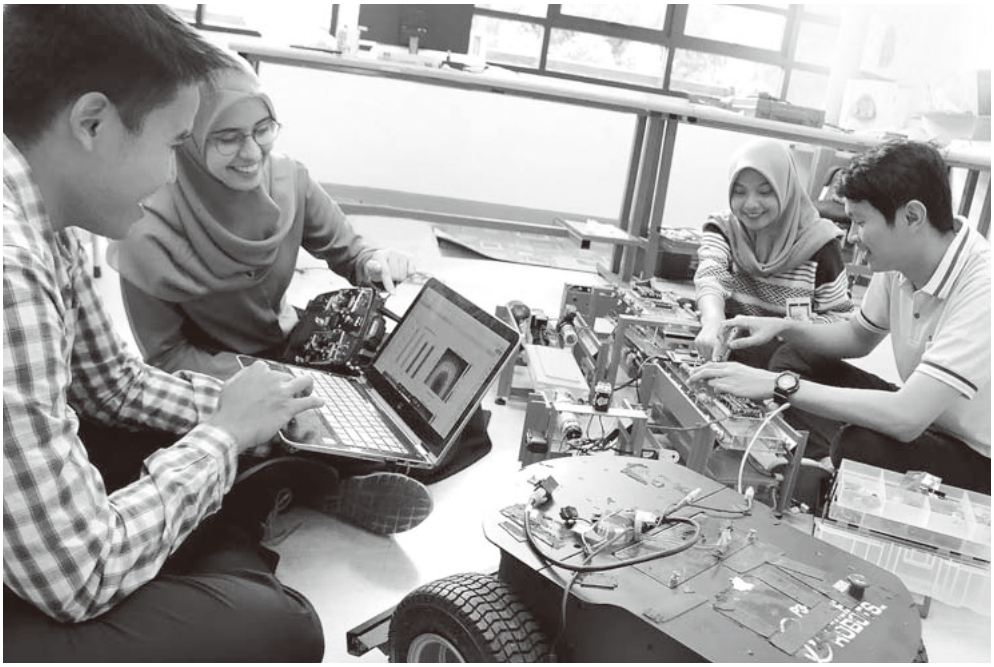
Academia-Industry Partnership: A Cornerstone of the Future Energy System

In this Perspectives, Akilur Rahman, Chief Technology Officer at Hitachi Energy India Limited, argues that in order to nurture future technology pioneers and net-zero entrepreneurs, industry and academia need to deepen their partnerships and invest in diversity to spark out-of-the-box thinking required to speed up the energy transition.



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New Talent Profiles for the Energy Transition

Traditionally, educational institutions passed on knowledge to their students who then applied it in industry. But we now know that building expertise is bi-directional: From academia to industry and industry to academia. In today's fast-paced world, time is of the essence, and this imperative is no different in education. A concurrent approach to teaching science in conjunction with hands-on industry experience is the ideal way to nurture new talent.

Government targets for reaching climate neutrality range from 2030 to 2070. This long-term view requires the industry-academia partnership in the energy transition to implement a more holistic approach with dynamic engagement and eyes on the broader picture in place of siloed thinking.

From left to right: Professor Iwa Garniwa; Professor Reini Wirahadikusumah; Niels de Boer; and Professor N Subrahmanyam.

The road to a net-zero economy demands a change in talent profiles, a meshing of expertise from various fields covering not only engineering, computer science, chemistry and physics, but also sociology and economics. Today's generation of budding talent has great potential to become knowledge multipliers, a workforce which is not trapped within its area of expertise but which thrives on collaboration and co-creation. The energy transition needs not only top-notch technologies, products, and services but also a huge amount of this new talent which we in the industry have an obligation to attract in order to pave the road to a low-carbon future.

How are academic institutions adapting to offering concurrent teaching methods that suit the needs of the energy transition? How are academia and industry facilitating the much-needed hands-on experience and how are they promoting adequate thought and gender diversity in key scientific degrees and job functions?

I had the pleasure of obtaining insights into these questions from some of South Asia's finest engineering academics:

- Professor Iwa Garniwa, Rector at the Institute of Technology PLN in Indonesia;
- Professor Reini Wirahadikusumah, the first female Rector of the Institut Teknologi Bandung (ITB);
- Niels de Boer, Program Director at the Centre of Excellence for Testing & Research of Autonomous Vehicles at the Nanyang Technological University (NTU) in Singapore; and
- Professor N Subrahmanyam, Head of the Department of Electrical Engineering at the National Institute of Technology, Warangal (NITW) in India.

Role of Academia in the Energy Transition

Academic institutions have a fundamental role in delivering the message about the urgency of combating climate change and speeding up the energy transition. Having already provided the foundation of what we know about tackling climate change, our universities contribute to advancing a more sustainable world by developing a new understanding of and insights into current energy system problems. They are a key stakeholder in the societal commitment to combating climate change and a source of knowledge independent from governments. They are also a resource pool for new talent capable of exploring the next technological breakthroughs in energy. It's critical that today's students help achieve our 2030, 2050 and 2070 carbon reduction goals and that they share in the culture and behavior of wanting to create a cleaner future.

NTU's Niels de Boer said nothing is more convincing to an engineer than seeing the direct, positive impact their own project results can have. Be it the amount of carbon emissions saved by a lithium-ion battery system in an electric vehicle or the number of clean electrons a solar photovoltaic installation can produce to power a home.

As a master in electrical power system engineering myself, I see making the connection between theory and practice as the most important means to give students the skills, confidence, and motivation to work in the energy transition.

As an industry, we must help establish the necessary laboratories and research centers where students can master

and apply the latest technologies to learn, research and innovate. Universities are indeed uniquely positioned to become important test beds for emerging technologies, processes, and strategies because they combine different research disciplines and consequently provide an unbiased environment for exploring new ideas. With digitalization driving more and more convergence between different technologies, the energy industry needs strong partnerships with academic institutions in order to give the engineers of the future an inter-disciplinary education and skills and to optimally prepare them for working in the energy transition.

Some institutions are already reaping the benefits of strong industry partnerships. Students at India's NITW, which offers a Smart Electric Grid master's program inspired by feedback from industry partners, have strong employment prospects. "We are seeing this happening in terms of our students getting ready for the industry and getting good job placements," said Professor N Subrahmanyam.

Offering Practical Experience

South Asia has recently seen a wave of innovative and high-tech power system solutions. For example, the Australia-Asia PowerLink project, which plans to lay a 4,200-kilometer long HVDC submarine cable—the world's largest—between Australia's Darwin and Singapore, transmitting Australian solar power to the metropole. In the Indian Himalayas, one of the world's biggest solar plants is being developed, targeted to have a capacity of 9 GW and to be combined with a 12 GWh battery-storage system and a 4 GW wind farm.

Impressive examples like these inspire students to help push the boundaries of electrical engineering, an ambition that is indispensable for enhancing the energy transition. Students' aims need to be encouraged in conjunction with where the industry requires innovative thinking and where they can make real impact on fighting climate change. Universities are a breeding ground for ideas that can leapfrog existing thinking and where out-of-the-box experimenting and research can test radically new approaches.

Many academic institutions have already laid the foundations for partnerships with industry. For example, Australia has seen a number of successful joint research projects between universities and the industry on renewable energy, resulting in total research investments from government and the public and private sectors of more than AUD54 million. The funding went to green energy projects including the production of biogas from sugarcane and investigating how robots could capture data for solar installation diagnostics.

Further, the Indian Institute of Technology Madras (IITM), for example, is running a highly respected start-up hub for entrepreneurs incubated through the university. The initiative has supported a number of innovative energy technology companies that are able to apply cutting-edge university research in an industrial setting. Ideas are converted to applications in the areas of EV, renewables, energy efficient equipment, solar-DC, energy management, quantum safe encryption, green building cooling, energy storage, etc. led by students, alumni and faculties together with industries.

At the Jakarta-based Institute of Technology PLN (IT PLN), an engineering-focused university directly supported by Indonesia's national utility PLN, students who graduate are also awarded a certificate of competence based on practical experience they gained during an industry internship as part of their degree. IT PLN's Professor Iwa Garniwa told me this close collaboration aimed to enable students to gain valuable employment in the industry.

Partnerships between industry and academia must also act as a catalyst for modernizing teaching curriculums. As future employers of those gaining engineering degrees, energy companies can help keep course content current and relevant and they can suggest topics for research projects. For example, the Smart Electric Grid master's program of NITW was developed through a comprehensive input from the industry, adapting the curriculum to meet emerging knowledge and skills requirements and driving new research activities on smart grid technologies and digital transformation. Often, these types of collaborations are anchored in the students gaining practical experience in the form of internships and work placements at the partnership companies. These allow future engineers invaluable access to potential employers but also to unique sets of data for new energy research and technologies.

Creating 'Living' Laboratories

Teaching about the energy transition mustn't stop at the curriculum. Many universities are improving the sustainability credentials of their own campus buildings and infrastructure. But much more can be done to offer students and staff live laboratories which in parallel reduce the universities' own carbon footprint. These are excellent opportunities for academia and industry to deepen partnerships of mutual benefit.

In India, which the International Energy Agency estimates could create a low-carbon technology market worth

Students at ITB

$80 billion by 2030, universities are investing heavily in creating low-carbon campuses. IITM, for example, is home to a state-of-the-art electric bus infrastructure project which pilots Hitachi Energy's flash charging technology and Indian bus manufacturer Ashok Leyland's electric bus designs. Students and staff alike will be using these electric buses to move around campuses, experiencing firsthand the benefits of low-carbon mobility and creating an actual transfer of knowledge regarding new technologies for the energy transition. Another similar example is NITW's Smart Electric Grid Laboratory, which Hitachi Energy helped set up and aimed to become a space to incubate new research ideas on integrating distributed renewable energy resources into Smart Electric Grid, among others.

"In order to approach net zero, we need to think about how to cut carbon footprint first from our backyard," is how ITB Professor Reini Wirahadikusumah made her point. The Indonesian university recently established a green campus where a forest and botanical garden surrounding the site act as practical laboratories, for example for how to use bio-based materials for renewable energy conversion.

Attracting New Talent

Focusing on academia being a place of out-of-the-box thinking and offering industry-linked research opportunities will also help make engineering and other energy transition related studies more interesting to entry-level students. Attracting talented graduates to work on the energy transition remains one of the sticking points as competition from other sectors is fierce. We urgently need young people who can confidently go beyond conventional thinking and who can try new ideas in the best possible setting.

Among other approaches, educators must help students understand the significant opportunities and career progression in the field of energy, such as electric power systems and energy engineering, which have been early developers and adaptors of software, automation and digital technologies in the industry. Be it domain technologies such as energy storage, green Hydrogen, distributed energy resource management, power electronics, HVDC or digital technologies including big data, cloud computing, AI-ML, AR-VR, digital twin, block chain, cyber security, opportunities are plenty. What is important is they are for real and helping to achieve energy transition targets, probably the domain with maximum convergence of these technologies.

Not just the technologies, but their positive impact on the society is tremendous. Prof. Subramanyam of NITW said that "economic prosperity and growth of society are directly related to electric energy developments in the energy sector." The importance of developing our energy system must be impressed upon future students early on to ensure they are motivated to take on the challenges confronting the electric power industry.

Life-long Learning

Attracting talent to the energy transition does not end at graduate level. An increasingly important factor in weighing a career move is whether an employer offers opportunities

for life-long learning and gaining additional qualifications. Companies must focus on retaining top talent by providing top-notch further education and career development. These training programs need to be put in place to help existing employees map out clear and purpose-driven career paths and to bring them up to speed on operating the latest innovative technologies and products.

The complexity of energy technologies is deepening at lightning speed, which means that both those employed directly in the industry and those teaching the next generation of workers need to stay up to date. Employers need to allow time for staff to attend relevant training courses and enroll in higher education courses needed to advance critical skills and sustain competence. Professional development should focus on new teaching practices adaptable to the digital mindset of young people as well as introduction to existing digital solutions being used in the industry. These retraining efforts can also tap industry professionals who can provide the practical industrial experience that some academic institutions need. NTU in Singapore, for example, is already preparing to increase its course offerings for professionals, said Niels de Boer. "Keeping existing staff's skills current is going to be an important role for universities in the future because the technology is changing faster and faster, and it's getting more challenging for engineers to stay up to date.

Diversity at the Heart of the Transition

By nature, energy is a highly intertwined ecosystem that dynamically controls and protects our world and which touches all aspects of life. It has tremendous potential to connect humans, machines and intelligence in working together for a sustainable future. We therefore need to incorporate diversity of thought, geography, culture, gender and generation into our academic research as well as our professional environment. Academia and industry must integrate a 360-degree view on diversity to foster collaboration and inclusiveness for the benefit of scientific progress.

Encouragingly, energy transition research and education is already a globally-minded discipline that includes several generations of workers. But one important aspect continues to lag: Gender diversity. Women represent only around one

third of the workforce in renewable energy, according to the International Renewable Energy Association. Although this percentage is higher than in the overall energy industry, the energy transition can only be effective if more women are included in shaping where the change is taking place.

The number of women graduating with engineering degrees is rising but remains notoriously low. Universities, colleges, and high schools have undertaken initiatives to encourage more female students to take up science degrees, and many energy companies have programs in place to recruit and promote female staff. However, a deeper collaboration on the topic between academia and the industry must bring further improvement. Energy companies should, for example, present female engineering role models more prominently and offer mentorships to link young female engineers with women in leadership functions.

Although more and more companies and educational institutions are launching initiatives to attract and retain female students and staff, more needs to be done. Changes can start with motivating and supporting female students to choose and pursue engineering courses. In India, for example, female students from rural backgrounds are supported by Hitachi Energy and other organizations as part of the "Women in Engineering" program for undergraduate courses. It provides them with educational aid, materials, coaching, mentoring, and summer schools in higher education institutions to help them advance their careers or prepare them for gaining employment in the industry.

In Australia, the Women in Climate and Energy Fellowship (WICEF) supported by the University of Technology Sydney offers female entrepreneurs access to workshops and mentoring to help them launch clean energy and climate tech start-ups.

Attracting more females to the energy transition will only work if we encourage as many young women and girls as possible to choose scientific degrees and subjects at universities and schools. In many places, this requires a deep-rooted societal mindset change that needs to be overcome.

Hiring more female senior members of staff will also go a long way at the universities themselves. ITB recently appointed four female heads of research centers, including Dr. Ir. Retno Gumilang Dewi, M.Env., Eng.Sc—Head of Center for Research on Energy Policy. This is a step in the right direction that many more institutions need to follow.

Conclusion

The academia-industry nexus is a crucial cornerstone of the future of the energy transition. Educational institutions are the testing grounds for new ideas that make away with old thinking and really push the envelope on energy technology innovation. We need to leapfrog conventional technical, economic and social thinking to create fresh solutions for a low-carbon world. Academia plays the important role of nurturing fresh talent that is required to bring the energy transition to the next level and industry has to help by providing fertile grounds for experimenting through deep-rooted partnerships.

The energy industry is intrinsically linked to education as it has an obligation to offer employees life-long learning opportunities that will help broaden the collaborative approach needed to tackle the energy transition challenges. The red thread winding its way through the energy transition is investing in diversity. Academia and industry need to help foster a change in the societal mindset that allows a 360-degree view on diversity, may it be related to gender, thought or age. It's only if we collaborate and include a multitude of viewpoints that the energy transition will truly flourish.