

Energy Security in Australia

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Abstract

Australia is drifting towards a situation, where in the event of a fuels emergency, there could be serious shortfalls in the supply of liquid fuels to the eastern seaboard and to critical sectors of the economy. This situation is exacerbated by the move away from crude oil refining in Australia and an increasing reliance of imported finished fuels. Current crisis management methods are considered inadequate to deal with such a scenario as they primarily assume a ninety day stock of crude oil and the ability to refine it. International agreements are unlikely to help as they, on the face of it, concern crude oil supply and without refineries, there being no means of producing finished fuels.

To date crisis management assumes suppliers will respond to price signals in the market. In the event of a crisis, latent nationalism in supplier countries may exacerbate the situation from Australia's standpoint, preventing timely supply of products.

Crisis management measures in place appear inadequate to deal with this situation and would require extensive revision in order to ensure adequate and timely supply of petrol, diesel and jet fuel to the eastern markets.

Australia is increasing its reliance on gas for domestic electricity production and is planning to increase this reliance further by installing base load gas power generation and converting coal-fired generators to gas. A crisis in the supply of gas to the eastern seaboard could have a dramatic impact on the continuous availability of electricity to metropolitan centres with consequential impacts on the supply of fresh food. On the face of it, there seem inadequate national measures to ameliorate this situation, for instance by mandating the use of export gas to supplement domestic supply in such an emergency.

Biographies

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Introduction

Energy supply is the cornerstone to our developed civilisation. Energy is required for all facets of our lives, and without adequate energy our existence, in the way we have become accustomed, will be jeopardised.

Australia is very vulnerable to failures in the supply of energy, liquid fuels, electricity and natural gas. The loss of energy supply to a business is one of the major threats to the operation of that business and thus their continuity. The loss of energy supply to a community can move from an inconvenience to become a cause of political instability leading to challenges to government from a range of groups. For some businesses fuel/power can be a major component and thus a critical business requirement, for others although fuel/power may be a minor expense but supply interruption can cause serious disruption to business continuity. Furthermore, supply interruption of fuel/power may have consequences on basic life requirements such as food and potable water supply with a consequential impact on the continuity of government and national security.

Energy comes as raw energy, for example coal and natural gas, and derived energy such as electricity, liquid transport fuels and the pressure head that provides flow for water and gas reticulation. A failure in raw energy supply can impact on derived energy, for example the stoppage of lignite mining (Victoria, early 2012) through inclement weather stopped a major power station from supplying electricity to the Victorian (in reality east Australian) electricity grid.

There are new and serious threats to energy supply, and these include disorganisation from restructuring, the shift in emphasis from supply at any cost to improved corporate bottom lines, shift to more environmentally friendly feedstocks and lastly terrorism. As the national energy supply continues to restructure, inherent risks to supply is compounded rather than mitigated.

This paper concentrates on the supply of liquid fuels, natural gas and electricity to industry and commerce and their increasing inter-dependence, and the vulnerabilities to disruption of supply from human error, plant malfunction or deliberate disruption, including terrorist acts. Scenarios/strategies for maintaining energy/power supply are examined as risk management procedures, the basis for these scenarios being the adoption of various countermeasures

Energy and the Australian Economy

The Australian economy has been in a state of change over the post Second World War period, where a strong trend towards de-industrialisation has become apparent. The importance of direct energy supply to heavy manufacturing has been reduced with energy being supplied to primary production (especially minerals and fuels) and commerce (inclusive of service industries) (DFAT. 2011). Concomitant with this has been the inexorable

rise in power supply to residential consumers paralleling the widespread introduction of energy intensive appliances such as air-conditioning units and plasma televisions.

De-industrialisation has occurred through the reduction in tariffs, globalisation of production to low labour cost nations, and the difficulties experienced by middle-sized economies (such as Australia) to match the high level of technological innovation to ensure on-going competitiveness. Significant lowering of energy intensity (as energy consumption per unit of gross domestic product) by around 18% has occurred between 1990 and 2008/9, but with the total energy consumption increasing from about 5000 PJ to 5945 PJ between 1999/2000 and 2009/10. (DRET, 'Energy in Australia', 2012) Some of the reduction in energy intensity can be attributed to increased energy efficiency in production (such as cement) whilst other reductions can be attributed to de-industrialisation, for example the reduction in steel production.

The Australian economy has thus become a 'serviced based', commercial and raw product export centred economy, retaining some manufacturing, where there are niche market opportunities servicing the export sectors or are increasingly subsidised, one way or another, by central government.

Of major importance to the Australian economy is the export of energy. The ABARE 'Energy-in-Australia-2011' Report (ABARE, 2012) states that, 'Since 1988/9, the value of Australia's energy exports (in 2009/10 Australian dollars) has increased at an average rate of 11% a year', and goes on to state, 'the share of domestic consumption in Australian energy production decreased, from an average of 49 per cent in the 1980s to an average of 42 per cent in the 1990s, and has continued to decrease, to an average of 33 per cent over the past decade.'

From trade statistics raw energy exports (excluding uranium) were around 12% of total exports in 2010 (ABARE, Update, 2011). The maintenance of energy exports is thus an important factor in the Australian economy's health (DFAT, 2011).

Disasters effecting Australasia

Disasters and major disruptions are easy to forget once the emergency is over. So it is worth recounting some of the major incidents that have affected Australasia in recent years:

- The December 2010 flooding of Central Queensland coal mines and disruptions to the rail systems (The Australian, 2011),
- The Flooding of Brisbane in January 2011 (The Brisbane Times, 2011),
- The September 1998 Longford gas explosion – 19 days gas disruption to Victoria (Longford Royal Commission, 1999),
- The feeder failure into Auckland SKM in mid February, 1998 shut down power to the Auckland Central Business district (SKM Consulting, 2012). and
- The Victorian bush fires of 2009 (Bush Fire Royal Commission, 2010).

As well as these local incidents there have been several major incidents which have had worldwide impacts of which BP's Deepwater Horizon blowout (Macondo Well, 2011), the Japan tsunami and subsequent Fukushima nuclear meltdown (BBC, News 2011) and the Lusi mud volcano BBC, News 2011) are incidents which are still having an impact.

The above disasters are mostly from human error and/or plant malfunction and do not include deliberate disruption or terrorist acts. Human error and plant malfunction (or lack of

planning) compounding a natural hazard (for example Fukushima where an earthquake was followed by tsunamis) are perhaps the most dangerous disasters in the above list.

The 'depth' of 'energy' disasters

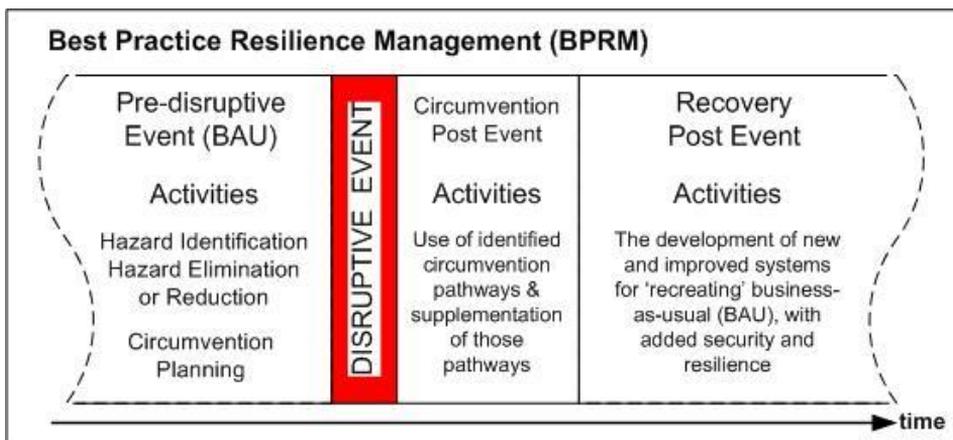
The disasters listed above all have very serious physical and economic connotations. They also have serious political and social ramifications. Security in-part means peace-of-mind to energy users and those that may be affected by existing or future energy related developments. The Sandman (P. Sandman, commercial presentation, viewed May 2002) definition of Risk is that: Risk = Hazard + Outrage. Disruptions of the supply of energy are an excellent reason for the creation of outrage. Disasters play into the hands of community members who push the 'precautionary principle' to the point that energy projects become impossible, since the 'what/ifs' become totally consuming. Such members of the community also help create outrage but more divisively help maintain outrage such that logical management strategies are not possible.

In the Fukushima aftermath all Japanese power reactors were shut-down, and the Japanese nation has been forced into looking for expensive fossil fuel alternatives for maintaining electricity supply. If the outrage from Fukushima could be abated, with selected power reactors being allowed to restart (after thorough safety reviews), then a more leveled and sustainable approach could be created for national energy supply over the long-term. This now appears to be occurring.

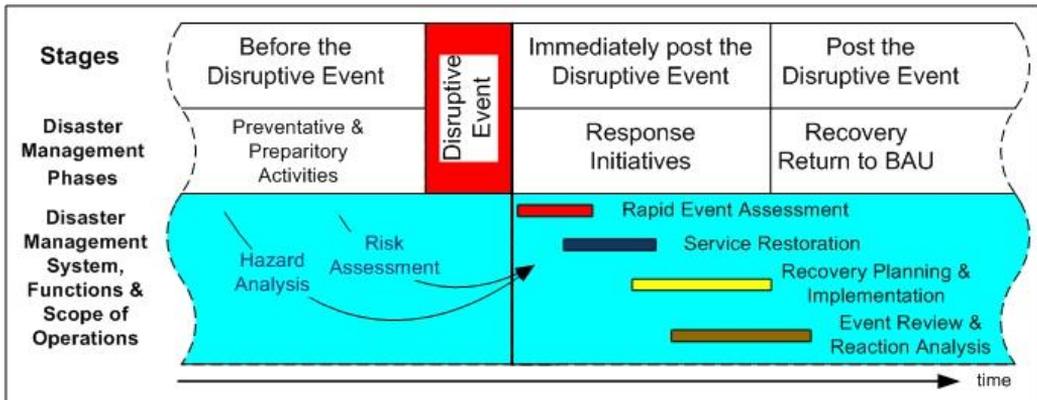
Scenarios/Strategies for Maintaining Fuel and Power Supplies

Barriers, buffers and resilience are tools to maintain energy supply. Barriers will help prevent incidents by keeping the hazard at a distance, where its effect will be lessened if not totally negated. Buffers, such as secure raw energy stocks, will help maintain energy flow during an incident, and will help lessen the immediate impact.

In the most general cases of post event risk management, the development of resilience is crucial. Having Resilience Management as a sub-set of risk management is crucial. The creation of resilience in any system that maintains energy flow is thus also crucial. The development of Best Practice Resilience Management will allow for return to Business-as-Usual (BAU).



Circumvention is the key to maintaining supply and service. It will often require use of buffer stocks, alternative pathways for supply and most of all ingenuity. It will be a major component of Rapid Event Assessment that will lead to service restoration. It will draw upon existing hazard analyses and risk assessments, to understand what systems are fully or partially functioning and what systems need to be replaced or mended.



We will now case study hypothetical disaster scenarios which could occur in Australia and indicate what would need to be done to mitigate them.

Disruptions to supply of liquid fuels, natural gas and electricity

Background

As world communications and logistic systems continue to speed-up, the world inexorably moves to become a global village. Thus, just as in the village rather than everyone making butter, one household provides butter for the village, so it is with the earth's economy in that some countries become specialists in supplying world needs and others look to this supply on a sustainable basis. For Australia it is clearly, on the one hand providing basic quarried products and LNG, whilst, on the other hand, moving away from value added energy intensive industries and manufacturing.

To-date this movement appears not only to work well but also, from the global standpoint, this moves the supply of goods to those regions which are most efficient in producing it with consequential economic (cheaper) and environmental (lower unit energy use) benefits. In the finality of the global village there is no room for "strategic" industries, for such industries have to be supported against the globalisation trend.

The move to globalisation can have profound consequences for national security and planning of energy supply which we discuss with reference to the supply of liquid transport fuels and natural gas to domestic users.

One point to emphasise is that the move to globalisation of the economy and the energy sector is not a centrally planned event, rather it is a consequence of the accumulation of many investment decisions over time by companies, suppliers and users. In capitalist or near capitalist economies this arrow of time inevitably leads to investment in the most profitable and efficient regions, starving less efficient regions of capital.

Another significant point to note is that all of the players have absolute faith in the transport logistics system and since these are generally in private hands, minimal capital will be expended on security of supply, rather a just-in-time system of minimising working capital (stocks) will hold for both liquid fuels and gas supply.

Consequence for Liquid Fuels

For transport fuels this has led to the growth in large regional refining centres such as Singapore which has been inimical to the growth of oil refining investment in Australia. Australia faces the prospect, that should globalisation of the hydrocarbon processing industry continue, then there will be no crude oil refinery operations on the eastern seaboard of Australia, with the concomitant closure of downstream hydrocarbon processing industries reliant on them. From a global perspective, this may bring efficiency gains by using larger scale operations overseas. It may also help achieve domestic political goals by removing large emitters of carbon dioxide from the economy. But there are also serious downsides.

Closure of refineries will have the consequential effect of turning refinery sites into import terminals for fully finished (Australian specification) products imported from overseas operations, in particular Singapore [this is now the openly stated policy of Caltex Australia]. One immediate outcome of this will be that Australia will not have the ability to upgrade any indigenous crude oil, should for whatever reason Australia become isolated. Continuance of supply in a stressed economy will be from the stocks kept in the system until the transport logistics system is restored. This is in contrast with today's situation where in the event of isolation, Australian refineries could produce some fuels (within limits) from the remaining indigenous oil production in the Bass Strait and oil from the small fields off Western Australia. Furthermore, in the non-refinery scenario, the stocks have to provide for three fuels – petrol, jet-fuel and motor distillate – with only minimal flexibility to switch, whereas a refinery would have the opportunity (again within limits, but broader limits) to change the relative availability of the three important fuel types.

Another feature of the non-refinery scenario is that disaster management is affected. In the refinery case, supply of fuels is provided by the ability to obtain crude oil, with stock control and supply in few hands. By contrast in the import terminal case, the import terminal may hold a limited quantity of stock compared to the general market requirement. For example many of us have experienced unplanned refinery shutdowns and noted the rapid movement of petrol stocks from petrol station forecourts to private vehicle tanks. In the terminal scenario, this may be exacerbated by not just petrol but also jet and diesel seeing a similar rapid change in location of stocks. Not only would authorities have to initiate petrol rationing, rationing of jet and diesel would be necessary.

Draft Energy White Paper

Australia's response to international disruption in the oil market is set out in a "Draft Energy White Paper" (DRET, 2011). This paper states that in the event of an emergency the government's response would be by the International Energy Agency's (IEA) collective emergency response mechanism and the Liquid Fuels Emergency Act of 1984. In the case of the IEA, it is not clear if the collective measures would ensure the supply of finished product as opposed to crude oil from various sources.

The white paper is rather dismissive of energy security stating "For a major global energy exporter like Australia, pursuing a goal of national energy self-sufficiency is

counterintuitive”, however, this rather naive view ignores the fact that Australia’s energy resources are in domestically unusable forms – coal and LNG – rather than the required forms of liquid transport fuels, natural gas and electricity. Historical parallels could be drawn with the Irish famine of the 1840s. At this time Ireland was a net exporter of foodstuffs (mainly meat and wheat), it was just not available at a suitable price for the starving masses of the western part of the country.

Another feature of the IEA commitment is that member countries (like Australia) hold 90 day stock supply. But in the non-refinery scenario, it is not clear if Australia would hold 90 days stock of finished products – petrol, jet and diesel¹. As noted above in the event of a crisis a large quantum of the stock could move from larger controllable centres (tank farms and distribution centres) to privately controlled storage out of the control of the government agencies charged with managing a crisis. The 90 day stock requirement could dramatically fall before government powers could be marshalled.

Latent Nationalism

One of the principal assumptions of the global village is that goods and services flow to the highest value sector, because price is the yardstick by which efficiency of distribution is judged. Thus in the case of a disruption, flow would be to the user who could pay the highest price. A key base of this assumption is that national interests play no part in resource allocation. But as has been demonstrated in the recent past, and is now becoming increasingly evident, in Europe, in time of crisis there is a re-emergence of nationalism which undermines this basic assumption.

An example is that regular disputes in the contracted gas supply between Russia, the principal gas supplier to the EU, and several of the countries of Eastern Europe results in limited supply of contracted gas to the western part of Europe. In the UK, in the far west, it was assumed that price signals from UK industry (rising prices) would assure continued supply. However, the gas flow is controlled by state and quasi-state controlled utilities which are often pressured by the national governments to ensure local domestic supplies irrespective for price signals from the UK. The resulting shortfall of gas supply in the UK has from time to time forced the closure of gas intensive industries and prompted increase supply from Norway and the expansion of LNG import terminals.

For Australia, there are two lessons from this development, the first concerns the provision of liquid fuels to Australia; namely can Australia rely on price signals alone or will, in the event of a serious international emergency, our suppliers pressured by nationalist interest divert supply to others. For example would Singapore be pressured to supply Malaysia or China rather than Australia? From Australia’s perspective this could both exacerbate and extend a supply disruption crisis.

Gas Supply

The other scenario concerns the risk of gas supply to the domestic market, which interestingly works in the opposite manner.

On the eastern seaboard, gas is dominantly supplied from three geographic areas. In the south, the Gippsland and Otway basins provide gas to Victoria, central Australian reserves

¹ Industry sources indicate that the stock level of finished product is less than 20 days.

supply Adelaide and Sydney and the developing coal seam gas reserves supply Brisbane and in future export LNG terminals at Gladstone.

Following a fire at the main Victorian gas plant at Longford in 1998 and the consequential shut-down of supply to Victorian industry, there has been integration of the pipeline network to ensure supply in the event of an emergency. One consequence, probably unintended, of this integration is that price for the entire eastern seaboard is determined by the highest price in the system which is soon expected to be the prices available in the export LNG industry.

Furthermore, although rising price and carbon tax could be expected to reduce industrial demand, there is a constantly rising demand for gas for power generation. This is driven by increasing use of unreliable renewable power generation which requires gas-turbine facilities as “dispatchable” power back-up, and by government fiat favouring new base-load generation to be gas based rather than coal based. We thus have a situation that a major disruption of gas supply could severely interrupt the supply of electricity.

Should a major disruption occur, say by the simultaneous disruption of supplies from the major Victorian facilities at Longford and the central Australian facilities at Moomba, in theory gas could flow via various interconnectors from the coal seam gas (CSG) operations in Queensland. However, most of this gas is likely to be committed to the export LNG business and it is a moot point to ask could export LNG be disrupted to support the domestic supply. In other words, does the government have the necessary power, or political will, to place contracted export gas at risk in order to support domestic supply of gas and power? At this time, as noted in the draft energy white paper (page 105), the government has no mandatory power concerning the distribution of gas, rather acting as a co-ordinator and leaving it up to market forces (price) to efficiently distribute gas in the system.

Furthermore, Australia does not possess the large gas storage facilities of other countries with large gas supply industries. Gas storage is by means of the stock within the pipeline system and in small gas fields primarily designed to even out local supply at times of a local peak demand. There are no national large scale storage facilities.

Another variation on this scenario is a major disruption to the CSG operations which would place the contracted export of LNG at risk. Would the government countenance limiting domestic supply in order to maintain output from the Gladstone export facilities?

The political decision would appear to be one of balancing the political stink of shutting down domestic supply in order to fulfil contracted obligations to foreigners versus offending powerful trading partners (China) in order not to suffer on the domestic political front. On present information it is not clear which way the government would choose and could be dependent on a random event such as an upcoming by-election.

Metropolitan Centres

The general disaster scenarios considered above and in the Draft Energy White Paper take little account of the demographics of Australia where it is important to note that most of the population is clustered in large metropolitan centres. Clearly there is a difference between managing an energy disaster scenario between relative remote towns and villages and the major metropolitan centres.

On the face of it the distributed centres would be better able to cope with an energy supply disaster since, being remote, they tend to carry a proportionally higher volume of stock, though this needs to be verified.

The situation could be quite different for metropolitan centres where it is likely that stocks are relatively lower and there is critical demand for fuel supply for maintaining life's necessities. For example, most supermarket chains appear to operate on a one week stock cycle and require significant volumes of diesel fuel to maintain adequate stocks and supply of fresh food. A national liquids fuel crisis would be required to ensure adequate distribution of fuel to food retailers. A further complication is that the urban areas are very large so that it would be critically important from a political standpoint to maintain a homogeneous supply across the region and not appear to favour one district relative to another.

A similar, but probably less severe situation would occur in the event of a natural gas/electricity crisis. Power disruption to supermarkets is likely to result in the wholesale destruction of fresh food, frozen and dairy products which would require rapid replacement or alternative delivery methods introduced. Again this is likely to exacerbate political considerations of managing the crisis.

Western Australia and Northern Territory

This discussion has concerned the energy supply on the eastern seaboard. Western Australia and the Northern Territory are isolated from the eastern supply chains in terms of liquid fuels and gas and should be considered separately. At the time of writing the refinery in WA is likely to remain operational and so the scenarios outline in the DEWP would be applicable. The Northern Territory has no refinery and is unlikely to attract such in the near future. The supply of fuels is by import of finished fuels and this is likely to persist. If local stocks are considered adequate (90 day minimum) then the issues raised in this paper are likely not to affect the Territory.

Conclusions

Australia is drifting towards a situation, where in the event of a fuels emergency, there could be serious shortfalls in the supply of liquid fuels to the eastern seaboard and to critical sectors of the economy. This situation is exacerbated by the move away from crude oil refining in Australia and an increasing reliance of imported finished fuels. Crisis management methods as set out in the DEWP are considered inadequate to deal with such a scenario as they primarily assume a ninety day stock of crude oil and the ability to refine it. International agreements are unlikely to help as they, on the face of it, concern crude oil supply and without refineries, there being no means of producing finished fuels.

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What is to be done?

On the face of it, following refinery closures, the current national response to a potential energy crisis involving the supply of liquid fuels is inadequate. A national response would have to address the following issues:

- The adequacy of present storage capacity for refined fuels, the distribution of this capacity and the logistics for effective distribution of the fuels according to national needs.
- If a significant increase in storage of refined fuels is required then not only will this requires additional tanks but the funds for the cost of this storage will have to be found. This is unlikely to be readily available from industry participants without the ability to pass this cost on to the consumer. For example, if an additional 70 days stock is necessary this could have a value in excess of \$3,000 million at current prices. Furthermore, the requirement to considerably increase holding times may result in product deterioration – petrol oxidation and gum formation, bio-infestation of jet-fuel and diesel.
- The logistics for sourcing additional supplies from outside the region. This would go beyond the relatively small refinery operations of New Zealand (which is also likely to be affected in a regional supply crisis) and probably consider supplies from across the Pacific from major refineries in California which are not reliant on oil supplies from the Middle East or the Far East.

For natural gas supply issues it would be necessary to have a formal response mechanism rather than “leaving it to the market” approach. This should not necessarily require a “strategic reserve” approach towards gas supply or the interference with price setting arrangements, but should set out the methodology of government control in the event of a national crisis. This may be extended to provision (by government investment) of strategic gas storage at appropriate points in the gas pipeline network.

References

- Commonwealth of Australia, Department of Foreign Affairs and Trade (DFAT), www.dfat.gov.au/publications/tgs/Australias-goods-services-by-top-25-exports-2011.pdf, accessed May 28, 2012
- Commonwealth of Australia, Department of Resources, Energy and Tourism (DRET), “*Energy in Australia*”, DRET, Bureau of Resources and Economics, February 2012
- Commonwealth of Australia, Australian Bureau of Resource Economics (ABARE), “*Energy-in-Australia 2011*”, ABARE, www.ABARE.gov.au, accessed May 28, 2012
- Commonwealth of Australia, Australian Bureau of Resource Economics (ABARE), “*Australian Energy Statistics - Update, 2011*”, ABARE, 2011, accessed May 28, 2012
- The Australian “Coal production grinds to a halt because of Queensland floods”, *The Australian*, January 12, 2011
- The Brisbane Times “Brisbane flood victims to confront the destruction”, *Brisbane Times*, January 14, 2011
- Longford Royal Commission, The Esso Longford Gas Plant Accident Report of the Longford Royal Commission”, Government Printer, Victoria, June 1999
- SKM Consulting, <http://www.skmconsulting.com/to-do-news/Archive/The-Auckland-CBD-Power-Failure.aspx>, accessed May 28, 2012
- Bushfires Royal Commission, “2009 Victorian Bushfires Royal Commission” Government Printer, Victoria, July 2010
- Macondo Well Deepwater Horizon Blowout”, National Academies Press, December 2011.
- DHSG Group, www.ccrm.berkeley.edu/pdfs.../DHSGFinalReport-March2011-tag.pdf, accessed May 28, 2012,

BBC News, March 11, 2011: www.bbc.co.uk/news/world-asia-pacific-12709598 accessed May 28, 2012
BBC News, February 25, 2011: <http://www.bbc.co.uk/news/science-environment-12567163> accessed May 28, 2012
Sandman P, Risk = Hazard + Outrage, Commercial Video Presentation, Viewed 2002.
Commonwealth of Australia, Department of Resources, Energy and Tourism (DRET), "Draft Energy White Paper"
Strengthening the Foundations for Australia's Energy Future', December 2011.
www.ret.gov.au/energy/facts/white_paper/ accessed May 28, 2012