WIND – NEW ZEALAND'S ENERGY

new zealand wind energy association

Wind Energy

Presentation to Energy Centre Summer School

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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

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- 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

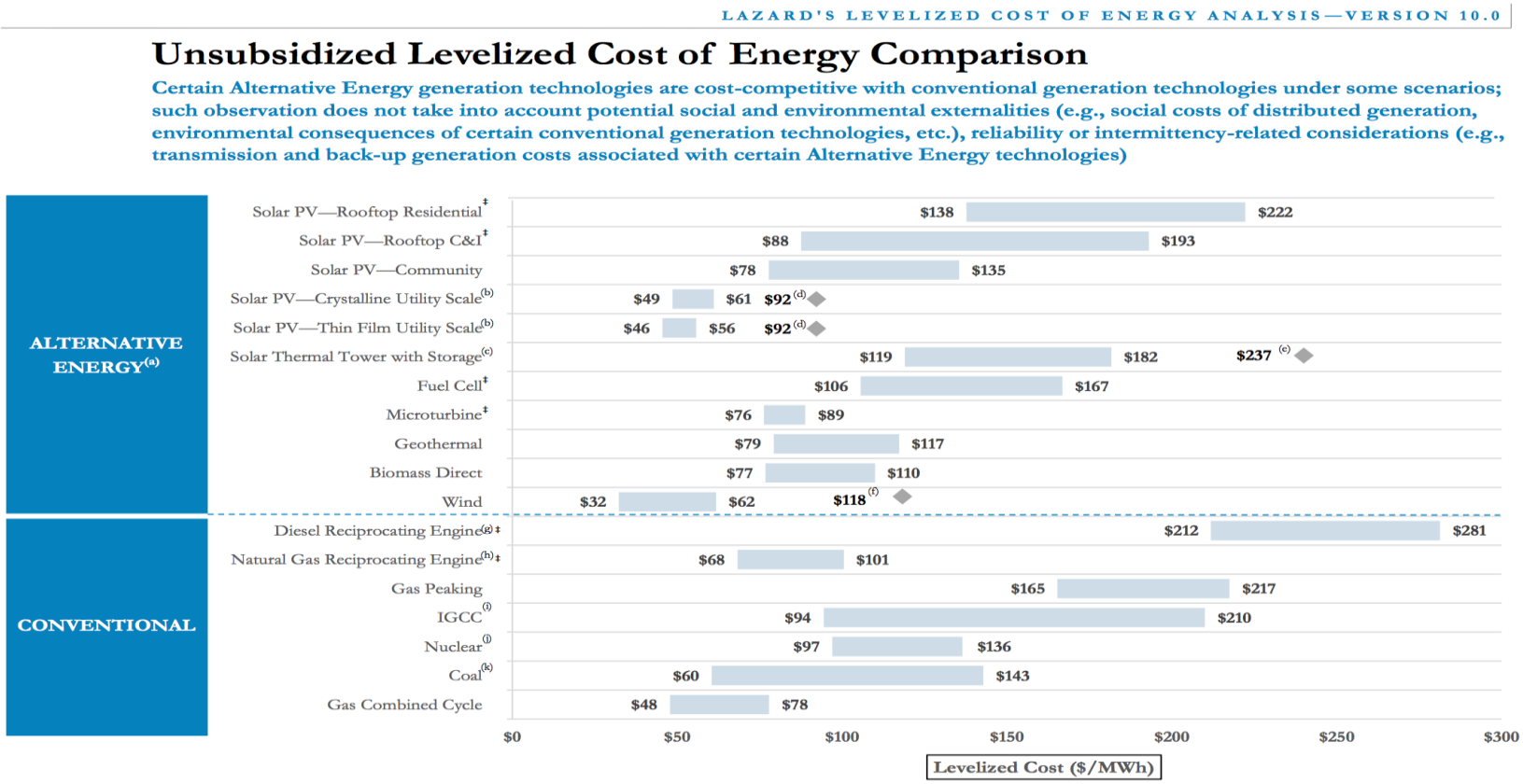
Why Wind?

- Renewable - produces no greenhouse gases

	Tonnes C02-e per GWh
Coal	1,000
Gas	501
Geothermal	125

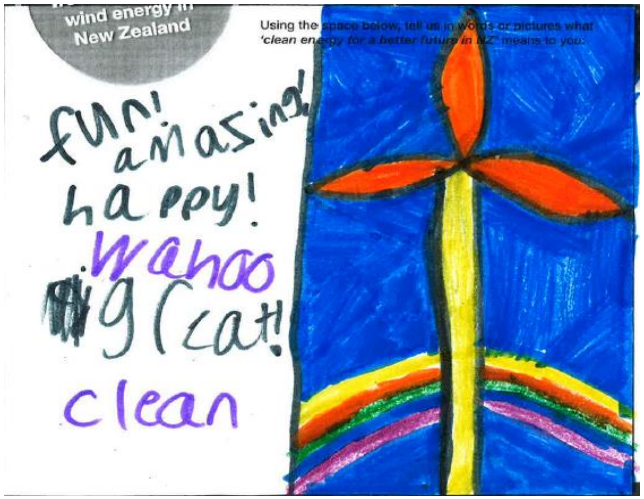
- Low investigation costs
- Cheapest form of new generation and scalable
- Consistent resource
  - Variable but seasonally reliable
  - Spatial diversity smooths output
- Synergies with hydro generation
- Strong public support

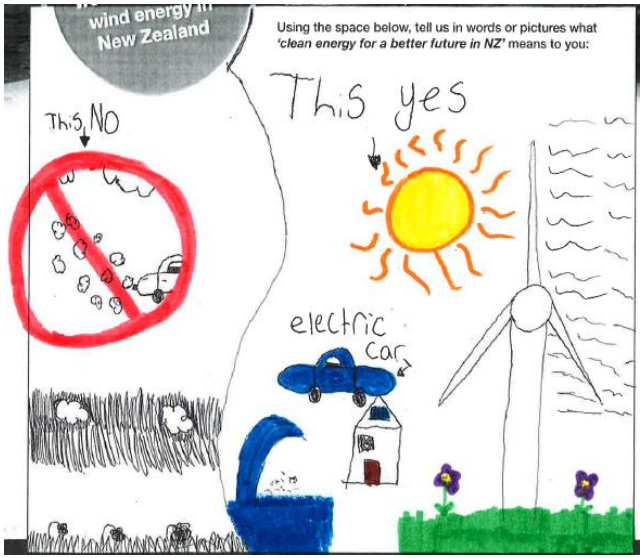
The Cost advantage of Wind



- Next NZ wind farm $60+ MWh
- 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+ is Wind

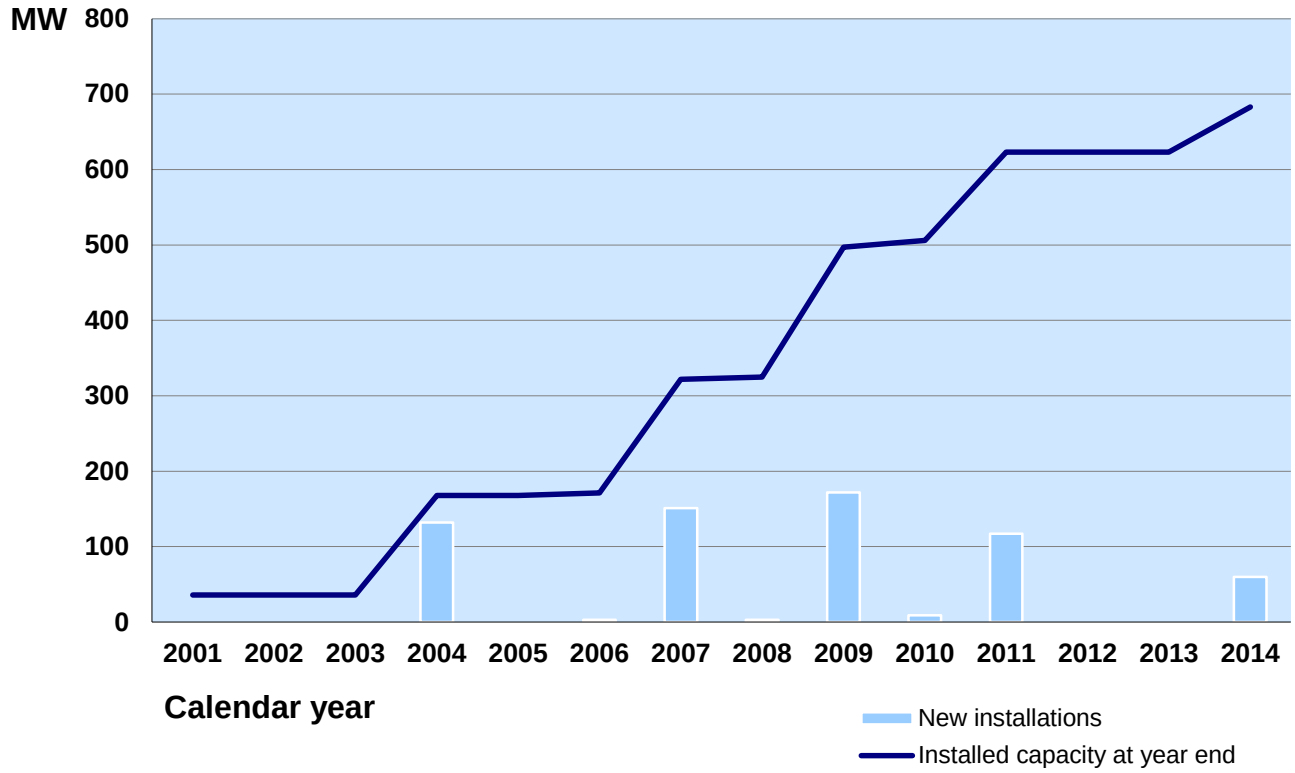
Trends in NZ

- 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
  - 83% in 2017
  - 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
- Around 6% of NZ's annual generation
- 2500MW consented
- Not all will be built

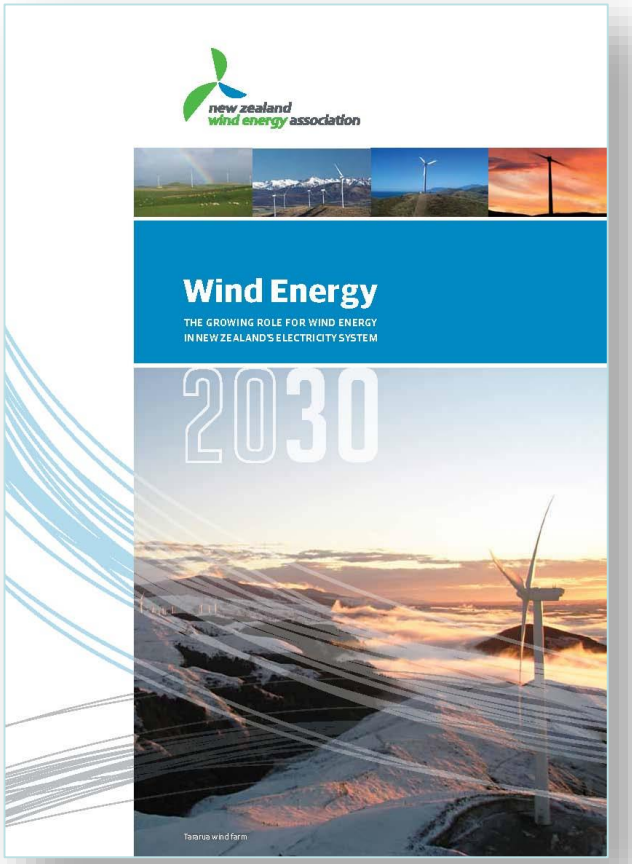
Wind Growth



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

Vision: Wind Energy 20% by 2035

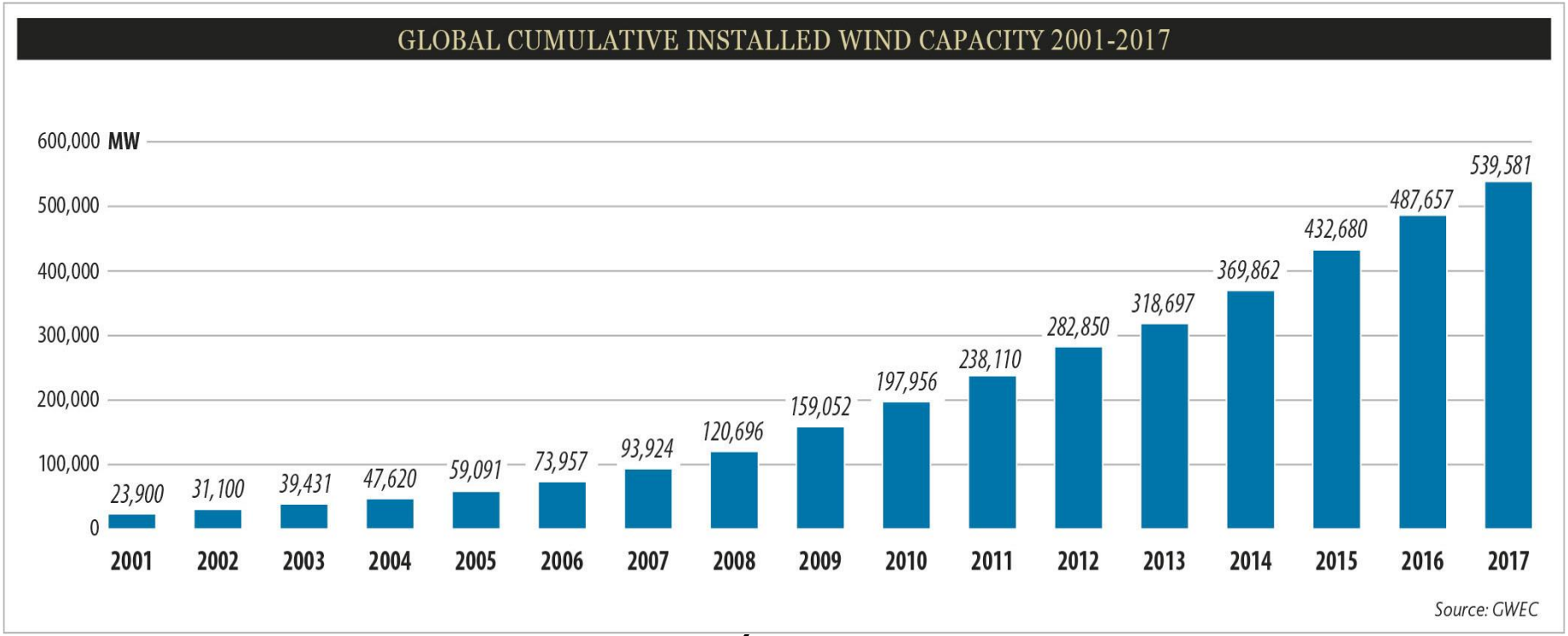
- **690MW now to 3100MW in 2035**
  - Requires 150MW / $300m investment p.a
- **20% wind energy**
  - NZ has excellent sites
  - Fits with the existing electricity system
  - Will deliver economic benefits
  - Wind can replace the majority of NZ's gas – fired baseload generation



International Trends

- The energy transition is gathering momentum
  - 53GW new capacity in 2017
  - Global capacity 540,000 MW
- Key growth markets - China, US and Germany
- 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
- The corporate imperative – renewable ppa's

Spectacular Global Growth

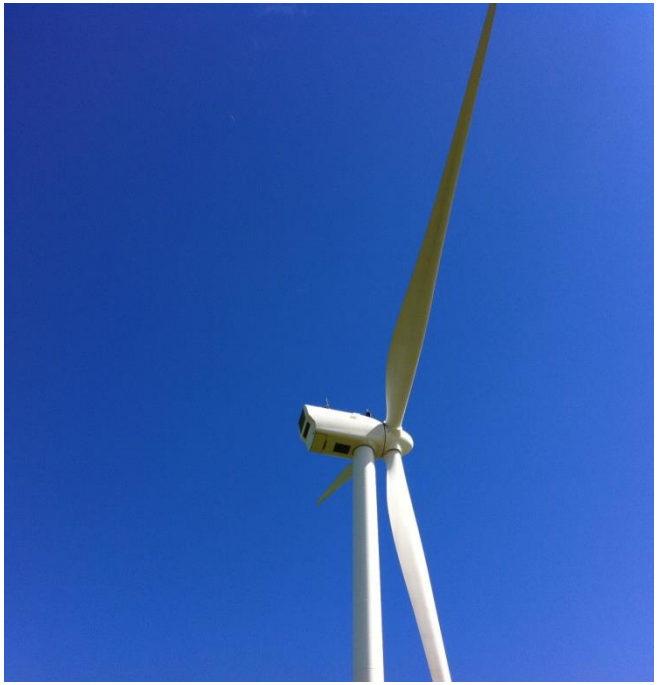


- 540GW = 60X NZ's total installed generation
- Forecast 790 - 880 GW by 2020
- 1,700 - 2,100 GW by 2030

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
$2m/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 and visual
  - National Policy Statement for Renewable Energy Generation
- Key opportunities
  - National environmental standard for noise
  - More directive NPS - REG
  - 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

- Gross emissions in 2015 were 80 Mt C02-e
  - Increase of 24% since 1990
  - Agriculture 38 Mt (48%)
  - Energy 33 Mt (41%)
  - IPPU / Waste 9 Mt (11%)
- Energy
  - Transport 14 Mt
  - Electricity generation 5 Mt
  - Manufacturing 5 Mt
- 30% below 2005 by 2030 = savings of 20+ Mt
- Cost without mitigations at $50/t = $1B +
- Net zero by 2050 ?

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 83% 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