

HYDROGEN

Newsletter of the Centre for Hydrogen Innovations



Round 1 of the 2025 Hydrogen Innovation Challenge attracted 250 participants

More than 250 pre-university students participated in the 2025 Hydrogen Innovation Challenge to explore Singapore's Green Energy Pathway

The Hydrogen Innovation Challenge returns for its second edition, this time with the theme "Singapore's Green Energy Pathway". This year's competition aimed to benefit an even wider audience by opening up to all pre-university students in Singapore, including students from polytechnics, junior colleges, and other institutes.

The first round of the competition, held on the 5th of June at NUS College of Design and Engineering, featured a 40 minute pen and paper test to test students on their knowledge of the theme (after equipping them with a study guide to learn from). 90 teams of 2-4 from 18 institutes, totalling 258 participants, battled it out that morning.

The quiz had multiple choice questions, a short answer section, and a particularly challenging crossword puzzle (fun fact: only

one team managed to solve the crossword puzzle completely! Kudos to them).

15 teams with the top scores advanced to the second round of the competition, the Performance round, which consisted of two parts. First, participants created infographics on a topic of their choosing related to the theme, which were then posted on our Instagram to spread information on the topic to the public. We were blown away by the students' creativity, they discussed wide-ranging ideas for Singapore's energy future, from hydrogen (our bread and butter) to nuclear reactors or even algae farms. Participants worked hard to promote their ideas to their communities and beyond for one week of public voting, leading up to the final event of the competition. You can still read all the entries on our Instagram @chi_at_nus today!

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Fourth grant call awardees

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Many heads were scratched during the Round 1 quiz!

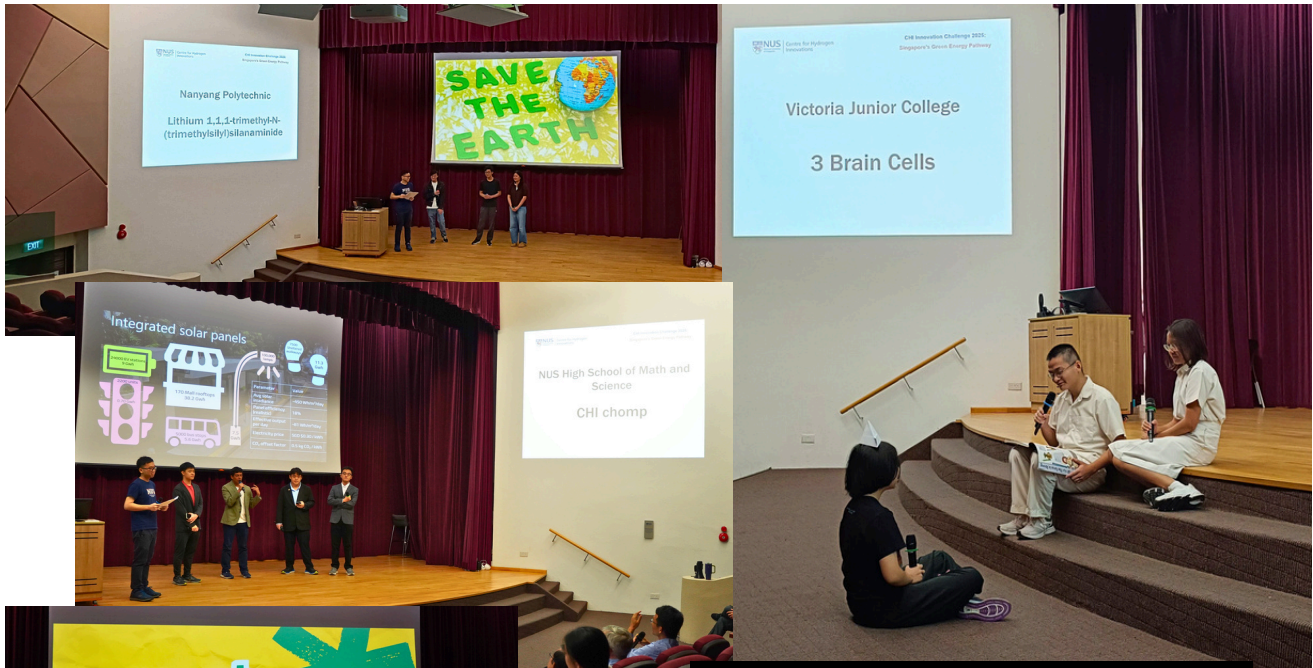


The very creative infographics made by the participants for the second round of the competition. Check them out on Instagram @chi_at_nus!

Finally, the participants returned to NUS on June 29 to present their infographic contents in a performance that they chose the format of, with points awarded for creativity and content. CHI Director Prof. Yan Ning opened the Final Round event, and we were honoured to have three experts on green energy and sustainability as our judges: Prof. Chan Siew Hwa (NTU), Prof. Thorsten Wohland (NUS), and Prof. Zhou Kang (Singapore Institute of Technology).

Each team had a unique take on the theme, and we were treated to many fun performances including an app demo, a Shark Tank-style skit, and multiple rap battles. After each performance, the participants valiantly answered tough questions from our expert judges, surely giving them a glimpse at the real intricacies of executing any green energy plans!

Following a tough deliberation with the judges (the results were quite a close call!), team HydroGen-Z of Hwa Chong Institution emerged as the winning team of this year's challenge! Congratulations! Second place winners include team The Environmentalist (Hwa Chong Institution) and CHI Chomp (NUS High School of Math and Science), and third place winners are teams Cations and HydrogenGoesBOOM of Raffles Girls' School, along with teams GOF (NUS High School of Math and Science) and Ballerina Cappuccina (Nanyang Girls' High School). Hwa Chong Institution took home the School Prize for their students' excellent performance across multiple teams.



Several Round 2 performance highlights



Discussions over the tea-break

We'd like to heartily congratulate our winning teams once more for their excellent explorations into Singapore's Green Energy Pathway, and thank all of the students who have enthusiastically participated in this event. We hope that all involved have learned something from the experience and that the next iterations of the Hydrogen Innovation Challenge continue to improve and inspire more towards the green energy pathway!

School Prize winners
Hwa Chong Institution

Winners of the challenge!

Visit by undergraduate students from POSTECH, South Korea

CHI was delighted to host four undergraduate students from Pohang University of Science and Technology (POSTECH), South Korea, for a half-day visit to CHI on the 11th of June. The students reached out expressing interest to learn more about ammonia cracking and other hydrogen technologies, and our researchers were more than happy to share knowledge, give a tour of our lab facilities, and converse about life at CHI both in and out of the lab over lunch with these young enthusiasts. It's always a pleasure to meet potential next generation hydrogen researchers!



Lunch and quick tour of UTown



Master students from University of Twente, Netherlands, drop by CHI during study tour of Southeast Asia



Prof. Jimmy Faria talks about his research



On July 18, a group of 20+ students from the University of Twente swung by our lab. The group of chemical engineering and science master's students came all the way from the Netherlands for a study tour of research institutes and companies of interest in Singapore and Malaysia, and we were happy that we were one of their stops. The tour was organised by their student study association C.T.S.G. Alembic, and they were accompanied by Prof. Jimmy Faria and Dr. Jere van Lente.

The students were introduced to the practicalities of hydrogen related research through a tour of our lab facilities. This was followed by a seminar from Prof. Jimmy Faria on his own research on ammonia decomposition for hydrogen generation, a topic we work on closely in CHI as well! An introduction to the work done by CHI was also given by Jackson. We

ended the visit with a lunch where we continued to share our knowledge and experiences. We hope the visit was fruitful for our guests and that we will cross paths again in future!



Twente students visit CHI's lab



CHI showcases innovations at the Toyota Carbon Neutrality Mobility Event in Jakarta



CHI and NUS researchers participate in panel discussions and exhibitions



On February 13, CHI was invited by Toyota Motor Manufacturing Indonesia (TMMIN) to the “Beyond Zero Carbon Neutrality Mobility Event” held in Jakarta, Indonesia. CHI’s booth was visited by VIPs including Mr Bob Azam (Vice President Director, TMMIN) and Prof Eniya Listiani Dewi (Director General of New, Renewable Energy, and Energy Conservation, Ministry of Energy and Mineral Resources). On the first day, CHI and three NUS start-up companies, Lincore, CRecTech, and Hyd-Gen showcased their innovative sustainable technologies.



Three NUS start-ups showcased their technologies at the event

In the afternoon, the start-up founders, Mr Saikiran Reddy (Lincore), Dr Goutam Kumar Dalapati (Hyd-Gen), and Dr Lim Kang Hui (CRecTech) were invited on stage for a panel discussion themed “Green Technology Innovation” moderated by Mr Bayu Prihatmoko (Deputy Chief, TMMIN), to share more about their companies and their innovative solutions that contribute to a greener future. On the second day, CHI representative Dr Melvin Wee was invited on stage as a panellist for a discussion on “Research Collaboration with Academia” alongside some of Indonesia’s esteemed researchers, Dr Sutarsis (Institut Teknologi Sepuluh Nopember), Dr Thoriq Teja Samudra (Universitas Gadjah Mada), and Prof Wahyudi Sutopo (Universitas Sebelas Maret); the session was moderated by Dr Ir Agus Purwadi (Institut Teknologi Bandung).



CHI is grateful to TMMIN for giving us this opportunity to showcase our hydrogen technologies and NUS Enterprise for connecting us to TMMIN. We look forward to a fruitful collaboration between CHI and TMMIN.

CHI takes a study tour to Kyushu University's International Research Centre for Hydrogen Energy and Takasago Hydrogen Park



On 27 March 2025, the Vice-Director of the International Research Center for Hydrogen Energy, Professor Masamichi Nishihara, hosted CHI's visit. He gave an overview of their centre's various research and educational activities. This was followed by active discussions on sharing experiences and possible research collaborations. Then he brought us to their "Hydrogen Society Showroom" where CHI learnt about advances in hydrogen energy-related technologies such as fuel cells. We also saw first-hand a demonstration prototype of an end-to-end solution for a hydrogen car from hydrogen production using electrolyzers to a hydrogen refuelling station. Finally, the lab tour ended with a comfortable ride in their hydrogen-powered car equipped with their latest fuel cell technologies, which has the smaller sized fuel-cell engine. We appreciate Professor Masamichi Nishihara's kind hospitality and hope that we can invite him to visit NUS in the future.

The next day, we travelled to Takasago Hydrogen Park for a tour, which was hosted by Mitsubishi Power Asia Pacific and organised by the Energy Market Authority (EMA) SIEWConnects@Kobe. We experienced Japan's latest advancements in the design and manufacturing of hydrogen-compatible gas turbines. Following the trip, we were treated to a series of welcome addresses by Mr Puah Kok Keong (Chief Executive, EMA) and Mr Takao Tsukui (Executive Vice President, Mitsubishi Power).

We also gained insights about Japan's energy plan from Mr Masanori Tsuruda (Deputy Commissioner for International Affairs Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry, Japan). Last but not least, Mr Masaru Tsuchiya (Partner, McKinsey & Company) moderated a panel discussion on "Unlocking Pathways for Energy Transition in Asia Pacific". We learnt a lot from Mr Keisuke Sadamori (Director, Energy Markets and Security, International Energy Agency), Mr Hiroki Sekine (Managing Executive Officer, Global Head of Infrastructure and Environment Finance Group, Japan Bank for International Cooperation) and Mr Vincent Lam (Head of Gas & LNG Commercial, Sembcorp Industries).

We're grateful for the opportunity to learn and collaborate with other hydrogen practitioners in Japan and thank our hosts for their hospitality!



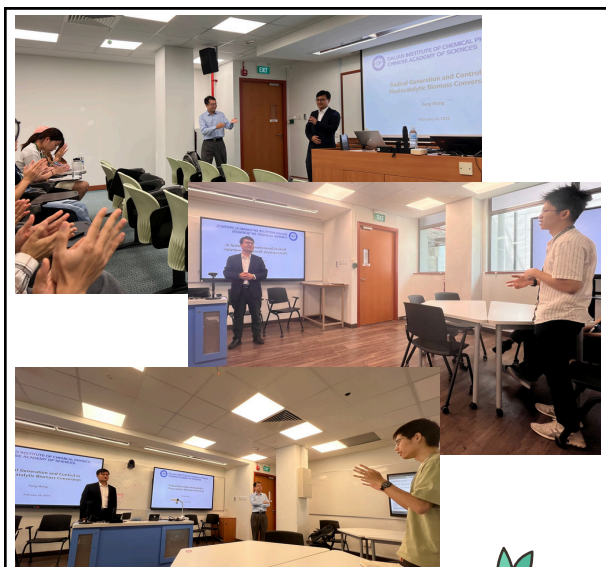
Group photo by SIEWConnects@Kobe organisers



CHI Director Prof. Yan Ning with Prof. Masamichi Nishihara (Kyushu University)



Distinguished Speaker Series



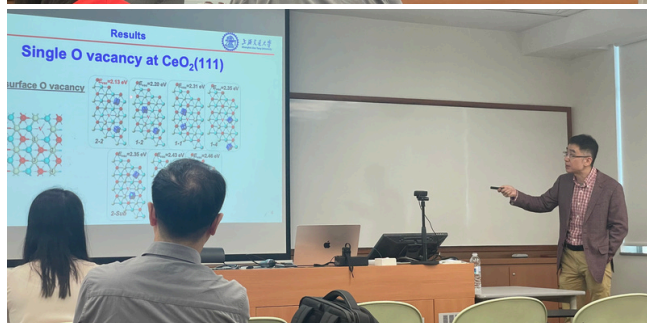
Prof. Wang Feng
10 February 2025



Prof. Wang Feng of the Dalian Institute of Chemical Physics (DICP), Chinese Academy of Sciences, presented his research on radical regulation strategies for selective photocatalytic conversion of biomass to renewable fuels and chemicals. As Vice Director of DICP, Prof. Wang also gave an introduction to the institute. Our researchers certainly had a lot of questions about his work!

Prof. Gong Xueqing
22 April 2025

Shanghai Jiao Tong University's Prof. Gong Xueqing presented his findings on the electron storage effect in rare-earth cerium dioxide catalysts this April. His work uses density functional theory to study surface structures and catalytic mechanisms of small molecule reactions on cerium dioxide, such as for automotive exhaust purification.



Prof. Wang Hai
23 May 2025

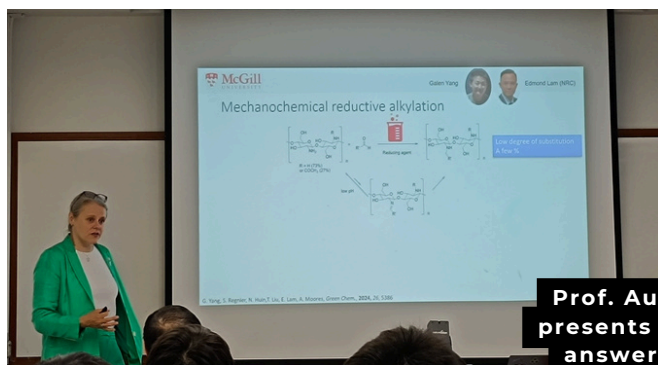
In May, Prof. Wang Hai of Stanford University gave a talk entitled "What is a good sustainable aviation fuel? Lessons learned from a US FAA SAF certification research program." He discussed the key properties that allow fuels to maintain predictable combustion chemistry for safe engine operation, and which hydrocarbon components are beneficial to improving engine combustion efficiency and reducing particulate emissions.



Prof. Audrey Moors
23 June 2025



Prof. Moors of McGill University in Canada presented her work on mechanochemistry and confinement catalysis, smart systems to activate nitrogen towards high value molecules and materials. In her lab, Prof. Moors uses mechanochemistry and aging to turn biopolymers such as chitin and cellulose to value-added products.

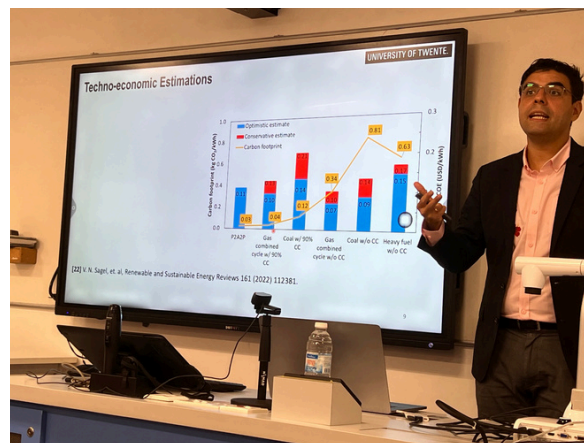


Prof. Jimmy Faria

18 July 2025



As previously mentioned, Prof. Jimmy Faria of University of Twente presented his work amidst his students' study tour to CHI. His presentation entitled "Dynamic Catalytic Ammonia Decomposition: A Strong Coupling between Localised Transient Heating and Reaction Kinetics" explained not only the techno-economics of ammonia decomposition in the context of hydrogen storage, but also introduced new science with how dynamic Joule-heating can influence the kinetics of the reaction.

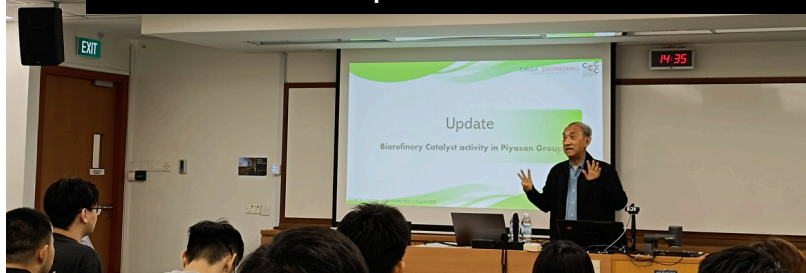


Prof. Piyasan Prasertthdam

1 August 2025



Prof. Paserthdam imparts his wisdom to the students



On his way to the 10th Asia-Pacific Congress on Catalysis (APCAT-10) held in Singapore, Prof. Piyasan Prasertthdam of Chulalongkorn University in Thailand stopped by NUS to give a seminar on the latest biorefinery catalyst research updates from his group. He is also the president of the Asia Pacific Association of Catalysis Societies (APACS) and the Founding Director of the Center of Excellence on Catalysis and Catalytic Reaction Engineering (CECC) at his university.

Prof Prasertthdam shared about his recent breakthroughs on the conversion of carbon dioxide to methane. He also shared an innovative work utilising hydrogen derived from the ketonisation of

biomass with carbon dioxide hydrogenation to produce methane gas. He also shared many different catalyst preparation techniques, such as sol-gel and dopant addition. Other than technical works, he also imparted his wisdom to the students and researchers on how to be successful chemical engineers in the academic and industrial career pathways.

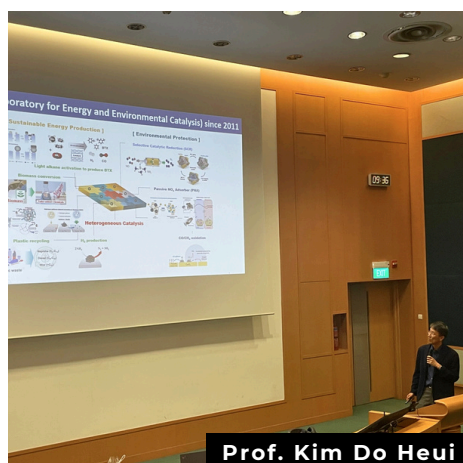
CHI holds joint workshop with NUS ChBE on Boosting Reactions

8 August 2025

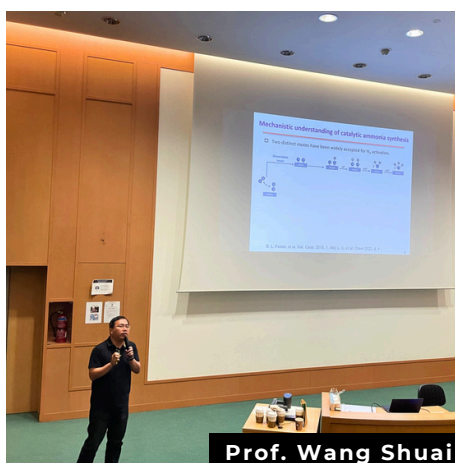
Thanks to the 10th Asia-Pacific Congress on Catalysis, there were many world experts on catalysis hanging around Singapore on the first week of August, and we were honored that six of them came to NUS to share their latest findings on hydrogen-related catalytic reactions.

The first speaker was Prof. Kim Do Heui from Seoul National University in South Korea, who spoke about novel sulfur-resistant catalysts for selective catalytic reduction of ammonia in stationary applications.

Meanwhile, Prof. Wang Shuai from Xiamen University discussed the ammonia synthesis reaction, which remains a hot topic despite being intensely studied for more than a hundred years. He presented a new H-assisted dissociative pathway in Ru-catalysed ammonia synthesis under high-pressures.



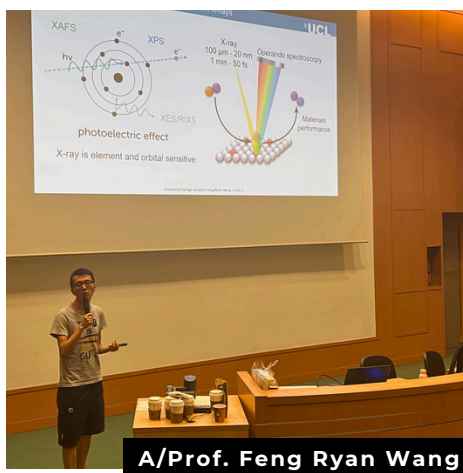
Prof. Kim Do Heui



Prof. Wang Shuai

Shenzhen University's Prof. Zhang Bin also discussed ammonia synthesis. He introduced a metal-free phosphorous-based catalyst that couples photocatalytic ammonia synthesis with water oxidation.

A/Prof. Duan Haohong of Tsinghua University presented recent works on electrocatalysis for organic synthesis and plastic up-cycling, all important and industrially relevant reactions.



A/Prof. Feng Ryan Wang



Prof. Lu Junling

Prof. Lu Junling of the University of Science and Technology of China is an expert on single-atom catalysis, and has recently unveiled fundamental insights on the metal-support frontier orbital interactions in these catalysts, and how they effect performance in the semi-hydrogenation of acetylene.



Prof. Zhang Bin



A/Prof. Duan Haohong

Lastly, catalysis is just as much about reaction performance as it is about catalyst characterisation, of which A/Prof. Feng Ryan Wang from University College London is an expert. Wang showcased works on operando X-ray spectroscopy for real-time reaction dynamics.

Prof. Zhao Dan receives promotion to full professor at NUS ChBE



Congratulations to our faculty member Professor Zhao Dan for his promotion to Full Professor!

Professor Zhao Dan has contributed significantly to the research community and has been placed among the world's most prominent researchers, based on Clarivate's Highly Cited Researchers™ 2024 List. We are looking forward to more exciting discoveries and innovations at the cutting edge of separations science in his career.

Welcome to CHI, Asst. Prof. Baek Jihyun!



Dr. Baek Jihyun joined NUS Mechanical Engineering as a Presidential Young Professor in July 2025. She completed her PhD and postdoctoral fellowship at Stanford University. Her research will focus on technologies for clean hydrogen production, carbon dioxide removal, and critical metal recovery.



A/Prof Zhang Huangwei of NUS ME promoted to associate professor with tenure

Congratulations A/Prof Zhang on his promotion to associate professor with tenure! A/Prof Zhang's group studies combustion and energy problems. Of particular relevance to CHI is his work on ammonia/hydrogen combustion and hydrogen safety.

CHI awards seven projects in grant call ceremony

CHI held a Grant Ceremony in conjunction with the launch of the NUS CHI-SEAS SCALE CET Course on 20 August 2025, graced by our Guest-of-Honour, Mr Eugene Kwok, Director of the New Energies Division, Ministry of Trade & Industry (MTI). He gave a keynote address, followed by the grant award ceremony. This year's grant call focused on hydrogen energy — a key enabler for deep decarbonisation across industrial, power, and mobility sectors.



Three projects were awarded in the Fourth Grant Call

- Catalysis-assisted ammonia combustion for decarbonised power generation - A/Prof. Zhang Huangwei (NUS)
- Phase-selective CO₂ capture using clathrate hydrate crystallisation in blue hydrogen production systems - Prof. Praveen Linga (NUS)
- Development of advanced polymer composites for liquid hydrogen storage with integrated smart sensing - Dr. Ice Tee (A*STAR)



Four projects were awarded for the Third Grant Call Type II (second stage)

- Graphene-based membranes for CO₂ separation from industrial gas mixtures - Prof. Antonio Castro Neto (NUS)
- Scalable high-entropy alloyed catalysts facilitating up to 2.0 A/cm² current density by proton exchange membrane (PEM) electrolyser - A/Prof. Huang Yizhong (NTU)
- Ammonia-hydrogen fusion marine engine with single ammonia fuel supply - A/Prof. Wenming Yang (NUS)
- An integrated system for hydrogen and freshwater production through indirect seawater electrolysis - Prof. Ho Ghim Wei (NUS)

Congratulations to all the awarded projects that we are confident will continue to push the boundaries of clean hydrogen energy innovations!

CHI launches first CET course in collaboration with SEAS

Following the CHI Grant Ceremony event, Ms Kavita Gandhi (Executive Director, SEAS) gave an opening address and launched the inaugural run of the CHI-Sustainable Energy Association of Singapore (SEAS) School of Continuing and Lifelong Education (SCALE) Continuing Education and Training (CET) course “Introduction to Hydrogen Energy”. This short course is an opportunity for participants to learn about the hydrogen industry and where it sits within the wider Asia-Pacific region/global process and energy industries space. It was open to anyone with a passion for driving change in Singapore’s energy transition, with no prior experience in renewable energy required.

13 learners from diverse backgrounds including market analysts, marketing and sales executives, engineers from construction/energy and professionals from trade associations, enrolled in this two-day course. They learnt from academics and industry veterans, like Asst Prof Wang Lei (NUS), Ms Li Huiqi (Chevron), and Mr Shyvesh Tyagi (AFRY), about the fundamentals of hydrogen energy technologies, policies, and the global markets with particular focus on the US, Europe and Southeast Asia. Look out for the next run of the course in the coming January!



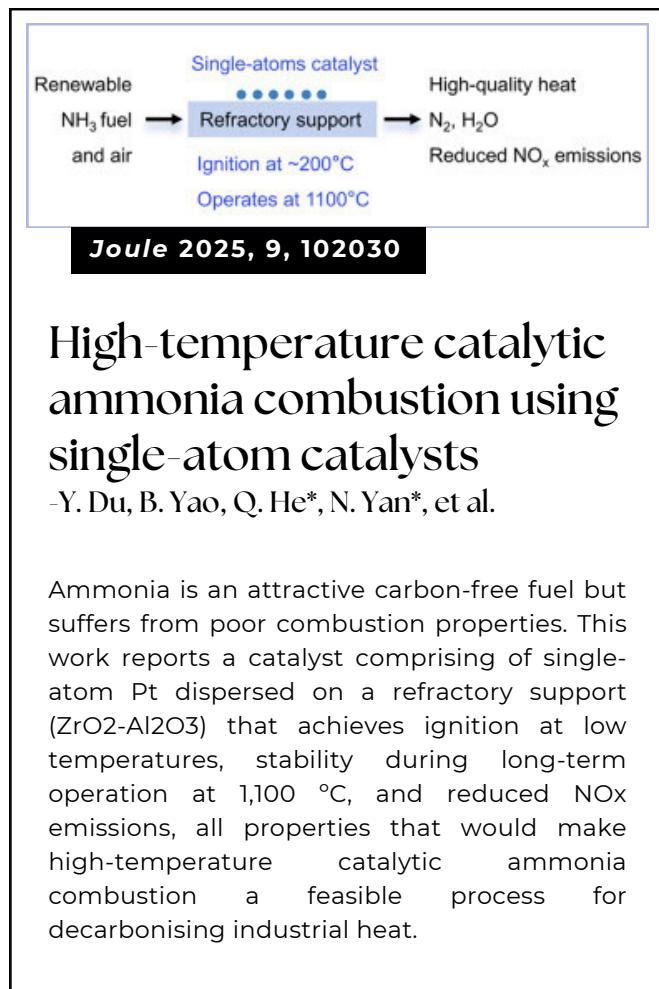
CHI supports launch of Minor in Hydrogen and Low Carbon Technology offered by NUS

The Minor in Hydrogen and Low-Carbon Technology at NUS is designed to address the global shift towards sustainable energy and support Singapore’s national strategies for a hydrogen economy. As hydrogen becomes increasingly vital across various industries, there is a rising demand for professionals skilled in hydrogen technologies. This Minor equips students with the expertise needed to support Singapore’s hydrogen initiatives and contribute to the nation’s sustainable energy ambitions. Graduates will be well-prepared to meet industry needs and pursue research and development in hydrogen production, storage, and utilisation—essential areas for Singapore’s energy future.

The broad learning outcomes of this minor are to gain comprehensive and practical knowledge in hydrogen production, storage, and utilisation technologies, develop an understanding of the regulatory, safety, and ethical considerations in hydrogen technology applications, understand hydrogen technologies as systems of interconnected components, encompassing chemical, physical, environmental, and economic aspects, apply basic simulation tools and methods to understand and analyse hydrogen systems, develop skills to work effectively in team settings, particularly in interdisciplinary groups, and acquire effective oral and written skills to convey complex concepts in hydrogen technologies to diverse audiences.

This programme is offered by NUS College of Design and Engineering, Department of Chemical and Biomolecular Engineering and supported by CHI. It is open to all NUS undergraduate students.

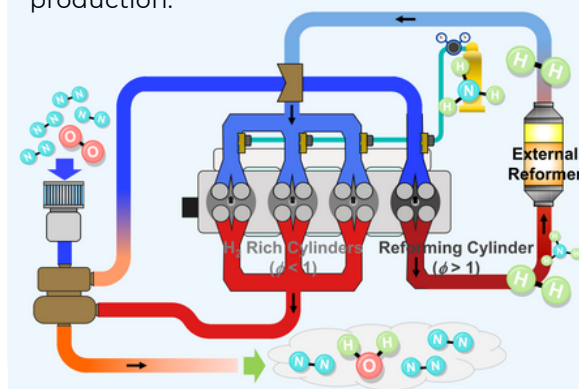
Research Highlights



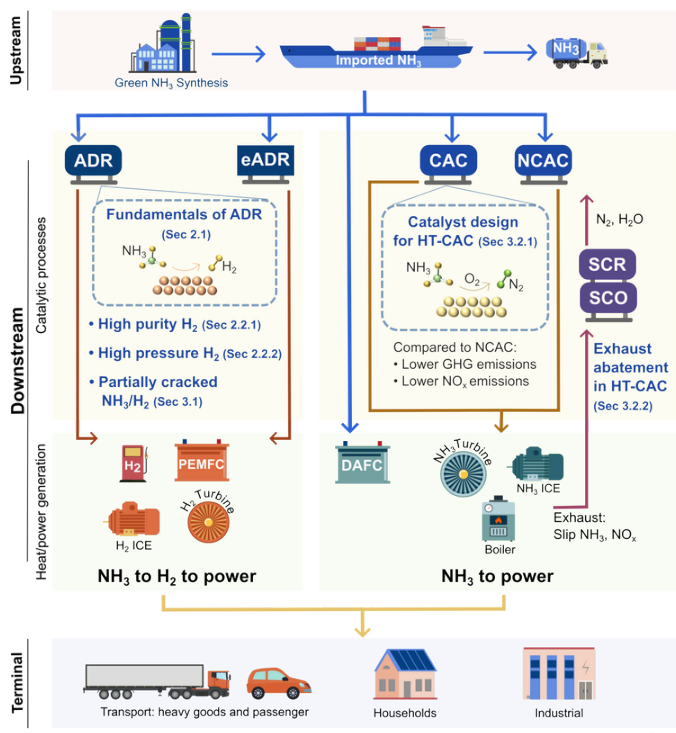
Ammonia-hydrogen engine with single ammonia fuel supply

–X. Zhou, T. Li*, W. Yang*

Since ammonia has poor combustion properties, many have proposed the use of an external reformer to first partially-decompose ammonia for hydrogen-enriched combustion. This work discusses the technical feasibility for an in-cylinder reforming route, and proposes the concept of a prechamber-assisted reforming cylinder design to ensure stable ignition, extend the boundary of the ammonia-rich limit, and increase in-cylinder hydrogen production.



Joule 2025, 9, 101922



Appl. Energy 2025, 393, 126099

Critical downstream catalytic processes for an NH_3 economy

–K. S. Indriadi, Y. Du, Q. He*, N. Yan*

In this mini review article, the authors summarised recent insights on two key catalytic reactions in the emerging ammonia energy economy: catalytic ammonia decomposition and (high-temperature) catalytic ammonia combustion. Different catalysts for various applications of hydrogen-derived ammonia were reviewed. High-temperature catalytic ammonia combustion is a relatively new concept that has the potential to decarbonise difficult sectors such as industrial heat. The authors' writing was well-informed by their experience in CHI-hosted projects such as the NRF-funded LCER project on partially-cracked ammonia for clean combustion.

