FINAL file

Western Australian Gas Supply and Emergency Management Review

Curtin University of Technology Submission

April 2009

Executive Summary

Curtin University of Technology is a teaching and research provider with a strong research presence in the resources, energy and policy areas. A key objective common to Curtin University's Australian Sustainable Development Institute, the Resources and Chemistry research initiative and The John Curtin Institute of Public Policy is to provide research to inform government policy. A list of key researchers at Curtin is included at Appendix 1 should the committee wish to follow up on any aspect of Curtin's submission.

While inviting respondents to address several points of interest to the Gas Supply and Emergency management Committee, the responses may be roughly placed under three categories: (1) what to do to facilitate mitigation of gas supply disruption(s), (2) what to do to allocate limited supplies of natural gas should a disruption nevertheless occur and (3) the emergency management regulatory and operational framework for managing a gas supply disruption.

Curtin University **supports the national definition of energy security elements** (adequacy, reliability and affordability) but believes **additional elements** of **sustainability** (economic, social and environmental dimensions) and **infrastructure security** need to be added to the WA Energy Security Plan (WAESP). Any energy security plan must also consider the short- and long-term impacts of exporting energy.

The previous State government sought to secure long-term domestic gas supplies through the establishment of a **domestic gas reservation policy**, with 15% of projected reserves for all new natural gas developments being required to be set aside for domestic purposes. However, it is unclear at this moment in time whether this policy objective will achieve the desired outcome of ensuring competitively-priced domestic gas is available for the State's long-term economic well-being. Further research on this is needed in developing the WAESP.

In response to the 2008 Varanus disruption, **diversification** of energy supply was obtained by the rapid redeployment of seemingly redundant coal-fired power stations to reduce the daily demand for gas. Learning from this experience may suggest that maintaining backup generation capacity may be the cheapest option to play a positive role in an energy security strategy. A detailed analysis is required.

Over the past two decades, **energy markets** around the developed world have progressively been liberalised to enable various competitive market arrangements to be established for the supply of and demand for energy. The focus of much research and regulatory attention in the early years of liberalisation was upon short-term market efficiencies and competitiveness. Further research on assessing the long-term dynamic performance of liberalised markets, with issues such investment in long-term adequacy of generation and production capacity and network infrastructure being uppermost of concern.

The trends impacting the global and domestic energy sector over the next decade or more foreshadow major and **disruptive changes** for the industry in the short and medium term.

Infrastructure security must be factored into any emergency management planning. Adequacy of monitoring programs, equipment failure, public and occupational health, environmental impact, industrial co location , impacts of climate change on extreme event risks, development of early warning systems and focus on low probability, high consequence risks are all essential elements in developing a infrastructure security plan.

Policy settings designed for the energy sector must negotiate a landscape where competition is entirely global for upstream production resources, and the considerations and decision-making priorities of global corporations can have significant impacts on local energy production and supplies to domestic consumers.

The **regulatory framework** for dealing with an **energy crisis** appears to be in place with two core underpinning pieces of legislation that can regulate the mitigation and response to a major gas supply disruption, these being the Energy Coordination Act 1994 and the Emergency Management Act 2005. However for an event like Varanus, the relevant roles and responsibility for prevention, preparedness, response and recovery were spread across several agencies. This is exactly why the Emergency Management Act 2005 was established. Fear of disrupting commercial markets is no reason not to invoke planned emergency responses. In most emergencies, markets are disrupted for both the short and longer term. The legislation requires the establishment of State emergency management policies and plans in relation to all hazards. This should now be a priority for the government.

A comprehensive **Energy Security Plan** must be developed for WA. The Plan should be more forward looking than the 15 years used in the national assessment and should look out to 2050. The plan should examine mechanisms to encourage diversification of domestic base load energy supply (for example geothermal, solar thermal), the future role of coal (lignite and black) use with appropriate CO2 capture and storage technologies, and the impact of the Carbon Pollution Reduction Scheme (CPRS).

There is a need to build an energy **research capacity** in WA. One of the issues evident in the responses to the Varanus incident was that the evaluation of its economic impact was different depending on the tools used and the detail provided on gas and other energy demand, supply, prices, and other market conditions. Without such robust data it is difficult to evaluate the economic impacts properly. As an example a framework for social/economic analysis of energy markets is needed to provide answers on the impact of policy decisions. A capacity for developing such tools is need in WA and would provide a toolset for policy makers to quickly assess the options available to them in situations of emergency constraints on energy supply, and develop "disaster recovery" plans for scenarios modelled in advance. Clear accountability for the assessment of impacts appeared 'ad hoc' following the Varanus incident.

Studies analysing the structure and level of natural gas demand in WA and the issues of gas supply security and measures for coping with gas supply disruptions need to be conducted in a broader context of an optimal energy mix. This point was raised by some stakeholders when the introduction of the Domestic Gas Reservation Policy was discussed in 2006.

Structure of submission

The submission structure consists of an introduction, background, energy security issues and options, allocation policies for limited supplies should a disruption occur and the emergency management regulatory and operational framework for managing a gas supply disruption.

Introduction

On 29 January 2009 the Western Australian Government announced the establishment of the Gas Supply and Emergency Management Committee to review the security of the State's gas supplies and how any future gas supply disruptions are to be managed. The Committee was tasked to review and provide advice to Government in regard to:

- gas supply security, both present and long term;
- the potential for gas storage or alternative schemes to avoid gas supply disruption or alleviate its effect; and
- lessons learnt from the disruption in supplies from Varanus Island in 2008.

Curtin University of Technology welcomes the opportunity to contribute to the consultation phase of the **Gas Supply and Emergency Management Review.** This submission acknowledges the significant background to the review with the following inquiries and reviews:

- NOPSA inquiry;
- Senate Economic Committee Inquiry (Appendix 2);
- Joint state and federal government Inquiry into the effectiveness of regulations for upstream operations;
- A national energy security assessment by Department of Resources Energy and Tourism; *and,*
- A related inquiry by the Ministerial Council on Energy on Management of emergencies in national electricity, gas and liquid fuel markets.

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Background

- Gas in WA is supplied to the South West and Kalgoorlie by 2 suppliers (Apache (Varanus), Woodside (North West Shelf)) via gas pipelines owned by private operators (DMP). Apache supplied 30% of the 800 TJ per day and in the height of the disruption smaller producers and Woodside reduced the reliance on Apache by 15%. This reliance on 2 suppliers is a key issue for consideration.
- Primary energy consumption in WA has grown by 3% per annum since 1998 and is forecast by the Australian Bureau of Agricultural and Resource Economics to grow by 3.8% in the medium term. This growth rate includes the effect of several new liquid natural gas projects, such as the Gorgon Venture.
- The Independent Market Operator (IMO), in its latest Statement of Opportunities (2008) has projected that electricity consumption and maximum demand (on the SWIS) grow through to 2017/18 at 3.9% per annum on average.
- Rises in global demand for natural gas has increased the pressure on supply and prices for natural gas for the State's domestic users. The State faces a growing local demand for gas at a time when most of the existing producers have fully contracted all their developed reserves.

- Large scale gas developments are planned but do not come on stream for 5-10 years and the costs and time frames are escalating. This will impact the cost of domestic gas supply.
- A small number of large industrial consumers (> 50 TJ per day) are the major users of SW delivered gas (Alcoa, Worsley, etc).
- Current gas specifications limit market entry.
- The gas market is distorted (international negotiations, local contracts locked in, little supply outside of the system).
- Equality of access and price rises too small to medium businesses during the Varanus incident appeared to be an issue for small business.
- The previous State Labor government sought to secure long-term domestic gas supplies through the establishment of a domestic gas reservation policy, with 15% of projected reserves for all new natural gas developments being required to be set aside for domestic purposes. However, it is unclear at this moment whether this policy objective will achieve the desired outcome of ensuring that competitively-priced domestic gas is available for the State's long-term economic well-being.
- The Dampier to Bunbury pipeline is now 25 years old.
- The Australian Government is encouraging the development of alternative energy to remove the national reliance on fossil fuels for electricity generation.
- State royalties generated by the petroleum sector were valued at over $700 million in 2007, comprising 34% of the State's total resources sector royalties.

Energy Security in WA - Mitigation of gas supply disruptions

Definition of energy security

The National Energy Security Assessment 2009 defined energy security as the adequate, reliable and affordable supply of energy to support the functioning of the economy and social development, where:

- Adequacy is the provision of sufficient energy to support economic and social activity;
- Reliability is the provision of energy with minimal disruptions to supply; and
- Affordability is the provision of energy at a price which does not adversely impact on the competitiveness of the economy and which supports continued investment in the energy sector.

Curtin University supports the national definition of energy security and suggests the inclusion of additional elements of; sustainability (economic, social and environmental dimensions) and Infrastructure security.

Against this domestic backdrop, Western Australian export of LNG is a significant industry in an economic context for the state (royalties, jobs, investment etc) and any definition of energy security must also consider the short- and long-term impacts of exporting energy.

History of Operational Gas Supply Disruptions in WA

Since 2004, Western Australia has experienced several events that many policy makers and market analysts consider having a probability approximating 1-in-25-years. These events include:

- **Black Wednesday (2004):** gas supply constraints on the DBP forces Western Power to advise all electricity consumers to avoid using air-conditioning to prevent rolling outages;

- **Gas Supply Shortage (January 2008):** an electrical fault within facilities managed by the North West Shelf venture leads to gas supply shortages for several days early in the New Year;

- **Varanus Island (June 2008):** an explosion at Apache Energy's Varanus Island facility forces significant reductions (30%) in daily natural gas supplies to the State, resulting in major business disruptions and the creation of the Gas Supply Coordination Committee to facilitate the delivery of additional gas and diesel supplies for the State. Provisional facilities established during the emergency include a gas bulletin board to enable

business-to-business gas trades. Estimates of the economic impact of the supply shortage range between $1-2 billion.

In addition to the operational supply events highlighted above, the State has also witnessed the rise in global demand for natural gas, increasing natural gas supply pressures and prices for the State's domestic users. The State faces concerns that growing local demand for gas is occurring at a time when most of the existing producers have fully contracted all their developed reserves.

The recent supply disruptions, particularly the latest and most severe at Varanus Island, together with concerns relating to domestic gas availability and pricing, have highlighted the State's vulnerability with respect to its energy supply security.

It should be noted that in response to the 2008 Varanus disruption, a rapid redeployment of seemingly redundant coal-fired power stations reduced the daily demand for gas and were brought on stream quickly to fill domestic electricity demand. Learning from this experience may suggest that maintaining backup generation capacity may be the cheapest option to play a positive role in an energy security strategy. Further research on the option is needed.

Energy Market Trends

Over the past two decades, energy markets around the developed world have progressively been liberalised to enable various competitive market arrangements to be established for the supply of and demand for energy. Much research and regulatory attention in the early years of liberalisation focuses upon short-term market efficiencies and competitiveness. In recent times, the increasing attention of academic researchers and policymakers has been directed at assessing the long-term dynamic performance of liberalised markets, with issues such as mechanisms to ensure investment in long-term adequacy of generation and production capacity and network infrastructure being uppermost of concern. Further information is at Appendix 3.

Globally, the energy sector undergoing change which shall dramatically alter the nature of the sector over the coming decade or more, including:

- **Carbon Trading / Renewable Energy Targets:** the institution of a price on carbon emissions promises to impact the energy sector in a profound and fundamental way. It is expected to not only raise the price of generation in the short-term, with associated political and economic ramifications, but is envisaged to promote the development and use of renewable/low-emissions generation capabilities within the sector. In addition, as a transitional measure towards a low-emissions economy, the Federal Government's Renewable Energy Target (RET) was increased in 2007 to ensuring 20% of Australia's electricity supply comes from renewable energy sources by 2020. The RET will compel investment in new generation to securing appropriate quantities of Renewable Energy Certificates (REC's), impacting the type of generation that will be constructed and the associated impacts on the design and construction of existing transmission systems to enable this generation mix;

- **Impact of Capture and Storage of CO2:** The national infrastructure requirements (pipelines from source to sink), the costs of capture and storage and the long term monitoring requirements will impact on new gas developments as well as existing and future coal fired power stations. The costs of capture and storage will add significantly to the price of future coal and gas generations' systems. Estimates of the increase in WA's green house gas emissions following the development of future gas production facilities in WA are around a 30% increase. This alone requires a detailed analysis of the cost and impact of mitigation. To comply with State and national CO2 emission targets capture and storage should be a feature of new gas developments. Retro fitting existing developments could add significantly to domestic gas prices;

- **Gas Market Development:** natural gas has increased from approximately 19% of world primary energy demand in 1980 to about 24% in 2007, with the commodity now produced and consumed in over 40 countries around the world. Natural gas consumption has doubled since 1980 and the International Energy Agency (IEA)'s recent *World Energy Outlook* stated that global demand is growing by 1.8% per annum, a higher rate than for oil. In 2004, the IEA predicted that the world natural gas demand will grow by 90% above current levels by 2030, and that the proportion of world primary energy demand satisfied by gas would rise to 25% during the same time, potentially overtaking coal as the world's second largest energy source. Recent market developments suggest the years ahead will see a substantial expansion in the global trade of natural gas, transforming the industry from a range of isolated markets into a more integrated and liquid global natural gas market;

- **Technology:** international climate change priorities and mechanisms have seen and foreshadow further significant technological developments impacting the energy sector. These technologies not only relate to generation capabilities and their associated distribution, but also look to enable more effective and responsive demand management, both on an industrial and residential level. Investment in these and other new technologies for the energy sector is expected to grow exponentially over the next 5-10 years, with the potential for "killer applications" to be developed that will transform the sector in ways not seen since its establishment over a century ago. Encouraging investment in geothermal, solar thermal and wave technologies is required and will diversify energy supplies (more to households than to high end business users of gas);

- **Price:** throughout the liberalisation of energy markets within Australia, State governments have maintained a great deal of control over the prices paid for energy by industrial, and particularly, residential consumers. With rising energy prices, ongoing market liberalisation, the introduction of a CPRS and other regulatory changes, as well as the utilisation of smart metering technologies, it is envisaged that price arrangements for energy consumers will increasingly be required to reflect the efficient outcomes of energy markets. Pricing policies around peak and off peak demand will be important when coupled with electric vehicle battery storage when and as electric vehicles become more prevalent and cost effective;

- **Security:** demand for energy, particularly within the APEC region, is expected to rise significantly over the coming decades, driven by increasing populations and expanding economic activity, particularly in developing economies. In 2004, APEC accounted for 60 per cent of the world's primary energy consumption. This increasing energy demand, combined with political instability in some energy producing regions, limited supplies of common primary energy sources such as oil and gas, climate change concerns, as well as potential terrorist activity, all highlight growing energy security concerns held by both developed and developing countries. Infrastructure security must be factored into any emergency management planning and include adequacy of monitoring programs, equipment failure, public and occupational health, environmental impact, industrial co location , impacts of climate change on extreme event risks, development of early warning systems and focus on low probability, high consequence risks.

The trends impacting the energy sector over the next decade or more foreshadow major and disruptive changes for the industry in the short and medium term.

Moreover, local policymakers face a significant challenge in determining the most effective policy settings for the State's energy sector due to:

- The complex interrelationships between the influences identified above and their associated net impacts on the sector as a whole; and

- The structure of the energy industry comprises large, multi-national corporations engaged in upstream production. Policy settings designed for the sector must negotiate a landscape where competition is entirely global for upstream production resources, and

the considerations and decision-making priorities of global corporations can have significant impacts on local energy production and supplies to domestic consumers.

Local Pressures

By 30 June 2008, the Western Australian gas distribution market comprised just under 596,000 residential and non-residential customer connections. This represents a 5.9% increase in residential connections, compared to 2006/07.

In WA, the IMO and ERA perform analogous functions to the Australian Energy Market Operator (AEMO) on an appropriate structure for electricity and gas emergency management (AEG Report - 2007/8).

In addition to the global and national trends identified above, Western Australia faces further specifically local pressures relating to:

- **Peak Electricity Demand:** peak electricity demand on WA's South West Interconnected System (SWIS) is rising and second only to South Australia in terms of its "peakiness" - the percentage of time maximum demand is reached on the system. Increasing peak electricity demand places pressure on WA's electricity infrastructure, currently requiring the installation of economically inefficient new electricity generation and network infrastructure upgrades to meet the disproportionate growth in peak demand. Peak demand occurs for only a small period of the year and electricity infrastructure required to support for this demand is likely to be utilised for as little as one to two days per annum.

- **Transport:** As Australia's largest state in geographic terms, Western Australia has considerable challenges relating to energy use for transport purposes. With growing requirements for increased mobility, significant difficulties lay ahead for the State in addressing greenhouse gas emissions from the transport sector. The State's cities have been traditionally planned around the availability of personal motor transport, discouraging more sustainable means such as public transport, walking and cycling. The Western Australian freight network is also dominated by motor vehicles with the associated investment made in fuel supply infrastructure. In addition to these "traditional" transport energy demands, WA also has very significant fossil fuel demand to support the mining industry; the other great economic sector of the State.

Developing a State Energy Security Plan and a State Emergency Management Plan for Energy Supply Disruptions

State Energy Security Plan

A comprehensive Energy Security Plan must be developed for WA. The Plan should be more forward looking than the 15 years used in the national assessment and cover the period out to 2050 and examine mechanisms to encourage diversification of domestic base load energy supply (for example geothermal, solar thermal), the future role of coal (lignite and black) use with appropriate carbon capture and storage technologies, and the impact of the Carbon Pollution Reduction Scheme (CPRS).

The recent National Energy Security Assessment (NESA) findings highlight that governments face a number of key challenges if Australia's energy security position is to be improved or at least maintained. These challenges are similar in WA and include:

- the need for further market (supply and demand-side) reforms to maximise appropriate investment and improve the flexibility and resilience of energy markets in the face of disruptions or structural change;
- the impact of tightening supply/demand balances and infrastructure reliability on supply chain resilience;

- an increase in energy costs, including those from policies to address climate change, notably the Carbon Pollution Reduction Scheme (CPRS) and the expanded national Renewable Energy Target (RET);
- the sharply increasing cost of investment capital, global demand for energy infrastructure components and skilled labour; *and*
- threats to well functioning international energy markets such as reduced availability of capital from the current global financial crisis and growing resources nationalism.

The NESA also concluded that consideration of the following points will enhance our energy security position in the future:

- investment frameworks for converting energy resources for delivery of energy to the economy;
- energy diversification to assist in managing supply shocks;
- price transparency and flexibility to signal appropriately timed, sized and located investment; *and*
- efficient allocation of resources in energy markets.

The NESA concluded that gas affordability (higher costs) will be the most significant factor in gas security out to in 2023; supply and reliability are only seen as low or moderate risks.

Emergency Management Regulatory Framework

The regulatory framework for dealing with an energy crisis appears to be in place with two core underpinning pieces of legislation that can regulate the mitigation and response to a major gas supply disruption, these being the **Energy Coordination Act 1994** and the **Emergency Management Act 2005.** However for an event like Varanus, the relevant roles and responsibility for prevention, preparedness, response and recovery were spread across several agencies. This is exactly why the Emergency Management Act 2005 was established. Fear of disrupting commercial markets is no reason not to invoke planned emergency responses. In most emergencies, markets are disrupted for both the short and longer term. The legislation requires the establishment of State emergency management policies and plans in relation to all hazards. This should now be a priority of the new government.

A State energy emergency management plan should be developed by the relevant agency (Office of Energy) under the auspices of the Emergency Management Act (EMA). The plan should develop clear Minister and agency accountabilities and incorporate all the elements of prevention, preparedness, response and recovery to possible disruptions to gas supply as an issue. The plan should also include an analysis of a wide range of scenarios.

In developing the management plan an assessment of future risks is essential to differentiate between long- and short-term disruptions, natural event disruptions (cyclone, flood, fire etc), terrorist events and events that could lead to loss of life or destruction to property or the environment. Each of these event types determines the type of emergency response and responsible agency. For example:

Event type	**Primary Legislation**
1. Terrorism	*Emergency Management Act 2005*
2. Cyclone, flood etc	*Emergency Management Act 2005*
3. Loss of life	*Emergency Management Act 2005*
4.Damage to property, environment	*Emergency Management Act 2005*
5. Fault damage to infrastructure	*Energy Coordination Act 1994*
6.Industrial dispute or civil disturbance	*Fuel, Energy and Power Resources Act 1972.*

Short and Long Term Impact Analysis

One of the issues evident in the responses to the Varanus incident was that the evaluation of its economic impact was different depending on the tools used and the detail provided on gas and other energy demand, supply, prices, and other market conditions. Without such robust data it is difficult to evaluate the economic impacts properly. As an example a framework for social/economic analysis of energy markets is needed to provide answers on the impact of policy decisions. A capacity for developing such tools is need in WA and would provide a toolset for policy makers to quickly assess the options available to them in situations of emergency constraints on energy supply, and develop "disaster recovery" plans for scenarios modelled in advance. Clear accountability for the assessment of impacts appeared 'ad hoc' following the Varanus incident.

An analysis of potential supply disruptions should be carried out in the context of a "low probability high consequence" framework. This approach is relatively common in industry, and it will produce estimates that may be fed into a cost-benefit risk mitigation analysis to facilitate policy development. It represents a tool of direct relevance to the gas supply security questions raised by the Varanus Island event, and it will be quite credible in the eyes of industry.

Issues and solutions to gas supply security are different for short-term (ST) and long-term (LT). ST supply security refers more to the stability of services provided at different parts within the gas supply chain (production, transmission, distribution, etc) whereas LT supply security refers to the availability of facilities and network infrastructure required to provide these services.

LT supply security

It is well known that WA has a large amount of natural gas deposits; enough to meet with domestic demand for the next 100+ years. Therefore the concern about LT supply security is more about the competition between local and international market. That is, how much gas is made available to WA market when international demand for natural gas has been growing in last several years? At the same time, many of major gas fields are located off shore and developing these fields requires a large initial investment. Since sales of processed gas into WA market alone do not allow field developers to recover such large investment, development of off-shore gas reserves requires sales of large volume of gas to export markets outside WA in the form of LNG. In other words, while the WA market competes with international market in receiving gas from the same fields, the LT supply of gas into WA is dependent on the conditions of international gas market.

A rapid increase in oil and natural gas prices internationally has attracted vast investment into the exploration and development of natural gas reserves off-shore WA. This raised a concern that too much of gas from the WA state was to be supplied to outside the state. This concern led the WA state to introduce the Domestic Gas Reservation Policy in 2006, which requires 15% of natural gas processed onshore WA to be set aside for supply into the WA market.

After a sharp decline of crude oil price in late 2008, a major concern regarding gas supply security seems to have shifted into delays in the prospective developments of gas fields and their impacts on the gas supply into the WA market. The state projects a continuous increase of domestic gas demand, which requires some of the major gas fields (Gorgon, Pilbara, and Pluto) to start operating in early 2010's. Further increase of domestic gas demand requires additional fields to start supplying to WA by the end 2010's. It, hence, is of great concern if currently experienced low price of crude oil (which determines the price of LNG) attracts new investments into the development of new fields to meet with the WA demand. It is important to construct a model of WA's natural gas sector (including both domestic and export market) and conducting a simulation study to examine how gas production and amount of gas made available for domestic use would be changed by significant world variations in natural gas demand. Any policies effective in securing LT gas supply needs to be designed based on such model.

Initial investment into the development of a major gas pipeline (i.e. DBP) was made with heavy support by the WA state. Private entities tend to under-invest into pipeline and other infrastructure development due to the size of investment as well as the uncertainty of the returns from such investment.

Pipeline owners have installed capacity reflective of contracted volumes at contracted gas quality. This is seen by owners as an efficient solution to gas transport in a market with a small number of market participants and a narrow produced gas quality (DBP submission to the *Gas Specification on Pipelines in Western Australia).*

Diversification is a good strategy to alleviate adverse impacts of LT as well as ST supply disruptions. For example, after the energy crisis in 2000, the state of California considered: (1) expansion of NG pipeline, (2) expansion of underground storage, (3) LNG receiving terminal. The increased use of NG turbine to substitute for nuclear energy during summer 2006 in Japan is another example. Use of coal turbines to replace NG turbine in WA last year is yet another example.

Diversification is generally accepted as an objective to achieve long term security of supply - and diversification not just in terms of energy source but geographic location and supplier e.g. Gazprom's hold over EU gas supplies

Gas transmission is inherently a different commercial enterprise from exploration and production. Investment is underwritten by firm, long-term contracts for shipping capacity. In the case of the DBNGP, the minimum term for shipping capacity is 15 years, and even modest levels of investment (in comparison to E&P investment levels) are contingent on each stage of expansion being fully contracted. This lower level of risk is also more closely aligned with downstream commercial enterprises. As a result, traditionally the downstream customer contracts for gas transmission capacity. An expectation of reasonably stable gas transmission charges and knowledge of its own gas consumption requirements (intra-daily and seasonal volume flexibility) allows the downstream customer to tailor services to its particular business needs. Upstream companies, having already taken significant risks and invested significant capital in bringing gas to shore, are unlikely to contract for gas transmission services (unless that upstream company is affiliated with a downstream consumer of gas, for example, BHPBilliton). (Woodside submission to the *Broadening the Gas Specification on Pipelines in Western Australia).*

Another issue for consideration in the LT supply security is the design and location of future gas hubs. Economies of clustering compared to spreading the risk are all issues that affect long term energy security. Diversifying the locations of gas hubs seem to bring benefits also by mitigating impacts of ST supply disruptions.

The importance of enhancing the demand response in coping with supply disruptions in an efficient manner is essential and should be an ongoing program from the Office of Energy (like the water demand education campaign of the Water Corporation). Broader planning issues in the built environment also need to be considered, eg new housing with a preference for solar water heating and on roof energy supplies, geothermal use for heating and cooling (not base load). This also applies to other major infrastructure developments including both State and Australian government infrastructure developments. Now is the time to implement these changes while the new infrastructure is in the planning phase. The long term benefits will be an important consideration in dealing with long term energy security (> 25 years).

ST supply security

For ST disruptions, the 4 main approaches to cope with their impacts are:
(1) diversify the source,
(2) develop storage facilities,
(3) develop mechanisms for demand to respond quickly to supply disruptions, i.e., to be reduced quickly to minimize imbalances and,
(4) Bring on redundant coal fired plants

For (1), as exemplified by the supply disruptions last year, WA has only limited capacity to diversify the sources of natural gas supply. One approach to diversifying supply sources is to broaden the many, acceptable gas specifications so that additional sources within WA will be able to contribute to supplies.

The Varanus gas supply disruption also illuminated that, the state possesses a limited but effective way of diversifying its energy source through procuring electricity from non-natural gas turbines. This highlights the importance of examining the issues of ST gas supply security in a broader context of energy diversification. Alternative gas supplies such as developing tight gas or alternative energy supplies through maintenance of backup coal-fired generation or geothermal and solar thermal need to be factored into the long term planning. This planning needs to include the impacts on WA CO2 emissions in the longer term. Full development of the North West Shelf will be a significant contributor to increased CO2 emissions to the atmosphere in the absence of capture and storage as part of the development.

Underground gas storage (2) is commonly used in the North American markets. Gas can be also stored in the form of LNG (for example, Japan). While motivated primarily for smoothing seasonal variation in demand, these means of gas storage also mitigate adverse impacts of ST gas supply disruptions, such as those resulting from unexpected outages of production and transmission facilities, through spreading these impacts over to longer periods.

The current natural gas market structure in WA does not have a system to effectively transmit the true cost of natural gas into the end-users. Without receiving proper price signals, end-users have no incentives to reduce their consumption in the case of supply shortage. Creating a market system or regulatory response that fully transmits the variations in wholesale gas price to end-users is desirable and needs to be considered in the future. However, such a system may expose end-users to much greater price variation. In practice, some intermediate solution, such as a choice over two types of service contracts; interruptible and non-interruptible service, and/or allowing retail service providers to adjust retail rate more frequently, say at monthly or quarterly intervals, to reflect short- to medium-term fluctuations in wholesale gas price, would provide a more practical way to improve the economic efficiency.

It is important to identify the benefits to end-users of alleviating gas supply disruptions users' and how this relates to their willingness to pay for a stable gas supply or for the costs of risk mitigation. Such information is essential in examining alternative approaches to mitigate the adverse impacts of supply disruptions as the optimal level of physical measures for supply security (such as underground storage or pipeline capacity expansion) is found where the marginal cost of additional installation of such measure is equal to the marginal benefits. It is important to also create a system to monitor market conditions (demand, supply, price) and to develop an optimal system to help mitigate supply security

Studies analysing the structure and level of natural gas demand in WA and the issues of gas supply security and measures for coping with gas supply disruptions need to be conducted in a broader context of an optimal energy mix. This point was raised by some stakeholders when the introduction of the Domestic Gas Reservation Policy was discussed in 2006.

Social impact of disruptions and the costs and-benefits of mitigation strategies

One of the key considerations is the loss of confidence of community trust in Government and the consequential impact on the "rational" use of natural and built resources.

A major loss of gas supply could lead to the following impacts:

- Delayed investment by a wide range of businesses and SME in particular due to the uncertainty created;
- Direct economic loss by industry and small business; *and*

- The State Government being required to administer a 'trade-off' allocation policy between essential services (e.g. hospitals), industry (major, medium and small) and household (residential) needs until normal supply is resumed. An example of this was the Victorian Longford gas disruption.

Policy regarding re-allocation of energy in a crisis

Policy development for a socially responsible allocation of restricted natural gas supplies following an unlikely disruption must take into consideration the relative costs and benefits of individuals, households, businesses, and industry. Such policy must also recognize the economic/risk implications (Health, occupational and safety) discussed under the mitigation analysis, impact on essential services (hospitals etc), domestic consumers, large industrial users and Small to medium businesses.

One option may be to offer rebates to domestic consumers for a bottled gas connection point (individuals manage their own risk). This could be done at any time and have at least highly reliant domestic consumers less reliant on the domestic gas supply system.

The bulletin board supply model should be explored further as should pricing mechanisms developed around an "interruptible supply price" and a fixed supply price for those businesses that can switch between energy supply options cheaply and quickly. This is done in the US.

Social impact of energy restrictions

Little has been studied of the social impact of the restricted energy supply in the middle of winter on the health of the elderly and disadvantaged groups with mortality and hospitalisation rates being largely unknown.

Communications /Public awareness

The Energy security Plan and the Energy crisis Management Plan to be developed should include a communications and public awareness component, including whole of government plan. This is a formal requirement under the EMA. This will go a long way to improving transparency.

The Office of Energy should examine and adopt the best practices from the Water Corporation (in reducing water consumption) and Consumer Protection (Fuel Watch for transparency of pricing) , Health Department (Obesity campaign - awareness raising) and DRET for incentives to reduce the growth in energy consumption and improve energy efficiency.

Research and Future Policy Development

Curtin has a range of independent researchers that may be brought to bear on future research needs in the energy sector. In addition Curtin University of Technology with its partners (University of Western Australia and CSIRO) in WAERA is seeking support from industry and government to the establishment of an Australian Centre for Energy Markets on the basis that:

- during the above inquiries it was clear that the economic models used nationally and locally gave differing outcomes and appeared at odds with the evidence from Small to medium enterprises that indicated impacts in excess of $1m per business
- provide research analysis to inform policy on issues such as;
  - uniform quality standards
  - impacts on households - social impacts were largely ignored in all of the inquiries
  - assessment of alternative energy supplies (increased coal generated electricity, geo thermal, tight gas, solar thermal

- need for and operations of gas bulletin board market
- Development of analytical tools

The proposed features of these tools and their governance, via the establishment of the Australian Centre for Energy Markets, would include:

- **Dynamic State-Specific Characteristics:** the tools and models will be designed to incorporate the specific and distinctive characteristics of WA's energy supply and demand over time. Detailed inputs covering energy consumption by local industry sectors will be collected on a regular basis to accommodate the dynamic and changing patterns of consumption within the domestic energy market. Similarly, local social and economic demographics will be utilised to enable discrete impact assessments to be made regarding the potential influence of policy proposals;

- **International Integration:** through the development of national and international market components, the tools and models will be designed to provide an accurate representation of the interaction and influence of external markets on WA's energy sector;

- **Collaborative Governance:** it is proposed that the development of the tools and models be facilitated by the creation of an institutional framework that supports their refinement and improvement over time. Through the establishment of the *Australian Centre for Energy Market*, a collaborative venture between the University of Western Australia and Curtin University, this framework will be realised. Moreover, it is recommended that industry support for the model's creation and ongoing development, and particularly its data and information sharing requirements, be facilitated through direct industry representation on the Centre's governing council, as well as the establishment of an industry advisory board for ACEM with representatives nominated by the State's main industry bodies, the Chamber of Commerce and Industry (CCI), the Chamber of Minerals and Energy (CME) and the WA Sustainable Energy Association (WASEA);

- **Public and Peer Review:** while some notable examples exist of economic models built and maintained by public agencies, much of the economic modelling undertaken for the energy sector is conducted by private, commercial firms. Understandably, the design underpinning these private models are often unavailable for public scrutiny or investigation. By establishing the proposed institutional framework to house and manage ACEM's toolset, these tools and models will be open to public and peer review, enabling widespread scrutiny and contributions to be made from both local and foreign expertise which the proponents of ACEM believe shall lead to best practice formulations and model construction;

- **Training and Skills Development:** there is an acute shortage of economists within the State, requiring government agencies to rely heavily for policy analysis on private consultants to carry out research. Utilising the traditional capabilities of universities to train researchers and analysts, the ACEM would seek to help overcome the highlighted skills shortage through the provision of short and longer-term training, provision of policy consulting services and/or the potential secondment of resources to the State Government for specific research and analytical requirements;

- **Research Leadership:** the considerable changes influencing the energy sector over the next decade or more will posit a host of challenges for policy makers. For example, the proposed Federal Carbon Pollution Reduction Scheme (CPRS) raises significant questions surrounding the independence and methodology for measuring the amount and value of carbon emissions, as well as potential compliance costs for industry, both now and into the future. Also, the development of new resources projects, both in energy and mining, generates significant demands for economy-wide understanding of the effects of these projects, as well as factors that may prevent them from being pursued by their proponents. The ACEM will look to provide research and analytical leadership for these issues and others identified as priorities by government and industry alike.

Appendix 1

Key Researchers at Curtin University of Technology

Professor Ronald Ripple, School of Economics and Finance, Curtin Business School
Dr Hiroaki Suenaga, School of Economics and Finance, Curtin Business School
A/Professor Martin West, School of Information Systems, Curtin Business School
Professor Fiona McKenzie, Housing and Urban Research Institute of Western Australia
Dr Lynne Chester, Senior Research Fellow, Research and Development
Ms Linley Lord, Graduate School of Business, Curtin Business School

Appendix 2

Conclusions and Recommendations of The Senate Standing Committee on Economics on Matters relating to the gas explosion at Varanus Island, Western Australia

Conclusions

Impact of the Varanus Island Gas Explosion

6.1 There is no doubt that the Western Australian community faced significant problems as a result of the gas explosion. Business and industry experienced significant loss and industry failed to meet production targets due to the lack of gas supplies.

6.2 However the committee found there was no evidence as to a large impact on employment in Western Australia. This is consistent with the view expressed by business to the committee. However, while few workers have lost their jobs, it was reported that some have been stood down or required to take annual leave at times not to their convenience.

6.3 It is the committee's view that due to reliance of the community and industry in the south west of Western Australia on the Varanus Island gas facility that there was a disproportionate disruption to that part of Western Australia. Evidence was received from individuals who experienced significant dislocation to the extent that their businesses were faced with closure.

Contractual Arrangements and Supply

6.4 Based on the evidence received by the committee, no definitive conclusion can be reached in relation to the nature of contractual arrangements forced on business and industry during the gas crisis, or their status since the resumption of gas supplies from Varanus Island. A definitive conclusion was not possible due to the decision by Alinta not to appear and provide evidence to the committee. Notwithstanding this, the committee has no evidence that price gouging or unfair contracts were a feature of the market during the crisis. There is no doubt that some witnesses have a strong perception of market abuse and unconscionable conduct by market participants.

Government Response

6.5 The committee believes that the former Western Australian government responded in an adequate manner to the crisis and their management of the crisis was professional and effective. There was no evidence that the former state government acted in an improper manner or refused to release relevant facts and documents.

Energy Security

6.6 Energy supplies in Western Australia are prone to serious dislocation due to the lack of a mature, diverse and competitive market. This situation, coupled with limited supply capabilities, leaves the Western Australian community and industry prone to severe dislocation as a result of plant or pipeline failure.

6.7 The reliance on limited sources of gas production and supply for the domestic market is a significant impediment to the continuity of supply of energy for Western Australian consumers and industry.

6.8 There is no short-term capacity to provide significant amounts of reliable and affordable supplies of alternative energy sufficient to mitigate against a similar crisis if another major gas failure is experienced.

6.9 The feasibility of developing emergency storage facilities of gas in depleted reservoirs or other repositories is limited and would not result in continuity of supply during a similar crisis.

Recommendations

6.10 The committee provides the following recommendations:

Recommendation 1

State Government crisis coordination

6.11 The Western Australian Government should convene a forum comprised of gas producers, suppliers, power companies, industry groups, media outlets and community representatives to discuss and develop a range of standardised emergency response measures in the event that another gas crisis is experienced in Western Australia.

6.12 The forum should examine initiatives, including but not limited to, providing increased transparency and improved communication during periods of disruption to gas supply. Improved communication from government to the community and industry groups to their members would assist in the dissemination of timely and relevant information to the public and industry throughout Western Australia. In addition an analysis of the feasibility of improved contingency planning by government and the market should be undertaken.

6.13 The forum should also discuss the operation of the Gas Supply Coordination Committee and the Gas Supply Disruption Recovery Committee and whether there are improvements that can be made to the operation of these committees if another gas crisis eventuates. An assessment should be made of the Office of Energy priority schedule for gas supply and, whether, in hindsight, any improvements or modifications should be made to the schedule.

Recommendation 2

Emergency powers and the market

6.14 The Western Australian Government should conduct an internal analysis of the effectiveness and appropriateness of the legislative framework to deal with periods of energy crisis in Western Australia. Issues such as the government's capacity to invoke emergency powers in the public interest and the effectiveness of government intervention in a market-based industry should be analysed. In particular the response to emergencies under the Energy Coordination Act 1994 (WA) and the emergencies under the Emergency Management Act 2005 (WA) legislation should be assessed for their appropriateness following the experience of the Varanus Island gas explosion crisis.

Recommendation 3

Energy security plan

6.15 The Western Australian Government should conduct, as soon as practicable, the review of gas security announced on 6 August 2008. The review should be conducted in coordination with the Commonwealth's National Energy Security Assessment currently being conducted by the Commonwealth Department of Resources, Energy and Tourism.

Recommendation 4

Increasing competition in the Western Australian energy markets

6.16 To support increased competition and provide the community with improved information the Western Australian Government should establish a permanent gas bulletin board. Any permanent gas bulletin board should include the provision of information on pipeline capacity and flows to increase the transparency of the gas market in Western Australia. The committee also recommends that the state government explore options to provide the Office of Energy with powers to examine and publish transportation figures from the Dampier Bunbury Natural Gas Pipeline and the Goldfields Gas Pipeline.

6.17 The Western Australian Government should actively engage with the alternative energy industry in Western Australia in order to progress energy diversification through increased alternative energy capacity.

6.18 The Western Australian Government should also examine whether the current market-based approach to energy supply is providing sufficient information, openness and competition to Western Australian consumers.

Recommendation 5
Short-term contractual arrangements during a period of crisis

6.19 The Western Australian Government should commence discussions with energy suppliers on the need to balance the market approach with community and industry needs during a period of gas shortage. In particular, the need for improved transparency and accountability from the gas and energy industry during periods of crisis should be addressed. Given the perception of "price gouging" and unfair contracts it is in the interest of the industry and the government to examine increased transparency and accountability during periods of energy supply crisis.

Recommendation 6
Contractors

6.20 The committee received evidence from several contractors in the south west who were severely affected by the gas shortage. It was reported that Centrelink are limited in the assistance they can provide to independent contractors. The Department of Human Services should undertake an investigation of these concerns.

Appendix 3: Energy Dependence in the WA Economy

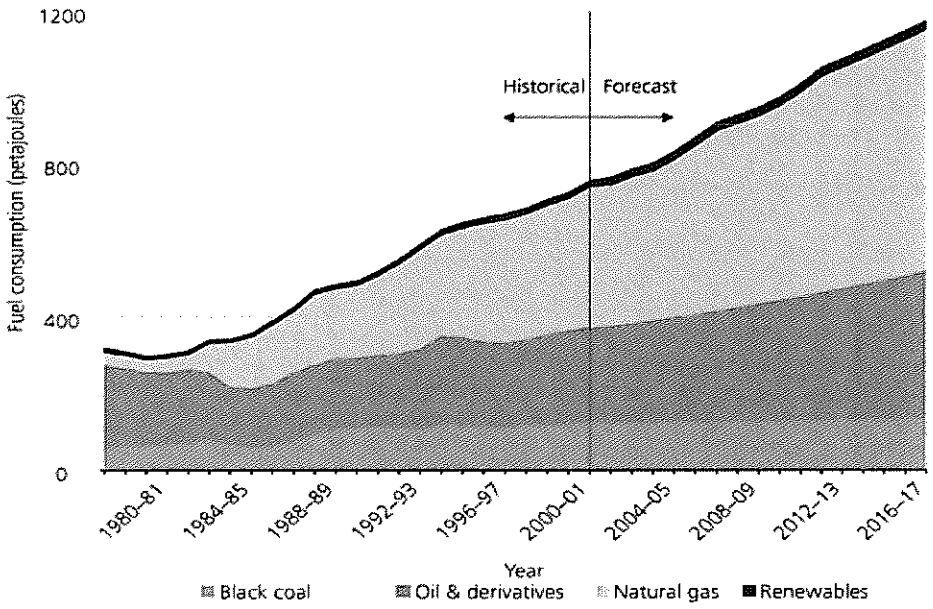
The Western Australian economy relies upon the production and export of energy. Much of the information provided in this section has been obtained from content published by the State's former Department of Industry and Resources (DoIR), the Office of Energy, and the Environmental Protection Authority's State of Environment Report 2007.

Western Australia is an energy-intensive, export-oriented economy. The State has an abundance of fossil fuels energy resources such as coal, oil and natural gas, and a growing quantity of renewable sources including wind, solar, wave, geothermal and biomass. Western Australia is a net exporter of energy with natural gas export contracts agreed with China, Japan, South Korea and Taiwan. The State also has significant reserves of uranium.

Energy Use in WA

Western Australia is heavily reliant on fossil fuels: 98% of WA's primary energy needs are supplied from fossil fuels. Nearly half of all fuel use is from natural gas, followed by oil (32%) and coal (17%). Renewable energy sources comprise 2% of primary energy in WA and include wood used for space heating and solar water heaters.

Figure 2: Western Australia's Sources of Primary Energy



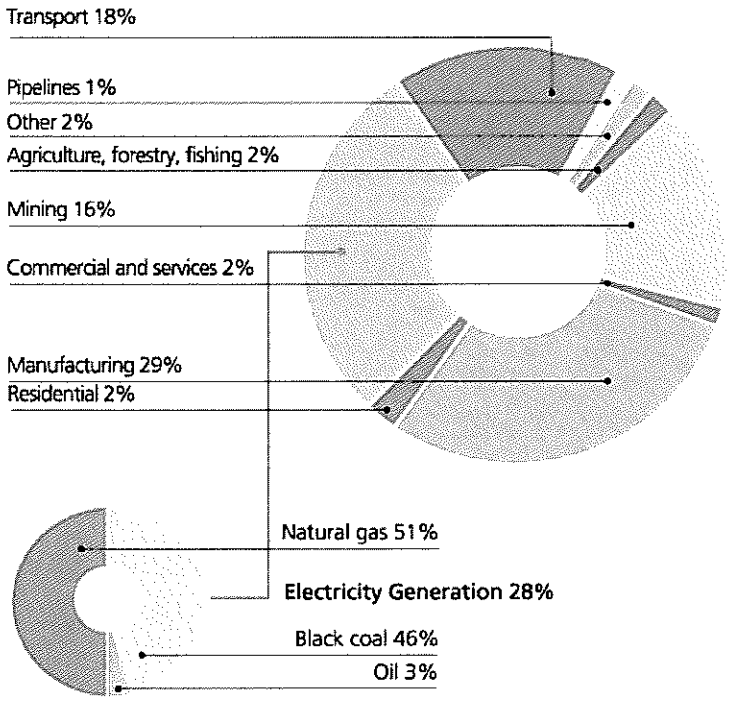
Source: Office of Energy estimate, based on Australian Bureau of Agricultural and Resource Economics (2005a); Akmal & Riwoe (2005).

Primary energy consumption has grown by 3% per annum since 1998 and is forecast by the Australian Bureau of Agricultural and Resource Economics to grow by 3.8% in the medium term[1]. This growth rate includes the effect of several new liquid natural gas projects, such as the Gorgon Venture.

Manufacturing is the largest sector in terms of primary energy use, accounting for 29%, followed by electricity generation at 28%, transport at 18% and mining. Bauxite refining, iron ore, nickel, mineral sands and silica processing are energy-intensive industries that collectively consume over two-thirds of the primary energy used in the manufacturing sector.

[1] *Australian Bureau of Agricultural and Resource Economics, Akmal & Riwoe, 2005*

Figure 2: WA Primary Energy Use by Industry Sector



Source: Office of Energy estimate, based on Australian Bureau of Agricultural and Resource Economics (2005a); Akmal & Riwoe (2005).

Over 80% of energy used in WA is used for stationary (non-transport) purposes, with natural gas being the most significant fuel used for around 60% of stationary energy, followed by coal (21%) and oil and its derivatives (17.5%). Renewable energy sources supply approximately 2.5% of stationary energy use. Since 1998, the stationary energy sector has increased by 3.6% per annum in primary energy terms.

Electricity is the main product from energy sources used for stationary purposes. Natural gas has become the dominant fuel source for electricity generation in the State, with growth in electricity demand supplied by natural gas-fuelled power stations. Coal use for electricity generation has remained stable since 1998. Renewable energy sources remain a small proportion (approximately 3.2% in 2005-06) of total electricity generation in WA.