A mechanism to account for locational carbon impact in electricity markets

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Abstract:
There are several challenges in existing mechanisms to recover the cost of carbons in the electricity market. For example, carbon pass-through incentivizes reduction in energy use, with challenges in terms of social equity. Both costs of carbon and energy are embedded in the cap & trade mechanism, resulting in difficulties in monitoring electricity prices and tracking the locational aspects of carbon emissions. The proposed method solves both challenges by considering coupled power and carbon flow markets. The power flow model could be utilized for calculating electricity transport, and the atmospheric dispersion model to track carbon flow. The participants in the energy market can now participate in the carbon market with their cost to not inject carbon into the environment, and the customers can bid their willingness to pay for reduced carbon available at their premises. Here, we assume the presence of an external entity that generates the demand function based on the social cost of carbon and regulation standards. This mechanism would provide an additional mechanism to recover the cost of infra-marginal renewable resources. Instead of subsidizing renewable energy producers, marginalized communities could be directly subsidized regarding their carbon costs. Therefore, this mechanism is Environmental, Social, and Governance (ESG) compliant. Given that the scope of market clearing in the electricity market would be limited to individual resource nodes, the granularity for calculating the impacts of carbon on the consumers would be limited to the span of the distribution network within a resource node. This mechanism could be extended to air pollution in general.

Keywords: Climate Change, Electricity Sector, Equity, Market Mechanism

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