

# **Economic Efficiency of Alternative Border Carbon Adjustment Schemes: A Case Study of California Carbon Pricing and the Western North American Power Market**

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This paper examines the impacts, effectiveness, and efficiency of alternative border carbon adjustment (BCA) schemes in electricity markets, focusing on interactions of California carbon pricing with the Western North American power market. The BCA schemes considered differ in how emissions associated with electricity imports into California are estimated.

Based on market simulations from a WECC-wide generation and transmission investment and operations model for the year 2034, we find that if there is a California carbon price but no BCA, California emissions decrease. However, the rest of the system's emissions increase in compensation, perhaps by even more than the California reduction. The emission leakage is primarily due to a shift from gas-fired power from California's existing gas power plants to those in the rest of the WECC. Under our case study's assumptions, local carbon pricing would raise both the cost to California consumers and the cost to the WECC in total without lowering emissions. Consequently, California carbon pricing without BCA is ineffective and costly. Furthermore, implementing BCA by estimating emission imports using the contract source's emission rate—the basis of the actual California BCA policy on electricity imports—is only marginally better. The efficiency improvement is negligible because of contract shuffling. Finally, the California carbon price also increases incentives for interstate transmission development.

Dynamically setting import emission rates based on external marginal emission rates provides the largest efficiency gains, and its solutions are Pareto efficient relative to other schemes. It is also the only BCA scheme that decreases coal power production in the rest of the system because it sets a high emission rate when non-California marginal units are coal-powered. Finally, this cost-effective BCA scheme dampens incentives provided by California carbon pricing for interstate transmission expansion.

Finally, even if augmented by the most efficient BCA scheme, California's unilateral carbon price remains far less efficient than a hypothetical WECC-wide carbon pricing policy. This result suggests expanding California's carbon pricing regimes through collaboration with other states as a more cost-efficient choice.

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