Optimal Electricity GRID Investment Models

Fall 2026

Learning Objectives: 1. Ability to apply OR Methodologies to Develop Models for Optimal Grid Investments 2. Ability to Solve Optimal Grid Investment Models

Description: This course covers OR methodologies to optimize investment decisions in GRID generation and transmission assets which will be operated in the Bulk Electricity System (BES). These include robust optimization, KKT optimality conditions, bilevel programming, stochastic programming, Bender's decomposition, continuous dynamic programming. The course will review the methodologies and apply them to model various BES investment decisions. Students will be expected to solve models using Gurobi Python (or equivalent) software.

Textbook: Investment in Electricity Generation and Transmission - Decision Making Under Uncertainty
by A.J. Conejo, L. Baringo, S.J. Kazempour, A.S. Siddiqui, Springer, 2016
https://link-springer-com.myaccess.library.utoronto.ca/book/10.1007/978-3-319-29501-5

Lectures: Mondays 10 am – 1 pm in HS696

Lecturers	Zeb Tate – before Reading Week	Daniel Frances – after Reading Week
Marking Scheme:	Project Part 1	30%
	Project Part 2	30%
	Final	40%
		100%

Wk#	Text Ref.	Coverage	Methodologies Used in Following Week
1	1	Introduction.	Tx Modeling, KKT conditions
2	2.1-2.2	Deterministic Transmission Expansion Planning (TEP) models	Adaptive Robust Optimization
3	2.3	Stochastic TEP models	Primal Dual Formulation
4	3.1-3.5	Deterministic Generation Expansion Models (GEP)	Stochastic Programming
5	3.6	Stochastic GEP Models	Risk Management
7		Project Presentations	
8		READING WEEK	
9	5.1-5.3	Investment in Generation - Model Development	Benders Decomposition
10	5.4-5.5	Investment in Generation - Model Solutions	Discrete Dynamic Programming (DP)
11	6	Investment Equilibrium Models under Competition	Continuous DP
12	7.1-7.3	Basic Alternative Generation Investment Decisions - NPV and Real Options	
13		Project Presentations	