Submission for the development of the Australian Government's Energy White Paper

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7 February 2014

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Executive Summary

Swinburne University of Technology (Swinburne, the University) is pleased to make this submission to the Federal Government's development of a new Energy White Paper.

As a leading university of science, technology and innovation, Swinburne makes a significant contribution to the field of energy research, including renewable energy (from generation and capture through to efficient use), digital and technology-based solutions to energy market management, social attitudes and implications, energy management and energy efficiency.

Swinburne's submission draws on our research expertise to present three themed contributions with associated recommendations for consideration in the development of future policy settings: *Energy Technology; Energy Efficiency;* and *Skills.*

A summary of Swinburne's research expertise and recent publications is outlined in Appendix 1.

About Swinburne

Swinburne continues to be ranked as one of the world's top 400 research universities (based on the Academic Ranking of World Universities 2013), and in the top 100 for physics.

Our combined expertise spans research, higher education, vocational education and training (VET). We produce career-ready graduates in energy related fields such as engineering, and enabling fields such as computational science and information and communication technology.

Our Response

Swinburne will focus on three key areas of consideration in energy policy development.

1. ***Energy Technology:*** *identifying and prioritising the game changers*
2. ***Improving energy efficiency:*** *design, adaptation and social impact*
3. ***Skills:*** *meeting the people and skills challenges of the energy market*

Recommendations

In developing the Energy White Paper, Swinburne recommends that:

1. The Government applies a prioritised approach to game changing energy technologies (refer to 1.6)
2. The Government supports awareness of design for energy efficiency, adoption of energy innovations in industrial processes and tools for measuring sustainable, low-carbon urban development gain a high priority (refer to 2.5)
3. The Government work closely with education and training providers, as well as energy industry participants, to prepare the future workforce and capitalise on skills export opportunities (refer to 3.2)

1. Energy Technology: identifying and prioritising the 'game changers'

Australia's research, development and implementation of renewable energy sources spans the breadth of the technology adoption lifecycle. Some sources are closer to market, requiring only minor funding and support in order to actively contribute to Australia's energy market mix. Swinburne recommends that the Government identify and prioritise the 'close to market' energy technologies currently in development across the country.

Equally, Swinburne recognises the new energy technologies that are still in the early phase of development. However, these innovations demonstrate potential to radically change Australia's energy market and it is critical that there is investment in these long-term solutions.

For example, some of the close-to-market technologies that Swinburne is actively contributing to through research and development are outlined below:

1.1 Smart grids

The emergence of smart grids together with smart meters, and other information and communication technologies, opens up the opportunity to drive more productive and efficient energy use enabled by distributed generation, storage and use of renewable energy.

Through this technology, consumers will be able to participate in the energy market as local energy producers who can generate and/or store renewable energy, manage energy in micro-grids, and collectively contribute to the existing baseline power by improving the load balance both at the local and global grid levels.

Most existing efforts towards building smart grids focus on providing the necessary infrastructure, such as smart meters, networking, dash-boards and portals for collecting and making the information about energy use available in real-time. This information will help the consumers in making decisions about their energy use, for example deciding when and which appliance to use depending on the current energy cost. It is envisaged that it will also allow the suppliers to more actively manage demand for the energy through the use of flexible tariffs and dynamic adjustments of the energy price in order to influence the consumer behaviour.

In order to realise the full potential of smart grids and achieve the envisioned efficiencies, new software solutions are required to support and automate energy management and deliver tangible benefits to all the participants in the energy market.

1.2 New solar technology

The challenge for new solar cell technology is to continue to develop efficiencies in the technology so it can successfully compete, in terms of cost, with current polluting forms of energy. These new technologies need to be scalable for industrial production and continued research by Swinburne, into the development of pilot production lines, is assisting in bridging the gap from laboratory to industry manufacturing.

Swinburne and Australia are leading the world in the development of cutting edge solar photovoltaic (PV) research. Specifically, nanophotonic solar technology, which allows more light into a solar cell and assists it to stay longer inside the cell, and has been demonstrated to drastically improve the energy efficiency of solar cells.

Development of new building materials, including solar skins and films are low cost innovations that can be integrated with glass building materials. This type of technology offers great flexibility for integration with current building stock and has a high efficiency if combined with nanophotonic technology.

Examples of longer-term technologies that Swinburne is actively contributing to in terms of research and development:

1.3 Solar thermal technology

Direct use of solar energy to either generate electricity or process materials has great potential in Australia. For example, our ore bodies are located close to excellent solar resources and it is possible to imagine a future where ores undergo smelting close to the mine site, before being exported.

At this time, the potential for solar thermal energy is held back by capital cost, low efficiencies and the inability to operate around the clock. Current research at Swinburne into developing storage materials for solar energy (e.g. molten salts) and developing hybrid solar systems (i.e. combining solar with other energy sources) are directly addressing these issues. Further investment into these technologies could greatly assist the mining, metallurgical and materials processing industries, which are major drivers of the national economy, move to a more sustainable future.

1.4 Ocean wave power

The development of wave and other forms of marine energy are further behind in technology development. Swinburne is supporting the area of ocean wave power through the Centre for Ocean Engineering, Science and Technology (COEST).

Ocean wave power offers regular, concentrated renewable energy unaffected by local weather. It also offers Australian coastal communities, remote from the electricity grid, base load power for the development of local industries, free from reliance on liquid fuel. Several ocean Wave Energy Converter (WEC) machines are now deployed in the early commercial phase, with three power stations operating or under construction in Australian waters. Globally, the annual growth rate of such technologies has been estimated at over 14 %.

Swinburne has been working with local wave-power companies, government agencies and other universities to lead a co-ordinated approach to this resource. Research includes the dynamics of wave-power machines in arrays, the internal hydrodynamics of wave-power machines and the mapping of Australian wave-power resources.

Generation and distribution of marine energy is inherently complex and subject to numerous variables which are principally determined by climatic and weather conditions. To optimise ocean wave energy sources, it is important to continue to conduct research into the effect of varying weather on the stability of the electricity grid. These research challenges mean that ocean wave power is further from commercialisation than solar technologies; however as a perpetual, renewable, clean energy source that is globally available, it is certainly worth pursuing.

1.5 Security of energy infrastructure

Security and operational needs of the offshore energy infrastructure are of enormous practical significance for Australia. The Australian offshore oil and gas industry is currently constructing $120b in projects on the North West Shelf alone, and is expanding into deep waters including the Great Australian Bight. Building large floating processing facilities, in order to replace traditional pipelines, inland facilities and ports is in progress. Energy concerns dictate that these ventures will only increase in the future.

Like any other offshore activity, such investments are high risk, and their security should be a priority at all levels, from the companies through to the governments. Extreme event induced failures are exceptionally costly, as demonstrated by a number of recent incidents. Following Hurricane Katrina, industry standards were changed from accounting for ‘one in 100 years’ extreme events to ‘one in 10,000 years’.

Operation and design of the offshore facilities and infrastructure is very expensive, if overly conservative or ineffective. Swinburne recommends more funding and support for this area which is of vital importance not only to Australia’s energy security but also as a significant export sector.

1.6 Recommendation 1

Swinburne recommends **a prioritised approach to game changing energy technologies** to ensure the acceleration of technologies that are already close to the market (eg: solar technologies with significant domestic and industrial potential, enabling technologies that allow domestic users to manage their participation in energy markets). At the same time, a long term technology pipeline must be maintained that addresses future concerns of energy facility security and emerging energy sources.

Appropriate prioritisation of emerging energy technologies will not only address the development of alternative energy sources, it will also protect and enhance the competitiveness of significant industry and export sectors.

2. Improving energy efficiency: design, adaptation and social impact

Swinburne believes there is enormous scope for Australia to lead the world in driving better use of energy through smarter design, increased energy efficiency in industry and social adaptation.

2.1 Incorporating design

It is well established that through clever design, the embedded energy of a product (i.e. the energy that has gone into making the item) and the energy associated with usage can be lowered. For example, this principle has been become commonly used in the design of modern buildings leading to widespread improvement in energy usage in our large office buildings.

Swinburne advocates that a similar approach could be extended to everyday consumer items and products (e.g. hand tools, cooking equipment, communication devices etc.). To facilitate these changes and stimulate research and development, government could set targets in key areas and provide funding for organisations to encourage adoption of new design thinking. This builds on the energy efficiency star system that consumers have embraced at the point of purchase, extending it upstream to the energy used in the manufacture of the item itself.

Greater emphasis on ‘design for energy reduction’ in the nation’s design schools is also likely to attract clever young engineers and designers to the area. Swinburne has found this approach to be very effective in our Product Design and Industrial Design courses and believes there is great potential for expansion of this philosophy to other areas of the economy.

2.2 Energy use in manufacturing

Australia’s manufacturing base is inherently energy intensive, which has implications both for competitiveness and the environment. The metallurgical and manufacturing industries are currently among the largest users of energy in the country. For example, the processing of bauxite ores to aluminium metal consumes over 10% of the national electricity supply. The downstream processing of metals in various casting, machining and fabricating shops around the country is far less than that used in the large smelting operations but energy still forms a large part of the their operating costs and directly affects the competitiveness of these operations.

Rather than this remaining a barrier to competitiveness, a significant amount of expertise in Australian universities could assist industry in reducing energy usage. For example, Swinburne, working directly with OneSteel, has been able to significantly lower the energy usage of their Laverton works (the largest electricity user in Melbourne) through studying the thermodynamics of their process and modelling their operations.

Swinburne believes there is a role for government to facilitate collaboration of this form between research institutes and heavy industrial users of energy, resulting in productivity as well as environmental benefits.

2.4 Human and social factors

Community acceptance is a critical element of the uptake of new technologies and the broad embrace of behavioural and social change that is necessary to meet the energy challenges ahead - particularly in a low carbon environment.

There are multiple pathways available for societies to move towards decarbonisation. These tend to fall under three categories: technological change, sustainable urban design and behaviour change. Technological change and voluntary consumer behaviour offers the clearest and most certain path to a low-carbon future, linked to renewable energy use. However, built environments must be designed in a way that makes it possible for residents to live more sustainable, low-carbon lifestyles. Innovation in urban design for low-carbon living is occurring across the urban planning spectrum. However, it is critical for government, industry and community to have access to scientifically validated instruments capable of providing an evidence base to any claims related to carbon performance.

2.5 Recommendation 2

Swinburne recommends that a significant focus of the policy framework in the White Paper embrace both **design for energy efficiency** and **innovation in industrial energy use.**

Further, it is critical that **tools for measuring sustainable, low-carbon urban development** gain a high priority in the Government's policy settings.

3. Skills: meeting the skills challenges

Swinburne believes developing new and improving current higher education and vocational training outcomes for the energy industry is vital to Australia's ability to face the future challenges of this sector. Specifically there are long-term training and skills development needs for alternative transport fuels, renewable energy, energy management and other clean energy industries. There is strong potential for Australia to cement a position as an exporter of energy industry skills and training to other countries in the Asia Pacific.

3.1 Immediate skills need

There is also growing demand in the VET sector for high quality, flexible training across the construction industry. Government funded programs - Solar *Panel Rebate* program, *Off Grid Solar Power* rebates and *solar power incentives, loans & rebates for small business* - are driving demand for skilled designers and installers of alternative energy systems. The Clean Energy Council's Accreditation requirement for designers/installers of solar photovoltaic systems has driven a demand for flexible training programs. Currently, there is a shortage of specialist trainers and quality resources available to teach the new skills - Solar Panel Design and Installation, Stand-Alone Power Systems, Micro-hydro design and Small Wind energy systems installation. The domestic and commercial construction sectors face rising utility prices, tightened regulatory requirements and more stringent insurance risk assessments which is driving demand for more energy efficient 'green buildings' and alternative energy sources in both the domestic and commercial construction sectors.

VET providers need to gear up to meet the coming increase in demand for alternative energy sources and 'green building' products, as energy prices rise and tightening regulatory requirements are implemented. Australia needs workers with skills relating to energy management, including clean energy and energy efficiency. Funding for 'training trainers' and for developing high quality teaching resources is crucial if the VET sector is to meet the immediate and long-term training and skills development needs of the Australian workforce.

3.2 Recommendation 3

Swinburne recommends that the Government **work closely with education and training providers and energy industry participants** to ensure that future energy market workforce needs are met and to capitalise on skills export opportunities.

Conclusion

We thank the Australian Government for the opportunity to provide input to the Energy White Paper and look forward to contributing to the further development of energy policy and directions in Australia. We would welcome the opportunity to discuss any of the issues raised in this response in more detail.

Swinburne Energy Experts

Swinburne would like to thank the following contributors.

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Appendix 1 - Swinburne 2013 Energy Publications

Conference papers

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