RENEWABLE AND SUSTAINABLE ENERGY LABORATORY

KATHMANDU UNIVERSITY

RSEL ANNUAL BULLETIN-2023

MESSAGE FROM LEAD

These years our lab has ardently worked towards 100% Renewable Energy, Circular Bio-Economy, Building Energy Efficiency, Energy Transition and Climate Change. Confronted with myriad constraints imposed in this part of the world, rather than dampening our spirits, these challenges have catalyzed a remarkable transformation, enhanced resiliency and heightened efficacy within our team. Despite navigating through a range of limitations, our team has not only persevered but has also managed to inspire and uplift students through both national and international collaborations.

Our laboratory is partnering with more than twenty professors form several universities and research institutes from USA, Australia, Germany, Sweden, Norway, Finland, Thailand, China, India and Sri Lanka. We currently partner with six international and one national project which are funded by German Academic Exchange Program (DAAD), Swedish Research Council, NORPART, Norway, ERASMUS plus, EU, the Academy of Finland and EnergizeNepal. These coalitions have created opportunities for about 45 masters and PhD students of Kathmandu University in multiple exchange program of three to six months in Germany, Sweden, Norway and Thailand. Along with that our lab currently has 5 PhD, 7 Master's thesis and five non-degree hard

Dr. Sunil Pd. Lohani

working researchers working together to attain a common goal in sustainable energy. We welcome and look forward to engage with any potential collaborators who share our passion and interest in our endeavor.

PhD RESEARCH ONGOING

Geeta Bhatta

Pathways to 100% Renewable energy in Nepal

The main objectives of this research is to set the pathways for the source diversification (high share of Solar) with hydropower. Comprehensive GIS-based machine learning approach for solar resource assessment will be carried out for the technical/economical potential of solar PV in Nepal. This study will estimate the capacity of energy storage that will be needed to balance the high share for solar energy and RoR hydro. For storage technology the study will mainly focus on pumped hydro energy storage (off-river) to balance the load fluctuation.

Navin K. Jha

Technical and Environmental Assessment of Household Bio-digester in Nepal

This study will conduct technical assessment of existing household bio-digesters in two different altitudes (Terai and Hilly region). The effect of temperature on biogas digestion will be evaluated and laboratory-scale biogas digester will be used for the validation. Along with that, the study will conduct life cycle assessment (LCA) and inventory analysis of household biogas plants in Nepal. Further, analysis on the social perception of biogas plants as alternative energy sources will be conducted.

Sujesh Shrestha

Techno-Economic Analysis of Hydrogen Utilization in Anaerobic Digestion Process of Biogas Plants in Nepal

The study will investigate Bio-methanation of CO2 sourced from biogas into CH4 through integration of H2 in anaerobic digestion process. The study will assess the reactor performance of converting CO2 into CH4 through establishment of lab scale reactor and assess the H2 utilization and CO2 conversion. The study will further explore probable sources of H2 for Nepal and Life Cycle Assessment and Economic Analysis of overall production process (from H2 production and utilization to CH4 production).

Utsav S. Rajbhandari

The optimal pathway to sustainable energy- An integrated energy system analysis

This study will focus on policy and planning based analyses – especially the o02nes formulated by Nepal. The study will evaluate the energy system - supply and demand in manufacturing sector. Similarly, the study will also evaluate the implications of current plans and policies in energy system for

manufacturing sector. Furthermore, the study will carry out optimization analysis to evaluate the least cost, low emission energy mix for the sustainable energy pathways for manufacturing sector.

Ravi Suwal

Sustainable Residential Building to cope weather induced variability in Nepal

The main objective of the research is to determine the heating and cooling energy demand in residential buildings and to predict the future energy demand at different scenarios. This study will determine the current energy demand in urban and rural areas to maintain weather induced variability of Nepal. Along with that, it will also investigate the possibility of retrofitting of existing buildings and construct energy efficient new buildings using local construction materials. Further, the study will estimate energy demand for heating and cooling at different development scenarios of Nepal up to 2050 while analyzing the climate change impact in future energy demand of Nepal.

Master's Thesis Students

Ongoing

Gaurav Tamrakar: Life cycle costing of Public EV: A comparative Study of BEV and Trolley Bus. (In collaboration with USN, Norway)

Rajani Neupane: Life Cycle Assessment of Bioelectrochemical System for Biogas Upgradation

Aayush N. Ghimire: Techno Economic Assessment of Sewage Sludge Valorization in Kathmandu Valley

Ashish D. Bhatta: Biochar's Effect on Direct Interspecies Electron Transfer (DIET) in Anaerobic Digestion for the Removal of Ammonia

Completed- 2023

Manisha Basukala: Technical Evaluation of EV-Penetration in Suryabinabinayak Feeder

Vijan Bhandari: Technical Performance of Commercial Biogas Plant in Nepal (A Case Study)

Prabin Dhakal: Techno-Economic Analysis of Pumped Hydro Energy Storage in Context of Nepal.

Dipesh KC: Assessing the Feasibility and Barriers to Induction Cooking Potential in Pokahara-Lekhnath Metropolitan City

Rohini Khyen: Energy and Carbon Footprint for Urban Food System: A Case Study of Kathmandu Valley

Biplab Lamsal: Effect of Conductive Material on Anaerobic Digestion/Co-Digestion of Organic Wastes

Researchers

Poushan Shrestha

Nawaraj Thapa Magar

Nishma Bhattarai

Rashmi Karki

Exchange Students

Program	Location	Student	Level	Year
SEED	KU to Linnaeus, Sweden	Ravi Suwal	PhD	2023
		Ajay Kr. KC	PhD	2023
		Navin Kumar Jha	PhD	2022
	KU to KTH, Sweden	Kushal Shrestha	PhD	2023
		Geeta Bhatta	PhD	2022
Re-Tech	KU to USN, Norway	Sujesh Shrestha	PhD	2023
		Rajani Neupane	Master's	2023
		Ayush N. Ghimire	Master's	2023
		Ashish Dutta Bhatta	Master's	2023
eREET	KU to TH Koln, Germany	Subodh Luitel	PhD	2023
		Gaurav Tamrakar	Master's	2023
		Upama Nepal	Master's	2022
		Dipesh KC	Master's	2022
		Rohini Khyen	Master's	2022
		Prabin Dhakal	Master's	2021
		Manisha Basukala	Master's	2021
		Sundar Shrestha	Bachelors	2021
	TH Koln, Germany to KU	Jorge Mayorga	Master's	2023
ForHimSDG	KU to AIT, Thailand	Utsav S. Rajbhandari	PhD	2023
		Sagar Pathak	Master's	2023
	AIT, Thailand to KU	Sarnai Battulga	PhD	2023
		Trishala Singh Rathour	Master's	2023

PROJECT INVOLVEMENTS

Year	Title	Countries Involved
2024 to 2026	Advanced Climate Change Education for Sustainable futures and Systems change (ACCESS). Funded by ERASMUS PLUS.	Finland, Nepal
2023 to 2026	Technological and socio-economic solutions to reduce small scale combustion emissions in Nepal (SmokefreeHome). Funded by Research Council of Finland.	Finland, Nepal
2022 to 2024	Project Lead (Kathmandu University): Demonstrating applicability of modified prefabricated household floating drum biodigester (ENEP-RENP-II-22-04). Funded by EnergizeNepal Project (NORAD).	Nepal
2022 to 2026	Instituting of Research-based education systems for the development of Renewable energy technology in the Circular economy (Re-Tech). Funded by Norwegian Partnership Programme for Global Academic Cooperation (NORPART).	Norway, Nepal, Bangladesh, Sri Lanka
2022 to 2025	Promoting Himalayan Development by Strengthening Teaching and Research on Sustainable Development Goals (ForHimSDG). Funded by Federal Ministry for Economic Cooperation and Development, German Academic Exchange Service (DAAD).	Germany, Thailand, Nepal
2022 to 2025	The Doctoral school in Sustainable Energy Engineering (SEED). Funded by Swedish Research Council (VR).	Sweden, Bolivia, India, Nepal
2021 to 2024	Energizing Higher Education – Renewable Energy for Economic Transition (e-REET). Funded by German Academic Exchange Program (DAAD), Germany.	Germany, Nepal

RECENT PUBLICATIONS

Shaw, T. K., Rajendran, D. K., Raghuvanshi, S.*, & Lohani, S. P. (2023). Anaerobic co-digestion of unavoidable and avoidable food-waste with addition of eggshells and applied kinetic studies. ***Materials Today: Proceedings***, October 2023. https://doi.org/10.1016/j.matpr.2023.11.138

Cheng S.*, Lohani S.P.*, Rajbhandari U.S., Shrestha P., Shrees S., Bhandari R., Jeuland M.,(2023): Sustainability of large-scale commercial biogas plants in Nepal, **Journal of Cleaner Production**, 139777, https://doi.org/10.1016/j.jclepro.2023.139777.

Sedai A.*, Dhakal R., Koirala P., Gautam S., Pokhrel R., Lohani S.P., Moussa H., Pol S. (2023): Renewable energy resource assessment for rural electrification: A case study in Nepal, **International Journal of Low-Carbon Technologies**1–13 https://doi.org/10.1093/ijlct/ctad089

Shrestha S., Pandey R., Aryal N.*, Lohani S.P.* (2023): Recent advances in co-digestion conjugates for anaerobic digestion of food waste, **Journal of Environmental Management**, 345, 118785,https://doi.org/10.1016/j.jenvman.2023.118785

Chen, H., Xu, Q., Cheng, S., Wu, T., Boitin, T., Lohani, S.P., Mang, H.P., Li, Z., Wang, X. (2023): Comprehensive Analysis and Greenhouse Gas Reduction Assessment of the First Large-Scale Biogas Generation Plant in West Africa. **Atmosphere**, 14, 876. https://doi.org/10.3390/atmos14050876

Jiang F., Xiong Y., Xu Q., Lohani S.P., Jiang Z., Zhao Y., Peng X. (2023): Materials, process, and applications in energy storage systems, **Frontiers in Energy Research**, 11, 1221873. https://doi.org/10.3389/fenrg.2023.1221873

Xu Q., Yang G., Wang C., Liu Z., Zhang X., Li Z., Lohani S.P., Zhao Y., Xiong Y., Ding Y. (2023): Experimental study on the reinforcement of a gravity heat pipe based on a latent thermal functionally fluid, **Energy**, 278, 127782,https://doi.org/10.1016/j.energy.2023.127782

Kafle U., Anderson T*, Lohani S. P.* (2023): The Potential for Rooftop Photovoltaic Systems in Nepal, **Energies**,16 (2), 747. https://doi.org/10.3390/en16020747

Lohani S.P.*, Gurung P., Gautam B., Kafle U., Fulford D., Jeuland M. (2022): Current status, prospects, and implications of renewable energy for achieving sustainable development goals in Nepal, **Sustainable Development**, 1-14. https://doi.org/10.1002/sd.2392

Bista U., Rayamajhi B., Dhungana B., Lohani S. P.* (2022). Biogas Production by Co-Digestion of Food Waste with Sewage Sludge and Poultry Litter: A Way towards Sustainable Waste-to-Energy Conversion. **Journal of Renewable Energy and Environment**. https://doi.org/10.30501/jree.2022.333462.13

Shrestha S., & Lohani S. P.* (2022). CFD analysis for mixing performance of different types of household biodigester, **Clean Energy**, 6(2) 325–334 https://doi.org/10.1093/ce/zkac009

Lohani S. P., Pokhrel D., Bhattarai S., & Pokhrel A. K. (2022). Technical assessment of installed domestic biogas plants in Kavre, Nepal. **Renewable Energy**, 181, 1250–1257. https://doi.org/10.1016/j.renene.2021.09.092

Dhungana B., Lohani S. P.*, Marsolek M., (2022). Anaerobic Co-Digestion of Food Waste with Livestock Manure at Ambient Temperature: A Biogas Based Circular Economy and Sustainable Development Goals. **Sustainability**; 14(6):3307. https://doi.org/10.3390/su14063307

Op-ed

Sunil Prasad Lohani & Prabin Dhakal, Energy Security: Diversify its sources, **The Himalayan Times**, June 2, 2022. https://thehimalayantimes.com/opinion/energy-security-diversify-its-sources

Sunil Prasad Lohani & Upama Nepal, Waste in Cities: Problem and awareness, **The Himalayan Times**, July 18, 2022. https://thehimalayantimes.com/opinion/waste-in-cities-problem-and-awareness

KEY ACTIVITIES

Workshop/Seminar

1. **Keynote: "Solar Energy in Nepal",** International Conference on Advancement in Energy by Department of Mechanical Engineering Motilal Nehru National Institute of Technology, Allahabad, India - December 2023, http://mnnit.ac.in/urjasangam-2023/

2. Workshop on Strengthening Teaching and Research on Sustainable Development Goals: Curriculum Transfer and Capacity Building hosted by AIT, Thailand – August 2023 (Activity of ForHimSDG, DAAD)

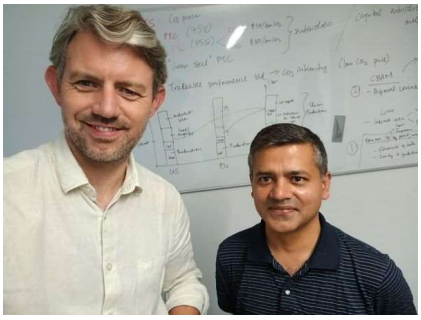
3. International Workshop on Research-based Education for Renewable and Sustainable Energy Development-December 2022 (Activity of Re-Tech Project, NORPART)

4. Curriculum exchange discussion and Review Workshop -October 2022 (Activity of e-REET Project, DAAD)

5. Strengthening Teaching on Sustainable Development Goals: Curriculum Co-development Workshop-July 2022 (Activity of ForHimSDG Project, DAAD)

International Networking

1. Karlsruhe Institute of Technology (KIT), Heidelberg University and Center for European Economic Research in Germany- September 2023



2. Visit to University of South-Eastern Norway (USN) - May 2023


3. Visit to TH Köln Germany- May 2023


Field Visits

1. Industry partner visit Pokhara wash Pvt. Ltd.-March 2023 (EnergizeNepal Field Visit)

2. Interaction program on Scope of Solar and Renewable energy in Province 1- January 2023(RE-Tech Project Networking Event)

3. Waste Water Treatment Plant at Biratnagar Metropolitan City- January 2023 (RE-Tech Project

Networking Event)

4. Shree Krishna Gau Sewa Sadan farm 200m^3 capacity biogas plant- January 2023 (RE-Tech Project Networking Event)

5. Interaction Program with the faculties and students at Gauradaha Agriculture Campus- January 2023 (RE-Tech Project Networking Event)

6. Waste-to-energy facility named Nextera Energy Pvt Ltd-January 2023 (RE-Tech Project Networking Event)

7. A visit to Venture Waste to Energy Pvt.Ltd. Panbari, Dharan-January 2023(RE-Tech Project Networking Event)

8. A Visit to Purwanchal Campus,Dharan- January 2023 (RE-Tech Project Networking Event)

9. Visit to waste to energy project at Itahari Sub-Metropolitan city-January 2023 (RE-Tech Project Networking Event)