

Renewables and Electricity Market Design

Peter Cramton
University of Cologne & University of Maryland

Abstract

Electricity markets are designed to provide reliable electricity at least cost to consumers. This paper describes how the best designs satisfy the twin goals of short-run efficiency—making the best use of existing resources—and long-run efficiency—promoting efficient investment in new resources. The core elements are a day-ahead market for optimal scheduling of resources and a real-time market for security-constrained economic dispatch. Resources directly offer to produce per their underlying economics and then the system operator centrally optimizes all resources to maximize social welfare. Locational marginal prices, reflecting the marginal value of energy at each time and location, are used in settlement. This spot market provides the basis for forward contracting, which enables participants to manage risk and improves bidding incentives in the spot market. There are important differences in electricity markets around the world, reflecting different economic and political settings. Electricity markets are undergoing a transformation as the resource mix transitions from fossil fuels to renewables. The main renewables, wind and solar, are intermittent, have zero-marginal cost, and lack inertia. These challenges can be met with battery storage and improved demand response. However, good governance is needed to assure the market rules adapt to meet new challenges.