ESIG 100% and Markets Activities

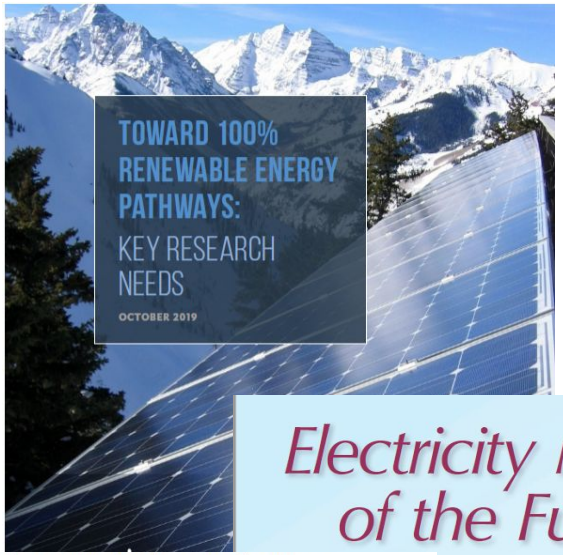
Erik Ela

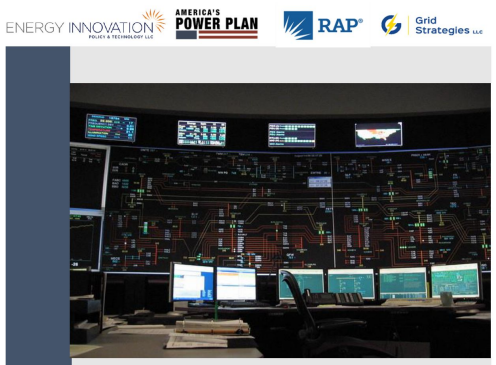
2nd Workshop on Markets for 100% Clean Energy

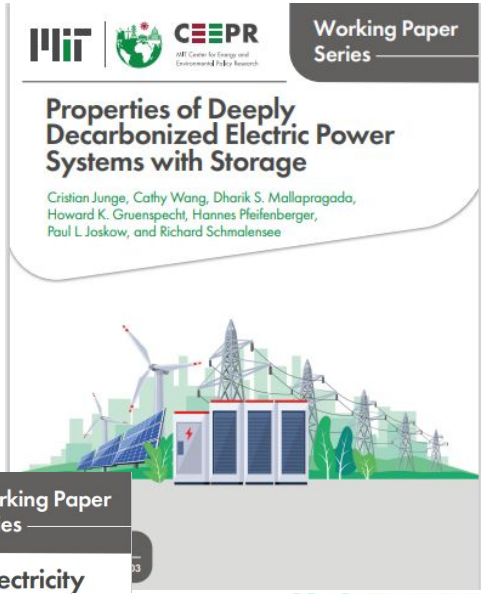
10/24/2024

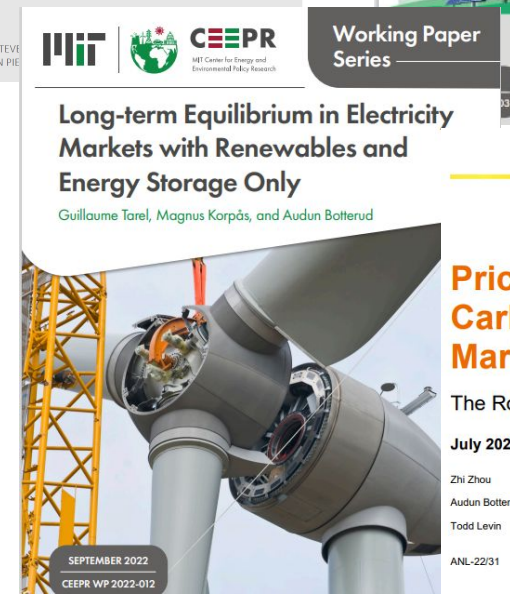
Providence, Rhode Island

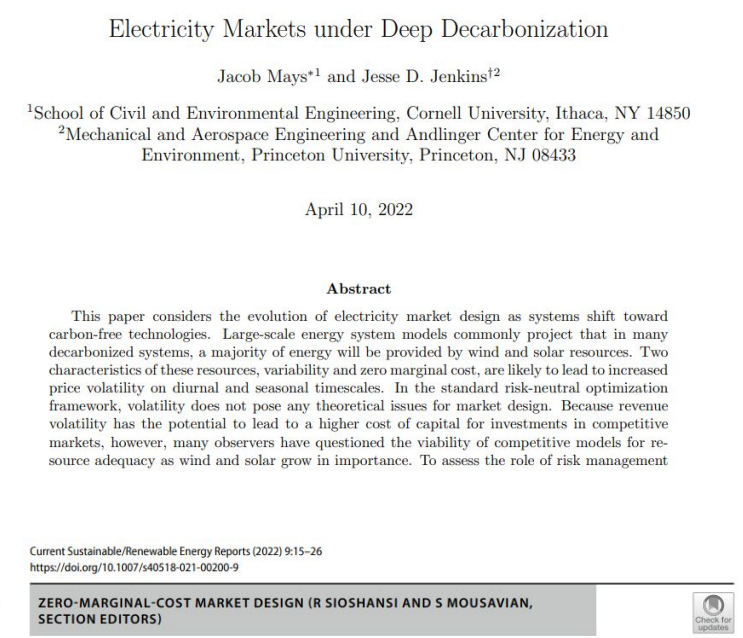
What will Electricity Markets look like?










Electricity Markets under Deep Decarbonization

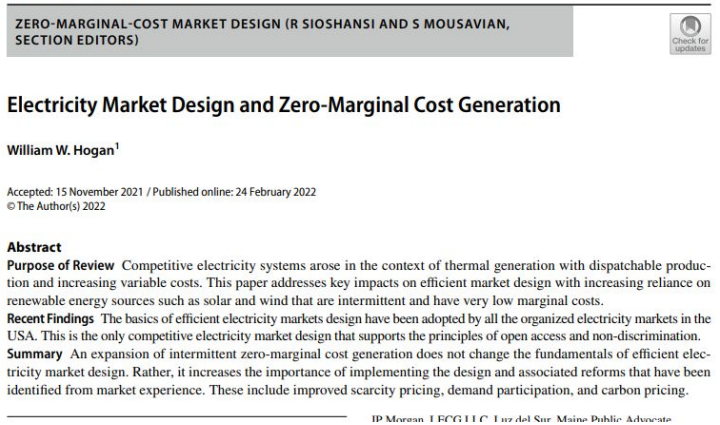
Jacob Mays*[1] and Jesse D. Jenkins[†2]

[1]School of Civil and Environmental Engineering, Cornell University, Ithaca, NY 14850
[2]Mechanical and Aerospace Engineering and Andlinger Center for Energy and Environment, Princeton University, Princeton, NJ 08433

April 10, 2022

Abstract

This paper considers the evolution of electricity market design as systems shift toward carbon-free technologies. Large-scale energy system models commonly project that in many decarbonized systems, a majority of energy will be provided by wind and solar resources. Two characteristics of these resources, variability and zero marginal cost, are likely to lead to increased price volatility on diurnal and seasonal timescales. In the standard risk-neutral optimization framework, volatility does not pose any theoretical issues for market design. Because revenue volatility has the potential to lead to a higher cost of capital for investments in competitive markets, however, many observers have questioned the viability of competitive models for resource adequacy as wind and solar grow in importance. To assess the role of risk management


Current Sustainable/Renewable Energy Reports (2022) 9:15–26
https://doi.org/10.1007/s40518-021-00200-9

ZERO-MARGINAL-COST MARKET DESIGN (R SIOSHANSI AND S MOUSAVIAN, SECTION EDITORS)

Electricity Market Design and Zero-Marginal Cost Generation

William W. Hogan[1]

Accepted: 15 November 2021 / Published online: 24 February 2022
© The Author(s) 2022

Abstract

Purpose of Review Competitive electricity systems arose in the context of thermal generation with dispatchable production and increasing variable costs. This paper addresses key impacts on efficient market design with increasing reliance on renewable energy sources such as solar and wind that are intermittent and have very low marginal costs.

Recent Findings The basics of efficient electricity markets design have been adopted by all the organized electricity markets in the USA. This is the only competitive electricity market design that supports the principles of open access and non-discrimination.

Summary An expansion of intermittent zero-marginal cost generation does not change the fundamentals of efficient electricity market design. Rather, it increases the importance of implementing the design and associated reforms that have been identified from market experience. These include improved scarcity pricing, demand participation, and carbon pricing.

JP Morgan, LECG LLC, Luz del Sur, Maine Public Advocate

ESIG: Toward 100% Renewable Energy Pathways

Lots of Building Blocks:

- Nuclear
- Carbon Capture
- Renewables/Storage
- Demand Participation
- Electrification

Source: ideas.lego.com

Meeting Materials

Report

Topic(s)	Notes
Electrification & Demand Participation	• Heavily electrified future economy; demand going up; demand profiles changing • More integrated electric system will be needed; Digitalization of society will lead to demand side participation • Getting to 80% penetration w/ existing tech is possible; 100% will require new tech/approaches
Storage	• Dramatic cost declines; Thermal storage becoming an option for the future
Decentralization	• Having energy production close to consumption may lead to changes to the centralized paradigm
Adequacy	• Adequacy metrics need to be updated to properly reflect the needs of society (i.e. LOLP is arbitrary) • Classical adequacy may be replaced by a cost-minimization problem (i.e. investment vs. reducing/shifting demand) • Transmission & distribution/storage resources should be modeled in adequacy studies
Operations & Flexibility	• Visibility and control at sufficient levels of detail needed; Adequacy/Flex considered simultaneously
Markets	• Unsure whether current market structures will lead to the investments needed to reach net-zero
Voltage & Frequency	• Will be challenging to design an AC system w/ little or no synchronous generation (need grid-forming converters)

Pathways will be regional, but renewables/storage, electrification, and responsive demand will be “global”

Markets under Deep Decarbonization:

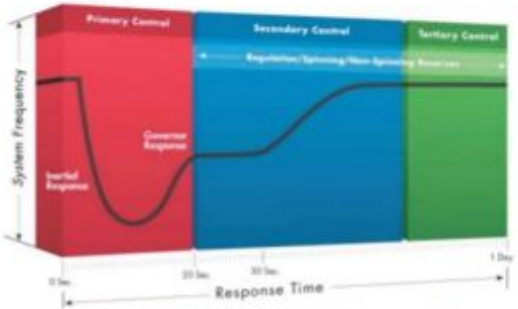
ESIG Workshop 1

- Generally, a consensus on the use of marginal cost pricing in the future, but:
  - How will storage and demand impact those prices
  - What will market power look like?
- What is the role of ISOs w/ Clean Energy Targets: prescriptive, facilitating, accommodating.
- Do GHG wholesale market integration design (GHG pricing, GHG constraints) make sense with other large-scale policies?
- Who makes the RA decisions? States, ISOs?
- What other attributes belong in the RA decision-making process
- How do you know when you need a new grid service market product? When a product vs. grid code?
- Is consumer demand participation a wholesale participation or a retail participation? How connected should the two be?
- Are markets for Operations only, or driving procurements too?

Price formation with zero-fuel-cost and opportunity-cost resources

Facilitating clean energy goals

Incentivizing supply resources to meet resource adequacy needs



Incentivizing resources to provide essential reliability services

Considering the importance of demand-side participation

Meeting Notes

Which of these gaps have we gotten closer to addressing in last 18 months?

ESIG Markets Next Steps

- Should the Task Force continue in a broad way, or should it become more granular with specific gaps?
- What other stakeholders need to be involved?
- What activities are helpful:
  - Education: for who?
  - Research: What types?
  - Pilots: What kinds?

Think about this throughout today and we will discuss at the end of the workshop