JOINING FORCES FOR SMART CITIES

Leading experts from UNSW SYDNEY and THE CHINESE ACADEMY OF SCIENCES (CAS) gathered in Beijing to develop a blueprint for international collaborations on sustainable energy, urban planning, artificial intelligence, and medical technologies for smart cities.

"Science knows no country", declared the 19th-century French vaccinologist, Louis Pasteur. This holds especially true in the context of technologies for smart cities. "A globalized vision helps us navigate an increasingly complex future of networked growth and disruptive technologies," said Jiaofeng Pan, president of the Institutes of Science and Development, CAS (CASISD), when he opened the second Sino-Australia Science Future Summit in September 2019, organized by UNSW Sydney and CASISD. The challenges, ranging from climate change and shifting demographics, to the search for alternative energy, also present a unique opportunity for collaboration between China and Australia, and across the world, according to Ian Jacobs, president and vice chancellor of UNSW Sydney.

By gathering scientists, along with industry representatives and policy-makers, the summit provides a platform to collaborate and discuss sustainable development, rapid urbanisation, and new technologies.

Alternative energy sources for lower carbon footprint

The Sino-Australia partnership was highlighted in a presentation by UNSW professor, Martin Green, a world-leading specialist in silicon solar cells, and director of the Australian Centre for Advanced Photovoltaics. As the inventor of the passivated emitter rear cell (PERC) technology, Green and the centre have been deeply involved in China's development of photovoltaic (PV) technology. Among the many PhD students he has supervised is the first solar billionaire and philanthropist, Zhengrong Shi, former chairman and CEO of Suntech Power, who helped transform Green's PERC technology to industrial success. PERC is the state-of-the-art technology, integral to most of today's solar cells.

Electricity generation and cars are major sources of global CO_2 emission, said Green. His solution for urban transport is to integrate solar panels into vehicles, so they generate their own electricity and charge as they run, enabling a fully solar-powered journey.

"We hope future electricity use will be based on a new approach, and I believe PV will continue playing a significant role here," said Green. "It helps meet cities' power needs, while addressing global warming issues."

In China, the world's largest CO_2 emitter, an energy revolution is vital, said Zhongmin Liu, director of the Dalian Institute of Chemical Physics at CAS. He introduced several routes to this revolution, including cleaner processing of fossil fuels, use of renewable energy, and liquid sunshine technology, which combines solar and nuclear power with CO_2 and water to produce green liquid fuels. A RMB 1.6 billion research project has already started at CAS looking at these options.

"Our goal by 2050 is to have more than half of our energy produced from cleaner sources than fossil fuels," said Liu. "We are keen to realize this by revolutionizing the production, consumption, and the technological system for energy, and encouraging international collaboration."

The need for systematic approaches and concerted efforts, across different sectors and countries, was also emphasized in the panel discussion, which agreed that wind, solar, and other renewables, should be treated as an integrated system.

Finer mapping for sophisticated urban plans

Reducing greenhouse gas emission in cities can also be achieved with smart urban design, according to another UNSW professor, Deo Prasad, a leader in sustainable buildings and cities. He pointed out that wealth is often linked to fossil-fuel reduction in resilient cities, that is, smart cities, which can adjust to the effects of climate change or other challenges. Evidence-based planning is essential to enable such smart, sustainable cities.

Here, big data has two crucial roles for Prasad: close monitoring of urban climate data with sensors to maximize comfort for its inhabitants, and a blockchain-empowered electricity grid to enhance distributed generation within communities. An integrated, data-driven approach is important for city planning and infrastructure, as Prasad emphasized.

Prasad also presented a project he led with the United Nations Environment Programme on a sustainable development guide, which has been implemented by five Chinese cities so far. It is a collaborative initiative involving multiple sectors and parties. "I believe this coordination model helps us learn from each other," said Prasad. "The ultimate goal is enhancing livability of cities in China and beyond."

The need for multisector coordination was echoed by a case study from Shanghai, introduced by Huaiyu Xu, from the Shanghai Advanced Research Institute, CAS, who discussed streamlining coordinated execution using artificial intelligence (AI). "Urban management needs to be detail-oriented," said Xu, "but this has also brought challenges."

He described the enormous effort for maintaining the city's 15 million manhole covers, with each being monitored by multiple sectors, from municipal government and telecommunication companies.

Xu outlined an AI-supported three-step approach. Issues are revealed autonomously using the internet of things; then, using AI and big data analysis, the problems are processed in an intelligent dispatch system; finally, through closed-loop management, relevant managers can ensure timely completion of each task.

Such an approach is already established in Shanghai, said Xu, allowing more attention to fine-tune the overall engine of urban development.

A holistic approach towards smart living

The wellbeing of city-dwellers goes beyond infrastructure. Health and technology are also critical aspects, and their importance was highlighted respectively by UNSW professor, Martina Stenzel, and Yi Zeng, from the CAS Institute of Automation.

Stenzel works with nano-technology to develop new materials for immunotherapy to fight cancer. The global market for nanomedicine is predicted to reach US$350.8 billion by 2025.

A common nanomedicine application is for drug delivery. As healthcare is shifting from the 'one size fits all' approach to personalized medicine, targeted therapy is needed. "We need to fine-tune nanomedicine based on the specific requirements of each patient," said Stenzel. And using nanoparticles, targeting of drugs can be enhanced.

"Enlisting external forces like light, heat, ultrasound and magnetism, we can further modify behaviours of nanoparticles," Stenzel explained. "This way, we can control the release of the drug in cells, influencing drug activity, including switching it on or off."

As well as helping urban management, AI is a valuable healthcare tool, though safety and control are major considerations. Different countries have issued various AI principles. Zeng introduced the Beijing AI Principles, which cover the R&D, use, and governance surrounding AI.

The principles are a starting point for a series of efforts, said Zeng, and coordination is needed, as all these interests should complement each other, rather than compete.■

Deo Prasad of UNSW Sydney, a leader in sustainable buildings and cities

Martin Green, a silicon solar cell expert, and director of the Australian Centre for Advanced Photovoltaics

Martina Stenzel, a nanochemist, and professor at UNSW Sydney

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