OAK RIDGE NATIONAL LABORATORY

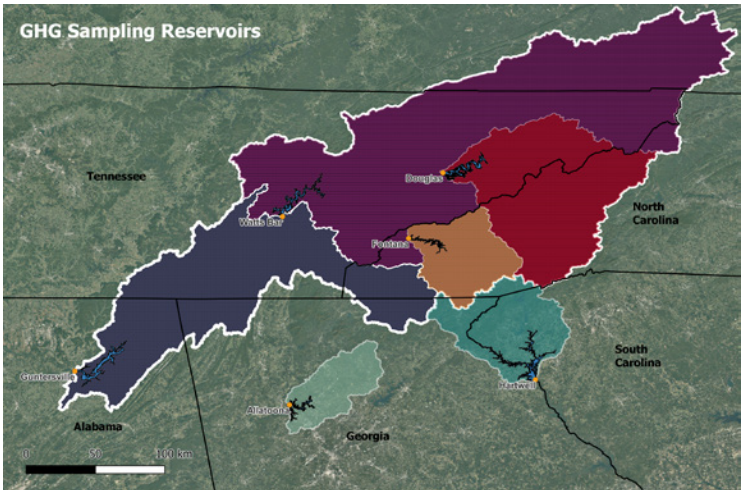
# Quantifying Greenhouse Gas Emissions from Hydropower Reservoirs

Although hydropower accounts for nearly 7 percent of US electricity generation and the majority of renewable energy, little is known about potential greenhouse gas emissions from US hydropower reservoirs.

To more accurately quantify GHGs, researchers at Oak Ridge National Laboratory are conducting a unique study that combines modeling with novel field measurements to assess three of the most common emission pathways of GHGs from reservoirs to the atmosphere.

## Answering a Complex Question

GHG emission estimates from hydropower reservoirs can range from 0.14 to 6.6 percent of global GHG emissions. The high variability in these estimates may be attributed to inconsistent and incomplete measurements and techniques. It is also very difficult to attribute GHG emissions to hydropower versus other uses in reservoirs, such as drinking water and flood control, since approximately 70% of hydropower reservoirs have multiple uses. These unknowns pose a risk for continued renewable hydropower development.




## Multi-Use Reservoirs

- ~1,500 providing hydropower generation
- Most support other uses:
  - Drinking water
  - Flood control
  - Crop irrigation
  - Recreation

## Impact

The team's findings are expected to provide a roadmap to more accurately quantify GHG emissions at hydropower reservoirs. The long-term goal is to develop GHG emission mitigation efforts based on more accurate assessments, enabling the continued development of hydropower as a resilient and sustainable clean energy source.

**HOW GHGs RISE TO THE ATMOSPHERE**

DIFFUSION

EBULLITION

DEGASSING

**Scan below to review the project profile**

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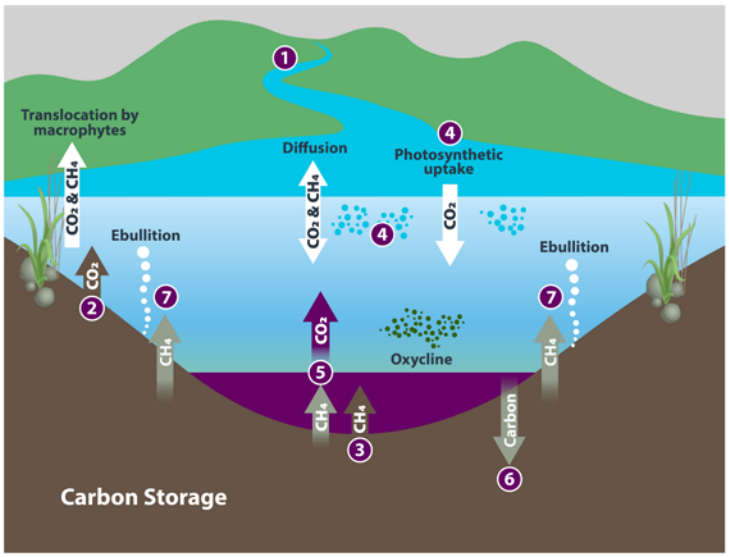
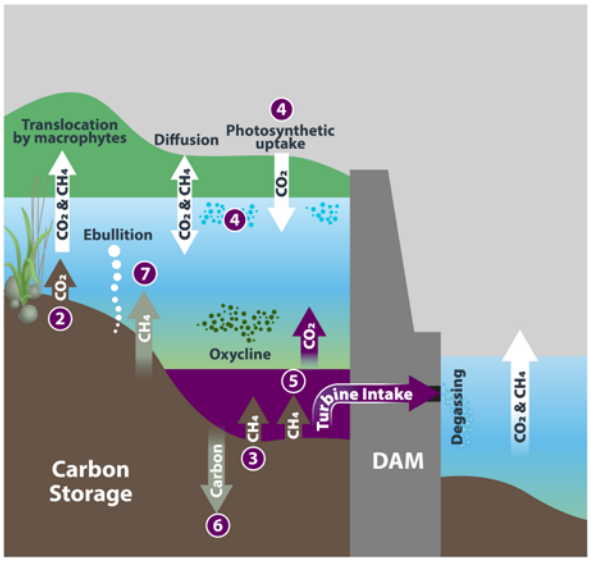
# Emission Pathways

**A. Watershed to reservoir**
(cross-section view)




**B. Reservoir upstream of dam to tailwater**
(river side view)




1 River Influx 2 Decomposition 3 Methanogenesis
4 Photosynthesis 5 Aerobic Methane Oxidation 6 Carbon burial 7 Ebullition zone

# Emissions Studied

For more information: https://doi.org/10.1016/j.rser.2022.112408

**Diffusion**: methane and carbon dioxide produced by microbes in the sediment and released at the water's surface

**Ebullition**: methane released to the atmosphere after methane bubbles rise to the surface

**Degassing**: methane and carbon dioxide released downstream of the dam as water passes through turbines or spillways, potentially pulling deep water with higher concentrations of methane

# Methodology

With support from the Department of Energy's Water Power Technologies Office, ORNL researchers are returning to six hydropower reservoirs in Tennessee, Alabama, Georgia, North Carolina, and South Carolina to measure carbon dioxide and methane emissions, which were initially studied in 2012. The team is using the International Hydropower Association's G-Res model to assess the carbon footprint of each reservoir, as well as traditional and novel field measurement techniques, including gas diffusion chambers, gas traps, and aquatic drones equipped with sensors. Any changes in recorded emissions can reveal the sensitivity of reservoir emissions to changing environmental conditions and hydropower operations.

# Findings

These new sampling methods provide higher-resolution data that can reduce some of the variability in prior GHG emission estimates.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