SHWETA SINGH
Associate Professor
Agricultural & Biological Engineering
Environmental & Ecological Engineering
Davidson School of Chemical Engineering (By Courtesy)
Purdue University, West Lafayette, Indiana – 47907, U.S.A.

Research Area

Integrated modeling for Sustainable Industrial and Natural Coupled Systems using principles of Industrial Ecology, Process Systems Engineering and Machine Learning. Focus areas: renewable energy, bio-based & circular economy and sustainable manufacturing.

Professional Experience

August 2022 - Present	Associate Professor, Agricultural & Biological Engineering and Division of Environmental & Ecological Engineering, Purdue University, West Lafayette, Indiana, USA
August 2023 - Present	Associate Professor, Davidson School of Chemical Engineering (By Courtesy), Purdue University, West Lafayette, Indiana, USA
Nov 2014 – July 2022	Assistant Professor, Agricultural & Biological Engineering and Division of Environmental & Ecological Engineering, Purdue University, West Lafayette, Indiana, U.S.A.
Oct 2013-Oct 2014	Postdoctoral Fellow, Department of Civil Engineering, University of Toronto, Toronto, Ontario, Canada Mentor: Prof Chris Kennedy Research Area: Urban Sustainability: Energy Consumption and C-N-Biodiversity Impacts
Sep 2012-Sep 2013	National Research Council Postdoctoral Fellow, National Academy of Sciences & U.S. Environmental Protection Agency, Western Ecology Division, Corvallis, Oregon Mentor: Dr. Jana Compton Research Area: Development of Nitrogen Physical Input-Output Table
July 2006- Aug 2007	Associate Software Developer, Sapient Corporations, Bangalore, India

Education

PhD. Sep 2007 - Aug 2012	Chemical Engineering	The Ohio State University, Department of Chemical Engineering Advisor: Bhavik R. Bakshi Phd Thesis: *Incorporating Biogeochemical Cycles and Utilizing Complexity Theory for Improving Sustainability Analysis Methodology*
Masters in Applied Statistics, 2011	Statistics	The Ohio State University, Department of Statistics

B.Tech, 2006	Chemical Engineering	Indian Institute of Technology- Banaras Hindu University (IIT-BHU) – Varanasi, India

Other Professional Preparation

Complex Systems Summer School, June 8 – July 1, 2011	Complexity Science	Santa Fe Institute, Santa Fe, New Mexico, USA
6th Annual Green Chemistry Summer School, July 2008	Green Chemistry and Sustainability	American Chemical Society, Golden, Colorado, USA

Awards & Honors

1. **Purdue Seed for Success Acorn Award, for external grant above 1 million $, 2024**
2. **Most Impactful Faculty Inventors of Fiscal Year, 2024 – New CoE Startups, 2024**
3. **Invited** to participate in the US National Academy of Engineering's 2021 US Frontiers of Engineering Symposium based on selection process held from Sep 22-24, 2021. 1 of 83 early career engineers across US academia, industry and government.
4. **American Institute of Chemical Engineers, Environmental Division, Early Career Award, 2021.** In recognition of contribution to advancement of methodologies and computational tools for sustainability assessment using principles of chemical engineering**.**
5. **Finalist - Johnson & Johnson Women in Science, Technology, Engineering, Manufacturing, Math and Design (WiSTEM2D) Scholar Award, 2017** - Among top 40 from about 500 applicants worldwide.
6. **Best Student Paper**, 2014, American Institute of Chemical Engineers (AIChE), Sustainable Engineering Forum
7. **National Research Council Award under the Research Associateship Program of National Academy of Sciences** to conduct independent research at US-EPA. April 2012.
8. **Outstanding Graduate Award** for Academic Achievement, Spring 2011, Department of Chemical and Bio-molecular Engineering, The Ohio State University. May 2011
9. **Awarded a Scholarship** by **Santa Fe Institute**, New Mexico, to attend a summer school on Complex Systems, 8 June – 1 July 2011 organized by Santa Fe Institute
10. **Best Student Paper at 2010***,* IEEE International Symposium on Sustainable Systems and Technology for the paper: *Enhancing the reliability of C and N accounting in economic activities: Integration of bio-geochemical cycle with Eco-LCA*
11. **Best Student Poster at 2010**, IEEE International Symposium on Sustainable Systems and Technology.
12. **Nanoscale Science and Engineering Center (NSEC) Fellow** at The Ohio State University*, 2009-2010.*

Editorial Positions

1. Managing Guest Editor for Special Issue on "Advances in Circular Economy" in Resources, Conservation and Recycling, Elsevier, 2017
2. Guest Editor for Special Issue on Eco-Summit 2016 in Ecological Modeling, Elsevier
3. Associate Editor – Journal of Industrial Ecology, April 2021 – Present
4. Associate Editor – PLOS Sustainability & Transformation, May 2021- Present

Professional Society Activities

1 Elected as Board Member of Socio-Economic Metabolism Section of International Society of Industrial Ecology (ISIE) (2023-2025)
2 Elected as Director of AIChE Environmental Division (2022- 2024)
3 Elected as member of Nominating Committee in International Society of Industrial Ecology for 2021- 2023 (only 6 members globally are elected in this position) (via Nomination and peer voting)
4 Executive Committee Member: AIChE Environmental Division (2020-Present)
5 **Program Chair**, International Symposium on Sustainable Systems & Technology (ISSST 2018) – Leading Section on Advances in Circular Economy.
6 International Society of Industrial Ecology (ISIE), Biennial Meeting, 2017 and ISSST 2017, Scientific Review Committee and Organizing Committee.
7 ISSST 2014, Member of Scientific Committee
8 International Conference on Sustainable Design, Engineering & Construction (ICSDEC 2015), Leadership Committee
9 ISSST 2016, Publicity Chair
10 **Session Organizer :** "Nitrogen and Sustainability" : In EcoSummit (Session #0234), France, Aug, 2016 (http://www.ecosummit2016.org/sessions-general-ecology.asp)
11 AIChE Area 23 C (Sustainable Engineering) Session Chair, 2017, 2018, 2019
12 Session Co-Chair, "Thermodynamics in Sustainability and Industrial Ecology", ISIE-2017

FUNDING

SPONSORED RESEARCH – PRINCIPAL INVESTIGATOR ($3,606,663)

1 **US National Science Foundation**, **CBET**, **Future Manufacturing**, FMRG: Eco: Cyber Enabled Transformation to Circular Supply Chains for Sustainable Pharmaceutical Manufacturing Networks **($3,000,000**) (Co-PIs: Gintaras Reklaitis, Zoltan Nagy, Vaneet Aggarwal, Carol Song, Kari Clase) 2022-2026

2 **Argonne National Laboratory, US Department of Energy, "**Supply Chain, Life Cycle and Material Flow Analysis of Critical Materials" **($64,189) (PI)** 2022-2023

3 **US National Science Foundation, CBET, Environmental Sustainability, GOALI** 2020-2021
Process Engineering Models to Physical Input-Output Tables (PIOTs): A Novel Approach to Reproducible, Transparent and Fast Regional PIOT Development Via Collaborative PIOT Hub: NSF Supplement to extend model for critical materials in US **($34,596) (PI)**

4 **PathZero Inc (Industrial Funding)** 2020-2021
Developing model and databases for achieving carbon neutrality in US: **($26,500)**

5 **Purdue Research Foundation**, 2020-

	Bio-electro hybrid tech for the Circular Ag-Economy of Phosphorus – Clean Water, Grow Food, Save Energy **($50,000)**	2021
6	**US National Science Foundation, CBET, Environmental Sustainability** Process Engineering Models to Physical Input-Output Tables (PIOTs): A Novel Approach to Reproducible, Transparent and Fast Regional PIOT Development Via Collaborative PIOTHub **($292,378)**	2018-2021
7	**Purdue Research Foundation** Developing a US Multi-Regional Input-Output Model for Sustainability Assessment **($8,000)**	2017
8	**International Renewable Energy Agency (Bonn, Germany)**: Modeling Global Urban Energy Consumption under climate change scenario **($10,000)**	2016
9	**Purdue Research Foundation**, International Travel Grant: For Organizing a Session on "Nitrogen and Sustainability" at EcoSummit, 2016; Montpellier, France **($1,000)**	2016
10	**US National Academy of Sciences, National Research Council Postdoctoral Award** Life Cycle Approach for Sustainable Management of Nitrogen Related Ecosystems Services: Development of a Nitrogen PIOT **($120,000)**	2012-2014

SPONSORED RESEARCH – CO-PI ($8,734,040)

1	**US National Science Foundation (NSF), Division of Environmental Biology** Collaborative Research: MRA: Scale, Space, and Time: A Unifying Approach to Aquatic Invasions **(Total Budget: $734,040; Co-I: $89,997) PI: Brandon Peoples**	2021-2024
2	**US Army Research Lab** Advancing Army Modernization Priorities through Collaborative Energetic Materials Research (**Total Budget: $8,000,000; Co-I: $267,000**) **Co-PI**: Stephen Beaudoin, **PI: Jeffrey Rhoads**	2020-2023

Student Fellowships and Awards

1 William Farlessyost, National Science Foundation Graduate Research Fellowship (March 2022)
2 Miriam Stevens wins the competitive national GEM fellowship, 1 year of support. (March 2021)
3 Miriam Stevens selected as Climate Corps Fellow to work on Environmental and Sustainability Standards of Products (Feb 2021)
4 Best Oral Presentation to Gargeya Vunnava, ISIE Americas 2020 Conference (July 2020)
5 Miriam Stevens selected as Emerging Leaders in Circular Economy for a mentorship

program with BASF, Green Biz conference 2020

6 ISIE Travel Grant to Gargeya Vunnava for Young Professional Symposium at ISIE Biennial Symposium, Beijing, China, June 2019

7 Purdue Ross Fellowship to Miriam Stevens: $50,000 (2019-2020)

8 2nd Prize on Poster to Gargeya Vunnava "An Automated Approach to build Industrial Ecosystem Networks using Physical Input Output Tables generated from Computational Process Models": NSF Workshop at Purdue, Center for Resilient Infrastructures, Systems and Processes.

9 Purdue Climate Change Research Center (PCCRC): Travel Grant to Gargeya Vunnava, PhD Student ISIE, $1,000

10 Purdue Ross Fellowship to Liz Wachs: $50,000 (2015-2016)

11 Purdue Climate Change Research Center (PCCRC): Travel Grant to Nehika Mathur, PhD Student ISSST, $1,000

12 Potash Corp i2i Fellowship to student Jacob Wheately for 2 semesters research on "Sustainability of Phosphorus Recovery", Fall 2015-Spring 2016

13 Walter J Hass Solar Scholarship to Heather Strathearn for work on Life Cycle Assessment of Solar Energy in Urban Systems ($18,000) (Fall 2017 – Spring 2018)

PUBLICATIONS (Journal & Conference Proceedings Peer Reviewed)

***Represent articles from work at Purdue.**
****Articles written at Purdue, some work was done at Postdoc positions**

Journal Articles in Preparation

1 *****Stevens, M., Geschke, A., Lenzen M., and **Singh S**., A MRIO approach to Cobalt tracking in US

2 Bademi A. and Singh S., "Economic and Environmental Impact of replacing single-use plastic packaging with bio-based plastics" To be submitted.

3 Uthayakumar H., Peoples, B., Olden J.D., Midway S. and Singh S. "Network Connectivity Based Stream Classification for the Conterminous United States (NetConUS) To be Submitted to Scientific Data

4 Ganguly B., Shekhar A.R., Chen Chang-Lin, Chen J., Aggarwal V. and Singh S., "Material Flow Analysis and Reinforcement Learning Approach to Design Zero Waste Networks for Pharmaceutical Industries", To be Submitted

Journal/Conference Articles in Review

1 *Shekhar A.R., *Farlessyost W. and Singh S., "Dynamics and Resilience for Design of Sustainable Processes, Supply Chains and Industrial Networks: Review and Perspective", Ready to Submit (*Joint first authors)

2 Bademi, A., Stevens, M., Sura I. and Singh S., "Estimating the Spatial Economic and Environmental Impact of planned offshore wind energy in the USA using Environmentally Extended Multiregional Input-Output Analysis" – (Revision stage), Applied Energy (Submitted July 2024)

3 Farlessyost, W. and Singh S., "Resilience Dynamics in Coupled Natural-Industrial Systems : A Surrogate Modeling Approach for Assessing Climate Change Impacts on Industrial Ecosystems" In review, Journal of Industrial Ecology (Submitted Dec 2024)

4 Jagadeesan P. and Singh S., "The Impact of Model Sloppiness on Linear Controller Design", In review, 14th IFAC Symposium on Dynamics and Control of Process Systems including Biosystems. (Submitted, Nov 2024)

Journal Articles

1 Fahimi A., Zhao, F., **Singh S**. and Vahidi E., "Mapping Complexity: Analyzing rare earth production life cycle inventories with. Network analysis", Resources Conservation and Recycling, 211, 107894 (2024)
2 Shekhar, R. A., Moar, R. R, and **Singh S**., "A Hybrid Mechanistic Machine Learning Approach to Model Industrial Network Dynamics for Sustainable Design of Emerging Carbon Capture and Utilization Technologies" Sustainable Energy & Fuels, Vol. 7, 20, 5129-5146 (2023)
3 *Farlessyost, W. and **Singh, S**., "Reduced order dynamical models for complex dynamics in manufacturing and natural systems using machine learning", **Nonlinear Dynamics,** (2022)
4 ***Singh, S.,** "Networking for food production", **Nature Sustainability,** (2022)
5 *Mathur, N., Sutherland JW**., Singh, S. "**A Study on end of life photovoltaics as a model for developing industrial synergistic networks**", Journal of Remanufacturing,** 1-21**, (2022)**
6 *Vunnava, V.S.G, Shin, J., Zhao, L. and **Singh, S**., "PIOT-Hub: Collaborative Cloud Tool for Generation of Physical Input-Output Tables Using Mechanistic Engineering Models", **Journal of Industrial Ecology** **https://doi.org/10.1111/jiec.13204** (2021)
7 *Vunnava, V.S. G and **Singh, S**., Integrated Mechanistic Engineering Models and Macroeconomic Input-Output approach to Model Physical Economy for Evaluating the Impact of transition to Circular Economy, **Energy & Environmental Science** (2021), 14, 5017-5034
8 Schull, Val Z., Mehan, S., Gitau, M.W., ***Singh, S**., Sesmero, J.P., Flanagan, D.C., "Construction of Critical periods of water resources management and their application in the FEW nexus", Accepted, **Water** (2021)
9 ***Singh, S**., Babbitt C., Gaustad, G., Eckelman, M.J., Gregory, J., Ryen E., Mathur N[G]., Stevens M.C[G]., Parvatker A., Buch R., Marseille A., Seager T., "Thematic exploration of sectoral and cross-cutting challenges to circular economy implementation.", Accepted, **Clean Technologies and Environmental Policy**, (2021)
10 *Vunnava, V.S.G and **Singh S.,** "Spatial Life Cycle Analysis of soybean-based biodiesel production in Indiana, USA using process modeling" (Invited Paper in Special Issue), **Processes** 8 (4) (2020)
11 *[UG]Subramanian, R., [UG]Moar, R. and **Singh S**., "White-Box Machine Learning Approaches to Identify Governing Equations for Overall Dynamics of Manufacturing Systems: A Case Study on Distillation Column", Accepted, **Machine Learning With Applications** (2020)
12 *Faturay, F., [G]Vunnava V.S.G., Lenzen, M**., Singh S.,** "Using a new USA multi-region input output (MRIO) model for assessing economic and energy impacts of Wind Energy expansion in USA." **Applied Energy,** 261, 114141 (2020)
13 *[G]Mathur, N**., Singh S.,** Sutherland J**.,** "Promoting a Circular Economy in the Solar Photovoltaic Industry using Industrial Symbiosis." **Resources Conservation and Recycling**, 11, 104649 (2020)
14 *[G]Wachs, E. and **Singh S**., Projecting Urban Energy Demand for Indiana, USA in 2050 and 2080. **Climatic Change**, 1-18 (2020)
15 *[G]Vunnava, G. and **Singh S**., "Entropy Generation Analysis of Sequential Anaerobic Digester

Ion-Exchange Technology for Phosphorus extraction from Waste", **Journal of Cleaner Production** 221, 55-62 (2019)

16 ***Singh S**., Ashton, W., Buch R., Babbitt, C. and Seager, T. "Advances in the Circular Economy", Resources Conservation and Recycling, 141, 499-500 (2019)

17 *[G]Wachs, L. and **Singh S**., A modular bottom-up approach for constructing physical input-output tables (PIOTs) based on process engineering models*,* **Journal of Economic Structures**, 7:26 (2018)

18 *Raymond L., Gotham D., McClain W., Mukherjee S., Nateghi R., Preckel, P.V., Schubert P., **Singh S**., and [G]Wachs E. Projected Climate Change Impacts on Indiana's Energy Demand and Supply, **Climatic Change**, (2018)

19 *Liu Y., Engel B.A., Flanagan D.C., Gitau M. W., McMillan, S. K., Chaubey I., **Singh S**., Modeling framework for representing long-term effectiveness of best management practices in addressing hydrology and water quality problems: Framework development and demonstration using a Bayesian method., **Journal of Hydrology**, Vol. 560, Pages 530-545, (2018)

20 **Liu, X., **Singh S.**, Gibbemeyer, E.L., Tam, B., Urban, R.A., Bakshi, B. R., *The Carbon-Nitrogen Nexus of Transportation Fuels*. **Journal of Cleaner Production**, (2018)

21 ****Singh S.,** Compton J.E., Hawkins, Troy R., Sobota, D. J., Cooter, E.J. *A Nitrogen Physical Input-Output Table (PIOT) model for Illinois.* **Ecological Modelling**, 360 (2017) 194-203

22 ****Singh S.** and C. Kennedy**,** The Nexus of Carbon, Nitrogen and Biodiversity Impacts from Urban Metabolism**. Journal of Industrial Ecology** (2017) doi:10.1111/jiec.12611

23 Sobota D., Compton J., McCrackin M., **Singh S.,** Cost of reactive nitrogen release from human activities to the environment in the United States**., Environ Research Letters**, 10 (2), 025006, 2015

24 **Singh S.** and Bakshi B.R., Footprints of Carbon and Nitrogen: Revisiting the Paradigm and Exploring their Nexus for Decision Making., **Ecological Indicators**. 53, June 2015, 49-60

25 **Singh S.** and C. Kennedy., Estimating Future Energy Use and CO_2 Emissions of the World's Cities., **Environmental Pollution**, Vol 203, August 2015, Pages 271-278

26 **Singh S.** and Bakshi B.R. Accounting for Emissions and Sinks from the Biogeochemical Cycle of Carbon in the US Economic Input-Output Model. **Journal of Industrial Ecology***, 18 (6), 818-828, 2014*

27 **Singh S.** and Bakshi B.R. Accounting for the Biogeochemical Cycle of Nitrogen in Input-Output Life Cycle Assessment. **Environmental Science & Technology**, 47 (16), pp 9388-9396, 2013 (**DOI:** 10.1021/es4009757)

28 Zhang Y, **Singh S.** and Bakshi B.R. Accounting for Ecosystem Services in Life Cycle Assessment Part I: A Critical Review*,* **Environmental Science and Technology***, 44, 7, 2232-2242, 2010*

Peer Reviewed Conference Proceedings

1 Farlessyost W. and Singh S., "Improving Mechanistic Model Accuracy with Machine Learning Informed Physics" Systems & Control Transactions, Vol. 3, Pages 275-282. (FOCAPD 2024)

2 Jagadeesan P. and Singh S., "Model assessment for Design of Future Manufacturing systems using Digital Twins : A case study on a single-scale pharmaceutical manufacturing unit", Systems & Control Transactions, Vol. 3, Pages : 778-782

3 *Maani, T., Mathur, N., **Singh, S.**, Chuanbing, R. and Sutherland, J. "Potential for Nd and Dy Recovery from End-of-Life Products to Meet Future Electric Vehicle Demand in the U.S., Procedia CIRP, Vol 98, 109-114 (2021)

4 *Mathur, N., Sidi D**., Singh, S**., Yih, Y., Sutherland, J. "Assessing the Opportunities and Benefits of a Circular Economy in the Context of Electric Vehicles", 26th CIRP Life Cycle Engineering Conference. (Conference Proceeding)

5 **Singh S.** and Bakshi B.R. *Insights into Sustainability from complexity analysis of Life Cycle Networks: A case study on Gasoline and Bio-Fuel Networks.* Proceedings of the 2011, IEEE International Symposium on Sustainable Systems and Technology (ISSST)

6 **Singh S**. and Bakshi B.R. *Enhancing the reliability of C and N accounting in economic activities: Integration of bio-geochemical cycle with Eco-LCA.* Proceedings of the 2010, IEEE International Symposium on Sustainable Systems and Technology (ISSST)

7 Urban R., **Singh S.,** Grubb G. and Bakshi B.R. *Establishing Synergies Between Technological and Ecological Systems for Sustainable Products and Process.* Sustainable Chemical Product and Process Engineering (SCPPE) Conference, Hangzhou, *China*, May 9-13, 2010

8 **Singh S.** and Bakshi B.R. *Eco-LCA: A tool for quantifying the role of ecological resources in LCA.* Proceedings of the 2009 IEEE International Symposium on Sustainable Systems and Technology (ISSST)

Book Chapters

1 **Singh S., "***Biogeochemical Cycles: Modeling the Interaction of Carbon and Nitrogen Cycles with Industrial Systems***" in "**Engineering and Ecosystems – Seeking Synergies Toward a Nature-Positive World**",** Springer, 2023, https://doi.org/10.1007/978-3-031-35692-6

2 **Singh S.** and Bakshi B. R. "*N Footprint and the nexus between C and N footprints*" in "Assessing and Measuring Environmental Impact in Engineering", Elsevier, Editor – Jiri Klemes, ISBN: 9780127999685

3 **Singh S.** and Bakshi B.R. "*Chemical Engineering and Biogeochemical Cycles: A Techno-Ecological Approach to Industry Sustainability*", in "Sustainability in the Analysis, Synthesis and Design of Chemical Engineering Processes, Elsevier, Editors: Heriberto Cabezas (US-EPA) and Gerardo Ruiz-Mercado (US-EPA)

Patents

WO2022/010927 – Material Dataflow Extraction and Simulation System – Pending, Jan 2022 (Provision Filed, 63/048 July 2020)

This patent is about a new method developed to automate building Physical Input-Output Table (PIOT) based models using engineering mechanistic models such as process system engineering models and python based simulations of engineered systems. The PIOTs allow for macroscale tracking of material flows in industrial networks, thus allowing to optimize resource flows for sustainable resource management and minimization of wastes.

CONFERENCE TALKS/POSTERS

1 Vunnava, V.S.G. and **Singh S**., "Spatial Life Cycle Analysis of Soybean-Based Biodiesel Production in Indiana Using Process Modeling", AIChE Annual Meeting, Nov 18, 2020 (Online)

2 Faturay, F., Vunnava, V.S.G., Lenzen, M., and **Singh S**., "Economic and Energy Impacts of Wind Energy Expansion in the US Using Multi-Regional Input-Output (MRIO) tables", AIChE Annual Meeting, Nov 16, 2020 (Online)

3 Vunnava, V.S.G., and **Singh, S**., "Identifying Strategies for Systems Scale Transition to Circular Economy via Physical Supply Use Tables Developed from Bottom-Up Models : A Case Study on Illinois Agro-Economy", AIChE Annual Meeting, Nov 17, 2020 (Online)

4 Stevens, M. and **Singh, S.**, "Subnational Supply Chain Analysis of Cobalt in the US to Guide Sustainable Manufacturing of Batteries for Renewable Energy: A Multi-Regional Input-Output (MRIO) Approach.", AIChE Annual Meeting, Nov 18, 2020 (Online)

5 Mathur, N., Sutherland, S., and **Singh, S.**, "Enabling Early Planning and Development of Eco-Industrial Parks for Photovoltaic Circular Economy Using Multi Objective Optimization Techniques", AIChE Annual Meeting, Nov 20, 2020 (Online)

6 Moar, R^{UG}., Subramanian, R^{UG}. and **Singh, S**., "White-Box Machine Learning Approaches to Identify Governing Equations for Dynamics in Complex Manufacturing Systems and Their Comparison : A Study on Distillation Column", AIChE Annual Meeting, Nov 20, 2020 (Online)

7 Vunnava, V.S.G., Macaggi, M., Chen, Y. and **Singh, S**., "Modeling Spatial and Temporal Emissions for Animal Farming Using Mechanistic Models", AIChE Annual Meeting, Nov 17, 2020 (Online)

8 Vunnava, G. and **Singh S**., "Computational approach to generate Physical Input-Output Tables", ISIE, July 2019, Beijing, China

9 . Mathur N., Sutherland J.W. and **Singh S**., "Identifying lucrative Life Cycle Symbiosis (LCS) Opportunities to Promote End of Life Solar Photovoltaic Recovery, ISIE, July 9, 2019, Beijing, China

10 . Mathur N, **Singh S** and Sutherland J.W., "", International Symposium of Sustainable Systems and Technology (ISSST), 2018, June 28-30, 2018, Buffalo, New York

11 . Wachs, E. and **Singh S.**, "A Physical Input-Output Model for the Food-Energy-Water (FEW) Nexus in Indiana", AIChE Annual Meeting, Oct 29-Nov 3, 2017, Minneapolis, MN

12 . Gargeya, Vunnava and **Singh S.**, "Thermodynamic Analysis of an Ion-Exchange Based Waste Water treatment for Phosphorus Recovery", AIChE Annual Meeting, Oct 29- Nov 3, 2017, Minneapolis, MN

13 . Wachs, E. and **Singh S**., "Changing Global Demand for Fossil Based Electricity with Adoption of Renewables at Urban Scale", AIChE Annual Meeting, Oct 29-Nov 3, 2017, Minneapolis, MN

14 . **Singh S.,** and Bristow D., "Thermodynamics in Industrial Ecology and Sustainability", Special Session, ISIE-ISSST 2017: Science in Support of Sustainable and Resilient Communities, ISIE-ISSST 2017, June 25^{th} – 29^{th}, Chicago, USA (Chair and Talk)

15 . V.V.S. Gargeya and **Singh S.,** "Thermodynamic Assessment of Ion Exchange Technology for Phosphorus (P) Recovery from Waste: Entropy Generation (S_{gen}) as Sustainability Indicator", ISIE-ISSST 2017: Science in Support of Sustainable and Resilient Communities,

ISIE-ISSST 2017, June 25th – 29th, Chicago, USA (Talk)

16 . Wachs E. and **Singh S.,** "Process Modeling Based Physical Input-Output Table (PIOT) for Nitrogen Flows Using ASPEN Plus: A Comparison with Empirical PIOT for Illinois", ISIE-ISSST 2017: Science in Support of Sustainable and Resilient Communities, ISIE-ISSST 2017, June 25th – 29th, Chicago, USA (Talk)

17 Wachs E. and **Singh S.,** "Computational Approaches in Systems Modeling for Environmental Impacts of Industries: Automating Physical Input-Output Tables (PIOTs) via ASPEN Process Modeling", AIChE, Nov 13-18, 2016, SF, USA (Talk)

18 **Singh S,** "Systematic Approach Towards Establishing Thermodynamic Principles of Sustainable Coupled Industrial-Natural Systems", AIChE, Nov 13-18, 2016, SF, USA (Talk)

19 **Singh S,** Compton J., Hawkins T., Sobota D. and Cooter E., "A Physical Input-Output Model of N Flows in Illinois Economy", Montpellier, France, Aug 29-Sep 2nd, 2016 (Talk)

20 **Singh S**. and C. Kennedy, "The role of Urbanization is Energy Sustainability Challenges", ICOSSE, Balatonfured, ICOSSE, May 26-29, 2015., Balatonfured, Hungary (Talk)

21 Bampoh D. and **Singh S**., Assessing the impact of contaminants of emerging concern on freshwater fish biodiversity. International Conference on Sustainable Design, Engineering and Construction, May 10th-May 13th, 2015, Chicago, IL, USA (Talk)

22 Bampoh D. and **Singh S.,** Fish biodiversity trends in response to pesticide toxicity in two North East US Rivers, The Association of Environmental Engineering & Science Professors (ASEEP), June 26 – Jun 23, 2015, New Haven, CT, USA (Poster)

23 Bampoh D. and **Singh S.,** Impact of Pesticides and nutrients on fish species biodiversity in agro-urban US. US-China Critical Zone Science, Sustainability and Services in a Changing World, 2015, Purdue University, USA (Poster)

24 C. Kennedy and **S. Singh,** *Estimating the Energy Use and CO2 Emissions of the World's Cities, Urban Environmental Pollution***,** 12th June-15th June 2014, Toronto, ON, Canada (Keynote talk)

25 **Singh S.** and C. Kennedy**,** *Identifying the scale and nexus of Carbon, Nitrogen and Biodiversity Impacts of Urban Systems***,** Gordon Research Conference on Industrial Ecology, 2nd June-6th June 2014, Lucca, Barga, Italy. (Poster)

26 **Singh S.** and C. Kennedy, *Identifying the scale and nexus of Carbon, Nitrogen and Biodiversity Impacts of Urban Systems***,** ISSST 2014, May 2014, Oakland, CA, USA (Talk)

27 **Singh S**., J. Compton, T. Hawkins, D. Sobota. *Utilizing a Physical Input-Output Model to Inform Nitrogen related Ecosystem services.* ISSST 2013, May 2013, Cincinnati, OH (Talk)

28 A. Fajardo, Z.A. Hamstead, N. Kunz, M. Sachs, **Singh S**. *Using insights from statistical physics to model common pool resource management,* EcoSummit 2012 – Ecological Sustainability – Restoring the Planet's Ecosystem Services. (Talk – Independent Research Collaboration at Santa Fe Institute Summer School)

29 **Singh S.** and Bakshi B.R. *Towards Improved C and N Footprints and Understanding Their Nexus.* AICHE Annual Meeting, November 2011, Minneapolis, Minnesota. (Talk)

30 **Singh S.** and Bakshi B.R. *Understanding the Evolution of By-Product Synergy Networks by Network Analysis*. AICHE Annual Meeting, 2011, Minneapolis, Minnesota. (Talk)

31 Bakshi B.R and **Singh S**. *In Saving the Carbon Cycle Are We Ruining the Nitrogen Cycle? Understanding the Carbon-Nitrogen Nexus via Ecologically-Based Life Cycle Assessment,* International Congress on Sustainability Science and Engineering, January 9-12, 2011, Tucson, Arizona (Talk)

32 **Singh S.** and Bakshi B.R. *Understanding the C-N-Water-Energy Nexus in US Economy via*

Eco-LCA. AICHE Annual Meeting, November 7-12,2010, Salt Lake City, Utah (*Talk*)

33 **Singh S.** and Bakshi B.R. *Complexity Analysis of Gasoline and Corn-Ethanol Networks*. AICHE Annual Meeting, November 7-12, 2010, Salt Lake City, Utah (*Talk*)

34 **Singh S.** and Bakshi B.R. *Enhancing the reliability of C and N accounting in economic activities: Integration of bio-geochemical cycle with Eco-LCA,* IEEE International Symposium on Sustainable Systems and Technology, May 17-19, 2010 *(Talk and Poster)*

35 **Singh S.** and Bakshi B.R. *Accounting for Ecosystem Services in Eco-LCA: Combining Quantitative & Qualitative Information*. AICHE Annual Meeting, November 8-13, 2009, Nashville, TN. (*Talk*)

36 **Singh S.** and Bakshi B.R. *Accounting for Ecosystem Services in Eco-LCA by combining quantitative and qualitative information*, Life Cycle Assessment IX, (toward the global life cycle economy), Sep 29- Oct 2, 2009, Boston, MA. (*Poster*)

37 **. Singh S.** and Bakshi B.R. *Eco-LCA: A tool for quantifying the role of ecological resources in LCA.* IEEE International Symposium on Sustainable Systems and Technology, May 18-20, 2009, Phoenix, AZ (*Talk and Poster*)

38 **Singh S.** and Bakshi B.R. *Rectification of Multiscale Data with Reliability Assessment to Guide External Data Procurement in Life Cycle Assessment*, AICHE, Annual Meeting, November 16-21, 2008, Philadelphia, PA. (*Talk*)

INVITED PRESENTATIONS

1 **Singh S., "Material Flow Analysis for Sustainable Manufacturing" –** Industrial Ecology and Data Science for Sustainable Manufacturing in India, Workshop Organized by IIT Madras, International Society of Industrial Ecology and Purdue University, Chennai, India **Dec 12th, 2024**

2 **Singh S, "**Advancing Methodologies and Computational Tools for Sustainable Transition Towards Low Carbon and Circular Economy – Integration of Process Systems Engineering and Macroeconomics", **Kotak School of Sustainability and Department of Chemical Engineering, IIT Kanpur, Kanpur, UP, India, Nov 27th, 2024**

3 **Singh S, Invited Keynote Presentation**
"Circular Economy for Sustainable Pharmaceutical Industries**", American Association of Pharmaceutical Scientists, AAPS 2024 PharaSci 360, Oct 20-23, 2024, Salt Lake City, UT, USA**

4 **Singh S., Shekhar A., Bademi, A.** "Building Circular Economy for Pharmaceutical Manufacturing"**, Evonik Sustainability Days, Evonik, Oct 4, 2024 West Lafayette, IN,**

5 **Singh, S., "**Advancing Methodologies and Computational Tools for Sustainable Transition Towards Low Carbon and Circular Economy – Integration of Process Systems Engineering and Macroeconomics", **Davidson School of Chemical Engineering Seminar, Purdue, 4th May 2023**

6 **Singh, S., "**Modeling Anthropogenic Material Cycles Using PIOTs for Sustainable Planet**" Trans-Atlantic Research and Development Interchange on Sustainability (TARDIS), Scientific Workshop sponsored by US National Science Foundation, Organized at University of Miskolc, Miskolc, Hungary, 14-16 September, 2022**

7 **Singh, S.,** "Advancing Computational Tools for Sustainability Assessment of Decarbonization and Circular Economy by Integration of Mechanistic Models with Macroeconomic Framework", 25th July 2022, **Department of Hydro and Renewable**

Energy, Indian Institute of Technology, Roorkee, India

8 **Singh, S.,** "Modeling Dynamics of Industrial and Life Cycle Networks: An Integrated Mechanistic Modeling and Machine Learning Approach" **13th June, 2022, Industrial Ecology Gordon Research Conference – Advancing the Circular Economy for Human and Planetary Wellbeing, June 12-17, 2022, Newry, Maine, USA**

9 **Singh, S.,** "Advancing Computational Tools for Sustainability Assessment of Decarbonization and Circular Economy by Integration of Mechanistic Models with Macroeconomic Framework" **14th April 2022, DOW Chemical, Research Seminar (Virtual talk)**

10 **Singh, S.,** "Computational Approach for constructing PIOT to Model the Physical Economy and Relevance for Trade Policies" **NITI Aayog, Policy Think Tank for Government of India (https://www.niti.gov.in/), 21st March 2022, New Delhi, India**
(Talk available at: https://www.youtube.com/watch?v=CU3zCrSEWXk)

11 **Singh S.,** "Integrated Mechanistic Engineering and Input-Output approach for automating generation of Physical Input-Output Tables via Collaborative Cloud Platform" **Session on Progress in Modeling the socio-economic metabolism – combining material flow principles and input-output analysis, International Society of Industrial Ecology, SEM Perpetual Online Conference, May 2021 (Online Global Conference)**

12 **Singh S.,** "Advancing Methodologies and Computational Tools for Sustainability Assessment of Transition to Low Carbon and Circular Economy" **Environmental Processes Seminar Series, Department of Civil and Environmental Engineering, Cornell University, Ithaca, NY, April 2021 (Online Webinar)**

13 **Singh S.,** "From Ecology to Industrial Ecology: Engineering for Circular Economy" **Sigma Xi, Penn State Chapter (Invited Lecture) April, 2021 (Postponed due to COVID)**

14 **Singh S.,** "Physical Input-Output Tables via Process Systems Engineering" **Gordon Research Conference on Industrial Ecology, June 2020 (Cancelled Due to COVID)**

15 **Singh S.,** "Developing Next Generation Industrial Ecology and Systems tools for Designing sustainable Industrial and Urban systems" EEE Seminar Series, Purdue, Feb 2020

16 **Singh S.,** Invited Panelist Talk, "Synergies in Industrial Manufacturing Network: Building Socio-Technical Resilience in Manufacturing", National Science Foundation Workshop on Resilience, Center for Resilient Infrastructure and Systems at Purdue. March, 2019

17 **Singh S.** Departmental Seminar, "Towards Sustainable Management of Biogeochemical Cycles in Coupled Industrial-Natural Systems." University of Illinois at Chicago, Department of Civil and Materials Engineering, Chicago, April 20th, 2018

18 **Singh S.** Seminar at Center for Energy & Environmental Sustainability (CEES), "Towards Sustainable Management of Biogeochemical Cycles in Coupled Industrial-Natural Systems." Prairie View A & M University, Texas, Nov 20, 2017,

19 **Singh S and C. Kennedy,** Estimating the Energy Use and CO2 Emissions of the World's Cities*,* IRENA Panel on Renewable Energy Deployment in Cities, Singapore International Energy Week, SIEW, Singapore. (Invited Panel Talk), Oct 2015

20 **Singh S**. *Developing Scalable Integrated Framework using Physical Input-Output Model for Nitrogen Related Ecosystem Services.* Division Seminar, Western Ecology Division, Corvallis, OR, September 26th, 2013

21 **Singh S.** *Incorporating Biogeochemical Cycles and Complex Network Analysis in Sustainability Assessment Methodologies: A Coupled Natural-Human Systems Approach*. Simon Levin Lab Tea, Princeton University, Princeton, NJ, May 27th, 2013

22 **Singh S.** *Introduction to Life Cycle Assessment (LCA), Economic-Input Output LCA (EIO-LCA) and Physical Input-Output Tables (PIOTs).*., Western Ecology Division, US-EPA, Corvallis, OR, October 18th, 2012

JOURNAL/CONFERENCE/PROPOSAL REVIEWING

ACS Sustainable Chemistry & Engineering.
2013, The International Symposium on Sustainable Systems and Technology.
Environmental Science & Technology.
Science of the Total Environment, Elsevier.
LCA XIII Conference, 2013
ISSST 2014, 2015, 2016
Applied Energy
Journal of Industrial Ecology
Resources, Conservation & Recycling
Ecological Economics
Journal of Clean Technologies and Environmental Policy
Served on panels for National Science Foundation, Research Foundation - Flanders (Fonds Wetenschappelijk Onderzoek - Vlaanderen, FWO

TEACHING EXPERIENCE

Purdue University (Instructor/Co-Instructor for All Courses Listed Below)

- EEE 430, Spring 2015, 2016, 2017, 2018: Industrial Ecology & Life Cycle Assessment **(**Senior UG Course Developed at Purdue, Student Enrollment > 55 each year, Interdisciplinary students from Chemical, Mechanical, Aeronautics, Environmental)
- ABE 307, Fall 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022: Momentum Transfer in Biological Systems (Redesigned Momentum Transfer Course for Junior Level Biological Engineering students)
- EEE 560, Fall 2016, 2017; Spring 2019 : Modelling Complexity (Graduate Interdisciplinary Course, Developed at Purdue)
- ChE 320, Spring 2021, Spring 2022 Statistics for Chemical Engineers (Junior level, UG) (Co-instructor)

The Ohio State University, Columbus, OH, USA (Guest Lecture/TA)

- Guest Lecturer for ChBE 760 Process Design Course: Life Cycle Analysis in Design of Systems (Winter 2012)
- Guest Lecturer for ChBE 772 – Principles of Sustainable Engineering: LCA fundamentals & sustainability metrics.
- Teaching Assistant: Process Control, Chemical Engineering Department. (Autumn 2010)
- Teaching Assistant: Principles of Sustainable Engineering course (Spring 2009 & 2010)

PROFESSIONAL ASSOCIATIONS

- American Institute of Chemical Engineers (AIChE)
- American Statistical Association
- International Society for Industrial Ecology (ISIE)