# Emission Reduction by Massive Integration of Solar Plants in the US Grid

**Dr. Esteban Alexis Soto Vera**
Department of Engineering and Technology
Southeast Missouri State University
Cape Girardeau, MO, USA
esotovera@semo.edu

**Gnanaprakash Athmanathan**
Department of Industrial Engineering
Purdue University
West Lafayette, Indiana, USA
gathmana@purdue.edu

**Brandon Yonnie**
Department of Industrial Engineering
Navajo Technical University
Crownpoint, New Mexico, USA
brandon.yonnie@student.navajotech.edu

**Amy LeGrande**
Department of General Engineering
Simpson University
Redding, California, USA
Amy.legrande@students.Simpsonu.edu

**Andrea Hernandez and Alexander Vizcarrondo Ortega**
Department of Industrial Engineering
University of Puerto Rico at Mayaguez
Puerto Rico, Mayagüez, USA
andrea.hernandez19@upr.edu, alexander.vizcarrondo@upr.edu

**Dr. Lisa Bosman**
Purdue Polytechnic Institute
Purdue University
West Lafayette, Indiana, USA
lbosman@purdue.edu

## Abstract

The primary source of energy in the United States is fossil fuels and it creates damaging consequences to our environment. It pollutes the environment, and it will continue to create negative issues for future generations to come, but renewable energy sources like solar would greatly reduce the production of carbon emissions, so solar has been on the rise in recent years. This study is important because with non-greenhouse emissions increasing it causes the temperature to rise dramatically. Humans have increased the number of emissions which resulted in climate change

and rising sea-levels. Electrical systems in California, the Southwest, New England, and New York were compared using data from the National Renewable Energy Laboratory (NREL) and the Energy Information Administration (EIA). The NREL includes data on daily hourly estimates of 6000 hypothetical PV installations and one year's worth of solar energy output every 5 minutes, while the EIA data talks about net generation by source, total carbon emissions, and carbon emissions by fuel type. The results show that there could be significant potential to reduce carbon emissions by incorporating 100% solar power plants in California and the Southwest. This demonstrates that the integration of solar energy would decrease carbon emissions caused by electricity, with California and the Southwest having the most significant decrease with incorporation of 100% of potential solar plants, and New York and New England needed more regulations and incentives to achieve emission targets.

## Keywords
Solar Energy, Fossil Fuels, Carbon Emissions.

## Biographies

**Dr. Esteban A. Soto** received his industrial engineer degree and master's degree in industrial management from the University of Concepcion (UDEC), Chile in 2014 and 2015, respectively. In 2022, he successfully completed his Ph.D. at Purdue University, focusing on renewable energy systems, specifically P2P energy trading models and large-scale integration of solar energy into the electrical grid. Currently, Dr. Soto works as a consultant at Sustainability Solution Group, specializing in decarbonization and energy transition projects. He assists organizations in devising and implementing strategies to mitigate greenhouse gas emissions and promote the adoption of renewable energy. Previously, he served as an instructor at Southeast Missouri State University and was the project coordinator for the Purdue Research Experience for Undergraduates (REU) Program, where he supported underrepresented students in gaining valuable research experience. Dr. Soto also has served as a mentor for Evergreen Climate Innovations and the NSF I-Corp program. Moreover, he is a Fulbright Scholar and has held leadership positions in both the Purdue Fulbright Association and the Purdue Chilean Association.

**Gnanaprakash Athmanathan**, MS Industrial Engineering at Purdue University.

**Brandon Yonnie,** BS Industrial Engineering at Navajo Technical University.

**Amy LeGrande,** BS General Engineering at Simpson University.

**Andrea Hernandez,** BS Industrial Engineering at University of Puerto Rico at Mayaguez.

**Alexander Vizcarrondo Ortega,** BS Industrial Engineering at University of Puerto Rico at Mayaguez.

**Dr. Lisa Bosman,** PhD in Industrial Engineering, was recently promoted to Associate Professor (to take effect August 2023) at Purdue University (West Lafayette, IN, USA). She is the founding director of iAGREE Labs (Inclusive, Applied, and Grounded Research in Entrepreneurially Minded Education) aimed to empower action through real-world solutions and evidence-based practices. While working at Purdue University (2018-present), Dr. Bosman (as a PI) was awarded 15 grants totaling $1,166,589. While working at a federally recognized tribal college and university, College of Menominee Nation (2011-2018) she was the PI for 15 awards totaling $897,551. Dr. Bosman has disseminated research through more than 75 peer-reviewed publications. In addition, she has published two teaching-oriented books: "Teaching the Entrepreneurial Mindset to Engineers (Springer, 2018)" and "Teaching the Entrepreneurial Mindset Across the University – An Integrative Approach (Springer, 2021)". According to Google Scholar (05/23/2023), since 2018, her research has resulted in 946 citations, a 15 h-index, and 19 i10-index. Her core research centers on three themes related to developing the entrepreneurial mindset in future leaders and innovators: (1) Teaching and Curriculum Development, (2) Educator Professional Development, and (3) Real World Applied Learning (Academic Entrepreneurship Research – Solar Energy).