Four Essays on Offshore Wind Power Potential, Development, Regulatory Framework, and Integration

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The potential of offshore wind power as an energy resource in the US has been recognized only recently. There is now a growing interest among the coastal states to harness this resource, particularly in the states adjacent to the Mid-Atlantic Bight where the shallow continental shelf allows installation of wind turbines using existing foundation technology. The promise of bountiful clean energy from offshore wind, however, could be delayed or forestalled due to policy and regulatory challenges. This dissertation is an effort to identify and address some of the key challenges. Focusing on Delaware as a case study, the study calculates the extent of the wind resource; considers one specific way to facilitate resource development—the establishment of statewide and regional public power authorities; analyzes possible regulatory frameworks to manage the resource in state-controlled waters; and assesses the use of distributed storage to manage intermittent output from wind turbines. In order to cover a diversity of topics, the dissertation employs a multi-paper format with four essays forming the body of work.

The first essay lays out an accessible methodology to calculate offshore wind resource potential using publicly available data, and uses this methodology to access wind resources off Delaware. The assessment suggests a wind resource approximately four times the average electrical load in Delaware. The second essay examines the potential role of a power authority, a quasi-public institution, in lowering the cost of capital, reducing financial risk of developing and operating a wind farm, and enhancing regional collaboration on resource development and management issues. The analysis suggests that a power authority can lower the cost of offshore wind power by as much as one-third, thereby preserving the ability to pursue cost-competitive development even if the current Federal incentives are removed. The third essay addresses the existing regulatory void in state-controlled waters. It outlines a regulatory framework, touching on key elements such as the leasing system, length of tenure, and financial terms for allocating property rights. In addition, the framework also provides recommendations for environmental assessment that would be required prior to lease issuance. The fourth and final essay analyzes offshore wind power integration using electric thermal storage in housing units. It presents a model of wind generation, heating load and wind-driven thermal storage to assess the potential of storage to buffer wind intermittency. The analysis suggests that thermal load matches the seasonal excess of offshore wind during winter months, and that electric thermal storage could provide significant temporal, spatial, and cost advantages for balancing output from offshore wind generation, while also converting a major residential load (space heating) now met by fossil fuels to low carbon energy resources. Together, the four essays provide new analyses of policy, regulatory, and system integration issues that could impede resource development, and also analyze and recommend strategies to manage these issues.