Some Issues & Proposals
in CO₂ Trading & Accounting:
Load-Based Systems, Allowance Allocation & Leakage

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General Objectives

1. Effective reductions in CO\textsubscript{2}
   ⇒ Deal with leakage

2. Avoid unnecessary distortions and inefficiencies in power markets
   ⇒ Avoid having to track power transactions from source to use
   ⇒ Avoid allocating free allowances to new investment, especially giving more allowances to higher emitting plants
One Approach to Avoid Tracking in Load-Based Systems: Decouple Emissions from Power

- Inspired by “Green Certificate” / “Renewable Energy Credit” programs
  - Power generator sells MWh to power market
    - Sells GCs/RECs to GC/REC markets
  - LSEs buy MWh to meet consumer power demands
    - Buys GCs/RECs to meet regulatory requirements

- As a result, the ISO does not need to:
  - Account for flow of green vs grey electricity to consumers through the grid
  - Have different prices for different colors of power (in addition to LMPs, spinning reserves, nonspinning reserves, reactive power, ….)

- As a result, desirable (green) producers do not have an incentive to avoid the ISO day-ahead and real-time markets under MRTU
  - If “greenness” attribute not separated from power, a single market would attract only the less valuable (grey) power
  - Would limit the flexibility of the operator, endanger system reliability
E.g., “Tradable Emission Attribute Certificates”  
(C. Breidenich and M. Gillenwater)

- LSEs buy both power and TEACs (MWh) from suppliers $j$, each with average emissions rate $E_j$.

- Regulator requires that the LSE satisfy:
  - $\sum_j TEAC_j = \text{Load}$
  - $\sum_j E_j \cdot TEAC_j = E_{\text{TARGET}} \times \text{Load}$
    - $E_{\text{TARGET}}$ = target emissions rate

- LSE pays $\sum_j P \times (E_{\text{DEFAULT}} - E_j) \cdot TEAC_j$
  - $P = $/ton price of CO$_2$

- Generator $j$ paid $P \times (E_{\text{DEFAULT}} - E_j) \times \text{MWh}_j$
This Type of System Simplifies to an Economically Equivalent System of (1) Source Trading + (2) MWh Tax

Mathematical result:
- If no imports & demand is perfectly inelastic, then $E_{DEFAULT}$ doesn’t matter
- *E.g.*, if $E_{DEFAULT}$ is set high, consumers pay more for TEACs, & generators receive more.
  - Then the equilibrium price of power is lowered, *exactly* compensating for the increased TEAC payments
- Might as well set $E_{DEFAULT} = E_{TARGET}$

If $E_{DEFAULT} = E_{TARGET}$, then each consumer pays, on net, zero for TEACs:
- Then no need for TEAC accounting or sales to consumers
- System simplifies to a source-based trading system,
  - with a cap = $total \ load \times E_{TARGET}$
- System is giving away allowances to producers in proportion to MWh production

Higher $E_{DEFAULT}$ values are equivalent to a consumption (per MWh) tax plus source-based trading:
- Tax + source trading is simpler to administer than load-based systems
- Tax + source trading is readily transitioned to national or regional system
Adapting “Tradable Emission Attribute Certificates” To A Power Market with Imports

- Assume $E^{\text{DEFAULT}} = E^{\text{TARGET}}$

- $E^W$ = the marginal CO2 emissions rate (t/MWh) at Calif border
  - Under a well-functioning power market, this would be the same no matter who is the nominal importer to California
    - Requires modeling; depends on season, time of day, and location of import

- For an importer, let $z_j = \text{imports}$.
  - Importer is allocated:
    $$E^{\text{TARGET}} z_i$$
  - ... and must buy the following allowances:
    $$E^W z_j$$
  - *Eliminates* the contract shuffling problem
    - And, if $E^W$ is correct, eliminates leakage.

- For an generator who exports, let $x_j = \text{imports}$
  - It is then allocated the following allowances:
    $$E^{\text{TARGET}} (MWh_j - x_j)$$
  - ... and needs to buy the following allowances:
    $$(E_j MWh_j - E^W x_j)$$
Free Allocation of Allowances to New Investment Can Distort Generation Mix and Increase Costs

- Our simulations of power markets have shown that if allowances are given freely to new investment, and more allowances are given to dirtier sources:
  - The mix of generation investment shifts from the least cost mix
    - In extreme cases, gas winds up being baseloaded and coal cycled, without decreasing emissions
  - Costs to consumers goes up
    - In extreme cases, many fold

- Do not allocate allowances in ways that provide incentives to change future investment decisions