Some Issues & Proposals in CO_2 Trading & Accounting: Load-Based Systems, Allowance Allocation & Leakage

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General Objectives

1. **Effective reductions in CO_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:
  - $Sum_j\ TEAC_j = Load$
  - $Sum_j\ E_j\ TEAC_j = E^{TARGET} * Load$
    - E^{TARGET} = target emissions rate

- LSE pays $Sum_j\ P\ x\ (E^{DEFAULT} - E_j) TEAC_j$
  - P = $/ton price of CO_2

- Generator *j* paid $P\ x\ (E^{DEFAULT} - E_j)\ x\ MWh_j$

This Type of System Simplifies to an Economically Equivalent System of (1) Source Trading + (2) MWh Tax

- **Mathematical result:**
  - If no impors & 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 x* 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 $E^{DEFAULT} = E^{TARGET}$
- 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 = imports.
  - Importer is allocated:

    $E^{TARGET}\, z_i$

    … 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 = imports
  - It is then allocated the following allowances:

    $E^{TARGET}\, (MWh_j - x_j)$

    … and needs to buy the following allowances:

    $(E_j\, MWh_j - E^W\, x_j)$

Free 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**

- **J. Zhao, B.F. Hobbs, and J.-S. Pang, "Long-Run Equilibrium Modeling of Alternative Emissions Allowance Allocation Systems in Electric Power Markets," Working Paper, April 18, 2007**