

PROBLEMS WITH 1S AND 0S

Aside from the difficulty of finding globally optimal solutions, the binary nature of Unit Commitment (UC) means that generalised relationships cannot be defined for ranges of inputs and outputs.

Schedules and prices are particularly sensitive to the reliability target, as it is a key influence on the choice of marginal unit.

RESEARCH OUTCOMES

For an Irish sized system with all input parameters kept constant and only the reserve formulations in the UC changed:

Largest difference in yearly cost: $\approx 2\%$

Difference in operational flexibility: $> 25\%$

PLANNING UNDER UNCERTAINTY

All models use forecasts for demand and variable generation, which have varying degrees of uncertainty and a finite resolution, to minimise expected system costs.

Realised system costs are a function not only of commitment decisions but also the real-time conditions and the cost of balancing services.

RESEARCH IMPLICATIONS

Inferred cost reductions of deterministic or stochastic, hourly or 15 minute resolution models can result in increased realised costs. Analysis of the implications across various time horizons is essential to understanding true potential benefits.

EXTERNALITIES AND THE VALUE OF RELIABILITY

Environmental externalities, particularly climate change, are often addressed via taxes, tradable permits, or subsidies which bridge the gap between marginal social and marginal private costs. The value of reliability is accounted for in models via a penalty cost - value of lost load (VOLL). The extrapolated prices of VOLL and CO₂ permits have a significant influence on unit commitment studies, however, their values vary over time and plausibility ranges across orders of magnitude.

RESEARCH IMPLICATIONS

Willingness to address environmental externalities is correlated with our ability to pay. Economic viability which is independent of CO₂ permit prices is the key to the deployment potential solutions. As the cost of reliability services increases with variable generation penetration and dependency on electrical appliances grows, will future consumers accept service interruptions or is VOLL dead?

WE'RE UNLIKELY TO FIND ATLANTIS

Without significant financial reward, consumers can be reluctant to change behaviours. Perfectly competitive electricity markets are an improbable utopian dream and even if centrally planned systems can be shown to be advantageous, reverting to vertically integrated utilities is even less likely. Legacy rules will persist but slowly change over time.

RESEARCH IMPLICATIONS

Scenarios which assume 100% of consumers with real-time pricing can only be viewed as an upper bound.

Renewables energy tends to reduce costs but market payment mechanisms may result in consumers paying more.

CURTAILMENT IS GOOD

Cost minimising unit commitment and dispatch is used to provide long-term economically efficient market outcomes. At first glance it may seem inefficient to "dump" "free" wind energy but curtailment provides an effective economic signal: to producers to improve forecasting, to demand side initiatives, to potential storage investments,.....

RESEARCH IMPLICATIONS

System level research should avoid using reduced curtailment as a measure of improvement. Reducing curtailment while also reducing total costs may be subjectively better, but unless you're a wind farm owner, costs reductions are what matter.