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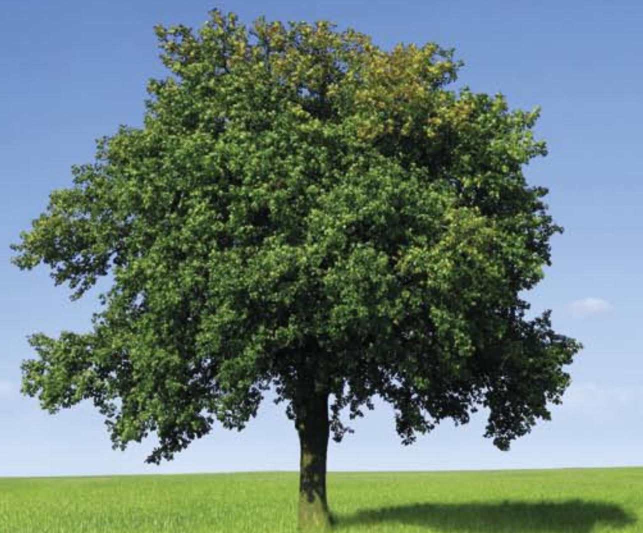
ELECTRICITY GENERATION TO 2050 SYMPOSIUM

23 MARCH 2010

UNIVERSITY OF SYDNEY

SUMMARY



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PROGRAM

TIME	SPEAKER	TOPIC
8:30	Quentin Dempster OAM	Welcome
	Professor Tony Vassallo	Introduction
PANEL ONE: DRIVERS FOR CHANGE		
8:40 – 10:05	Dr. Cameron Hepburn Oxford University School of Enterprise and Environment	Post Copenhagen – Status of the Global Accords
	Professor Geoff Garrett, CEO The United States Study Centre	The United States Policy Context and Implications for Australia
	Anna Skarbek, Executive Director ClimateWorks Australia	Policy Settings for Low Emissions Energy Infrastructure
	Open Forum Discussion	
10:05 – 10:25	Morning Tea	
PANEL TWO: TECHNOLOGY FOR CHANGE		
10:25 – 11:45	Philippe Paelinck, Director CO_2 Product Alstom	Adapting Existing Technologies
	Professor Tony Vassallo Delta Electricity Chair in Sustainable Energy Development	Distributed Energy and Storage and Renewables
	Richard Wagner Head of Investment Banking Morgan Stanley	Financing New Generation Facilities
	Open Forum Discussion	
11:45–12:10	Break	
PANEL THREE: CHANGING GENERATION INFRASTRUCTURE TOWARDS 2050		
12:10 – 1:10	Brendan Lyon Executive Director Infrastructure Partnerships Australia	Building Infrastructure for 2050
	Nick Rowley, Director Kinesis	Challenges and Opportunities Towards 2050
	Open Forum Discussion	
1:10 – 1:15	Peter Young AM, Chairman Delta Electricity	Concluding Remarks
1:15–2:00	Lunch and Networking	

FOREWORD

As the inaugural Chair in Sustainable Energy Development at the University of Sydney, sponsored by Delta Electricity, Professor Tony Vassallo and Peter Young, Chairman of Delta Electricity, were pleased to host the first *Electricity Generation to 2050 Symposium*.

This timely discussion brought together internationally recognised speakers and industry leaders. They examined the political, technological and financial aspects of electricity generation in the future.

Each speaker has provided us with a summary of their contribution to the day's proceedings and these are printed here in this booklet to provide a reference for reflecting on the future of this vital sector.

In addition, the presentations are available at http://www.chem.eng.usyd.edu.au/research/generation_symposium.shtml

Comments from attendees emphasised that they valued the unique opportunity provided by the Symposium for thought leaders to share their knowledge and perspectives.

Looking at the generation industry in 2050 and discussing its future was an ambitious task. It was a timely discussion given the current policy context and the long lead times for energy infrastructure development.

Both Tony Vassallo and Peter Young thank the speakers and invited guests for their attendance and contribution to a very successful and valuable Symposium.

DR CAMERON HEPBURN

Senior Research Fellow, Smith School of Enterprise and Environment, University of Oxford

Post Copenhagen – The Status of the Global Accords

Dr Cameron Hepburn set the context of the Delta Electricity symposium. He gave an account of the Copenhagen Accord and examined the policy consequences.

While he agreed with the commonly expressed view that the Copenhagen talks were disappointing, Hepburn considered the expectations for a global agreement were set too high.

The disappointments included:

- No binding 2020 targets.
- No agreed 2050 emissions targets and no peaking date set for emissions.
- No negotiation pathway was determined.
- No agreement on research and development – R&D did not achieve the priority focus that is required.

The strong positives from Copenhagen included:

- The US and China were deeply engaged in the Copenhagen negotiations and now have emissions targets.
- A system to monitor, report and verify the emissions of each country is within reach.
- More than 100 countries filled the appendices of the Accord with national targets.
- Reduced Emissions from Deforestation and Degradation (REDD) is a "no brainer" and is being looked at seriously.

- Key finance decisions were made with agreed fast-start capital of $30 billion being directed to developing countries in the period 2010-2012.
- Additional finance of $100 billion has been pledged beyond this date.

There was no elegant global solution from Copenhagen and no legally binding agreements. However, the Accord allowed countries to better cater to their own national interests when setting emissions targets. Emissions promises may be more secure as they are being made to voters.

What this means for policy

Dr Hepburn believes the most important negotiations will be carried out at the G8, G20 and major economic and trade forums.

The UNFCCC is likely to be a forum for the formal discussion and acceptance of a deal hammered out in a smaller group.

China

China is encouraging strong low-carbon policies in the west to create markets for its growing green industrial complex. It leads the world in solar photovoltaic production and is rapidly gaining market share in wind – the "green race" is on, and China intends to win. Domestically, China has promised to:

- Reduce emissions intensity by 40-50%.
- Increase non-fossil fuel component of primary energy to 15% by 2020.
- Increase forest cover by 40 million hectares by 2020.

European Union (EU)

A key change in EU policy has been more serious discussion and implementation of carbon taxes in several EU member states. These taxes set a minimum carbon price which increases certainty for investors in the renewable energy sector.

US Policy

The US has become very active in R&D support for clean energy technology after recognising China is stealing the march in this sector. There is a growing realisation in the US that clean energy leaders will gain geopolitical advantage.

The US legislative process on cap and trade is continuing, with a new draft from the Senate expected to be released shortly. It is unlikely a bill will pass through congress this year.

What the future holds

Geoengineering – except in the context of Carbon Capture and Sequestration (CCS) – is not a silver bullet according to Dr Hepburn. To explain this issue in depth, he referred delegates to the report *Geoengineering the climate – Science, governance and uncertainty, Sept 2009 – The Royal Society.*

Dr Hepburn said Carbon Capture and Storage is likely to be vital for the transition to a low carbon economy. The use of coal continues to rise in total quantities and as a percentage of world energy generation fuel.

However, another significant development is a technological breakthrough that is reported to halve the cost of shale gas extraction. This would be a "game changer". If the technology succeeds, the US has 100 years additional gas supply and the EU will have access to large deposits in Poland.

The next few years will be vitally important to create the structures and set in place policy that will help the world transition to a low carbon economy.

PROFESSOR GEOFF GARRETT

CEO, The United States Studies Centre

The United States Policy Context and Implications for Australia

Despite the rise of China, the US will remain the world's most powerful country for decades. Its climate and energy policy will have global ramifications, including in Australia.

Professor Garrett said the GFC continues to constrain President Barack Obama. Near double-digit unemployment is the number one issue. The US response to the GFC has added trillions of dollars in public debt. The crisis has also made it more difficult for Obama to push through domestic legislation.

With healthcare finally passed, the administration will move on to energy/climate change and financial reform.

Professor Garrett believes it will be easier to pass financial reform because getting tough with Wall Street is popular whereas Americans are more sceptical about climate change and more wary of big government policies than Australians. It is no surprise that Senator John Kerry has spruiked his new approach as a jobs and energy bill, with "climate change along for the ride".

The Kerry bill is not expected to be passed in 2010, but it is the new focal point for debate and discussion of US policy. It does not include an economy wide Emission Trading Scheme (ETS), but will likely emphasise:

- Targeted carbon controls and incentives.
- Emphasis on investment strategies in clean and alternative energy.
- Support for CCS.
- Support for nuclear power.
- Carbon tariffs on big emitters (like China).

The US Environmental Protection Agency has declared carbon dioxide a pollutant that it can regulate, but legal challenges to aggressive use of executive power are likely.

ANNA SKARBEK

Executive Director of ClimateWorks Australia

Policy Settings for Low Emissions Energy Infrastructure

Ms Skarbek said Australian business and investment confidence were shaken by the apparent failure of the Copenhagen talks, the shift in the Coalition's position on climate change policy and the inability of the Federal Government to deliver legislation through a hostile senate.

However, there is strong interest in practical solutions to reduce emissions. The recent release of ClimateWorks' *Australia's Low Carbon Growth Plan* – identifying 54 tangible ways to reduce emissions using available technologies – received significant interest from the media and public.

Despite the lack of bipartisan support for an ETS, most business leaders and policymakers accept a price on carbon is inevitable. They also understand a carbon price by itself is not sufficient to reduce emissions in all sectors.

Currently, non-price barriers are affecting the take-up of many emissions reduction opportunities which are already profitable for investors. These barriers include decision-making processes, lack of information/awareness and access to capital.

Beyond the ETS, there is activity around other aspects of Federal climate change policy, particularly energy efficiency. In light of this the government has:

- Created an energy efficiency task force headed by Howard Bamsey.
- Following a UK model, set up an Australian carbon trust to broker funding for R&D and work on energy efficiency.

- Begun considering vehicle fuel efficiency standards.
- Improved a range of domestic energy efficiency standards and incentives.

This focus on energy efficiency may be incorporated into energy market regulations that directly impact generators. Policymakers are considering a Californian approach that means utilities must factor in efficiency costs before electricity supply can be increased. Amendments may be made to the national electricity market.

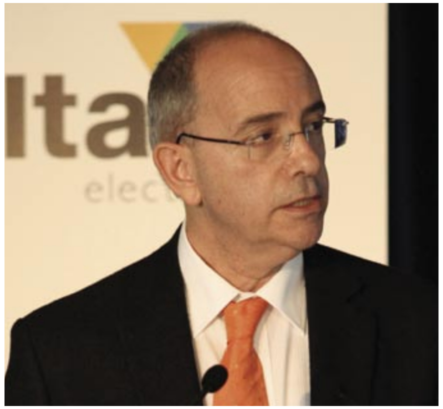
A carbon price will significantly increase potential investments in emissions reduction opportunities. This price can create increased opportunities for energy-savings companies and demand-side management.

Ms Skarbek also believes Australia should follow the lead of the US and increase R & D incentives for the private sector.

PROFESSOR TONY VASSALLO

Delta Electricity Chair in Sustainable Energy Development

Distributed Energy, Renewables and Energy Storage



Our future power supply will come from intelligent electricity networks, smart use of storage technology and diverse sources of generation, according to Professor Tony Vassallo.

When examining renewable energy generation, planners take into account that energy demand varies from minute to minute. Alone, renewable sources would not always match the demand but, combined with an increasing fraction of gas generation, this could be easily managed.

Professor Vassallo does not see this stopping Australia from reaching its 20% renewable generation target by 2020. He believes we will be well on the way to a 50-60% renewable supply by 2050.

Distributed energy networks – particularly those using rooftop photovoltaic solar cells and building integrated cogeneration – combined with smart grids will play an important role meeting these targets by reducing demand at high load times.

A potentially revolutionary solution is the use of distributed energy storage.

Looking at high demand times for electricity in NSW, in 2009 the top 10% of the load curve represented 68 hours over about 20 days. The average cost for this part of the curve was $874/MWh, compared to an average price of around $48/MWh.

If energy was stored to cope with this peak demand, each year the requirement for additional generation and distribution capacity would be significantly reduced. It is possible to store electricity to cope with this demand – not necessarily in one large battery but through hundreds of smaller units at substations and commercial and industrial sites. Each battery would be the size of a small skip bin and could hold 1MWh to be called on at peak times. These systems may be economic now after all costs are accounted for.

According to Professor Vassallo there is no single, silver bullet. Emissions targets will be reached by assembling all these elements – significant diversity, greatly expanded renewables, significant cogeneration and distributed energy storage. Through this Australia can gain reliable, high quality, low emissions energy by 2050.

PHILIPPE PAELINCK

Alstom, International

Technology for change – The Status and Potential of CCS

Mr Paelinck opened his presentation with the fact that 40% of the world's man-made CO_2 emissions came from the power generation sector. He said with global energy demand expected to double by 2030, the power industry needs to find solutions to curb the CO_2 emissions it creates. In other words, we need to "decarbonise" power generation.

Alstom's Clean Power Today! Strategy is a three pillared-approach to the issue. It focuses on a more balanced technology mix with more renewables and CO_2-free technologies; improved production efficiency for both new and existing power stations and CCS for both gas and coal power stations.

CCS is an essential part of this strategy. The International Energy Agency (IEA) has estimated that CCS can contribute over 20% of the emissions cuts needed globally by 2050 and that, without CCS, the overall costs of reducing emissions to 2005 levels by 2050 would increase by 70%.

The presentation showed the global progress in the development of carbon capture technologies worldwide. It focused on Oxy-Firing and post-combustion

technologies, and showcased 12 CCS projects Alstom is running around the globe then the roadmap for commercially offering CCS technologies by 2015.

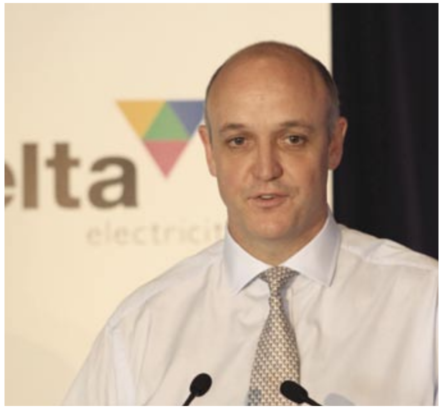
The presentation emphasised the importance of "capture ready" power plant designs and of retrofittable CCS technologies – in particular how these approaches could help to transition Australia towards a low carbon economy. The applicability of CCS technologies currently being developed to low-rank coal fuels was highlighted.

Finally, Mr Paelinck summarised key policy developments worldwide and the importance of government support to establish large-scale demonstration projects.

RICHARD WAGNER

Head of Investment Banking, Morgan Stanley

Financing New Generation Facilities



Financing New Generation Facilities

Capital markets dislike uncertainty. Unfortunately, the Carbon Pollution Reduction Scheme (CPRS) debate, its failure to pass, the lack of a carbon price and the threat of equity impairment have created an uncertain investment environment.

Challenges for the generation sector

Coal – The Australian coal-powered sector has significant problems including:

- The current owners paid a high price for generation businesses - particularly Victorian assets.
- These assets are highly geared. Banks must be paid down before further investment in replacement low emission infrastructure.

Gas – Gas powered generators cannot make 20-year investment decisions because long term fixed-price gas contracts are unavailable.

Renewables – Solar, geothermal and CCS have not been proven commercially viable.

What the future holds

The estimated level of investment over the next 10 years in power generation facilities is $40-50 billion. The cost of transmission and distribution is likely to be $47-65 billion. Over $100 billion could be needed over the next decade.

There is also $9 billion non-recourse debt due for renewal over the next four years. Every major Australian bank is exposed to the sector. Foreign banks will increase pressure on these borrowers to repay capital because many are exiting Australian markets.

A CPRS, if passed, will impact generator cash flows and would increase variable costs for high emission generators. The profit-margins of these generators would then shrink rapidly. The estimated loss may only be partially offset by the Federal Government's proposed free permit allocation.

What needs to happen

A stable price for renewable energy certificates (REC's) is crucial for new investment in wind energy.

Government intervention in REC pricing distorts market outcomes. Any new programs or policies must consider the impact on REC prices.

Existing generators are best placed to time investments to manage the transition to low carbon electricity generation.

A solution that restores the confidence of capital markets must be found soon.

BRENDAN LYON

Executive Director, Infrastructure Partnerships Australia

Building Infrastructure for 2050

According to Brendan Lyon, governments cannot afford to pay for the necessary major infrastructure projects required over the next 10 years. It is estimated the cost could go as high as $770 billion. The only way to afford these projects is through private investment.

Electricity generation alone requires around $97 billion of total investment over the next decade.

Residential energy needs are expected to increase 56% between 1990-2020. While there has been a significant increase in energy infrastructure investment since the 1990s, more is required to bridge the emerging gap. Mr Lyon said the financial path to infrastructure renewal must be resolved urgently.

To meet their capital expenditure requirements, state governments must reduce their debt load. The two immediately available options are to improve government efficiency or to follow Queensland's lead and give up a Triple-A rating. The first of these options has greater appeal for most State governments.

Privatising the electricity generation sector in Queensland and NSW would improve market wide efficiency. Mr Lyon said research showed energy assets were optimised when entirely privately owned.

According to Mr Lyon, the stagnating value of energy generation assets and the fact that a quarter of the NSW budget goes into the sector creates further

incentive for the NSW Government to fully privatise the sector.

The following reforms could increase investment in the sector and set up future growth.

- Sell the three retail businesses.
- Sell or provide long-term leases on existing generators.
- Sell all seven generator development sites.

Mr Lyon discussed the challenges posed by the uncertainty in carbon abatement policies and the challenge of refinancing privately-held generators across the national energy market as a result of this uncertainty.

He said to secure a functional and truly national energy market Australia needs to deliver a competitive and properly interconnected national grid. This would harness the benefits of Australia's federation to drive an efficient and secure energy sector.

NICK ROWLEY

Director, Kinesis

Challenges and Opportunities Towards 2050

Mr Rowley summarised key contributions from the speakers.

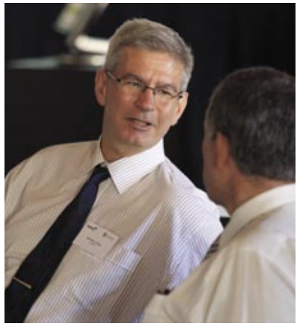
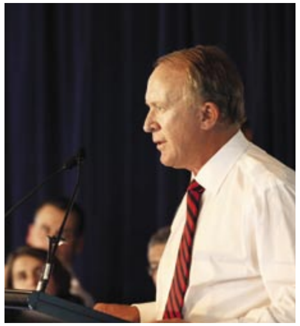
He warned delegates not to be distracted by the politicisation of the energy policy and climate change debate in Australia. The debate around the CPRS did not diminish the need for rigorous, cost effective and practical approaches to reducing carbon emissions.

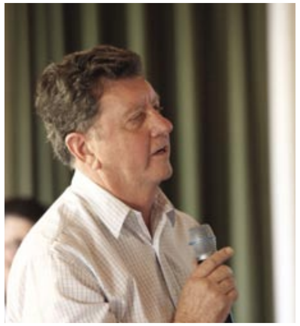
Mr Rowley highlighted some key insights:

- Although not a total failure, Copenhagen failed to provide the clarity a more effective international climate treaty could have achieved. Meaningful climate policy must be negotiated by heads of state given the implications for energy, transport, economic and trade policy.
- Climate change is an unprecedented problem. Business-as-usual involves significant risk.
- Climate change does not recognise national boundaries – nor does climate policy. Decisions by major governments could have major implications for the Australian economy.
- International climate negotiations may be most effectively advanced by the G8, G20 and the Major Economies Forum on Energy and Climate.
- The US remains important. If it imposes a carbon price other countries will be more likely to follow.
- As Australia's population grows so will its energy needs. Energy efficiency is important but it is not an alternative to de-carbonising our energy supply.
- Australia will be investing billions in new infrastructure in the immediate future. The cost of carbon must be factored into electricity generation investment. Until there is greater policy certainty, it will be harder for investors to commit to new projects.
- The government sees energy and climate policy as separate challenges. Rather than debating the merits of energy supply-side technologies, policies need to establish how Australia will generate the energy it requires while achieving the emissions reductions climate change demands.

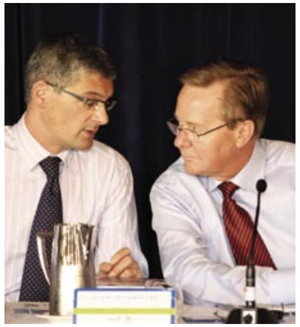
According to Rowley, the symposium demonstrated that Australia's largest generator was taking climate change seriously. Barriers remain, but if industry worked with government and research sectors it was possible to achieve a low carbon electricity mix by 2050.

MOMENTS FROM THE SYMPOSIUM





BACKGROUND

Delta Electricity is an electricity generation corporation that provides 12% of the electricity for the National Electricity Market (NEM). This market covers South Australia, Queensland, NSW, Victoria, the Australian Capital Territory and Tasmania.

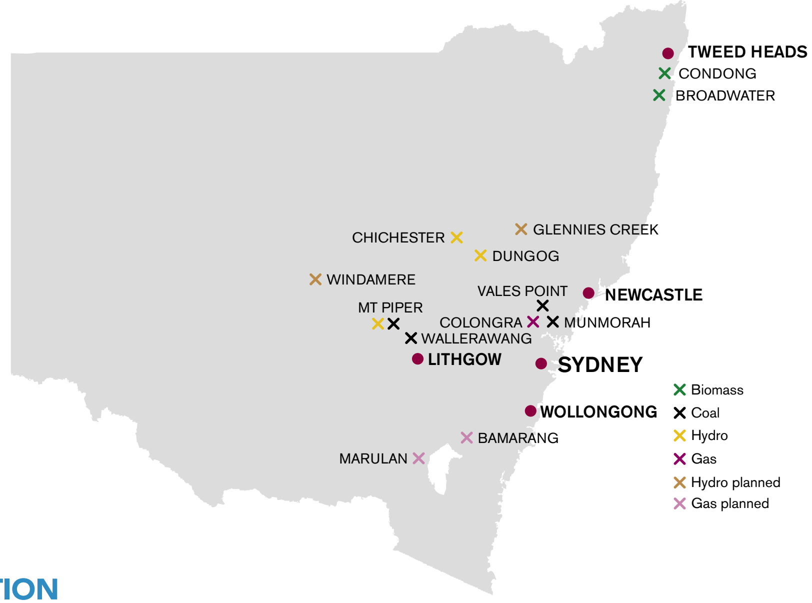
It is the largest generator in the NEM with over 5,000 MW of installed capacity. Generation from the portfolio is co-ordinated, helping Delta maximise efficiencies and respond to market demand and plant changes.

We produce electricity using diverse energy sources including gas, coal and biomass as well as from mini hydro-electric plants.

Our primary objective is to operate facilities for efficient, safe and reliable energy production for industry and the community.

We recognise the environmental impacts from the use of fossil fuel in power production and are focusing considerable investment into improving our sustainability.

DELTA OVERVIEW



LOCATION

Location	Unit Size	Total Units	Capacity
Gas			
Colongra	667MW		667MW
			667 MW
Coal			
Mt Piper	700 MW	2	1,400 MW
Vales Point	660 MW	2	1,320 MW
Wallerawang	500 MW	2	1,000 MW
Munmorah	300 MW	2	600 MW
			4,320 MW
Hydro			
Mt Piper	350 kW	1	350 kW
Chichester Dam	110 kW	1	110 kW
Dungog Water Treatment Plant	110 kW	1	110 kW
			570 kW
Biomass			
Condong	30 MW	1	30 MW
Broadwater	30 MW	1	
	8 MW	1	38 MW
			68 MW

Biomass operations at Wallerawang and Vales Point involve the addition of biomass materials to the coal being conveyed to the station for combustion. This activity does not change the capacity of the station.