WESTERN ENERGY IMBALANCE MARKET: AN EFFICIENT MARKET WITH CONFLICTING CARBON POLICIES

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ELECTRICITY MARKET — Energy Market Design

The U.S. experience illustrates successful market design and remaining challenges for both theory and implementation.

- **Design Principle: Integrate Market Design and System Operations**

  Provide good short-run operating incentives.

  Support forward markets and long-run investments.

- **Design Framework: Bid-Based, Security Constrained Economic Dispatch**

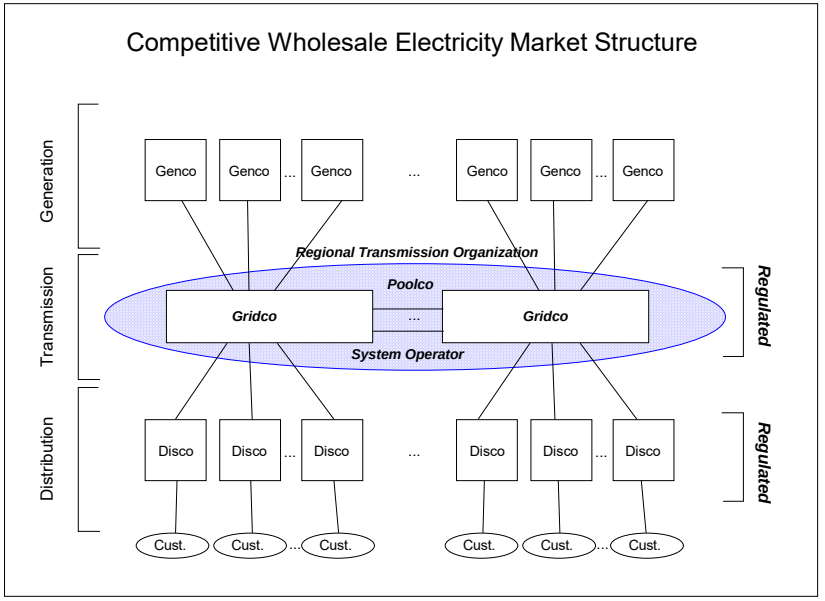
  Locational Marginal Prices (LMP) with granularity to match system operations.

  Financial Transmission Rights (FTRs).

- **Design Implementation: Pricing Evolution**

  Better scarcity pricing to support resource adequacy.

  Unit commitment and lumpy decisions with coordination, bid guarantees and uplift payments.



- **Design Challenge: Infrastructure Investment**

  Hybrid models to accommodate both market-based and regulated transmission investments.

  Beneficiary-pays principle to support integration with rest of the market design.

The independent system operator provides a dispatch function. Three questions remain. Just say yes, and the market can decide on the split between bilateral and coordinated exchange.

- **Should the system operator be allowed to offer an economic dispatch service for some plants?**

The alternative would be to define a set of administrative procedures and rules for system balancing that purposely ignore the information about the costs of running particular plants. It seems more natural that the system operator considers customer bids and provides economic dispatch for some plants.

- **Should the system operator apply marginal cost prices for power provided through the dispatch?**

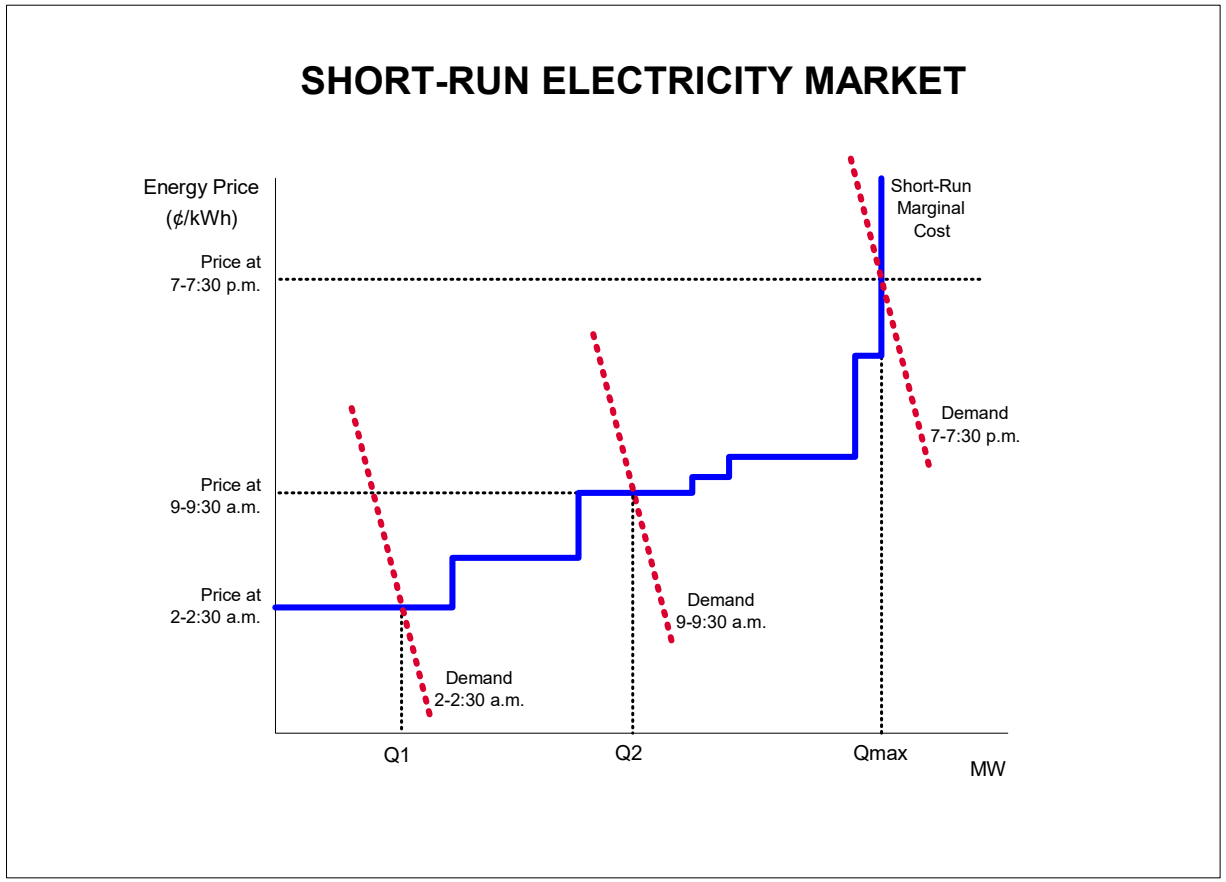
Under an economic dispatch for the flexible plants and loads, it is a straightforward matter to determine the locational marginal costs of additional power. These marginal costs are also the prices that would apply in the case of a perfect competitive market at equilibrium. In addition, these locational marginal cost prices provide the consistent foundation for the design of a comparable transmission tariff.

- **Should generators and customers be allowed to participate in the economic dispatch offered by the system operator?**

The natural extension of open access and the principles of choice would suggest that participation should be voluntary. Market participants can evaluate their own economic situation and make their own choice about participating in the operator's economic dispatch or finding similar services elsewhere.

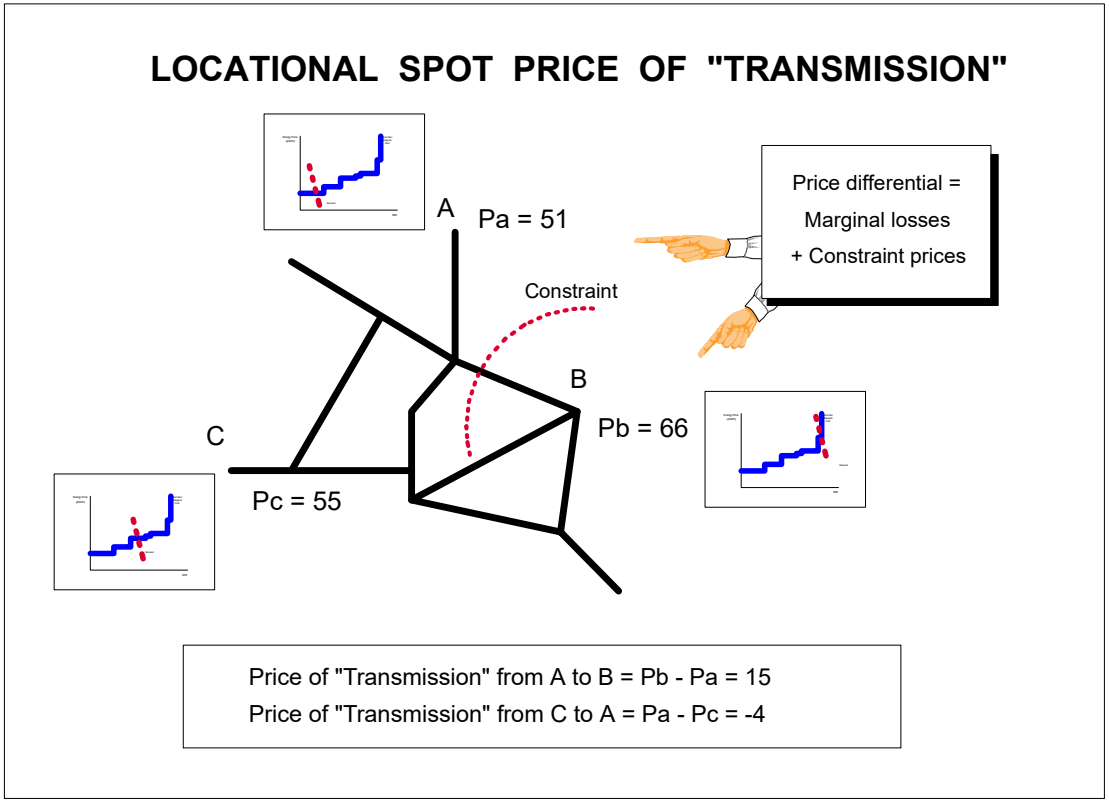
ELECTRICITY MARKET — Pool Dispatch

An efficient short-run electricity market determines a market clearing price based on conditions of supply and demand balanced in an economic dispatch. Everyone pays or is paid the same price. The same principles apply in an electric network. (Schweppe, Caramanis, Tabors, & Bohn, 1988) (Hogan, 1992)



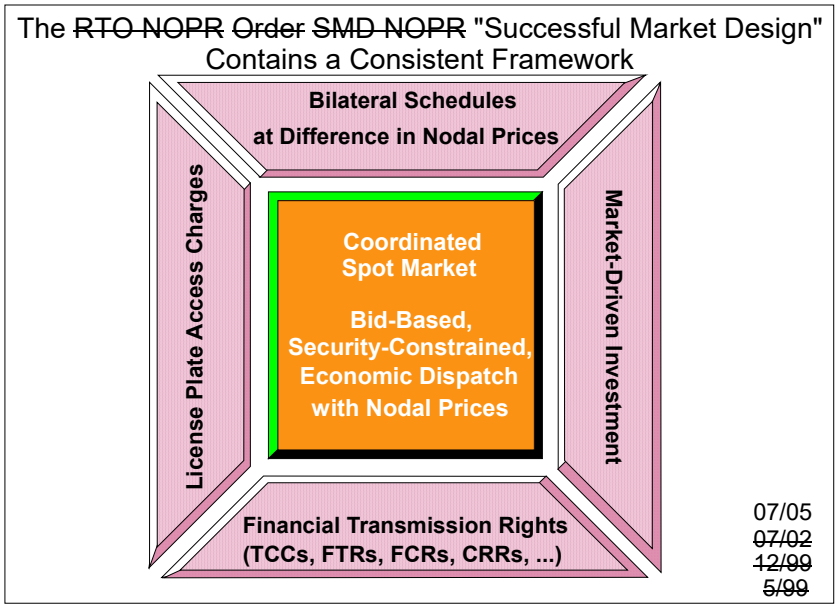
The natural extension of a single price electricity market is to operate a market with locational spot prices. (Schweppe et al., 1988)

- It is a straightforward matter to compute "Schweppe" spot prices based on marginal costs at each location.
- Transmission spot prices arise as the difference in the locational prices.



ELECTRICITY MARKET A Consistent Framework

The example of successful central coordination, ~~CRT, 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.



Poolco…OPCO…ISO…IMO…Transco…RTO… ITP…WMP…: "A rose by any other name …"

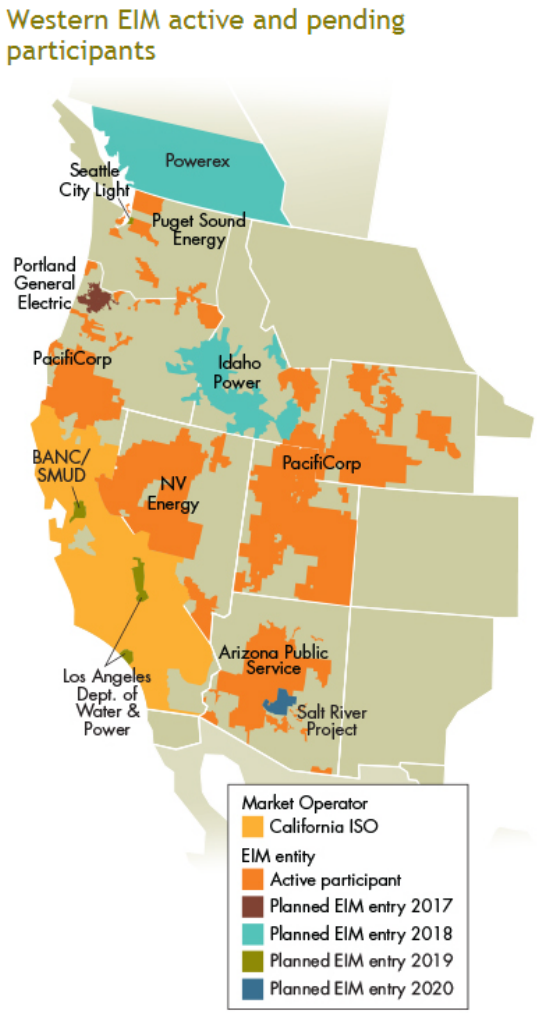
"Locational marginal pricing (LMP) is the electricity spot pricing model that serves as the benchmark for market design – the textbook ideal that should be the target for policy makers. A trading arrangement based on LMP takes all relevant generation and transmission costs appropriately into account and hence supports optimal investments." (International Energy Agency, 2007)

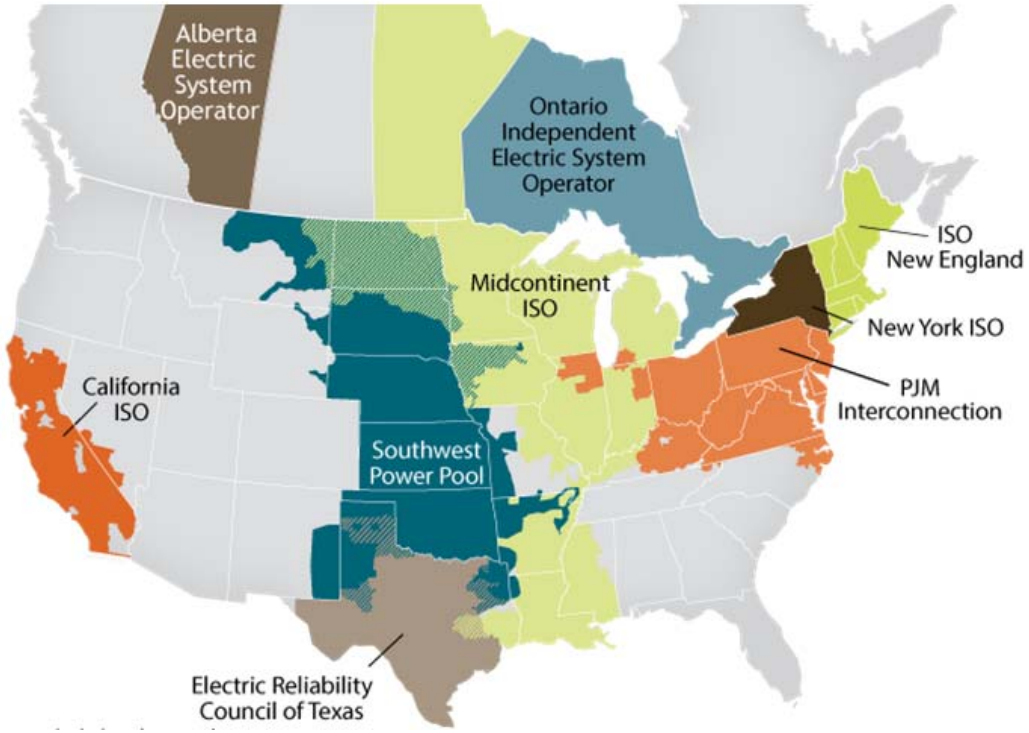
This is the only model that can meet the tests of open access and non-discrimination.

Anything that upsets this design will unravel the wholesale electricity market. The basic economic dispatch model accommodates the green energy agenda, as in the expanding Western Energy Imbalance Market (EIM).

ELECTRICITY MARKET — A Consistent Framework

The basic model covers the existing Regional Transmission Organizations and is expanding through the Wester Energy Imbalance Market. (www.westerneim.com)





(IRC Council and CAISO maps)

The small volumes in the EIM do not imply that it is unimportant. The real-time imbalance market sets prices and expectations for all other transactions.

- **Design of the energy imbalance market is the most important element in an electricity system.**
  - Principles of open-access and non-discrimination point to an efficient market design.
  - Prices and associated payments should support efficient dispatch.
    - Economic dispatch gives rise to locational marginal costs that determine efficient prices.
    - Given the prices and payments, generators and loads should have no incentive to deviate from the dispatch.
- **Past attempts to deviate from the principles of efficient design have produced costly mistakes.**
  - CAISO (ISO/PX), PJM, ISONE, and ERCOT all tried to operate without prices needed to support an efficient dispatch. Despite advanced assurances that the defects were small, the markets were “fundamentally flawed” and required major redesign. (Hogan, 2002)
  - Eventually, all organized markets in the United States converged on the core elements of bid-based, security-constrained, economic dispatch with locational prices.
  - The existing EIM is an example of a market that utilizes these fundamentals. (Hogan, 2013)

The basic EIM design works. But it has been criticized because of concerns that it produces dispatch results that embody "resource shuffling" which assigns low carbon generation to California when the actual marginal source of generation might be a higher carbon emitter.

- **The California Air Resources Board (CARB) definition of resource shuffling is somewhat vague.**

  "Resource Shuffling" means any plan, scheme, or artifice undertaken by a First Deliverer of Electricity to substitute electricity deliveries from sources with relatively lower emissions for electricity deliveries from sources with relatively higher emissions to reduce its emissions compliance obligation." (California Air Resources Board, 2017)

- **An underling difficulty is the implicit assumption that the concept of "deliveries [to load] from sources" is well-defined.**
  - In fact, power flows intermingle from all sources and the "deliveries from sources" are just after-the-fact accounting conventions that should be better labeled as "deemed deliveries." The substitutions are all on paper.
  - Discussions of CARB concerns, that the EIM description of deliveries from sources to load does not capture the "atmospheric effect of ISO load relying on resources external to the ISO balancing authority," reveal how the accounting fiction is confused with the physical reality (California Independent System Operator, 2017, p. 9).

A proposed reform for the EIM invokes a novel two-stage dispatch intended to reduce or foreclose resource shuffling.

- **The new model would create two-stages based on the bids and offers.** (California Independent System Operator, 2017)
  - The first stage would determine a reference dispatch with generation deemed to be supplied without California imports. This generation would not be eligible to supply California imports.
  - The first-stage solution is used to discriminate in the second stage, which includes California imports and provides the actual dispatch and associated prices.
- **The reform proposal is problematic, and the difficulties are inherent.** (Hogan, 2017)
  - Prices don't support the final dispatch.
    - Low carbon emitters would have an incentive to provide bids to ensure that they are not selected in the first stage. This recreates the perverse conditions found in past failed market designs.
    - The structure of the market takes on many of the features of a pay-as-bid approach. Such designs are known to be inefficient, especially in the presence of transmission constraints.
  - The proposed two-stage reform does not eliminate behavior which could be interpreted as resource shuffling.
    - Even if successful, the first stage discriminates against low carbon emitters.
    - Transmission constraints make the problem complicated and can produce counterintuitive results.

The motivation for an EIM design change is to deal with resource shuffling. The design challenge confronts two related but distinct problems. One arises from the change in the volume of imports and the other concerns the composition of imports.

- **Import Leakage.** This is a familiar problem wherein high carbon external resources, which do not face a carbon limit, replace lower carbon internal resources.
  - Leakage necessarily involves a change in the level of imports or exports, relative to a counterfactual.
  - The usual recommendation for addressing such border effects is to impose an incremental charge on imports or a payment for exports. (Newell et al., 2017)

- **Import Composition.** This is a less familiar problem. It is important in the context of the electricity sector and the CARB/CAISO/EIM settlement system
  - There is no change in the level of imports or exports.
  - There is no change in total dispatch or carbon emissions.
  - All the changes refer to “deemed” assignments of generation to load.
  - The impact is on the payments in the settlement system.

The vague definition of “resource shuffling” conflates the two ideas. Thus confusion between real effects and deemed dispatch accounting leads us astray.

A key problem is to specify a counterfactual for evaluating the impact of EIM design features. A reasonable design choice would be to compare to the results of a common carbon price across the EIM. As inside California, suppose that all generators in the region faced the same price for carbon emissions.

- **Efficient Dispatch.**
  - The market reduces to a bid-based, security-constrained, economic dispatch.
  - Prices differ by location and equal the marginal cost of generation plus carbon emission.
- **Marginal High Carbon Emitters Internalizes the Carbon Price.**
  - The marginal generator faces a locational price equal to its combined generation and emission cost.
  - Higher cost generators are not dispatched.
- **Low or Zero Carbon Emitters Earn Greater Profits.**
  - Renewables with zero marginal cost capture the full benefit of substituting for marginal carbon emissions.
  - Other low or lower carbon emitters capture a faction of the marginal cost of carbon emissions.
- **Import Level Would Be Efficient, and Import Composition Would Be Undefined.**
  - Efficient dispatch implies no import leakage.
  - Deemed import composition would be irrelevant, so there is no resource shuffling.

The existing EIM design captures some of the features of a common carbon price approach, implemented within a cap-and-trade framework. But with different carbon policies, the design has different impacts inside and outside California.

- **Generators Inside California Face a Common Carbon Price.**
- **Generators Outside California See Different Carbon Prices.**
  - Deemed imports act as though being produced in California.
    - Deemed imports are paid the marginal energy plus carbon price.
    - Deemed imports must purchase carbon permits for their actual emissions.
  - Other generation and load outside California do not see a carbon price.
    - Energy price determined by locational marginal cost of generation.
    - No obligation to purchase carbon permits.
- **The Difference in Carbon Prices Creates Incentives Affecting Imports.**
  - **Import Leakage**: There is an incentive to increase imports above the level implied by the common carbon price counterfactual.
  - **Import Composition**: The deemed California imports will consist of low or zero carbon emitting resources. The settlements system implies different net carbon benefits.
    - Marginal carbon emitting resources will receive no net carbon benefits.
    - Low or zero carbon emitting resources will capture net carbon benefits.
    - The net price differences approximate the outcome of the common carbon price case.

The exiting EIM design creates a mix of good and bad: solutions and remaining problems.

- **Solutions.**
  - The exiting EIM follows the essential electricity market design fundamentals and produces prices that support the dispatch.
  - The deemed import composition of the exiting EIM works to better approximate the payments and incentives of the common carbon price counterfactual. This is the pure resource shuffling effect.
- **Problem.**
  - The existing EIM design allows for import leakage compared to the standard of the common carbon price counterfactual.
  - This is a familiar problem, distinct from pure resource shuffling.

Import Leakage Creates One Problem.

(Pure) Resource Shuffling is a Solution to Another Related Problem.

This diagnosis of the existing EIM, compared to the common carbon price counterfactual, points to a targeted EIM reform. This draws from the related study of import (and export) leakage issues in systems without the EIM feature of deemed imports incorporated under a cap-and-trade approach.

- **Target the Problem: Import Leakage.**
  - The problem lies in changes in the level of imports, not the composition of imports.
  - The usual recommendation is to charge for imports (and pay for exports) at the implied marginal emission cost.
  - Under the existing EIM framework, this approach translates into a charge that is an estimate of the difference between the marginal emission cost under the current design versus the marginal emission cost under the common carbon price counterfactual.
- **The Rest of the EIM is Not Broken: Don't Fix It.**
  - After correcting for the level of imports, the current policies for deemed imports and their settlements become pure resource shuffling.
    - Pure resource shuffling has no impact on aggregate emissions.
    - The remaining price and payment effects approximate the outcome of a common carbon policy from the perspective of imports, and a different carbon policy for the other regions.
  - The prices support the dispatch solution.

The proposed two-stage EIM reform is likely to do more harm than good. The more modest imposition of an incremental import charge would address the real problem of import leakage without undermining the basic purposes of the EIM.

- **The Two-Stage Reform Proposal Would Repeat Errors of the Past.**
  - The problem is inherent in a two-stage approach. The solution is not in perfecting the first stage to find a better method for separating the markets and discriminating among potential imports.
  - Any non-trivial two-stage approach would, as intended, produce discriminatory administrative constraints that apply in the second-stage. This would create incentives for the excluded generators to avoid the first-stage constraint.
- **A More Modest Reform Would Incorporate an Import Charge and Maintain the Rest of the EIM.**
  - The prices from the EIM economic dispatch would support the dispatch.
  - Implementation of the EIM would be no more difficult than in the existing design.
  - The market design would not confuse real dispatch effects with deemed transactions, would be easier to explain, and would not break what isn't broken.
  - The benefits of carbon emission substitution would flow to low carbon resources, approximating the common carbon price counterfactual.

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