Report on Australian electrical power engineering human resources for the electricity supply industry

API WORKFORCE PLANNING

SKILLS & DEMAND IN INDUSTRY REPORT

The Australian Power Institute

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Executive Summary

One of the most important input tools used by the API is accurate information on both supply and demand for professional power engineers. To gain this information, the API conducts 2 yearly workforce planning surveys. Accordingly we have updated our data and information on the current and future forecast power engineering workforce requirements by surveying our Industry members, and we greatly appreciate input from the organisations who have responded to the 2015 survey.

The major conclusions from the 2015 API Workforce Planning Survey are summarised below:

Mike Griffin, Chief Executive
Australian Power Institute

Gender Diversity is not improving

Although responding companies report an increase in the number of females into engineering roles over the last 4-5 years (50% c.f report increase in 2015, 24% in 2013 and 47% in 2011) there has not been an overall increase in the proportion of females as part of the overall professional power engineering workforce (9.5% in 2015 c.f. 10% in 2013 and 13% in 2011). With 57% of companies stating that they do not have a strategy to address this issue the achievement of greater gender diversity is of great concern.

Professional Power Engineering Age Profile Normalising

The age distribution of power engineering professionals is trending towards a normal distribution following a number of years where the age distribution was heavily weighted to 50+ years and less the 30 years. The predicted forecast of high retirements in 2013 appears to have occurred and the forecast retirements into the future is predicted to reduce from 2013 levels.

Future Employment Requirements Forecast to Decline

36% of companies in 2015 forecast the requirement for professional engineers to decrease compared to 22% in 2013. However 62% of companies forecast the requirements for the power engineering workforce to remain steady.

Graduate Employment Declining

In 2015 participating companies have shown a consistent reduction in graduate employment over the last 3 years dropping from 2.6% of the total workforce in 2011 to 1.8% of the total workforce in 2015 (a reduction of 30%).

Graduate Quality Positively Rising

The amount of graduates with average to strong skills increased from 53% in 2013 to 83% in 2015 which indicates that graduates are better prepared than they used to be.

Graduate Future Skills to New & Emerging Technologies and Commercial/Business Skills

Traditional power engineering is still needed but also there is a need for renewables and new technologies integration capabilities. Also there is a need for financial/commercial skills and asset management skills.

A number of recent Workforce Planning Reports (CEDA – Australia's Future Workforce : June 2015 and NBN – Super Connected Jobs : Understanding Australia's Future Workforce : September 2015) have reported that 40% of existing jobs will not exist in the next decade and of the new jobs that are created 70% will come from people with Science, Technology, Engineering, Entrepreneurial and Mathematics (STEEM) skills.

The energy industry will be competing with other existing and new emerging industries in the energy sector as well as other related electrical industries (e.g. NBN Co) to secure professionals with these skills. It is considered important that current short term business pressures (e.g reduction in graduate employment rates) do not jeopardise the long term future and capability of the industry.

All stakeholders – industry, government, individuals, education providers – need to put in still greater efforts if we are to provide the "people and skills to Power Australia's Future".

Mike Griffin
Chief Executive
Australian Power Institute

Contents

introduction

workforce trends and the changing landscape

The API Members Workforce Planning Survey was first conducted in March 2011. This survey has been conducted every two years since this initial survey. The results of the 2011 and 2013 surveys are summarised below:

2011

- Whilst a significant number of respondents predict workforce to remain steady, a number of forecasting tools indicate a downturn.
- Shortages and recruitment difficulties are being experienced for Senior Engineers throughout the industry, and for power engineering management very widely.
- The historically large proportion (25%) of power engineers under 30 years of age, combined with the reduction in the 40-49 band (from 30% to 20%), will accentuate continuing professional development challenges.
- With 29% of the estimated 6,500 power engineers already over 50 years of age there will be a major exodus of professional staff through retirements over the next decade.
- University programs for power engineers need to be modified to improve graduates capability to meet future industry technical challenges.
- Universities are graduating approximately 260 power engineering students each year and if sustained over the next 5 years would approximately equal the forecast needs of the electricity supply industry. Notwithstanding competition from other industries (e.g. mining), there are also significant leakage of graduates to overseas employment, and a a large proportion (31%) of engineering.students are overseas students.

2013

- Size of power engineering workforce is set to remain steady as indicated by survey respondents (67%). Increase (17%) and decrease (22%) in demand for power engineers come from management, transmission and distribution companies.
- Ageing workforce remains an issue with an increase to 33% (2013) from 29.04% (2011) of the professional engineer workforce over 50 years of age, an increase of 2% within a span of 2 years.
- While the 40-49 year age group remains relative unchanged from between 2013 and 2011 (22%and 23%, respectively), these figures are relatively low compared with 30% in the 2004 survey. This age group typically provides the senior professional leaders and managers.
- Females remain grossly under-represented in power engineering roles with a mean employment of 8 (10%) and 50% of companies employing below the mean. This is a declining trend from a mean of 10 (13%) and 56% in 2011.
- A comparison of the 2011 average 5-year retirement forecast of 11% (total278) with 2013 average 2-year retirement forecast of 7% (total 142) would indicate that there has been a slow down over the last 3 years.
- An overall improvement in the assesment of graduate power engineering professionals preparation to meet future industry challenges (e.g. energy security and sustainability, intelligent generation and networks) has improved overall from the 2011 survey.

2015 Report

research method

Survey questions, shown in Appendix 1, were sent to the 18 member companies of the Australian Power Institute in September 2015. Responses were received from the 14 companies shown below:

There was a decreased representation in the survey from 18 companies in 2013 to 14 companies in 2015.

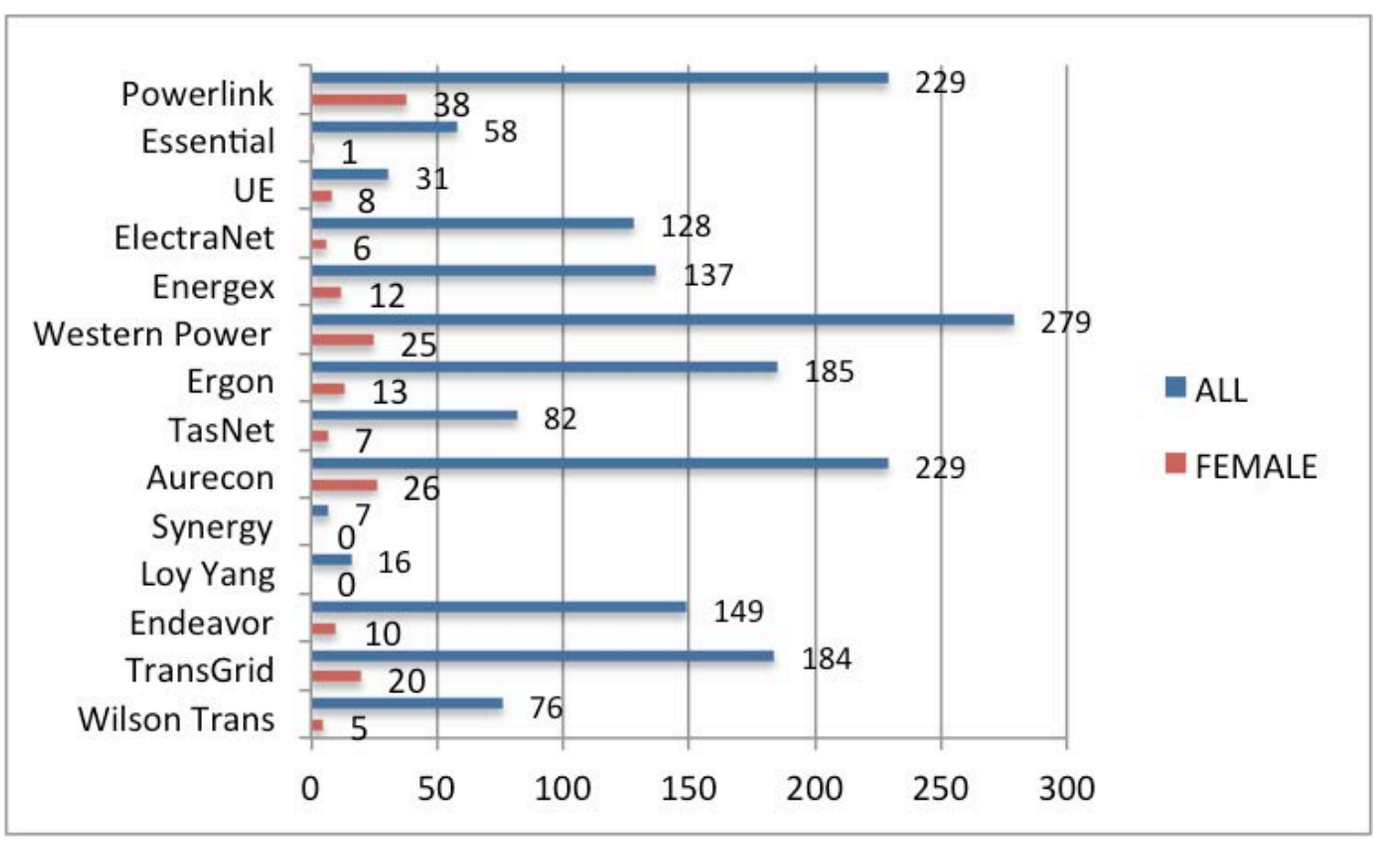
Company responses to survey questions that were incomplete or erroneous were eliminated from the data analysis. This data is either excluded all together or indicated by the empty data values in the charts contained in this report. Descriptive and correlative analyses were used to interpret quantitative data, while qualitative data was used to derive in-depth analysis of the responses.

In this report, a comparative analysis of the API Members Workforce Planning Surveys in 2011 and 2013 were presented where relevant. Four out of the 14 companies in this 2015 report were not participants to the 2013 survey.

findings of the survey

power engineering employment profile – key statistics

- 1,790 power engineers represents a range of 4-40% of the total workforce across 14 companies that participated in the survey.
- 171 (9.6%) of total workforce from the survey comanpies in 2015 are female. This compares to 10% in 2013.
- 64% of survey companies have more than 100 professional power engineering in 2015, compared with 60% in 2013.
- Further decline in proportion of female engineers in employment from 13% employed in 2011 to 10% in 2013 and 9.6% in 2015.



findings of the survey

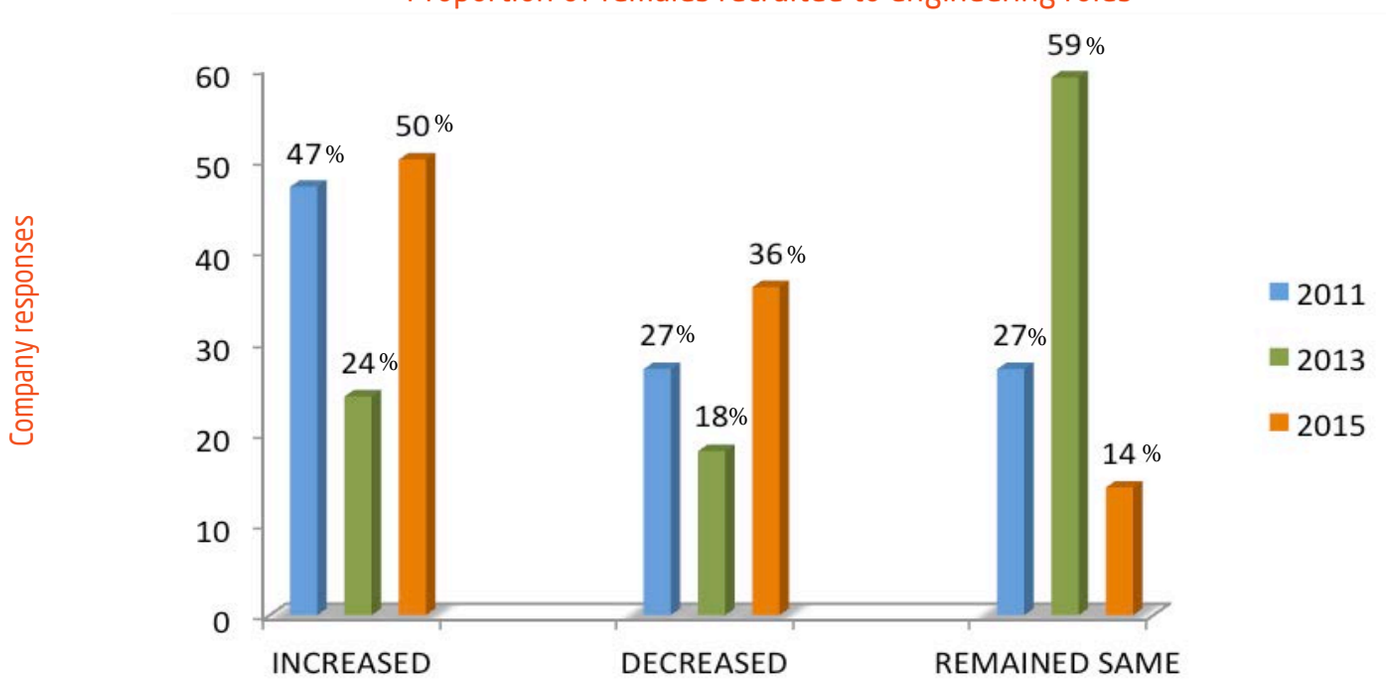
gender diversity is not improving

- Although responding companies report an increase in females recruited into engineering roles over the last 4-5 years (50% in 2015, 24% in 2013, and 47% 2011), there has not been an overall increase in the proportion of females as part of the professional power engineering workforce (9.5% in 2015, 10% in 2013 and 13% in 2011).

- Only 43% of companies report that they have a strategy to address this problem and increase the amount of females. 57% of companies state they do not currently have a strategy in place to address this area of concern.

Risk of continued decline in female employment despite the increase in proportion of female recruits and targeted strategies

Proportion of females recruited to engineering roles

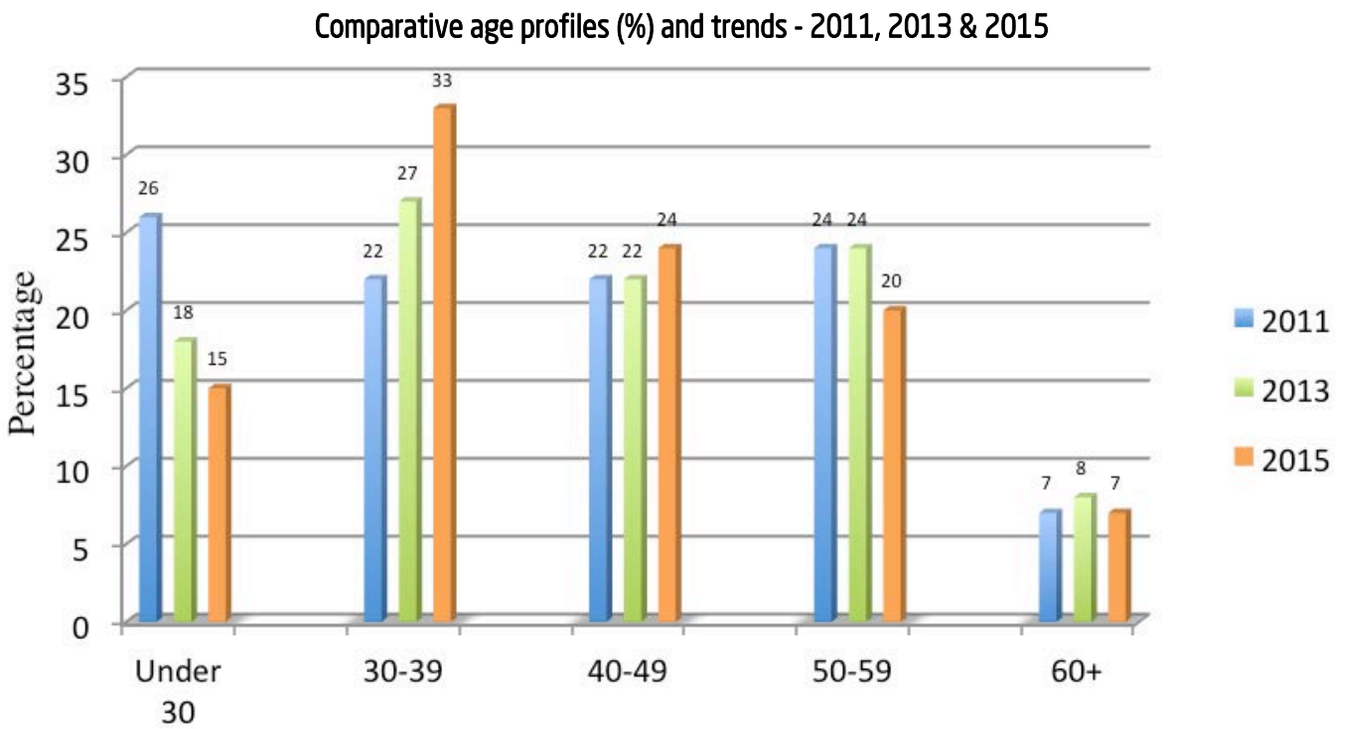


findings of the survey

ageing power engineering workforce

- There has been a decrease of the professional engineer workforce 50+ years of age from 33% (2013) to 28% (2015). This is a decrease of 5% within a span of 2 years.
- While the 40-49 year age group remains relatively unchanged from between 2011 and 2015 (22%-24%), these figures are relatively low compared w ith 30% in the 2004 survey. This age group typically provides the senior professional leaders and managers.
- A significant decline in the recruitment of new graduates and young engineers from 26% (2011) to 18% (2013) and further decrease to 15% (2015). The 10% decline (2011-2015) is indicative of a reversal of positive employment trends shown in 2011 when it jumped by 11% from 2004.

The 2015 results show a trend towards a better balance age profiled workforce



age and sectoral employment

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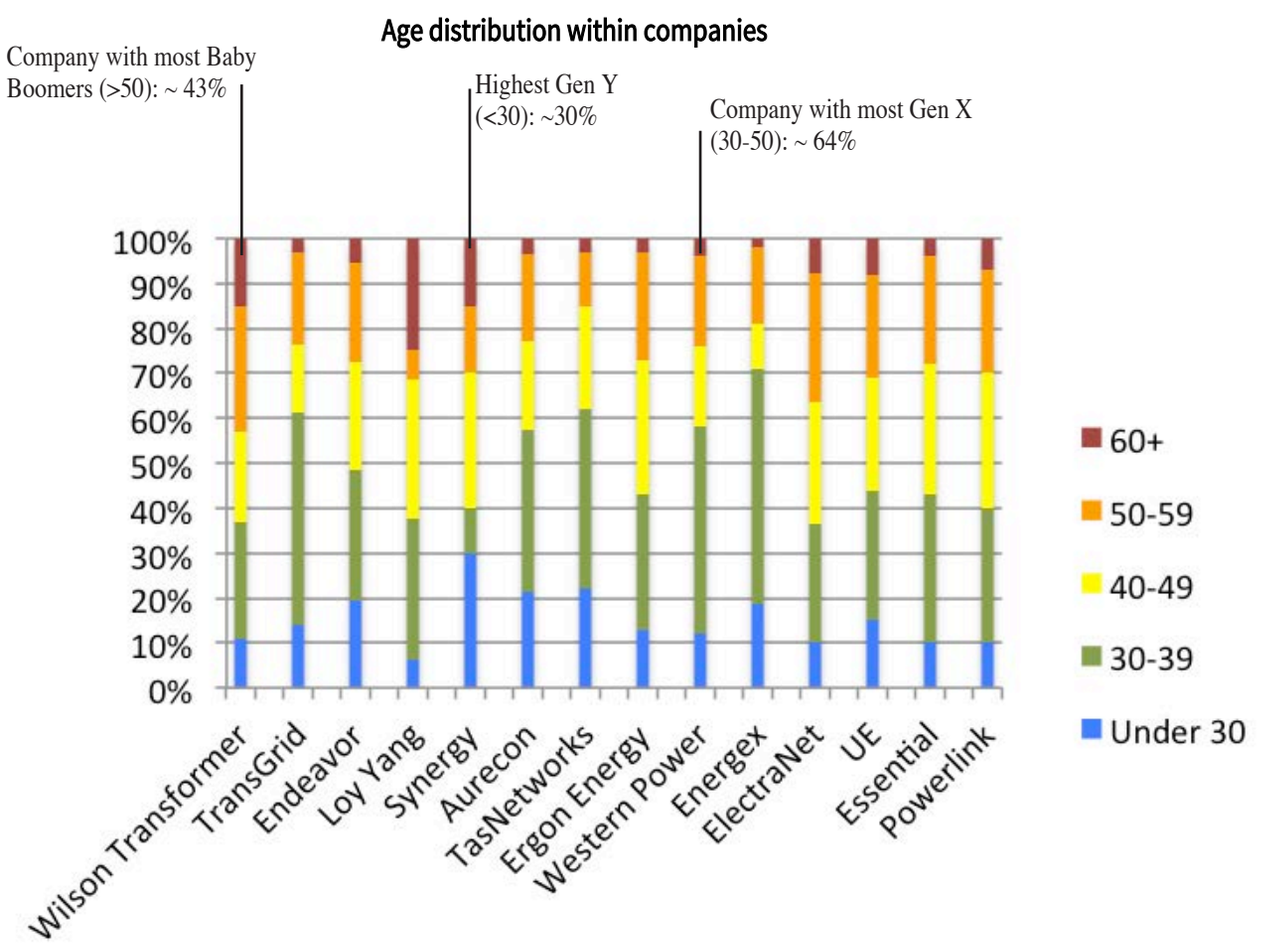
- In 2015, 1 out of 14 (7%) of companies in the survey had 40+% Baby Boomer (>50 years) professional power engineers. Compared with 2013 as 5 out of 18 (28%) with 40%+ baby boomers. On average, 28% of the participating companies' current workforce consist of 50+ years of age.
- In 2015, 12 out of 14 (86%) of participating companies had 50% or more of their power engineers belonging to Gen X (30-50 years). This compares to 2013 as there were 8 out of 18 (44%) in the same category.
- In 2015, 11 out of 14 (79%) of companies reported to have 20% or less Gen Ys (less than 20 years of age). Where as in 2013, there were 10 out of 18 (55%).

*Approximate figures given due to generation definitions in current literature and age bands in the survey.

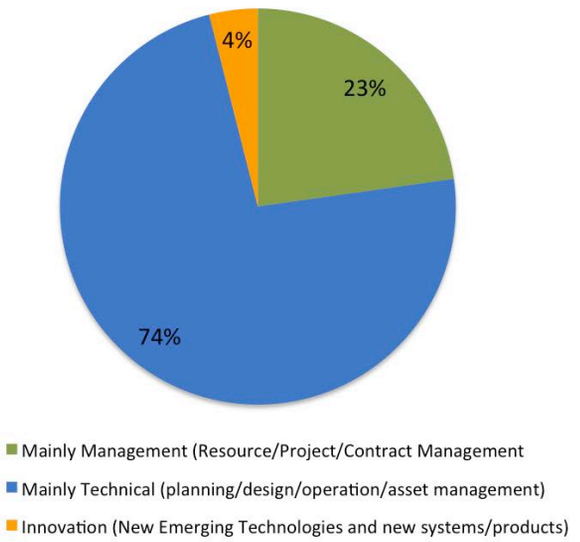
Young engineers have declined in numbers while middle-aged engineers have increased



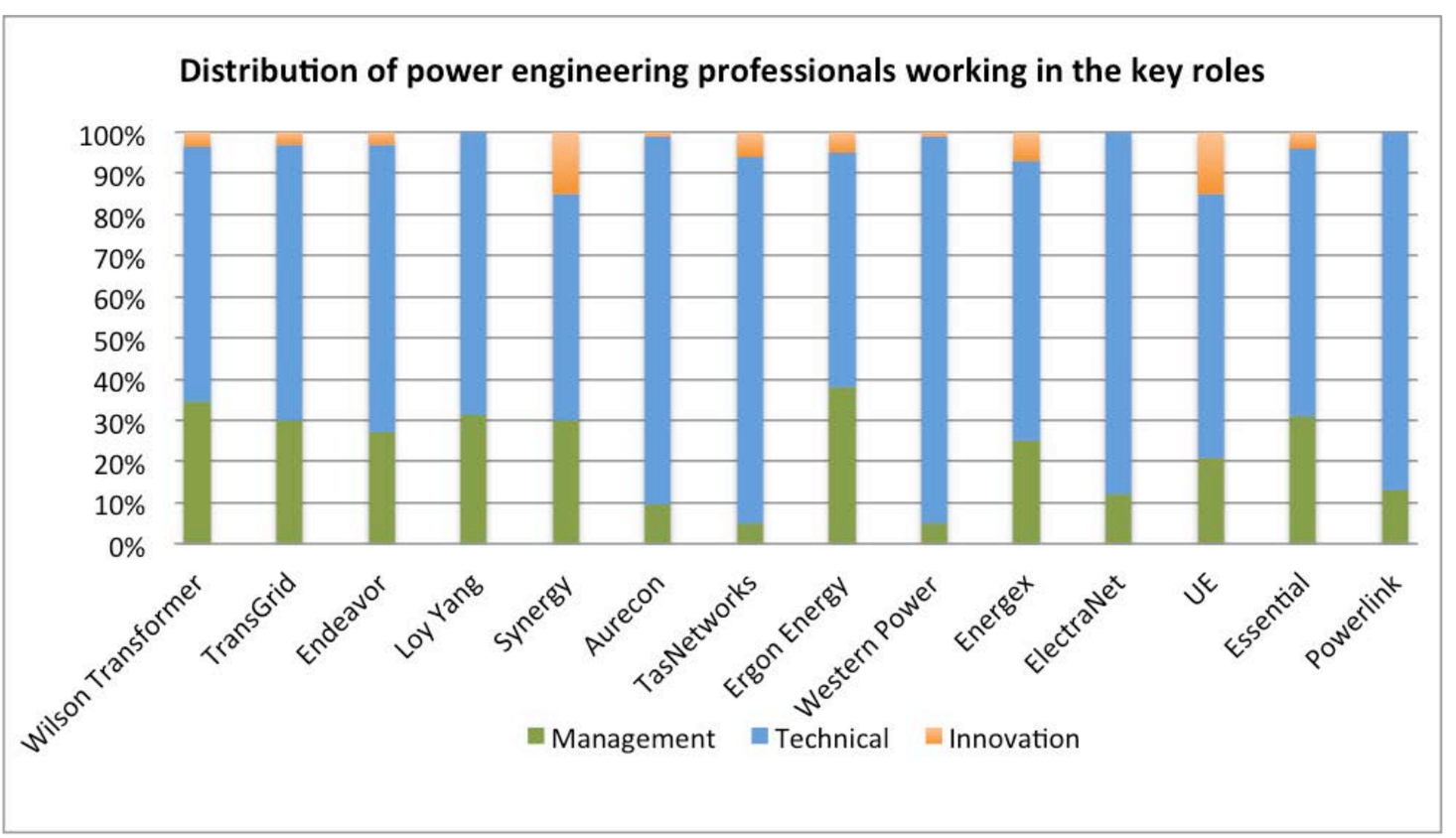
findings of the survey

power engineering key roles

- In 2015, 12 out of 14 (86%) of companies reported 60+% of their Professional Power Engineers workforce consisted of mainly technical roles. Compared to 2013 as there were 14 out of 18 (78%).
- In 2015, 23% of professional power engineering workforce consisted of management roles, compared to 22% in 2013.
- In 2015, 4% of PPEs consisted of innovation roles compared to 7% in 2013.



Overall, 74% of all power engineers employed by these companies in 2015, were generally assigned to mainly technical roles.

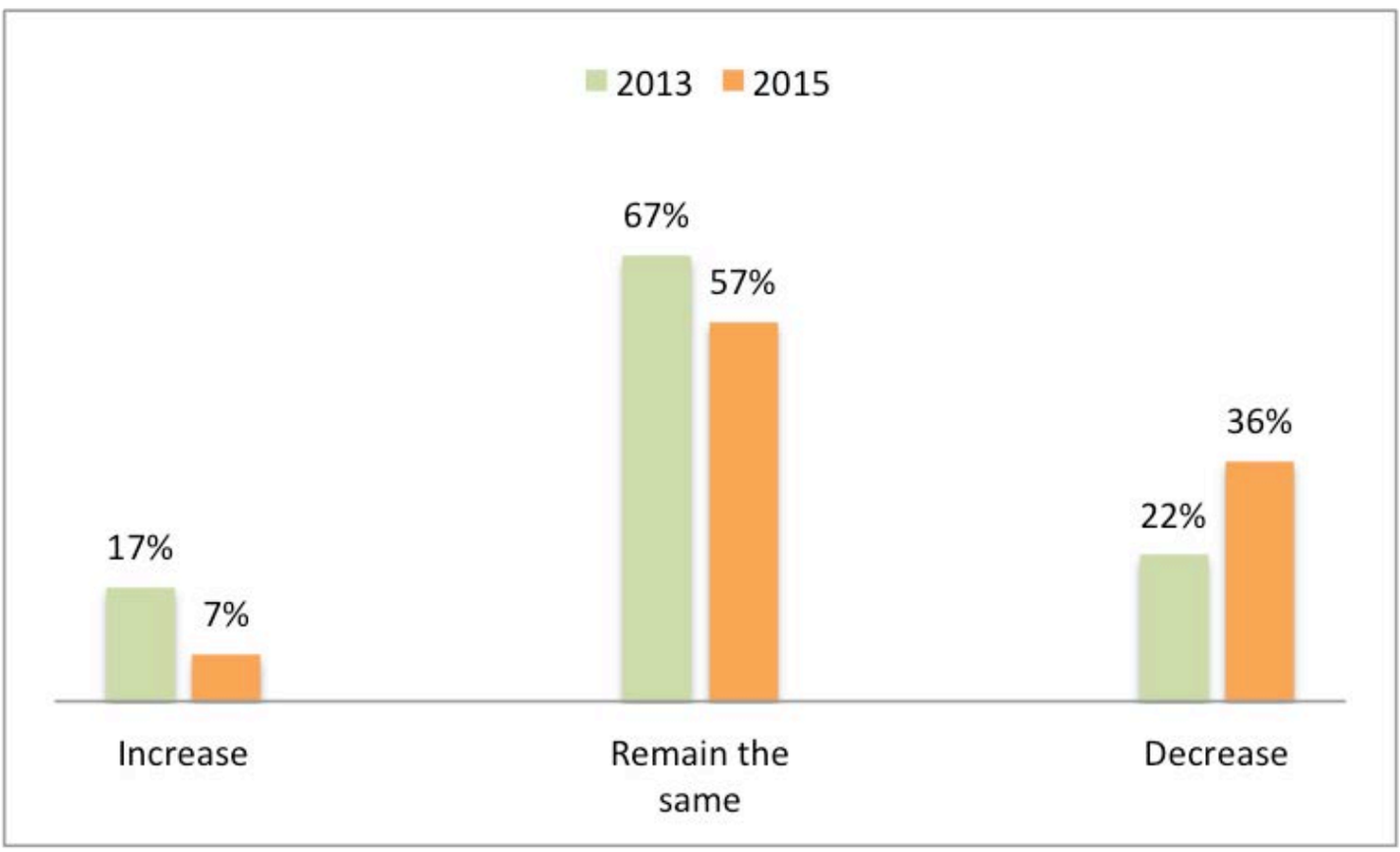


future employment requirements

- In 2015, 57% (8/14) companies predict the size of the power engineering workforce is set to remain steady. This is similar to the results from 2013 as 67% (12/18) of companies also predicted the size to remain steady.

- 36% (5/14) of 2015 companies predict the industry to decrease in size compared to 22% (4/18) in 2013.

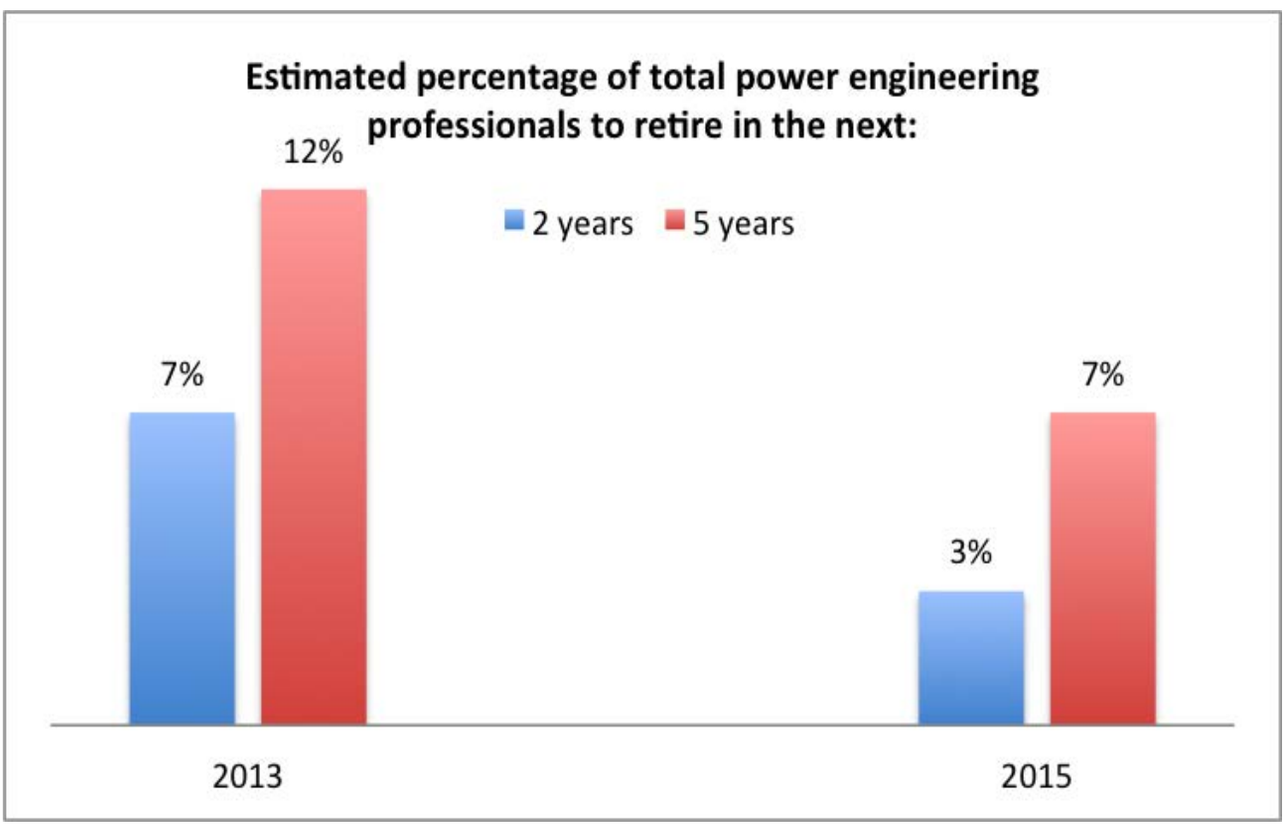
Overall power engineering professional workforce size in near future (1-3 years) is expected to:



retirement forecasts

- An approximate total of 51 professionals (2.8%) from the 14 participating company's total workforce are predicted to retire over the next 2 years compared to 7% foretasted in 2013.

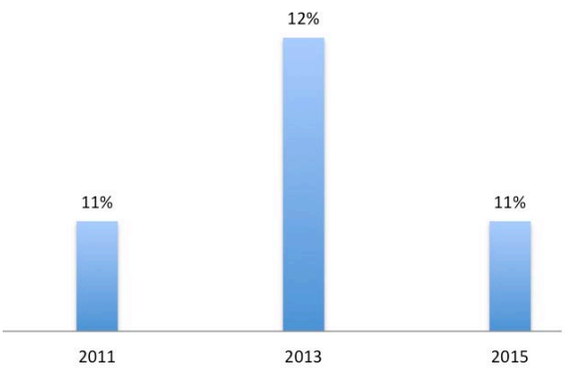
- There appears to be a decreasing trend of retirements into the future. (A significant proportion of retirements have occurred as predicted between 2013 and 2015).



findings of the survey

retirement trends

- Forecast 5-year retirement rates were 11% (2011), 12% (2013) and returned to an average of 11% in 2015.

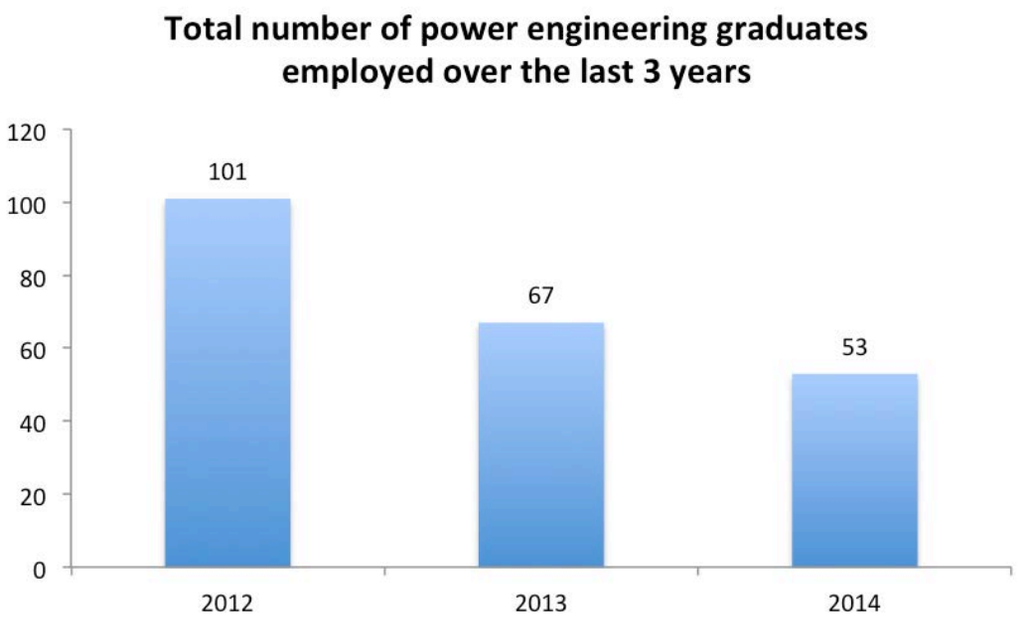


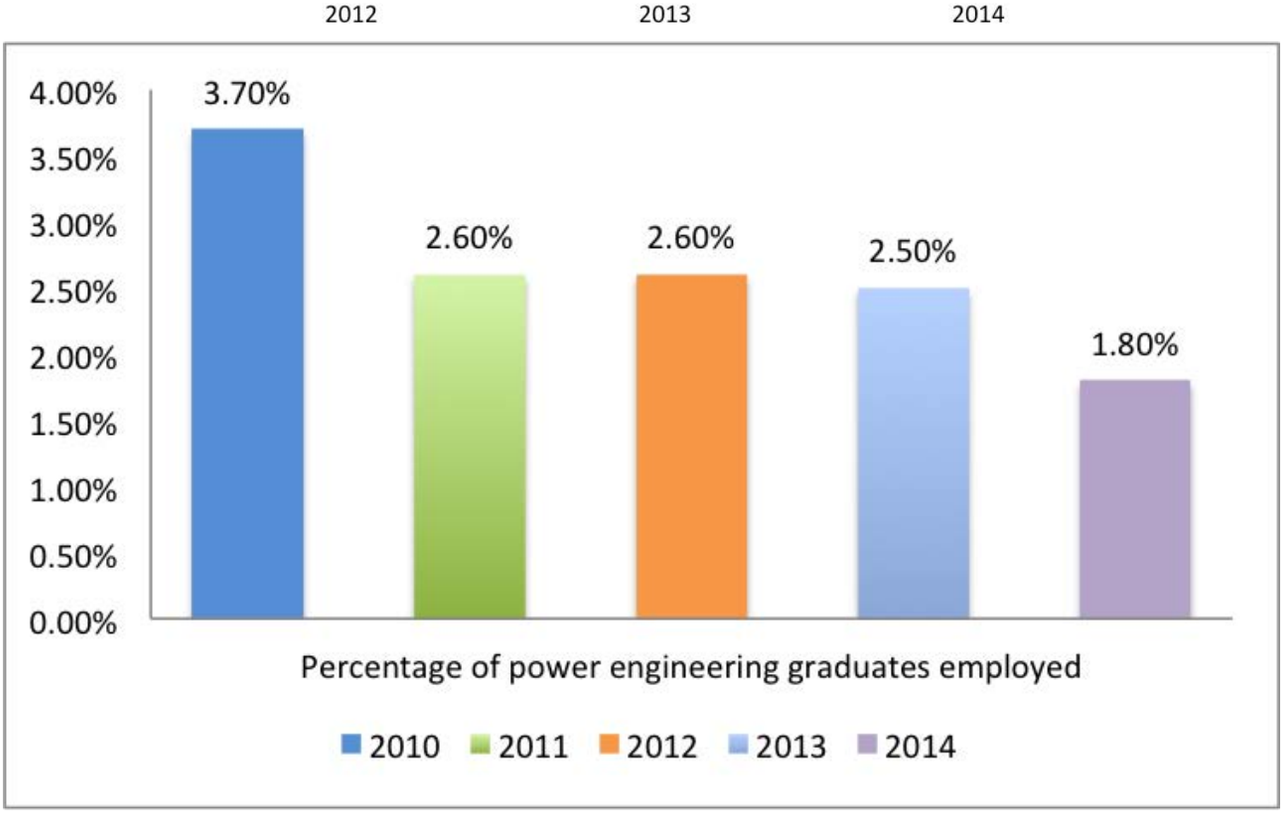
Estimated number of power engineering professionals to retire in:

	Years 2016/2017	Years 2016-2021
Wilson Transformers	5 %	12 %
TransGrid	2.7 %	7.6 %
Endeavor	5 %	7 %
Loy Yang	2 %	4 %
Synergy	15 %	15 %
Aurecon	1 %	7 %
TasNetworks	3 %	8.5 %
Ergon Energy	-	-
Western Power	1.7 %	3.9 %
Energex	1.9 %	4.7 %
ElectraNet	7.94 %	10.32 %
UE	6 %	4 %
Essential Energy	6 %	18 %
Powerlink	2%	6%

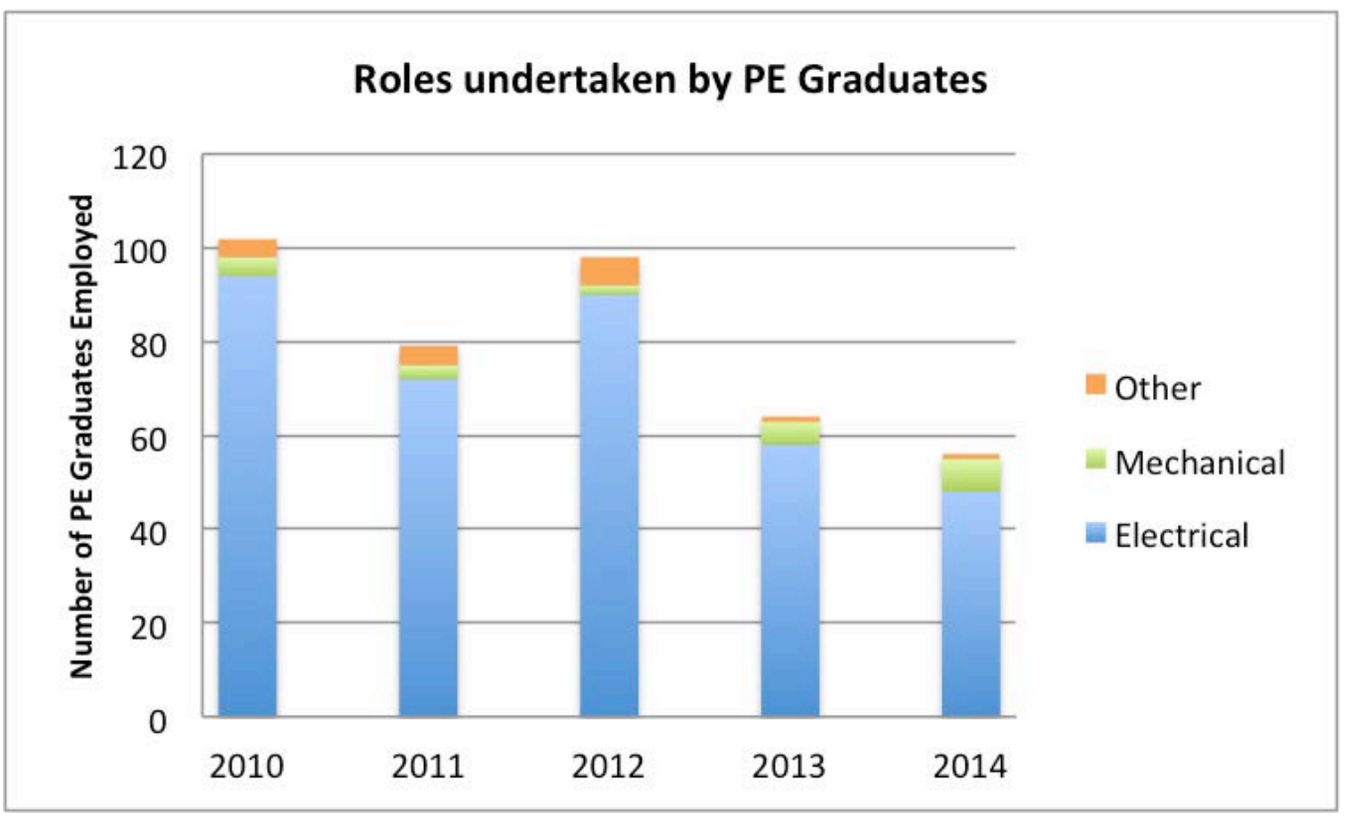
graduate employment - declining

- In 2015, the 14 participating companies have shown a consistent reduction in the amount of graduate employment over the last 3 years, dropping by 34% (2012-2013) and a further 21% from 2013-2014. An overall decrease of 48% from 2012-2014.





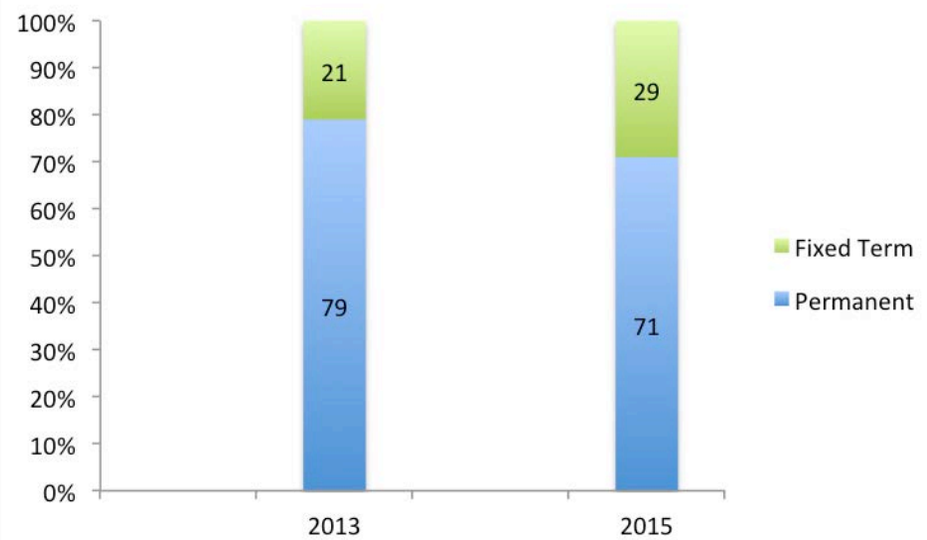
graduate employment roles



- The roles undertaken by power engineering graduates employed over the last 5 years are shown above.
- Majority of power engineering graduates continue to be employed in electrical engineering roles.

graduate retention rates & employment conditions

- There has been a small shift towards fixed term contracts with an increase of 8% from 2013 to 2015.
- Retention rates have stayed consistent at approximately 85-86% over the last 5 years.



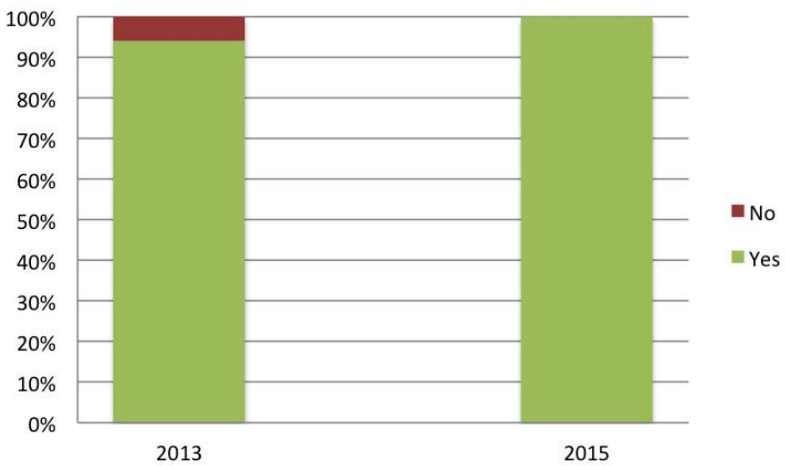
The 14 participating companies hold an average retention rate of 86.5% for 2015.

Organisation	Retention Rate
Wilson Transformers	85%
TransGrid	92.5 %
Endeavor	89 %
Loy Yang	100 %
Synergy	80 %
Aurecon	75 %
TasNetworks	100 %
Ergon Energy	93 %
Western Power	93 %
Energex	100 %
ElectraNet	64.71 %
UE	83 %
Essential Energy	60 %
Powerlink	96 %

capacity and capability
is the work of API required?

- In 2013, 94% of companies responded to the survey indicated an ongoing need for development of power engineering capacity and capability to meet industry's medium to longer term needs. In 2015, all 14 respondents unanimously declared an neongoing need for support.

- Ongoing development programs will be contingent on changes to the market.



Continued need for capacity and capability development

however...

Respondents to the survey indicated areas of improvement for graduate engineers entering the workplace:

- **Personal attributes and non-technical skills:** Still an ongoing need for more individuals to have the ability to think outside the square, possess problem solving skills, self-awareness, better safety awareness, inclusive and leadership behaviours, good communication and presentation skills.
- **Work readiness:** Preparation for working in the workplace (e.g. basic influencing skills, appreciation of risk management, appreciation of business case application, etc.), technical report writing.
- **Increased understanding of commercial and business fundamentals:** Ability to work with big data analytics. Need for better understanding of the National Electricity Market (NEM) and the interaction that power engineering has with economics. There seems to be little appreciation of the commercial operation of energy infrastructure in an environment which is heavily scrutinised and regulated.
- **Better technical skills & understanding of new technologies:** Deeper understanding, retention of theoretical fundamentals and appreciation of practical aspects of power system analysis, earthing and risk assessments. Need for better commissioning practices. There is a greater need to develop customer, technical and commercial centric capability and thinking. How do we shift away from a build / maintain infrastructure in light of new technology and customer use. greatest risk reduction for the available investment. Off-grid options, virtual power stations, mini / small grids, maximising investment benefits in life cycle management and costs. Power engineer with key power skills eg power studies, motors and machines etc.
- **Project management:** Project leadership, contract management, basic financial planning and control, stakeholder engagement and people management.

recruitment issues - feedback and strategies

- Recruit industry graduates from API students and University Leadership Programs. Recruit experienced industry professionals from other industries (i.e automotive etc).

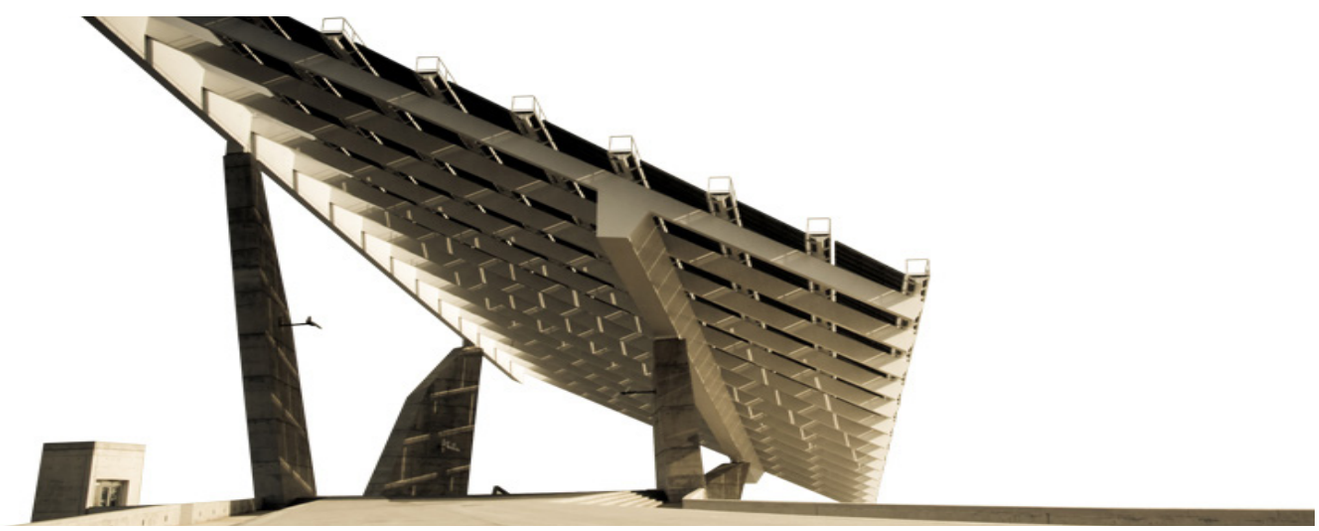
- A couple organisations have indicated that they have not experienced problems sourcing candidates at this point in time. The power distribution industry has a labour oversupply in many career streams with a large pool of internal and external candidates available for most positions. Only specialist roles are going to external recruitment where candidates are readily sourced and relocated, particularly from SA and WA due to the wind down of mining infrastructure projects. The key priority presently is to manage labour oversupply. Early retirement and voluntary redundancy programs are operating to address this issue.

- Trickle feed organisation as financial circumstances permit

- Recent recruitment efforts suggest that there is no shortage of engineers with a broad smattering of general experiences including team leadership capabilities. It is still difficult to locate and secure certain specialist skill sets including engineers that can offer field based practical experiences to complement theoretical understanding. Companies to create a new Graduate Development Program with the objective of delivering focused, in-house training opportunities covering both distribution and transmission networks with the intention of developing the “hard to recruit” skill sets. The program will also form part of the businesses long term succession planning strategy.

- Train and develop our own less experienced engineers and support them with older (55+ yr) staff to mentor them

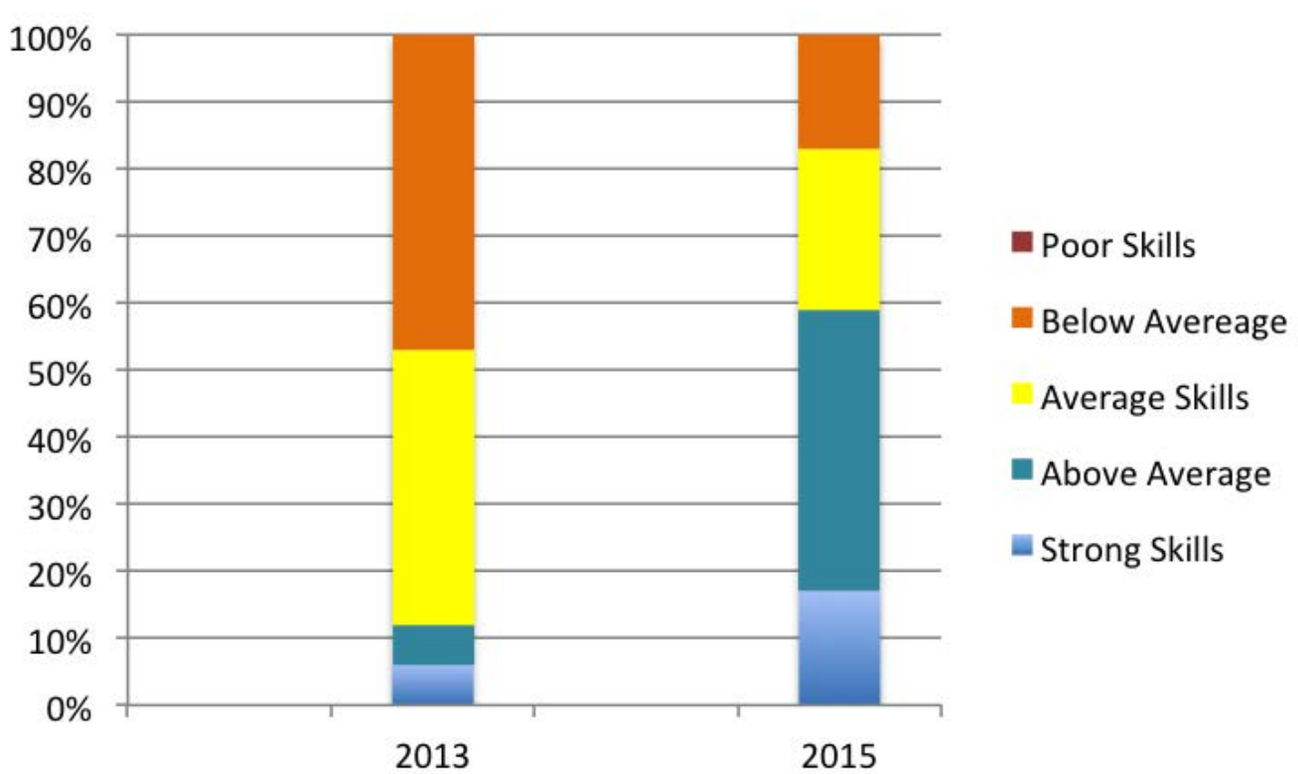
- Difficulty in attracting to a regional location, strategy has been to recruit cadets with regional links however current recruitment freeze has halted this strategy



graduate quality rating

- The amount of graduates with average to strong skills increased from 53% in 2013 to 83% in 2015 which indicates graduates are better prepared than they used to be.
- Not one of the 31 companies who have completed this survey from 2013/2015 have felt graduate applicant skills were ever poor.
- An overall improvement in the assessment of graduate power engineering professionals preparation to meet future industry challenges (e.g. planning, power system analysis, asset management, protection, power electronics, real time digital systems, renewables and new technology integration capabilities, financial and asset management skills)

Graduate quality positively rising



specialised and other skills for the future

The survey identified five new streams of engineering and non-engineering skills that companies anticipate will be needed to support their business.

Systems Engineering

- power system analysis
- asset management
- real time digital systems
- renewable and new technology integration
- storage systems
- asset management

System Planning, Design and Analysis

- operational technology/IT linkages
- leveraging software/data skills
- data collection and secuirty
- thermodynamics and performance
- analytics/modelling

Business & Commercial Management

- project management
- financial management
- risk based asset management
- life cycle asset management and costing
- regulatory management
- contract management
- stakeholder management

Intelligent Networks and Protection

- digital networking and telecoms for intelligent networks
- power source isolation
- IT/Engineering mix - integration of communication and control systems
- SCADA/Telecom
- protection engineering
- smart grid
- IEC61850 Systems Integration
- handling big data using database applications

Renewable and Alternate Technologies

- renewable energy
- batteries and storage
- new energy storage technologies
- managing new technology
- renewable generation technologies and integration
- environmental and chemical engineering
- embedded generation and power storage
- battery technology

findings of the survey

actions for the future

A number of actions that can be undertaken by API and industry**,** universities and government were identified to address the skills shortage**.**

API and Industry

- Endeavour to boost University interest in power engineering so that when demand increases again there will be a supply of graduate power engineers.
- Increase collaboration between industry associations and universities.
- Provide appropriate mentoring & coaching to students undertaking work placements and/or recent graduate engineers.
- Attraction strategies to target not only university but secondary school level early in their studies.
- Promote the exciting futures that industry anticipates.
- Improve professional development for mid/late career through accreditation requirements with development and increased targeted recruitment actions.
- Provision of or connection with bodies who can provide relevant, cost effective avenues to up skill/ refresh existing employees.
- Undertake continued industry refresher education (studies, conferences, of site training).
- Invest in training graduate engineers.

University Institutions

- Annual reviews of course content and pedagogy (best practice) to create a better learning environment. Invest time in evaluating the current and future needs of the industry as well as applying the results of those findings to future academic planning; better tailoring of courses to industry needs.
- Increase collaboration and sharing of information between industry associations.
- Include basic business professional fundamental courses (i.e communication skills, public speaking, professionalism etc.)
- Develop non-technical skills as these are equally as important as technical skills.
- Ramp up studies into emerging technologies.
- Encourage practical work place exposure to expose students to develop practical skills.
- Provide appropriate mentoring & coaching.
- Participation in technical education providing pragmatic and learned experience to students through lectures.
- Continue promotions towards females within the power engineering industry.
- Post graduate courses targeted to meet needs.

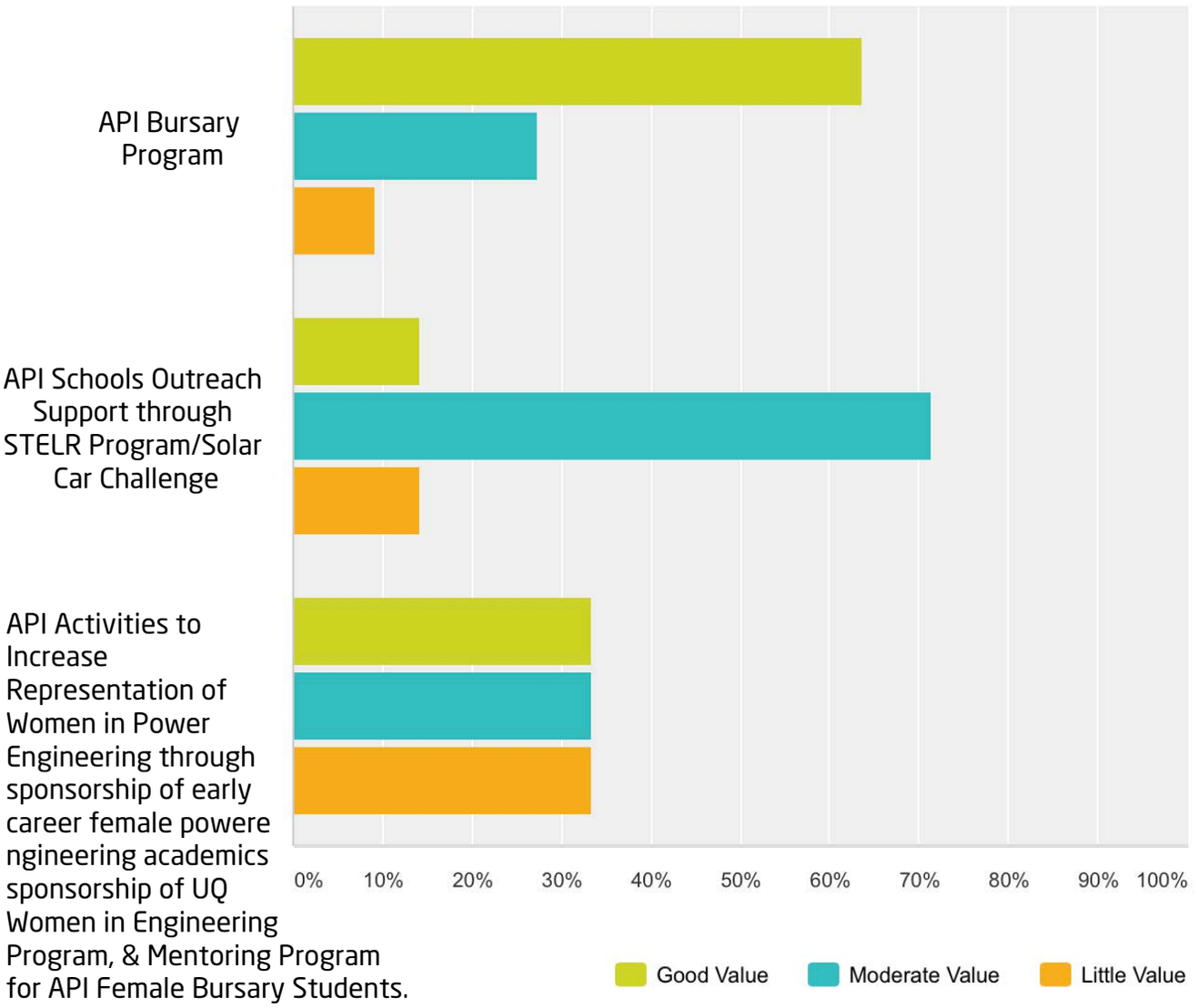
Government

- Funding for relevant degrees and work placements.
- Clear direction of regulatory direction.
- Future incentive programs for distributed energy organisations - future of carbon tax, electronic cars and new technologies.
- Greater government/industry engagement and coordinated workforce planning strategies.

Members Assessment of API Activities & Value

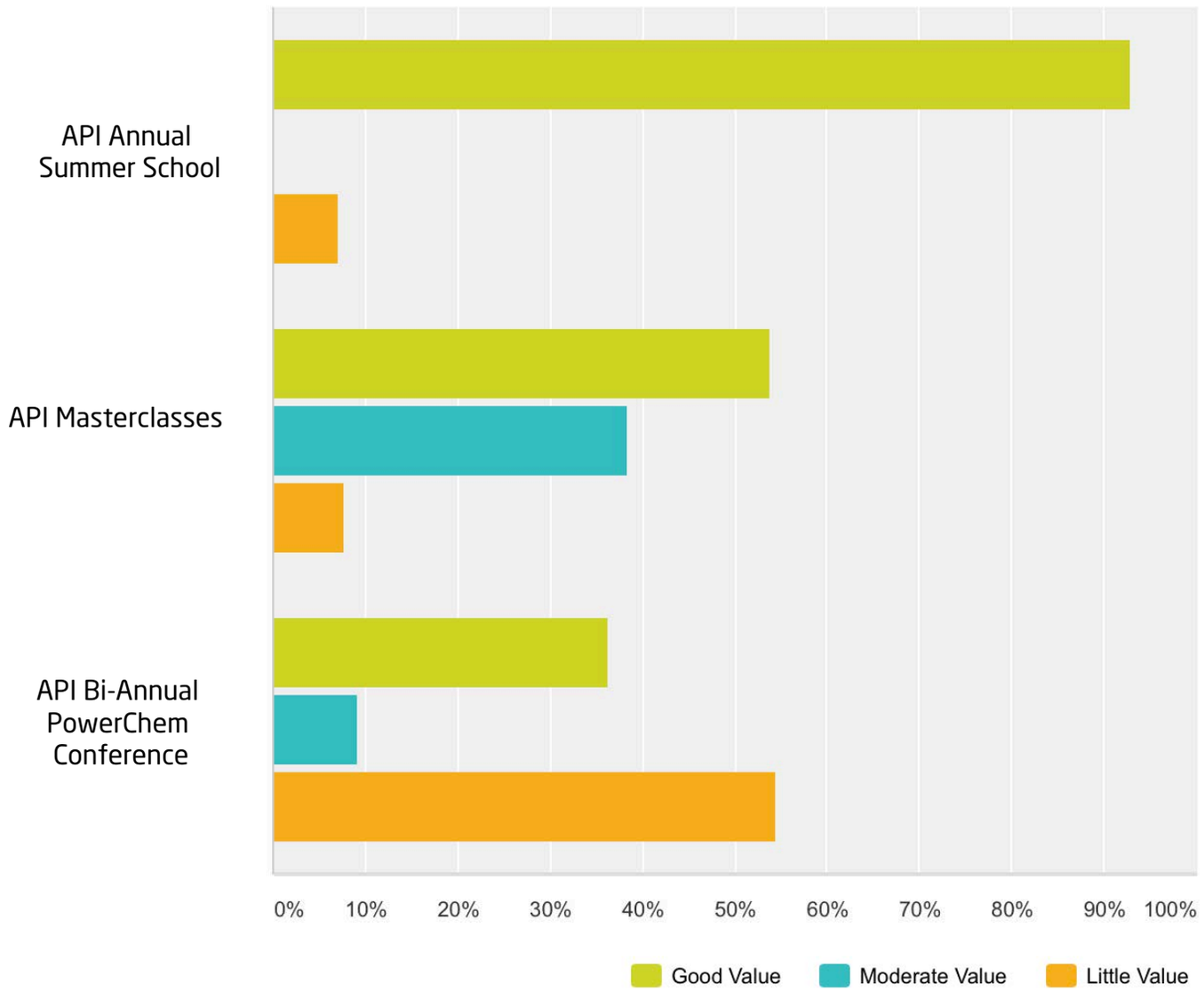
Value & Effectiveness of the Following API Activities:

The Australian Power Institute strive to provide a sustainable supply of quality power engineering graduates to industry through the following programs and initiatives. In 2015, the 14 companies rated the overall value and effectiveness of the following programs.



Members Assessment of API Activities & Value

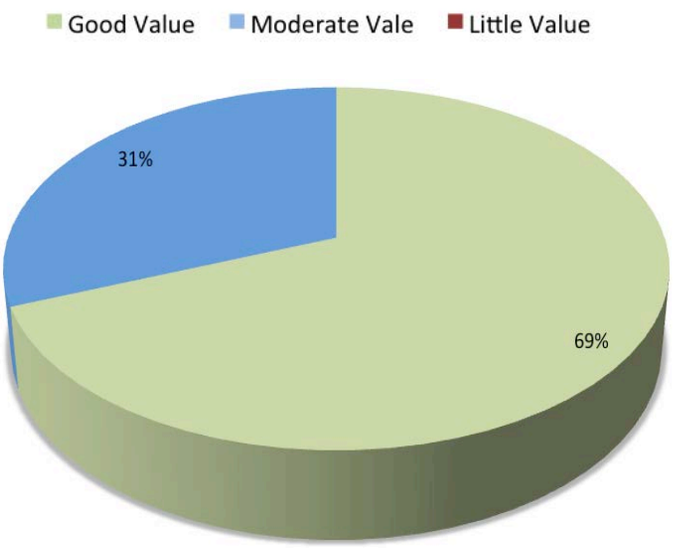
Value Added Continuing Professional Development Programs:



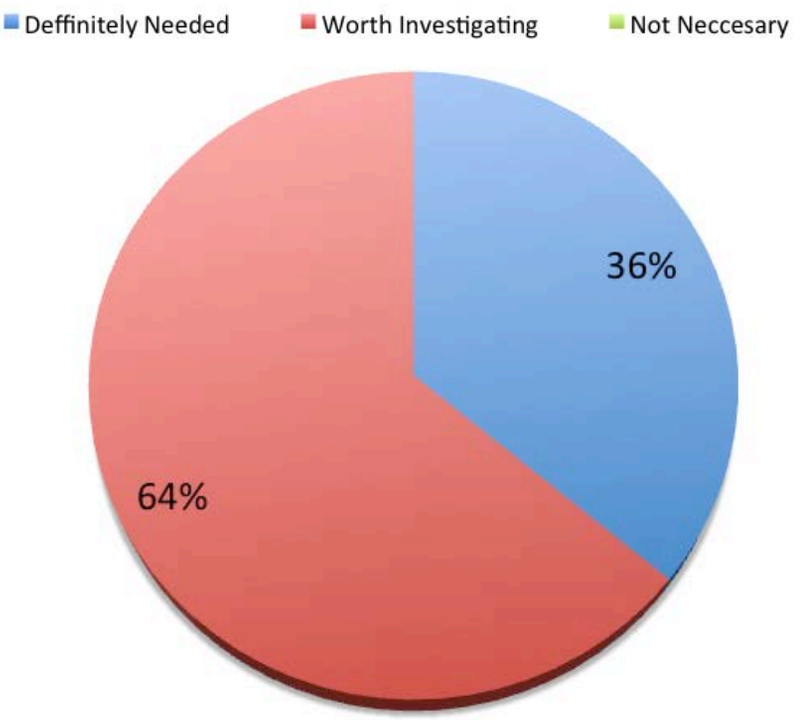
Members Assessment of API Activities & Value

API Support Evaluation

API Support for Universities to Provide Industry Relevant Skills from Undergraduate Teaching and Learning(e.g. Undergraduate Curriculum, Early Career Academics, Female Academic Support)



The API Support/Facilitation of an Industry Driven Innovation Vision and Agenda based on Collaboration Between Industry and Leading University Academics/Researchers Across Australia is...



Members Assessment of API Activities & Value

Value of API Initiatives and Activities

Member Comments

- "Given there are a limited amount of recruitment needs and a supply of professional power engineers that far outweighs current recruitment demand, plus a cost- focused climate, the Bursary/Outreach is not currently deemed to offer the value students may have received previously. Industries have little exposure/knowledge on the continuing professional development programs."
- "There seems to be a key opportunity going forward for API to take a more active leadership role in collaborating with organisations on future requirements to inform education bodies. Additionally, collaboration with industry bodies with a view to providing cost-effective re-skilling/up skilling in line with emerging technologies and markets. Keen to keep working with you on this basis."
- "API is a good initiative, the summer school is beneficial."
- "Industry/university collaboration needs to be strengthened, but it appears that university activities are not targeting the same outcome as industry, nor are they operating with the required urgency. There is also a spread of approaches and it is felt that the universities need to get on the same page."
- "The API Bursary Program will continue to be part of our organisation's graduate recruiting process as it provides a practical way for our business to assist with the training and development of high calibre individuals. The program also provides potential recruits with the opportunity to 'get to know the business' (and vice versa) before the opportunity to move into a formal graduate position is offered. The API Summer School continues to be viewed as beneficial for recent graduates, as it provides one mechanism to in-fill the knowledge gaps discussed in previous questions."

appendix 1

survey questions

1. How many existing professionals with power engineering qualifications (i.e. electrical, mechanical, mechatronic engineering) there are in your organisation?

   Power Engineering Professional Percentage of Total Workforce?

   Number of female professionals with power engineering qualifications?

   Over the last 4-5 years has the proportion of females you recruited to engineering roles (please circle):

   - Increased
   - Remained the Same
   - Decreased

   Do you have a strategy to increase female engineering participation?

   Approximate number of power engineering professionals working for your business in a consulting and/or contracting basis?

   Estimated % of power engineering professionals working in the following roles:

   Mainly management
   (Resource/ Project/ Contract Management)

   Mainly technical
   (Planning/ Design/ Operation/ Asset Management)

   New Emerging Technologies
   (Innovation and new systems/ Products)

   Overall power engineering professional workforce size in near future (1-3 years) will (please circle):
   - Increase
   - Remain the Same
   - Decrease

2. Age profile of these power engineering professionals (number/ (%) in each age band).
   Total number of engineers with engineering qualifications:

Under 30	30-39	40-49	50-59	60+
____(____%)	____ (____%)	____ (____%)	____ (____%)	____ (____%)

3. Estimated number of power engineering professionals to retire (number and percentage of total engineering workforce) in the next:

   - 2 years = (%)
   - 5years = (%)

4. Number of power engineering graduates employed over the last 3 years

Year	Total	Electrical	Mechanical	Other
2012				
2013				
2011 2012				

5. What is the approximate retention rate of power engineering graduates you have employed over the last 5 years?

6. What is the current Tenure/ Employment conditions offered to Engineers in Graduate Program (please tick)
   - Permanent Employment
   - Fixed Term Contract
   - Other

7. Number of previous API Bursary Holders now working in the company?

8. Estimated number of future power engineering graduates required in:

Period	Total	Electrical	Mechanical	Other (specify)
This year – 2015				
Next year -2016				
Three Years - 2018				

9. Is there an ongoing need for development of power engineering capacity and capability to meet industry's medium to longer term needs?

10. Are you currently experiencing problems in recruiting (please circle):

    - Graduate Engineers
    - Senior Engineers
    - Engineering Management

    What are your recruiting strategies to address these problems:

12. Quality of graduate power engineering professional applications for vacancies (i.e. fundamental engineering skills to match business needs)

Strong skills		Average skills		Poor skills
5	4	3	2	1

13. Power engineering skills/competencies graduates are lacking/need to be improved in their university courses are:

14. Assessment of graduate power engineering professionals fundamental skills/competencies to meet future industry technical challenges (e.g. energy security and sustainability, intelligent generation and networks)

Well prepared		Some preparation		Little preparation
5	4	3	2	1

15. What new streams of engineering do you anticipate will be needed for your business in the future?

16. What actions, either by the engineering institutions, the Government, yourselves, API or others do you believe would help resolve any skills shortages you perceive.

17. Additional comments/information you consider relevant to power engineering workforce planning

appendix 2

Feedback/Assessment of API Activities

1. Please rate the value/effectiveness of the following API activities to provide a sustainable supply of quality power engineering graduates to industry through the following:

    - API Bursary Program
    - API Schools Outreach Support through STELR Program/Solar Car Challenge
    - API Activities to Increase Representation of Women in Power Engineering through sponsorship of early career female power engineering academics, sponsorship of UQ Women in Engineering Program, Mentoring Program for API Female Bursary Students

    Good Value Moderate Value Little Value

2. Please rate the Value Added Continuing Professional Development Programs:
    - API Annual Summer School
    - API Masterclasses
    - API Bi-Annual PowerChemical Conference

    Good Value Moderate Value Little Value

3. Please rate the API Support for Universities to Provide Industry Relevant Skills from Undergraduate Teaching and Learning:
    (e.g. Undergraduate Curriculum, Early Career Academics, Female Academic Support)

    Good Value Moderate Value Little Value

4. API Support/Facilitation of an Industry Driven Innovation Vision and Agenda based on Collaboration Between Industry and Leading University Academics/Researchers Across Australia is:

    Deffinitely Needed Worth Investigating Unnecessary