

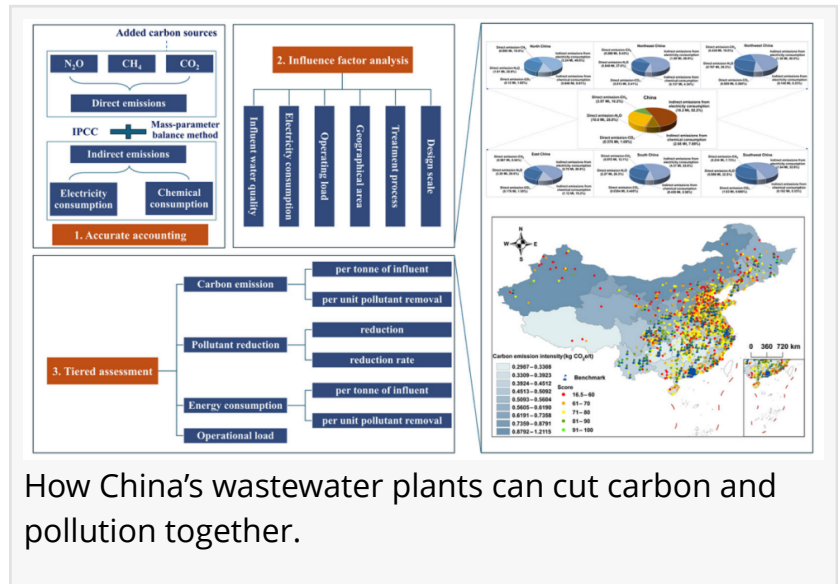
From pollution to solution: A tiered pathway for low-carbon wastewater treatment

FAYETTEVILLE, GA, UNITED STATES, January 5, 2026 /EINPresswire.com/ -- [Wastewater treatment plants \(WWTPs\)](#) are essential for clean water, yet they also generate significant greenhouse gas (GHG) emissions. A new study introduces a comprehensive tiered assessment framework that simultaneously targets pollution control and carbon reduction.

Globally, Wastewater treatment plants (WWTPs) account for about 3% of electricity use and 2% of greenhouse gas (GHG) emissions, largely due to heavy reliance on fossil-based power and chemical inputs. In China, rapid expansion of wastewater capacity since 2015 has been accompanied by rising energy and chemical consumption. While stricter discharge standards improved water quality, they also brought diminishing returns, as additional upgrades often yield higher emissions than environmental benefits. Existing research has outlined emission sources but rarely addressed the synergy between pollution control and carbon reduction. Due to these challenges, there is an urgent need to explore integrated strategies that simultaneously reduce pollution and carbon emissions in WWTPs.

Researchers from Tsinghua University, the Chinese Academy of Environmental Planning, and the China National Environmental Monitoring Centre have developed a tiered benchmarking framework to optimize both pollution control and carbon reduction in wastewater treatment. Their findings, published (DOI: [10.1016/j.eehl.2025.100155](https://doi.org/10.1016/j.eehl.2025.100155)) on May 20, 2025, in [Eco-Environment & Health](#), are based on operational data from 2,232 WWTPs across China. The study highlights benchmark plants that achieve optimal synergy and provides targeted policy recommendations, offering a science-based roadmap for greener urban wastewater systems.

The study conducted GHG accounting and factor analysis using over 247,000 monthly records from WWTPs nationwide. Annual emissions in 2019 were estimated at 34.8 million tonnes CO₂-equivalent, with indirect emissions from electricity and chemicals accounting for nearly 60%.



How China's wastewater plants can cut carbon and pollution together.

Electricity use alone contributed more than half of total emissions, reflecting China's dependence on fossil fuels for power generation. Researchers identified six critical factors shaping emission intensity: plant scale, treatment process, geography, operational load, electricity intensity, and influent quality.

A new tiered assessment classified WWTPs into three groups: 861 priority control plants, 730 general control plants, and 641 maintenance plants. Additionally, 222 facilities were identified as benchmark plants with optimal synergy. For these, carbon intensity ranged from 0.258–0.482 kg CO₂e per tonne, and operating loads were near full capacity. Modeling showed that raising all plants to benchmark performance could reduce national WWTP emissions by 30%. The study also found that oxidation ditch and A₂/O processes emitted far less than sequential batch systems, emphasizing the importance of technology choice in future upgrades.

“Our research demonstrates that wastewater treatment can no longer be viewed solely through the lens of pollution control,” said Dr. Miao Li, corresponding author of the study. “By integrating carbon reduction strategies into operational and policy frameworks, we can turn WWTPs into pivotal actors in both clean water management and climate mitigation. Benchmark plants show that achieving this synergy is possible, and scaling their practices across the sector will be key to reaching China's dual-carbon goals while maintaining environmental protection standards.”

The framework offers policymakers and plant operators clear pathways for action. Priority should first be given to low-performing plants with high emissions, particularly those with underloaded operations. Benchmarking best practices can guide upgrades in energy efficiency, operational management, and treatment technology selection. The study also calls for integrating renewable energy, such as solar power, into WWTPs to further cut emissions. By aligning wastewater management with national climate commitments, China can make significant progress toward Sustainable Development Goals on clean water and climate action, while providing a replicable model for other countries facing similar challenges.

References

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