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Implementing New Zealand's Distributed Generation Options

CAE programme presentation to E21 meeting,
Wellington, 12 September 2005

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Outline for today...

- *The Case for Distributed Generation - electricity system modernisation*
- *Evaluating the DG opportunity – does DG decrease or increase resilience?*
- *Realising the opportunity for DG – economic implications*

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Types and Fuels for DG..

	Electrical Efficiency (%)	Cogeneration efficiency (%)	Size Range	Fuel
Gas turbine	25 - 40	85 - 87	500 kW - 300 MW	Natural gas, liquid fuels
Steam turbine	25 - 35	85 - 93	Extensive	Natural gas, liquid and solid fuels
Reciprocating engines	25 - 40	50 - 70	1 MW - 15 MW+	Combustible gas, gasoline, diesel
Microturbine	25 - 38	50 - 60	25 - 500 kW	Natural gas, diesel, propane
Stirling engine	32 - 20	50 - 70	1 - 25 kW	Natural gas, diesel, some liquid fuels
Fuel cell	30 - 55	70 - 90	1 MW - 10 MW	Natural gas, liquid, hydrogen
Biomass systems	17	60 - 80	Extensive	Biomass - gas, liquid and solid
Photovoltaics	8 - 18	N/A	1 - 100 MW	Sunlight
Small hydro	N/A	N/A	<10 MW	Water head
On-site wind	N/A	N/A	5 kW - 5 MW	Wind

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Various configurations....

Applications can include:

- Co-generation plant at industrial or commercial sites
- Standby generation using diesel, gas, coal, geothermal and other fuel sources
- Generation plant supplying directly into distribution networks
- Micro-grid (islanded) operation
- Electricity storage devices to meet demand peaks
- Fuel-switching at times of system peaks
- Demand-side management systems.



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The DG potential...

Contribution to 2015

The Technology	Current and assisted routes	Engineered market route
reciprocating engines	20 - 40 MW	250 MW
gas turbines	0 - 20 MW	50 MW
combustion/steam turbine	40 - 80 MW	100 MW
geothermal	20 - 80 MW	100 MW
small scale hydro	10 - 30 MW	80 MW ¹
biomass systems	0 - 5 MW	10 MW
wind	5 - 20 MW ²	160 MW ²
Maximum projected installed capacity	85 - 275 MW	750 MW

1 Not fully constructed by 2015.
2 Annual capacity factor output, i.e. up to 3x these figures in terms of maximum rated output.

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Common Themes.....

CAE studies show that:

- DG Opportunities highly niche
- High regional development focus
- Line companies biggest enablers
- Customer relationships are an industry issue
- Maximum benefits require all local interest to be working together
- Regulatory changes are positive influences

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CAE *Government policy context...*
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- DG expected to play increasingly important role
- DG can contribute to energy policy objectives
- DG can provide benefits to distribution networks
- But DG can also create problems and impose costs
- Weak incentives for distributors to connect DG
- Distributors have market power – potential barrier?

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CAE *Key policy decisions...*
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- Regulated process and timeframe for reaching agreement on connection terms and conditions
- Regulated terms and conditions to apply if no agreement reached
- Two categories of DG (under and over 10 kW)
- No incremental cost expected for DG under 10 kW but DG must meet relevant standards

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CAE *Key policy decisions...*
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- Distributor may recover reasonable incremental costs to ensure sufficient capacity and safe operation
- May decline connection if where insufficient capacity and generator unwilling to pay the incremental costs
- Distributors may require separate meters to record export and import
- Distributors required to make available their:
 - application forms
 - standard contract terms and conditions
 - technical connection standards


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CAE *Further issues being considered..*
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- Regulate for firm or unfirm access (or both)?
 - generators may prefer firm access
 - but may be prepared to accept unfirm access in return for lower connection charge
- Incentives to free-ride
 - when a generator pays for a network upgrade and creates spare capacity that others may use
- Network benefits (avoided network costs)
 - In principle, generators should face the full social cost and capture the full social benefit of DG investment
 - Should regulations require distributors to pass through 'avoided transmission charges'?

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CAE *Industry Responses....*
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Guide for Connecting Generation Plant: 

- Safety – People & Plant
- Not Compromise Supply System
- Assist Engineers to determine appropriate connection and protection requirements.
- Advise Customer on Protection and Supervisory equipment requirements.
- Excludes Financial Arrangements

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CAE *Connection Guidelines....*
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Special aspects of Parallel Supply: 

- Plant Energises Network
- Asynchronous condition (supply restoration)
- System Earthing
- Fault Level Contribution
- Isolation for Line Mechanic Work Safety
- Power Quality (Frequency and Voltage)


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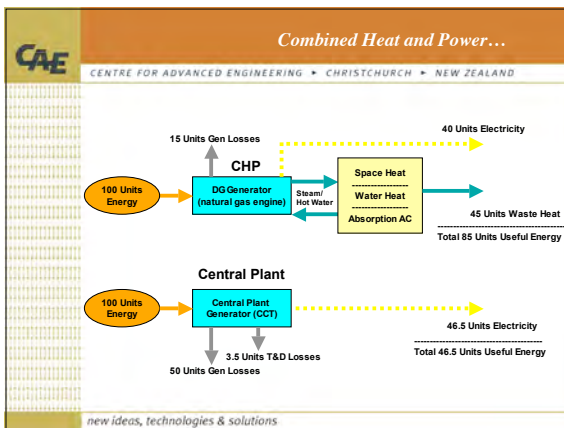
Connection Guidelines....

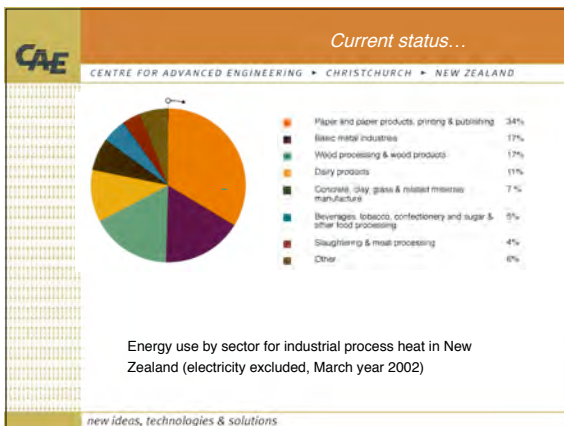
Network Standards Required at Customer Interface:

- Plant function, rating, operation
- SLD, Earthing, Switchgear
- Fault ratings, OC & OV factors
- Protection and Control Systems
- Fault contribution
- Metering



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The CAE programmes....

Energy 21:

- An independent collaborative programme for modernisation of NZ's electricity system.
- Contributing through the delivery of policy-level research that acts to promote the realisation of DG.
- Aim is to lead and inform public debate around strategies for improving energy security.
- Active work streams providing practical guidance on DG opportunities directly to the customer.

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The CAE programmes....

Communicating the DG opportunity -


Production of Application Guides for;

- Diesel/gas engines
- Hydro integrated with irrigation
- Geothermal
- Biomass
- Solar
- Wind
- Waste-to energy

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Purpose of Application Guides...



- Achieving a technical solution that works
- Model approach to assessing opportunity
- Establishing commercial viability robustness
- Providing a Business Case model
- Re-establishing customer relationships

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CAE *Value-creating opportunities...*
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- Avoidance of interconnection charges
- Deferral of transmission and distribution new investment
- Deferral of consumer new investment
- Alternative to security upgrades
- Management of energy risks - pricing and supply
- Wholesale energy values.

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CAE *DG configuration #1...*
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- Embedded capacity at key host load sites
 - Typically a permanently installed generator owned by a customer
 - Primarily to ensure security of supply for customer's premises and to manage demand charges
 - Sized to the customer's load and not exported unless rewarded with favourable terms
 - Ideal candidate for CHP if waste energy can be used in an industrial/commercial process i.e. heating or cooling

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CAE *DG configuration #2...*
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- Embedded capacity on a semi-permanent site
 - 1MW – 5MW of synchronised generators feeding 11kV mains
 - Containerised generators, dedicated transformers and control modules
 - Capable of being shifted to alternative locations – good medium term solution
 - Upgrade deferral, staged line upgrade, GXP demand management
 - Service and security standards not able to be met economically any other way
 - Owned/leased/hired by Lines Company

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Hurdles for DG investors...

- Partnership with industry player to manage 5 – 10 year paybacks
- Access to benefit sharing is controlled by the industry
- Cost plus attitude to demand management and facilities upgrades
- Utility company attitudes that relies on regulatory provision
- A strong industry resistance to any departure from the status quo

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Business issues...

1. Pricing structures don't always signal long term economical solutions
2. Displaces retail sales of centrally distributed power
3. Retailing of electricity produced by small scale DG unprofitable unless delivery savings recognised
4. Uncertainty of the benefits that could arise over the life of an investment
5. Management of DG assets not core business

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Implications for network design...

The Challenge going forward is to provide greater flexibility and technical innovation:

- Continuing trend to DG with new technologies
 - Fuel cells and micro-CHP
- Evolution of the 'virtual utility'
 - Control both customers loads and generation at multiple sites via Internet
- Network companies become co-ordinating agents
 - Two-way flow of communication and control
 - Optimise the system to supply power and services
 - Protect the system against faults

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Future Programmes.....

This meeting is about industry support

Continue development of the E21 initiative;

- Strengthen consumer representation in industry policy development
- Delineating the capacity and security contribution possible for DG
 - System resilience
 - Regional economic opportunities
- Ongoing communication through the DG website and E21 Bulletin.

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Future Programmes.....

Future Research Programme


An investigation of the strategic opportunities for DG in development of the electricity supply system:

- Identify regional energy resources
- Recommendation of the target mix of opportunities
- Develop load generation curves at individual GXP's
- Comparison between GXP's normalised over an "average" year
- Policy recommendations on adapting existing industry structures;
 - Technology performance requirements
 - Generation portfolios
 - Optimal demand side strategies.

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The way forward..



Discussion on strategic directions, priority areas for research and financial support

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