Wind Power: sustainable energy in Nature's frame

Windflow Technology

Geoff Henderson – CEO/Director

Outline

- Windflow Technology
- Wind Energy 101
- The future of wind power in NZ
- Implications for Local Communities
- Two “visions” of wind power: big vs mid-sized

Windflow Technology

- NZAX listed New Zealand company
- design, development & manufacture of utility size wind turbines
- based on experience since 1984 in California and UK
- turbines with over 90% NZ content

MISSION:

to be a global leader in wind turbine technology innovation

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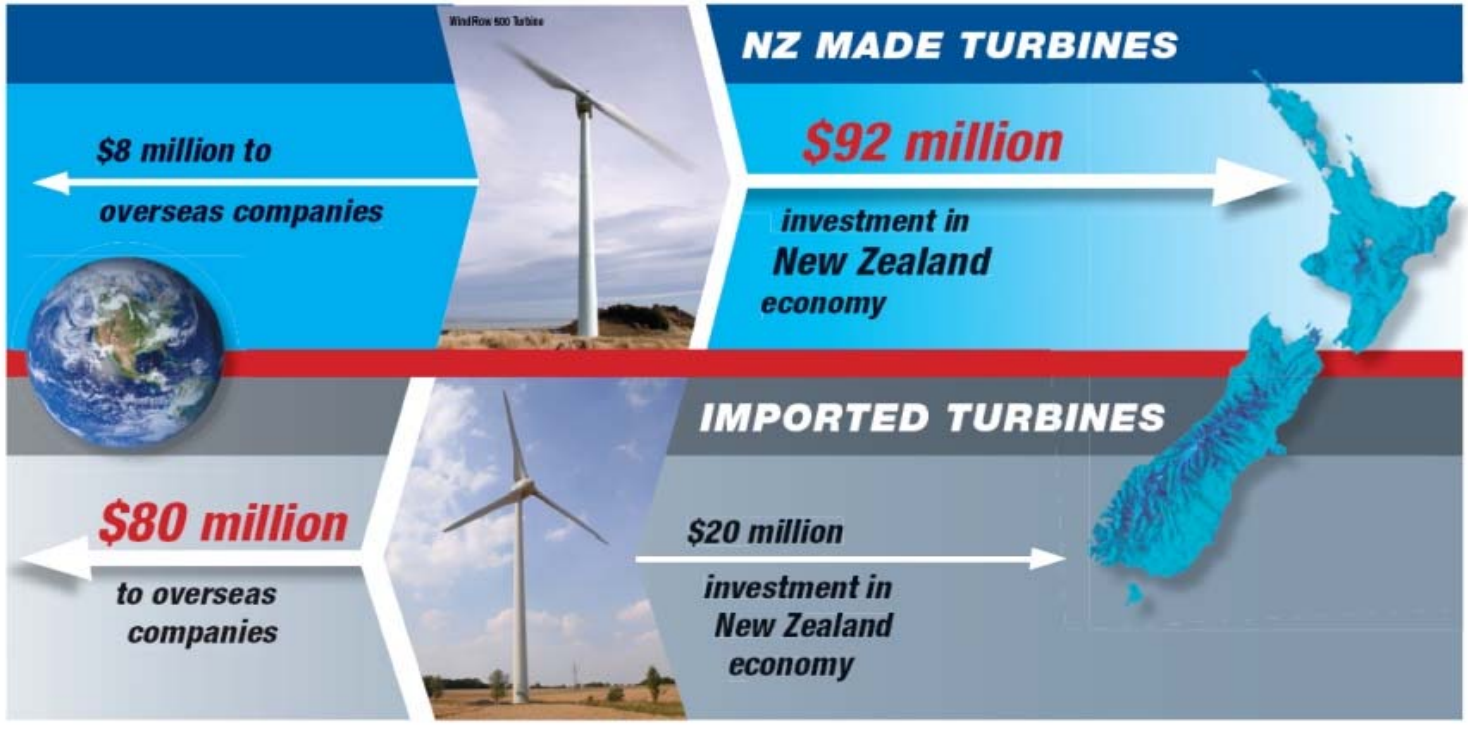
NZ Made vs Imported Turbines

Comparative investment in New Zealand Economy

Based on a $100 million Wind Farm Development



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Windflow Technology Ltd

- 2001
  - Windflow Technology IPO
- 2003
  - Built prototype at Gebbies Pass
  - CCC purchase electricity
- 2004
  - Prototype testing. Resolved issues with noise, software control, destruction testing

Windflow Technology Ltd

- 2005
  - Retrofitted with improved production model
  - Resource consent to build 48.5 MW wind farm
- 2006
  - Manufactured and installed five turbines at Te Rere Hau
  - IEC certification

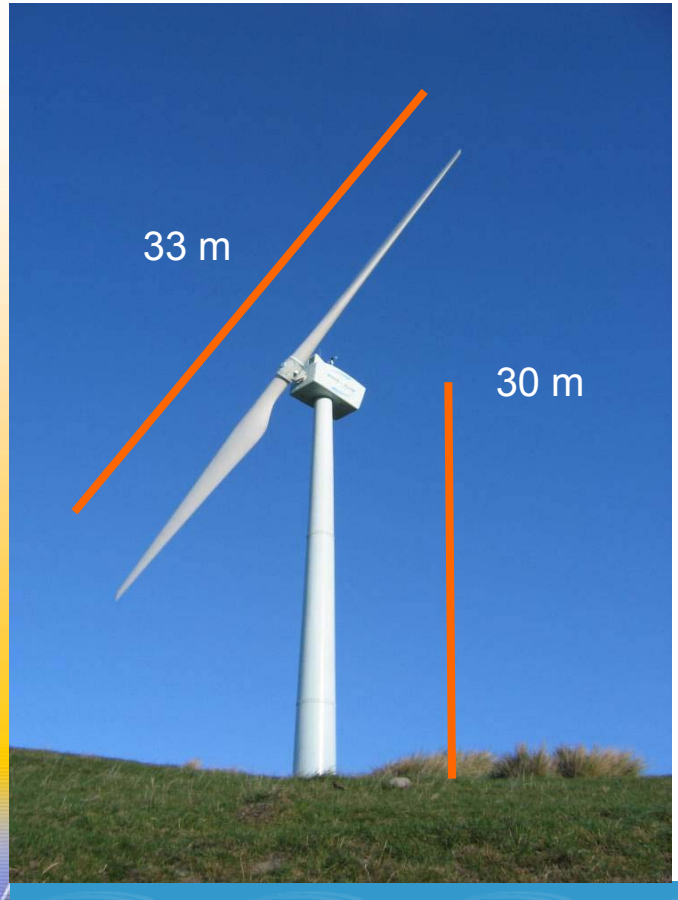
Windflow Technology Ltd

- 2007
  - IEC certification continued
  - Set up new nacelle assembly facilities in Riccarton
  - Staff of approx 30

Windflow Technology Ltd

- 2008
  - IEC certification continued
  - Production of 5 turbines a month
  - Wholly owned subsidy Wind Blades and Joint Venture Wind Gears
  - Staff of approx 50

The Windflow 500



- Provides electricity for approx 200 households (avg NZ site)
- Patented Torque Limiting Gearbox
- 2 bladed teetering rotor
- 500 kW synchronous generator
- Operates in wind speeds from 20 – 110 km/hr

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Designed For NZ:
Geography and Infrastructure

Feature	Technical Benefit	Commercial Benefit
Mid-size	Less visually obtrusive Easy to transport / install	Easier to consent More sites / Low cost
Synchronous, synchronised generator	Grid compliant Better electrically	Easier to connect Lower cost

Designed For:
High Wind Conditions

Lower cost over life of wind farm

Feature	Technical Benefit	Commercial Benefit
2 bladed, pitch-teeter rotor	Rocks in gusts Robust Less weight	Reliable Cost-effective
Torque Limiting Gearbox	Slips in gusts Robust Compact, light	Reliable Cost-effective
20% higher cut-out wind speed	More kWh	More $ revenue

Low visual impact

160 m high - approx 3.6 MW

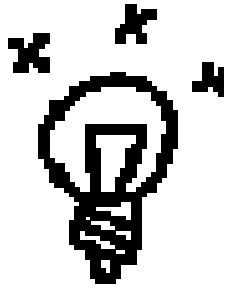
Photo-simulations of the Octagon, Dunedin

47 m high – 0.5 MW

Why Wind Power?

- Business Case is simple and compelling:
  - The input fuel (wind) is free, non polluting and will last forever
  - The output (electricity) is sold into a large & expanding market
  - Electricity prices continue to rise
  - Once built, operational costs are low and largely independent of revenue
  - Good option for NZ
- The New Oil? Or better yet?

Can wind help energy security?



- Distributed generation
  - More smaller wind farms spread throughout the country providing electricity to local networks
- During dry years
  - When wind blows, can hold back water in hydro lakes (storage)

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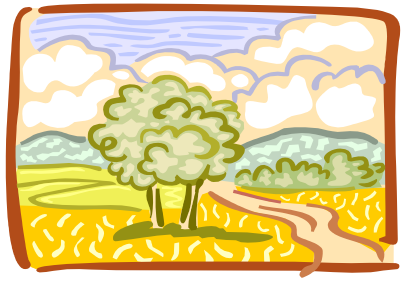
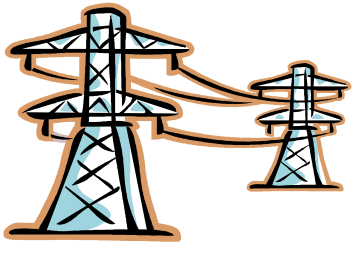
Wind Farming 101

Need four base elements:

Wind



Land



Electricity

Money

Windfarms Need

- Appropriate sites
  - Wind
  - Access
  - Power
  - [illegible] support
  - [illegible]consent

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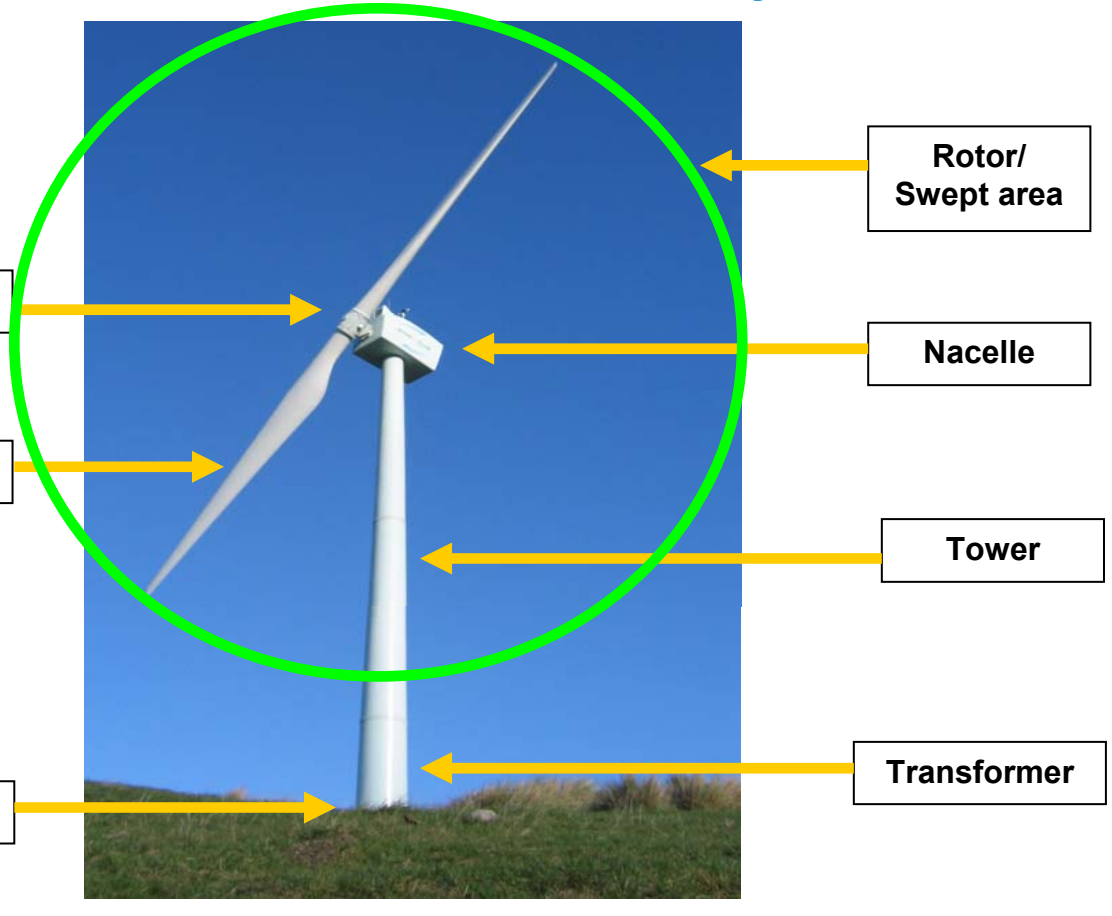
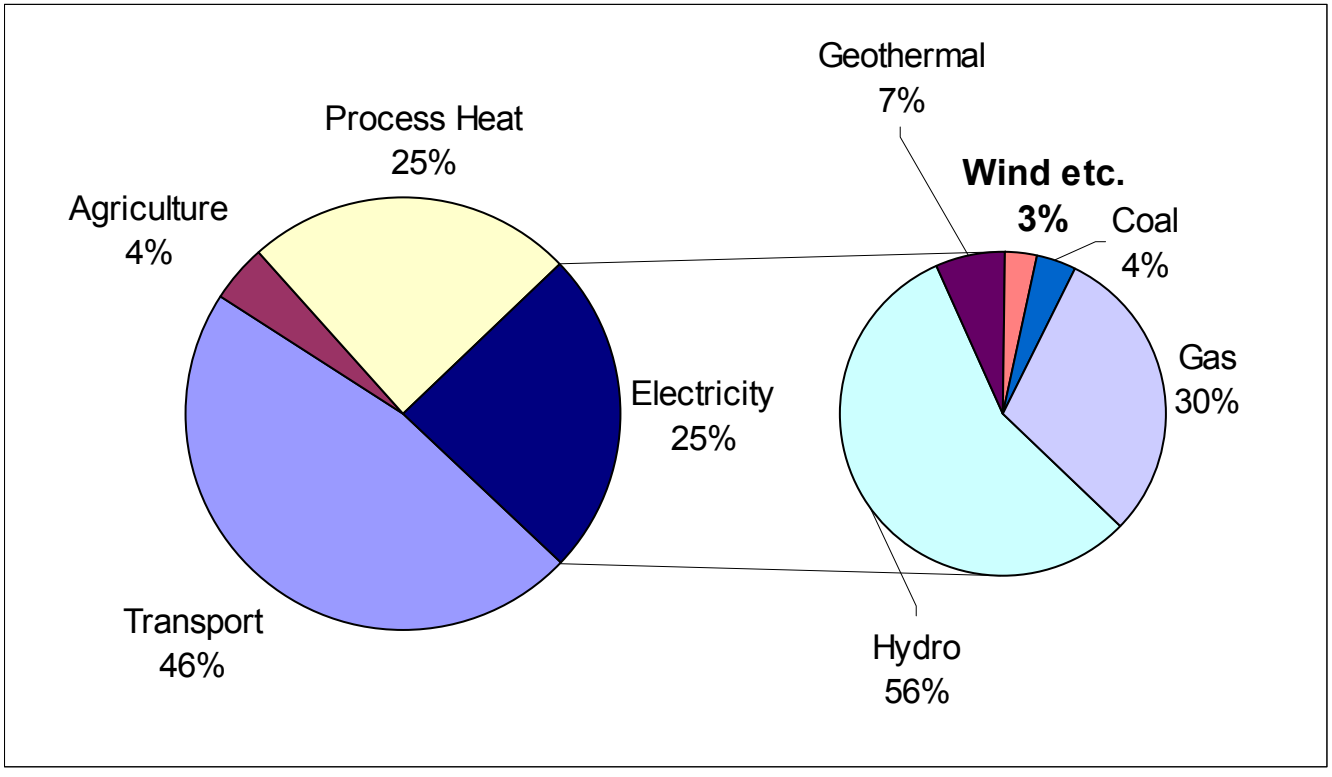
Turbine Anatomy

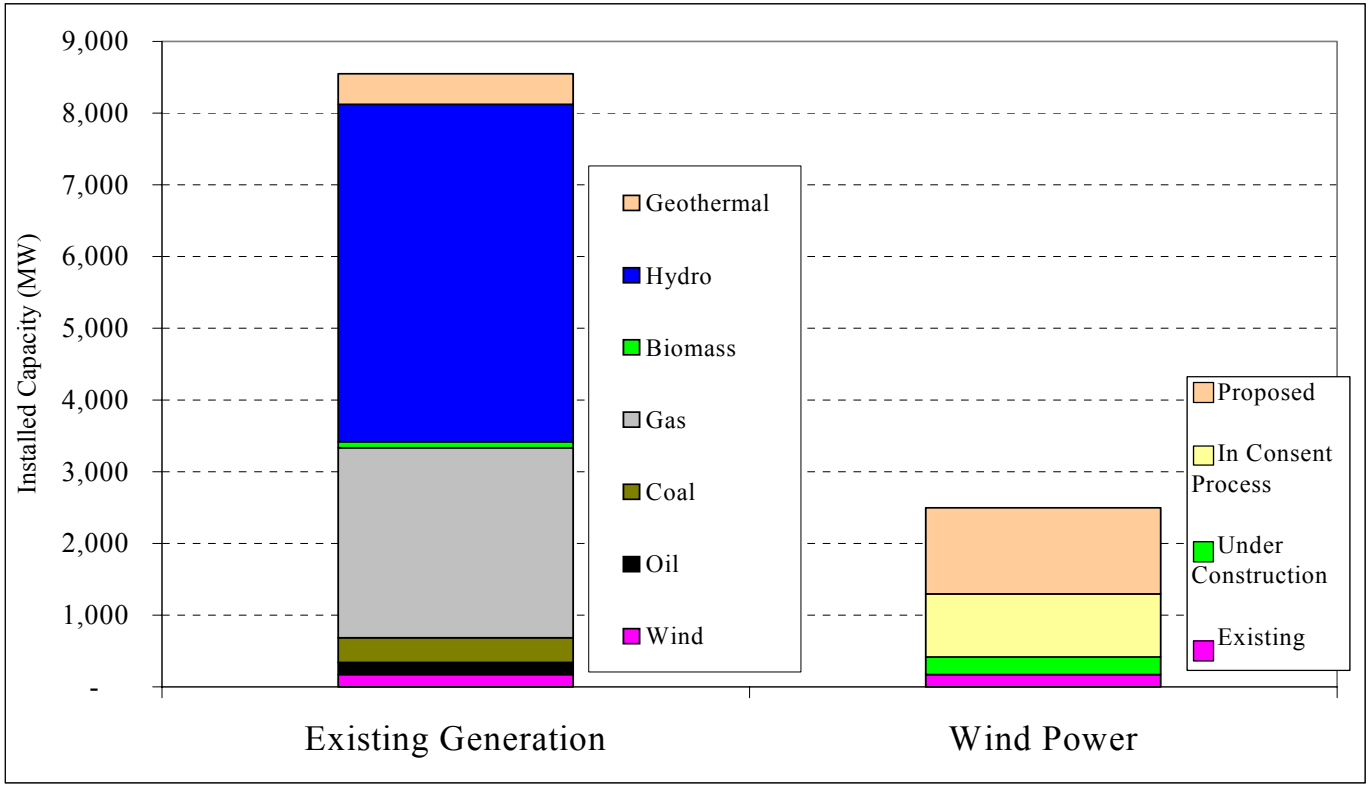


The Future of Wind Power in NZ:

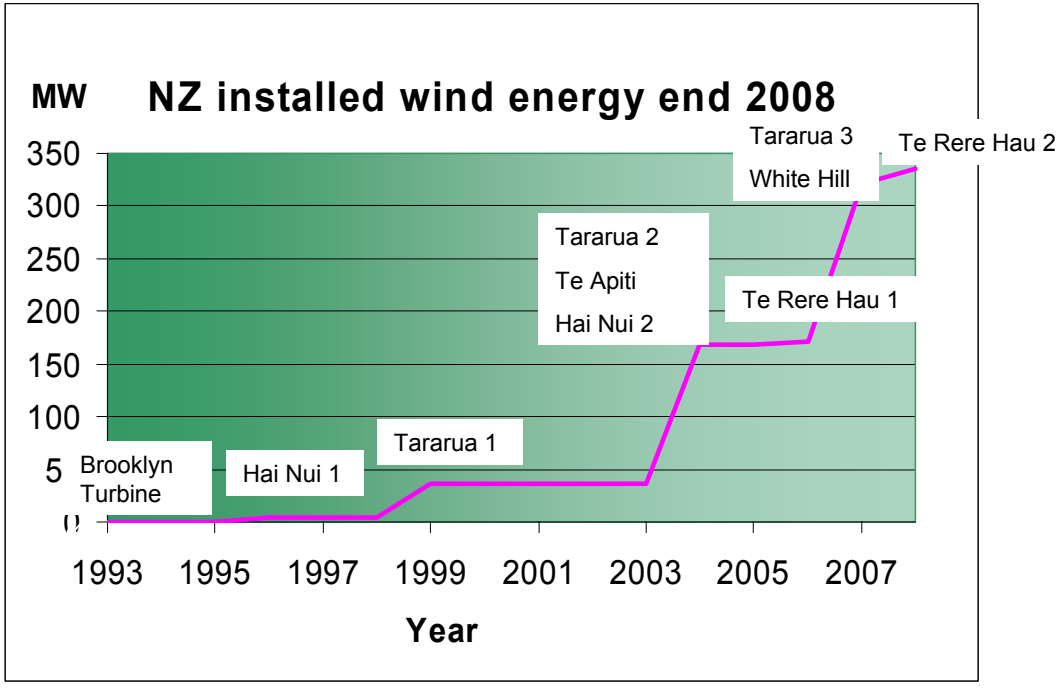
Current NZ energy mix



Growth Industry



NZ Wind Energy Growth



- Currently 322 MW installed in New Zealand
- Additional 2000 MW in consent process

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Wind Farm Locations

Existing, under construction

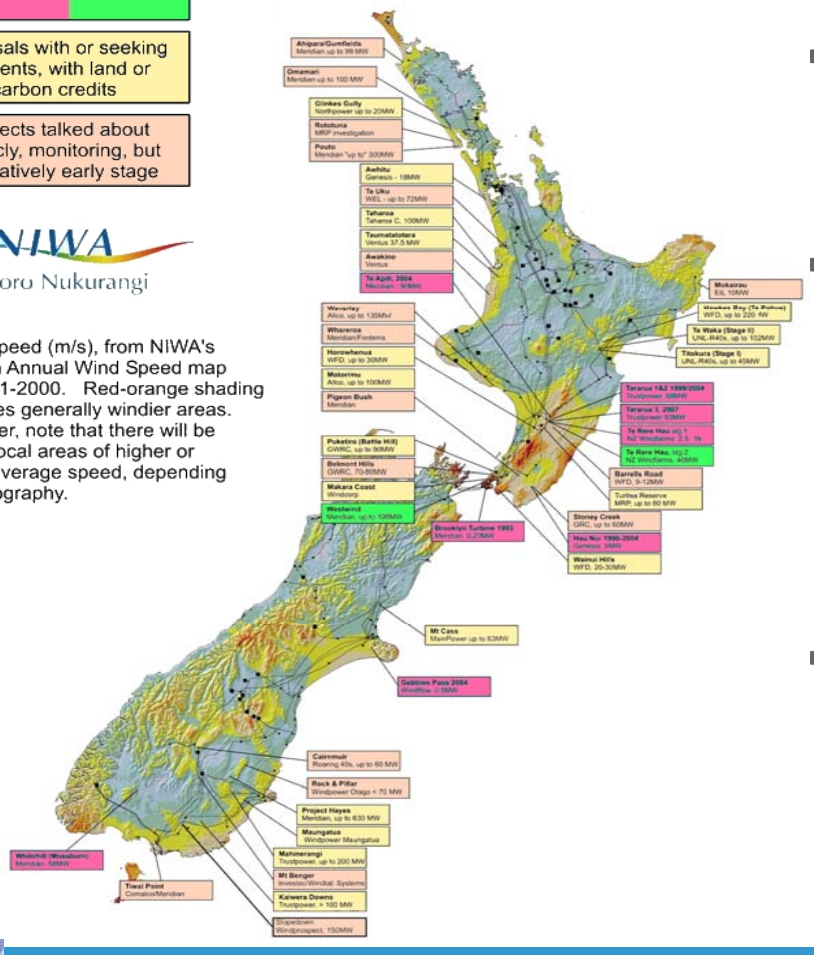
Proposals with or seeking consents, with land or carbon credits

Projects talked about publicly, monitoring, but at relatively early stage

NIWA
Taihoro Nukurangi

8
7
6
5
4
3
2

Wind speed (m/s), from NIWA's Median Annual Wind Speed map for 1971-2000. Red-orange shading indicates generally windier areas. However, note that there will be many local areas of higher or lower average speed, depending on topography.



- Generator/retailers
  - TrustPower, Genesis, Mighty River Power, Meridian, Contact
- Developers/lines companies
  - NZ Windfarms
  - MainPower
  - Ventus
  - Unison/Hydro Tasmania
  - Hawkes Bay Wind Farms
- Councils
  - PNCC, Greater Wellington Regional Council

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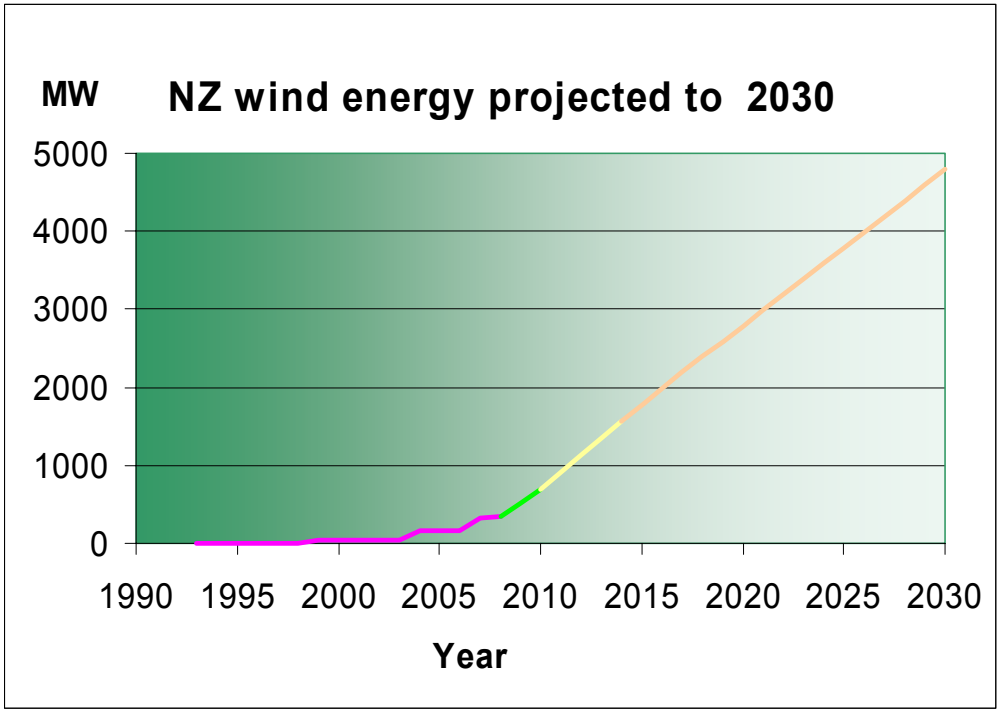
Future NZ Wind Energy Growth



Approximately 200 MW estimated to be installed a year

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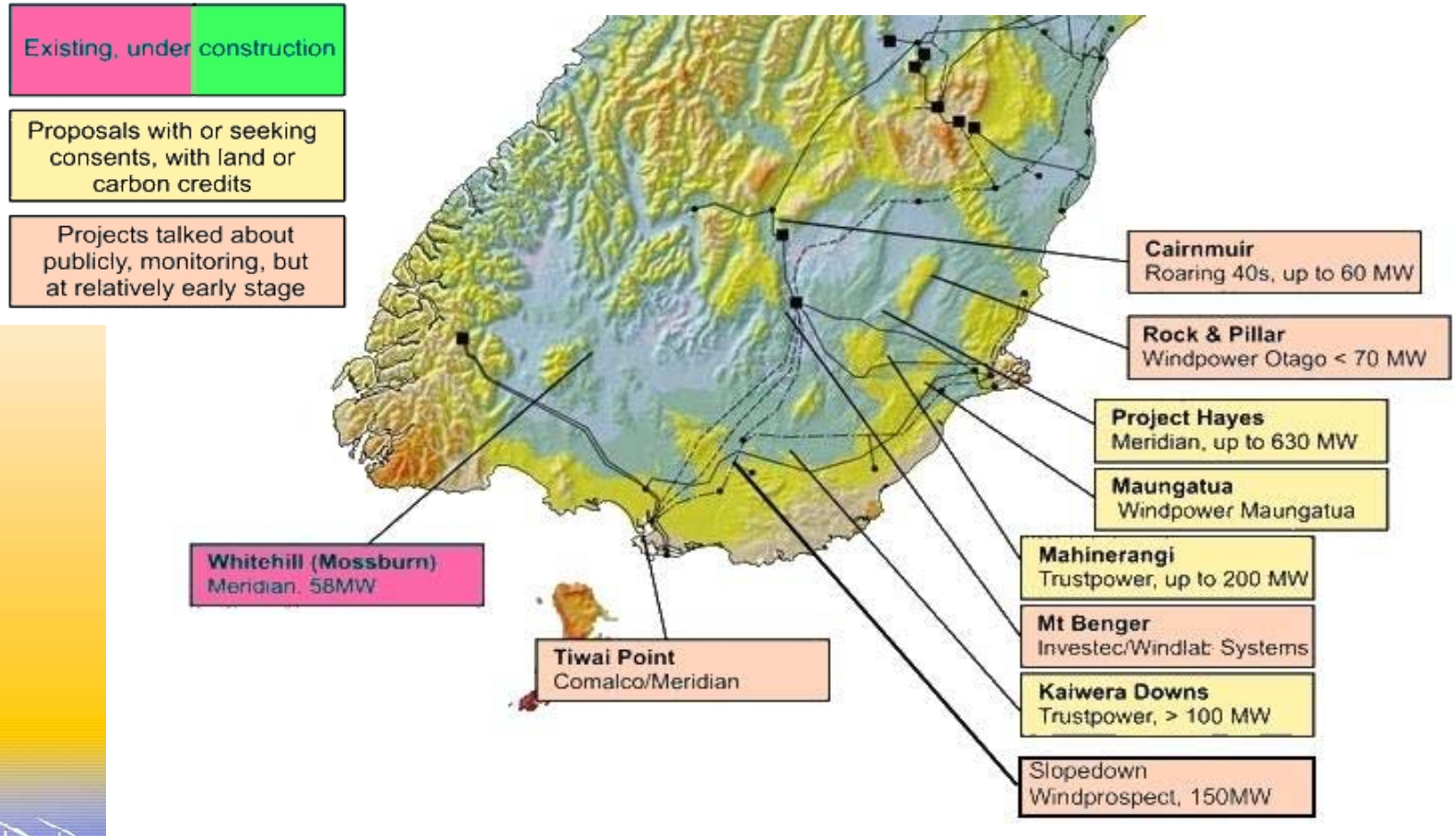
Otago/Southland wind farms



Local Impacts

- Visual
- Noise
- Construction / vehicle movements
- Ecology
  - Birds, land disturbance etc
- Cultural / Archaeological
- Employment / Tourism

Local Impacts

- Visual
  - Significant landscapes debate but inherently subjective:

> *"There are few merrier spectacles than that of many windmills bickering together in a breeze over a woody country, their halting alacrity of movement, their pleasant business of making bread all day with uncouth gesticulations, their air gigantically human, as of a creature half alive, put a spirit of romance into the tame landscape."*
>
> Robert Louis Stevenson

  - Scale images, opinion surveys are the only ways to be objective.

Visual impact to scale

160 m high - approx 3.6 MW

Photo-simulations of the Octagon, Dunedin

47 m high – 0.5 MW

3 times bigger or 9-10 times bigger?

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Within Nature's Frame

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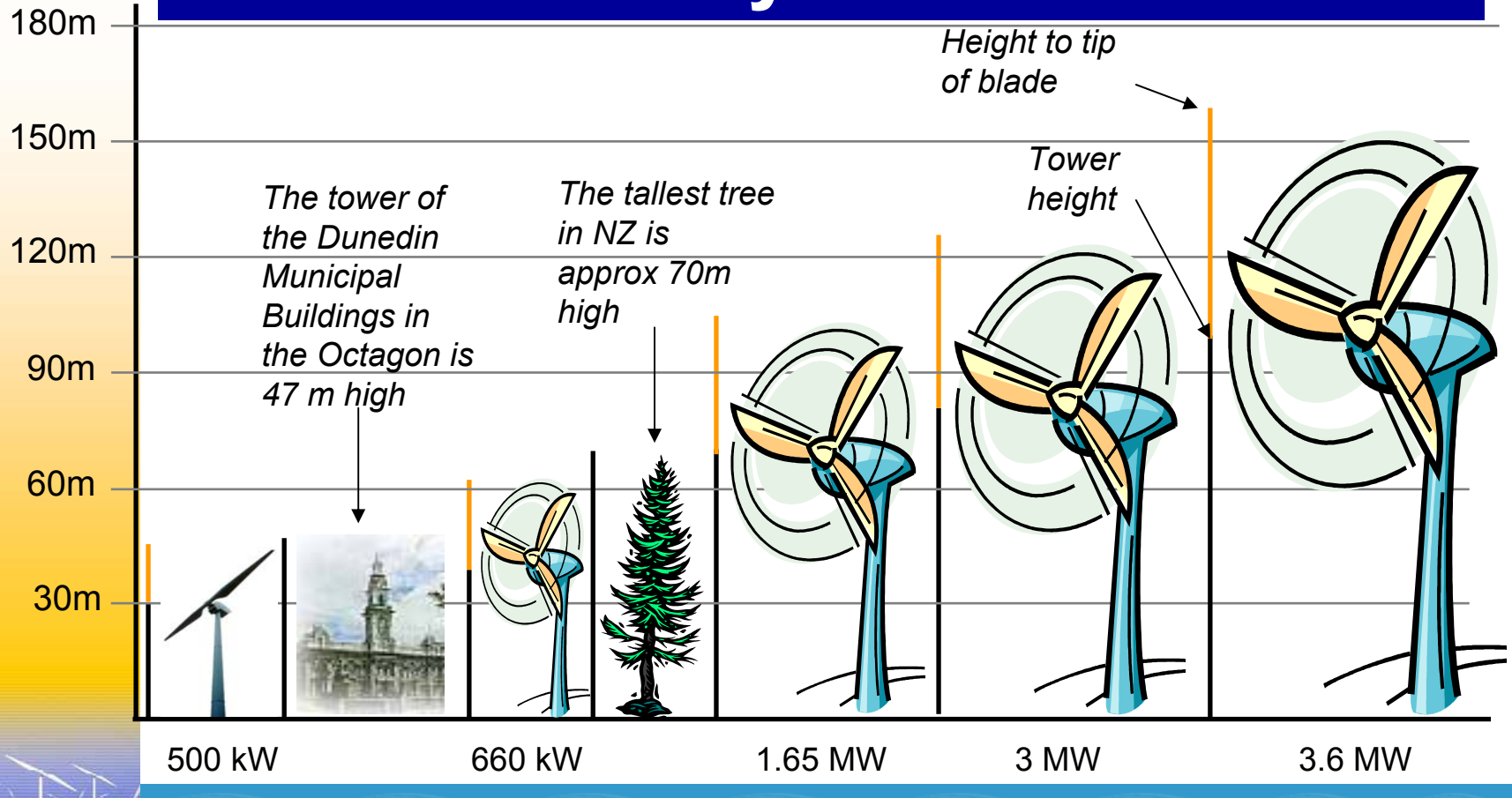
Wind turbines come in a variety of sizes



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Visual Impact to Scale

The R33 wind farm option showing 83 turbines measuring 47m at the highest tip point and 33m rotor diameter.
Photo taken from near Reeces Road corner, Omihi (5km from site) at 8.05am on 16 April 2007.

The R90 wind farm option showing 26 turbines measuring 125m at the highest tip point and 90m rotor diameter.
Photo taken from near Reeces Road corner, Omihi (5km from site) at 8.05am on 16 April 2007.

Local Impacts

- Visual
- Noise
  - Standard (typical 40 dBA limit)
- Construction / vehicle movements

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Transport and Installation

	500 kW	2 MW
Transport	Standard trucks (5/MW)	Oversize truck/trailers, (>5/MW) + pilot vehicles
Closures	None	Possible
Earthworks	1 unit/MW	2 units/MW
Roads	5 m wide	10 m wide
Craneage	Common 80 tonne crane	400 tonne crane

Smaller and Smarter

- Smaller wind farms distributed around the country is a smart idea:
  - Power used locally – security and reduced losses
  - Public opinion will probably favour -> cheaper consents
  - More windy sites close to local lines
  - More competition in electricity market
  - Can be built as needed – increased price stability (as opposed to 'lumpy investment')
- But isn't bigger better?
  - No, it can be more expensive and have larger environmental impacts and affect competition (lumpy investment problem)
  - Square-cube law works against larger turbines

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What's a Square-Cube Law?

Several in energy-related science:

- 19th Century Steamships
  - Output (payload and also range due to coal capacity) goes with cube of waterline length
  - Input (propulsive energy per km) goes with square
- Wind turbine design
  - Output (electrical energy) goes with square of diameter
  - Input (weight-related costs) goes with cube
- Ice melting (cf climate change)
  - Inertia (resistance to melting) goes with cube of length
  - Input (heat transfer) goes with square

Definition of Energy Efficiency

- Efficiency = output/input
- To be more precise:

  what you get out **that you want**
  what you put in **that you pay for**

- Therefore the effect of a square-cube law changes depending on whether the cube part is an input or output
- In wind power, the weight-related costs of energy go with cube

Two visions

Big turbines and big wind farms

- Project Hayes – 630 MW, 160 m tall
- Mahinerangi – 200 MW, 145 m tall

Mid-size turbines and small wind farms

- WindPower Maungatua proposal – max 25 MW, 47 m tall

www.wmltd.co.nz

Summary

- Wind power has a BIG future in New Zealand but …
- BIGGER is not better
- Most years wind power will be 100% of new generation
- Various impacts on local communities
- Good option for NZ ….
- especially when done the Windflow way ☺

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