



Wind Energy

*Presentation to Energy
Centre Summer School*

Grenville Gaskell, NZ Wind Energy Association
February 2016

Contents

- About NZWEA
- A Historical Perspective
- Advantages of Wind Power
- National and International Trends
- Environmental Impacts
- An Operational View
- Climate Change
- Domestic Wind Turbines
- Summary

About NZWEA

- Established 1997
- An industry association
 - Promotes the development of wind as a reliable, sustainable, clean and commercially viable energy source
 - Policy & regulatory advocacy, public awareness and industry development
- Represents around 40 companies:
 - Generators and developers
 - Turbine manufacturers, equipment suppliers, consultants
- Utility scale generation

Wind Energy, An Historical Perspective

- Internationally
 - 500 to 900 A.D - used for pumping water
 - 1890's - pumping water and electricity
 - 1980's - first large scale wind farms
 - 1991 - first off shore wind farm
 - 2002 - first 3MW wind turbine
- New Zealand
 - 1970's - research commenced
 - 1980's - recognition of commercial opportunities
 - 1990's - first turbines and commercial deployment
 - 2004 - first grid connected wind farm

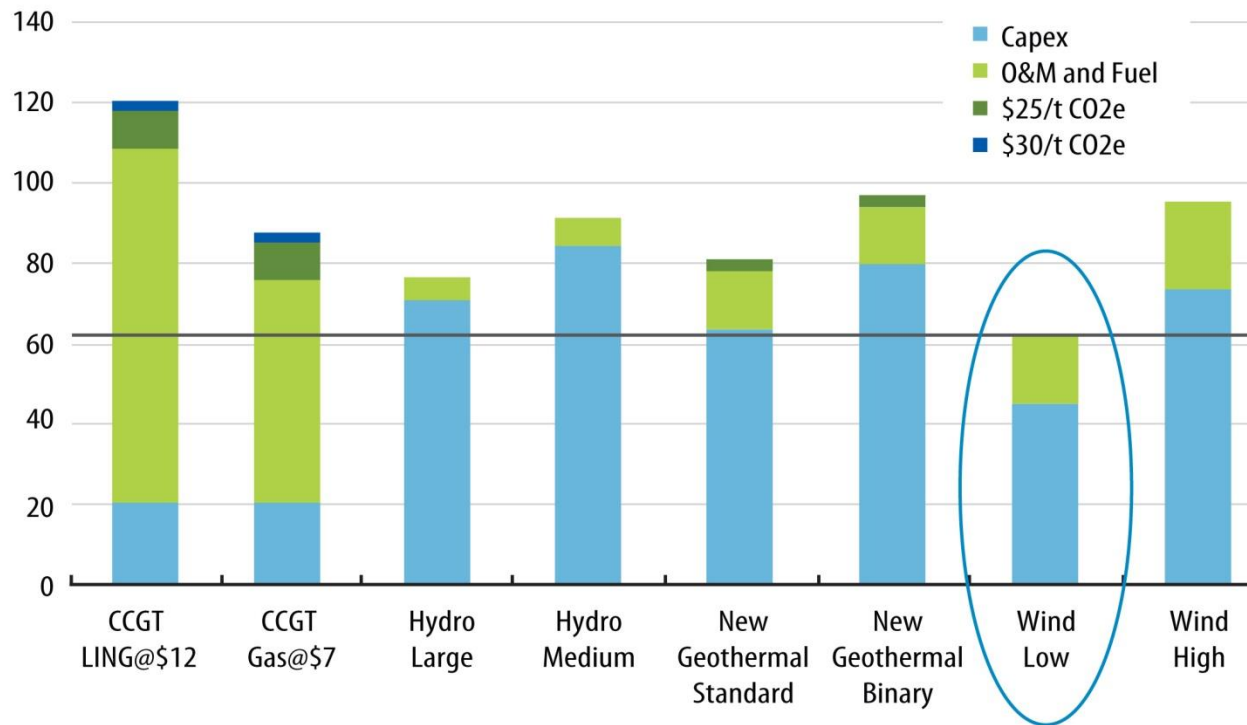


Why Wind?

- Renewable - produces no greenhouse gases
 - Coal 1,000 tons CO₂-e per GWh
 - Gas 501 tons CO₂-e per GWh
 - Geothermal 125 tons CO₂-e per GWh
- Low investigation costs
- Cheapest form of new generation
- Scalable
- Consistent resource
 - Variable but seasonally reliable
- Synergies with hydro generation
- Strong public support

Wind is Cost Advantaged

LRMC - 2016 \$/MWh



- Low-cost option for new electricity generation
- Benefits from economies of scale and innovation

Mostly, We Like Wind but...



- 76% of support for wind (EECA survey 2011)
- Increasing number of community wind initiatives
- Visual impacts and noise the main issues
- Challenge is for developers and operators to be good neighbours

Electricity Generation in NZ

Four Key Stages:

1900 - 80s: Hydro

1970s - 2000s:
Thermal

1990s - 2020:
Geothermal

**2000s - 2030:
Wind**



Trends in NZ

- Around 40% of gas produced in NZ is used for electricity generation
- 50% of coal used for electricity generation
- NZ baseload – geothermal & combined cycle gas plants
- Renewables are increasing
 - 72% in 2000
 - 81% in 2015
 - 90% in 2025 (Govt target)
- Thermal plant closures in 2015
 - Otahuhu 400MW
 - Southdown 130MW
- Future of Huntly?

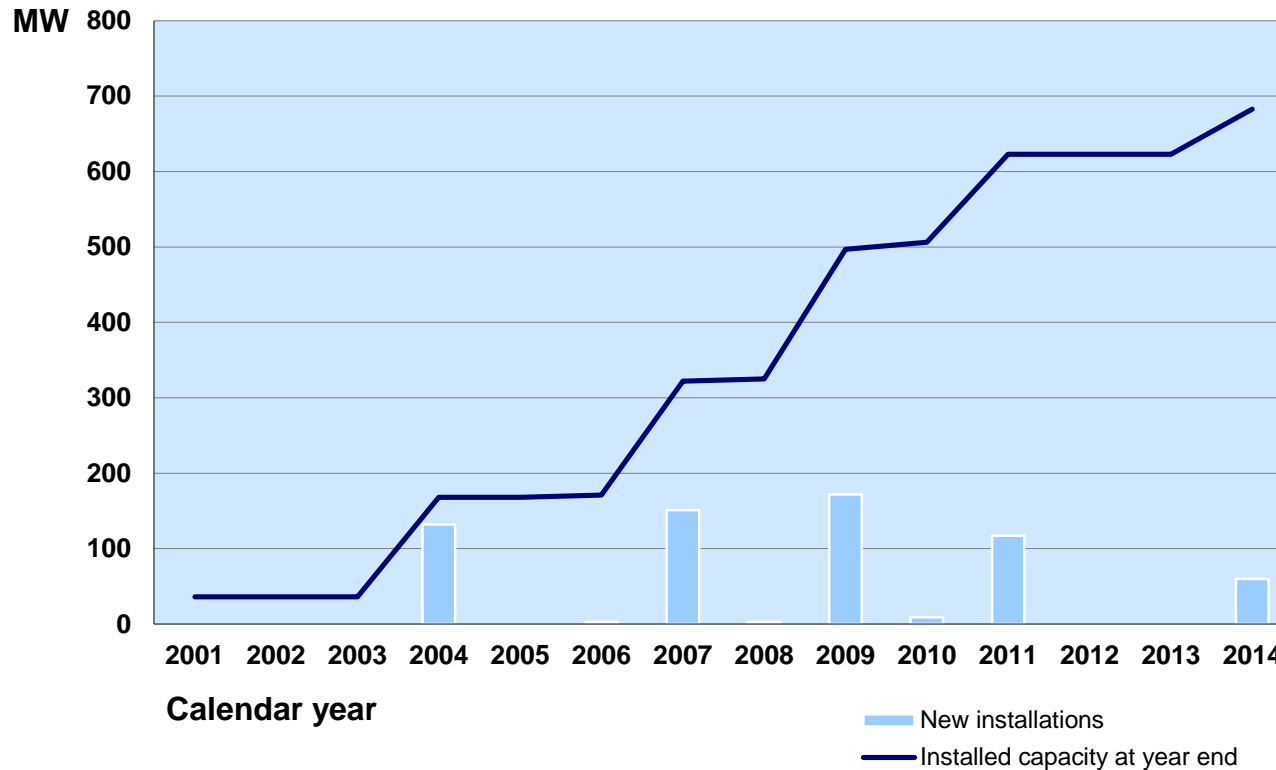


NZ - Wind Generation Today



- 19 wind farms
- 690 MW generating capacity
- 6% of NZ's annual generation
- 2500MW consented
- Not all will be built

Wind Growth

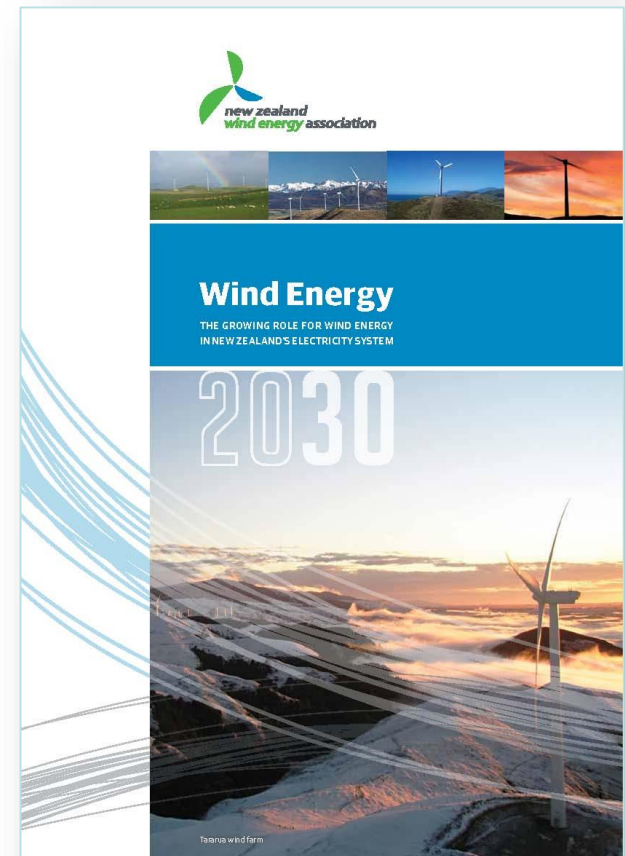


- No major new development since 2014
- Market now talking about needing new capacity

Vision: Wind Energy 20% by 2030



- **690MW now to 3000MW in 2030**
 - Requires investment of \$300m per year
- **20% wind energy**
 - NZ has excellent sites
 - Fits with the existing electricity system
 - Will deliver economic benefits
 - Wind can replace the majority of NZ's gas – fired baseload generation

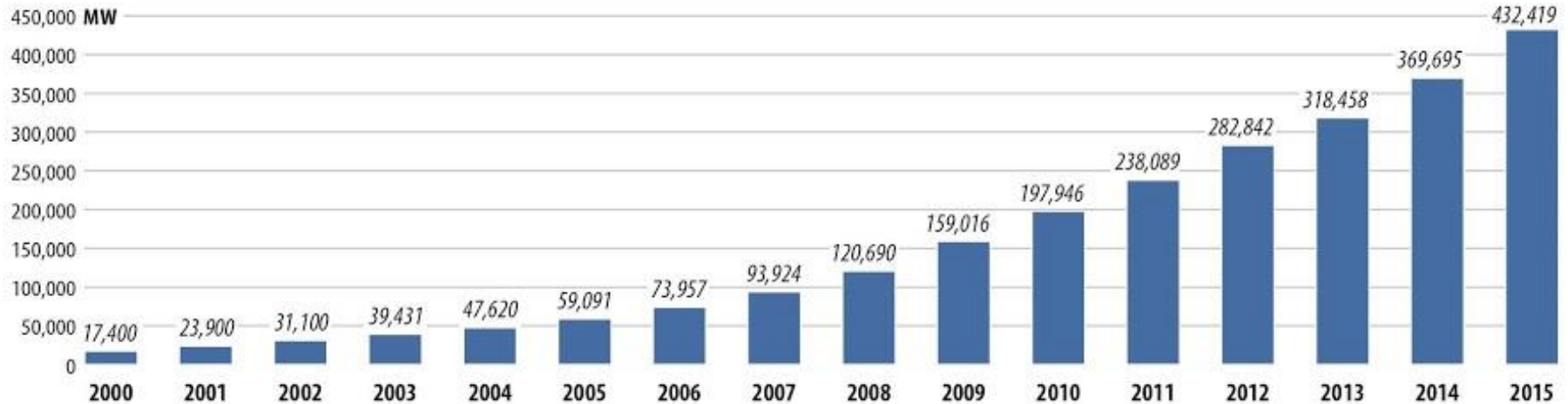


International Trends

- Wind is the fastest growing source of generation
 - 63GW new capacity in 2015
 - Annual investment 110b euro (\$165b NZ)
 - Capacity doubling every 3 years
- China now accounts 50% new of installations
 - New capacity equals a coal plant every 1-2 weeks
- Wind 17% of EU's generation capacity
 - 51% new EU generation was wind power
- Coal use in the US is the lowest since 1983
- Wind energy on track to supply 20% of US electricity by 2030
- Australia has 1,500 MW of new wind build

Spectacular Global Growth

GLOBAL CUMULATIVE INSTALLED WIND CAPACITY 2000-2015



Source: GWEC

- Total of 432 GW installed by the end of 2015
- 432GW = 50X NZ's total installed generation
- 790 - 880 GW by 2020
- 1,700 - 2,100 GW by 2030

A long way in a short time...

- 13 fold increase in capacity in 14 years
- 4 to 6 fold reduction in costs
- Ongoing innovation in blades and software



1993: 0.225MW
\$13m/MW



2007: 3MW
\$2-3m/MW

Environmental Impacts

- RMA key to the sustainable management natural and physical resources
- Construction Phase
 - Earthworks
 - Visual
 - Noise
 - Ecology
 - Transportation / traffic effects
- Operation Maintenance Effects
 - Visual and Landscape
 - Noise
 - Ecology
 - Productive land

RMA Challenges and Opportunities

- Balancing perspectives
- Every site is different
- Stakeholder management
- Time and Cost
- Consistency of interpretation
 - Amenity impacts
 - Noise
 - Visual
 - NPS for Renewable Energy Generation
- Key opportunities
 - National environmental standard for noise
 - Repowering as a distinct activity in district plans

Operational Challenges

- Health and safety
- Wind speed
- Maintenance windows
- Market and rules
- Landowner and stakeholder management
- Ensuring compliance with consents
- Changing regulatory environment impacting investment decisions
 - Transmission / distribution pricing

Climate Change

- NZ's gross emissions in 2014 were 81 Mt CO₂-e
 - Agriculture 40 Mt (49%)
 - Energy 32 Mt (40%)
 - IPPU / Waste 9 Mt (11%)
- Energy
 - Transport 14 Mt
 - Electricity generation 5 Mt
 - Manufacturing 5 Mt
- Target is 30% below 2005 by 2030 = savings of around 25 Mt
- Cost without mitigations at \$50/t = \$1,250m

The Opportunity



- Options are to buy or domestic mitigation
 - Mitigation = reduce emissions or LULUCF
 - Improving energy efficiency a given
- NZ's electricity generation opportunity
 - Already 82% renewable
 - Our hydro, wind and geothermal resources are unique
 - Significant capacity to increase renewable generation
- Leverage our renewable opportunities to:
 - Replace thermal fuels used in electricity generation
 - Electrify the light vehicle passenger
 - Replace thermal fuels used to provide industrial heat
- Focus and investment required

Domestic Wind

- Several types
 - horizontal – as per most windfarms
 - Vertical
 - Generally 5 kW or smaller
- Cost around \$10k + per kW
- Difficult in urban areas
 - Wind turbulent, weak and erratic
- Require speed of 4.5m/second
- Tower mounting improves performance
- Best for rural areas with consistent wind speed
- Community wind has possibilities



Wind is Now...

- From a science experiment 25 years ago wind offers an amazing opportunity

