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Submission to the NSW Productivity Commission

Discussion Paper – *Kickstarting the productivity conversation*

27 November 2019

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DISCUSSION PAPER – KICKSTARTING THE PRODUCTIVITY CONVERSATION

The Australian Academy of Technology and Engineering (ATSE)[1] welcomes the opportunity to provide input into the NSW Productivity Commission's reform agenda. ATSE Fellows from the Academy's NSW Division attended the roundtable meetings on human capital, energy and water. This submission addresses these areas.

Scientists, engineers and technologists will continue to make enormous contributions to the State's future economy and wellbeing. With new and emerging materials, analytical techniques, systems and processes, their creativity and expertise will contribute to the productivity ecosystems in education, innovation and entrepreneurship, manufacturing and infrastructure planning and implementation.

Key points and recommended actions:

1.1 Building human capital - improving school education

Support NESA's Curriculum Review, but as a matter of urgency:

- Mandate increased in-service professional development for teachers in science, mathematics, digital technologies and design and technology;
- Recruit more bachelors graduates into teacher education programs for all STEM subjects, possibly though NSW government scholarships.
- Trial the introduction of senior projects into selected STEM subjects.

1.2 Building human capital - improving Vocational Education and Training

- Support work to understand and reduce attrition from trade apprenticeships and traineeships.
- Explore, with all stakeholders, the needs for **technician training** particularly for emerging industries, encourage corresponding provision of awards and strengthen technical pathways in school education.

2.0 Reliable, sustainable and productive use of our water and energy – broader contexts

- Develop a public information and education campaign on water value, conservation and recycling technologies.
- Develop clarity in long term energy and emissions policies that are comprehensive, but do not necessarily require a direct linkage "mechanism".
- Urgently develop NSW and Victorian gas reserves.

[1] ATSE is an independent think tank that comprises the leaders in the fields of technology and engineering who gain Fellowship to the Academy in a highly competitive process. ATSE is one of Australia's four national Learned Academies but uniquely its 800-strong Fellowship come from industry, government and research organisations, as well as academia. Our Fellowship develops trusted, informed and visionary views to persuade decision-makers to implement the most progressive policies on the development of technology for the betterment of Australia and its people. www.atse.org.au

- Reform the market institutions i.e. AEMO, AER and AEMC, to ensure focus on capabilities which energy markets need to ensure an efficient transition to a system which accommodates a high penetration of renewable energy sources with efficient demand response deployed to ensure efficient future investment.

2.1 Improving governance in the rural and urban water sectors

- Establish an independent body to develop a system approach to all aspects of integrated water management and planning.

2.2 Improving water and sewerage service delivery in regional areas

- Trial reverse osmosis treatment and aquifer injection in selected regional communities, with the full engagement of those communities.

2.3 Expanding the role of water recycling and greater efficiency

- Introduce sliding scale pricing of drinking water.
- Mandate dual cycle water reticulation in new suburbs, and during infrastructure renewal.
- Encourage consumers to install rainwater tanks.

2.4 Improving electricity asset utilization and demand management

- Ensure operators have access to the latest predictive maintenance tools and necessary repair equipment.
- Undertake a State survey to locate industries with spare capability, to take part in demand management as part of a review of the demand management strategy.
- Identify industries with interruptible demands that can offer short term system capacity when required.

2.5 Lowering electricity prices through investment certainty

- Place development and evaluation of dispatchable generation technologies on the program for the NSW Research Advisory committee.
- Give serious consideration to long term introduction small nuclear power generation into the equation for NSW dispatchable electricity generation.

2.6 Efficiently determining electricity reliability standards

- Ensure State distribution authorities identify and link those with critical needs on identified high reliability circuits.
- Recommend that the NSW Research Advisory committee supports work to investigate means of reducing down-time to a minimum after a power system failure.
- Develop consumer awareness programs on managing usage.

2.7 Ensuring secure and reliable supplies of gas

- Consider hosting consultative meetings between the parties to gain public acceptance.
- Place shorter time limits on developments for both agricultural and CSG projects.
- Encourage the continued supply of CSG gas to Sydney.

2.8 Streamlining energy regulatory arrangements

- Consider amalgamating the multiple regulations concerned with safety into one framework.

- Amend the system security regulations to include guidelines for closing or repurposing existing plants.

As detailed on the following pages, the Academy's NSW Division is keen to work with and support the Productivity Commission, and the relevant State agencies, on these actions. We are planning to hold a public symposium on water systems and management during the first half of 2020 and offer to discuss with the Commission the programme for that event, to maximise its value to the State.

For further information about this submission, and related matters, please contact the [redacted]

Part 1 Building human capital for a modern and evolving economy

We address the two educational issues raised in the Discussion Paper.

Lifting school performance and education outcomes

Headline issue

- *The most recent PISA results (an OECD school performance benchmark) show declining reading, mathematics and science performance in NSW schools.*

Discussion questions

- *How can the NSW Government improve student outcomes and the performance of NSW schools?*
- *What are the core competencies that a modern school system should provide, given the increasing digitalisation of the economy?*

ATSE shares the Commission's concern about the implications of the declining PISA results in reading, science and mathematics, and their medium and long-term impacts on the nation's future. The 2018 PISA results are due to be published in December 2019, so we wait to see if the downward trends have been reversed. If they have not, they will confirm the need for urgent action. In any case, we cannot be happy that a whole cohort of school children has not, on average, achieved the learning in core areas attained by their predecessors. The current NESA Review of the NSW Curriculum is therefore very timely.

ATSE made a detailed submission to that Review[2]. The submission stressed the importance of sound science, mathematics, and digital technology as core subjects for all school students, while advocating for the need and value of strengthening engineering concepts within the curriculum, as embodied in the Technology national curriculum learning area. We also advocated for increased and systematised in-service professional development for teachers in STEM subjects and disciplines at all levels of the curriculum, and the need for more teacher recruitment of bachelor graduates of STEM subjects into initial teacher education programs for secondary teacher. A year on from that submission, these needs are becoming urgent.

The recently published Interim Report of the Review provides a very comprehensive coverage of the challenges facing school education in NSW. We concur with the inclusive purpose for school education, and acknowledge that the 15 Reform Directions are well conceived. The notion of balancing knowledge and application (skills) throughout the curriculum is strongly supported. ATSE also supports the notion of the major project in senior secondary years, and of undertaking a review of ATAR and alternative university entrance methods.

Major curriculum reform, such as that envisaged by the Review, will take a long time to design and implement. ATSE would wish to see Government require NESA progress agreed reforms as rapidly as possible.

We recommend three immediate actions to reverse downward trends in students' participation and performance in STEM subjects from primary school up:

- **mandate increased in-service professional development for teachers in science, mathematics, digital technologies and design and technology;**

[2] The ATSE submission to the NESA Curriculum Preview is at https://www.atse.org.au/research-and-policy/publications/publication/submission-to-the-nsw-education-standards-authority-nesa-nsw-curriculum-review/

- **recruit more bachelors graduates into teacher education programs for all STEM subjects, possibly though NSW government scholarships.**
- **trial the introduction of senior projects into selected STEM subjects.**

ATSE may be able to provide direct support in these areas, though its STELR[3] program in schools and its Fellows' expertise and networks.

Improving Vocational Engineering and Training

Headline issue

- *The VET sector's ability to provide effective training programs for the current and future economy is being hampered by excessive complexity and a lack of flexibility.*

Discussion questions

- *Do the issues and challenges identified in this section reflect the challenges facing the VET sector in delivering skills for a modern economy? What can be done to address these challenges?*
- *How could governments raise the profile of VET, and shift cultural attitudes towards the sector?*

The Discussion Paper correctly identifies issues and challenges in the VET sector. The funding and structural challenges have been well articulated by the Joyce Review, and are not further addressed here. We concentrate on our concerns with numbers of enrolled students, and the capability of VET to be able to deliver training in emerging areas related to technology and engineering.

In its pre-election statement to NSW political leaders, ATSE urged action to *"Reinvigorate the TAFE sector and focus on upskilling the existing workforce for emerging technologies and advanced manufacturing (Industry 4.0), where the future jobs will be generated."* Our emphasis on TAFE reinforces the strong likelihood that private colleges are very unlikely to invest in the equipment-intensive training that will be needed to support high value manufacturing: it will fall to government providers to ensure training for such skills. We are pleased to see that the Government has recently announced work on the Meadowbank TAFE *Multi Trades and Digital Technology Hub*.

The primary activity of the VET sector in STEM is in Engineering and Building/Construction Trades. There have been increased enrolments in most of the Certificate III and Certificate IV program areas over 2015-18. But as noted in the Discussion Paper, low completion rates for traineeships and apprenticeships are of concern. The reasons for this must be investigated.

VET is also been responsible for education and training of technicians via Diploma and Advanced Diplomas at Levels 5 and 6 of the Australian Qualifications Framework. Technicians are critical members of the workforce, classed as having 'intermediate skills': in technological domains they typically have high-level hands-on skills and expertise with specific equipment and software tools. Large reductions in national and NSW enrolments by Australian students in Advanced Diplomas and Diplomas in IT, Engineering (except for Aerospace) and Building are evident in the data tabulated below. The highlights show the NSW percent reductions over 2015 to 2018.
The absolute numbers of enrolled student in these qualification levels are quite small. In 2018, NSW had more than 19,000 domestic undergraduate enrolments in degrees and 49,500 domestic

[3] STELR (Science and Technology Education Leveraging Relevance) is ATSE's in-curriculum, inquiry based, program for STEM teaching in secondary schools. https://stelr.org.au/ There are currently 290 schools in NSW with STELR kits and teacher resources.

enrolments in Certificate III engineering trade training. Even taking in account the shorter duration of Diploma and Advanced Diploma programs compared with degrees, the enrolments in these awards would not appear to be able to satisfy the technician requirements of an advanced economy. Indeed, Australia "has been identified by the OECD as having a shortage in its intermediate skilled workforce", and "sits at the bottom of the OECD ladder"[4]. We have an apparent 'Technician Gap'.

While the decline in VET enrolments may have been partially replaced by students progressing to university, it is also clear that enrolments in undergraduate engineering programs in universities have not taken up more than a fraction of that slack.

Entry to Diplomas and Advanced Diploma qualifications may be from school, or via Certificate training. The STEM senior school subject participation rate trends and the relatively low levels of enrolments in related VET Certificates add to ATSE's concerns about the apparent or imminent shortage of technicians to support the advancing knowledge base of the professional scientists, technologists and engineers.

Table. Enrolments in 2018 in VET Diplomas and Advanced Diplomas in selected fields, and percent changes since 2015, NSW and Australia-wide

Selected field of education subfield	Advanced Diplomas				Diplomas			
	New South Wales		Australia		New South Wales		Australia	
	2018	% ch'ge fr 2015	2018	% ch'ge fr 2015	2018	% ch'ge fr 2015	2018	% ch'ge fr 2015
02 Information technology - total	**574**	**-32%**	1,183	-41%	1,598	-71%	5,182	-74%
0201 Computer science	369	-45%	894	-48%	246	-85%	1,204	-82%
03 Engineering and related technologies - total	**444**	**-24%**	**2,780**	**-26%**	**1,879**	***13%**	**6,989**	**-16%**
0301 Manufacturing engineering and technol'y	24	-60%	582	-29%	75	-32%	551	-64%
0303 Process and resources engineering	83	1283%	131	4%	135	15%	806	12%
0305 Automotive engineering and technol'y	0	-	0	-	0		48	-87%
0307 Mechanical and industrial eng. and tech'y	118	19%	636	-11%	238	-10%	977	-33%
0309 Civil engineering	22	-33%	133	-36%	238	-8%	429	-32%
0311 Geomatic engineering	0	-100%	103	29%	177	-29%	414	-25%
0313 Electrical and electronic eng. and tech'y	192	-44%	1,045	-34%	255	-24%	782	-40%
0315 Aerospace engineering and technol'y	1	-75%	31	-18%	695	*348%	2,638	118%
0317 Maritime engineering and technology	14	-71%	95	-36%	32	-64%	162	-54%
0403 Building	362	457%	1,095	103%	2,231	-43%	10,251	-33%

Source: NCVER COCSTATS database

Note: this increase is due almost entirely due to enrolments in 0315Aerospace engineering and technology. These qualifications are vital for the aviation industry.

Increasing the number of school students inclined towards VET will require action on several fronts:

- **in schools**, by strengthening the senior Technology and Applied Studies areas;

[4] Bruce Mackenzie, *The Australian*, 3 Nov 2019.

- **in VET**, by designing and offering attractive and forward-looking award programs; and
- **in industry,** by clearly specifying future need and working with the VET sector towards the best possible education and training solutions.

Increasing the status of VET qualifications is desirable, but this will be earned from increased value and recognition by its stakeholders, not by assertion.

High quality technical training needs to be designed and delivered by experts with state-of-the-art equipment, software and real experience. It is not evident that the NSW VET system has been able to maintain adequate resources and instructors for the task ahead. The titles of most of the award programs appears dated. The lack of dual-sector institutions that operate in some other States may make it more difficult for NSW to share facilities and staff between the VET and Higher Education sectors.

To assist the State to re-invigorate VET in the STEM areas, the NSW Division of ATSE is keen to work with NSW Government and its agencies, and representatives of employers and relevant industries, to explore what are the most urgent training gaps for technician training, and how they can be most expeditiously filled.

Part 2 Reliable, sustainable and productive use of our water and energy

These are two critical areas of infrastructure facing our community, both requiring sound national and State policy development and actions for the long term, as well as the short and medium-term matters raised in the Discussion Paper. We set the scene before addressing these points.

Water resources, supply, technologies and management

The availability of water at sustainable levels for the community, agriculture and environmental river flows is fundamental to an overall healthy society. ATSE has addressed national water reform in previous work[5]. With Australia's fast-growing population, the predicted likelihood of further severe droughts and the crucial need for environmental river flows and irrigation, means that the desalination option needs to be considered more strongly in future policy formulation. Clearly this interlinks the twin challenges of providing reliable, affordable, sustainable and socially acceptable electricity *and* water supplies.

Desalination of both sea water and wastewater (storm water run-off and from sewage) must be introduced. The thermodynamics of the desalination process is such that it is much cheaper in energy terms to process wastewater, using reverse osmosis membranes. However, public acceptance of wastewater reuse[6][7] is generally low and perceptions of low purity of such water will

[5] ATSE Submission to Commonwealth Productivity Commission's National Water Reform Inquiry, October 2017. https://www.atse.org.au/wp-content/uploads/2019/02/national-water-reform-issues-paper.pdf

[6] ATSE Report, Drinking water through recycling, October 2013. https://www.atse.org.au/wp-content/uploads/2019/04/drinking-water-through-recycling-full-report.pdf

[7] ATSE Report, Wastewater – an untapped resource, October 2015. https://www.atse.org.au/wp-content/uploads/2019/01/wastewater-untapped-resource-full-report.pdf

need to be overcome through public information and education. A technical approach is to pump wastewater treated by reverse osmosis into aquifers, and subsequently redraw this at distant locations. This approach is used at large scale in California.

The typical Sydneysider probably does not appreciate the high purity and low price of their water. There are examples from overseas (e.g. Singapore) of successful public education programs that bring the public into wastewater treatment plant to explain the value of water, water conservation and the membrane technology that brings them "New Water" – as it is called.

Better use of water for agricultural processes, in particular for the commercial production of vegetables and other market garden products, also need to be addressed. At present, there is too great a reliance on open-field agriculture. Experience in the Netherlands has shown that market garden production in high tech glasshouses requires only 10% of the water needed to grow these crops in the field. This experience is based on very large-scale production; The Netherlands produces some 30% of the world's market garden produce (it is only second to the USA in total production). Implementation along the Murray-Darling of this technology would require large investment but has the potential to almost eliminate the problem of water availability along this basin.

ATSE would support the development of a public information and education campaign on water value, conservation and recycling technologies.

Electricity demand growth, supply and transitions

Electricity is perhaps the most important element of infrastructure underpinning economic development and standard of living. Electricity demand is now relatively flat – in part because some industry has either shut down or moved because of high energy prices. The transition of transport to electricity, together with other technology driven developments, and population growth should mean that future electricity demand will continue to grow. Ensuring flexible generation and reliable and affordable supply for productivity growth go beyond State issues and the specific points and questions in the Discussion Paper. We set the context in the following paragraphs.

Australia is blessed with abundant energy reserves of all forms and should be an energy powerhouse with low cost energy being a comparative advantage. Given the need to limit our emissions, Australia has the advantage of the world's best wind and solar resources which are able to be developed near transmission lines, although the grid will need to be augmented to accommodate the investments required. Strong and coordinated policy initiatives are urgently required to ensure that this potential comparative advantage is realised[8].

The transition of electricity generation away from coal to renewables is well underway, but will need to be closely managed to ensure reliability is preserved and that investments in new generation sources are efficiently deployed.

[8] ATSE input to the Australian Renewable Energy Agency ,May 2019, https://www.atse.org.au/wp-content/uploads/2019/09/2019-04-10-ARENA-Investment-Priorities.pdf

Efficient investment in renewables requires that firming generation is consistent with emissions targets. Accordingly, there is an urgent need for clear energy market and emissions policies which have a long-term focus.

Whether these policies are directly linked through "mechanisms" (like the National Energy Guarantee) is less important than whether each is comprehensive and clear. Indeed, some economists would argue that the assignment principle should apply here – i.e. there should be one policy instrument for each policy goal. It should be clear by now that policy makers have unnecessarily tied themselves in knots looking for the perfect linking mechanism.

It is also abundantly clear by now that wind and solar are by far the lowest cost new build electricity generation capacity and their costs continue to trend lower. Most industry observers believe that solar PV will be the technology which will do the heavy lifting in terms of the transition from coal. However, the key policy requirement to support this is the need for clear policies (both technical and economic) to ensure timely and efficient investment in firming capacity to ensure reliability.

All firming options should be considered, including gas (both open and closed cycle), large scale pumped hydro, distributed pumped hydro, batteries and demand response. Batteries are unlikely to be deployed at scale over the next two decades (although their use in ancillary services such as voltage control and frequency control as well as location-specific grid support is likely to grow).

However, it is likely that the key transitional firming capacity will be provided by gas. It is therefore important that roadblocks to the development of gas reserves on NSW and Victoria should be removed. This should be an urgent policy priority. And it is worth reflecting that the Queensland LNG export licences were granted on the understanding that NSW and Victoria would develop their reserves. The high gas prices in the Eastern states are largely a consequence of the fact that this has not happened.

Hydrogen to store excess solar generation is also a strong prospective storage technology[9], that has been boosted by COAG adoption of the National Hydrogen Strategy on 22 November 2019.

Snowy 2.0 is now committed and although its economics remain controversial, it is worth observing that to firm up all the renewables required to transition away from coal in the NEM, ten times the capacity of Snowy 2.0 will be required.

Another key requirement will be the need to fast track transmission augmentation to assist with the need to maintain reliability as the penetration of renewables on the system grows. No major transmission development has occurred in the NEM for over 25 years, so regulatory and planning roadblocks need to be removed.

In addition, when it comes to regulatory roadblocks, the technology to support the deployment of demand response at scale has been available for more than a decade, but the market institutions have not progressed beyond supporting the occasional trial. Meanwhile, the industry continues to do

[9] ATSE Submission to the National Hydrogen Strategy papers, July 2019. https://www.atse.org.au/research-and-policy/publications/publication/submission-to-the-national-hydrogen-strategy-issues-papers/

what it has always done – i.e. build more capacity to meet peak demand, which continues to grow as the number to hotter than average days increases with climate change.

There are some proposals for nuclear generation[10] (particularly small modular reactors located at existing coal generators) as a source of dispatchable power to transition away from coal. While this option deserves consideration (see below) and may be prospective in jurisdictions less well endowed with first class renewable resources, it is unlikely to be able to compete on cost terms with other low or zero emissions options. Furthermore, the current legislated restriction on adoption would have to be lifted, requiring a social mandate for this controversial technology when more cost competitive options are available. The latter include capabilities which substitute for mechanical inertia to stabilise the electricity system and are provided by modern power electronics.

The key points and recommendations which flow from the above observations therefore include:

- **There needs to be clarity in long term energy and emissions policies which need to be comprehensive, but do not necessarily require a direct linkage "mechanism".**
- **NSW and Victorian gas reserves need to be urgently developed.**
- **The market institutions i.e. AEMO, AER and AEMC need to be reformed to ensure that the historical focus on low cost interventions with lengthy and convoluted processes for change are replaced with arrangements which focus on capabilities which energy markets need to ensure an efficient transition to a system, which accommodates a high penetration of renewable energy sources with efficient demand response deployed to ensure efficient future investment.**

We now turn to the issues and questions in the Discussion Paper.

Improving governance in the rural and urban water sectors

Headline issues:

- *Governance of the rural and urban water sectors is complex. Functions are spread across government departments, independent regulators, and state-owned corporations.*
- *This can create overlap and gaps in roles and responsibilities, and coordination problems.*

Discussion questions:

- *How could New South Wales improve governance and institutional arrangements for water management?*
- *How could the State improve water planning, and what are some possible ways to:*
  i) clarify the roles and responsibilities of State Owned Corporations (SOCs), government, and regulators in water planning?
  ii) increase integrated water cycle management approaches where they are cost-effective?

As outlined above, ensuring sufficient water from catchments, desalination, run-off and treated sewage, distribution and recovery is a complex system, in terms of physical infrastructure,

[10] ATSE Submission to the House Of Representatives Standing Committee on the Environment and Energy Inquiry Into Prerequisites for Nuclear Energy in Australia , September 2019, https://www.atse.org.au/wp-content/uploads/2019/09/Inquiry-into-the-prerequisites-for-nuclear-energy.pdf

technologies, management and governance. For optimum performance and to guide future investment, a whole of systems approach is needed. This must operate independently of narrow interests, while respecting the responsibilities and expertise of the current elements of the system.

With water valued properly, a focus on integrated water cycle management should be cost effective in the medium and longer terms. We would urge government to:

- **Establish an independent body to develop a system approach to all aspects of integrated water management and planning.**

Improving service delivery in regional areas

Headline issues:

- *Bills for water and sewerage services in regional NSW are higher on average, than in metropolitan NSW and regional Victoria.*
- *These outcomes are linked to the challenges faced by largely council-run local water utilities.*

Discussion question:

- *How could the efficiency of local water utilities be improved to increase water security and quality, and lower bills for regional communities?*

Membrane-based water treatment provides a means of recycling of water using sewage wastewater and storm water. Such recycling would be particularly attractive in regional areas. As noted earlier, the main obstacle to its implementation is public resistance to recycling water for potable use. The intermediate approach that could be effective in regional areas would be to pump wastewater treated by reverse osmosis into aquifers. **ATSE recommends that:**

- **Trials of reverse osmosis treatment and aquifer injection should be undertaken in regional communities, with the full engagement of those communities.**

Expanding the role of water recycling and greater efficiency

Headline issues:

- *Water recycling and greater water-use efficiency can play a significant role in achieving sustainable growth, alongside traditional measures to increase supply.*
- *Metropolitan New South Wales uses more water per person than metropolitan areas of Queensland and Victoria, benchmarking data indicates.*

Discussion questions:

- *What are the barriers to New South Wales achieving larger scale and cost-effective water recycling?*
- *How can the NSW Government encourage households and businesses to be more water efficient, particularly in metropolitan New South Wales?*

As outlined earlier, reverse osmosis of wastewater offers a lower cost solution than desalination of seawater. Negative public perception of the quality of recycled water quality from such processes is the most critical barrier that can be overcome only by information and education, and experience.

Potable water, as available to the average Sydneysider, is a product of high purity and is so cheap that it is undervalued by the customers. Sliding-scale pricing (with accompanying education

programs) would have an impact on consumer use. New suburbs should have dual cycle water reticulation, and could be introduced in established suburbs as part of infrastructure renewal. Installation of rainwater tanks in suitable domestic homes should be encouraged.

ATSE recommends:

- **Sliding scale pricing of drinking water**
- **Dual cycle water reticulation in new suburbs, and during infrastructure renewal.**
- **Encouragement of installation of rainwater tanks.**

Improving electricity asset utilization and demand management

Headline issue:

- *Electricity process have risen over the past decade due to a combination of significant network investment, rising demand, commodity process and the closure of coal generators.*

Discussion question:

- *Are there further steps we can take to achieve greater efficiency in network businesses and environmental programs in the NSW?*
- *How could electricity demand management be further improved in New South Wales?*

Asset utilization is critical. The main trunk lines for electricity and water are aged. Although electricity transmission and especially distribution assets have been subject to significant investment in recent years, any failure to meet demand, either through technical fault or 'congestion' (i.e. inadequate load transfer capacity) can put critical production assets at severe economic risk.

As described in the Discussion Paper, this situation in the case of electricity may be a result of splitting generation and transmission assets. Failure of any of these trunk lines represents a significant potential loss of State productivity. In order to minimize this potential loss there are positive actions that can be taken now. The best predictive tools and support facilities need to be utilised to identify potential failures and reduce repair downtime to a minimum. **ATSE recommends** that the NSW operators:

- **Have access to the latest predictive maintenance tools and necessary repair equipment.**

Demand Management is an important tool to utilize the production flexibility of major users to prop up the power system when it is overloaded. This is considered admirable under potential emergency conditions, but should be encouraged only when an industry has genuine spare capacity such as "off season" to avoid reducing NSW State productivity. Using advanced digital technology to manage demand efficiently will reduce the need for expensive failure mode capacity. To improve the scope of demand management, **ATSE recommends**:

- **A State survey is developed to locate industries with spare capability, to take part in demand management as part of a review of the demand management strategy.**
- **Identification of industries with interruptible demands that can offer short term system capacity when required.**

Lowering prices through investment certainty

Headline issue:

- *Policy uncertainty about greenhouse gas reduction is limiting investment across the NEM and putting upward pressure on prices.*

Discussion questions:

- *How can NSW work to reduce uncertainty in electricity generation and emission reduction requirements to improve the investment outlook?*

It is unwise to use incentives to encourage inefficient investment in the power industry as this will lead to a consequent increase in power price. As discussed above, we have good wind and solar resources, against which low emission dispatchable sources must be operated. Greater investment certainty can come from defining the development of dispatchable low emission generation technologies as a key driver for the new NSW Research Advisory committee. Such technologies include gas (of which NSW has ample reserves, see below), pumped hydro, hydrogen and battery storage, and nuclear power reactors.

Nuclear generation is proven and new small modular reactor (SMR) technologies are under development. Importantly, SMRs are able to operate as baseload, and are extremely safe with automatic fail safeguards. They can provide both heat and/or power, relevant to many industrial process applications, water desalination and hydrogen production. Repurposing of sites of current aging coal-fired power stations could enable reuse of significant existing infrastructure and provide ongoing jobs for experienced staff. Public attitudes to nuclear power are changing. However, until the legal impediments prohibiting nuclear facilities are repealed, there is no valid or realistic opportunity to assess options for nuclear power generation and what this might enable for NSW productivity. The Australian Nuclear Science and Technology Organisation (ANSTO) has a charter to provide reliable internationally accredited professional advice on nuclear power reactors that could be deployed in Australia.

ATSE recommends that:

- **Development and evaluation of dispatchable generation technologies is part of the program undertaken by the NSW Research Advisory committee**
- **That serious consideration be made for introducing small nuclear power generation into the equation for NSW dispatchable electricity generation.**

Efficiently determining electricity reliability standards

Headline issue:

- *Reliability is important, but it is critical to avoid ad hoc policy making and inefficient expenditure.*
- *Cost-effective solutions and consumer willingness to pay for reliability provide guidance for evaluation.*

Discussion questions:

- *What in the best framework for future evaluations of generation and network reliability*
- *What additional measures, if any, can we take to cost-effectively improve reliability?*

Reliability standards for acute medical care, including provision of life support, or for critical data centres, such as in the financial sector, can differ markedly from standards acceptable to most commercial and domestic customers in the community. Supplying those key users from protected high security circuits would be a long-term goal. However, until such a differentiated power system is available, reliability must be left close to the existing high level. To optimise variability of reliability and to support critical needs, **ATSE recommends**:

- **State electricity distributors must identify and then link those with critical needs on identified high reliability circuits.**

Reliability versus Affordability. The impacts of generation or network failure on State productivity have become more critical. Brief power outages are not particularly costly to productivity, but can become very costly if industrial processes are disrupted. It is difficult to predict system failure so industries have to prepare for outages to minimize their downtime. In recent times, operators have increased network charges sharply in order to maintain and improve reliability. Improving coordination between generators, network operators and high-end consumers, especially if there is an increased focus on recovery time may be more effective than retaining expensive generation units that are only brought online during failures.

From a consumer perspective, affordability is generally preferable to the additional costs associated with higher reliability. Better coordination with high-end industry users, for whom reliability is more critical, is needed. A more efficient way of managing reduction of demand from high-end users during peak load times for the wider community could improve reliability. Education of consumers to modify their usage of electricity in accord with peak demands, could address their sensitivity to actual cost (i.e. price x consumption) compared with slightly reduced reliability. This raises an equity challenge in that as some consumers with sufficient means move off the grid (via solar PV and battery storage) to reduce their costs, people unable to make such investments will shoulder an increased share of fixed system costs. **ATSE recommends that:**

- **The NSW Research Advisory committee supports work to investigate means of reducing down-time to a minimum after a power system failure.**
- **Consumer awareness programs on management of electricity and gas usage are developed.**

Ensuring secure and reliable supplies of gas

Headline issue:

- *NSW has significant reserves of gas but a relatively low share of production in Australia.*
- *Gas-fired electricity generation will likely be needed to supplement intermittent energy sources, particularly to meet demand in critical peak periods.*

Discussion questions:

- *What initiatives could we consider to remove barriers to gas exploration and production?*

An increased level of coordination and cooperation between the agricultural and the coal seam gas (CSG) development industry is needed. This is particularly pertinent in sharing bore information with respect to water availability and vulnerability of supply. NSW has very substantial gas reserves that are not yet open for development, despite a report outlining the importance of managing these issues by the previous NSW Chief Scientist and Engineer. Analysis of the impact of CSG exploitation

on precious ground water and aquifers must be undertaken. If agricultural land is affected, ongoing partnership with the farmers is crucial. Shorter time limits should be placed on areas set out for development. Importantly, gas providers must continue to supply Sydney from the Camden region as has been the case for many years.

- **Consider hosting consultative meetings between the parties to gain public acceptance.**
- **Place shorter time limits on developments for both agricultural and CSG projects.**
- **Encourage the continued supply of CSG gas to Sydney.**

Streamlining energy regulatory arrangements

Headline issue:

- *NSW regulatory activities are currently dispersed across a number of agencies.*

Discussion questions:

- *How could we improve the NSW energy regulatory framework?*

Relevant NSW regulations cover diverse topics, many concerning safety. Current electricity regulations on system security refer to investigations for proposed additions. Proposals for closing down generation facilities may be especially problematic and should be included. **ATSE recommends:**

- **Amalgamating the multiple regulations concerned with safety into a single framework.**
- **Amend system security regulations to include guidelines for closing or repurposing existing generation plants.**