



Date Posted: Monday, September 11, 2023

REQUEST FOR PROPOSALS (RFP)

Developing a Greenhouse Gas Emissions Library for Unit Processes by Water Utilities and Decentralized Systems (5255)

Due Date

Proposals must be received by 3:00 pm Mountain Time on Tuesday, November 21, 2023.

WRF Project Contact

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Project Sponsors

This project is funded by The Water Research Foundation (WRF) as part of WRF's Research Priority Program.

Project Objectives

- Develop a standardized approach for the water sector to determine baseline greenhouse gas (GHG) emissions according to common unit processes and evaluate the impact of process/operational changes to their systems
- Establish a "GHG Emissions Library" with a basic framework in place that allows future updates as GHG emissions data from unit processes become more available

Budget

Applicants may request up to \$250,000 in WRF funds for this project.

Background and Project Rationale

Many water and wastewater utilities want to embed GHG mitigation into their capital planning processes. This is particularly impactful when done at a very early stage while asking questions like, "What unit treatment process should we choose?" and "What is the best use of our biogas if related GHG emissions are also considered?" A "GHG Emissions Library" would help utilities, practitioners and designers include GHG emissions in decision-making. In addition, there is a need for better GHG emission estimates at the level of unit treatment processes for existing and proposed facilities. This will enhance the understanding of GHG emissions for common unit processes as "building blocks" to assess the impact of changing processes/operations.

Furthermore, as communities deal with increasing populations and water demand, implementation of distributed treatment systems will increase in order to more sustainably cope with population shifts. Adequate information on GHG emissions for small-scale water and wastewater systems (including those relating to decentralized systems) are not currently

available. The comparison between treatment flow sheets on a normalized basis would add significant value. Therefore, there is a great need to develop a GHG emissions library based on unit processes for water and wastewater systems, including decentralized systems.

The outcome of this research will provide a standardized library of GHG emissions for the full suite of unit treatment processes for water and wastewater systems, which will allow owners to make informed decisions on the impact of process changes or introducing new processes. This effort will focus on both Scope 1 and 2 emissions, with consideration of incorporating Scope 3 emissions whenever possible. For example, it would be important to include chemicals relating to Scope 3 emissions when carbon footprint information on those chemicals is publicly available. This will facilitate benchmarking progress in the net zero journey. In addition, this research will apply to the One Water context as the library establishes a standardized framework for applications of drinking water, wastewater, stormwater, and recycling water; big and small municipalities; industrial systems; and decentralized systems. The library of processes would include liquids and solids processes as well as include traditional and non-traditional technologies.

Research Approach

The research team will conduct a comprehensive literature review including WRF's research efforts to date (please refer to selected examples in the "References and Resources" section). The research team will start with a desktop analysis to identify the full suite of treatment processes/technologies to be included in the library. This includes identification of the most common and useful unit processes for water, wastewater, and decentralized systems to cover the most promising emerging processes based on the current number of installations or potential future installations. Based on all available published literature, the research team will synthesize information about common unit processes from selected water and wastewater utilities, including decentralized systems in North America and elsewhere (as applicable).

The research team will conduct an online survey and virtually interview selected utilities, focusing on the perspective of utilities in North America with the aim of building from publicly available data and synthesizing the latest real-world practices on unit processes across diverse geographic regions. The research team will connect national organizations (e.g., Water Environment Federation, American Water Works Association, US Water Alliance, International Water Association, and others as needed) and their respective networks to advance the exchange of best available information to date regarding the current practices.

In addition, the team will collaborate with participating utilities and perform one additional study (e.g., field monitoring) for selected unit processes that would be required to validate the estimation of GHG emissions for a given process to supplement the desktop analysis. This will provide some first-hand experience in terms of data generation, quality assurance/control process, and subsequent inclusion into the database/library of data.

The team will develop an expandable database of information that can be updated in the future, including full referencing of all source data and assumptions. The team is expected to conduct multiple updates to add in processes throughout the project duration (approximately

two years) and one additional year after project completion to ensure incorporation of users' feedback from the first year after launch. The supporting database must be meticulously referenced so that users can clearly access the setup, methodologies, and/or estimates/calculations. This could be achieved by developing a user guide for the database. Given the current state-of-the-practice, this first version of the supporting database intends to cover basic available data while allowing for straightforward future updates as GHG emission data from unit processes becomes more available.

To facilitate feedback, the research team will host one invitation-only virtual workshop. The virtual workshop participants will include the Project Advisory Committee members (i.e., a technical review committee managed by WRF), representatives from participating utilities, WRF's collaborators and partners, and other invitees recommended by WRF. For the identified research gaps that may not be addressed through the current study (given the level of effort and/or state-of-the-knowledge), the research team will provide recommendations on preliminary research concepts for future consideration. For broader community outreach, the research team will conduct one webcast hosted by WRF and collaborating organizations on the overall findings of this project. The research team should consider additional outreach activities, such as presenting project findings at conferences and submitting a paper to an open access peer-reviewed journal.

Expected Deliverables

- A stand-alone comprehensive literature synthesis document built from completed and ongoing research, including annotations for the list of publications and resources used
- A transparent, accessible, editable, and fully referenced electronic library of GHG emissions from centralized and decentralized water, wastewater, and stormwater unit processes (e.g., macros-free Excel spreadsheet or another format deemed appropriate)
- A related user-friendly utility-facing guidance document
 - Part of this document will include a chapter and supporting technical appendix that summarizes the knowledge gaps, research needs, and preliminary project concepts for recommended research projects to fill those remaining gaps
- One invitation-only virtual workshop, along with workshop planning and all supporting materials (e.g., agenda, presentations, meeting notes, and workshop summary)
- Broader outreach:
 - Webcasts and public outreach materials such as conference presentations
 - Submitting one open access peer-reviewed journal paper and additional outreach products as applicable

Communication Plan

Please review WRF's *Project Deliverable Guidelines* for information on preparing a communication plan. The guidelines are available at <https://www.waterrf.org/project-report-guidelines#project-deliverable-guidelines>. Conference presentations, webcasts, peer-reviewed publication submissions, and other forms of project information dissemination are typically encouraged.

Project Duration

The anticipated period of performance for this project is 24 months from the contract start date. The final update of the “GHG emissions library” can be completed one additional year after the project end date and based on users’ feedback from the first year after launch of the database.

References and Resources

The following list includes examples of research reports, tools, and other resources that may be helpful to proposers. It is not intended to be comprehensive, nor is it a required list for consideration.

- Chandran, K. 2012. *Greenhouse Nitrogen Emissions from Wastewater Treatment Operation: Phase I – Molecular Level through Whole Reactor Level Characterization*. Project 1791. Alexandria, VA: Water Environment Research Foundation; London: IWA Publishing. <https://www.waterrf.org/research/projects/greenhouse-nitrogen-emissions-wastewater-treatment-operation-phase-i-molecular>
- Chandran, K. 2015. *Greenhouse Nitrogen Emissions from Wastewater Treatment Operation: Phase II – Molecular Level through Whole Reactor Level Characterization*. Project 1792. Alexandria, VA: Water Environment Research Foundation; London: IWA Publishing. <https://www.waterrf.org/research/projects/greenhouse-nitrogen-emissions-wastewater-treatment-operations-phase-ii-molecular>
- Leverenz, H. L., G. Tchobanoglous, and J. L. Darby. 2010. *Evaluation of Greenhouse Gas Emissions from Septic Systems*. Project 1362. Alexandria, VA: Water Environment Research Foundation; London: IWA Publishing. <https://www.waterrf.org/research/projects/evaluation-greenhouse-gas-emissions-septic-systems>
- Debarbadillo, C., J. Barnard, M. Benisch, and M. Falk. 2015. *Evaluation of Performance and Greenhouse Gas Emissions for Plants Achieving Low Phosphorus Effluents*. Project 1523. Alexandria, VA: Water Environment Research Foundation; London: IWA Publishing. <https://www.waterrf.org/research/projects/evaluation-performance-and-greenhouse-gas-emissions-plants-achieving-low>
- Green, D. 2022. *Workbook for estimating operational Greenhouse Gas emissions (CAW v16)*. UK Water Industry Research (UKWIR).
- Henderson, P. 2022. *Calculating Whole Life/Totex Carbon*. UK Water Industry Research (UKWIR).
- Huxley, D. E., W. D. Bellamy, P. Sathyanarayan, M. Riddens, and J. Mack. 2009. *Greenhouse Gas Emission Inventory and Management Strategy Guidelines for Water Utilities*. Project 4156. Denver, CO: Water Research Foundation. <https://www.waterrf.org/research/projects/greenhouse-gas-emission-inventory-and-management-strategy-guidelines-water>
- Intergovernmental Panel on Climate Change (IPCC). 2022. *Sixth Assessment Report (AR6)*. IPCC. <https://www.ipcc.ch/assessment-report/ar6/>
- Moore, D. P., N. Li, L. Wendt, S. Castañeda, M. Falinski, J. J. Zhu, C. Song, Z. J. Ren, and M. A. Zondlo. 2023. *Underestimation of wastewater treatment methane emissions in the United*

States. *Environmental Science & Technology*, 57 (10): 4082–4090.

<https://pubs.acs.org/doi/10.1021/acs.est.2c05373>

- Parravicini V., P. H. Nielsen, D. Thornberg, and A. Pistocchi. 2022. Evaluation of greenhouse gas emissions from the European urban wastewater sector, and options for their reduction. *Science of the Total Environment*, 838 (2022): 156322. <https://www.sciencedirect.com/science/article/pii/S0048969722034192>
- Ren, Z. J., J. L. Schnoor, K. R. Pagilla, A. J. Simon, S. W. Snyder, A. Shaw, K. Chetty, T. F. Chan, E. Lindsey, A. Kadava, B. Stevenson, K. R. Pagilla, P. Parameswaran, J. A. Deaver, S. C. Popat, V. Khanna, M. Kratzer, M. Harclerode, J. M. Sonawane, D. Plant, K. McCullough, S. Klaus, C. Bott, A. Onnis-Hayden, D. Wang, A. Akbari, M. Nguyen, A. Z. Gu, L. Mendez, C. A. Sepulveda-Munoz, M. del Rosario Rodero, I. de Godos, R. Munoz, M. Urgan-Demirtas, R. Dalke, K. R. Pagilla, B. Xu, S. Huang, C. Wang, T. C. A. Ng, H. Y. Ng, H. R. Molitor, J. L. Schnoor, A. Wang, B. Wang, Z. Guo, W. Cai, W. Liu, J. McQuarrie, J. Qu, H. Ren, H. Wang, K. Wang, G. Yu, B. Ke, H.-Q. Yu, X. Zheng, J. Li, K. B. Newhart, A. S. Hering, T. Y. Cath, J. A. Turgeon, S. A. Conrad, P. A. Vanrolleghem, and G. T. Daigger. 2022. *Pathways to Water Sector Decarbonization, Carbon Capture and Utilization*. Edited by Z. J. Ren, and K. Pagilla. IWA Publishing. <https://doi.org/10.2166/9781789061796>
- Rennert, K., F. Errickson, B. C. Prest, L. Rennels, R. G. Newell, W. Pizer, C. Kingdon, J. Wingenroth, R. Cooke, B. Parthum, D. Smith, K. Cromar, D. Diaz, F. C. Moore, U. K. Muller, R. J. Plevin, A. E. Raftery, H. Ševčíková, H. Sheets, J. H. Stock, T. Tan, M. Watson, T. E. Wong, and D. Anthoff. 2022. Comprehensive Evidence Implies a Higher Social Cost of CO₂. *Nature*, 610: (687–692). <https://doi.org/10.1038/s41586-022-05224-9>
- Song, C., J. J. Zhu, J. L. Willis, D. P. Moore, M. A. Zondlo, and Z. J. Ren. 2023. Methane Emissions from Municipal Wastewater Collection and Treatment Systems. *Environmental Science & Technology*, 57 (6): 2248–2261. <https://pubs.acs.org/doi/full/10.1021/acs.est.2c04388>
- Foley, J., Z. Yuan, E. Senante, K. Chandran, J. Willis, M. van Loosdrecht, and E. van Voorthuizen. 2011a. *N₂O and CH₄ Emission from Wastewater Collection and Treatment Systems State-of-the-Science Report – Report of the GWRC Research Strategy Workshop*. Project 1336. Denver, CO: The Water Research Foundation; London: Global Water Research Coalition. <https://www.waterrf.org/research/projects/n2o-and-ch4-emission-wastewater-collection-and-treatment-systems-state-science>
- Foley, J., Z. Yuan, E. Senante, K. Chandran, J. Willis, M. van Loosdrecht, and E. van Voorthuizen. 2011b. *N₂O and CH₄ Emission from Wastewater Collection and Treatment Systems Technical Report*. Published by Global Water Research Coalition. Project 1337. Denver, CO: The Water Research Foundation; London: Global Water Research Coalition. <https://www.waterrf.org/research/projects/n2o-and-ch4-emission-wastewater-collection-and-treatment-systems-technical-report>
- The Water Research Foundation (WRF). 2023. *Climate Change-Related Projects*. Denver, CO: The Water Research Foundation. [waterrf.org/sites/default/files/file/2023-04/WRF-Climate-Change-Project-List.pdf](https://www.waterrf.org/sites/default/files/file/2023-04/WRF-Climate-Change-Project-List.pdf)
- Ye, L., J. Porro, M. Pijuan, Y. Zhao, O. Gutierrez, H. Duan, Z. Wu, K. R. Sharma, A. C. Brotto, A. Lake, V. Parravicini, A. Filali, A. Delre, V. Vasilaki, E. Katsou, M. Sperandio, L. Lang, F. Sabba,

R. Nerenberg, P. Vanrolleghem, C. Domingo-Felez, B. F. Smets, B.- J. Ni, Z. Yuan, K. Sharma, M. R. J. Daelman, M. C. M. van Loosdrecht, E. I. P. Volcke, X. Flores-Alsina, M. Arnell, L. Corominas, C. Sweetapple, G. Fu, D. Butler, K. V. Gernaey, J. Porro, G. Bellandi, and I. Nopens. 2022. *Quantification and Modelling of Fugitive Greenhouse Gas Emissions from Urban Water Systems*. Edited by L. Ye, J. Porro, and I. Nopens. IWA Publishing.
<https://doi.org/10.2166/9781789060461>

Proposal Evaluation Criteria

The following criteria will be used to evaluate proposals:

- Understanding the Problem and Responsiveness to RFP (maximum 20 points)
- Technical and Scientific Merit (maximum 30 points)
- Qualifications, Capabilities, and Management (maximum 15 points)
- Communication Plan, Deliverables, and Applicability (maximum 20 points)
- Budget and Schedule (maximum 15 points)

PROPOSAL PREPARATION INSTRUCTIONS

Proposals submitted in response to this RFP must be prepared in accordance with WRF's *Guidelines for Research Priority Program Proposals*. The current version of these guidelines and the *Instructions for Budget Preparation* are available at <https://www.waterrf.org/proposal-guidelines>. The guidelines contain instructions for the technical aspects, financial statements, indirect costs, and administrative requirements that the applicant must follow when preparing a proposal.

Proposals that include the production of web- or software-based tools, such as websites, Excel spreadsheets, Access databases, etc., must follow the criteria outlined for web tools presented in the *Web Tool Criteria and Feasibility Study for The Water Research Foundation Project Deliverables* at <https://www.waterrf.org/project-report-guidelines#webtool-criteria>.

Eligibility to Submit Proposals

Proposals will be accepted from both U.S.-based and non-U.S.-based entities, including educational institutions, research organizations, governmental agencies, and consultants or other for-profit entities.

WRF's Board of Directors has established a Timeliness Policy that addresses researcher adherence to the project schedule. The policy can be reviewed at <https://www.waterrf.org/policies>. Researchers who are late on any ongoing WRF-sponsored studies without approved no-cost extensions are not eligible to be named participants in any proposals. Direct any questions about eligibility to the WRF project contact listed at the top of this RFP.

Administrative, Cost, and Audit Standards

WRF's research program standards for administrative, cost, and audit compliance are based upon, and comply with, Office of Management and Budget (OMB) Uniform Grants Guidance (UGG), 2 CFR Part 200 Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, and 48 CFR 31.2 Contracts with Commercial Organizations. These standards are referenced in WRF's *Guidelines for Research Priority Program Proposals*, and include specific guidelines outlining the requirements for indirect cost negotiation agreements, financial statements, and the Statement of Direct Labor, Fringe Benefits, and General Overhead. Inclusion of indirect costs must be substantiated by a negotiated agreement or appropriate Statement of Direct Labor, Fringe Benefits, and General Overhead. Well in advance of preparing the proposal, your research and financial staff should review the detailed instructions included in WRF's *Guidelines for Research Priority Program Proposals* and consult the *Instructions for Budget Preparation*, both available at <https://www.waterrf.org/proposal-guidelines>.

Budget and Funding Information

The maximum funding available from WRF for this project is \$250,000. The applicant must contribute additional resources equivalent to at least 33% of the project award. For example, if an applicant requests \$100,000 from WRF, an additional \$33,000 or more must be contributed

by the applicant. Acceptable forms of applicant contribution include cost share, applicant in-kind, or third-party in-kind that comply with 2 CFR Part 200.306 cost sharing or matching. The applicant may elect to contribute more than 33% to the project, but the maximum WRF funding available remains fixed at \$250,000. Proposals that do not meet the minimum 33% of the project award will not be accepted. Consult the *Instructions for Budget Preparation* available at <https://www.waterrf.org/proposal-guidelines#RPP-instr-budget-prep> for more information and definitions of terms.

Period of Performance

It is WRF's policy to negotiate a reasonable schedule for each research project. Once this schedule is established, WRF and its sub-recipients have a contractual obligation to adhere to the agreed-upon schedule. Under WRF's No-Cost Extension Policy, a project schedule cannot be extended more than nine months beyond the original contracted schedule, regardless of the number of extensions granted. The policy can be reviewed at <https://www.waterrf.org/policies>.

Utility and Organization Participation

WRF encourages participation from water utilities and other organizations in WRF research. Participation can occur in a variety of ways, including direct participation, in-kind contributions, or in-kind services. To facilitate their participation, WRF has provided contact information, on the last page of this RFP, of utilities and other organizations that have indicated an interest in this research. Proposers are responsible for negotiating utility and organization participation in their particular proposals. The listed utilities and organizations are under no obligation to participate, and the proposer is not obligated to include them in their particular proposal.

Application Procedure and Deadline

Proposals are accepted exclusively online in PDF format, and they must be fully submitted before 3:00 pm Mountain Time on Tuesday, November 21, 2023.

The online proposal system allows submission of your documents until the date and time stated in this RFP. To avoid the risk of the system closing before you press the submit button, do not wait until the last minute to complete your submission. Submit your proposal at <https://forms.waterrf.org/cbruck/rfp-5255>.

Questions to clarify the intent of this RFP and WRF's administrative, cost, and financial requirements may be addressed to the WRF project contact, Harry Zhang, PhD, PE; 571.384.2098 or h Zhang@waterrf.org. Questions related to proposal submittal through the online system may be addressed to Caroline Bruck at 303.347.6118 or cbruck@waterrf.org.

Utility and Organization Participants

The following utilities have indicated interest in possible participation in this research. This information is updated within 24 business hours after a utility or an interested organization submits a volunteer form, and this RFP will be re-posted with the new information. **(Depending on your settings, you may need to click refresh on your browser to load the latest file.)**

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