# Smaller and Smarter Wind Energy

## Windflow Technology

Geoff Henderson – CEO/Director

*A global leader in wind turbine technology innovation*

# Overview

- Introduction
- Smaller and smarter
  - Economic
  - Social
  - Environment
- Conclusion

# Windflow Technology

- NZAX listed New Zealand company
- Design, development & manufacture of utility size wind turbines
- Based on experience since 1984 in California and UK




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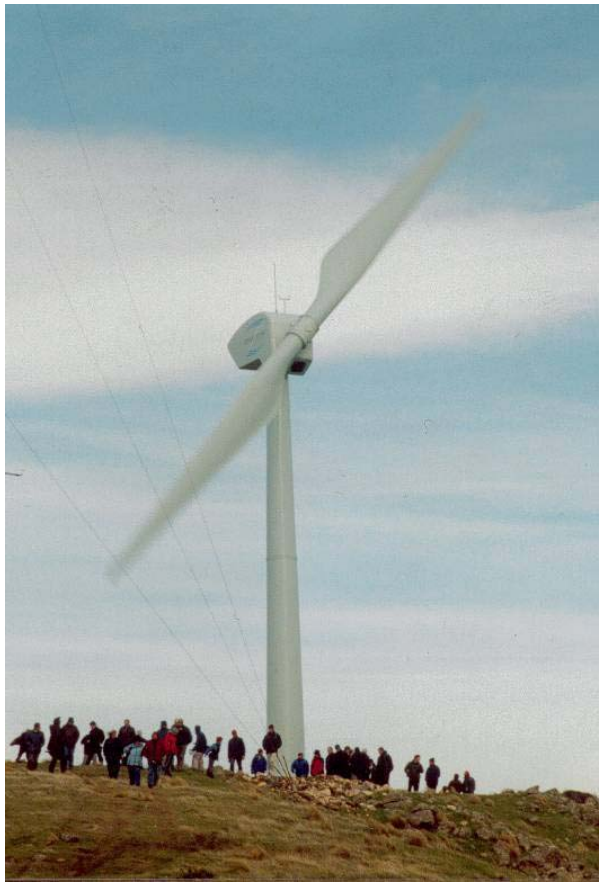
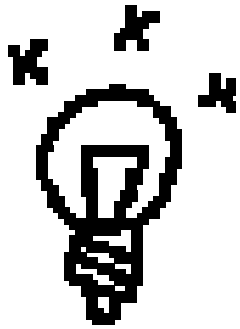
# The Windflow 500

- 30 metre to hub (47 m to tip)
- 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
- Turbines with over 90% NZ content



# 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)

# Electricity Security

Don't believe the propaganda – the reality is:

- wind enhances dry-year security
  - more reliable on a monthly or annual basis
  - "firm capacity" argument irrelevant in dry year
- wind speeds predictable day-ahead
- wind farms provide smooth output
- hydro provides short-term storage
- extra hydro capacity a cheap option 10 years hence

# Cost of Electricity (cont'd)

Don't believe the propaganda – the reality is:

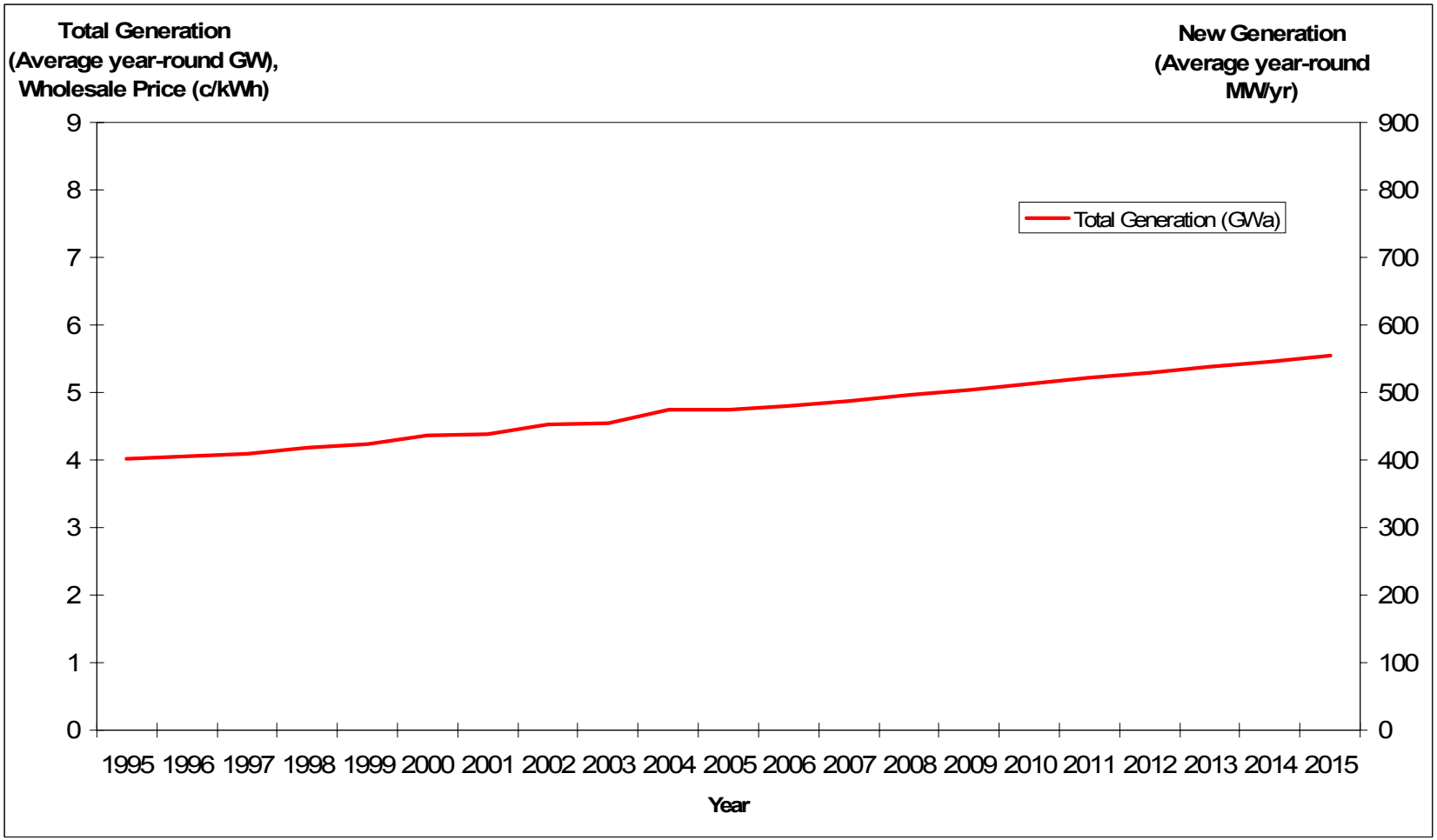
- no shortage of 10 m/s sites in NZ - prospecting to date "scratching the surface"
- large 3-bladed turbines are fundamentally more expensive (if Newton's Laws and the square-cube law said otherwise, WTL would build large 3-bladers)
- talk of 40% price rises is either sheer ignorance or oligopolistic behaviour (i.e. market failure)

# Smaller and Smarter

- Smaller wind farms distributed around the country is a smart idea:
  - Power used locally – security and less losses
  - Public opinion will probably favour -> cheaper consents
  - More windy sites close to local lines
  - Lines companies reduce peaks and thus avoid transmission charges
  - 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's more expensive and can kill competition because of the lumpy investment problem

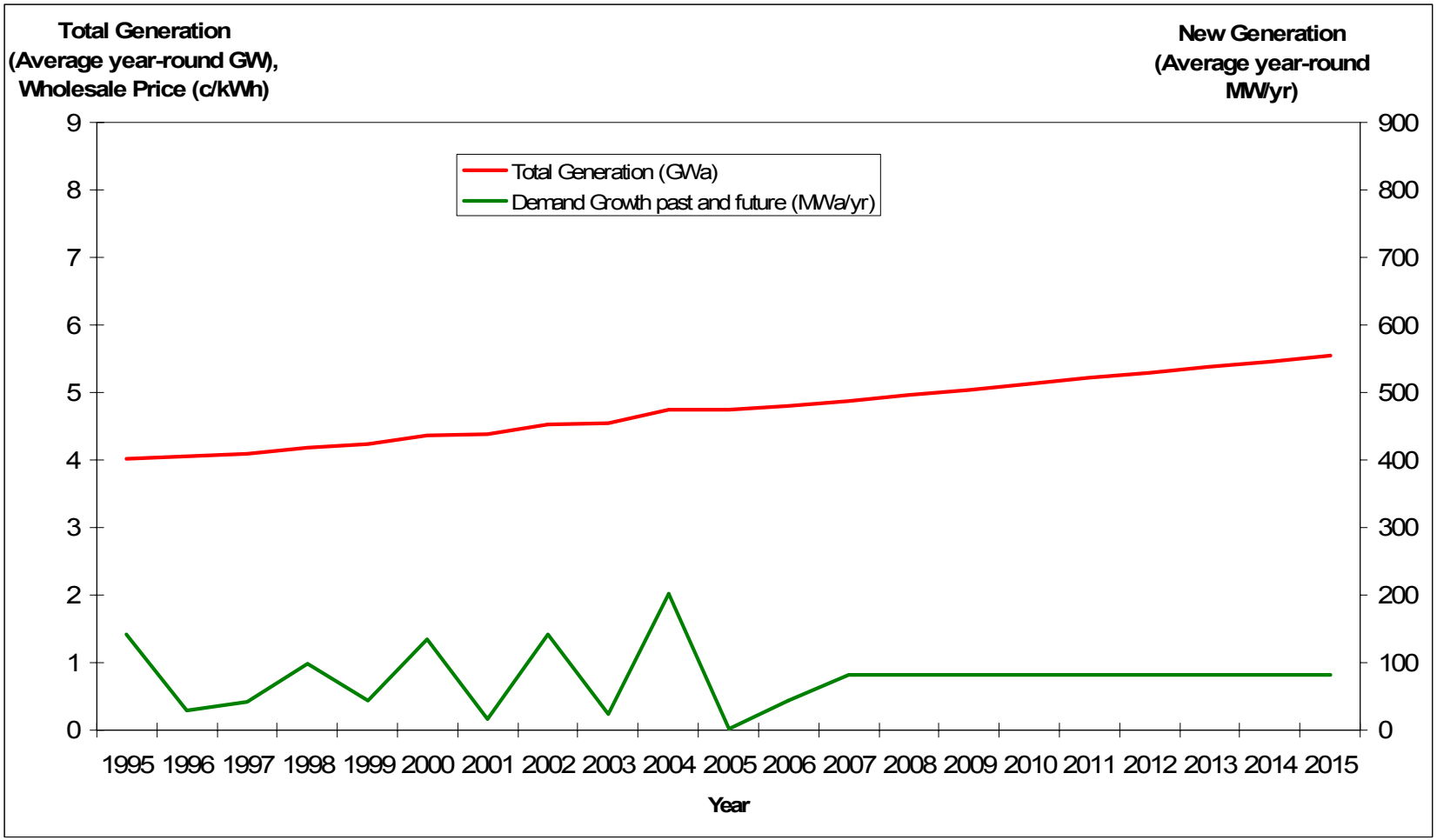
# Economic Effect of Lumpy Investments

Total NZ generation in yearly average GW, included expected future growth



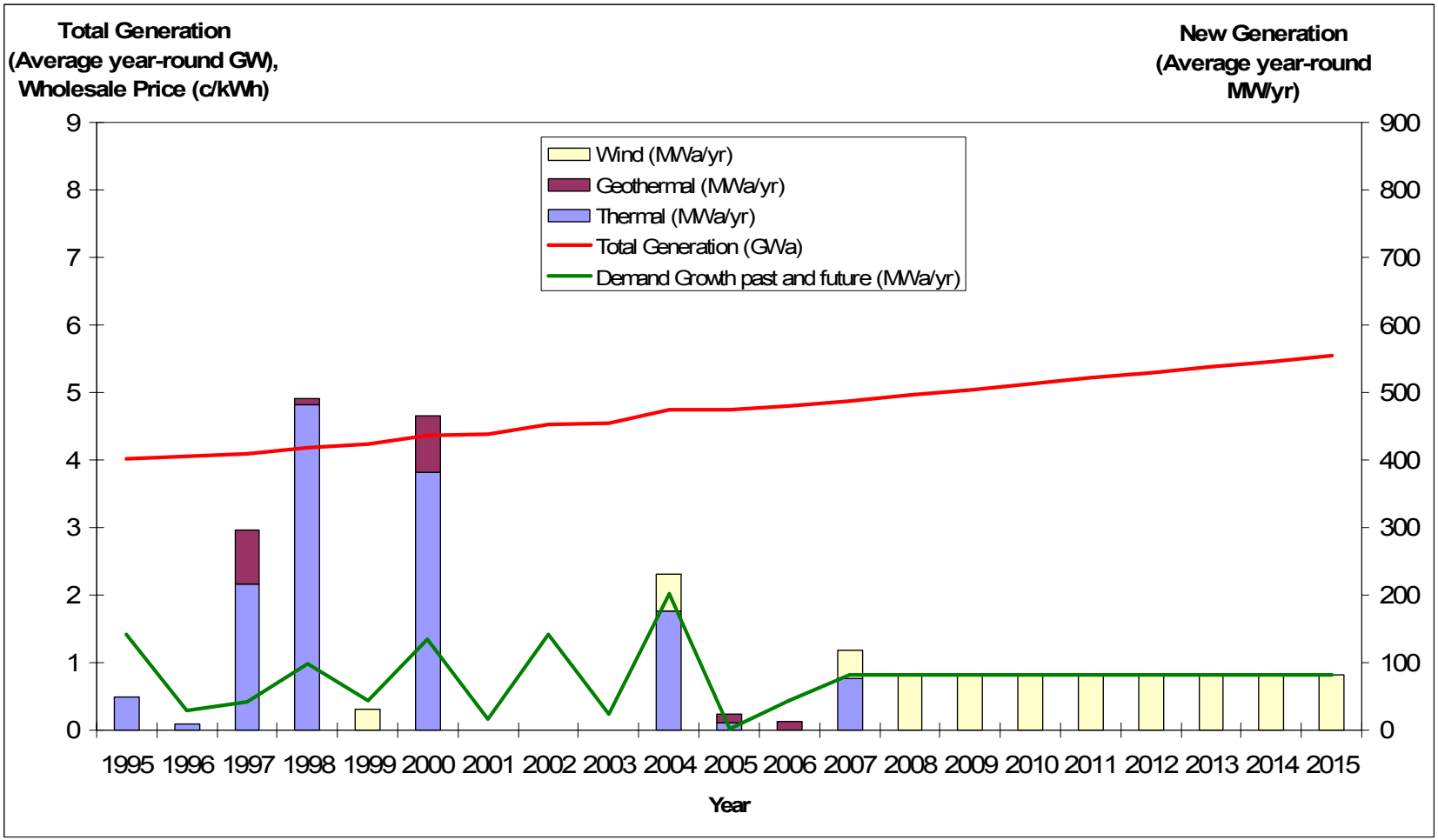
# Economic Effect of Lumpy Investments

Demand growth in the past and expected in the future in MWa/yr



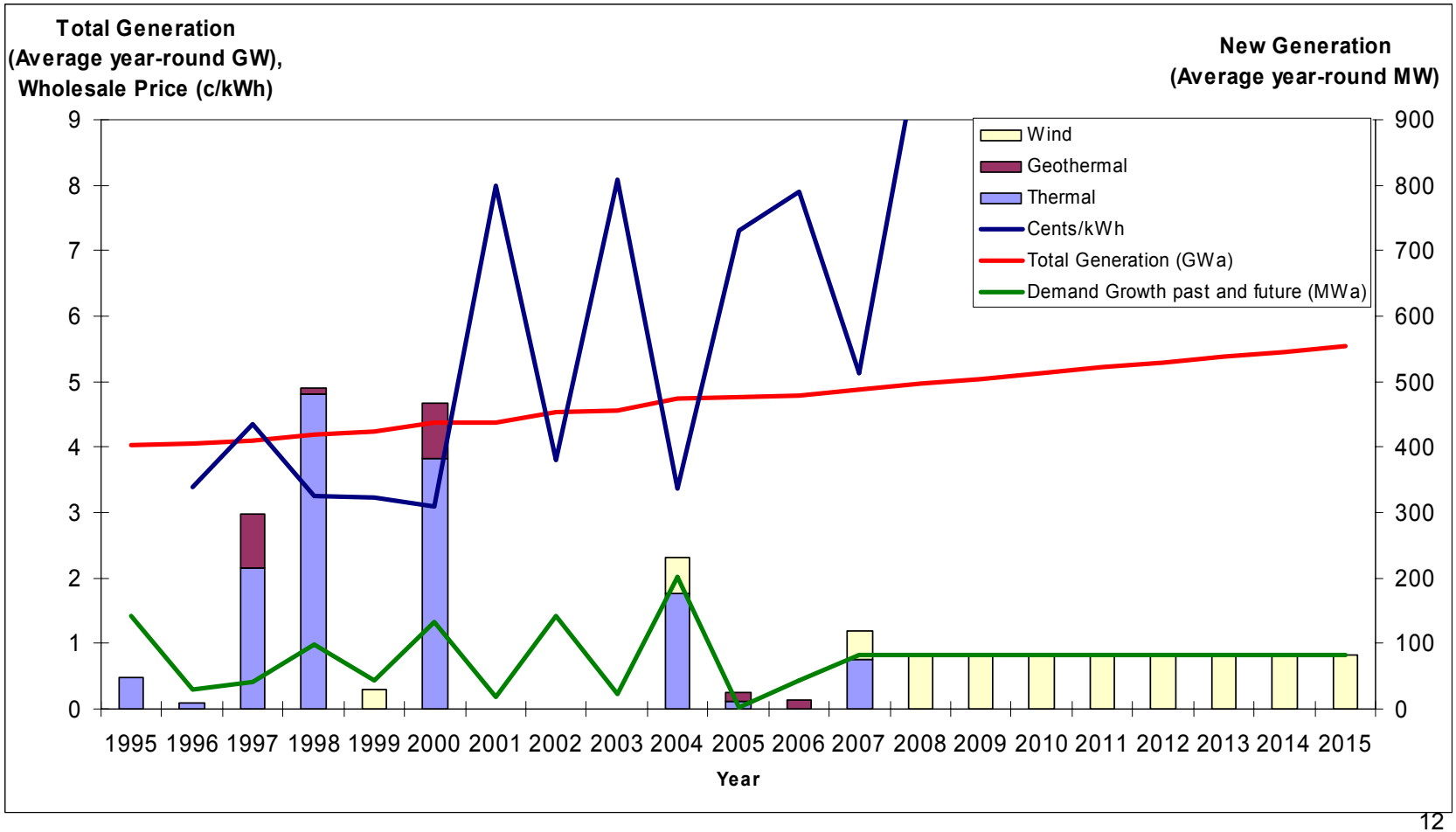
# Economic Effect of Lumpy Investments

New generation past (and future?) divided into thermal, geothermal and wind



# Economic Effect of Lumpy Investments

Wholesale electricity price in cents/kWh, average of whole country



# Economic
# Lumpy investment

- Wind solves lumpy investment problem
  - 30 MW wind farm increments suit NZ market size and competitive model
  - 400 MW thermal, hydro or wind (!) increments don't
- 200 MW/yr wind power at 40-50%CF would meet demand growth (about 80-100 MWa/yr)
- Windflow factory in Riccarton can supply 50%
- 8 projects/yr = healthy competition
- 3-5000 MW wind target easily achievable (cf Denmark or California with 10 times population density and half the wind)

# The Competition Argument: Why and Where?

- Economic Efficiency - competition:
  - lowers prices to consumers
  - minimises infrastructure gigadollar costs
  - politicians don't pick winners (sink big)
- Generation most logical sector:
  - T&D are natural monopolies
  - Retail okay but low macro-economic value
- Therefore "competition" = competition to build new generation
- By this logic the NZ system has failed!

# The Competition Argument: How?

- Structural changes to favour competition:
  - Ensure lines companies can be generators and retailers
  - If not, or possibly in addition, separate generators and retailers (otherwise WEM is a farce)
  - Ensure market for long-term hedge contracts is substantial
  - Consider regulating the large hydro players to put a floor on prices (or accelerate DSM measures/smart metering to mop up excess supply in wet years – what future EV's?)
  - Rational carbon pricing would be good (now please!)
  - Line companies should follow Orion in stimulating DG & DSM

# The Competition Argument: How?

- Transmission Pricing:
  - Existing system is inconsistent and illogical
  - If SI generators should pay for Cook Strait cable, what should NI generators pay for?
  - If lines companies should pay for rest of core grid, how does that stimulate rational generation decisions, DG and DSM?
  - If advocates can construct an economic efficiency argument in favour or any arrangement, how to choose, and why change from BAU?
  - Answer to these conundrums - since any solution will have theoretical flaws, err in favour of competition: generators should pay for the whole core grid based on MWh-km.

# Economic - smaller and smarter turbines

- Windflow 500 smarter than other turbines
  - Lower weight = lower cost overall
  - Capital cost:

| | |
|---|---|
| Windflow 500 | ~$2000/kW installed |
| Other turbines | ~$2500 - $3500/kW installed* |

- Larger projects/large turbines can be more expensive
  - Logistics, cranes, road/bridge upgrades, etc

* Expected costs across range of project sizes – Connell Wagner – Transmission to Enable Renewables Report – March 2008

# Environmental

- Designed for New Zealand conditions
- Lower impact

| Feature | Technical Benefit | Commercial Benefit |
|---|---|---|
| Medium size | Less visually obtrusive<br>Lower environmental impact<br>Easy to transport / install | Easier to consent<br>More sites / Low cost |
| Synchronous, synchronised generator | Grid compliant<br>Better electrically | Easier to connect<br>Lower cost |

# Environmental - Visual impact


160 m high - approx 3.6 MW

Photo-simulations of the Octagon, Dunedin


47 m high – 0.5 MW

# Environmental - Visual impact vertical 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.

# Environmental - 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 |

# Social

- Lines companies own wind farms
  = consumers own through Trust
- Distributed Generation
  = energy security
- Windflow 500
  = local and national jobs
- Local companies more likely to be used
- Less disruption during construction

# Conclusion

- Smaller is smarter for New Zealand
- c/kWh and reliability drivers
- Smaller turbines can be more cost – effective (include as consent option!)
- Smaller projects may be more acceptable and viable on local distribution networks
- Policy changes needed to encourage competition from non-retailer generators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