for sustainable energy production. Microalgae can thrive on land unsuitable for growing traditional crops. Additionally, microalgae use wastewater, reducing resource competition and lowering production costs. **Optimized production methods for microalgae-based biofuels could cut greenhouse gas emissions by up to 50% compared to traditional diesel.** Government incentives, like subsidies, can help make algae-based biodiesel more economically viable and accelerate adoption by reducing financial costs and risks.

Food Security and Ecosystem Resilience

Climate change threatens crop production by intensifying temperature extremes, water stress, pest and disease pressures and soil degradation. Microbes can help counter these challenges by improving soil health, boosting food production and strengthening ecosystems to support the nutritional needs of a growing global population.



Case study: Biofertilizers

Application of plant growth-promoting microorganisms, known as biofertilizers, enhance soil nutrient absorption, reducing reliance on costly chemical fertilizers that contaminate nearby waterways and are produced by greenhouse gas-intensive processes. By improving crop yields and lowering input costs, microbial treatments can increase farm profitability while promoting long-term food system sustainability.

Urgent Methane Mitigation

Microbes are vital in lowering methane emissions and potentially removing atmospheric methane. By leveraging methanotrophs to lower emissions in terrestrial and aquatic ecosystems—and converting methane from high-emission sites into energy, fuels and valuable chemicals—greenhouse gas levels can be significantly reduced.

Case Study: Landfill Gas

Landfills are a major source of methane emissions, but **biofilter systems can capture 60-90% of methane** while also reducing carbon dioxide emissions. Over 30 years, these systems could **prevent up to 3.9 gigatons of greenhouse gases.** Microbial solutions offer environmental, economic and public health benefits by lowering emissions, reducing regulatory costs and improving air quality. Financial incentives, such as carbon credits and subsidies, can help scale adoption by offsetting costs and encouraging investment.

The scientific advisory group outlines the following important considerations to implement microbial solutions effectively:

Biosafety Considerations: Many microbial solutions, like fungi-based materials and bio-based plastics, have a low-risk profile. Others—like bioremediation and microbial carbon sequestration—require a more careful approach. Identifying potential risks early and conducting contained field testing will be key to developing effective solutions.

Scaling & Oversight Challenges: While microbial solutions are proven effective and safe on a small scale, large-scale deployment could introduce unforeseen complications. Strong policies, effective monitoring frameworks and international cooperation are essential to ensure safe and effective implementation.

Global Standards & Industry Collaboration: Establishing international biosafety standards can promote public trust and regulatory clarity. Collaboration between academia, industry and policymakers can help determine necessary testing and shape policies that provide clear, predictable pathways for bringing microbial innovations to market.

Microbial Solutions as Part of a Broader Strategy: To achieve maximum impact, microbial interventions should complement—not replace—other global climate mitigation strategies, such as solar and wind energy and reforestation.