NET-ZERO INDUSTRIES MISSION

NET-ZERO INDUSTRIES AWARD

2023

ALL WINNERS AND RUNNERS-UP

Preface

The heavy emitting sectors such as steel, cement, chemicals and aluminium, are a major source of global greenhouse emissions. They have come under increasing pressure to accelerate their way to net-zero emissions.

Although we are still a considerable distance away from our ultimate goal, net-zero emissions, there are encouraging signs of progress in this sector. Continued advancements each year build on our confidence to enable further innovations that accelerate the industrial deployment of decarbonisation technologies.

In celebration of the trailblazers spearheading this transformation, Mission Innovation Net-Zero Industries has instituted the 2023 Net-Zero Industries Award. The winners are not just recipients of a prize; they stand as pillars of inspiration.

The outstanding projects, the female innovators, and the promising young talents that are recognized exemplify the change we strive to see in the world.

This booklet showcases all the winners, runners-up, and national winners of the 2023 Net-Zero Industries Award. These outstanding individuals and projects were selected from nearly 70 submissions by an independent expert jury.

Content

Category YOUNG TALENTS

WINNER Dr Suneeti Purohit

Dr Suneeti Purohit is an accomplished Research Scientist at CSIRO Australia, originally hailing from India. With an educational and research background in Metallurgical Engineering, she has made remarkable contributions in this field. Her research primarily focuses on reducing the carbon footprint in the steelmaking industry, aiming for a sustainable future. She has invented a novel route to process Australian iron ores that could greatly benefit Australia's iron ore export economy and at the same time make the country a global leader in decarbonisation. Her ground-breaking research has resulted in impactful publications, patents, and recognition through esteemed awards such as the Exceptional Woman in Victorian Resources, Amplify Ignite Award, HDR Publication Award, and the prestigious DAAD scholarship.

Statement of the Jury: *"Dr. Purohit, a graduate of the Indira Gandhi Institute of Technology, has been dedicated to developing net-zero pathways for iron and steel production since 2011. Her groundbreaking LMP technology, developed during her PhD at Swinburne University, offers a low-temperature iron ore agglomeration process that significantly reduces CO_2 emissions. The technology could potentially reduce emissions by up to 32% with future use of hydrogen. As a co-inventor and holder of two patents, and a recipient of numerous awards, Dr. Purohit's commitment to sustainable innovation makes her a deserving winner of the Net-Zero Industries Award in the Young Talents category."*

RUNNER-UP

Dr Lukas Kasper

Dr. Kasper, an esteemed alumnus of the Technical University of Vienna (TU Wien), was drawn to the confluence of energy technology, mathematical modeling, and informatics, which led him to pursue a doctoral degree at the same institution. His doctoral research was centered around enhancing the efficiency and capacity of thermal energy storage in the industry. He proposed a novel hybrid retrofit concept aimed at cost-effectively increasing the storage capacity of industrial steam storage. Additionally, he developed innovative methods for the intelligent operation of industrial energy systems, leveraging the latest advancements in computer science and digitalization. His exceptional work earned him a doctorate with distinction in 2023. Currently, Dr. Kasper continues to contribute to the field as a Post-Doc at TU Wien, furthering his research and pushing the boundaries of energy technology.

RUNNER-UP

Dr Serene Sow Mun Lock

Dr. Sow Mun Lock, a distinguished scholar, was awarded the prestigious Public Service Department (PSD) scholarship by the Malaysian government to study Chemical Engineering. She is currently a senior lecturer at UTP, where she develops computational inventions and digital solutions to address decarbonization, climate, sustainability, and education issues. Her well-cited and award-winning computational invention has been commercialized to natural gas sweetening facilities in Southeast Asia, assisting oil and gas companies in realizing decarbonization. This achievement has earned her many international and national recognitions, including the Carbon Capture Canada Emerging CCUS Leader Award 2023. She is also an advocate for women's empowerment in the carbon capture industry and STEM fields, and her efforts have been recognized with several accolades.

National winners

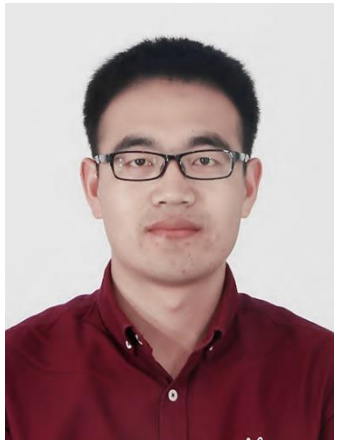
NATIONAL WINNER CANADA

Hui Huang Hoe

Hui Huang Hoe, a cleantech entrepreneur and specialist in Sustainable Energy and Environmental Engineering, founded elerGreen. This innovative startup recovers valuable polymers, metals, and chemicals from chemical waste and renewable electricity in an economical and eco-friendly way. He is a serial inventor in green electrochemistry, with his notable research on “Electrochemical Carbon Dioxide Utilization” patented by the University of Toronto. Beyond his contributions to cleantech, Hui Huang nurtures youth entrepreneurship by coaching students. He has authored numerous journals and published a free book for students demonstrating his commitment to fostering the next generation of innovators.

NATIONAL WINNER CHINA

Dr Zekai Miao



Dr Miao is an Associate Professor at the College of Chemistry and Chemical Engineering (State Key Laboratory of High-efficiency Utilization of Coal and Green Chemical Engineering) at Ningxia University. His research focuses on CO_2 capture and the resource utilization of coal-based solid wastes. With a track record of over 10 published papers and the application for four patents, he has contributed significantly to his field. Dr. Miao has taken on roles in various research projects, including a natural science foundation, the National Key Research and Development Program in China, and five provincial research projects.

Category FEMALE INNOVATORS

WINNER Prof Mercedes Maroto-Valer

Prof Maroto-Valer, Director of the UK Industrial Decarbonisation Research and Innovation Centre (IDRIC), has led and co-led projects worth over £82M to decarbonise energy-intensive industries. She unites 135 researchers from 34 universities, delivering 80+ projects and collaborating with 200 industry stakeholders. Her whole system approach for industrial decarbonisation has resulted in 70+ IDRIC papers, policy briefs, reports, and £5.5M additional funding. She also serves as Deputy Principal (Global Sustainability) at Heriot-Watt University and Director of the Research Centre for Carbon Solutions (RCCS). Her contributions have earned her numerous awards, including the 2021 ACES-Margarita Salas Prize and the 2020 Top 50 Women in Engineering Sustainability.

Statement of the Jury: *"Over the past 25 years, Professor Maroto-Valer has become a world-leading energy innovator specialising in industrial decarbonisation, with expertise in energy systems, Carbon Capture Utilisation and Storage, integration of hydrogen technologies and sustainable aviation fuels. In her current role, she is leading the UK's largest industrial clusters towards creating the world's first industrial net zero cluster. She is an inspiring example for a successful career in research and innovation, but her commitment to equality, diversity and inclusion goes beyond that. By deliberately showcasing diverse role models for decarbonisation in media campaigns, placing women in key positions in her team and promoting young talent, she is creating equal opportunities and laying the foundation for the best talent to work on the decarbonisation of the industry."*

RUNNER-UP Dr Ekaterina Kravchenko

Dr. Kravchenko began her career as a railroad engineer, tackling engineering challenges in the transportation sector. This ignited her interest in inventing materials for thermal stabilization and the sustainable development of transportation infrastructure. Now a specialist in civil and environmental engineering, her research is focused on decarbonizing heavy and construction industries. Her work encompasses carbon sequestration techniques and waste recycling in both industrial and construction sectors. She has developed innovative materials such as phase change materials and biochar, aimed at significantly reducing carbon emissions. A key aspect of her research is exploring the carbon capture capabilities of construction materials, like carbonated steel slag. Dr. Kravchenko has also conducted feasibility studies on recycling waste concrete powder, a topic with direct implications for reducing the carbon footprint in construction and heavy industries.

RUNNER-UP Sophia Hamblin Wang

Sophia Hamblin Wang, COO and board member at MCi Carbon, is a top female innovator in Australia. She has been the global face of MCi Carbon for a decade, coordinating activities including project management, communications, finance, human resources, stakeholder management, and commercialisation. Sophia played a key role in securing funding for MCi's global reference pilot plant facility and raised an additional US$10m from international investors and partners in 2022-2023. Recognized as a World Economic Forum Young Global Leader, Sophia is an expert in the circular economy and a graduate of Harvard University's Executive Education program. She inspires emerging female leaders and has been recognized with an Order of Australia Student Citizenship Award. Currently, she is a lecturer at the University of Sydney Business School.

National winners

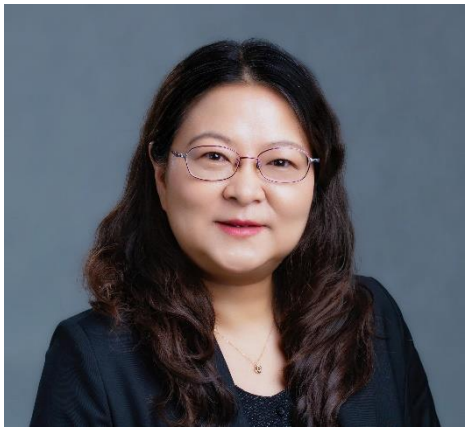
NATIONAL WINNER AUSTRIA

Dr. Gabriela Straka

Dr. Gabriela Straka is an outstanding figure in the Austrian energy industry. She advocates for the decarbonization of breweries through creative measures for CO_2 sequestration. In 2021, Dr. Straka made history as the first woman to be appointed to the board of Brau Union Österreich in its 100-year corporate history. The Göss Brewery in Styria, Austria, has been a model for CO2 neutrality since 2016, inspiring other breweries worldwide. It´s energy supply is now fully based on renewable energy, and CO_2 emissions from fossil fuels are zero. Actively promoting women, Dr. Straka was elected as a board member of "Zukunft.Frauen" to support women in leadership roles and provide them with opportunities to become board members in the industry.

NATIONAL WINNER CHINA:

Prof Shengping Wang



Prof. Wang, affiliated with the School of Chemical Engineering & Technology at Tianjin University, is a leading researcher in carbon capture, utilization, and storage (CCUS). She has made significant contributions to green chemical technologies for clean energy, with over 150 published papers and numerous patents. Her team's innovative production technologies for CO2 capture and utilization are being piloted and are on the path to commercialization. They've also successfully applied their research to industries, achieving carbon fixation and high-valued utilization of exhaust gas.

NATIONAL WINNER GERMANY

Dr Victoria Ossadnik

Dr Victoria Ossadnik, COO of Digital & Innovation at E.ON SE and a member of Linde Plc's supervisory board, uses her extensive experience in IT and energy to spearhead digitalization initiatives in the energy sector. Recognizing the pivotal role of digitalization in the energy transition, she established a dedicated department within the traditionally commodity-oriented energy sector. This innovative move has inspired 70,000 employees, fostering a culture of innovation and facilitating a seamless transition towards a well-connected, digital structure. Her leadership has enabled the development of solutions that optimize energy consumption, enhance efficiency, and promote sustainable practices. These efforts significantly contribute to the decarbonization of the industry, aligning with the commitment to environmental sustainability.

NATIONAL WINNER CANADA

Dr. Sabereh Rezaei

Dr. Sabereh Rezaei is a seasoned professional with over a decade of experience in industrial technology-oriented projects. She has led dynamic CO_2 capture process modeling teams and managed cross-departmental collaborations. A confident speaker, she has presented at numerous international industrial and academic meetings. Dr. Rezaei holds a Ph.D. in Chemical Engineering from the University of Alberta, Canada, and currently serves as the Program Manager for Advanced Process Development at Svante Inc., Canada. She is also active in social and volunteering activities. Her work is characterized by a strong commitment to sustainability and innovation. She has made significant contributions to the field of CO_2 capture and has been instrumental in advancing the state of industrial technology. Her leadership and technical expertise have been recognized and appreciated by her peers and colleagues.

Category OUTSTANDING PROJECTS

WINNER Carbon2Business - Holcim GmbH Germany

The project, located at Holcim Germany's facility in Laegerdorf, is on track to become the world's first carbon-neutral cement plant by 2028. It involves the construction of a new kiln line that utilizes a unique 2nd generation oxyfuel process and a downstream Compression and Purification Unit (CPU). Funded by the EU Innovation Fund with 109.8 million euros in 2022, this first-of-its-kind carbon capture technology will supply captured CO_2 as a raw material to various regional industries. Collaborating with technology partners ThyssenKrupp Polysius and Linde Engineering, Holcim aims to capture and further process over 1 million tons of CO_2 emissions annually, contributing to the production of E-Fuels or plastics as part of the Power to X supply Chain project HySCALE/Westküste 100.

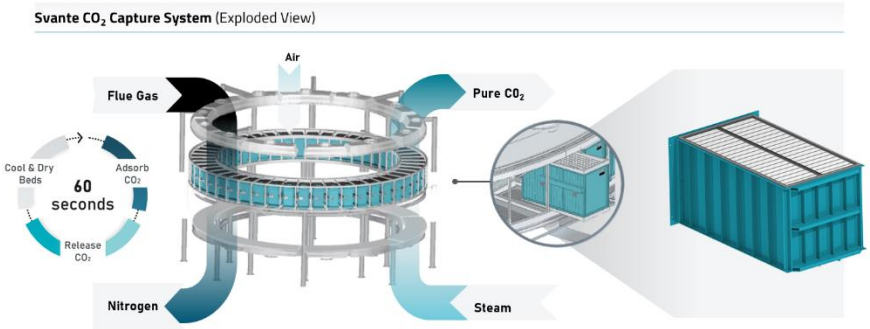
(c) Timo Lutz Team für Industriefotografie

Statement of the Jury: *"The decarbonization of the cement industry is one of the major technological challenges to achieve Net-Zero Industries. The project stands out as a breakthrough innovation by using a unique combination of an oxyfuel process and a downstream compression and purification unit in a first-of-a-kind application. In the combustion process air is substituted with pure oxygen from electrolysis resulting in a CO_2-rich flue gas, which is then cooled down, purified and liquified. The flue gas is then further processed into a high-purity CO_2 gas as a raw material for other industries. Although the technologies are in principle available, they have not yet fully reached the commercialization stage due to the inherent technological risk that comes with the large-scale demonstration, as well as a lack of cost-effectiveness and market incentives. The project presents a completely new full-scale process in the cement. With this Carbon Capture and Utilization (CCU) high-volume project, Holcim is creating new value chains and developing technologies to enable the decarbonization of industrial companies beyond the cement industry."*

RUNNER-UP

Calf-20 Metal-Organic Framework for Carbon Capture & Removal, Svante Technologies Inc. & George Shimizu, University of Calgary

Rotary Adsorption Machine (RAM) & Carbon Capture Cycle



The outstanding project “CALF-20 Metal-Organic Framework for Carbon Capture & Removal” is not only the national winner from Canada, but also the second-best project overall. Svante Technologies Inc. (Svante) and George Shimizu (University of Calgary) have collaborated to develop and apply novel CALF-20 metal-organic framework to the carbon capture and removal market. Svante's use of the breakthrough CALF-20 MOF in its carbon capture filters (structured adsorbent beds) and temperature swing adsorption process is now in use at two pilot plants in North America and has the capability to decarbonize heavy hard-to-abate industries such as cement, steel, aluminum, oil & gas, pulp & paper, fertilizer, petrochemicals, and more.

Svante's structured adsorbent beds known as "filters" coated in CALF-20 MOF will be manufactured at Svante's new Centre of Excellence for Carbon Capture and Removal in Burnaby BC, where it will be able to supply 10 commercial sized carbon capture plants with enough filters to capture 1 million tonnes of CO_2 per plant, per year, compounding annually.

Svante has been named in the Global Cleantech 100 since 2019 and is now on the XPRIZE's World's Top 100 Deep Tech Companies list for its novel approach to carbon capture and removal using metal-organic frameworks, namely, CALF-20, which was invented at the University of Calgary.

RUNNER-UP

Building the Future of E-Waste Recycling To Accelerate Circular Green Metals

Mint Innovation, New Zealand

Mint Innovation is a clean technology company that has commercialised a proprietary low-carbon, local and circular solution to extract metals and other waste material from printed circuit boards (PCBs) in old electronics.

This pioneering technology uses a combination of natural biomass, smart chemistry and processing expertise, carefully engineered to process PCBs in a low-impact, cost-effective way, returning high-value 'green' metals to local economies.

Their 'city-scale' technology can significantly reduce the reliance on mining and accelerate the circular supply of ‘green metals’. At scale, the technology can play a significant role in the decarbonisation of metal recovery from PCBs across the globe, enabling accelerated progress to deliver net zero.

With it´s world-leading ‘biorefinery’ fully commissioned in Sydney, Mint Innovation can process about 3,000 tonnes of PCB waste annually, returning nearly half a tonne of gold and up to 1,000 tonnes of copper to Australia, approximately USD $30M in value.

HONOURABLE MENTION Of THE JURY: 5-Tonne Per Day CO_2 Capture from Blast Furnace Gas

Tata Steel Limited, India

MOST OUTSTANDING PROJECT FROM THE GLOBAL SOUTH

Tata Steel, adhering to its values of “Responsibility” and “Pioneering”, aims to achieve carbon neutrality by 2045 through a dual approach of Carbon Direct Avoidance (CDA) and CO_2 Capture and Use (CCU). Given that the Blast Furnace (BF) contributes to about 70% of total scope 1 emissions, CO_2 capture from BF gas is a strategic step towards decarbonization. An amine-based absorption technology is used to separate CO_2 from the BF gas mixture. The residual BF gas, with 20% higher calorific value, is utilized as a thermal energy source in downstream processes, while the captured CO_2 is used for in-house wastewater treatment. This not only reduces CO_2 emissions but also saves costs. The high-purity captured CO_2 can be converted into value-added products like methanol and mineral carbonates, contributing to decarbonization and potentially benefiting other carbon-intensive sectors.

Statement of the Jury: *“The 2023 Net-Zero Industries Award has received more than 35 submissions for the category “Outstanding Projects” around the globe. There was a close race for the first three places. The project entitled "5 tonnes per day CO_2 Capture from Blast furnace Gas" by Tata Steel was judged by the jury to be highly innovative and can be highlighted as the most outstanding project from the Global South. Tata Steel's collaborative approach with its technology partners enabled the joint development and installation of this first-of-its-kind plant for CO_2 capture from blast furnace gas. The process produces high-purity CO_2 with a purity of more than 99% at low operating costs and with minimal environmental impact. The captured CO_2 can be converted into value-added products such as methanol and mineral carbonates, driving the downstream green products economy. The project is one of a number of key projects undertaken by Tata Steel in line with its Tata Value of Responsibility and Pioneering and its long-term goal of achieving carbon neutrality by 2045.”*

NATIONAL WINNERS

NATIONAL WINNER AUSTRIA

AHEAD (Advanced Heatpump Demonstrator) project by Takeda Manufacturing Austria AG

The project demonstrates an innovative heat pump system at Takeda in Vienna. It consists of a steam-generating heat pump from SPH Sustainable Process Heat, adapted for the use of natural refrigerants and combined with steam compressors to generate steam at 11 bar(a)/184 °C. This achieves a CO_2 reduction of up to 90% and complete CO_2 emissions-free operation for over seven months per year at one of the largest Takeda pharmaceutical

production sites located in Vienna.

NATIONAL WINNER CHINA

Tianjin University “Comprehensive utilization of industrial exhaust gas to yield high-valued chemicals”

China has a significant amount of industrial exhaust gas rich in CO, which traditionally contributes to carbon dioxide emissions. This project repurposes these gases, converting them into high-value chemicals like ethylene glycol and oxalic acid after purification. The technology behind this has earned 7 international and 32 Chinese patents and has been industrialized in China. It has led to the signing of 16 industrial tail gas purification equipment contracts, producing a total of 1 million tons/year of ethylene glycol, among other chemicals. This initiative reduces annual carbon dioxide emissions by 1.5 million tons.

NATIONAL WINNER USA

The Fortera Redding ReCarb® Plant, Fortera

Fortera is a materials science, engineering and technology company focused on the development of low to zero CO_2 cement. Inspired by nature, Fortera's patented ReCarb® process generates cement with 70% less $C0_2$ from its proprietary chemistry, and when combined with Green Energy becomes zero CO_2 cement. Fortera's flagship product, ReAct™ is a customizable low CO_2 cementitious product solution tailored to cement producers' business needs and marketplace requirements and works with current standards, regulations, and applications as a standalone, mixed, or supplemental cementitious material. ReAct will be available in the first quarter of 2024 from Fortera's first ReCarb process plant in Redding,

NATIONAL WINNER AUSTRALIA

MCi Carbon Plant - Myrtle, MCi Carbon

The MCi Carbon Plant is a groundbreaking project that aims to decarbonize hard-to-abate industries globally. The plant captures and converts industrial CO_2 emissions into solid bulk materials used in new low-carbon products for construction, manufacturing, and consumer markets. This process is known as mineral carbonation, a carbon dioxide capture and utilization (CCU) technology solution. The plant is expected to capture and store between 1,000-3,000 tonnes of CO_2 annually while simultaneously delivering products such as magnesium and calcium carbonates, and amorphous silica to materials offtake customers for testing. The plant's construction at Orica's Kooragang Island manufacturing site began in 2023.

Members of the Expert Jury

The Net-Zero Industries Award team would like to express sincere appreciation for the expert jury's meticulous evaluation of the 66 submissions. The jury, composed of members from all over the globe, contributed their time, effort, and expertise, which have been instrumental in the success of this initiative.

- **Andrew Purvis**, Worldsteel,
- **Harald Friedl**, COP-Climate Action Champions Team
- **Jenny Selway**, Heavy Industry Low-Carbon Transition Cooperative Research Centre (HILT CRC)
- **Dr Michaela Titz**, Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, Republic of Austria,
- **Dr Michio Kondo**, Vice Chair of the Mission Innovation Technical Advisory Group
- **Prof Peter Taylor**, University of Leeds
- **Radhika Lalit**, Climate Imperative Foundation
- **Rana Ghoneim**, United Nations Industrial Development Organization (UNIDO)
- **Soo Jung Kim**, Worldsteel
- **Wrenna Robertson**, Natural Resources Canada
- **Zafar Samadov**, IRENA
- Moderator of the Jury Meetings: **Dr Karl-Heinz Leitner**, AIT Austrian Institute of Technology