Wind Farm Investment in New Zealand

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Energy Centre
Low-emissions transition

- Government’s target of net-zero carbon by 2050
- Energy sector accounts for 40% of the total GHG emissions
- Government’s goal: 90% of electricity generated from renewables by 2025
- Currently wind generation contributes 6%
- NZWEA target’s of 20% wind energy by 2030
Wind energy expansion

Research questions

Q1: How does an increase of wind penetration influence the nodal price?

Q2: Is the MOE larger during the peak demand, and smaller during the off-peak demand?

Q3: Can we use answers to question (1) to predict the regional price reduction for each node and to further explore where to build wind sites?
Econometric Models

Spatial Models – The Transmission Line Capacity in MW

[Map of New Zealand showing transmission line capacities in MW]
Average network hourly price effects of an increase of 10% in wind penetration on nodal price

Average hourly effects of an increase of 10% in wind penetration on nodal price:
- Peak hours: 18, 19, 20, 21
- Night hours: 0, 1, 2, 3
- Shoulder hours: 4, 5, 6, 7

Nodal Price ($/MWh):
- Daytime prices range from $-1.13 to $-1.40
- Nighttime prices range from $-3.45 to $-3.55
- Shoulder prices range from $-2.76 to $-2.81
The regional price effect \$/MWh of a 10% point increase in wind penetration at BPE
The regional price effect $/MWh of a 10% point increase in wind penetration at HAY

- $0.11
- $0.11
- $0.16
- $0.23
- $0.41
- $0.41
- $0.39
- $0.26
- $0.21
- $0.21
Price prediction and simulation
Price prediction and simulation

Estimated net annual savings (million $) per MW installed

Net savings (million $) per MW installed

- $0.32 mil  - $0.57 mil  - $0.44 mil  - $0.69 mil  $2.75 million  $2.55 million  - $0.19 mil  - $0.44 mil  - $0.61 mil  - $0.86 mil  $1.79 mil  $1.55 mil  - $0.66 mil  - $0.9 mil  $8.44 mil  $8.19 mil  $0.77 mil  $0.53 mil  - $0.59 mil  - $0.84 mil

BPE  HAY  HLY  HWB  OTA  ROX  TIW  TKU  TWZ  WKM

LRMC ($82/MWh)  LRMC ($110/MWh)
From national point of view: where to build?

Estimated net annual savings (million $) per MW installed – (Rank#)
LRMC ($82/MWh)

- $0.61 mil - (9)
- $0.59 mil - (8)
$2.79 mil - (2)
$8.44 mil - (1)
$0.77 mil - (4)
- $0.32 mil - (6)
$1.79 mil - (3)
- $0.44 mil - (7)
- $0.19 mil - (5)
- $0.66 mil - (10)
Take away

• Results show that private investment in additional wind capacity leads to positive gains in economic value.

• However, it’s not clear if private investment is financially profitable. Investing in capacity at a given node can reduce the return to a generator’s assets in the network.

• Reaching the goal of 20% electricity from wind generation depends on growth in demand. Maybe, this can come about from growth in electrification of transport.
Thank you for your attention!

“We cannot direct the wind, but we can adjust the sails.” --Dolly Parton

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