Energy Policy 37 (2009) 290–299

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Internalizing carbon costs in electricity markets: Using certificates in a load-based emissions trading scheme

Michael Gillenwater [a,*], Clare Breidenich [b]

[a] Science, Technology and Environmental Policy Program, Woodrow Wilson School of Public and International Affairs, Robertson Hall, Princeton University, Princeton, NJ 08540, USA
[b] Independent consultant, Seattle, WA, USA

ARTICLE INFO

Article history:
Received 19 February 2008
Accepted 20 August 2008
Available online 21 October 2008

Keywords:
Emissions trading
Load-based cap
Electricity markets

ABSTRACT

Several western states have considered developing a regulatory approach to reduce greenhouse gas (GHG) emissions from the electric power industry, referred to as a load-based (LB) cap-and-trade scheme. A LB approach differs from the traditional source-based (SB) cap-and-trade approach in that the emission reduction obligation is placed upon Load Serving Entities (LSEs), rather than electric generators. The LB approach can potentially reduce the problem of emissions leakage, relative to a SB system. For any of these proposed LB schemes to be effective, they must be compatible with modern, and increasingly competitive, wholesale electricity markets. LSE's are unlikely to know the emissions associated with their power purchases. Therefore, a key challenge for a LB scheme is how to assign emissions to each LSE. This paper discusses the problems with one model for assigning emissions under a LB scheme and proposes an alternative, using unbundled Generation Emission Attribute Certificates. By providing a mechanism to internalize an emissions price signal at the generator dispatch level, the tradable certificate model addresses both these problems and provides incentives identical to a SB scheme.

1. Introduction

In the United States, a lack of regulatory initiative to address greenhouse gas (GHG) emissions at the federal level has induced state governments to develop their own or regional policies. The electric power industry is the largest contributor to US GHG emissions, accounting for just over 33%, and so has been the focus of several state-sponsored initiatives (EPA, 2007).

The policy approach for regulating emissions from the electric power industry adopted in the European Union's Emission Trading Scheme (EU-ETS) and most frequently proposed in the United States is to cap industry-wide emissions at the source and allow emission allowances to be traded between regulated entities. These emission "cap-and-trade" schemes specify that power plants (i.e., electricity generators) that directly emit pollutants, such as carbon dioxide (CO_2), are the regulated entities responsible for compliance.

In general, this type of source-based (SB) cap-and-trade scheme is an efficient means of reducing emissions of the electric power industry. However, if the boundaries of the scheme that specify which entities are capped do not include all or most of the entities operating in the regional electricity market, then emissions reductions from a capped region can be countered by increases in emissions from entities outside the scheme's boundaries. This problem is referred to as emission "leakage."

In attempting to address this problem, several western states have considered utilizing an alternative regulatory approach for the electric power industry, referred to as a load-based (LB) cap-and-trade scheme. A LB approach differs from the traditional SB cap-and-trade approach in that the emission reduction obligation is placed upon Load Serving Entities (LSEs), rather than electric generators.[1] LSEs purchase power wholesale or generate it themselves and then distribute it to retail (i.e., residential, commercial, and industrial) consumers. Allowances, that convey the right to emit one ton of a pollutant, are distributed to LSEs who are then required to surrender allowances to cover aggregate emissions associated with the electricity they sell.

The LB approach to regulating GHG emissions from the electric power industry has been proposed for several states and regions because it can potentially reduce the problem of emissions leakage. States do not have the legal authority to regulate power plants located in other states; however, they do have the authority

* Corresponding author. Tel.: +1 202 997 3335.
E-mail addresses: gillenwater@alum.mit.edu, mwgillenwater@yahoo.com (M. Gillenwater), cbreidenich@yahoo.com (C. Breidenich).

[1] Depending on regulatory definitions, LSEs may be referred to as retail electric providers or retail electric suppliers.

0301-4215/$ - see front matter
doi:10.1016/j.enpol.2008.08.023

to regulate LSEs serving retail customers in their state, and thus emissions from all electricity consumed.

To date, Oregon[2] is pursuing and California[3] actively considered a LB approach. Not surprisingly, imports account for a significant fraction of the electrical load served (i.e., retail sales) in each state. In California, net electricity imports account for around 30% of total load,[4] but roughly 50% of the GHG emissions (CEC, 2007). In contrast, Oregon is a net exporter of electricity in years when snowfall is sufficient for hydroelectric facilities to operate near capacity. However, because of the seasonal nature of hydroelectric power, Oregon's overall consumption of electricity is still heavily dependent on imports from coal-fired power plants in Utah, Wyoming, and Montana (GAGGW, 2004; ODP, 2005).

States in the West and Northeast are also considering a LB approach to a cap-and-trade program. Participants in the Western Climate Initiative, which includes Oregon and California, considered developing a regional LB scheme. And states that are part of the Regional Greenhouse Gas Initiative (RGGI) are also considering supplementing their SB cap-and-trade scheme with a LB approach that targets only the portion of electricity imported from states not participating in RGGI (e.g., Pennsylvania) (RGGI, 2007).

For any LB scheme to be effective, it must be compatible with modern, and increasingly competitive, wholesale electricity markets. These markets are no longer dominated by vertically-integrated utilities. Instead, independent power producers, power marketers and brokers, and spot markets play significant roles.

Because much (and in some cases, all) of the load served by a LSE is purchased from other entities, LSEs are unlikely to know the emissions associated with their power purchases. Therefore, a key challenge for a LB scheme is how to assign emissions to each LSE.

Currently, the most detailed model for assigning emissions to load is that proposed in Oregon. The Oregon model requires that regulators track financial transactions for wholesale power by following the contract-paths between generators and LSEs. This paper discusses the problems with the contract-path model, and proposes an alternative, using unbundled generation emission attribute certificates (GEACs). This alternative model offers several benefits, most important of which is that it is more compatible with competitive wholesale electricity markets. Although we will briefly contrast the LB approach to an emissions cap-and-trade scheme with a SB approach, this paper does not take a position on whether a SB or LB approach is preferable. Rather, it solely aims to elaborate and justify this alternative model for a LB approach.

2. Load-based cap-and-trade scheme

The LB approach represents an evolution of electricity procurement policies, such as Renewable Portfolio Standards (RPSs) and Emission Performance Standards, both of which mandate the type of electricity procured by a LSE. A LB approach is in many ways analogous to an RPS; however, whereas an RPS requires the tracking of generation from eligible renewable energy technologies that supplies a portion of a LSE's load, a LB approach requires the tracking of all generation, and associated emissions, supplying a LSE's entire load. Regulators and experts in California, in particular, have developed procurement policies to reduce emissions from the electric power industry over the last several years (Potts, 2006).

The tracking and capping of emissions associated with all load served inside a jurisdiction, as opposed to only generation inside a jurisdiction, creates the potential to address emissions from imports and control emissions leakage from a shift to dirtier electricity imports (Burtraw et al., 2006; Cowart, 2006a, b). This shift can take the form of moving facilities, production, or purchases to an unregulated jurisdiction. Because electricity can easily be imported from uncapped sources that do not face emission compliance costs, the potential for leakage is of particular concern for the electric power sector (RGGI, 2007).

2.1. Comparison to a source-based approach

Under a traditional SB cap-and-trade scheme, regulators determine a cap on allowable emissions, and distribute emission allowances (i.e., emission permits) to regulated sources (i.e., electricity generators) equal to the level of the cap. These sources can then trade allowances so that reductions are achieved at the lowest aggregate cost to society.[5] Each source monitors and reports emissions and then surrenders allowances equal to the quantity of its emissions. A SB approach internalizes the cost of pollution at the generator level, because higher emitting generators face higher compliance costs than low-emission generators. This additional cost reduces the differential between the variable costs of these generators (e.g., coal and gas, respectively), with the result that cleaner generators dispatch more frequently and displace dirtier generation.

A LB approach also regulates emissions through the allocation and surrendering of emission allowances; however, allowances and the obligation to surrender them are assigned to LSEs, rather than generators. Under a LB approach, generators face no direct compliance requirement to reduce emissions. However, faced with compliance penalties if they exceed the emissions cap, LSEs will prefer to procure generation from lower emitting sources. Over time, the wholesale electric market should value less-emitting generation.

Advocates of a LB approach over a SB approach commonly cite three advantages. The first is that a LB approach provides regulated entities with a low-cost mitigation option not available to generators under a SB scheme. LSE can invest in improvements in the energy efficiency of their retail customers, thereby lowering their overall load and emissions burden. For the electricity sector, energy efficiency may be the lowest cost mitigation strategy (IPCC, 2007), and many LSEs have extensive experience in managing demand side management programs (Berry, 1993). However, the significance of this effect is questionable, as LSE have not historically demonstrated a willingness to heavily invest in end-user energy efficiency (Wirl, 1994).[6]

A second argument claims that a LB approach provides a better incentive for LSEs to procure electricity from renewable energy

[2] The Oregon Legislative Assembly recently introduced House Bill 3545, which would establish a LB cap-and-trade scheme for LSEs in Oregon. (http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_0001-0050/ab_32_bill_20060927_chaptered.pdf).

[3] California enacted Assembly Bill 32 in September 2006. The Bill explicitly requires that the state account for emissions from both in-state electricity generation and electricity imported from outside the state (http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_0001-0050/ab_32_bill_20060927_chaptered.pdf). Initially, the California Public Utilities Commission (CPUC) stated its intention to develop a LB emission trading scheme for the electric power sector. However, in March 2008, the CPUC and California Energy Commission jointly recommended to the California Air Resources Board that it instead designate "deliverers" of electricity to the California grid as the point of regulation. (http://docs.cpuc.ca.gov/PUBLISHED/NEWS_RELEASE/80131.htm).

[4] http://www.energy.ca.gov/electricity/gross_system_power.html.

[5] In the case of CO_2 and other GHGs, the ability to trade allowances is especially appropriate, given that the environmental impacts of GHGs are independent of the location of emissions.

[6] The revenue and profits for most LSEs are based on electricity sales. Therefore, unless profits and sales volume have been decoupled, a LSE will have an incentive to invest in energy efficiency only if the emissions compliance cost savings are greater than the lost profits from reduced sales.