Technology Innovation Project

Project Brief

TIP 330: Co-Optimization and Anticipative Planning Methods for Bulk Transmission and Resource Planning under Long-run Uncertainties

Context

Changes in public policy coupled with the maturation of new technologies suggest that the future will see a significant shift in electric utility portfolios. For example, older generation plants with high emissions may be replaced with cleaner alternatives. However, a wide range of plausible replacement scenarios exists.

Facing an increasingly uncertain future, BPA must prudently allocate scarce capital given that many investments have long lead times and economic lives. Profound uncertainty over the planning horizon implies a need to robustly consider how planning alternatives would affect the flexibility of the power system to adapt to circumstances that are continually changing, perhaps in unforeseen ways. Scarce resources need to be allocated carefully, as some choices may preclude others. This project will furnish the ability to identify attractive alternatives that might otherwise be missed and to test their robustness under various futures.

Description

This project implements and tests the applicability of two new computational methods for identifying long-term power system expansion planning solutions. The two methods co-optimize both generation and transmission options. This means that they find minimum cost solutions over a range of transmission and generation combinations . This makes it possible to undertake *anticipative transmission planning* in which the response of both generation siting and operations, (and the resulting costs, emissions, and environmental impacts) to network expansion is estimated and factored into benefit-cost analyses of alternative transmission plans. Another key attribute of both methods is that they address uncertainty in future conditions, but in different ways. Researchers at Iowa State University will test an approach called adaptation, while researchers at Johns Hopkins University will test an approach called stochastic programming; results will be compared and contrasted to enable utilization of the strengths of each.

The project will involve database and scenario development for two planning problems (based on an aggregate and more detailed representation of the BPA system, respectively); methodology improvements and software implementations; demonstration applications to co-optimization and planning under uncertainty; report writing; and the holding of workshops at BPA.

Why It Matters

BPA's transmission-related capital investments over the next 10 years are expected to be on the order of $4B. This project provides unique support for the planning process regarding what, where, when, and how much investment is needed operate BPA's grid economically, effectively and robustly under a wide range of future uncertainties.

The methodologies produced by this research will provide information on alternative investments and how they enhance or restrict the flexibility of the grid to respond to possible long-run technological, economic, and policy developments.

Goals and Objectives

The objective of this project is to implement, illustrate, test, and evaluate two newly-developed computational methods for identifying long-term power system expansion planning solutions, using models of the regional electric grid.

Deliverables

The project will provide a detailed description of the developed methods and a summary of their relative strengths and weaknesses. We will also deliver a carefully articulated set of procedures of how to implement the methods, together with associated software, with illustrations using BPA datasets and planning problems. We will work closely with BPA engineering staff to ensure that the procedures, software, and illustrations, are developed and communicated in a way that is relevant in the context of BPA planning needs.

Deliverables will include: Half-day workshop in Year 1 at BPA; Year 1 report: illustration and validation on an aggregated BPA system model; Year 2 report: illustration and validation on a more geographically detailed BPA system planning model; Full-day workshop at BPA; Final report

TIP 330: Co-Optimization and Anticipative Planning Methods for Bulk Transmission and Resource Planning under Long-run Uncertainties

Project Start Date: October 1, 2014

Project End Date: September 30, 2017

Reports & References

- F.D. Munoz, B.F. Hobbs, J. Ho, and S. Kasina, An Engineering-Economic Approach to Transmission Planning Under Market and Regulatory Uncertainties: WECC Case Study, *IEEE Transactions on Power Systems*, 29(1), January 2014, 307-317
- A. Liu, B.F. Hobbs, J. Ho, J. McCalley, V. Krishnan, M. Shahidehpour, and Q. Zheng, "Co-optimization of Transmission and Other Supply Resources," Prepared for the Eastern Interconnection States' Planning Council, National Association of Regulatory Utility Commissioners, Washington, DC, Dec. 20, 2013. Available: naruc.org/Grants/Documents/Co-optimization-White-paper_Final_rv1.pdf.

Funding

Total Project Cost:	$987,776
BPA Share:	$493,879
External Share:	$493,897
BPA FY2015 Budget:	$170,683

For More Information Contact:

BPA Project Manager:

Anders Johnson, Long Term Planning
aljohnson@bpa.gov

Principle Investigators:

James McCalley, Project Director, IEEE Fellow and chaired professor of Electrical and Computer Engineering at Iowa State University (ISU).

Benjamin Hobbs, IEEE Fellow, Director of Johns Hopkins Environment, Energy, Sustainability and Health Institute

Participating Organizations

Iowa State University
Johns Hopkins University