SEMINAR ANNOUNCEMENT

Monday September 8th, 2025

at 11:30 am
Room "Sala Seminari" - Abacus Building (U14)

Integrated investment, retrofit and abandonment energy system planning with multi-timescale uncertainty using stabilised adaptive Benders decomposition

Speaker
Dr Hongyu Zhang
University of Southampton

Abstract
Achieving a cost-effective and reliable energy transition in Europe requires advanced planning tools that can jointly account for new infrastructure investments, the repurposing of existing assets, and the deep uncertainties inherent in evolving energy markets. Current approaches to energy systems planning often address these aspects in isolation, limiting their ability to capture the complex interdependencies of the transition. To address this gap, we propose the REORIENT (REnewable resOuRce Investment for the ENergy Transition) model, which introduces two key novelties: (1) the integration of capacity expansion, retrofit, and abandonment planning, and (2) the use of multi-horizon stochastic mixed-integer linear programming with multi-timescale uncertainty. We apply the model to the European energy system, considering hydrogen infrastructure investment, power system expansion, retrofitting and abandonment of oil and gas assets in the North Sea region, as well as long-term fuel price and short-term time-series uncertainties. To solve the model efficiently, we develop a stabilised adaptive Benders decomposition. Results from sensitivity analyses and benchmarking show that retrofitting becomes cost-effective when costs fall below 20% of new infrastructure investment, while oil platform clusters remain profitable until late-stage abandonment. Compared with a traditional planning model, REORIENT achieves 24% lower investment costs in the North Sea region, and the proposed algorithm is up to 6.8 times faster than existing solution methods. These findings highlight the potential of REORIENT to support robust, cost-efficient decision-making for Europe's energy transition.

Short Bio
Dr Hongyu Zhang is a Lecturer in optimisation for machine learning and AI at the University of Southampton, and a member of the CORMSIS Research Centre. He previously held a Researcher position at NTNU and was a visiting scholar at institutions including Princeton University, the University of Edinburgh and Carnegie Mellon University. He holds degrees from NTNU (PhD in Operational Research, supervised by Professor Asgeir Tomasgard, Professor Ignacio E. Grossmann and Dr Brage Rugstad Knudsen), the University of Edinburgh (MSc in Operational Research with Data Science, supervised by Professor Ken McKinnon and Dr Nicolò Mazzi), and Huaqiao University. His research focuses on stochastic programming, decomposition algorithms, and the integration of optimisation, AI and quantum computing for energy system planning.

contact person for this Seminar: enza.messina@unimib.it