

# **ELECTRICITY MARKET DESIGN: ENVIRONMENTAL DISPATCH**

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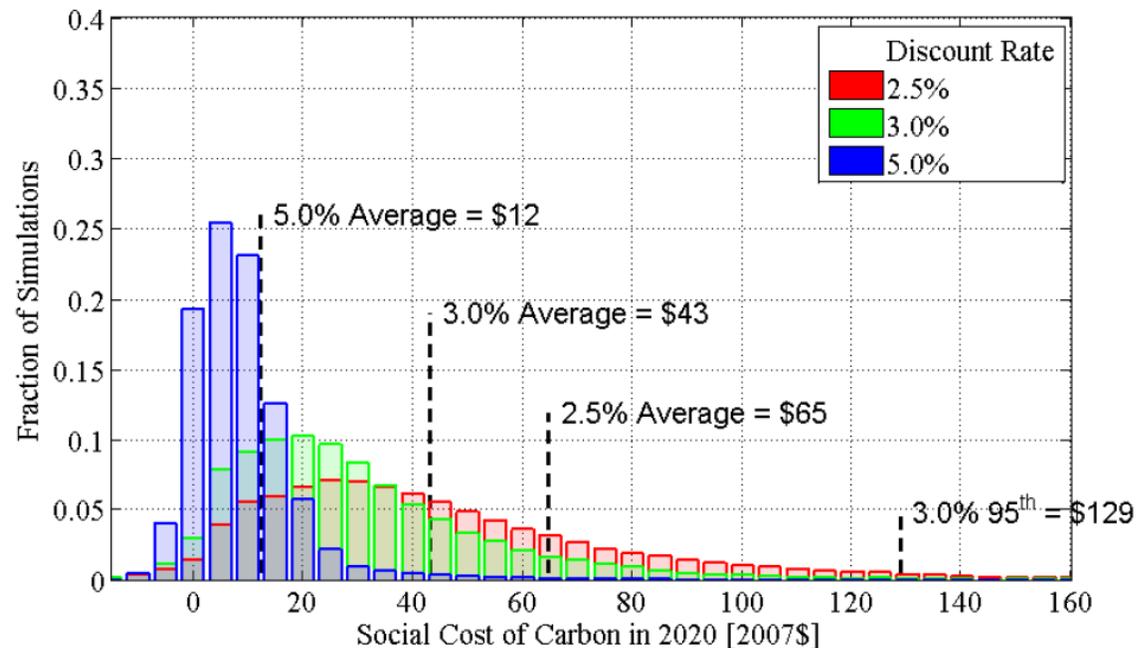
**New Orleans, LA**

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## **ELECTRICITY MARKET**

## **Environmental Dispatch**

Although there is significant uncertainty, the estimates from the U.S. government imply a substantial social cost of carbon dioxide (\$/ton CO<sub>2</sub>) that is not internalized in the market.



Regulatory Impact Analysis - Under Executive Interagency Working Group on Social Cost of Carbon. (2013). Technical Update of the Social Cost of Carbon for Order 12866, p. 14.

**The EPA Clean Power Plan seeks to apply a carbon policy within the framework of Clean Air Act authority applied to existing fossil fuel electricity generation.**

## **ELECTRICITY MARKET**

## **Environmental Dispatch**

**EPA’s Clean Power Plan (CPP) under Sec 111(d) envisions four building blocks, including changing the dispatch of Electricity Generating Units (EGUs). There is confusion about what this means.**

“Overall, the BSER proposed here is based on a range of measures that fall into four main categories, or “building blocks,” which comprise improved operations at EGUs, dispatching lower-emitting EGUs and zero-emitting energy sources, and end use energy efficiency.”

Environmental Protection Agency, “Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Proposed Rule,” 40 CFR Part 60, June 18, 2014, p. 34835.

The Clean Power Plan analysis utilizes EPA’s “Integrated Planning Model (IPM) ... a multi-regional, dynamic, deterministic linear programming model of the U.S. electric power sector. It provides forecasts of least cost capacity expansion, electricity dispatch, and emission control strategies while meeting energy demand and environmental, transmission, dispatch, and reliability constraints.” This is a zonal model built on load duration curves and inter-zonal transmission limits. IPM cannot replicate the impact of transmission constraints in actual dispatch operations. (<http://www.epa.gov/airmarkt/progsregs/epa-ipm/BaseCasev513.html>)

“EPA recognizes that the word “dispatch” can be used to describe how balancing authorities conduct real-time selection of specific generation (supply) to meet load (demand), on an hourly or even 15-minute basis. In the context of the proposed CPP and in this [Technical Support Document], the word “dispatch” is intended to refer to broader patterns of generation across different generating technologies over longer periods of time, in keeping with the compliance flexibilities afforded under this rule (e.g., where emission performance can be averaged over multiple years).”

U.S. Environmental Protection Agency, Office of Air and Radiation, “Translation of the Clean Power Plan Emission Rate-Based CO2 Goals to Mass-Based Equivalents,” Technical Support Document (TSD) for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, Docket ID No. EPA-HQ-OAR-2013-0602, November 2014, footnote 6.

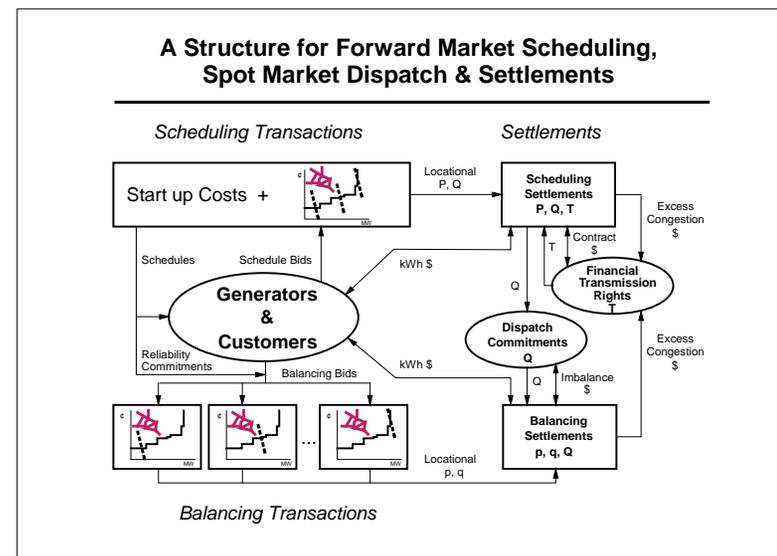
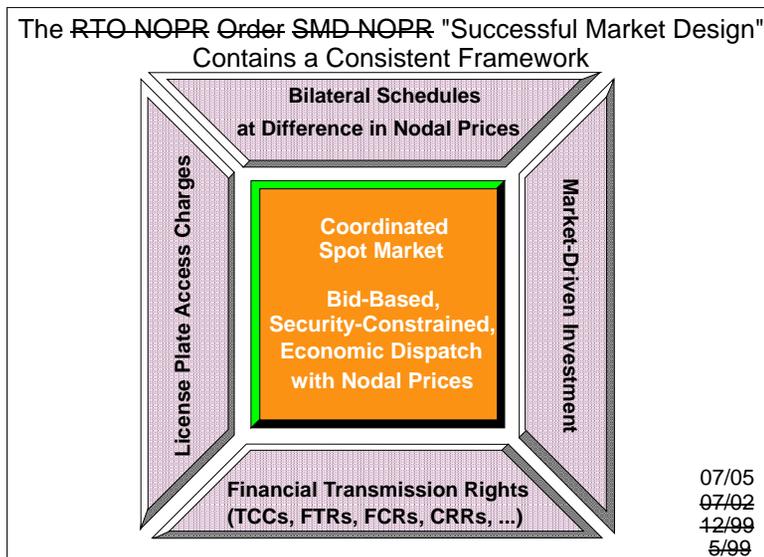
**What does all this mean?**

# ELECTRICITY MARKET

# A Consistent Framework

The example of successful central coordination, ~~GRT, Regional Transmission Organization (RTO) Millennium Order (Order 2000) Standard Market Design (SMD) Notice of Proposed Rulemaking (NOPR)~~, “Successful Market Design” provides a workable market framework that is working in places like New York, PJM in the Mid-Atlantic Region, New England, the Midwest, California, SPP, and Texas. This efficient market design is under (constant) attack.

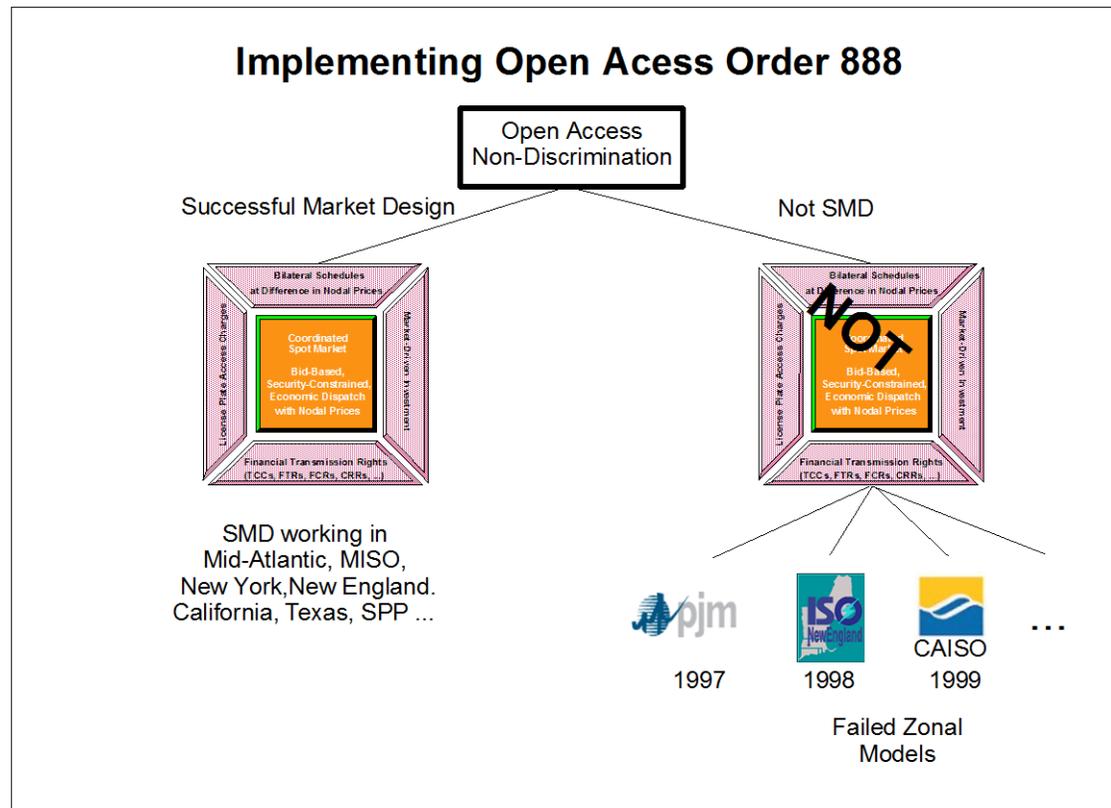
“Locational marginal pricing (LMP) is the electricity spot pricing model that serves as the benchmark for market design – the textbook ideal that should be the target for policy makers. A trading arrangement based on LMP takes all relevant generation and transmission costs appropriately into account and hence supports optimal investments.”(International Energy Agency, *Tackling Investment Challenges in Power Generation in IEA Countries: Energy Market Experience*, Paris, 2007, p. 16.)



# ELECTRICITY MARKET

# A Consistent Framework

Why is this important? The basic structure of the organized electricity markets depends on the successful market design framework of economic dispatch and financial transmission rights.



This is the only model that can meet the tests of open access and non-discrimination. Anything that upsets this design will unravel the wholesale electricity market.

## **ELECTRICITY MARKET**

## **Environmental Dispatch**

**Mechanisms that put a price on carbon will change the environmental footprint of economic dispatch.**

- **Carbon Tax.** The most direct means. The tax becomes part of the marginal cost for carbon emitting plants. There is a seamless integration with short-run economic dispatch.
- **Cap and Trade.** An indirect approach. If the cap and trade system allows for banking and borrowing over any reasonably extended period, the current price of permits operates like a carbon tax. There can be a seamless integration with economic dispatch.
  - **Regional Greenhouse Gas Initiative (RGGI).**
  - **CARB and CAISO-Pacificorp Energy Imbalance Market.**

**EPA acknowledges the importance of pricing carbon:** "... there are a number of different ways that states can design programs that achieve required reductions while working within existing market mechanisms used to dispatch power effectively in the short term and to ensure adequate capacity in the long term. These programs and programs for conventional pollutants, such as the Acid Rain Program under Title IV of the CAA, have ***demonstrated that compliance with environmental programs can be monetized*** such that it is factored into power sector economic decision making in ways that reduce the cost of controlling pollution, maintain electricity system reliability and work within the ***least cost dispatching principles that are key to operation of our electric power grid***. The proposal would also allow states to work together with individual companies on potential specific challenges. These and other flexibilities are discussed further in Section VIII of the preamble."

Environmental Protection Agency, "Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Proposed Rule," 40 CFR Part 60, June 18, 2014, p. 34834. (emphasis added)

## **ELECTRICITY MARKET**

## **Environmental Dispatch**

**Pricing carbon is the only way to maintain integrity of the electricity market design. Failure to acknowledge this reality can lead to mistaken or unintended consequences. The EPA Clean Power Plan analysis proceeds as though economic dispatch is not central to the market.**

“Based on the analytic approach summarized above, the EPA has identified the following four principal categories—“building blocks”—of measures that provide the foundation of our BSER determination for CO2 emissions from existing EGUs:

1. Reducing the carbon intensity of generation at individual affected EGUs through heat rate improvements.
2. Reducing emissions from the most carbon-intensive affected EGUs in the amount that results from substituting generation at those EGUs with generation from less carbon-intensive affected EGUs (including NGCC units under construction).
3. Reducing emissions from affected EGUs in the amount that results from substituting generation at those EGUs with expanded low- or zero-carbon generation.
4. Reducing emissions from affected EGUs in the amount that results from the use of demand-side energy efficiency that reduces the amount of generation required.”

Environmental Protection Agency, “Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Proposed Rule,” 40 CFR Part 60, June 18, 2014, p. 34858.

Yet, real dispatch results may be different.

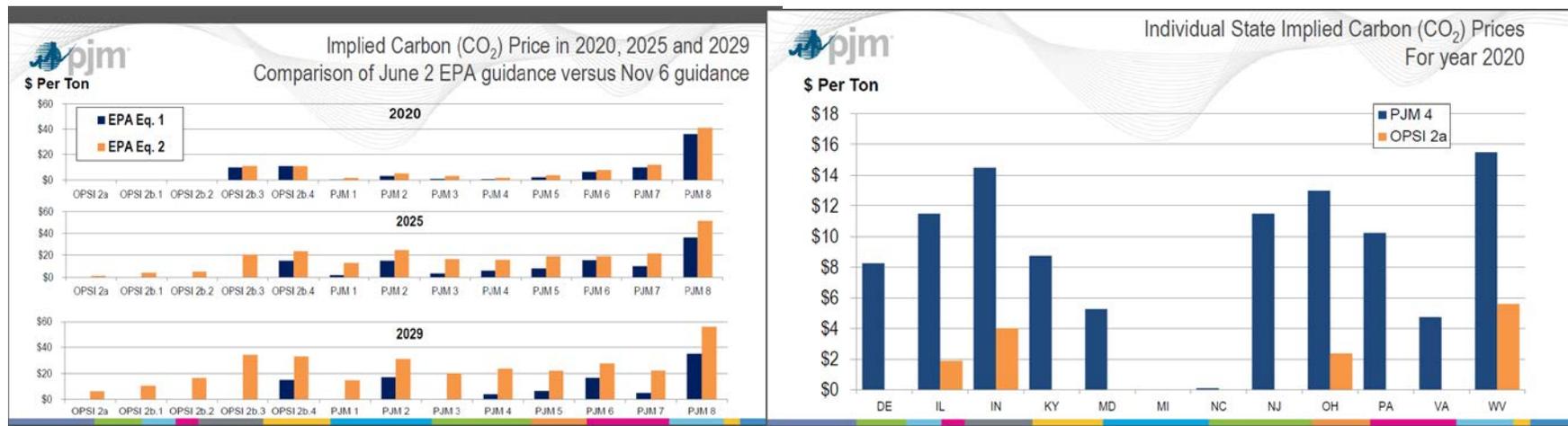
- **Improved efficiency for coal plants can result in more CO2 emissions.** (EPA p.34882)
- **Increased use of gas may substitute for other renewables or nuclear.**
- **New renewable plants may substitute for other renewables or nuclear.**
- **Energy efficiency can interact with grid congestion to cause higher CO2 emissions.**

# ELECTRICITY MARKET

# Environmental Dispatch

The PJM analysis of the Clean Power Plan confirms both the importance of pricing carbon and the surprising results of actual dispatch testing.

- **PJM modeled everything by using a price on carbon.** The analysis included coordinated regional solutions and individual state solutions.
- **The result is uncertainty about the implied price of carbon.** The uncertainty is not related to the long-run climate factors driving uncertainty for the social cost of carbon.



Sotkiewicz, Paul and Muhsin Abdur-Rahman, "EPA's Clean Power Plan Proposal Review of PJM Analyses Preliminary Results," November 17, 2014, p.26, 36.

**With a well-designed carbon policy, all the options would produce the same price of carbon. These disparities signal trouble in electricity markets.**

## **ELECTRICITY MARKET**

## **Environmental Dispatch**

**Why is this important? The Clean Power Plan embeds contradictions of the Clean Air Act, carbon policy, and a collision with electricity market design.**

- **Wholesale power markets depend on the economic dispatch framework.**
- **Monetizing carbon is the key to meshing environmental goals and electricity market design.**
- **National carbon policy rejects a carbon tax (so far).**
- **EPAs Clean Power Plan does not require monetizing carbon.**
- **The Clean Power Plan proceeds with CAA supported rate-based standards and new ad hoc “building blocks” that are only loosely connected to the underlying social cost of carbon or the workings of electricity markets.**

**Will state implementation plans thread the needle to meet environmental goals?**

**Will the necessary electricity market design survive the regulatory gauntlet?**

**Will environmental dispatch implementation create perverse outcomes and arbitrage opportunities?**

**Will the future be the RGGI or CARB-CAISO-Pacificorp models, meshing carbon pricing and economic dispatch? Or will the future repeat the fiasco of the California-Enron electricity market design that prohibited economic dispatch?**

William W. Hogan is the Raymond Plank Professor of Global Energy Policy, John F. Kennedy School of Government, Harvard University. This paper draws on research for the Harvard Electricity Policy Group and for the Harvard-Japan Project on Energy and the Environment. The author is or has been a consultant on electric market reform and transmission issues for Allegheny Electric Global Market, American Electric Power, American National Power, Aquila, Atlantic Wind Connection, Australian Gas Light Company, Avista Corporation, Avista Utilities, Avista Energy, Barclays Bank PLC, Brazil Power Exchange Administrator (ASMAE), British National Grid Company, California Independent Energy Producers Association, California Independent System Operator, California Suppliers Group, Calpine Corporation, CAM Energy, Canadian Imperial Bank of Commerce, Centerpoint Energy, Central Maine Power Company, Chubu Electric Power Company, Citigroup, City Power Marketing LLC, Cobalt Capital Management LLC, Comision Reguladora De Energia (CRE, Mexico), Commonwealth Edison Company, COMPETE Coalition, Conectiv, Constellation Energy, Constellation Energy Commodities Group, Constellation Power Source, Coral Power, Credit First Suisse Boston, DC Energy, Detroit Edison Company, Deutsche Bank, Deutsche Bank Energy Trading LLC, Duquesne Light Company, Dyon LLC, Dynegy, Edison Electric Institute, Edison Mission Energy, Electricity Corporation of New Zealand, Electric Power Supply Association, El Paso Electric, Energy Endeavors LP, Exelon, Financial Marketers Coalition, FTI Consulting, GenOn Energy, GPU Inc. (and the Supporting Companies of PJM), GPU PowerNet Pty Ltd., GDF SUEZ Energy Resources NA, Great Bay Energy LLC, GWF Energy, Independent Energy Producers Assn, ISO New England, Koch Energy Trading, Inc., JP Morgan, LECG LLC, Luz del Sur, Maine Public Advocate, Maine Public Utilities Commission, Merrill Lynch, Midwest ISO, Mirant Corporation, MIT Grid Study, Monterey Enterprises LLC, MPS Merchant Services, Inc. (f/k/a Aquila Power Corporation), JP Morgan Ventures Energy Corp., Morgan Stanley Capital Group, National Independent Energy Producers, New England Power Company, New York Independent System Operator, New York Power Pool, New York Utilities Collaborative, Niagara Mohawk Corporation, NRG Energy, Inc., Ontario Attorney General, Ontario IMO, Ontario Ministries of Energy and Infrastructure, Pepco, Pinpoint Power, PJM Office of Interconnection, PJM Power Provider (P3) Group, Powerex Corp., Powhatan Energy Fund LLC, PPL Corporation, PPL Montana LLC, PPL EnergyPlus LLC, Public Service Company of Colorado, Public Service Electric & Gas Company, Public Service New Mexico, PSEG Companies, Red Wolf Energy Trading, Reliant Energy, Rhode Island Public Utilities Commission, Round Rock Energy LP, San Diego Gas & Electric Company, Secretaría de Energía (SENER, Mexico), Sempra Energy, SESCO LLC, Shell Energy North America (U.S.) L.P., SPP, Texas Genco, Texas Utilities Co, Tokyo Electric Power Company, Toronto Dominion Bank, Transalta, TransAlta Energy Marketing (California), TransAlta Energy Marketing (U.S.) Inc., Transcanada, TransCanada Energy LTD., TransÉnergie, Transpower of New Zealand, Tucson Electric Power, Twin Cities Power LLC, Vitol Inc., Westbrook Power, Western Power Trading Forum, Williams Energy Group, Wisconsin Electric Power Company, and XO Energy. The views presented here are not necessarily attributable to any of those mentioned, and any remaining errors are solely the responsibility of the author. (Related papers can be found on the web at [www.whogan.com](http://www.whogan.com) ).