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JULY 2026

# goZERO

RINA'S MAGAZINE ON THE ENERGY TRANSITION

RINA

Our experience. Your growth.

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# No transition without **connection**

We are witnessing a transformation at the global level which is reshaping the value chains, the approach to energy security, and the priorities of leading industries.

New global alliances, competition for critical minerals, strategic rivalries, a more regionalised approach, and the overriding need for energy security is disrupting the old order, and the international system is searching for a new equilibrium: technological capabilities, industrial autonomy and selective cooperation are becoming ever more strategic.

With the importance of the energy transition to society, its achievement must not become a competition between winning technologies. Instead, it must be a systemic process, with collaboration between the available tools to achieve the best result.

As a result, open innovation will be decisive. This is not just a slogan, but a method to connect skills, value chains and sectors, in order to convert ideas into effective solutions.

Today, the critical issue is no longer the availability of solutions, but their scalability. Many technologies now exist and show great promise, but struggle to move beyond the pilot phase.

Bridging this gap means integrating research, finance and industry, while incorporating regulatory frameworks and standards that allow innovations to be deployed safely and at scale. Geopolitical trends have hastened this process.

This complexity and the need for open discourse is captured in this latest issue of goZERO which addresses real-world projects, industrial experience, and a diversity of perspectives that show how the transition is built by connecting technologies, skills and territories.

In this context, the role of a knowledge company such as RINA is to connect: to integrate multidisciplinary expertise, translate innovation into tangible applications, and reduce technical and operational uncertainty. The decarbonisation process does not just require technology, it also demands execution.

The digital element is an integral part of this journey. Data, artificial intelligence and digital twins are transforming the way we design, monitor and manage assets, enabling a step change in efficiency, safety and sustainability.

Looking ahead, the transition will depend on the ability of players to act as a system: across technologies, stakeholders and geographies. Decarbonisation is not only about reducing emissions, but about building new industrial models that are more resilient and competitive.

Achieving this will require an open, collaborative and pragmatic approach, capable of turning complexity into opportunity.

**Carlo Luzzatto**
CEO & General Manager, RINA

goZERO | JULY 2026 EDITORIALS

# Open innovation drives the **future energy mix**

The energy transition is entering a more tangible and less theoretical phase where industrial choices now matter more than abstract principles. One element is becoming increasingly clear: the challenge is not to select a single technology, but to coordinate a system of interacting solutions which can evolve and improve over time.

In this context, innovation is becoming the true differentiator. The future energy mix will not be defined by a winning technology, but by the ability of players to continuously enhance performance, accelerate development and bring solutions to scale. Those who innovate more effectively will ultimately secure a stronger position in the market.

Today, the challenge is not only to produce energy, but to do so while ensuring continuity, predictability and competitiveness. From this perspective, technological progress must be supported by a clear vision, strong expertise and well-structured value chains capable of sustaining innovation over time.

The contributions to this issue of goZERO reflect this evolution: from conceptualisation to practical application, and ultimately to the development of industrial capabilities and specialised expertise across the entire value chain. What emerges is a transition that is increasingly driven by tangible projects and measurable progress.

At the same time, this transformation cannot happen in isolation. Open Innovation is becoming a key approach to connect competencies, industries and stakeholders, enabling the transition from promising ideas to concrete, scalable solutions.

In addition to the technological dimension, other elements are gaining importance: the development of skills, the ability to build robust industrial supply chains, and the management of the entire lifecycle of solutions. These are areas that require structured approaches, transparency and rigorous standards.

In this scenario, the role of companies like RINA is to foster trust: ensuring reliability, supporting the creation of standards, and accompanying technologies throughout their lifecycle, from design to deployment.

The energy transition requires pragmatism as much as vision. Building a sustainable energy system means integrating solutions, strengthening capabilities and continuously advancing innovation. The credibility of the transition, in the long term, will depend on the ability to translate this innovation into a workable reality.

**Andrea Bombardi**
Executive Vice President, Open Innovation Hubs, RINA

# Malaysia:
# Asia's regional CCS hub

Carbon Capture and Storage (CCS) is a critical lever for achieving net-zero targets, particularly in hard-to-abate industries. Wider trends are also shaping CCS, such as the continued reliance on conventional energy, which requires CCS as a solution, and the shift towards lower-carbon products, which require CCS as a production enabler.

In late 2021, Petronas initiated a strategic effort to position Malaysia as a regional CCS hub. Malaysia is among the leading countries in Asia with geological sites suitable for carbon dioxide ($CO_2$) storage, offering a strong foundation for scalable CCS development. The identified storage sites are located offshore, with the majority of reservoirs more than two kilometres below the seabed. This geological configuration provides enhanced environmental and public safety assurance, strengthening Malaysia's attractiveness as a secure and responsible CCS destination.

Malaysia is also situated outside the "Ring of Fire", the 40,000-kilometre belt in the Pacific Ocean which contains up to 90% of the world's active volcanoes and 90% of its earthquake areas. Thus, the storage sites are located in an area of negligible seismic/tectonic plate shift.

Malaysia's geographical location offers significant advantages for cross-border CCS, with strategic location for transporting $CO_2$ from emitter countries to Malaysia. In recognition of this, Petronas has been actively advancing cross-border CCS solutions since 2021, supporting regional countries with limited domestic geological storage capacity.

Interview with **Nor A'in Md Salleh**
CEO, Petronas CCS Solutions

**CCS hub development strategy**
The development strategy has been carefully curated to account for all aspects of the hub project, including risk, liability, and affordability, to ensure a smooth execution of the full CCS life cycle.

Petronas' strategy involves focusing on three value chains: onshore gathering terminal infrastructure, including port facilities; transportation options to create the network to the hub, with a focus on liquefied $CO_2$ vessels/ships; and, finally, storage sites.

Petronas is also conducting a parallel assessment of multiple hub and storage locations to create optionality and support future development that can cater to higher demand. For each value chain, Petronas is partnering with industry players to fill any gaps in Petronas' own capacity and capability.

Today, Petronas expects to achieve FID for our Southern CCS Hub as early as 2027. The onshore terminal will be located within the vicinity of Kuantan Port in Pahang with two pipeline networks to offshore storage sites.

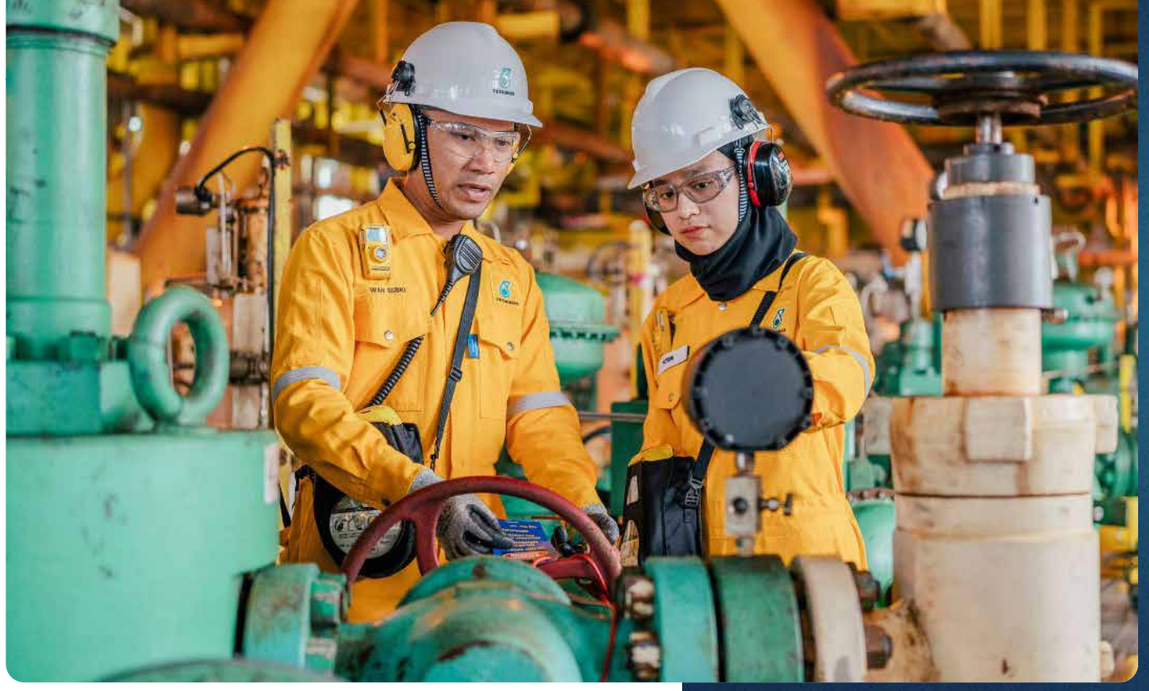
For long-haul ship transport, a new joint venture, Jules Nautica Sdn Bhd, was established in June 2025 with partners Mitsui OSK Line, MISC Berhad and Petronas CCS Venture Sdn. Bhd. This company will be responsible for building, owning and operating the liquified $CO_2$ ship for the cross-border CCS market in this region.

**Offering an affordable solution**
Decarbonisation is an important cost for industry and requires affordable solutions. In Malaysia, in the absence of financial incentives such as those available in Europe, the UK or the US, Petronas has established a long-term multi-pronged strategy to ensure affordability.

This includes the establishment of business risk profiles which robustly address liabilities, hazards and technical requirements at an early stage to achieve proper allocation of risk and liability along the value chain.

Petronas also focused on fit-for-purpose infrastructure precisely tailored for $CO_2$ transportation and storage.

It also worked on standardisation across the value chain, establishing a homogeneous $CO_2$ spec to enable common receipt from diverse industries, allowing Petronas to build standardised infrastructure, achieving economies of scale and accelerated construction times.



The next step in Malaysia's energy transition will be the development of spin-off opportunities from CCS. This includes decarbonisation in the marine industry. Petronas is also exploring the Onboard Carbon Capture (OCC) whereby emissions captured from ships can be offloaded directly at the port and channelled to storage sites connected to the onshore CCS terminal.

Here, companies like RINA can play an important role in the Environmental, Social, and Governance factors affecting the project, and by giving the technical advice needed to realise the OCC technology itself.

RINA can also play a key role in the independent verification, certification and risk assessment of projects. Given CCS is a solution that offers the physical removal of $CO_2$ from the atmosphere, it is critical to ensure and verify that Petronas' own CCS infrastructure emissions are as low as possible. The methodology for calculating the molecule's movement from sources to storage sites, including clarity on the risk-transfer points for cross-border activity, is also critical to securing the credibility of CCS as an effective decarbonisation solution.

Scan the QR code to learn more about **Petronas**

**BIOGRAPHY**

Nor A'in is currently the General Manager for Petronas Carbon Capture & Storage (CCS) in the Carbon Management Division (CMD) and CEO of PETRONAS CCS Solutions Sdn Bhd. She is the Chairman of the Board for Jules Nautica Sdn Bhd, an incorporated joint venture to undertake the development of liquified $CO_2$ ($LCO_2$) ships for transboundary CCS.

She graduated with a Bachelor of Mechanical Engineering from Rensselaer Polytechnic Institute (RPI) in Troy, New York, USA in 2001. In 2016, Nor A'in obtained Project Management Professional (PMP) certification from the Project Management Institute.

Nor A'in began her career in oil and gas field development, before transitioning into corporate roles shaping Petronas' energy transition portfolio. Since 2021, she has been at the forefront of advancing CCS as a critical decarbonisation solution for regional industries.

She has been identified as a Thought Leader in Sustainability after completing in 2022 the Leadership Program on Sustainability, a joint program delivered by World Business Council for Sustainable Development (WBCSD), Yale University and IMD Business School.

# Achieving a **"fair" energy transition**

The energy transition roadmap of Petrobras is grounded in a dual commitment. We want to maintain leadership in competitive offshore oil and gas, particularly in the pre-salt, while progressively reducing emissions and expanding low-carbon businesses.

The company's strategic plan 2050 and business plans clearly frame this approach as a 'fair energy transition', where oil and gas continue to finance decarbonization and diversification.

The key pillars to this strategy include:

- Operational decarbonization, with systematic reduction of emissions intensity in Exploration and production (E&P) and refining, leveraging high efficiency assets with one of the lowest carbon footprints globally.
- Portfolio diversification, focusing on biofuels, biorefining, renewable power, low-carbon fuels and new energy solutions integrated with existing assets.
- Technology and innovation, with strong emphasis on electrification, Carbon Capture Utilization and Storage (CCUS), digitalization, and R&D to enable scalable decarbonization pathways.
- Robust governance and transparency, ensuring capital discipline, economic resilience and credibility in climate commitments.

Indeed, Brazil occupies a unique and strategic position in the global energy transition, combining large-scale offshore production with strong natural advantages in renewables and bioenergy. Petrobras' offshore pre-salt production stands out for its low emissions intensity, positioning Brazil as a competitive supplier even in tighter carbon-constrained scenarios.

In parallel, Brazil's long-standing expertise in biofuels, combined with expanding initiatives in Sustainable Aviation Fuel (SAF), biorefineries and renewable electricity, strengthens its role as a bridge between conventional energy security and low-carbon solutions.

Petrobras' strategy explicitly seeks to leverage these national advantages to support both domestic development and global decarbonization efforts.

**CCUS will play a key role**

Biofuels, electrification, and carbon capture, utilization and storage (CCUS) are gaining momentum worldwide. However, for hard-to-abate segments, Petrobras recognizes CCUS as a cornerstone technology, particularly in offshore and gas processing operations. The company already applies largescale $CO_2$ reinjection in pre-salt fields and is advancing dedicated CCUS pilot projects, positioning the technology as both a mitigation tool and a future business opportunity.
In addition, biofuels and biorefining - including SAF and renewable diesel - are seen as critical to decarbonizing aviation and heavy transport, while electrification and renewable power will support emissions reduction across refining, upstream and industrial operations. This integrated portfolio reflects a pragmatic focus on solutions that are technically viable, scalable and aligned with Petrobras' asset base.

Petrobras has a wide portfolio of technologies under development, such as exhaust carbon capture, AI process optimization, full electric systems and others. They all play important roles in decarbonizing our operations since there is no unique solution to a complex production system, and each contribution counts on an incremental evolution of our strategy.

Balancing decarbonization with competitiveness is a key challenge for energy companies which we address through capital discipline and asset selectivity. Oil and gas remain central to value creation, particularly high return, low emission projects in the pre-salt, which generate cash flow to finance the energy transition.

At the same time, decarbonization initiatives are embedded into investment decisions, with incentives linked to emissions performance and rigorous economic evaluation. This ensures that sustainability is not treated as a cost center, but as a driver of long term resilience, risk management and competitiveness.

**Verification and certification**

Of course, independent verification and certification play a critical role in credibility, transparency and market access. The recent certification of the REDUC (Duque de Caxios Refinery in Rio de Janeiro) refinery by RINA under ISCC CORSIA standards for SAF production demonstrates Petrobras' commitment to internationally recognized sustainability criteria, including traceability, mass balance control and verified emissions accounting.

Such certifications strengthen stakeholder confidence, support regulatory compliance and enable Petrobras to participate in global low carbon fuel markets with recognized standards.

International partners such as RINA contribute technical depth, independent assurance and global benchmarking. Their role spans certification, technical advisory, ESG alignment, risk assessment and engineering support, helping Petrobras translate strategic ambitions into implementable and auditable solutions.

These partnerships are particularly valuable in emerging areas - such as SAF, CCUS and sustainability verification - where international standards and cross-sector experience accelerate learning curves and reduce execution risk.

**The future**

Looking ahead, Petrobras envisions itself as a diversified and integrated energy company, not abandoning oil and gas abruptly, but progressively expanding its role across multiple low carbon solutions.

The strategic plan 2050 clearly positions the company as a player that combines responsible hydrocarbon production with leadership in bioenergy, low carbon fuels and new technologies, supporting a fair and orderly transition.

In this sense, Petrobras' evolution is not a binary shift, but a managed transformation, leveraging its scale, technical expertise and asset base to remain relevant, competitive and aligned with a net zero future.

Interview with **Flavio Bretanha**
Head of Subsea Area, Petrobras

**BIOGRAPHY**

Flavio Bretanha is the Head of Subsea Area at Petrobras. Flavio has worked as an engineer for 28 years, holding various managerial and executive positions in this time.

His main areas of expertise include project management, operations, logistics, maintenance, technical standardization, and knowledge management.

Flavio began his career as an auto entrepreneur, before joining Pepsico, and subsequently Brazilian national postal service Correios.

He joined Petrobras in 2007 where he has held several senior positions including Midstream Logistic Service Manager, E&P Logistics Project Manager, and Commercial and Operational Director at PB-LOG.

Flavio is a member of the board of several companies. He is always striving towards results and performance, from reducing operational and maintenance costs to standardization, organizational and unit restructuring.

Scan the QR code to learn more about **Petrobras**

# Nuclear: a key **energy pillar for shipping**

The global maritime sector is entering a structural transition shaped by three major forces.
First, there is regulatory pressure through the International Maritime Organization (IMO) Net Zero Framework which is creating economic signals for low and zero carbon fuels.
Second, energy security and resilience now sit alongside decarbonization as strategic priorities.
And third, there is growing recognition that no single solution will decarbonize shipping. A portfolio approach is emerging.

**Where does nuclear energy slot into this transition?**
Nuclear fits where energy density, endurance and reliability matter most. It offers zero operational emissions and freedom from fuel price volatility.

Civilian nuclear propulsion is not new. Vessels such as the NS Savannah, the world's first commercial nuclear-powered merchant ship, demonstrated its feasibility decades ago. What is new is the climate imperative and the development of advanced reactors and Small Modular Reactors (SMRs) with enhanced passive safety.

The central question is no longer technical feasibility, but whether the enabling governance frameworks can evolve in time.

Maritime nuclear will only move forward if nuclear safety, maritime regulation, liability, insurance and port governance evolve together.

Three conditions are essential:
- Alignment between nuclear and maritime regulators, particularly through the International Maritime Organization (IMO) and the International Atomic Energy Agency (IAEA).
- Transparent international liability and insurance frameworks.
- Clear port entry, emergency preparedness and waste management pathways.

Public confidence depends on credible, independent oversight and international cooperation. Deployment must be incremental, evidence-based and transparent.

NEMO's role, as a consultative NGO at both the IMO and IAEA, is to convene regulators, classification societies, insurers, ports and industry to close practical gaps before first deployment.

**A long-term solution, a scalable pillar, or a niche option?**
In the near term, nuclear is most likely to serve specific segments such as large vessels on fixed routes, ice-class operations and energy intensive offshore activities.

Over the longer term, if regulatory clarity and financing confidence mature, nuclear could become a scalable pillar for parts of the fleet where high energy density and endurance are decisive advantages.

It is not a universal solution. But neither is any other pathway. Nuclear's role is likely to be complementary within a diversified decarbonization portfolio.
In addition, SMRs and next generation systems are set to take the potential deployment of nuclear energy in the maritime sphere beyond vessel propulsion alone, opening up broader opportunities.

For instance, they could also power large ocean going vessels, ice-class shipping, offshore platforms, remote energy hubs and port infrastructure requiring firm, low carbon baseload power.

Ports are increasingly electrified industrial ecosystems. Shore power, hydrogen production and digitalisation all increase demand for reliable clean power.

SMRs could provide stable long term energy independent of weather conditions, strengthening resilience while reducing emissions.

**Future priorities**
Going forward, NEMO has the following targeted goals for the near and medium term, which demonstrate the priorities for nuclear energy's maritime adoption:

2026:
- Advance working group outputs on regulation, liability and port readiness
- Expand cross sector membership
- Contribute formally to IMO and IAEA discussions
- Deliver focused technical workshops

2027:
- Support clearer international guidance pathways
- Strengthen collaboration with Organisation for Economic Co-operation and Development (OECD) Nuclear Energy Agency (NEA) and classification societies
- Publish practical recommendations on insurability and port governance

2030:
- Help enable internationally aligned pilot frameworks for civil nuclear maritime applications
- Ensure governance is globally coordinated, transparent and safety led

NEMO's mission is to enable the safe, secure, insurable and internationally workable use of nuclear energy in the maritime sector.

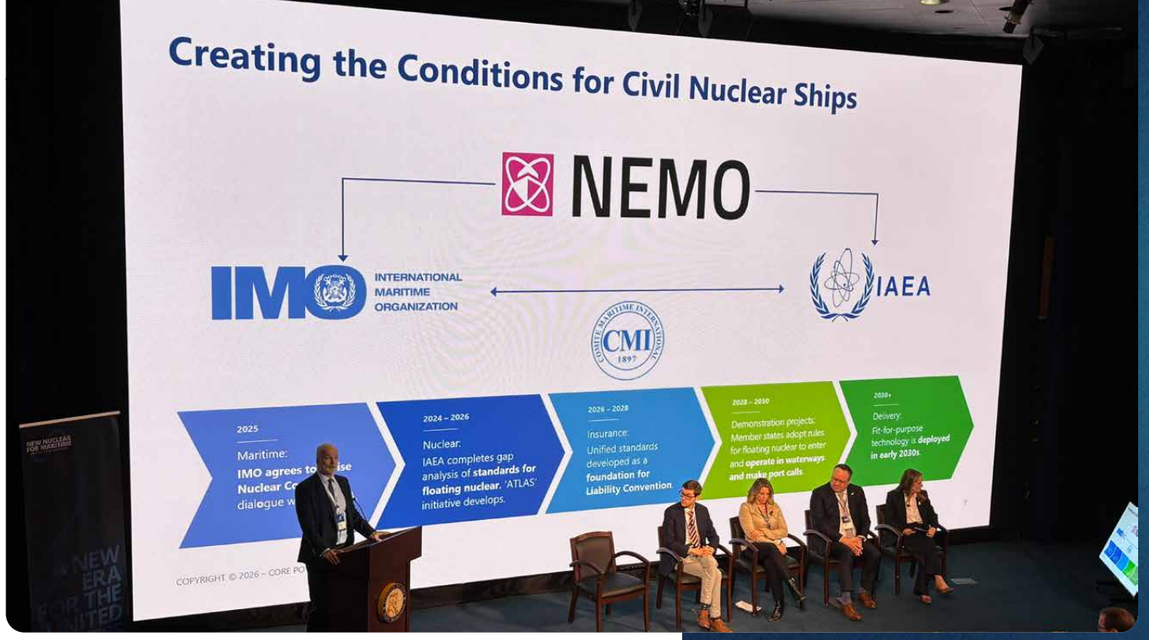
**Partnerships with industry stakeholders are crucial**
Classification societies are critical to translating regulatory intent into workable technical standards.

Organisations such as RINA, a NEMO member, alongside other class societies within our membership, play an essential role in developing risk assessment methodologies, design codes, survey regimes and assurance mechanisms.

They bridge theory and practice. Their expertise helps ensure safety frameworks are rigorous, internationally harmonised and insurable in real-world maritime operations.

Partnership across governments, regulators, class, insurers and research institutions is indispensable. No single actor can create a viable framework alone.

Interview with **Virginia Crosbie**
Managing Director, NEMO




**BIOGRAPHY**

Virginia Crosbie is Managing Director of the Nuclear Energy Maritime Organization, NEMO, an international NGO with consultative status at the International Maritime Organization (IMO) and the International Atomic Energy Agency (IAEA).

She brings together regulators, ports, insurers, shipowners and the nuclear sector to make maritime nuclear energy safe, secure and insurable in practice.

A former UK Member of Parliament, she chaired the All Party Parliamentary Group on Small Modular Reactors and has championed credible, evidence-led clean energy for hard-to-abate sectors.

She serves as Chair of Supporters of Nuclear Energy and as a Board Director of the Nuclear Institute. Her focus is on building confidence through clear governance and international collaboration so innovation can move from ambition to responsible delivery.

Scan the QR code to learn more about **NEMO**

# Reforming Italy's **extractive and energy sectors**

Italy's upstream energy and mining sectors are being reshaped by the dual challenges of decarbonization and strategic autonomy.

The current geopolitical scenario has increased the urgency for a national strategic oil and gas production program. Furthermore, the transition to a decarbonized economy is bringing a renewed focus on critical raw materials. These are essential for renewable technologies, electric mobility, storage systems, and the broader industrial ecosystem.

Italy is attempting to respond to these trends through changes in its oil and gas legal framework, and through initiatives such as the National Mineral Exploration Program for critical materials.

Collaboration between industry and institutions is crucial. However, this common ground is unlikely to be sufficient without a comprehensive revision of the national legal and permitting framework, and a simplification of the process.

For the mining sector, the law and permitting framework needs an even more drastic update and revision as mining activity has undergone a strong decline in Italy in the last thirty years. This implies a complete re-working in order to achieve the development of an integrated domestic raw materials value chain.

**Critical raw materials and strategic minerals**
At Assorisorse, Italy's Sustainable Energy & Resources Industry Association, we have a number of other long-term goals, including several in relation to critical raw materials and strategic minerals.

Interview with **Francesca Zarri**
President, Assorisorse

Building a national raw materials supply chain means going well beyond exploration and extraction. It requires strengthening all downstream phases, including refining, processing and the production of intermediate materials, which are currently often concentrated outside Europe. It also implies investing in industrial capabilities for recycling and urban mining, enabling the recovery of critical materials from end-of-life products such as batteries, electronic devices, and industrial waste.

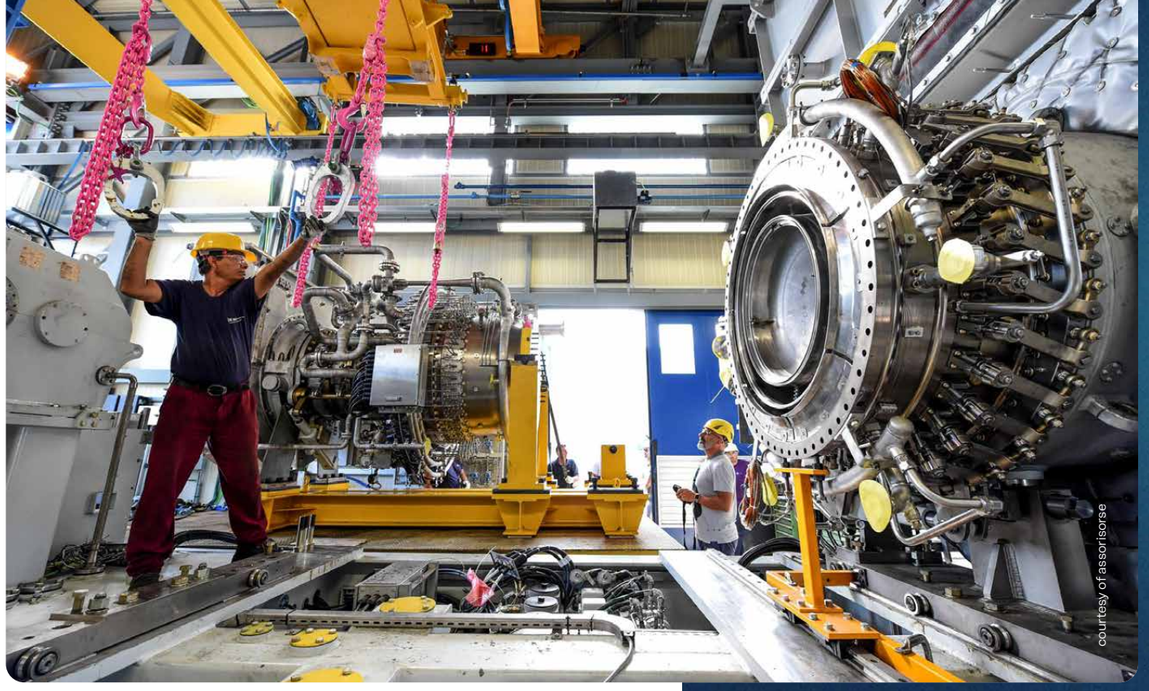
Equally important is the integration between mining activities and manufacturing sectors, ensuring that domestically-sourced materials can effectively support national value chains in energy, mobility, and advanced technologies. Developing such a supply chain also entails fostering innovation, skills and infrastructure, as well as creating stable regulatory conditions that can attract long-term investments and reduce project risks.

Part of our work is of course to enhance the competitiveness of the Italian industrial supply chain in the energy and extractive sectors. This requires a systemic approach that rebuilds and strengthens the entire value chain while accelerating innovation and sustainability.

Italy needs to consolidate an integrated raw materials supply chain, connecting upstream activities - such as exploration and extraction - with downstream phases including processing, refining, manufacturing, and recycling. Reducing external dependencies is essential, but competitiveness will ultimately depend on the ability to retain value within the country, ensuring that domestically-sourced materials feed strategic industries such as renewable energy, batteries, and advanced manufacturing.

Streamlining the regulatory and permitting framework is crucial to attract investment and reduce uncertainty for operators. Clear, predictable, and efficient authorization processes can significantly improve project timelines and make Italy more attractive compared to other jurisdictions. At the same time, targeted public support for strategic projects, including access to funding and incentives for innovation, can help scale industrial initiatives.

**Mapping domestic rare materials**
To best encourage resource development and low-carbon technologies, Italy is attempting to respond through initiatives such as the National Mineral Exploration Program, aimed at mapping domestic sources of lithium, graphite, and rare earth elements to reduce dependence on imports. However, these efforts are unlikely to be sufficient without a comprehensive revision of the national legal and permitting framework and, crucially, without the development of an integrated domestic raw materials value chain. It is important to find the right balance between environmental safeguards and industrial competitiveness.


courtesy of assorisorse

Overall, Assorisorse sees innovation, the creation of a resilient and integrated raw materials supply chain, and environmental stewardship as central pillars for revitalizing Italy's upstream industries and ensuring their competitiveness within a decarbonized and increasingly resource-constrained global economy.

**Aligning domestic and European initiatives**
Looking ahead to 2030 and beyond, through initiatives such as the Osservatorio Italiano Materie Prime Critiche Energia (OiMCE, Italian observatory on critical raw materials for energy) Assorisorse can help align industrial strategies with national and European priorities, supporting informed policymaking and coordinated action.

In this context, Assorisorse can play a pivotal role as a facilitator and catalyst, and actively foster technological innovation across its member companies by encouraging joint research and development projects, supporting pilot initiatives, and promoting partnerships with universities and technology providers.

Ultimately, strengthening the Italian supply chain will depend on the ability to integrate industrial capabilities, invest in innovation, and create a stable and supportive ecosystem - areas where Assorisorse can act as a key enabler and strategic guide.

**BIOGRAPHY**

Francesca Zarri is the President of Assorisorse, Italy's Sustainable Energy & Resources Industry Association, and a senior director at Eni.

Born in Bologna, Francesca graduated with an MS degree in Mining Engineering.
In 1997 she joined Eni, working in the group's Upstream business.
Since then, Francesca has occupied a series of roles at the group: from 2011-2013 Head of American Region, Head of Procurement Services and Eni's representative for Commercial Committee in the South Stream Project. In 2013, she became VP for W. Africa Projects Monitoring & Technical Coordination, and between 2020 and 2024, she was Director of Technologies (CTO).
Today, she is the Head of Upstream Italy at the group.

In addition to being President of Assorisorse, Francesca is President of Eniservizi, a director at Assolombarda, and on the Advisory Board of Eni International BV.

Since June 2024, she has also served as President of the OMC Med Energy Conference and Exhibition.

Scan the QR code to learn more about **Assorisorse**

# Real projects, real data, **real impact**

From our perspective at the Fondazione Bruno Kessler (FBK), three technology trends will be particularly decisive in accelerating deep decarbonisation in Europe.

The first is the integration of hydrogen into real industrial ecosystems. The focus is no longer on hydrogen production alone, but on its effective coupling with demand in sectors such as steel, chemicals and heavy mobility, where it can enable structural emissions reduction. This will open a perspective of new green molecules that will cover plenty of demands in all the heavy duty sectors.

The second trend is electrification, supported by advanced storage solutions. The combination of batteries - particularly long-duration technologies such as flow batteries - with renewable generation is becoming essential to ensure system stability and flexibility. This is coupled with a new wave of nuclear energy that is safer and more sustainable, as well as decentralized.

Finally, digitalisation is playing an increasingly central role. The use of artificial intelligence (AI), predictive control, and integrated modelling allows for the optimisation of complex and hybrid energy systems.

Overall, the real acceleration will not come from individual technological breakthroughs, but from the integration of these technologies into functioning, interconnected systems.

**Finding a route to scale-up**
As a multidisciplinary research institution, FBK today operates 12 specialist research centres, including sustainable energy. Here, we work with a wide range of technologies including hydrogen, advanced batteries (including flow batteries), advanced materials and tools for smart energy systems.

Interview with **Andrea Simoni**
Secretary General, Fondazione Bruno Kessler

Among our projects, several are approaching a level of maturity that makes them ready to scale. Hydrogen systems at mid-to-high technology readiness levels, battery integration solutions and system-level optimisation tools are increasingly deployable in real contexts.

However, the main barriers are no longer technological. They are related to the lack of coordinated infrastructure, regulatory and permitting complexity, and high upfront investment costs combined with uncertainty and demand. In addition, there is still a need for industrial validation at scale.

In this sense, the technologies are largely available, but the challenge lies in creating the right conditions for infrastructure development, for technology deployment, integration and market uptake.

**The potential of Hydrogen Valleys**
We have two initiatives in particular with strong potential to impact the energy transition in the short term.

The first is the realization of the new facilities at the foundation's Center for Sustainable Energy supported by, among others, two Important Projects of Common European Interest (IPCEI), EuBatIn and Hy2Tech.

FBK will implement at full scale the "one-stop shop model", supporting our partners from industry at their relevant scale through an integrated approach of services and support.

This aims to create local interconnected ecosystems around technologies that could play a relevant role, as well as a positive impact on the economy, energy sovereignty, resilience, and the environment in the local Autonomous Province of Trento, Italy.

The second, and one of the foundation's most significant initiatives, is FBK's involvement in the EU-supported Hydrogen Valleys, developing local industrial or transport clusters where renewable hydrogen supply feeds local demand, such as the North Adriatic Hydrogen Valley. These initiatives are especially relevant because they bring together research, industry and infrastructure in real regional ecosystems.

Hydrogen Valleys goes beyond pilot projects, demonstrating in this case how hydrogen can be deployed across multiple sectors simultaneously, from industry to mobility and energy systems. The value of the valleys lies in their ability to create replicable models that can be adopted in other regions, while also bridging the gap between research and industrial deployment.

**RINA collaboration**
Working towards real world solutions, RINA and FBK have just signed two letters of intent: one on energy transition and shared strategic areas, and another on AI and new projects linked to gigafactories.

This is expected to lead to joint projects on energy system integration, and the development of AI-driven optimisation tools for industrial and energy processes.

Additional areas of collaboration include support to gigafactory ecosystems, particularly in the battery and hydrogen sectors, and the development of testing, validation and certification services that will take place at the future FBK facilities in Rovereto, a unique hub to test MW-scale modules, today with a planned final investment of about € 40 million.

The success of this collaboration over the next 12 to 24 months will be defined by tangible and measurable outcomes. This means the launch of joint pilot projects with industrial partners, the deployment of AI-based tools in real energy systems, and the development of new services for industry, such as validation, optimisation and sustainability assessments.

In short, success will mean moving from collaboration agreements to real projects, real data and real impact.

**BIOGRAPHY**

Andrea Simoni graduated in Electronic Engineering from Milan Polytechnic in 1987 and joined Fondazione Bruno Kessler (FBK) in 1988.

He has carried out research in the field of devices for high-resolution 3D measurement systems and integrated CMOS (Complementary Metal-Oxide Semiconductor) digital cameras, publishing more than 100 scientific papers in leading journals and proceedings of international conferences.

In 2008-2009 he served as director of the Foundation's Materials and Microsystems Center, coordinating the activities of 140 researchers.

In February 2009, he was appointed Secretary General of Fondazione Bruno Kessler and was then reappointed to the role in 2013, in 2017 and again in 2021 and 2023.

The Secretary General sees to the unified vision of the President's and the Board's directives, coordinating both Fondazione Bruno Kessler's twelve research centers and the Administration and Research Support Services Division.

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# Bringing sustainability to the **Winter Olympics**

Sustainability has become a key tenet in public events and activities, and particularly global sporting events bringing together multiple nations.

This year, Italy played host to the XXV Winter Olympic and Paralympic Games, which took place from February 6 to 22 and from March 6 to 15 respectively. The organization and promotion of the 2026 Winter Games, including the related cultural events, was awarded to Cortina d'Ampezzo-based organizing body Fondazione Cortina.

The Fondazione was given a mission to deliver the Games with a strong focus on sustainability from an economic, environmental, and social perspective, and also to create a cultural legacy comprising best practices, as well as a sustainable infrastructural legacy for future generations.

Organisation of the event took inspiration from the 2020 International Olympic Committee (IOC) Agenda, which was updated by the IOC Agenda 2020+5 document, and the IOC New Norms, which represented a new vision for the Olympic and Paralympic Games.

In practical terms, the Fondazione adopted as operational references the international standards ISO 20121 "Event Sustainability Management Systems" for the development and maintenance of the event sustainability management system.
In addition, it took ISO 14064-1 as its reference for the development and maintenance of the greenhouse gas (GHG) emissions inventory over the period 2022-2026. This covered both activities under the direct control and outside the direct control of the Games, such as the construction sites and activities related to spectators' transport and accommodation.
Both ISO 20121 and ISO 14064-1 were applied across all phases of the event: design, venue installation, event organization and management, as well as the decommissioning and restoration of temporarily occupied sites.

In this context, RINA performed independent third-party audits and verification/certification tasks to assess the correct application of ISO 20121 and ISO 14064-1 standards throughout all phases of the event, for both the Olympic and Paralympic Games.

The adoption of the event sustainability management system in accordance with ISO 20121 enabled the Fondazione to:

- demonstrate a responsible approach towards the environment and the community
- manage environmental, social, and economic risks and opportunities
- strengthen the organization's position within the community.

Meanwhile, the reporting of greenhouse gas emissions in accordance with ISO 14064-1 enabled the Fondazione to:

- continuously monitor GHG emissions associated with current and future activities
- identify potential improvement strategies by determining the most critical elements
- enhance the organization's commitment to environmental issues
- ensure a more transparent relationship with clients and, more broadly, all stakeholders.

The successful event will stand as a useful blueprint for the next Games due in 2030, as well as other future sporting events where economic, environmental and social sustainability are set to become increasingly important.

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# Planning for **real estate decarbonisation**

The energy transition of real estate assets is now one of the most pressing challenges for operators, investors and property owners.

In an increasingly demanding regulatory landscape - ranging from the Corporate Sustainability Reporting Directive (CSRD) to the recast of the Energy Performance of Buildings Directive (EPBD) and the EU Taxonomy - isolated interventions are no longer sufficient. What is required is a structured, measurable and long-term strategy.

Against this backdrop, the Energy Transition Plan developed by RINA Prime for Reale Immobili plays a pivotal role. It is a technical and strategic pathway that supports the client from an initial snapshot of the current portfolio to the definition of a clear and actionable roadmap for decarbonisation.

The Plan builds on a comprehensive analysis of buildings' energy and environmental data - covering consumption, $CO_2$ emissions, energy performance classes and system configurations - integrated with sector benchmarks and internationally recognised models such as Carbon Risk Real Estate Monitor (CRREM).

This approach enables not only an assessment of current performance, but above all the objective identification of intervention priorities, taking into account asset stranding risk and the evolution of climate targets for 2030 and 2050.

The increasing use of artificial intelligence (AI) further enhances the process, supporting predictive modelling, advanced risk analysis and simulations of regulatory and energy scenarios, while strengthening the link between ESG performance and financial outcomes. Rather than replacing expertise, AI amplifies the analytical and decision-making capabilities of professionals.

A distinctive feature of the service is its strong operational focus. The Energy Transition Plan goes beyond defining environmental targets by translating strategy into concrete actions, with clear estimates of investment costs, energy savings and emission reductions.

From quick wins in building management and operations to more capital-intensive interventions on envelopes and systems, each measure is assessed in terms of technical and economic feasibility and alignment with the client's ESG strategy.

The approach is further strengthened by alignment with leading international frameworks, including the UN Principles for Responsible Investment (PRI) and Global Real Estate Sustainability Benchmark (GRESB) benchmarks, and by deep technical expertise in green building standards such as Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM) and WELL Building Standard (WELL).

Particular attention is paid to integration with Corporate Sustainability Reporting Directive (CSRD) reporting processes and EU Taxonomy requirements, supporting corporate functions involved in both disclosure and investment planning. In this way, the Plan becomes a cross-functional tool—supporting not only emissions reduction but also the long-term protection and enhancement of real estate asset value.

The result is a dynamic, continuously updatable document that accompanies the client throughout the energy transition journey, turning regulatory obligations into tangible opportunities for efficiency, resilience and value creation.

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# Using drones to **detect fugitive emissions**

Monitoring methane emissions has emerged as one of the biggest challenges in the energy field. Since methane has a Global Warming Potential (GWP) many times higher than that of carbon dioxide over the 20 year period, the identification, quantification, and mitigation of so-called 'fugitive emissions' has now become a high priority globally for operators, regulators and other stakeholders.

In recent years, RINA has gained invaluable experience in the use of Unmanned Aircraft Systems (UAS) and numerous applications to continuously monitor methane emissions over complex industrial facilities. RINA has developed an effective methodology that integrates advanced drone technologies, specialist gas sensing instrumentation and highly skilled personnel to deliver safe, efficient and high-quality data with limited disruption to operations.

One example of this experience is RINA's collaboration with TotalEnergies where methane detection and monitoring was successfully conducted in operational energy production sites.

The majority of projects utilized drones outfitted with specialized methane sensors that are able to perform remote inspections on infrastructure that would otherwise require labour-intensive access processes.

UAS technology allows inspecting vertical assets like elevated structures, pipelines, processing equipment, storage systems and other critical assets at a safe distance from areas that pose risk.

With meticulous flight operations, methane concentration data was acquired alongside geo-referenced imagery to deliver actionable data to operators for use in maintenance planning and emission reduction.

In addition to the operational advantages, drone-based monitoring greatly reduces the time taken to conduct inspections and the number of personnel deployed to areas with difficult access. With TotalEnergies, the collected data additionally helped improve the understanding of overall asset health and the potential sources for leaks, thus supporting more informed decision making processes.

With the experience gained with these projects, RINA is now ready to start a new methane monitoring initiative with Società Gasdotti Italia (SGI, Italian gas transmission company). The forthcoming project will be focused on the ongoing validation of drone-enabled methodologies for gas transportation infrastructures,

in order to improve early detection solutions to mitigate methane leaks and protect operational integrity, as well as meet Health, Safety and Environment (HSE) environmental compliance.

The operations will build on lessons learned in previous field deployments, combining advanced sensing, together with strict operational procedures and data analysis methodologies. Emphasis will be placed on measurement assurance, campaign repeatability and the incorporation of collected data into the clients' asset management environment.

With the ongoing transition of the energy sector into more sustainable and environmentally responsible operations, new technologies like drone-based methane monitoring are needed now more than ever.

RINA has actively helped energy operators reach their drivers for emissions reductions while improving safety and operational performance through our multidisciplinary expertise in inspection, certification, engineering and digital innovation.

In addition, the tools developed in major energy company projects show how innovative UAS solutions can enhance environmental monitoring of energy infrastructures, enabling more transparency, efficiency and sustainability.

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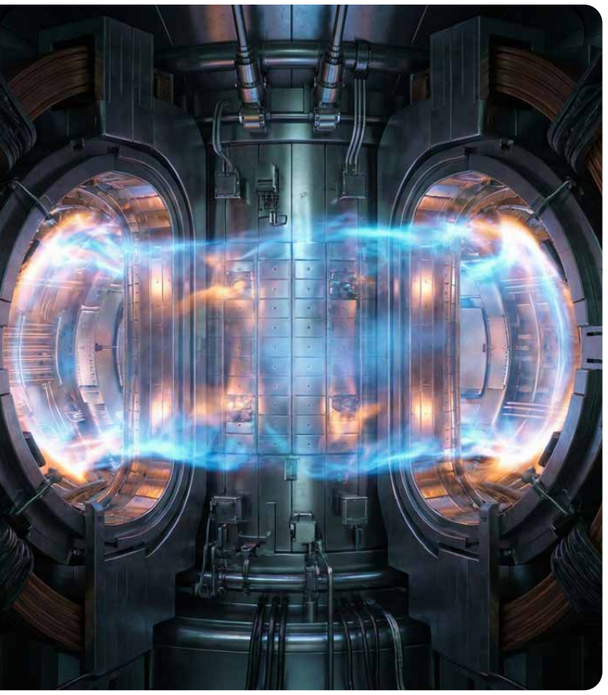
# EUROfusion: creating **fusion power in Europe**



Fusion energy has the potential to provide a virtually inexhaustible source of low-carbon electricity by reproducing on Earth the process that powers the Sun. Europe has been at the forefront of fusion research for decades and, through the EUROfusion Consortium, is now preparing the expertise and technology needed to move from experimental devices to future fusion power plants.

EUROfusion is a consortium of more than 30 research organisations and over 150 affiliated entities across Europe, bringing together thousands of scientists, engineers and technicians. The programme coordinates and funds research activities ranging from plasma physics and materials science to advanced technologies and reactor design, while also supporting the education and training of the next generation of fusion experts.

While ITER ("The Way" in Latin) in southern France remains the flagship international fusion project, Europe is increasingly focusing on the development of a pilot plant that can demonstrate the production of electricity from fusion and pave the way to commercial deployment.

Current activities are therefore aimed at accelerating technology readiness, integrating public and private initiatives, and developing key enabling technologies in parallel with ITER operations.

One of the major technological challenges lies in the development of the superconducting magnet systems that generate the powerful magnetic fields required to confine the plasma.

EUROfusion is currently investigating both conventional low-temperature superconductors and innovative high-temperature superconductors, which could enable new reactor architectures and simplify future plant operation and maintenance.

The programme is also addressing critical issues such as tritium breeding, neutron shielding, remote maintenance, power exhaust and materials qualification under reactor conditions.

System-level studies indicate that achieving a commercially viable fusion power plant requires a careful balance between physics performance, engineering feasibility and plant integration.

RINA contributes to this effort by supporting engineering analyses, technology development and qualification activities, helping to bridge the gap between conceptual design and industrial implementation.

The collaboration between research institutions and industrial partners such as RINA is essential to accelerate innovation and prepare the technologies that will underpin Europe's first fusion power plants.

The coming years will be decisive for fusion development. With ITER progressing towards operation and the European strategy increasingly focused on Pilot Plant deployment, EUROfusion is laying the technological foundations for a future in which fusion becomes a reliable, safe and sustainable source of energy.

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# Haouma project drives **Morocco's ambitions**

NAREVA's Haouma Green Hydrogen Project represents an important step in Morocco's transition toward low-carbon industry and renewable-based hydrogen production. Presented as a pilot initiative, the project combines renewable electricity, electrolysis technology, and industrial offtake to demonstrate the operational viability of green hydrogen in the Moroccan context.

Beyond its pilot scale, the initiative is positioned as a strategic building block for future large-scale hydrogen and green ammonia developments.

RINA is supporting NAREVA as Owner's Engineer, starting from the preliminary development phases and working until the commissioning of the plant, underscoring both companies' commitment to the energy transition and industrial decarbonization.

For RINA, the project also reflects a strategic opportunity to expand its hydrogen portfolio and reinforce its role as a trusted partner in Morocco's rapidly advancing clean energy sector.

Although limited in scale, the Haouma pilot project carries broader strategic significance. By validating the integration of wind energy and electrolysis under real operating conditions, the project generates valuable insight into technical performance, operational feasibility, and the management of renewable intermittency. It also contributes to the development of Morocco's emerging hydrogen ecosystem and supports the longer-term potential for derivative products such as green ammonia.

NAREVA brings to the project a strong renewable energy platform and a proven track record across wind, solar, hydro, and thermal generation, supported by collaborations with major technology providers such as Siemens Gamesa. The Haouma site further benefits from its proximity to Tangier and the Tanger Med Port complex, creating longer-term potential to connect hydrogen production with industrial demand and export-oriented value chains.

For RINA, participation in this initiative reinforces its position as a trusted engineering and advisory partner for energy transition projects in high-potential markets.

The plant has been conceived as a compact, modular hydrogen production unit integrating the electrolyze, utility and auxiliary containers, medium-voltage infrastructure, transformer and rectifier systems, and dedicated cooling equipment. This configuration makes the project especially relevant as a live demonstration platform for renewable-powered electrolysis in an operating wind environment. Through its engineering support, RINA helps ensure that the pilot is underpinned by robust technical oversight and a disciplined approach to performance validation.

A defining strength of the delivery model is its combination of international expertise and local execution. RINA in Italy contributes specialist hydrogen and engineering capabilities, including detailed engineering review and the preparation of a 24-month test protocol, while RINA in Morocco provides on-the-ground support for site supervision, commissioning, start-up, and performance testing.

Together, the two organizations deliver a model that combines technical depth with local responsiveness, an essential requirement for this developing industrial segment.

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# Verifying cross border **'carbon leakage'**

The Carbon Border Adjustment Mechanism (CBAM) is a key environmental policy adopted by the European Union to address the risk of carbon leakage beyond its borders.

Carbon leakage occurs when production is relocated from the EU to countries with less stringent climate policies, or when EU-produced goods are replaced by more carbon-intensive imports.

CBAM applies to:

- Importers of goods listed in Annex I to the CBAM Regulation that are released for free circulation in the EU customs territory. These goods include cement, iron and steel, aluminium, fertilisers, hydrogen, and electricity.
- Operators of installations outside the EU that export these goods to the Union.

From 1st January 2026, importers and indirect customs representatives acting for non-EU importers must be authorised as CBAM declarants.

And from 2027 onwards, authorised CBAM declarants must submit a CBAM declaration to the European Commission reporting the greenhouse gas emissions embedded in the goods imported into the EU during the previous year.

By the same deadline, authorised CBAM declarants must purchase and surrender CBAM certificates corresponding to the embedded emissions declared, at a price aligned with the carbon cost that would have applied had the goods been produced under the EU Emissions Trading System (EU ETS).

Where authorised CBAM declarants choose to report actual embedded emissions, rather than the default values from the external installation operators, those emissions must be independently verified. RINA can act as a partner for the verification of these emissions under CBAM.

Verification typically includes the following steps: Conducting a strategic analysis and risk assessment, reviewing the calculation of embedded emissions and the monitoring procedure, to assess compliance with the CBAM methodology, conducting a site visit, preparing the verification report and issuing the final verification report and verification opinion.

RINA combines technical competence and practical experience in greenhouse gas verification with several accreditations under EN ISO 14065 and EN ISO/IEC 17029. Together, these competencies and accreditations provide a strong foundation for CBAM-related activities in line with CBAM accreditation criteria.

In addition, RINA holds multiple accreditations for the validation and verification of greenhouse gas reduction and removal projects. Although distinct from CBAM verification, these additional competencies and accreditations may also be relevant in CBAM-related





contexts, particularly as the European Commission continues to define the rules on carbon price deduction and to assess whether, and to what extent, carbon credits or other offsetting mechanisms from regulated or voluntary markets may be taken into account under the evolving CBAM framework.

For the authorised CBAM declarant, priorities should be to:

- Set up clear internal responsibilities, procedures, and records for CBAM compliance
- Ensure access to the CBAM Registry
- Track imported goods by type, supplier, and country of origin
- Assess supplier readiness to meet CBAM requirements
- Obtain verified embedded emissions data from non-EU operators
- Estimate certificate needs and the related financial impact
- Prepare the annual CBAM declaration well in advance
- Include contractual requirements for data quality, supporting evidence, and cooperation.

For the non-EU installation operator, priorities should be to:

- Set up clear internal responsibilities, procedures, and records for CBAM compliance
- Ensure access to the CBAM Registry
- Establish a robust monitoring and reporting process for embedded emissions
- Define reporting boundaries, identify emission sources, and ensure reliable data collection
- Prepare the Embedded Emissions Report in line with CBAM requirements well in advance
- Collect evidence of any carbon price effectively paid, where applicable
- Select the verification body.

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**Carbon Border Adjustment Mechanism (CBAM) embedded emissions and cost formula**

$$N=(a \times Q) - (b \times f \times Q) - \left[\left(\frac{C \times a}{P}\right) \times Q\right]$$

N: Number of CBAM Certificates (t CO2e)

a: specific embedded emissions (actual or default) (t CO2e/t goods)

b: CBAM benchmark (t CO2e/t goods)

f: CBAM reference parameter, defined in Article 10b of Directive 2003/87/EC and incorporated in Implementing Regulation (EU) 2025/2620; for 2026 it is set at 97.5% and then decreases progressively in the following years (e.g. 95% in 2027, 90% in 2028, etc.), until reaching zero when free allowances are completely phased out

C: carbon price already paid (€/t CO2e)

P: price of CBAM Certificates (€/t CO2e)

Q: quantity of goods

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