Centre for Energy and Environmental Markets

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Full Retail Competition, Interval Metering & Distributed Resources in the NEM

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CEEM Seminar, 15/3/06

Outline

- What are the key challenges for a restructured electricity industry?
- What are the goals of full retail competition?
- What should be the transition process?
- Is the MCE reform agenda compatible with this direction?

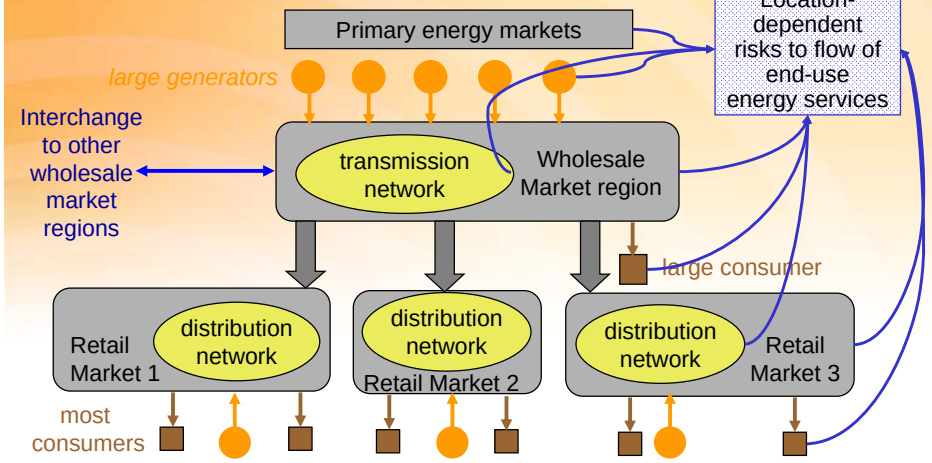
Key features of the electricity industry

- A continuous, *uncertain* energy flow industry:
  - From primary to end-use energy forms with *fungibility* & *minimal intermediate storage* of electrical energy
  - Regarded as providing *essential services*
  - Delivers unintended as well as intended outcomes
  - Subject to uncertainties at all stages in the energy conversion chain
- Created & sustained (& sometimes damaged) by human decision making:
  - *Decentralised:* industry participants (generators, end-users, NSPs):
    - Competition & efficient pricing deliver productive & allocative efficiency
  - *Centralised:* policy makers, regulators, system operators:
    - Fungibility:- *innovation & dynamic efficiency must be driven centrally*

Availability & quality of supply

- Quality of supply attributes (QOS):
  - Voltage, frequency, waveform purity, supply availability
  - *Important location-specific characteristics*
- ESI can't achieve perfect availability & quality:
  - Supply availability & quality can vary widely in distribution networks
  - Customer equipment can also affect quality
- Risks to availability & quality of supply threaten the flow of end-use energy services:
  - Directly or indirectly through equipment malfunction
  - Hard to define legal obligations (mainly on distributors) for availability & quality at end-user connection points

A restructured electricity industry



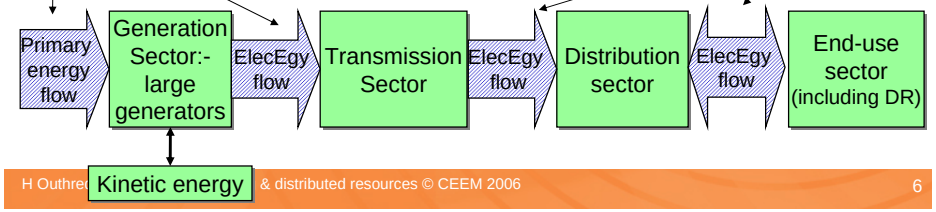
- *Small consumers, embedded generators & storage should be supported by energy service advisers*
- *Wholesale & retail designs should be compatible, with spot & derivative markets that model flow constraints*

Energy conversion chain uncertainties & risks

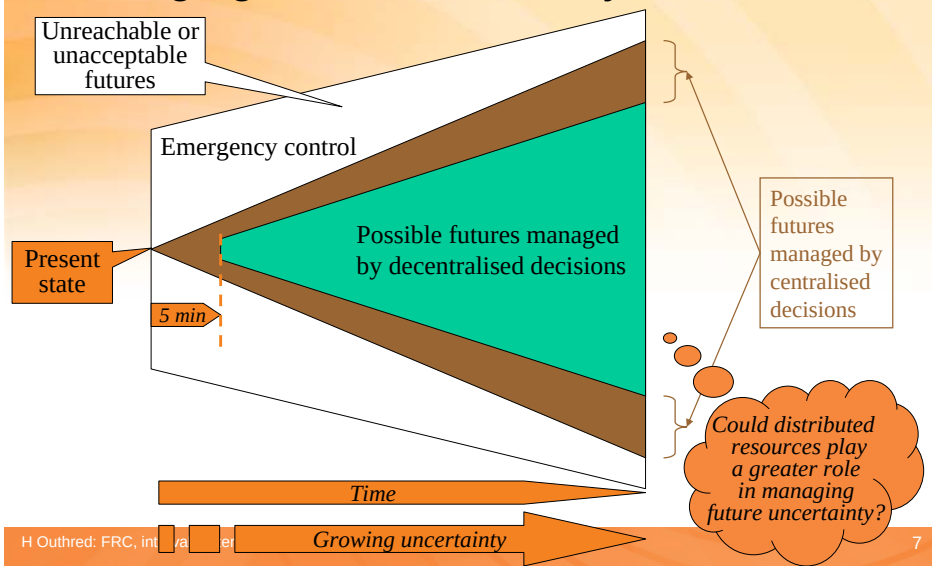
(geographically local issues in blue)

Could distributed resources play a greater role in managing future uncertainty?

- End-user operation & investment
- End-use equipment forced outages
- Availability of fossil & fission fuels
- Variable renewable energy fluxes
- Distribution forced outages
- Availability & quality of supply at end-user point of connection
- Generator decisions
- Generator forced outages
- Power system security
- Transmission forced outages
- Power system security



Managing future uncertainty in the NEM

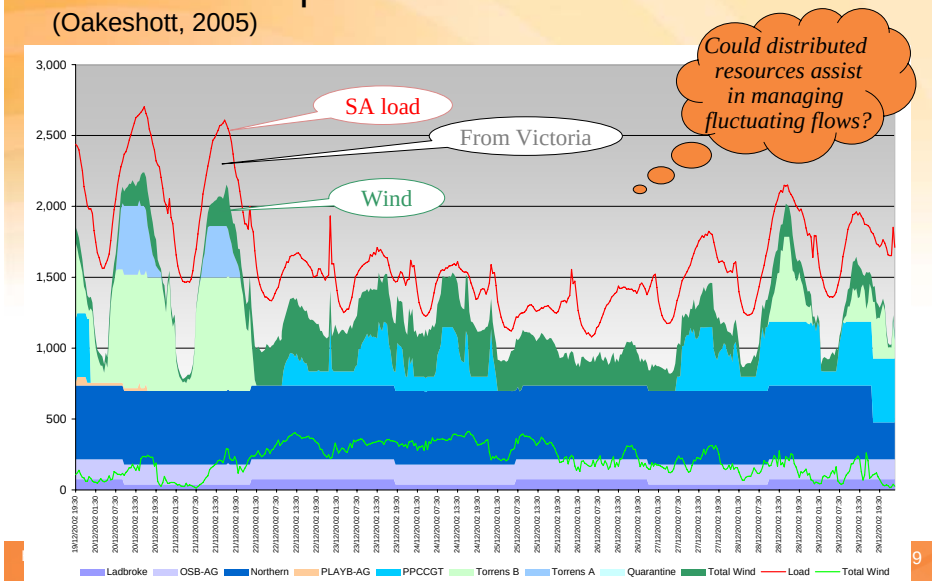


Decision-making in the Australian National Electricity Market (NEM)

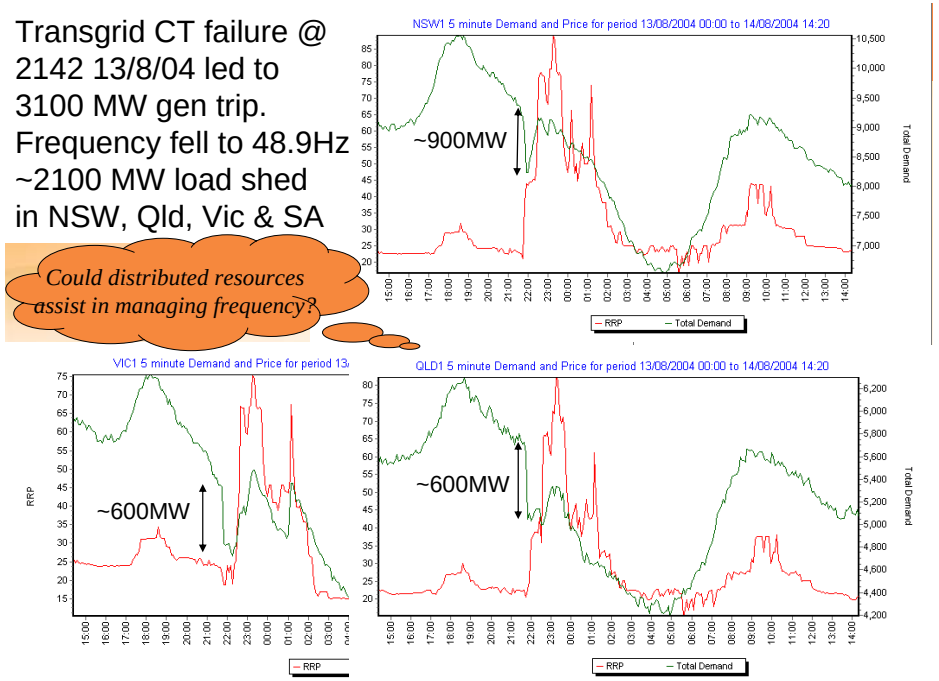
- *Centralised* decision-making (security-managing):
  - 5-minute determinations by NEMMCO:
    - FCAS & other ancillary service requirements; security constraints
  - Projections by NEMMCO of the above (information only):
    - 1-week, 2-yr daily peak, 10-yr annual peak
  - Last resort intervention by NEMMCO (max 6 mth horizon)
- *Decentralised* decision-making (security-constrained):
  - 5-minute spatially-differentiated spot energy & derivatives:
    - Support dispatch, commitment, operation planning & investment
  - 5-minute Frequency Control Ancillary Service (FCAS):
    - Continuous frequency control; contingency raise & lower

Simulated dispatch with 500MW wind in SA

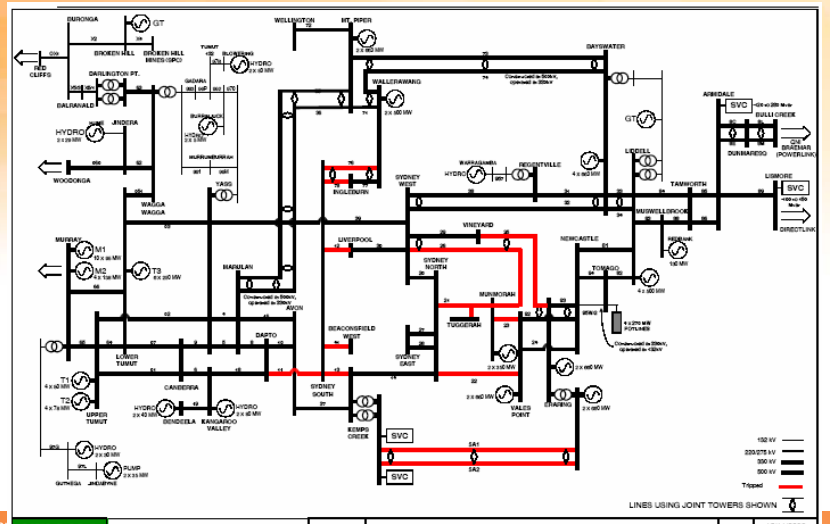
(Oakeshott, 2005)



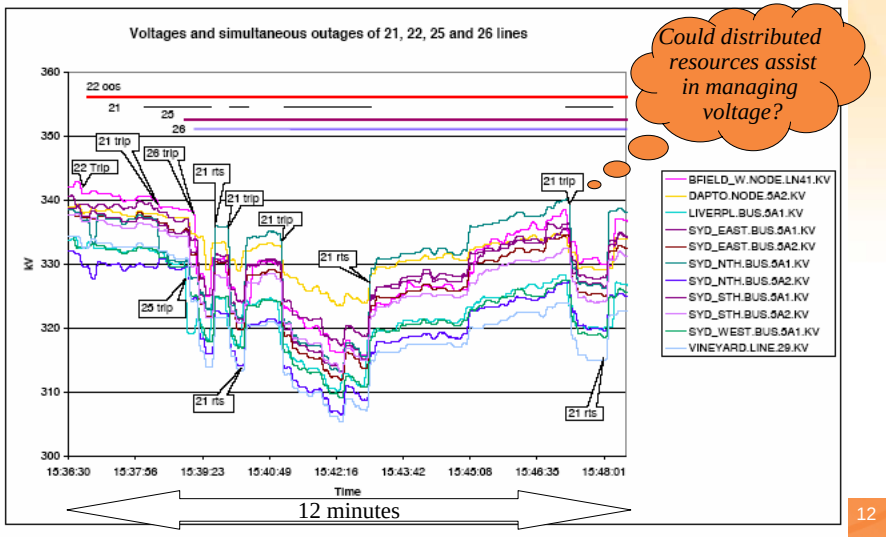
Transgrid CT failure @ 2142 13/8/04 led to 3100 MW gen trip. Frequency fell to 48.9Hz ~2100 MW load shed in NSW, Qld, Vic & SA



Australian management of severe network contingencies: NSW bushfires Dec 2002; lines with multiple trips shown in red



Sydney region voltages during 2002 bushfire outages: managed by under-voltage relays shedding load



Widespread voltage collapse in North America

- Voltage is challenging to manage in a restructured electricity industry:
  - Can lead to major blackouts (eg North America, 2003)

Could distributed resources assist in managing voltage?

Source: Overbye & Wiegmann, 2005

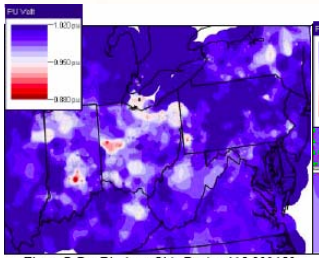


Figure 7: Pre-Blackout Ohio Region 115-230 kV Voltage Contour

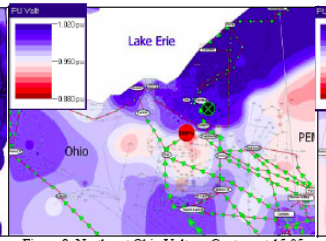


Figure 8: Northeast Ohio Voltage Contour at 15:05 EDT

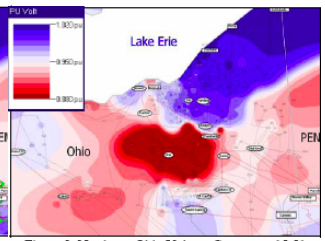
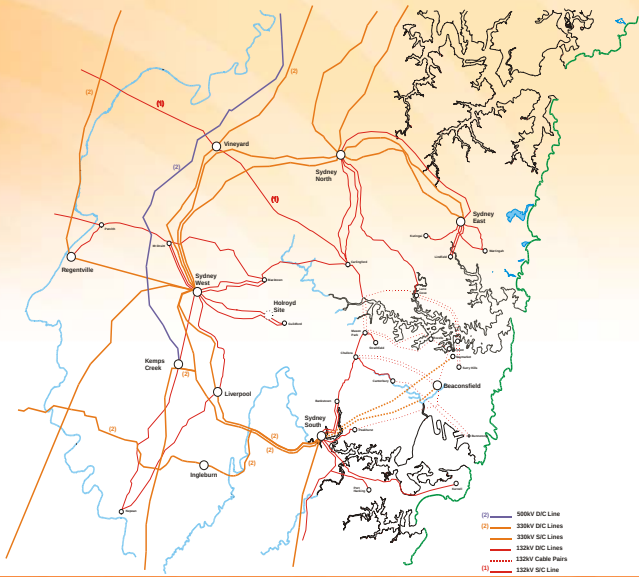
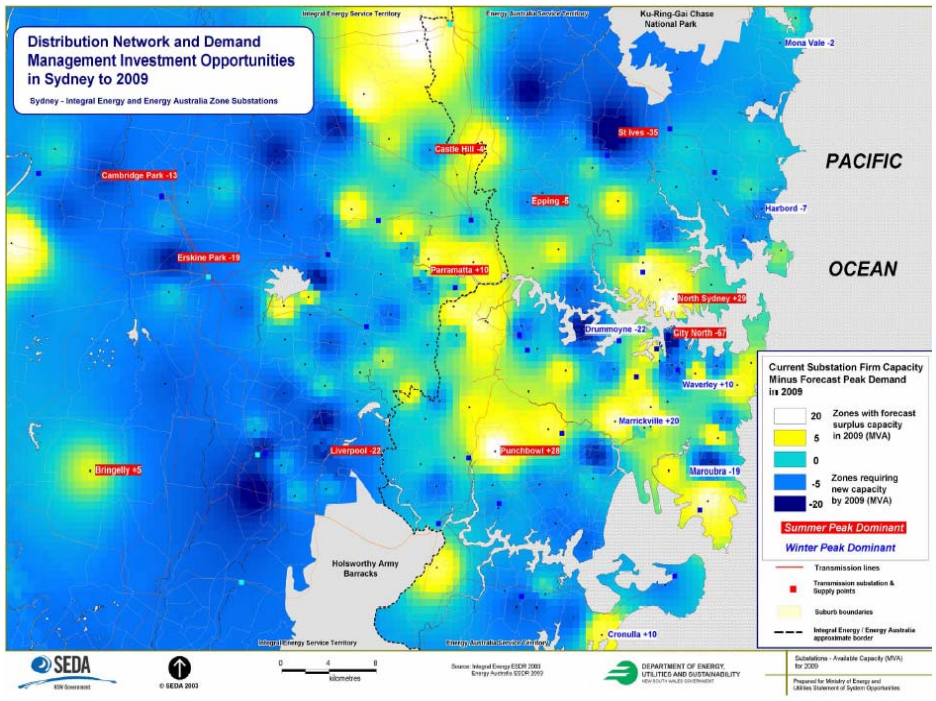


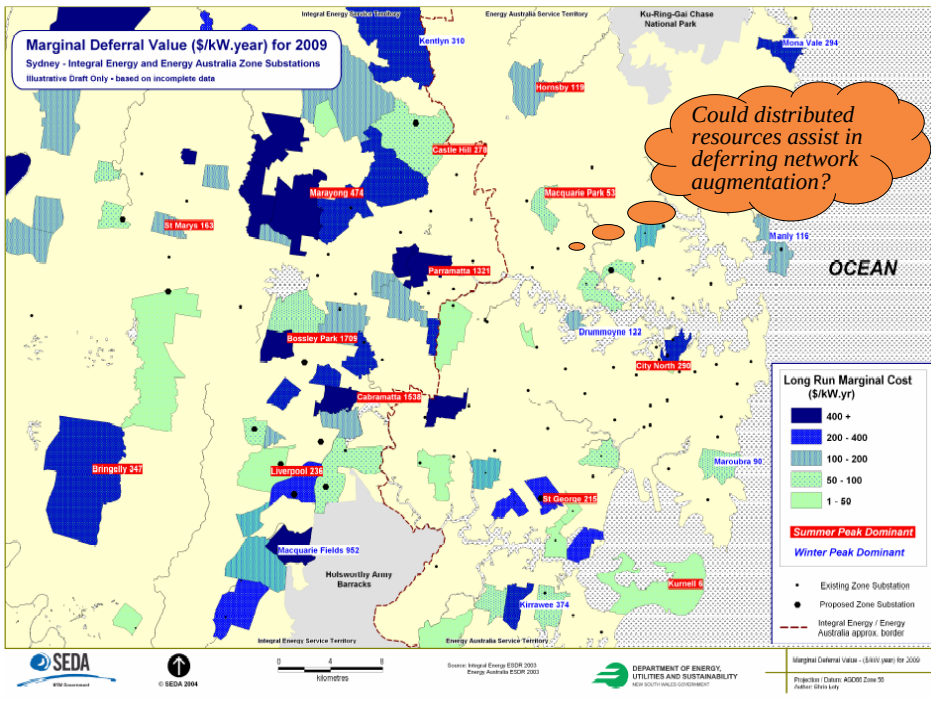
Figure 9: Northeast Ohio Voltage Contour at 15:51 EDT

NSW transmission network, Sydney region

(M Park, 2005)







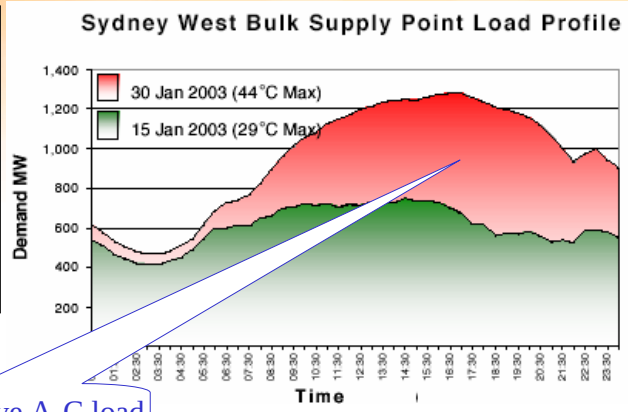
Residential & commercial air conditioning is the key driver for peak demand growth

(IE Submission, IPART DNSP Review, 2003)

Residential ADMD

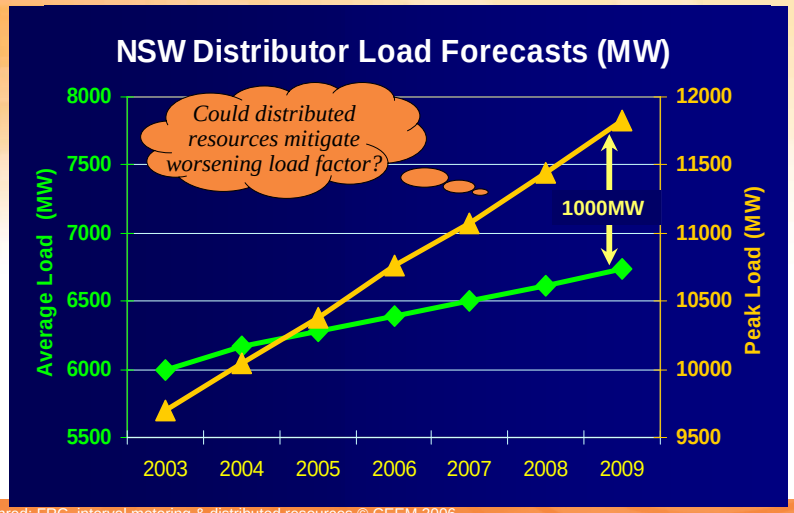
Pre 2000 houses: 3.5-4.0 kVA

Post 2000 houses: 5.0-7.5 kVA



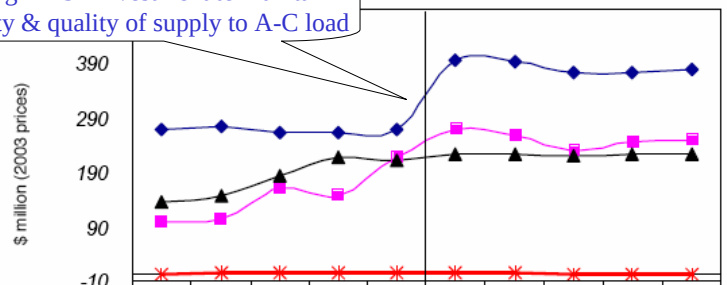
Growth in NSW summer peak demand

(MMA, Review of Demand Forecasts for the 2004 Electricity Network Review, 12/03)



NSW distributor actual & forecast capital expenditure (IPART, Dist Pricing Draft Rpt, 2004)

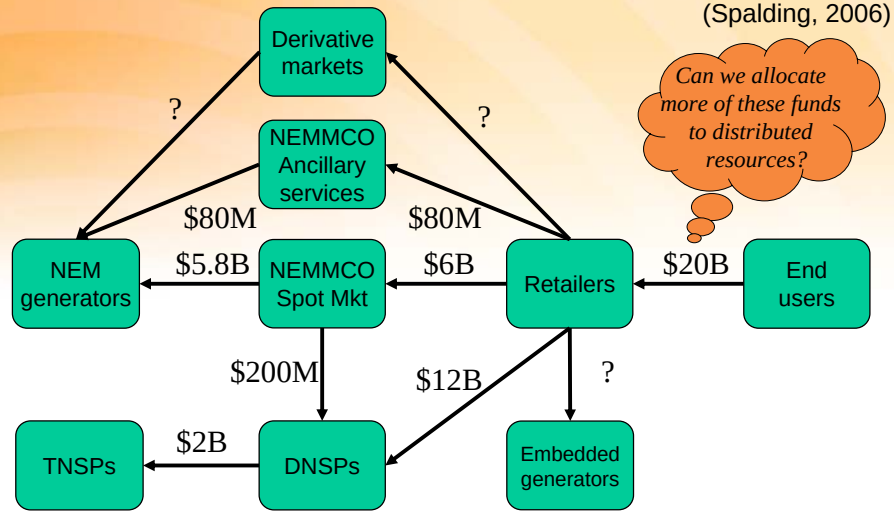
Increasing DNSP investment to maintain availability & quality of supply to A-C load



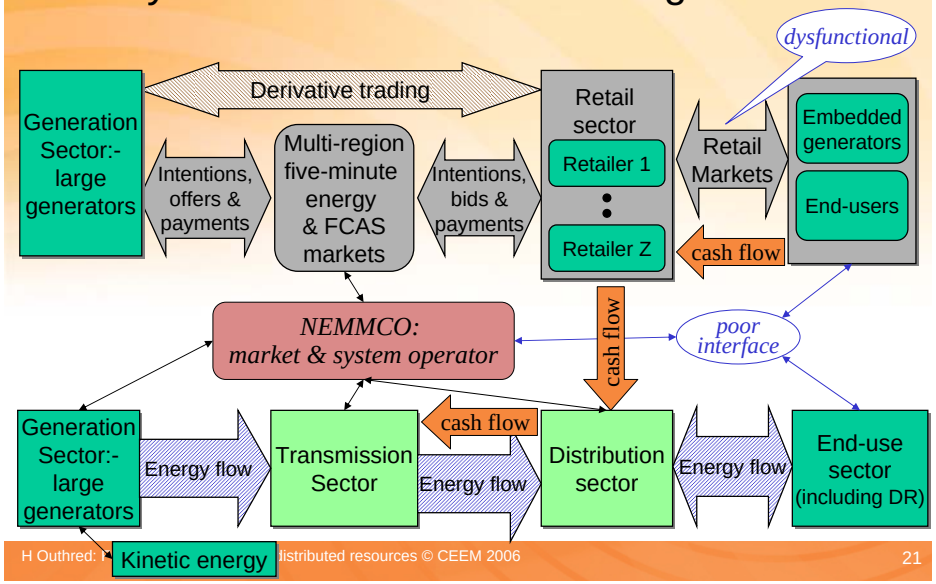
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Energy Australia	271	275	264	263	270	398	394	374	375	379
Integral Energy	101	106	162	148	218	270	257	230	248	249
Country Energy	138	148	185	218	213	225	224	222	224	224
Australian Inland	3	3	4	3	5	3	3	3	2	2

Cash flow in SE Australia electricity industry

(Spalding, 2006)



Industry structure & decision-making in the NEM



The new overall objective for the National Electricity Market (NEM)

- *NEL Section 7:*
  - *The national electricity market objective is to promote efficient investment in, and efficient use of, **electricity services** for the **long term** interests of **consumers of electricity** with respect to **price, quality, reliability and security** of supply **of electricity** & the reliability, safety and security of the **national electricity system***
- Short-comings of this objective:
  - Emphasises electricity rather than end-use energy services
  - Fails to mention sustainability - in 1991, COAG said the NEM should be *efficient AND sustainable*

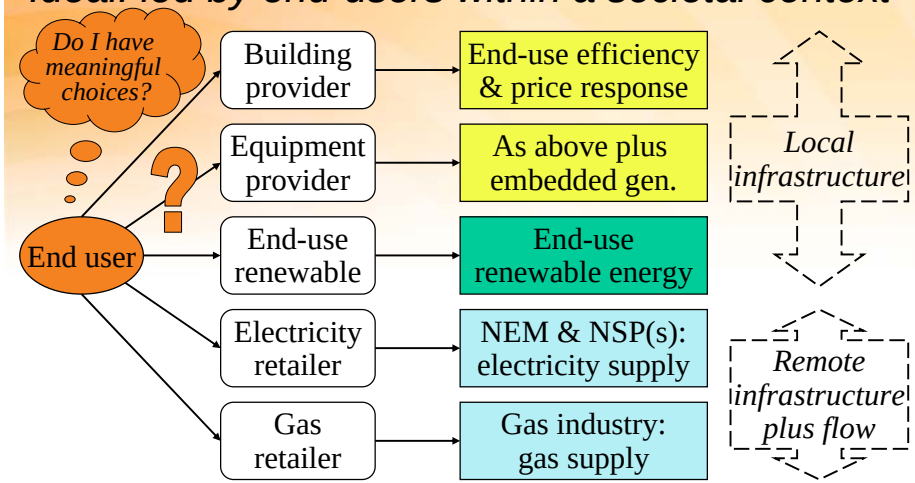
What should be the goals of electricity industry restructuring?

- Environmental sustainability (uncertain):
  - Local, regional & global; short & long term *(judgemental)*
- Economic sustainability (uncertain):
  - Allocative, productive & dynamic efficiency *(judgemental)*
- Social sustainability (uncertain):
  - Intra- and inter-generational equity *(judgemental)*
- Physical sustainability (uncertain):
  - Robust management of physical uncertainties & risks

How should these goals be implemented?

- Sound decision-making led by end-users:
  - As consumers of end-use energy services, and
  - As employers, employees & members of civic groups
- Effective electricity industry restructuring:
  - Efficient electricity markets involving end-users:
    - Ancillary services, spot energy, derivatives differentiated by price and location
  - Effective regulation & system operation:
    - For situations that require group and/or non-economic decisions
  - A sound policy framework:
    - Rules for regulation, and for market & system operation
    - Internalisation of market externalities; eg climate change

Decision-making in the stationary energy sector: *Ideal: led by end-users within a societal context*



Barriers to good end-user decision-making

(can only be overcome by innovation)

- Barriers for local infrastructure options:
  - Knowledge, cash flow, innovation & risk exposure
  - Limited influence over options (dependence on others)
  - Need for coordinated decision making to value diversity
- Barriers for remote infrastructure & flow options:
  - Limited knowledge & influence (dependence on others)
  - Revenue recovery retail tariffs (ex-post taxation)
  - Business as usual (status quo rather than innovation)
  - Regulators & system operators take key decisions:
    - To maintain availability & quality of energy flow
    - For which end-users bear most of the costs

Why Full Retail Competition (FRC)?

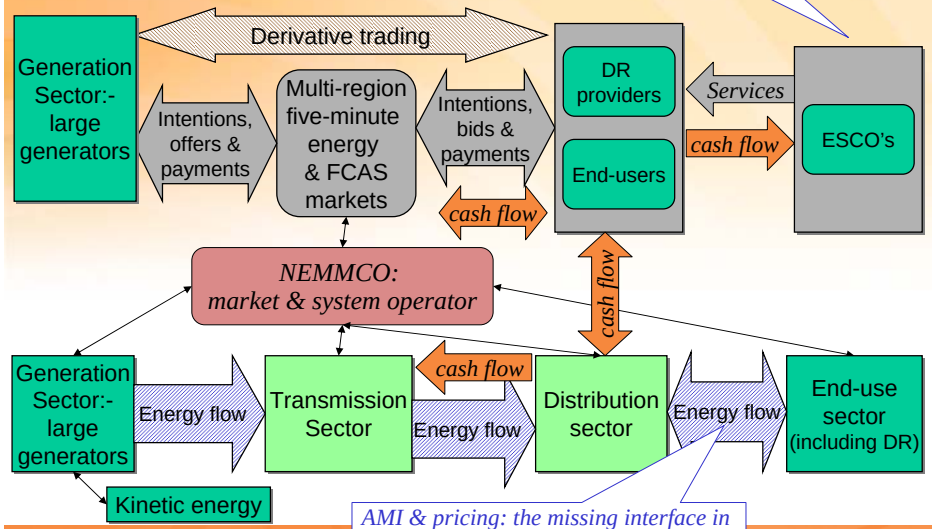
- *To facilitate better end-use decision-making:*
  - Requires multi-party agreements with clear delegations & accountabilities
- Key prerequisites for effective FRC:
  - Interval metering for all end-users, which records voltage & availability as well as energy & can communicate
  - Retail tariffs that mirror NEM wholesale prices:- ancillary services, energy spot & derivatives (with externalities)
  - Decision-making support for small end-users
- This means that end-users should participate in NEM & retailers should look more like ESCOs

Energy service companies (ESCOs)

- Promote distributed resource (DR) options, such as embedded generation, demand reduction, increased end-use efficiency
- Find it easier to work with commercial & industrial end-users (eg energy contracting) than residential end-users
- Should consider both cost-benefit based on tariffs and availability & quality of supply
- ESCOs need efficient spot & forward prices for energy & ancillary services:
  - Without efficient & consistent prices, rebound effect will negate energy efficiency enhancements

Improved industry structure

ESCOs: the missing players in the restructured electricity industry

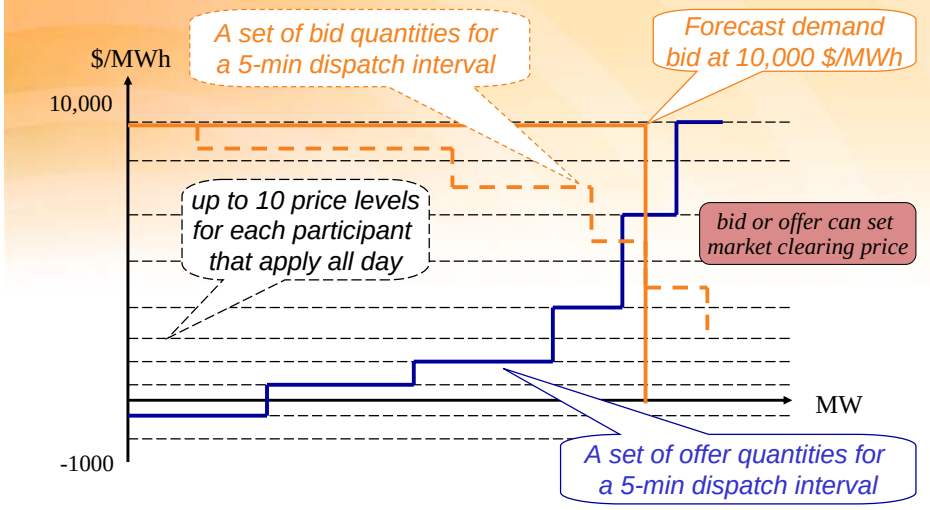


AMI & pricing: the missing interface in the restructured electricity industry

AMI: Interval meter & communications

- Meter should record, for 5 & 30 minute intervals:
  - Real & reactive energy
  - Key attributes of quality of supply:
    - voltage & waveform purity
  - Key attributes of availability of supply:
    - Frequency & duration of outages
- Communications interface should support:
  - Communication with NEMMCO, NSP & Regulator(s)
  - Participation in energy & FCAS (& NCAS) markets:
    - Bid & offer submission
  - Interface with end-user & end-use equipment:
    - Automated control if desired or required

Offer & bid structure for 5-min NEM spot market



Transition path for NEM markets

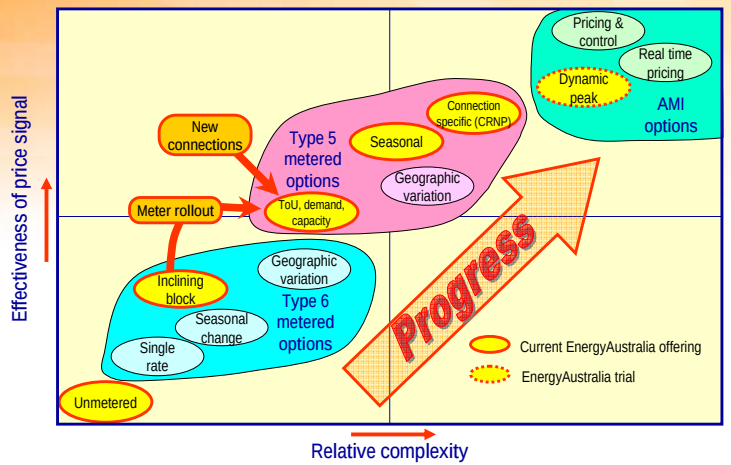
- NEMMCO would calculate intra-regional spot prices for energy & FCAS at all zone substations
  - To apply to all end-users & DR operators in the zone
  - Corrected for network loss factor
  - With a separate DNSP network access contract
- NEMMCO (or another body) would implement auction-style derivative markets that replicated the spot energy & FCAS markets, trading:
  - Standardised derivative contracts 3-5 years ahead:
    - CFDs & call options at zone substations, with TNSP obligations
  - Potential role for location-based aggregation

Transition path for DNSPs

- DNSPs play an essential role in providing access to the meshed transmission network & the NEM
- Don't yet have correct interface with end-users & distributed resource (generator, storage) providers
- Transition path would have these components:
  - Direct contracts with end-users & DR providers
  - Access agreement with clear technical obligations on both parties in place of traditional "obligation to serve"
  - Access tariff in spot & derivative form for energy & ancillary services

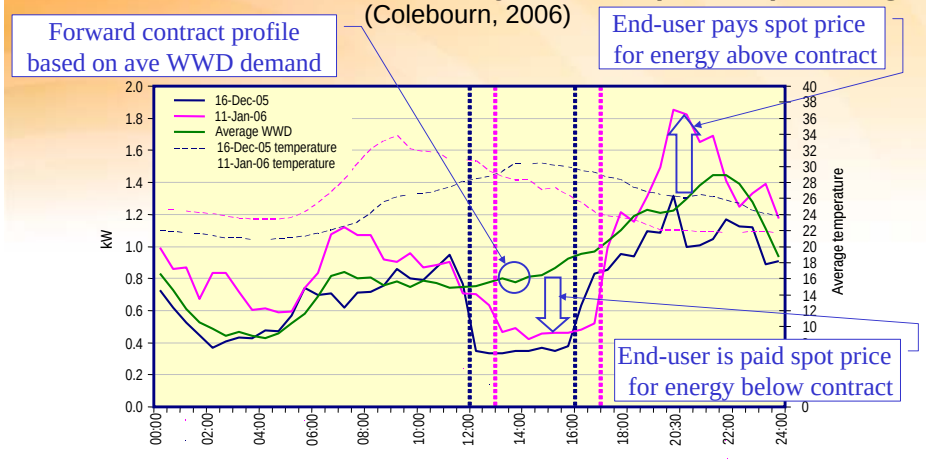
EnergyAustralia vision for network pricing

(Colebourn, 2006)



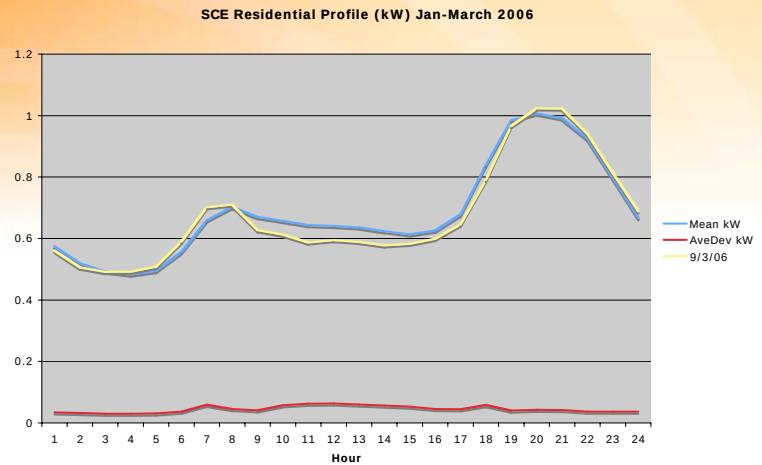
Spot & forward access contract based on EA trial of residential dynamic peak pricing

(Colebourn, 2006)



Profile example: SCE Residential load

(http://www.sce.com/AboutSCE/Regulatory/loadprofiles/2006loadprofiles.htm)



Default residential NSP forward contracts

- Forward demand profile to meet basic household needs for normal weather conditions:
  - May include allowance for air-conditioning in some areas
  - May be a function of household size
  - May include energy as well as network pricing
- Forward price profile determined by area-specific network LRMC estimate for cost of supply:
  - Considering economically efficient investment
- Forward term to be 3-5 years with annual update
- To be determined by regulator & offered by DNSP:
  - As default derivative aggregator if energy pricing included

Transition path for retailers

- Retailers currently play an ambiguous role:
  - They do not participate in the physical industry
- With interval metering roll-out, retail tariffs should evolve to a spot & derivative form:
  - Based on NEM wholesale spot & derivative prices
  - Supplemented by NSP access spot & derivative prices based on distribution flow constraints
- Retailers could evolve to become:
  - ESCOs, supporting end-use decision-making
  - Derivative market (location-based) aggregators

Possible transition for distributed resources

- Three important issues in valuing DR:
  - Time-varying value of energy should reflect flow constraints
  - Quality of supply, particularly voltage & frequency
  - Obligation to serve *(externalities also important)*
- DR role can be facilitated by coordinated technical, market & contract obligation mechanisms
  - Spot & derivative prices for energy, access & AS:
    - Value DR improvements to availability & quality of supply
    - Penalise disturbances to availability & quality of supply
  - Communication & interval metering that measures QOS
  - ESCOs to assist end-users to actively participate

Current MCE reform agenda

- *Governance and Institutions, Gas Market Development, Transmission….*
- *Economic Regulation*
  - Establish national Dx and retail framework (*1 January 2007*). Transfer Dx functions to the AER and AEMC (*1 Jan. 2007*), other functions to be transferred (*1 Jan. 2008*)
- *Retail Pricing*
  - Phase out energy retail price regulation where effective competition can be demonstrated (*reviews start 1 Jan. 2007*)
- *User Participation*
  - Implement new consumer advocacy arrangements (*mid 2006*, end 2006).
  - Consider demand side response options (*late 2006*)
- *Energy Efficiency*
  - Implementation of the NFEE (Stage 1) (*end 2007*).
  - Response to PC Inquiry, Consideration of the NFEE (Stage 2) (*mid 2006*).
- *Renewable and Distributed Generation*
  - Issues paper on options available in NEM to max. benefits of DG (early 2006)
  - Development of code of practice for embedded DG (*end 2006*).
  - Development of policies to facilitate increased penetration of wind (end *2006*)

Latest additions to agenda (COAG Communique, Feb. 2006)

2.2: Improve price signals for energy investors and customers by committing to
- progressive roll out of electricity smart meters to allow time of day pricing + for users to respond to prices and reduce demand for peak power;
- MCE to agree on common technical standards for smart meters and implement roll out as may be practicable from 2007 in accordance with an implementation plan that has regard to costs and benefits and takes account of different market circumstances in each State and Territory;
- implementing MCE work program to establish effective DSR mechanisms in mkt, including network owner incentives, effectively valuing DSR, regulation and pricing of distributed and embedded generation, and end user education.

2.4: Reaffirmed commitment to implement mkt structures that foster competition
- endorsing ongoing structural separation of the competitive generation and retailing activities from the natural monopoly Tx functions in the NEM;
- requesting MCE to develop specific recs under NEL to maintain such separation
- considering operation + structure of government-owned businesses wrt ensuring equivalence between them and private sector for policy, legal + mkt arrangements;
- committing to maintain and increase reliance on market-based risk mitigation and hedging measures, and to remove barriers to full retail competition

2.5 …. COAG to establish high-level Energy Reform Implementation Group… ?

Conclusions

- Effective FRC requires more than ending franchise:
  - Transition to end-user focus with ESCO support
- The necessary conditions are achievable:
  - Interval metering with measurements of quality of supply
  - Direct interface between DNSP & end-user with clear technical & commercial obligations
  - Spot & derivative tariffs for energy & ancillary services
  - Policy for end-use efficiency & climate change response
  - Regulator-determined default residential forward contracts offered by default aggregator
  - ESCOs to support decision-making by small end-users

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