Erick Arwa

Abstract

Negative emission technologies such as direct air capture (DAC) of carbon dioxide are a necessary addition to the climate change mitigation agenda. Integrated into the electrical power systems, they are likely to significantly reduce the cost of decarbonizing these systems. This research focuses on modeling the integration of DAC plants into the Canadian energy system with the goal of recommending alternative pathways to the government's goal of decarbonizing the electrical energy system by 2035. The modeling will start with the modification of the chemical process flow of the liquid solvent DAC and the optimization of its operations to maximize the consumption of variable renewable energy. This first output will help in making DAC plants flexible. Next, two power generation expansion planning models will be developed as mixed-integer linear programs to optimize investment in both generation and storage assets as well as DAC plants to achieve net-zero emission by 2035. The first model will focus on co-optimizing generation expansion and placement of DAC plants to analyze the impact of including flexible DAC the cost of achieving net-zero goal. The second one will analyze the impact of grid flexibility through hydrogen storage and regional water supply constraints on the generation mix trajectory in the net-zero pathway. Finally, models will be tested using case studies in Alberta. The results are expected to inform short-term and medium-term policies in the run-up to the achievement of the targeted net-zero emission goals.

Bio

Erick Arwa is a PhD candidate at the department of Mechanical and Aerospace engineering. His research focuses on modeling the integration of carbon removal technologies into the Canadian energy system with the aim of recommending cost-effective and technically sound pathways to a carbon-neutral and socially responsive electricity supply system. This research is conducted under the supervision of Prof. Kristen Schell and Prof. Ahmed Abdulla, the co-directors of the Alternative Pathways for Energy Transition Research Group. Previously, Erick graduated with a master's in electrical engineering from the University of Cape Town, South Africa and a BSc in electrical and electronic engineering from the University of Nairobi, Kenya. His past research was on the application of reinforcement learning to power grid operation and control.