# ESRI Research Bulletin

## *The impact of the North Atlantic Oscillation on electricity markets: A case study on Ireland*

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This Bulletin summarises the findings from: Curtis, J., Lynch, M. Á., and Zubiate, L. (2016). The impact of the North Atlantic Oscillation on electricity markets: A case study on Ireland. *Energy Economics*, 58:186–198.

# The impact of the North Atlantic Oscillation on electricity markets[1]

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## Introduction

The extended period of very cold temperatures and low wind speeds during the winter of 2009–2010 has been attributed to the North Atlantic Oscillation (NAO). The NAO is the change in pressure difference between the Azores High and the Icelandic Low pressure systems and it is the main driver of winter climate variability over the North Atlantic region. Positive NAO phases are associated with wet, warm and windy conditions in Ireland and, as in 2009-2010, negative phases with dry, cold conditions and calm winds.

When temperatures are very low there is usually an increase in electricity demand. If this coincides with low wind speeds and therefore idle wind turbines the electricity sector relies to a greater extent on coal and gas fired electricity generation, which in turn generally results in higher electricity prices. Previous work has shown that increased levels of wind generation capacity reduce the variability of both costs and prices, meaning that generation companies are less likely to be faced with very high production costs, and consumers are less likely to be faced with very high electricity prices.[2] The purpose of this research was to examine how climate variability via the NAO will amplify the effect of wind generation on the electricity market.

This study uses a computer model of the electricity system that enables us to examine many different scenarios for NAO phases, electricity demand, wind generation and fossil fuel prices. In total we analysed 10,000 winter scenarios each of six month's duration, October to March, to assess the impact of NAO on the electricity system.

## Research Results

Our analysis found that NAO has a statistically significant effect on both thermal generation costs and wholesale electricity prices. At current levels of installed wind capacity total thermal production costs are 3% lower under positive NAO phases compared to negative NAO phases, wholesale electricity prices decline by 1% or €0.8/MWh, and subsidies to wind generators increase by 14.5%. Earlier

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[2] Lynch, M. Á. and Curtis, J. (2016). The effects of wind generation capacity on electricity prices and generation costs: a Monte Carlo analysis. *Applied Economics*, 48(2):133–151

research has shown that this coincides with a 3% reduction in carbon dioxide ($CO_2$) emissions from the electricity sector.[3] As investment in wind capacity increases the impact of changes in NAO phases will be proportionately greater.

## IMPLICATIONS

The impact of NAO on electricity price represents a substantial component of a generator's profit margin and hence investment decisions in new generation plant that do not allow for the distribution of NAO phases and its impact on the wind resource could lead to unexpected deviations from expected revenue and profit, either positive or negative. In windier positive NAO phases wholesale electricity prices fall but wind generators revenue increase by 12%, as turbines are online more often than during less windy spells. At the same time revenue and profits of thermal generators decline in inverse proportion to the level of installed wind capacity. It is widely accepted that new investment in wind generation capacity has implications for the profitability of all existing generation capacity. What this research shows is that the distribution of NAO phases can have a significant additional impact on revenues and cash flow that need to be incorporated into investment decisions.

## REFERENCES


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[3] Curtis, J., Lynch, M. Á., and Zubiate, L. (2016). Carbon dioxide (CO2) emissions from electricity: The influence of the North Atlantic Oscillation. *Applied Energy*, 161:487–496.