15 June 2012

Abigail Groves
Inquiry Manager
Parliament of New South Wales
Macquarie Street
Sydney NSW 2000

Dear Ms Groves,

Re: CSIRO's response to Questions on Notice

Please find in the following CSIRO's response to the questions on notice from the NSW Public Accounts Committee hearing on 11 May 2012. This document should be read in conjunction with its 6 attachments that provide additional detail to the responses.

1. **In regards to storage of electricity, is the Hampton Wind Farm initiative producing the results that you expected? And at what point do you think it will become commercially viable for wind farms, or solar farms, to incorporate that sort of battery storage technology in New South Wales?**

CSIRO considers the Hampton Wind Farm project as a great success. CSIRO is also grateful for the support the NSW government has provided to the project. The project enabled CSIRO's Sydney based spin-out company Ecoult to demonstrate at scale a combined battery/wind smoothing algorithm package. Based on the results of the project, Ecoult has developed a commercial product that is already been deployed in a number of applications in the United States. Attachment [1a] describes the commercial product that has been developed based on the Hampton project and in particular page 38 contains a case study of the Hampton project.

The current and future economic viability of storage solutions, such as the one developed at Hampton, depends on a large variety of factors. These factors include for example, the demand and supply characteristics at the specific location where the device is located in the electricity grid, the ability to access benefits such as avoided network expansion costs, the type of application (eg short term storage to deal with second or minute fluctuations or longer term, peak shifting, applications to deal with demand-supply imbalances on an hourly time-scale). CSIRO has not yet done a comprehensive evaluation of the economics of storage options in Australia. CSIRO believes it is important to do such an analysis and is in the process of launching the industry-led Future Grid Forum in August 2012, see attachment [1b] for a description. The forum will deliver Australian specific insights on the value of storage. CSIRO would welcome the participation of NSW in the Forum. In absence of an analysis that takes the characteristics of the Australian electricity grid into account, the Electric Power Research institute (EPRI) in the US has done an in depth analysis of the economics of storage solutions in the US, see attachment [1c]. Figure ES-13 on page ES-15 (page 27 in the pdf) shows the different storage applications and their potential value and size of market segment. Table ES-4 on page ES-18 (page 30 in the pdf) shows the costs of the major available storage technologies. This analysis is only indicative of potential applications in Australia due to the different characteristics and size of the Australian grid.

2. Do you think there is a role for government to better introduce, implement or facilitate measures to manage demand more effectively? If so, how might government do that?

CSIRO analysis has shown that demand side measures are the most cost effective measures to contain the rise of electricity prices while at the same time reducing carbon emissions intensity of our electricity system. In 2009, CSIRO has completed an analysis of the economic benefits to Australia of energy efficiency, distributed generation and demand side management. In this study, we found that the benefit of a scenario where energy efficiency, distributed generation and demand side response is enabled compared to a scenario where these options are not available has a net present value (at 7% discount rate) of $130 billion, see page 12 in attachment [2a], which provides a summary of the Intelligent Grid report. The full 600 page report can be downloaded at http://www.csiro.au/en/Outcomes/Energy/Carbon-Footprint/IG-report.aspx. It contains a comprehensive list of barriers to demand side measures. Since CSIRO has published its initial report, other reports have looked at specific angles of this issue in more detail. For example ClimateWorks has published at http://www.climateworksaustralia.com/publications.html its report on "Unlocking Barriers to Cogeneration".

Regarding specific actions that government can take to manage demand effectively, it is worth noting that government already supports a range of effective measures, for example building codes and Minimum Equipment Performance Standards (MEPS). Continued support of such measures (ideally in conjunction with other States to minimise compliance costs for industry across Australia) provides a good foundation for effective demand management.

Additional measures should be targeted at addressing market failures and barriers because they are considered by the majority of economists to be the most cost effective.

Often market failures are around information. For example CSIRO through its Energymark (with support from the NSW government), see http://www.csiro.au/Outcomes/Energy/Energymark.aspx, and EnergySavers program, see http://www.csiro.au/energysavers, have provided Australians with targeted information to help them manage their energy demand and reduce their energy bills, which is particularly important for low income and financially constrained households. Programs of this type can have meaningful results, typically in the 10-20% energy reduction range and, depending on design, may be delivered at low costs, often with a net societal benefit.

Other market failures are often around split incentives. For example the Draft Energy White Paper 2011 by the Federal Government states: "while it may cost around $1500 to purchase and install a 2 kilowatt (electrical input) reverse-cycle air conditioner, such a unit could impose costs on the energy system as a whole of $7000 when adding to peak demand. These capital costs are recovered over time through energy bills, but because of the way energy is priced only some of the costs are paid by the purchaser of the air conditioner while the broader system costs are spread across all customers." (see http://www.ret.gov.au/energy/facts/white_paper/draft-ewp-2011/Pages/Draft-Energy-White-Paper-2011.aspx; p. 209). There is hence only limited incentive by the buyer of a conventional air-conditioning unit to invest into passive (eg insulation) or active (eg solar thermal air-conditioning systems – CSIRO is currently developing such a system together with a local industry partner) alternative solutions that could significantly reduce the total system costs (without even taking into account subsidies such as RECs). Therefore providing a market based mechanism to pass avoided network costs onto those who make investments to avoid peak demand could be one of the single most effective measures to manage demand effectively.

3. Do you have a view on any further appropriate action that government can take in terms of facilitating investment in new electricity generation projects?

Conducting research into how to facilitate investment in new electricity generation is not a core research priority for CSIRO. In our real options economic analysis of the energy sector, we typically find that uncertainty is the key inhibitor to investment. Government can reduce uncertainty and create a stable and predictive environment for investors by providing regulatory and market certainty. Government can also help to reduce technical risks of new technologies by supporting technology demonstration at scale, an activity CSIRO is often involved in. Key uncertainties by technology are listed in our report http://www.ret.gov.au/energy/Documents/Unlocking_Australias_Energy_Potential.pdf.

4. Can you provide the Committee with your draft strategy/program of work needed to support geothermal, coal seam gas, shale gas and carbon capture and storage?

Geothermal energy has the potential to be a low-cost, "base-load", low emissions energy technology. However the technology still has significant technical and commercial risks associated with it, which need to be addressed before it could play a major role in our energy system. New South Wales has potentially attractive geothermal resources in the Hunter Valley, covered by thick coal seams which may be working as insulators to enhance temperature prospectivity at depth. These resources are close to significant electricity infrastructure. Proximity to New South Wales' coal fired power stations also opens the opportunity for hybrid application to pre-heat steam. CSIRO with a number of partners have developed a proposition for a Co-operative Research Centre (CRC) for geothermal energy. The focus of such a CRC is on "flow", ie on predicting and ensuring high flow rates of a working fluid such as water through the sub-surface structures. Economic analysis suggests that understanding and enhancing flow is the key for creating certainty for potential investors and delivering competitively priced geothermal electricity. Attachment [4a] describes the proposed geothermal research program. Note that the proposal has not been submitted to this year's CRC round due to insufficient financial support.

CSIRO together with key industry participants from the gas industry have recently established the Gas Industry Social and Environmental Research Alliance (GISERA). This alliance focuses on researching the social, economic and environmental impacts of the natural gas industry and in particular unconventional gas such as coal seam and shale gas. Attachment [4b] contains a summary of GISERA's research program.

CSIRO has been actively progressing post-combustion carbon dioxide capture (PCC) technology in NSW. This has included the establishment of a PCC pilot plant at Delta Electricity's Munmorah Power Station and its subsequent relocation to Delta's Vales Point Power Station on the shores of Lake Macquarie. The NSW pilot plant is focussed on the characteristics of NSW black coal in contrast to some other pilot studies that have been applied to Victorian brown coal. Research results have highlighted the opportunity to remove both SO_2 and CO_2 in an integrated emissions control system. Thermodynamic assessments have indicated that the potential for efficiency improvements is at least 50 per cent. CSIRO's strategy is to undertake further research and development programs to improve efficiencies and lower costs in order for PCC to have commercial uptake potential. This includes developing designer amines and testing a range of amine absorbents, functionalised ionic liquids and enzyme technologies as well as the integration of renewable energy into PCC technology at the Vales Point power station. Additional demonstration of PCC technology is required to address scale-up issues such as integrating PCC plants with power plants and assessing the emissions from the power plant before and after the capture process.

Unfortunately, NSW presents particular challenges for geological carbon dioxide storage. Extensive low permeability sandstones characterise the Sydney Basin area and these rocks make it difficult to find locations that easily allow carbon dioxide to be injected at the required rates. Sites that have the potential to be geologically attractive may impact other land uses or be close to coal bed methane. These and other issues would need to be resolved and require an additional resource conflict study program. CSIRO's

strategy would be to evaluate geological carbon dioxide storage, especially at potential sites in northern NSW, to ensure the viability of an integrated capture and storage project at a particular location. The potential sites should be considered in terms of their technical suitability as well as their compatibility with other resource and land use requirements. A component of the program should monitor issues and provide public information. Storage of carbon dioxide should commence at demonstration scale before proceeding to the commercial scale.

I hope this addresses the questions adequately. Please do not hesitate to contact me should you require any further information.

Yours sincerely,

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Attachments:
[1a]
[1b]
[1c]
[2a]
[4a]
[4b]