



Saudi Arabia
Centre for the
Fourth Industrial
Revolution

Quarterly Newsletter

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01

Welcome to the 4IR in Saudi Arabia

Welcome to the latest edition of C4IR Saudi Arabia's newsletter, a quarterly round-up of expert perspectives from our community, as well as key developments from the wider field of advanced and frontier technologies.

In this issue, we highlight how the Kingdom is enhancing the sustainability, affordability, and accessibility of critical minerals essential to the development of frontier technologies, from cutting-edge lithium extraction methods developed by the King Abdullah University of Science and Technology (KAUST) and Lithium Infinity (Lihytech) to the C4IR Saudi Arabia project that aims to support the wider critical minerals ecosystem in the Kingdom.

Over the past quarter, C4IR Saudi Arabia hosted the latest installment of our Quantum Nexus Webinar series with the [Saudi Quantum Computing Association \(SQCA\)](#) on 'Quantum Computing: The Next Frontier', which examined how principles like superposition and entanglement are transforming computational capabilities.

On the vital topic of AI, we contributed to the World Economic Forum's white paper, [Physical AI: Powering the New Age of Industrial Operations](#), and hosted a multi-stakeholder workshop on 'Response Plans for Synthetic Media Risks and National Teacher Upskilling.' The workshop was conducted in partnership with the [Ministry of Education](#), the [Saudi Data and AI Authority \(SDAIA\)](#), the [National e-Learning Center](#), [Alfaisal University](#), the [National Institute for Educational Professional Development](#), and the [International Center of Artificial Intelligence Research Ethics](#), alongside experts from other stakeholders. The workshop was part of C4IR Saudi Arabia's broader Synthetic Media project, which aims to integrate generative AI responsibly and develop a national framework for safe use in children's education.

As we enter the final quarter of 2025, C4IR Saudi Arabia is proud to organize and host the [3rd Saudi Forum for 4IR 2025: Frontiers of Global Technology](#), reaffirming our role as a convener, collaborator, catalyst, and connector for stakeholders driving the future of advanced and frontier technologies. [Registration is now open](#), and we hope you will join us.

Sincerely,

Dr. Basma AlBuhairan

Managing Director of C4IR Saudi Arabia

To engage with us and be part of C4IR Saudi Arabia's future activities, follow the links below:



02

Insights and Reflections

Solving the Contradiction at the Frontier of Critical Mineral Innovation



Zhiping Lai

Professor of Chemistry

Co-Chair of the King Abdullah University of Science and Technology's (KAUST's) Center for Renewable Energy and Storage Technologies, and founder of Lithium Infinity (Lihytech)

Dr. Zhiping Lai, Professor of Chemistry, Co-Chair of the King Abdullah University of Science and Technology's (KAUST's) **Center for Renewable Energy and Storage Technologies**, and founder of Lithium Infinity (Lihytech), provides his insights on the extraction technologies that could support a virtually unlimited supply of lithium – a critical mineral vital to frontier innovation and the global energy transition.

The world cannot build a tech-enabled future without lithium. From electric vehicles to renewable energy storage, it is the foundation of global electrification and demand is expected to more than triple between 2024 and 2040.

Yet lithium supply is constrained by a contradiction: although naturally abundant in salt lakes, oilfield brines, geothermal effluents, and seawater, conventional extraction technologies demand purer, higher-concentration deposits. This narrows supply and adds heavy environmental costs – MIT estimates that traditional methods can emit up to 15 tonnes of CO₂ per ton of lithium extracted, undermining the goals of the global energy transition.

At King Abdullah University of Science and Technology (KAUST) this contradiction inspired a frontier challenge: Could lithium be extracted directly from low-grade, widely available sources? Thanks to our **innovative research**, we can now produce battery-grade lithium directly from seawater – a world-first achievement.

A world-first in seawater extraction

At KAUST's **Inorganic Membrane Lab**, researchers demonstrated that solid-state lithium superconductor (SSLS) materials can be engineered into membranes capable of selectively recovering lithium even from highly impure sources. This has since advanced into a membrane-free electro-adsorption process requiring no chemical additives, generating no harmful waste, and consuming minimal energy.

The result is battery-grade lithium produced directly from seawater for the first time in history. Out of this breakthrough, Lithium Infinity (Lihytech) was founded to take the innovation forward, aiming to support a virtually unlimited lithium supply with a dramatically smaller carbon footprint.

What remains is not a question of science, but of scale. Like many university-born innovations, the leap from laboratory to industry depends on commercial and financial adoption. Through KAUST and Lihytech, we are building the partnerships needed to accelerate the deployment of this transformative technology. We look forward to working with stakeholders across Saudi Arabia and the world to turn scientific breakthroughs into industrial realities.

Implications for Saudi Arabia and beyond

For Saudi Arabia, the implications are profound. While the Kingdom lacks conventional lithium reserves, it has vast volumes of oilfield produced water. Our estimates suggest this resource alone could yield over 100,000 tons of lithium carbonate per year – enough to power around two million electric vehicles. For the Kingdom, this represents an opportunity to establish a localized lithium supply chain, aligning its renewable energy ambitions and the wider energy transition.

In addition, this breakthrough technology has implications for the global community too. The underlying membrane and electro-adsorption platforms are not limited to lithium. They point to future applications in CO₂ capture, pollutant removal, and the recovery of additional critical minerals – broadening the scope of separation science in addressing climate and resource challenges.

From laboratory to industry

The remaining hurdle is not scientific feasibility but industrial scale-up. Like many university-born innovations, progress depends on commercial adoption and financial support. Through KAUST and Lihytech, efforts are underway to forge the partnerships needed to accelerate deployment of this transformative technology, moving from experimental science to industrial implementation.

Critical mineral innovation is no longer just about discovering new deposits – it is about redefining extraction itself. Breakthroughs such as seawater lithium recovery highlight how science can unlock resources once thought unreachable, with transformative implications for the energy transition.

LEARN MORE

- World Economic Forum: [What are the critical minerals for the energy transition – and where can they be found?](#)
- KAUST: [Lithium extraction from brine through a decoupled and membrane-free electrochemical cell design](#)

03

In Conversation with...



Dr. Ziyad Albeshar

Critical Minerals Project Lead
C4IR Saudi Arabia

Dr. Ziyad Albeshar shares his perspective on how critical minerals can drive innovation, strengthen supply chains, and position Saudi Arabia as a leader in the global energy transition.

What are the goals and desired outcomes of C4IR Saudi Arabia's Critical Minerals Project, and who are the key partners involved?

Our goal is to develop the critical minerals innovation ecosystem in the Kingdom with a community of policymakers, industry leaders, and innovators. Together with the World Economic Forum's [Centre for Energy and Materials](#), Saudi Arabia's [Ministry of Industry and Mineral Resources](#), [National Industrial Development and Logistics Program](#) (NIDLP), Mining Fund, [Maaden](#), and local and international innovators and startups like [NewLab](#), we're working on developing an Innovation Assessment Framework that evaluates emerging critical mineral exploration, extraction, and processing technologies. Our aim is to provide policymakers with essential insights on how to reduce investor risk and create opportunities for startups in the sector.

Where is the project today and what are its next milestones?

We've just completed a global survey with more than 50 local, regional, and international startups and innovators to map current maturity, needs, and barriers. This data will inform our Innovation Assessment Framework white paper, providing a roadmap for

decision makers to evaluate and accelerate the adoption of innovation across the critical minerals ecosystem. We will build on this with a series of collaborative roundtables between startups, mining companies, and government stakeholders.

What does this project mean for Saudi Arabia's leadership in the field of critical minerals and what are your hopes for how advanced and frontier technologies will be adopted in Saudi Arabia and globally?

This project reinforces Saudi Arabia's commitment to becoming a critical minerals hub in the region, ensuring supply chain security both locally and internationally, and shaping global standards for a sector vital to the global energy transition. In the long term, I hope to see frontier technologies accelerate exploration, reduce environmental impacts, and strengthen supply chain resilience. Here in Saudi Arabia, we need to support local startups and innovators to integrate into global value chains and attract international partners to pilot and scale their solutions. I believe Saudi Arabia has the ability to showcase how frontier technologies can power the energy transition responsibly by supporting more sustainable mining and making investment more attractive.



Dr. Abdulrahman Habib

Director

International Center for AI Research and Ethics (ICAIRE)

Dr. Habib leads ICAIRE, an independent global center acting as a bridge between global AI policy and local implementation.

How did you come to work in the field of data and AI?

After earning my PhD in Data Science from the University of North Texas, I invited the Saudi Data and AI Authority (SDAIA) to speak with my students – at the time, it was one of the world's few dedicated national AI authorities. Eventually I joined SDAIA myself, where I helped shape national projects such as Saudi Arabia's [AI Ethics Principles](#). And today, I lead ICAIRE in advancing responsible AI globally, with a focus on amplifying the voices of developing countries, women, and underrepresented communities.

How did ICAIRE's partnership with C4IR Saudi Arabia begin and what does it enable?

Our collaboration began with joint sessions on AI in education and media, which then expanded to multiple AI-related initiatives. Through the C4IR global network, we are able to exchange knowledge and practical experience with global leaders, policymakers, and experts both locally and globally – accelerating responsible AI adoption while maintaining a strong ethical foundation.

How do SDAIA and ICAIRE complement each other in driving Saudi Arabia's unique approach to data and AI strategy?

SDAIA anchors Saudi Arabia's national AI and big data leadership, which is unique in its provision of practical tools, guidelines, and indices that balance innovation with responsible risk management. For example, SDAIA's AI Ethics Digital Badging supports

compliance, builds trust in AI products, and elevates the Saudi AI market's alignment with internationally recognized principles. ICAIRE, which was established with SDAIA support, extends that leadership to the international arena, helping UNESCO countries adopt global AI policies, tools, and best practices.

What do you see as the biggest challenge in accelerating the responsible and inclusive adoption of AI, and how is ICAIRE addressing it?

I think uneven global readiness is one of the key challenges. Many countries, especially in the Global South, lack the technical capacity, regulatory frameworks, and skilled talent to fully benefit from AI, which could widen existing digital and economic divides. ICAIRE is addressing this by bringing regional voices to the international stage; building capacity through training, awareness, and the development of practical tools; and by working with UNESCO and other multilateral organizations to translate global principles into local practices.

04

Frontier Technologies in the News

The latest in global and local news coverage of key domains across the landscape of advanced and frontier technologies.

GLOBAL NEWS



ARTIFICIAL INTELLIGENCE

Caltech: “Artificial Intelligence Helps Boost LIGO”

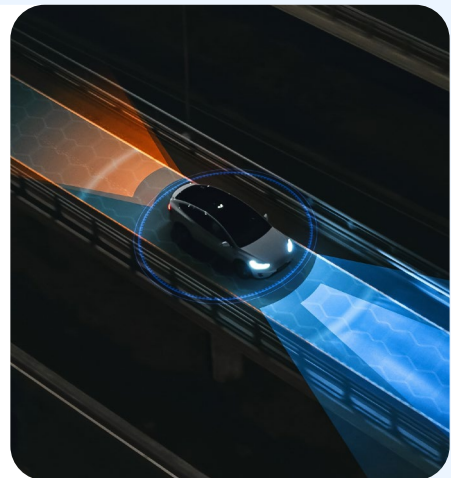
Researchers at the California Institute of Technology (Caltech) and Gran Sasso Science Institute in Italy teamed up with Google DeepMind to develop a new AI algorithm to enhance the [Laser Interferometer Gravitational-wave Observatory](#) (LIGO). Called Deep Loop Shaping, the algorithm enables LIGO to filter out background vibrations and detect gravitational waves with greater clarity. These ripples in space-time, created by cataclysmic events like colliding black holes, open a new window on the cosmos – revealing phenomena invisible to telescopes and deepening our understanding of how the universe evolves.



ADVANCED AND AUTONOMOUS MOBILITY

Techxplore: “New AI system could change how autonomous vehicles navigate without GPS”

Researchers at the University of Surrey have developed PEnG (Pose-Enhanced Geo Localization), an AI system that reduces localization errors from 734 meters to just 22 meters without relying on GPS – offering a breakthrough for navigation in dense urban areas, tunnels, and regions with poor connectivity. The system has major implications for autonomous vehicles, robotics, and delivery services, providing reliable, precise navigation in fast-moving, unpredictable, or GPS-denied environments.



BIOTECHNOLOGY

CORDIS: “Biotechnology brings mycelium-based materials to market”

Innovative biofabrication processes that produce raw, fully biologically-based materials from fungi offer both producers and consumers a promising path towards greater sustainability across a multitude of sectors. Recent work by [My-Fi](#) offers the textile industry a fungi-based alternative to conventional materials including leather, cotton, and wool, as well as synthetic and hydro-carbon based materials. These new materials are smooth, durable and high-performing. Capable of replacing leather in high-end fashion products and automotive upholstery, there are also opportunities to employ grown fungi-based materials across sectors, including pharmaceuticals, bioremediation and agriculture.





QUANTUM COMPUTING

Financial Times: “Google and IBM believe first workable quantum computer is in sight”

Google and IBM both claim to be on track to build the first industrial-scale quantum computer by the end of the decade, following recent breakthroughs that resolve many of the core physics problems holding the field back. However, scaling up remains the biggest challenge. Today's quantum systems have fewer than 200 qubits but will need over 1 million qubits to become truly useful. Google was the first to demonstrate the essential step of scalable error correction and so avoid the construction of expensive, unreliable machines that deliver little real-world value. IBM, on the other hand, believes its new design could reach scale with fewer qubits, and observers now await proof of this design's ability to function practically.



SMART CITIES

UNDP: “Human-Centricity as the Driver of Smarter Cities and Urban Innovation”

Cities produce 80% of the world's GDP, but they also create 70% of emissions and consume 75% of global energy supply. With 90% of urban growth expected to take place in Africa and Asia by 2030, cities are both engines of growth and places of risk. The UN Development Programme (UNDP) reviewed over 150 projects across 90 countries and found that real progress happens when people are at the center of smart city plans — focusing on improving lives rather than just innovation or efficiency. The UNDP urges decision-makers to design solutions that fit local needs, combine both high-tech and simple solutions, and adopt flexible and inclusive strategies.



CRITICAL MINERALS

Financial Times: “Race for critical minerals sparks call for new materials agency”

Dr. Patrick Schroeder (Chatham House Fellow) warns that the scramble for critical minerals risks fueling trade wars and geopolitical instability. He calls for the creation of an International Materials Agency to provide reliable market data, co-ordinate global policies, resolve disputes, and strengthen the negotiating capacity of resource-rich nations.





SAUDI NEWS

Zawya: “Madinah Regional Municipality and DeepMinds launch Madinah Venture Studio”

Madinah Regional Municipality, in collaboration with DeepMinds, launched the Madinah Venture Studio, a venture-building platform focused on DeepTech, AI, HealthTech, Sustainability, and ESG aligned with Vision 2030. The studio connects local talent, corporates, and government with international innovators to create and scale ventures that deliver economic, social, and environmental impact.

Gulf Business: “WeRide’s Robotaxi secures autonomous driving permit in Saudi Arabia”

WeRide’s Robotaxi has secured Saudi Arabia’s first autonomous driving permit, making it the only company with AV permits across six countries: Saudi Arabia, China, UAE, Singapore, France, and the US. The permit allows WeRide to operate Robotaxis nationwide, beginning with a pilot in Riyadh alongside Uber and local partner Ai Driver, and a full commercial launch is planned by the end of 2025.

Gulf Business: “How Saudi Arabia is measuring AI readiness across government”

SDAIA has launched the National AI Index, a strategic tool to assess government readiness for AI adoption, with over 180 government representatives participating in the first assessment cycle. The Index evaluates institutional preparedness and offers tailored recommendations to accelerate AI maturity and generate national-level impact.

SDAIA: “SDAIA, Oxford University Partner on AI Engineering Camp to Empower Saudi Graduates”

SDAIA, in partnership with Oxford University, has launched an eight-week AI application engineering camp to train Saudi and international graduates in advanced AI skills. This initiative will further support Saudi Arabia’s leadership in AI development, as seen earlier in the year with [the launch of “HUMAIN”](#), a Saudi Public Investment Fund (PIF) company focused on developing and managing AI technologies and investing in the sector.

05

Join Us in the Future

Our mission to advance the inclusive, sustainable, and responsible adoption of Industry 4.0 and frontier technologies will continue through the remainder of 2025. To achieve this, we will:



Accelerate the development and implementation of governance principles, policies, and protocols for advanced and frontier technologies



Engage a collaborative and diverse community of stakeholders to generate insights and address challenges



Enhance the capabilities of our team and Saudi leaders in the governance of advanced and frontier technologies

UPCOMING EVENTS



3rd Saudi Forum for 4IR 2025: Frontiers of Global Technology, 29-30 October, Riyadh

C4IR Saudi Arabia will host the premier Forum for exploring new developments, challenges, and opportunities in the world of 4IR technology. In collaboration with the World Economic Forum and King Abdulaziz City for Science and Technology (KACST), the **3rd Saudi Forum for 4IR 2025** will host discussions to guide and support innovation, responsible scaling, and inclusive access to technology, alongside considering the emergence of the bioeconomy and quantum economy as engines of national transformation, and sustainable approaches to industrial innovation in the Intelligent Age.

[Register now to attend.](#)

Our Partners for the Forum:



Quantum Nexus Webinar, online

In collaboration with the Saudi Quantum Computing Association (SQCA), our next webinar in the Quantum Nexus series will examine global quantum strategies, including approaches from the US, EU, China, the UK, and beyond, while highlighting key technology frontiers in computing, communication, and sensing. It will also explore commercialization trends, such as the role of startups, funding, and industry adoption, alongside ecosystem challenges related to talent, scaling, and global standards.

[Register now to attend.](#)

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