Impacts of Wind Resources and Environmental Regulation to Future Generation Portfolio and its Capacity Factor in ERCOT

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Introduction

As more renewable resources are added into the grid and environmental regulations are imposed to reduce emission from generators, there will be dramatic changes in generation portfolios. Assessing the impact of these changes is important for policy makers, market participants, and general public to understand trends in the electricity market. This paper addresses this issue by analyzing how the ERCOT generation portfolio may evolve with different levels of wind penetration.

AURORAxmp, a commercially available market simulator, is utilized to capture both long term and short term dynamics in the deregulated market. With the tool, the study assess the impacts of 10%, 20%, 27%, and 33% wind penetration level to the ERCOT generation expansion.

Past ERCOT Market Overview

- Capacity Expansion of ERCOT
- Wind Development of ERCOT
- Energy Penetration Level By Fuel Type

Methodology

In order to study the impacts of renewable resources on electricity market in long term perspectives, the model should properly represent:

- Short-Term Market Dynamics: operational limits, flexibility and variability of resources at least with hourly resolution
- Long-Term Market Dynamics: economic investment decisions

AURORAxmp Long-Term Logic Optimization

- Economic Investment Decision
- Energy Production and Capacity by Unit Type
- Amount of Emission

A unit’s profit is calculated from hourly prices generated by UC and OPF logic every hour and converted into Present Value. A small set of most profitable units in a candidate unit group is added, while a small set of least profitable units in an existing unit group is retired. The process is repeated until the model finds the optimal set of units.

Future of Power Industry

- Capacity Penetration Expansion
- Energy Penetration Level

Data and Scenario Assumptions

- Fuel Prices, Inflation ⇐ EIA AEO 2012 / Capital Cost ⇐ EIA AEO 2011
- Resource Information ⇐ AURORAxmp Database ⇐ NERC Electric Supply and Demand Database and EIA Annual Electric Power Report

Environmental regulation ⇐ CO2 price from EIA GHG15 case is assumed to be representative for short term dynamics in the deregulated market.

Environmental regulation •⇐

Five Scenarios: Base, Base without CO2 Regulation, 20%, 27% and, 33% Wind Penetration

Note that in this study, penetration is defined in terms of energy, not capacity.

Estimated Results for Future ERCOT Capacity

- Capacity Penetration Expansion
- Energy Penetration Level

_base w/o CO2 900 79,470 2,850 4,070 6,550 42,065

20% Base 900 77,795 6,350 10,520 46,246

27% Wind 900 70,795 7,130 41,884 -8,292 44,096

33% Wind 900 70,795 6,700 54,300 -9,390 47,885

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