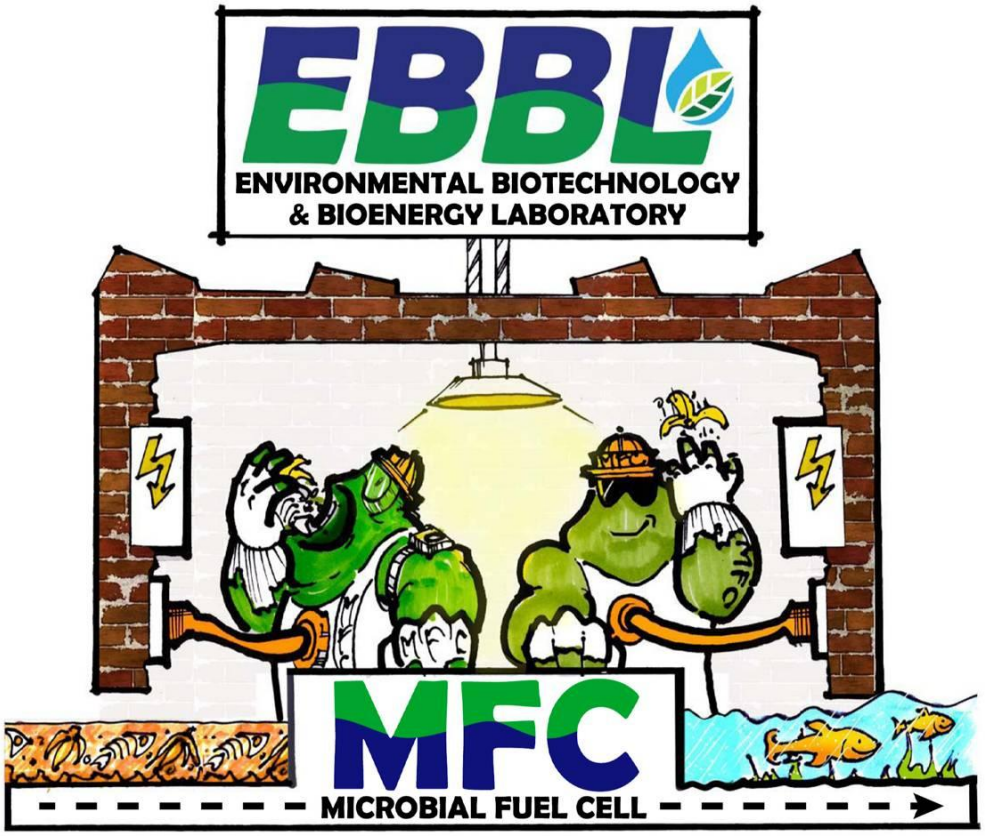
WashU



2025 Report

It's time to say farewell to 2025. We said farewell during the year to several lab members who completed their graduate, undergraduate, or visiting research at WashU and started their new journeys. After being in this "business" for 16 years, I feel stronger that my best accomplishments are those who may benefit from the training and research in our lab. That's exactly what I said during my professorship installation talk. It has been a pleasure to meet our alumni on various occasions such as conferences, workshops, or personal visits. This bonding, created from a few months or years in the lab, can last for a long time.

Environmental Engineering is a relatively new major at WashU. It received ABET accreditation in 2025, but there still lacks a feeling of "home." Our students' active participation in professional societies is helping to create a home for Environmental Engineering. Grace led two teams that both won first place in the Central State Design Contest and then were top-ranked in the national student design competition during the 2025 WEFTEC. We established a WashU Chapter of Tau Chi Alpha (TXA), the Environmental Engineering Honor Society; I became an honorary member of TXA and faculty advisor of the WashU Chapter. I am confident that our Environmental Engineering community at WashU will become larger and stronger.

As always, thank you for a wonderful year in 2025!

Zhen (Jason) He
Laura and William Jens Professor





Yue (April) Rao has successfully defended her PhD and graduated from WashU in December. She was a key player of our DOE project on biogas upgrading. She will join AECOM's office in California as an environmental engineer.



Shruti Kadam graduated from WashU with a MS degree in December. She won the 2nd place in Wastewater category at MWEA/MO-AWWA Joint Annual Meeting and received J R Popalisky scholarship by MO-AWWA.



Paloma Santiago submitted her first EBBL paper (under review). She became EBBL's "lab manager". She is a key member of the competition team that won both regional and national awards. She is the EECE GSC secretary.



Soyoung Park submitted her first EBBL paper (under review). She participated in the competition team led by Grace. She manages our collaborative project with Cranfield University and expects a manuscript soon.



Ariel Richards completed her BS/MS study at WashU. She joined Jacobs' office in St. Louis as an engineer. In the fall, Ariel came back to the campus and shared her experiences with EnvESA members.



Marcelle Santana Rovira graduated from WashU with a BS degree in Chemical Engineering. She then joined Thermo Fisher Scientific's St. Louis office as a process engineer.



Kuan-Lun Chen joined EBBL as a PhD student. He completed his BS and MS in Geosciences at National Taiwan University. He is working on electrochemical treatment of contaminants and machine learning.



Kaichao Yang graduated from WashU with his PhD degree and started a postdoctoral researcher position at the University of California Berkeley. He received the 2025 CAPEES-Elsevier Outstanding Graduate Student Award.



Jiasi Sun published two papers in *Water Research* (highlighted on the McKelvey news) and *Critical Reviews in Environmental Science and Technology*. Her paper was selected as a Top Cited Article in *Water Environment Research*.



Shih Kuan Tsai had his first EBBL paper published in *Separation and Purification Technology* and another paper accepted by *ACS ES&T Engineering*. He is overseeing purchase orders for the lab.



Grace Duong led two teams to (both) won the 1st place at the 2025 Midwest Student Design. These teams later won the 2nd and 3rd places at the national competition during WEFTEC. She also presented at Gateway High School.



Tommy Xi completed his undergraduate study at WashU. He went to the University of California Berkeley for a MS study in Environmental Engineering.



Jianpeng (Jim) Zhou did one-semester sabbatical at WashU. Dr. Zhou is a Professor of Civil Engineering at Southern Illinois University Edwardsville. He is involved in Grace's research on sludge dewatering.



Chao-Chin Chang completed his postdoc and started a tenure-track Assistant Professor position at National Kaohsiung University of Science and Technology. He joined WER Early Career Editorial Board.

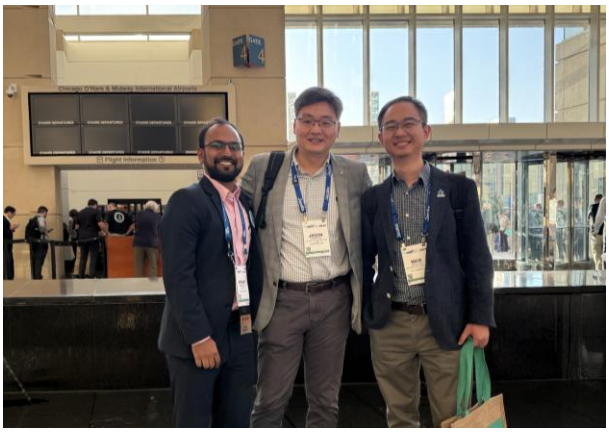




Congratulations!



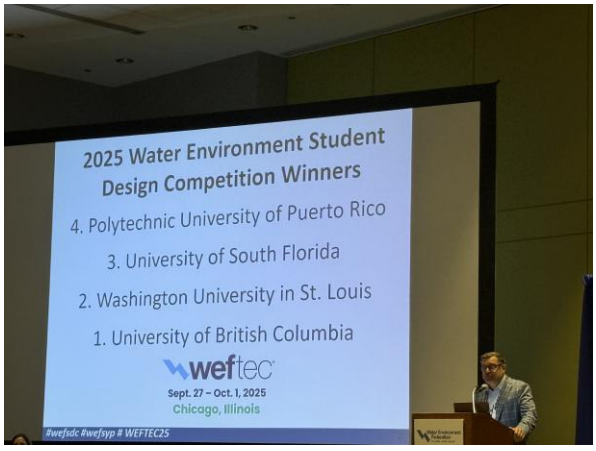






Two student teams led by EBBL members Grace, Paloma, and Soyoung, both won awards at the WEF Student Design Contest (2025 WEFTEC, Chicago): 2nd place in the Water Environment category and 3rd place in the Wastewater category.

Earlier this year, those teams won the first place in both the wastewater design and water environment categories at the 2025 Midwest Student Design Competition.









Dr. He was installed as the Laura & William Jens Professor of Environmental Engineering.

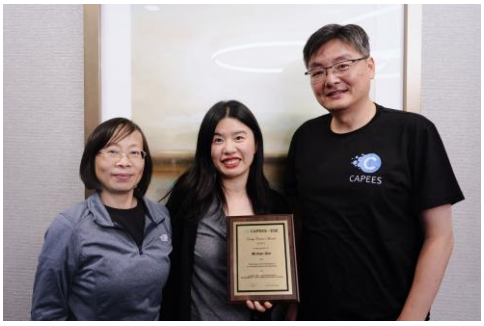
In 1992, Stifel Jens, who earned a Bachelor of Science in civil engineering in 1932 and a Master of Science in 1933 from WashU. helped launch the WashU's environmental engineering program. He endowed the Laura and William Jens Professorship in Environmental Engineering in honor of his parents.



The EBBL members attended the 2025 AEESP conference at Duke University and reunited with several lab alumni. Dr. Mohan Qin won the CAPEES-UCEEF Early Career Award, Dr. Zixuan Wang won the CAPEES-Elsevier Thesis/Dissertation Award, and Dr. Kaichao Yang received CAPEES-Elsevier Outstanding Graduate Student Award.









Dr. Zixuan Wang received an Honorable Mention for the 2025 Jacobs Engineering Group/AEESP Outstanding Doctoral Dissertation Award.

Dr. He received the Frederick George Pohland Medal from AEESP/AAEES.





Chang, C.C., Lin, Y.W., Yu, C.P.* and He, Z.* (2025) In-situ control of biohythane production in electro-anaerobic digestion. *Chemical Engineering Journal*. Vol 526, Article 170783.

Yang, K. and He, Z.* (2025) Formation of disinfection byproducts in electrochemical water disinfection. *Current Opinion in Environmental Science & Health*. Vol 48, Article 100685.

Tsai S.K., Liu, P., J., Zhang, W. and He, Z.* (2025) Integrating solvent extraction with electrochemical separation for nutrient recovery from anaerobic digested sludge. *Separation and Purification Technology*. Vol 379, Article 135088.

Sun, J. and He, Z.* (2025) Light stimulated H2O2 inhibition on methanogenesis during anaerobic digestion towards enhanced VFAs production. *Water Research*. Vol 286, Article 124229.

Rao, Y. and He, Z.* (2025) Hythane production from brewery wastewater generated biogas using a membrane electrochemical cell. *Water Environment Research*. Vol 97, Article e70098.

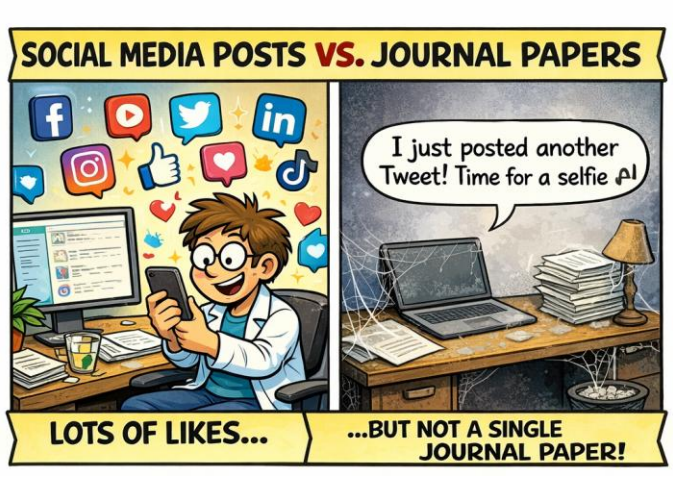
Yang, K. and He, Z.* (2025) Integrating oxidation and reduction processes in electrochemical wastewater treatment for contaminant removal with byproduct control. *Water Research*. Vol 599, Article 118466.]

Sun, J., Wang, Z. and He, Z.* (2025) Indirect electrochemical leaching and separation of cobalt and lithium from spent LiCoO2 through recovery and reuse of sulfuric acid. *Separation and Purification Technology*. Vol 364, Article 132587.

Mohamed, A.A.R., Ali, A.ED., Hassouna, M.S.ED., Elhusseiny,A.F., He,Z. and Moustafa, H.* (2025) Efficacy of bioelectrochemical and electrochemical systems in ammonia recovery from slaughterhouse wastewater. *Applied Water Science*. Vol 15, Article 28.

Yang, K. and He, Z.* (2025) Electrochemically assisted water softening with disinfectant production for wastewater reuse. *Desalination*. Vol 599, Article 118466.

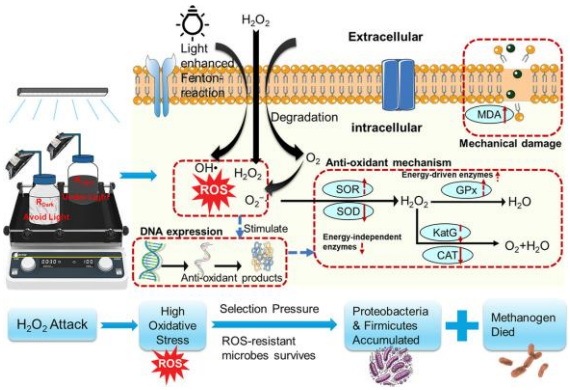
Mohamed, AAR., Ali, AE., Hassouna,MSE., Elhusseiny, AF., Kashyout,AEB., He, Z. and Moustafa, H.* (2025) Performance evaluation of microbial fuel cell fabricated using green nano-graphene oxide as coating anode material. *Biomass Conversion and Biorefinery*. Vol 15, PP 297–310.





Light Enhanced VFAs Production

Producing volatile fatty acids (VFAs) from anaerobic digestion (AD) of sewage sludge is of strong interest and can be realized via arresting methanogens. Herein, in situ hydrogen peroxide (H_2O_2) dosage has been demonstrated to be an effective approach to suppress methanogenesis and promote VFAs accumulation in the presence of illumination. Two AD reactors operating under different conditions produced average VFAs concentrations of 11,456.5 mg COD L^{-1} (R_{Light}, 80 mg L^{-1} H_2O_2) and 11,896.5 mg COD L^{-1} (R_{Dark}, 380 mg L^{-1} H_2O_2). Visible light significantly reduced the H_2O_2 dosage level from 380 to 80 mg L^{-1} to achieve complete methane inhibition, likely due to light-activated H_2O_2 producing ·OH. The light-exposed H_2O_2 elevated intracellular reactive oxygen species (ROS) levels, leading to a sharp decline in methanogen abundance. Firmicutes became dominant, increasing from 14.03 % (inoculum) to 52.35 % under high oxidative stress. Metagenomic functional predictions inferred microbial communities that tended to mitigate oxidative stress by reducing ROS generation, as shown by the relative gene abundance reduced from 0.0577 to 0.0472 %.



Source: Sun, J. and He, Z.* (2025) Light stimulated H2O2 inhibition on methanogenesis during anaerobic digestion towards enhanced VFAs production. *Water Research*. Vol 286, Article 124229.

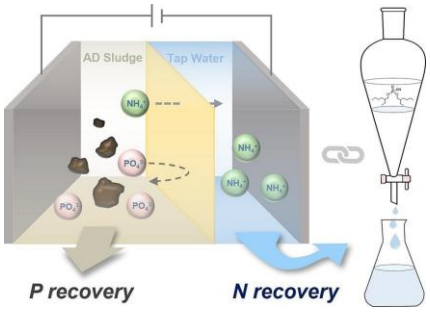
Electrochemically assisted water softening

Highly purified wastewater has great potential for potable reuse but its treatment by commonly used technologies like reverse osmosis (RO) is facing challenges of membrane scaling/fouling. Herein, a chemical-free electrochemically assisted treatment process was developed and investigated for water softening with simultaneous disinfectant production; such a process could serve as a pretreatment step to control scaling/fouling in the subsequent RO treatment. The secondary effluent sampled from a local wastewater treatment plant was firstly treated by OH^--containing catholyte to raise the solution pH to ~11 for hardness removal, and subsequently treated by H^+- and chlor(*am*)ine-containing anolyte to adjust pH and achieve disinfection. The electrochemical treatment has decreased Ca^{2+} and Mg^{2+} from 1.8 and 0.9 mM to 0.3 and 0.4 mM with removal efficiencies of >80 % and > 50 %, respectively. Meanwhile, total coliform and *E. coli* were reduced by >5-log and > 4-log, and the final effluent had a pH of ~7 and a residual chloramine concentration of ~0.04 mM that would be suitable for further control of microbial contaminants. Those results would encourage further exploration of electrochemical processes as a chemical-free pretreatment method for RO membrane fouling control in potable reuse.

Source: Yang, K. and He, Z.* (2025) Integrating oxidation and reduction processes in electrochemical wastewater treatment for contaminant removal with byproduct control. *Water Research*. Vol 599, Article 118466.

Solvent extraction with electrochemical separation

Anaerobically digested sludge (ADS) from municipal wastewater treatment plants contains a large amount of inorganic nutrients such as phosphorus and ammonia, and recovery of those nutrients will not only reduce pollutants but also contribute to a circular economy. An integrated nutrient recovery system was developed by coupling electrochemical treatment with solvent extraction to enable efficient and selective nutrient recovery. Ammonium was enriched in the catholyte through electromigration, accompanied by an electrolysis-induced pH increasement. Subsequent extraction using di(2-ethylhexyl) phosphoric acid (D2EHPA) achieved more than 70 % efficiency with evident selectivity over sodium and potassium. Consistence performance was maintained over ten consecutive extraction – stripping cycles. Meanwhile, phosphate leached into the anolyte was recovered via calcium precipitation with a 7-mM calcium dosage, achieving a recovery efficiency of 92.0 %. The unreacted calcium was subsequently recovered using D2EHPA with an extraction efficiency of 94.3 %. Those results encourage further exploration of integrating solvent extraction with electrochemical processes for nutrient recovery.



Source: Tsai S.K., Liu, P., J., Zhang,W. and He, Z.* (2025) Integrating solvent extraction with electrochemical separation for nutrient recovery from anaerobic digested sludge. *Separation and Purification Technology*. Vol 379, Article 135088.

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