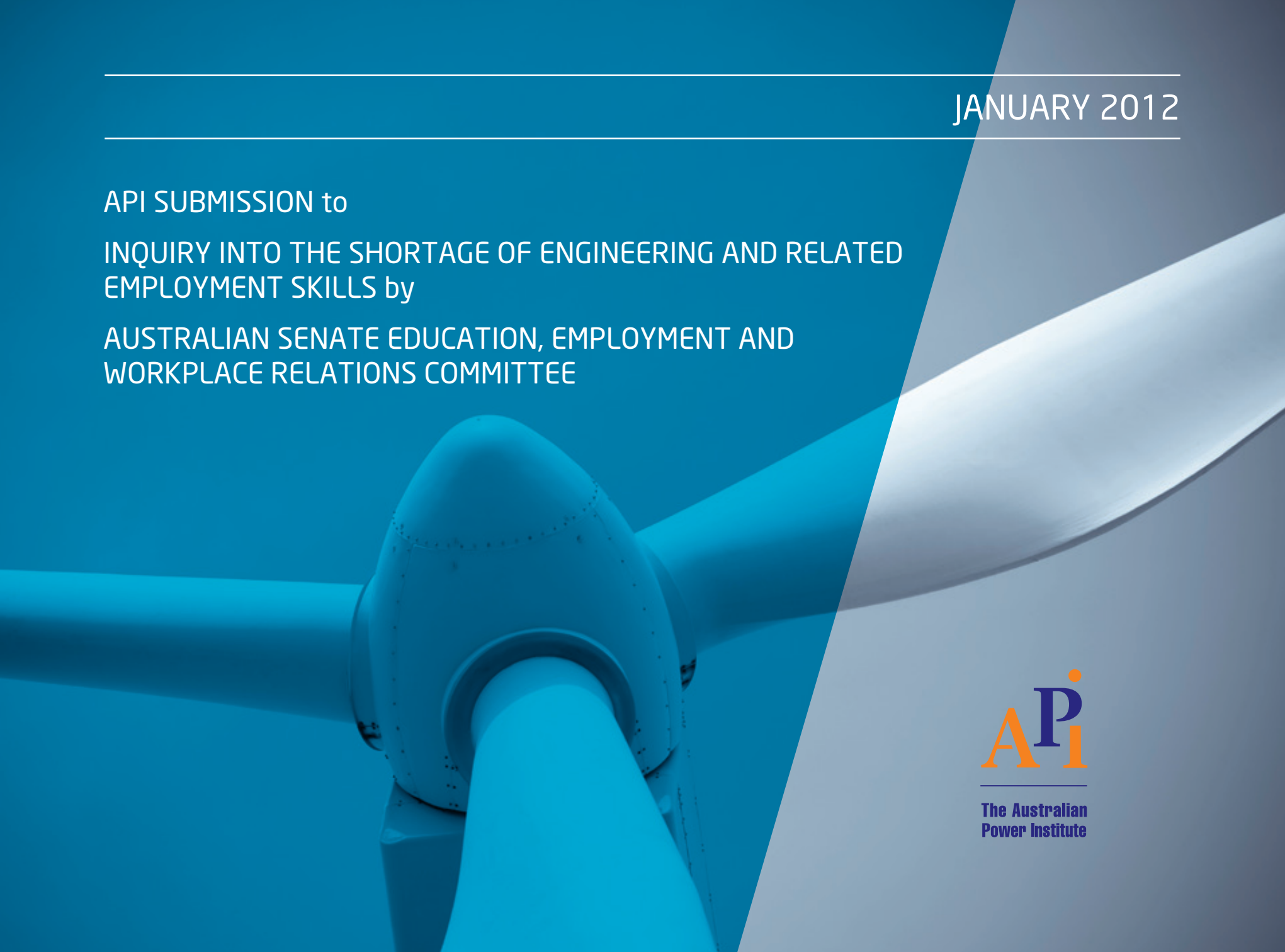
JANUARY 2012

API SUBMISSION to

INQUIRY INTO THE SHORTAGE OF ENGINEERING AND RELATED EMPLOYMENT SKILLS by

AUSTRALIAN SENATE EDUCATION, EMPLOYMENT AND WORKPLACE RELATIONS COMMITTEE



The Australian Power Institute

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The Australian Power Institute (API) represents 35 major Australian power companies in addressing the skills gap in power engineering.

Continuing demand for engineering expertise is being driven by forecasts of extremely high expenditure in the energy industry, and because energy system architecture is undergoing a period of high technological development and change. Transitioning to a low carbon economy while addressing community concern regarding energy sustainability, security and price demands high quality engineering solutions. Containing electricity prices demands significant innovation in the sector to do more with less. Professional engineering expertise is critical to this innovation. Australia's unique energy challenges means solutions cannot be merely imported from overseas.

The supply of power engineers is constrained by an ageing workforce with commencing elevated retirement rates, fragmentation of professional career paths due to changed industry structures and increased outsourcing, low participation rates in high school advanced maths and science studies, and intense competition from other fields including the mining industry. API research of member companies shows a universal shortage of the Senior Engineers so important in meeting current and imminent technical challenges.

As electricity is at the heart of the modern Australian society, commerce and industry, failure to attract, develop and retain the best engineering talent could have dire consequences. Australia could fail to meet its objectives of lower carbon emissions and to supply competitive (low price), reliable electricity to underpin the Australian economy. Australia is facing the greatest transformation in the past century of its energy system by moving to a low carbon, cost effective, reliable energy industry, and critical to achieving this will be attracting and educating highly skilled power engineering professionals. API has developed a number of industry sector strategies to address this issue, and has the strong engagement of the power industry and Australian universities in their implementation. These strategies are progressing effectively but could be greatly enhanced and accelerated with additional Federal Government support in key areas. **It is recommended that** consideration be given to providing increased resources to:

- Support expansion of API's whole-of-sector programs for continuing professional development of power engineers
- Augment the API bursaries and work experience program for power engineering students, including initiatives to increase the representation of women in power engineering
- Fund a new stage of the Collaborative Power Engineering Curriculum Development Project to complete the development of shareable learning and teaching resources
- Expand the STELR (Science and Technology Education Leveraging Relevance) project to all Australian high schools; and
- Stimulate applied research and development within the power industry.

Government support through additional targeted funding will enable rapid advances to be made by building on early success and leveraging the engagement and commitment of API members and university partners.

ROLE OF API

The Australian Power Institute (API) is a not for profit national organization established by the electricity power industry to boost the quality and numbers of power engineering graduates with the skills and motivation for a career in the energy industry which encompasses:

- Generation utilities
- Transmission utilities
- Distribution utilities
- Manufacturers and suppliers to the industry
- Consultants to the industry, and
- End users of electricity in their operations.

Membership of the Institute includes 35 of the largest employers in the industry, as shown.

The API is promoting power engineering to young Australians and helping universities to provide world class education to position power engineering graduates to be "work ready" so they can help deliver solutions for the future success of the power industry and Australia. The API was formed in October 2004 to facilitate, encourage and promote education, research and training in the electricity supply industry.

The establishment of the API by the power industry to address the provision of power engineering professional capacity and capability has been characterised by:

- API growing rapidly to represent all sectors of the Australian power industry, from eight members in 2007 to 35 in 2011
- A wide range of programs to promote the power industry and to improve power engineering capabilities of Australian universities
- Signs of success – more students, higher quality and increased number of bursary students and applicants for new graduate power engineering positions

API has set the benchmark for industry to engage with and support universities, and was recently awarded the 2011 Business Higher Education Roundtable Award for Outstanding Achievement in Collaboration in Higher Education and Training, sponsored by the Federal Department of Education, Employment and Workforce Relations.

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INTRODUCTION

There is widespread understanding that Australia faces an engineering skills shortage, and that this shortage presents significant problems for business, the economy and the community generally. This national challenge requires and demands overarching systemic workforce development responses. These may include actions to increase the proportion of students choosing to study advanced maths and science at high school, and then to choose to study engineering at university.

In addition, an **industry sector approach** will be essential to effectively address the differing needs and conditions of impacted industries, and to enable effective partnering between industry participants, schools and universities, and government agencies. This submission concentrates on the specific needs of the **Electricity Supply Industry**, and the approaches considered relevant to addressing this sector's chronic and substantial shortage of professional engineering skills, and para-professional skills.

In this sector, the skills shortage is real and growing. The API has been formed to address this shortage and is achieving results and the strong support of the industry. Effective partnerships have been formed with Australian universities, and strategies have been collaboratively developed that are progressing effectively. There is however, scope for more to be done. The Federal Government can make a significant difference by providing financial support in selected key areas to greatly magnify the substantial benefits to be gained.

DEMAND FACTORS

Programs of Work for the electricity supply industry are at elevated levels to meet increasing electricity consumption, increased peak demand, and to replace ageing infrastructure. In addition to these pressures, the industry faces the challenges of the transfer to a low carbon economy as well as the need to minimise rising energy prices. Significant innovation in engineering practices is required to achieve required outcomes while reducing costs at all stages of the electricity supply chain. As highlighted in the Draft Energy White Paper recently published by the Department of Resources Energy and Tourism, **the scale of investment required in the Australian energy sector is unprecedented**. The draft report estimates investment of approximately $240 Billion will be required in Australia's electricity and gas generation, transmission, and distribution sectors between now and 2030. In the order of $100 Billion will be needed in this decade. This is forecast to "intensify the demand for existing skills while also creating demand for skill sets in a range of new specialised technologies" (p244). Problems are anticipated in meeting growing needs for highly skilled engineering and other graduate level professions to address new technologies in "energy generation, end use and advanced networks and communications" (p245).

The original electricity supply model of delivering power from central generators to households and industry is being disrupted by the move to distributed renewable generation, from remote wind farms to solar panels on home roofs. This is turning the "one-way" power flow paradigm upside down, as there may be bi-directional flow on any particular power line and potentially between what were traditionally consumers only. This is moving to create a web of energy flows, with multiple undefined suppliers and customers, not unlike the internet. To meet this challenge, the power industry must change, and new skills and approaches are needed.

The Australian Department of Education, Employment and Workplace Relations (DEEWR) Industry Employment Projections 2011 Report indicates that Electricity, Gas, Water and Waste Services industry will experience strong employment growth of 3.9% per annum between 2010/11 and 2015/16. This represents an increase of 32,400 employees over the 5 year period. Growth is forecast to be even higher in electricity generation (5.1% per annum), with 28.2% or 5,600 additional staff required over the period. DEEWR forecasts specifically for the engineering occupation indicate growth of 4.8% per annum (37,500 over the 5 years), with annual growth of 5.7% per annum for electrical engineers (6,000 over the next 5 years).

API research of member organisations **reinforces these forecasts** of strong demand for professional power engineering skills. In March 2011, a Workforce Planning Survey was completed by 16 of our member companies currently employing a total of 2595 Power Engineers and 254 power engineering consultants (representing approximately 40% of the existing total professional power engineering workforce). Key findings of the survey included:

- Demand for engineering graduates will remain at historically high levels for the next 3 years and beyond
- Shortages and recruitment difficulties are being experienced for Senior Engineers universally, and for engineering management very widely
- There remains considerable scope to further improve the preparation and education of engineering students to meet the challenges of the power engineering field.

It is estimated that there are currently approximately 6,500 power engineering professionals in the industry and it is forecast that 1,300 additional graduates will be needed in the next 5 years to meet growth and retirements from the industry. Some skills shortages may be partially offset by the introduction of new technology that requires less staff. Examples include highly automated gas-fired power plants that require less staff than coal-fired plants, and renewable generation technologies (especially wind) that require less operating and maintenance effort. Growth will occur, however in the distributed energy and energy efficiency sectors, as well as generally in roles associated with developing, designing, and implementing technical changes in the industry. Skills that will be most in demand will be high level professional technologist problem solving skills to support the transformational change in technology and operations which will be demanded.

Competition for engineering talent, particularly from the mining and petroleum sector, is adding significantly to the intensity of demand for scarce professional skills needed in the energy supply industry.

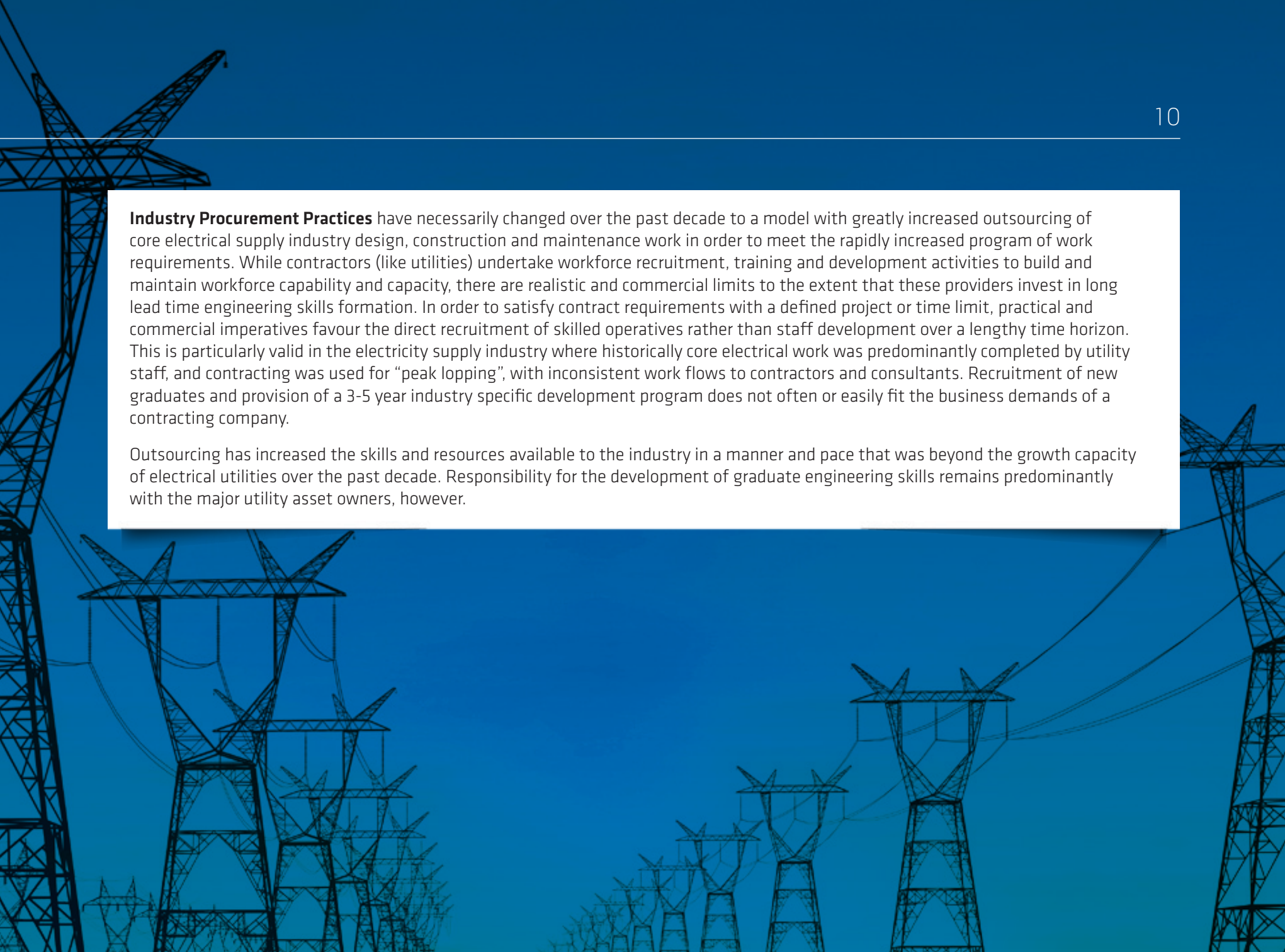
SUPPLY FACTORS

The **ageing workforce** within the electricity supply industry significantly contributes to forecast pressures in ensuring an adequate supply of skilled engineers to meet pending challenges. DEEWR employment projections identify that employees in the Electricity, Gas, Water and Waste sector are relatively older. A total of 44% within this industry are over 45 years of age, compared with 38.5% in all industries. This is most prevalent in Electricity Generation where the median age is 46 years compared with 41 years in the Electricity, Gas, Water and Waste sector and 39 years in all industries.

In the ten years from 1999 to 2009, the number of employees in the Electricity, Gas, Water and Waste Services Sector over 55 years of age, increased from 5,800 to 22,300 employees. This will result in a much increased exodus of talent from the industry as these people retire over the coming years. API research shows approximately 30% of power engineers are currently over 50 years of age, and 6.5% are over 60. With an average retirement age of approximately 58, there are expectations of a serious loss of key expertise over the coming decade in this critical sector.

The education of power engineers is also impacted by the large proportion of **international students** enrolled in engineering programs at Australian universities. International students commencing courses in Australian engineering and related technology courses represented 38% of all enrolments in 2009. International students comprise 31% of all current engineering students. This impacts the teaching workloads in these programs.

Participation by females in power engineering studies and work is particularly low, as applies within the Australian engineering profession generally. Females comprise only approximately 10% of the Australian engineering labour force, and approximately 14% of students in Australian engineering and related technology courses. This reduces the pool of talent available for power engineering roles. API research shows only 13% of power engineers employed in member companies are female.



Industry Procurement Practices have necessarily changed over the past decade to a model with greatly increased outsourcing of core electrical supply industry design, construction and maintenance work in order to meet the rapidly increased program of work requirements. While contractors (like utilities) undertake workforce recruitment, training and development activities to build and maintain workforce capability and capacity, there are realistic and commercial limits to the extent that these providers invest in long lead time engineering skills formation. In order to satisfy contract requirements with a defined project or time limit, practical and commercial imperatives favour the direct recruitment of skilled operatives rather than staff development over a lengthy time horizon. This is particularly valid in the electricity supply industry where historically core electrical work was predominantly completed by utility staff, and contracting was used for "peak lopping", with inconsistent work flows to contractors and consultants. Recruitment of new graduates and provision of a 3-5 year industry specific development program does not often or easily fit the business demands of a contracting company.

Outsourcing has increased the skills and resources available to the industry in a manner and pace that was beyond the growth capacity of electrical utilities over the past decade. Responsibility for the development of graduate engineering skills remains predominantly with the major utility asset owners, however.

IMPLICATIONS FOR AUSTRALIA

Key professional power engineering skills are needed to ensure the large scale investments that are required can be made in a timely, effective and efficient manner to meet growing peak electricity demand. Shortages of capable power engineers in this critical period of investment threaten achievement and/or maintenance of **reliability** standards due to delays in the replacement of ageing infrastructure and the reinforcement of essential supply networks. If the required quantity of work is not completed in a timely way, consequences may include delays or risks to development within industries dependent on power supply availability. The reduced network reliability and resilience would also directly impact existing businesses and households.

Constraints on the availability of professional power engineers would be expected to increase the costs of both capital and maintenance projects within the electricity supply industry as engineering standards, designs and the technical supervision of each project would have less professional input than would be optimal. These **higher construction and operating costs** would add to the pressures for increased electricity prices which flow on to industry, commerce and households and which have a multiplier effect in constraining economic growth across the Australian economy.

Of even more concern in the longer term, shortage of engineering skills may lead to a lower level of **innovation and adaptation** in the electricity supply industry with negative impacts on efforts to improve energy productivity and on the pace of adopting technological changes necessary to meet carbon reduction targets. This exposes utilities to risks of adding to redundant infrastructure not suited to the low carbon future. A high level of technical innovation is essential in meeting the challenge of electricity price pressures through productivity improvements at all stages in the electricity supply industry. This depends on the availability and quality of power engineering skills. Failure to achieve the needed innovation and efficiency will result in a flow-on of increased costs which will impact Australia's economic growth and international competitiveness.

The achievement of **carbon reduction targets** depends to a great extent on effective implementation of changes to technology and practices within the electricity generation, distribution and retail industries. The large investments to be undertaken by the electricity supply industry in the near and medium terms provides a **unique opportunity** to update and upgrade electricity infrastructure to meet future challenges as well as immediate needs. Failure to do so entails very large opportunity costs for the industry and the broader economy.

A high level of technical innovation is essential in meeting the challenge of electricity price pressures through productivity improvements, and the achievement of carbon reduction targets.

CURRENT API INITIATIVES TO CLOSE SKILLS GAPS

API has developed and implemented a range of initiatives to address the needs of the power industry for enhanced professional engineering capacity and capability. These are broadly aligned with the API's strategic objectives which are:

- to position power engineering as an attractive career choice;
- to facilitate world class undergraduate power engineering teaching and learning;
- to ensure value added continuing professional development programs and applied research; and
- to develop API as a vibrant, nationally respected organisation.

1. Key Strategies and Actions to Promote Power Engineering as an Exciting Whole of Life Career Choice to Young Students

A major initiative has been to implement a National Power Engineering **Bursary Program** to attract young Australians to study power engineering.

Key features of the API National Power Engineering Bursary Program are:

- Available to engineering students committed to study electrical, mechanical/mechatronics or sustainability engineering with an interest in power engineering
- Cash value of $A8,000 over four years with paid vocational employment with member companies potential with a value of $A20,000 over three summer vacations
- Bursary holders and member companies have no binding commitments following graduation and bursary holders are encouraged to work for different members
- Annual bursary award ceremonies are conducted in each state attended by API bursary holders, their parents and API member representatives, with awards presented by State Energy Minister or industry Chief Executives
- Two networking events are held in each state each year to allow bursary holders to meet engineers in power industry and visit power engineering sites.

There are now almost 200 bursary holders, with 21% female. The API National Bursary Program has been successful by attracting growing numbers of students to careers in power engineering with the number of bursary applications increasing from 116 in the first year 2007 to 288 in 2009; 298 in 2010; and 305 in 2011.

CURRENT API INITIATIVES TO CLOSE SKILLS GAPS

Another initiative has been the development of a website www.powerengineering.org.au devoted to promoting and providing information on "what power engineers do" and aimed at students in high school and early years of university. The focus areas of the website are:

- Be Challenged
- Be in Demand
- Reap the Rewards
- Make a Difference

The website features seven young recent graduates (four male, three female) on video speaking of the exciting challenges and opportunities they have encountered since joining the power industry.

Other initiatives undertaken to promote and attract young people to a career in the power industry include:

- Four day summer camps for year 10 and 11 school students interested in mathematics and science
- Support for the Academy of Technological Sciences and Engineering STELR project (Science and Technology Education Leveraging Relevance) which interfaces with 183 schools drawn from each State and territory across Australia. Over 24,000 students have participated in the project which aims to increase participation rates in physics, chemistry, biology, and mathematics. STELR utilises the theme of global warming to deliver content about renewable energy and electricity generation. It also has a careers focus with students.
- A number of essay competitions have been conducted that require API bursary holders to increase their understanding of the future of the power industry.

The website attracts an average of 420 visits per month.

2. Key Strategies and Actions to Provide World Class Undergraduate Power Engineering Teaching and Learning

Having attracted more young students to study power engineering at university it is critical to ensure that students have a challenging, motivating learning experience so they remain committed to power engineering.

As found in the 'Assessing the Future of Electrical Power Engineering" Report (esaa 2004), there is a perceived wide gap between industry expectations and graduate attributes. This has been addressed to some extent, however 2011 research by API shows more can still be achieved.

To address the above issues the API has sought to achieve the following outcomes:

- A sustainable and high quality learning environment is maintained between academics, students and industry
- University students have access to world class under-graduate laboratories that support learning and provide the link to industry for students
- Student access to world class education and learning drawing on specialised expertise/skills at a rationalised group of universities.

This has been supported through two major initiatives, these being;

- API Annual Request for Funding Proposals from universities to improve power engineering teaching capability and;
- Collaborative Power Engineering Curriculum Development Project to provide third and fourth year undergraduate power engineering curriculum modules free of charge to all universities with a commitment to power engineering education in Australia.

The selection criteria for the **API Annual Request for Funding Proposals** from universities are:

- Contribution to API Strategic Objectives (i.e. promotion and attraction of students to power engineering, world class power engineering education and learning resources, provision of continuing education and support for applied research). A spread of projects across the 3 strategic objectives should be sought.
- Projects are equally matched by university contributions to the project
- Projects are generally not in excess of $50,000 per proposal (as a guide)
- Where academic resource support (i.e. staff salary contributions) is sought, this should be for early career academics (to address the ageing profile of power engineering academics)
- The impact of the project on the maximum number of power engineering students
- National support recognising API's national membership and approach
- Preference shall be given to proposals which are ongoing from last year's funding round (where satisfactory performance can be demonstrated).

The API has committed almost $3.4 million over the last three years to fund 55 projects at 19 universities.

CURRENT API INITIATIVES TO CLOSE SKILLS GAPS

Examples of projects approved for 2011/12 are:

- Electrical engineering summer camp for year 10 and 11 science/maths students in Western Australia
- A micro generation test facility for the assessment of power quality and hybrid system control
- Lecturing position in distance education and power systems operations.
- A mobile learning platform for sustainability in power engineering, based on hybrid renewable energy
- To incorporate UQ Remote Labs of Electrical Machines into API Module of AC Machines developed by UTS
- Development of laboratory test setups for enhancing students understanding on asset management.
- Continuation of early career academic with power systems expertise.

The second major initiative to improve teaching and learning in power engineering has been a project **"Collaborative Power Engineering Curriculum Development"** which has been led by the API in partnership with nine Australian universities, and the power industry. This project has received funding from the Australian Federal Government through the Collaborative and Structural Reform Fund (CASR) and the Diversity Fund.

The key objectives of the project were to provide an industry relevant program of modules and resources that are designed to allow integration into university undergraduate curricula. The development of shareable learning and teaching resources by key subject matter experts from each of the partner universities and the energy industry is unprecedented in the field of power engineering in Australia.

The following Power Engineering Curriculum Model was developed after extensive consultation and input from API Member companies (from both engineering and human resource executives and recent graduates).

Twenty undergraduate modules have now been developed and made available free of charge to all universities with a commitment to power engineering. These are being accessed by university academics for use in subject development and upgrading.

API Power Engineering Curriculum Model

CORE

(21 topic modules)

Systems Eng

1. Energy system fundamental
2. Electricity supply chain major plant and equipment
3. Alternating current machines for power systems
4. Transmission system fundamentals

System Planning, Design and Analysis

1. Real and reactive power and load flow analysis
2. Dynamic transient stability
3. Transient analysis and surge protection
4. Insulation coordination and S/S design principles
5. Earthing system design
6. System planning
7. Fault studies

Intelligent Networks and Protection

1. Protection of electrical plant and equipment
2. Protection of transmission and distribution networks
3. Telecommunications and communication protocols
4. Power quality and harmonics
5. Reliability
6. Instrument transformers and protection settings
7. SCADA, metering and automation

Energy Markets and Sustainability

1. Environmental issues and sustainability
2. Regulation principles and workplace OHS
3. Supply chain fundamentals, demand side management and forecasting

STRONG PROJECT-BASED, SITE VISITS AND APPLICATION

LEARNING AND TEACHING APPROACH

Work-based, activity-based highly contextualised, strong industry relevance

ELECTIVES/ ADVANCED

(19 topic modules)

Generation

1. Condition monitoring
2. Renewble power technology
3. Power generation
4. Scheduling and dispatch
5. Technical and economic analysis and asset management

Transmission and Distribution

1. Asset management maintenance
2. Medium and low voltage distribution
3. Specialised HV equipment
4. Condition monitoring
5. Planning and design of overhead lines
6. Underground design and construction

Manufacturing

1. Power electronics
2. Process control management
3. PLC and cost control
4. Heating, ventilation and air-conditioning

Management and Economics

1. Project management
2. Contract management
3. NPV analysis
4. Energy industry economics and regulation

PREDOMINANTLY CASE STUDY WORK

3. Key Strategies and Actions to Provide Continuing Professional Development Programs and Applied Research for the Energy Industry

The flagship **Continuing Professional Development** activity of the API is the annual API Power Engineering Summer School. This accelerated development program is held in residential mode over two weeks with the following aims:

- Provide power engineers with 4-15 years' experience from all sectors of the industry with a broad understanding of the drivers and key issues in generation, transmission, distribution and the electricity market.
- Provide accelerated career development training to high performing power engineering staff. Delegates consider it an honour to attend the school.
- Bring industry personnel with diverse experience together to share learnings and experiences and develop personal networks.

The API Summer School is held in a different state each year with API member companies and partner universities forming the Steering Group to guide the program. In the four programs 2008 – 2011 more than 50 delegates have attended each year and the API also provided 2-3 positions free of charge to early career academics to attend.

API also conducts a small number of master classes each year where national and international technical experts share their learnings and experiences with experienced power engineering professionals over a 1-3 day period. Examples of API master classes held over the last few years include:

- Reactive Power Management and Voltage Stability
- Energy Sustainability – The Californian Experience
- Modern Partial Discharge Detection and Analysis for Insulation Assessment
- High Voltage Engineering
- Wind Power in Power Systems
- Reliability Evaluation in Electric Power Systems

API recognizes that **high quality applied research** complements quality teaching outcomes and provides a pathway for future industry leaders and academics. Outcomes of research can also contribute substantially to improved industry outcomes and facilitate industry innovation and transformation. API is therefore working with partner universities to increase the Research and Development activities within the energy industry in a coordinated, concerted manner. This is being progressed via Australian Research Council Linkage Grant Applications and/or CSIRO Energy Flagship Project Applications based on priorities and commitment to funding by API member companies and funding by API. The ARC's Linkage funding scheme promotes national and international research partnerships between researchers and business, industry, community organisations and other publicly funded research agencies. By supporting the development of partnerships, the ARC encourages the transfer of skills, knowledge and ideas as a basis for securing commercial and other benefits of research. The proposals must involve a collaborating organisation from outside the higher education sector which must make a significant contribution equal to, or greater than the ARC funding. API will be participating in submissions due by May 2012 for commencement in 2013.

API will also make a submission to the soon to be established Australian Renewable Energy Agency in the Department of Resources, Energy and Tourism portfolio. API will be seeking funding for research proposals supported by the energy industry and to be undertaken in partnership with selected universities with substantial power engineering research expertise. It is intended that the industry relevant concerted research effort will support development of a pipeline of future engineering academic leaders in the universities, as well as contributing to professional development and innovation within the electricity supply industry.

4. Positioning API as a Vibrant Nationally Respected Organisation by Key Stakeholders (i.e. Industry, Universities, Governments)

The API has grown its membership strongly from eight members in 2007 to 35 members in 2011. API is positioned as the nationally recognised representative of the power industry in Australia on power engineering skills and education. The API recognises that the skills gap in power engineering is not only an Australian challenge but also a global issue and hence has formed close relationships with the IET Power Academy in United Kingdom and the IEEE Power and Energy Society in the United States of America.

GOVERNMENT SUPPORT REQUIRED FOR IMPROVED OUTCOMES

The API industry sector collaboration model has been successfully developed to address the critical engineering skills shortage facing the electricity supply industry. This is a problem that requires coordinated and long term efforts to produce results. Early outcomes have been pleasing and encouraging. Much work remains to be done however, as the engineering challenges facing the industry are increasing and competition for talent is intense.

There are real benefits available through being able to further leverage the collaboration model that has been developed and proven since API was established. There may be scope, for instance, to apply the API model to other industry sectors. Within the electricity supply industry, the work of the API could be enhanced and "taken to the next level" with targeted Government support of key API programs, including:

1. Continuing professional development of power engineers
2. Bursaries and work experience for power engineering students
3. Industry focussed university course development
4. Encouraging a pipeline of student enrolments in maths and science at high schools through STELR, and
5. Stimulating applied power industry research and development.

GOVERNMENT SUPPORT REQUIRED FOR IMPROVED OUTCOMES

1. Continuing professional development of power engineers.

API provides continuing professional development for power engineers utilising the pooled senior industry expertise of member companies and the teaching and research expertise of partner universities. This will only increase in relevance as the pace of industry transformation increases, as key technological changes are implemented, and in response to the continuing need to fast-track development of industry professionals to fill senior technical roles.

Programs are funded by the participating API member companies and have been well supported to date, albeit on a limited scale. Responsibility for early career development of power engineering professionals tends to fall to asset owning utilities, with consultants and contracting firms tending not to engage engineers until after their early post graduate development. Utilities therefore generally carry the costs of the longer term investments in professional development of power engineers. Cost constraints on energy utilities are significant and are increasing, as electricity price increases are causing serious concerns throughout the industry and with regulators. Given the potential impact of the engineering skills shortage, and the immediate demand for senior professional skills development, this area justifies higher priorities for government training grants to encourage the expansion and improvement of continuing professional development programs targeted to areas of electricity industry demand. API has the capacity to expand targeted continuing professional development offerings to industry professionals, if government support was available.

2. Bursaries and work experience for power engineering students, including initiatives to increase the representation of women in power engineering.

The API bursary program offers $8,000 over 4 years ($1,000 in year 1, $2,000 in years 2 and 3 and $3,000 in year 4) to offset university costs, plus the opportunity to undertake relevant work experience in member companies during summer vacation periods for engineering students interested in power engineering. Academic workloads in electrical engineering courses are heavy, and this places some restriction on the capacity of students in these programs to undertake part time work to financially support their studies. The bursaries, while modest in size, help to partially offset this limitation.

Applications for these bursaries have grown steadily and now exceed 300 annually, while only 50 awards are available each year. Promotional efforts including targeted publications and face-to-face presentations to schools and universities are needed to emphasize opportunities for female careers in the power engineering field. Government support in the form of matching funding would enable wider promotion and the number of bursaries to be increased and/or an increase in the bursary stipend, making power engineering study more attractive, effective and valuable.

Industry sponsored work experience provides the opportunity to apply academic learning in the industry setting and magnifies the value of university studies.

3. Industry focussed university course development.

The quality of graduates is heavily dependent on the quality of undergraduate courses. With early support and funding from the Federal Government, API has worked with nine university partners to develop the Power Engineering Curriculum Model and to publish 20 course modules that have been made available for use by all universities in course development.

This provides a solid and useful foundation for implementation of “best-of- breed” course content and structures in major universities to match the needs of the power industry. It is now proposed to continue this approach for further modules in the curriculum and to implement distance learning modules based on the existing modules produced. This could be achieved by another stage of the Collaborative Power Engineering Curriculum Development Project to address education in energy sustainability/efficiency, climate change, customer support technologies and intelligent grid technologies. This new stage would also involve provision of support to universities in implementation of the power engineering curriculum and enhancement of the learning resources associated with key modules. The aim will include the reinforcement of key power engineering subjects as core offerings supported by superior quality teaching materials.

4. Encouraging a pipeline of student enrolments in maths and science through STELR.

A major restriction on university enrolments in engineering studies is the small proportion of high school students completing the required advanced maths and science subjects. After falling for some years, the proportion of year 12 students undertaking advanced mathematics has stabilised at just over 10%. Students enrolled in science subjects are also very much in the minority of high school students, with Chemistry attracting approximately 18% and Physics around 15% of those in year 12.

The STELR (Science and Technology Education Leveraging Relevance) project sponsored by the Academy of Technological Sciences and Engineering (ATSE) utilises the relevant context of Global Warming to deliver, to high school students, content about renewable energy resources and electrical generation. The aim is to improve the quality of science education, raise interest in the sciences, and to increase enrolments in physics, chemistry, biology, and mathematics. The program also has a careers focus with students required to research the careers of people working in the renewable energy industries. API supports the project and the results achieved to date after implementation in approximately 183 schools. Continued funding support by API has been approved for 2012. The Federal Government provided initial funding support for the project. Additional and continuing funding is now required to extend the project to achieve the original goal of coverage in all 2000+ high schools across Australia, and to develop resources to support promotion of power engineering, particularly to female students. This would make an important contribution to securing the pipeline of future engineering students to meet the continuing needs of the energy industry.

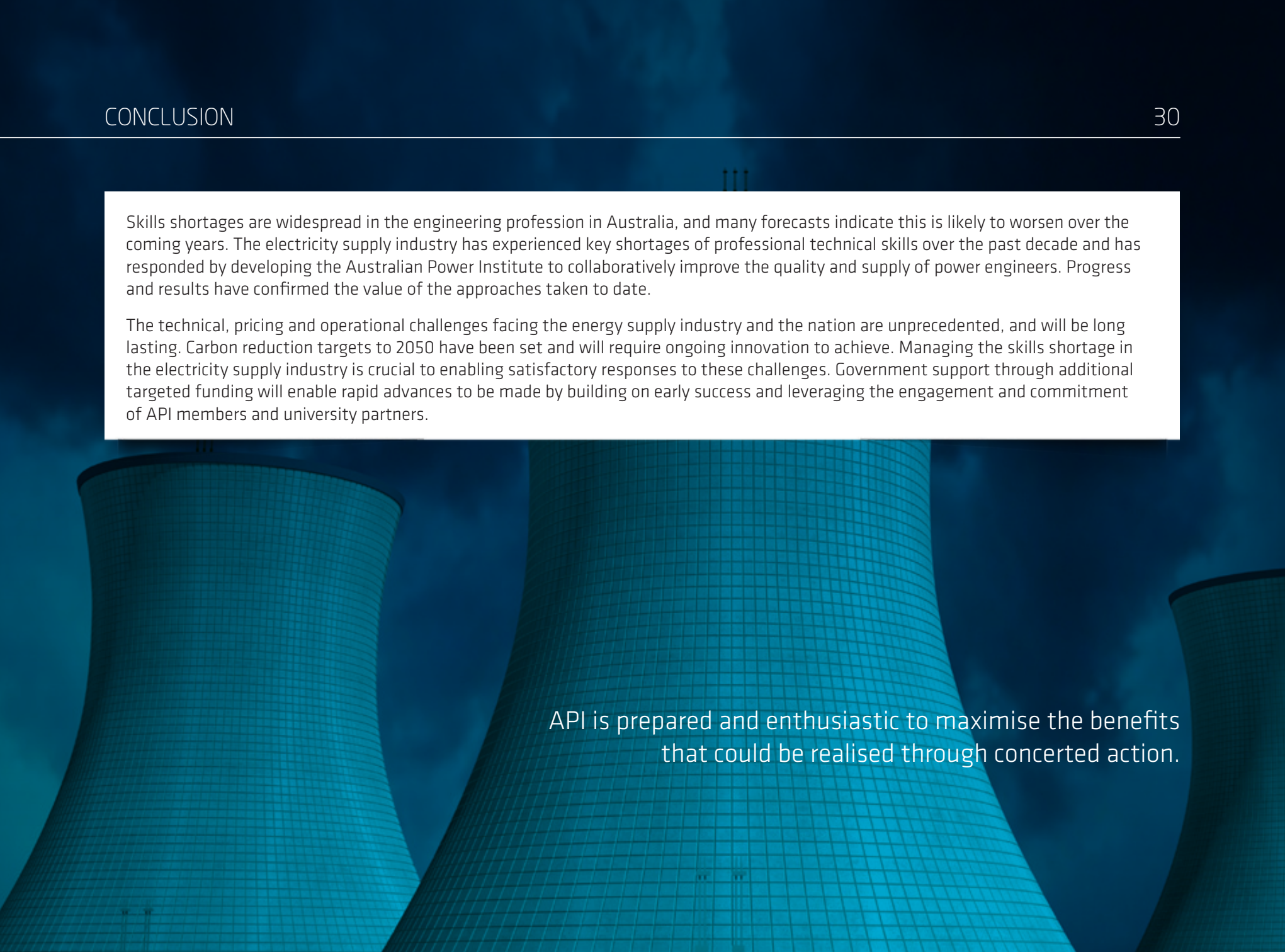
5. Stimulating applied power industry research and development.

Innovation will be crucial to the energy supply industry transition to a low carbon economy, and to the challenge of increasing energy productivity to minimise electricity costs for Australian business and households. Regulatory funding formulae in Great Britian's energy supply industry have recently been changed to recognize this need, with value being assessed in terms of the potential of innovation to meet the pressing challenges of power productivity and transition to a low carbon future e.g. research into the evolution of the power system to accommodate distributed, intermittent renewable generation, electric vehicles and demand side/energy efficiency initiatives. Australia will also need to further develop mechanisms for resourcing and rewarding applied research and innovative practices across the value chain of electricity supply. One adverse impact of the vertical disaggregation of the Australian electricity supply industry that has occurred over recent decades is that while each sector is seeking efficiencies within its control, incentives have been lost for integrated and co-ordinated value chain innovation.

Under current research support arrangements such as through the Australian Research Council and CSIRO, and under new mechanisms such as the Australian Renewable Energy Agency, appropriate weight needs to be afforded to projects based on Power Industry priorities and needs. API is working with member organisations to prioritise applied research projects of maximum value to the electricity supply industry. Value is being assessed in terms of the potential of innovation to meet the pressing challenges of power productivity and transition to a low carbon future. It is also assessed in terms of contribution to the development of the industry's professional expertise to overcome skills shortages and the development of academic researchers and thought leaders in this crucial area. There is a critical need to stimulate the next generation of power engineering academic leaders (the age profile of the existing power engineering academic leaders is such that many will be retiring in the next 5 years) and concerted, coordinated industry research will assist in this stimulation.

Skills shortages are widespread in the engineering profession in Australia, and many forecasts indicate this is likely to worsen over the coming years. The electricity supply industry has experienced key shortages of professional technical skills over the past decade and has responded by developing the Australian Power Institute to collaboratively improve the quality and supply of power engineers. Progress and results have confirmed the value of the approaches taken to date.

The technical, pricing and operational challenges facing the energy supply industry and the nation are unprecedented, and will be long lasting. Carbon reduction targets to 2050 have been set and will require ongoing innovation to achieve. Managing the skills shortage in the electricity supply industry is crucial to enabling satisfactory responses to these challenges. Government support through additional targeted funding will enable rapid advances to be made by building on early success and leveraging the engagement and commitment of API members and university partners.



API is prepared and enthusiastic to maximise the benefits that could be realised through concerted action.

The Australian
Power Institute