SEMINAR SERIES

International Institute for Carbon-Neutral Energy Research
Kyushu University

Title **Optimization of Energy Usage for a Fleet-Wide Power Generating System Under Carbon Mitigation Options**

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Date & Time Friday, February 19, 2016 4:00 p.m.

Place I²CNER Hall, Ito campus, Kyushu University

Abstract

A cost effective reduction strategy of greenhouse gas emissions is vital to the national interests of many countries in order to comply with international agreements to reduce greenhouse gas emissions without losing their economic competitiveness. Recent studies point to a broad array of emerging carbon dioxide capture and sequestration technologies that could help meet carbon dioxide emission goals for the next century. In general terms, the carbon management problem involves the energy conservation, process efficiency, fuel switching, capture, transportation and storage of CO_2. In this talk, a systems approach which can take into account all the interactions among the possible mitigation alternatives will be introduced. A number of fleet-wide models that are able to determine the optimal power generation structure necessary to meet a given CO_2 reduction target while maintaining or enhancing power to the grid will be presented.

The models incorporate power generation and CO_2 emissions from a fleet of generating stations using a variety of fuels (hydroelectricity, fossil fuels, nuclear and wind). Electricity production is modeled macroscopically as a function of fuel flowrates into the boilers. Nevertheless, the models can be used to optimize an existing fleet as well as recommend new additional generating stations, capture and storage strategies, and retrofit actions on existing stations to meet a specified CO_2 reduction target and electricity demand at the minimum overall cost. The models can determine the best mix of fuels, capacity for existing and new plants, and technologies for capturing CO_2. The models are also able to determine the location of carbon capture plants that should be put online. Both deterministic and stochastic models will be presented. Stochastic planning accounts for uncertainties in parameters such as demand and fuel prices.

A case study from Ontario Power Generation, the largest power utility company in Ontario - Canada, is considered. The models are illustrated on this case in order to examine the economical, structural, and environmental effects that would result if Ontario's electricity sector was required to reduce its CO_2 emissions to a specific limit. The presented models offer many potential benefits to the energy sector. In addition to providing an optimal solution for meeting future electricity demand, they can help in meeting emissions targets while minimizing the overall cost of electricity. Although the models are illustrated on Ontario's future energy supply mix, they can also be readily applied to other regions or even countries as a whole.

About the Speaker

Prof. ALI ELKAMEL is Professor of Chemical Engineering at the University of Waterloo. He holds a BSc in Chemical Engineering and BSc in Mathematics from Colorado School of Mines, MS in Chemical Engineering from the University of Colorado-Boulder, and PhD in Chemical Engineering from Purdue University – West Lafayette, Indiana. His specific research interests are in computer-aided modeling, optimization and simulation with applications to energy production planning, sustainable operations and product design. His research output includes over 200 journal articles, 90 proceedings, and 30 book chapters. He is also a co-author of four books; two recent books were published by Wiley and entitled Planning of Refinery and Petrochemical Operations and Environmentally Conscious Fossil Energy Production.

Host: Professor Bidyut Saha

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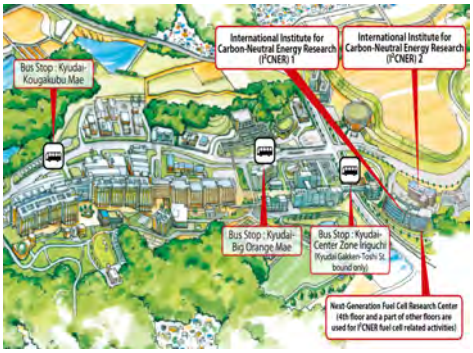

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