The New Zealand Experience

78% Renewables and Increasing

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New Zealand

Africa Clean Energy Corridor - Executive Strategy Workshop
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New Zealand – recognised for…

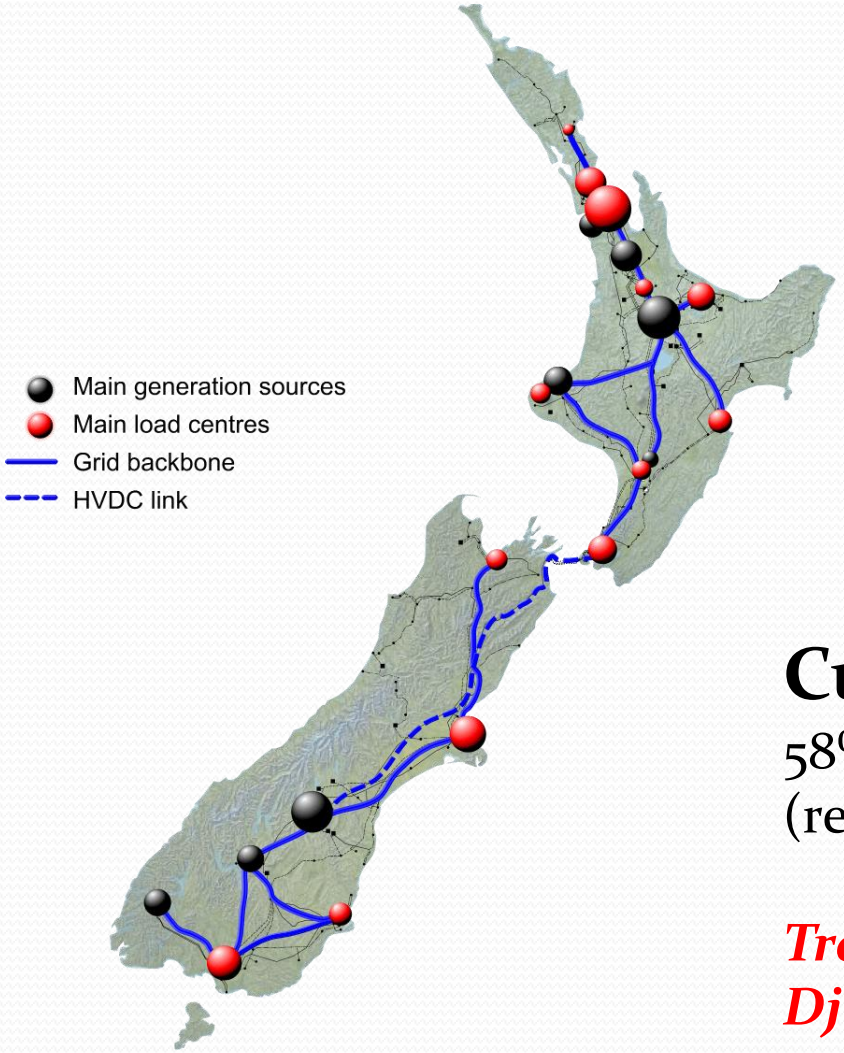
4.2m

31m

3

2

New Zealand's Generation Sources



- Isolated Island System
- Two AC island power systems
- **700 MW** HVDC link
- Peak Demand, **7040 MW**
- Installed Generation, **9751 MW**
- Total Energy, **43,138 GWh**

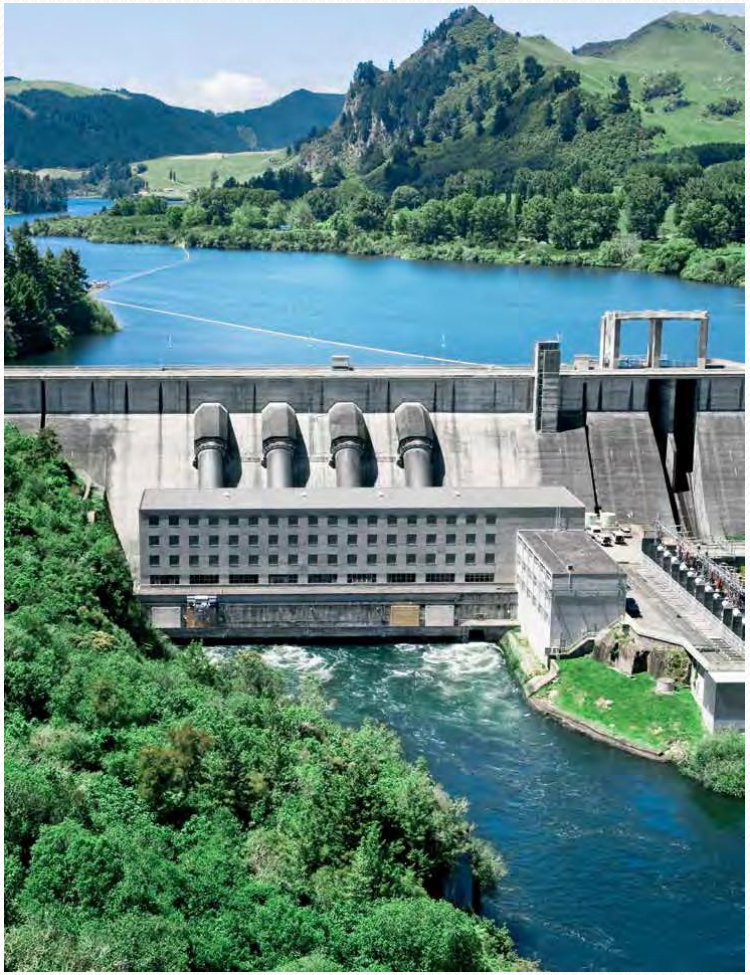
Currently 78% renewable:

58% hydro, 15% geothermal, 5% wind
(remainder gas and very limited coal)

Transmission over 1,400 km – similar to Djibouti to Tanzania

Hydro Electricity – 6,000 MW

- Basis of system
- Main supply in South Island
- Considerable operational history
- Limited storage
- Limited future development



Geothermal – 1,000 MW

more than 55 year's of operational history

Excellent base load – weather independent

140 MW – largest single geothermal unit in world – installed 2010

82 MW binary plant being commissioned

Wind – 620 MW

10 year's operational history

17 wind farms

623 MW generating capacity

60 MW under construction

4.5% of NZ's annual generation

1600MW + consented

Wind - helping to stabilise the network

Reactive power

Frequency keeping and voltage support

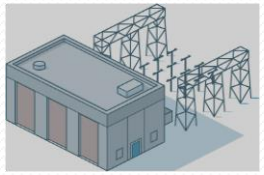
Fault ride through

Spinning reserve

Power Companies

Company	GWh to 30 June 2010	Operating Revenue $B 2009/10	Ownership
Contact Energy	10,183	2.16	Listed
Genesis Power	3,535	1.48	SOE
Meridian Energy	13,000	2.06	SOE
Mighty River Power	5,812	1.06	MOM from May 2013
Trust Power	4,033	0.77	Listed

The Wholesale Market Model



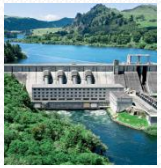
Grid assets

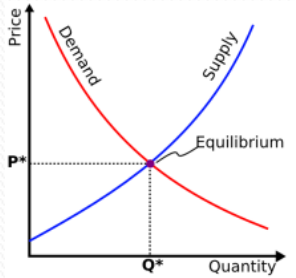
Demand forecast and purchaser bids

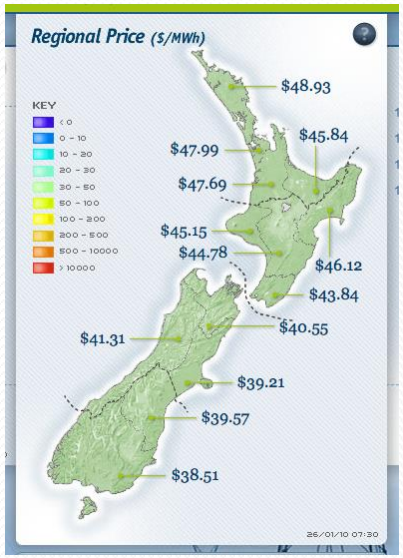
Security constraints (eg N-1)

Generation offers

Economic scheduling model
Optimal use of all assets based on bids and offers







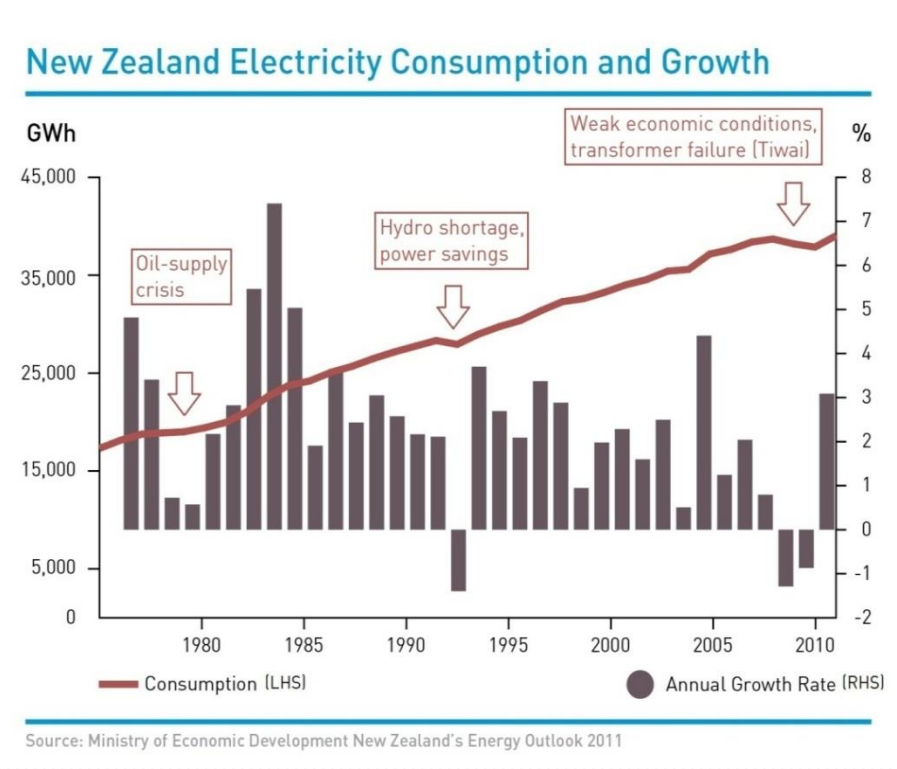
Bid based, security constrained

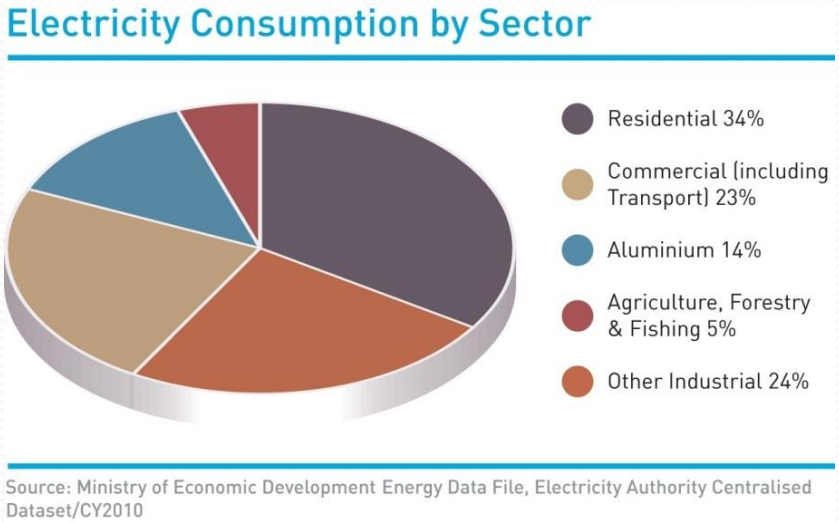
Economic dispatch
Co-optimised reserves
Demand response

Locational marginal prices

Market Dynamics – Demand

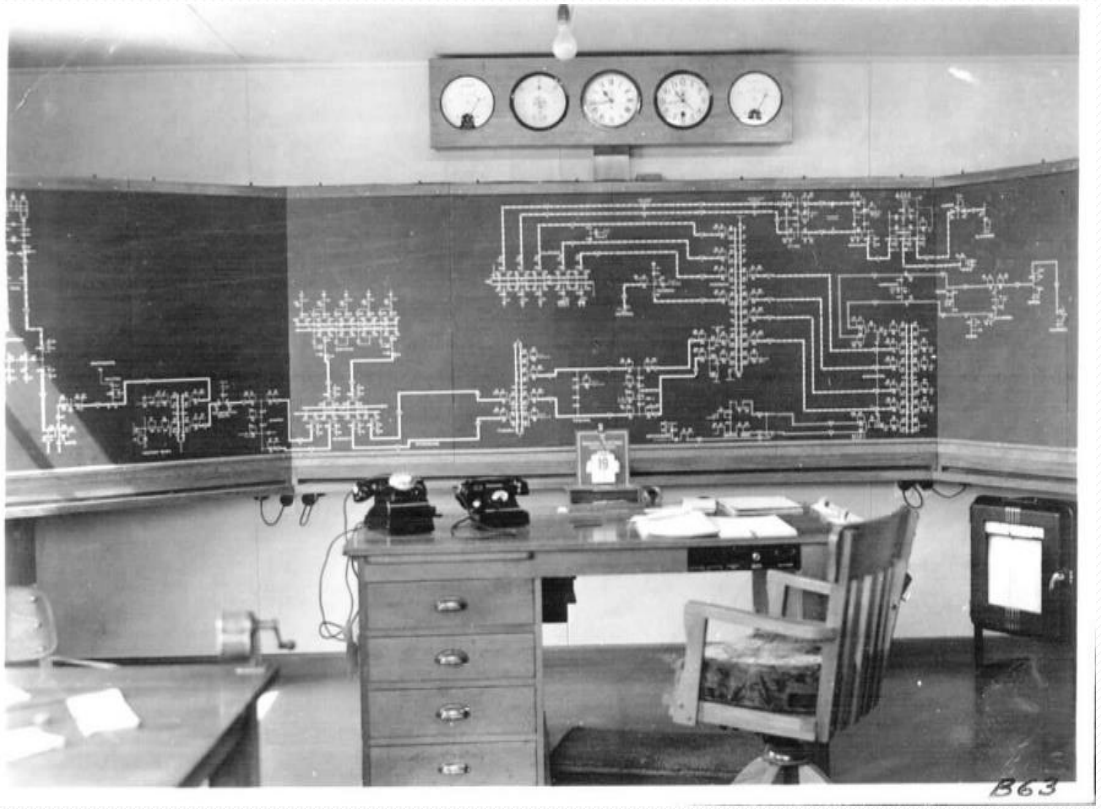
- Electricity demand growth of 670GWh per annum from 1976 – 2007 (CAGR of 2.5%), 2012 demand back at 2008 levels due to weak economic conditions
- Seasonal electricity demand profile with winter peaking system – temperate climate
- Residential segment drives daily evening demand peaks
- Major demand in north, significant supply in south; Transmission investment removing bottlenecks





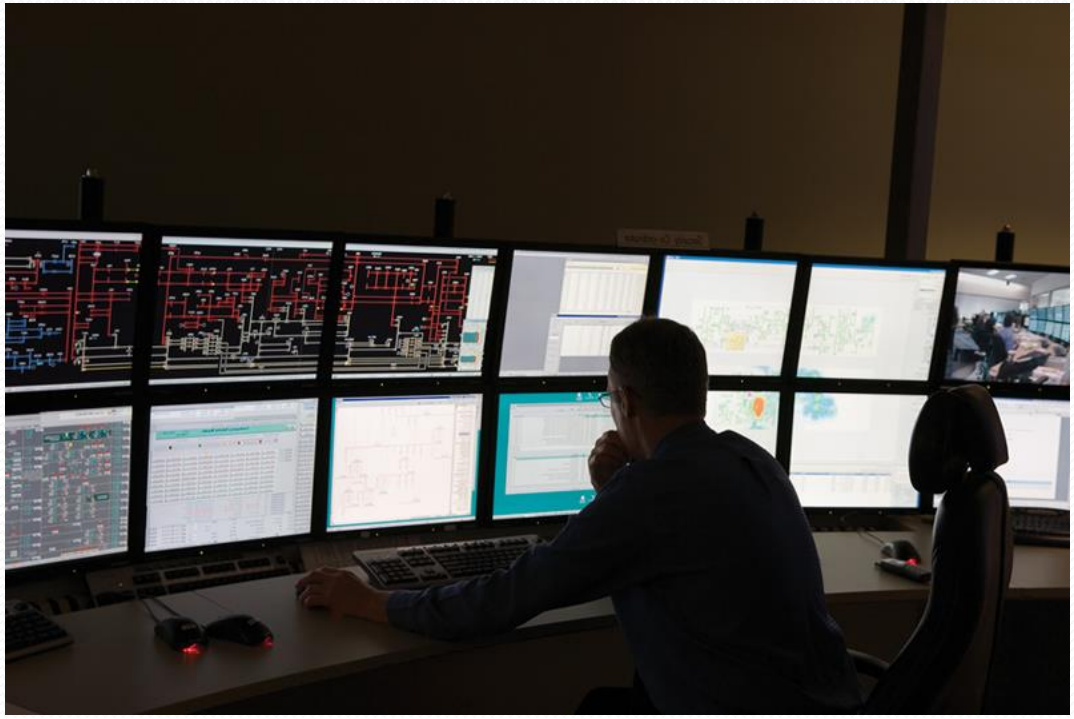
The System - Early Beginnings (c1940)

- Limited technology
- A static operation
  - Fuel cost
  - Outage planning
- Experience based – if it worked yesterday try it today



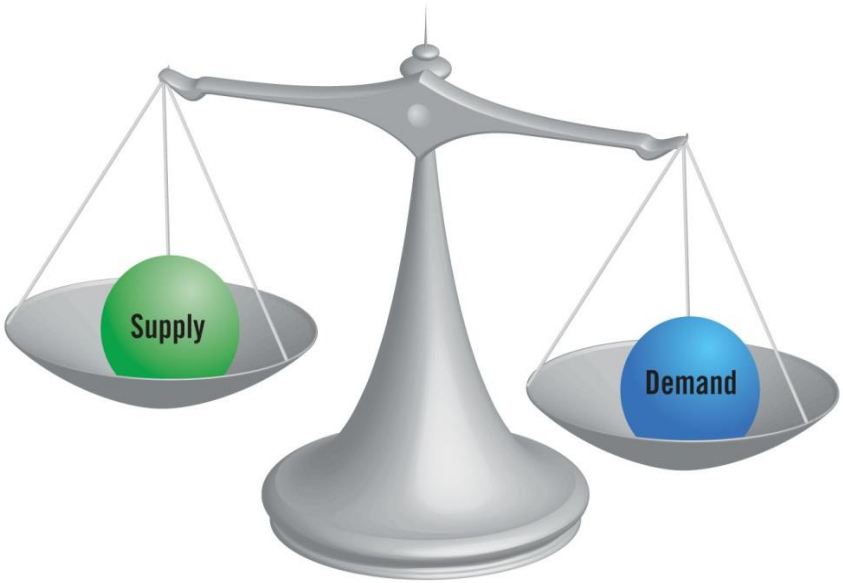
The Future Arrives

- The wholesale market arrives
  - Secure economic dispatch
    - Nodal dispatch
    - Co-optimised reserves
    - Frequency keeping, voltage support and black start markets
  - 30 minute trading periods
- Static Operation
  - Security analysis tools
  - Stability analysis tools
  - Automated constraint management
- Training and Experience
  - The new operators
  - Support tools
    - Decision support
    - Situational awareness

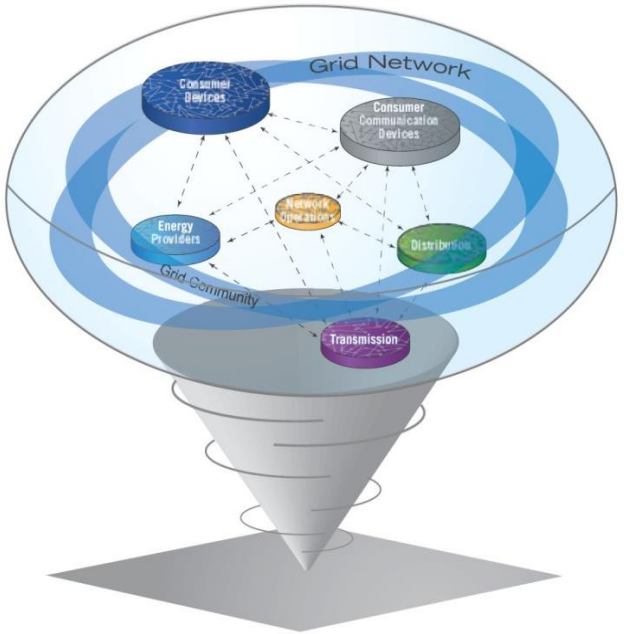


System Operation Challenges

Reliability is Maintained by Keeping Power in Balance



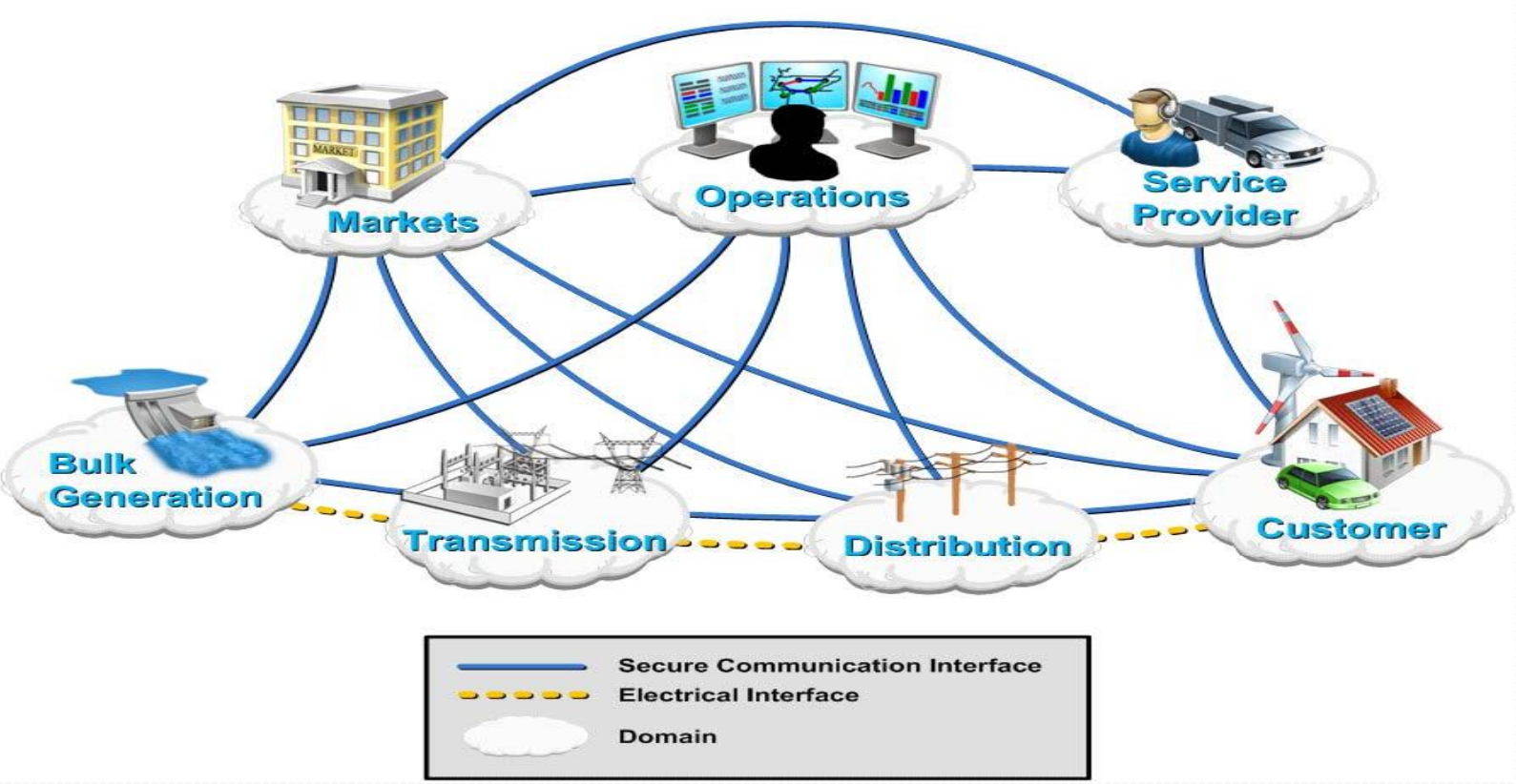
Reliability in Historic Grid Operations



Reliability in Future Grid Operations

@ pjm

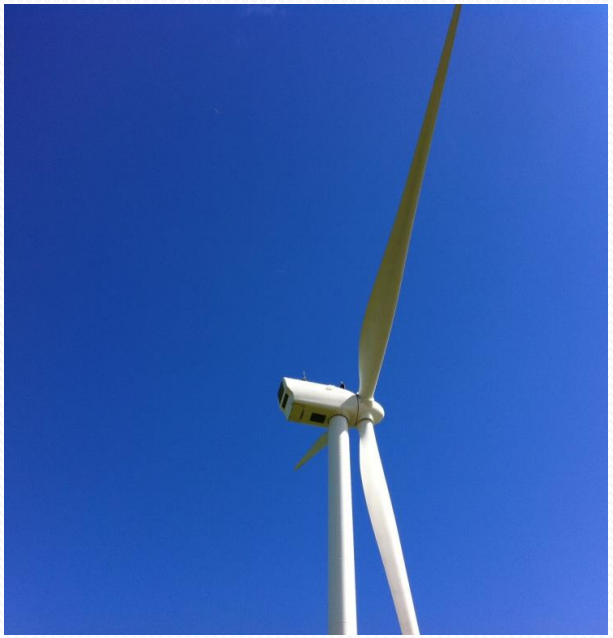
NIST Smart Grid Reference Model



Wind - medium term option

Rapid progress - 13 fold increase in capacity in 14 years
4 to 6 fold reduction in costs

1993: 0.225MW
$13m/MW



2007: 3MW
$2-3m/MW

The future – 90% renewables

The electricity system in 2030:

43,000 GWh in 2010 to 53,000 GWh

7GW peak to 8GW

Generation Capacity (GW)	2012	2030
Hydro	5.2	5.4
Geothermal	0.7	1.2
Wind	0.6	3.4
Gas	1.4	2.3
Coal	1.0	0
Other	?	?

How can we help?

- New Zealand always open to sharing experience
- Considerable international consultancy in all technologies
- Understand small scale and large development
- Successful deregulated domestic market with effective wholesale trading – replicated in Singapore and Philippines
- Active support to geothermal developments in East Africa since 1970s
- Fully behind IRENA initiative

Thank you

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