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goZERO

RINA'S MAGAZINE ON THE ENERGY TRANSITION

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RINA

Our experience. Your growth.

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Energy transition needs **global effort**

We are living in a time of change which is both complex and unpredictable.

But the energy transition is still not optional; it is necessary. How we move forward requires fresh thinking and shared responsibility.

Technology is evolving fast, and digital tools are now central to how we design and manage energy systems. Innovation is key: artificial intelligence, data platforms, and remote monitoring solutions help make systems more efficient, flexible, and resilient. At the same time, we must remember that these technologies also consume energy and resources. It's a balance that requires careful choices.

This edition of goZERO reflects a global perspective. It brings together stories and insights from very different geographies: from Brazil's energy ministry to the state electricity company in Indonesia, and from nuclear innovation in Europe to lessons from the Mediterranean.

Each voice highlights a different way to approach the same challenge.

No participant can do it alone. The transition needs the involvement of institutions, companies, researchers, and local communities. It requires collaboration between regions with different resources, priorities, and timelines.

We must learn from each other - adapting technologies to local contexts, and sharing successful models across borders.

RINA is present in many parts of the world and across the energy value chain. This gives us a wide view: we observe what works, help adapt ideas to different settings, and connect actors who might not otherwise meet.

We are part of a larger ecosystem, one that moves forward only if all its parts work together: Hydra project shows just how effective this approach can be.

We are also seeing new frontiers emerge: underwater infrastructure, floating solar units, energy use in space, and the growing role of data centers.

These are not just engineering challenges, but signs of how energy is becoming more interconnected and global.

The energy transition will not follow a single path. It will be shaped by local needs, tested solutions, and the global exchange of information.

This is the spirit of goZERO: a forum to listen, share, and build bridges between sectors, disciplines, and countries.

Carlo Luzzatto
CEO & General Manager, RINA

Grounded strategies for **real impact**

The energy transition is a shared goal, but the path each country takes must be unique. Every region has its own mix of climate, economy, infrastructure, and energy needs. These differences are not simply context, they are the building blocks for creating real solutions.

For example, there are countries which benefit from abundant sun and wind, making renewables a logical focus. By contrast, industrial economies with high energy consumption might need a balanced combination of renewables, efficiency upgrades, and storage systems. Islands or remote regions often prioritise energy security and local resilience through microgrids and battery systems.

Because of this variety, the transition must start with a clear understanding of local conditions: what resources are naturally available? What infrastructure is already in place and can be upgraded? What energy demands do industries and communities have?

Tackling these questions ensures that plans do not become empty slogans. When strategies overlook local details - like grid capacity, regulatory frameworks, or workforce skills - they risk slowing down the process, or even failing. A practical transition must be incremental: testing a technology here, upgrading an asset there, and scaling solutions that deliver real impact.
Moreover, strategy must align not only with physical infrastructure, but also with socio-economic realities and long-term energy demand. Including aspects such as local regulations, financing models, and human and digital capacity, ensures that solutions are sustainable - technically, economically and socially.

The transition process should be a mosaic, not a monolith. Each region needs its own roadmap, evolving over time and shaped by continuous feedback from all stakeholders. Only gradual, context-aware progress builds trust, resilience, and momentum.

In this context, technical support alone is not enough.

What is required is a partner who listens, analyses, and helps tailor solutions to each reality. A partner who asks: what can be improved now? What requires investment later? Who needs to be involved?

RINA does this every day - turning global insight into local action.

At the end of the day, the energy transition is not just about cleaner power – it's about delivering energy that is reliable, reachable, and adapted to people's lives. It's about connecting technology to places, and ambition to concrete action.

Andrea Bombardi
Global Market Development Executive Vice President, RINA

Conversation with **Alexandre Silveira** Minister of Mines and Energy in Brazil

BRAZIL: TAKING A GLOBAL LEAD

Brazil is committed to being a firm leader in the global energy transition. Indeed, we are seen as a benchmark for a country that is moving towards decarbonisation without giving up development, as confirmed by the World Economic Forum's Energy Transition Index and the review of national energy policies conducted by the International Energy Agency.

We have created this by being consistent in the formulation and implementation of public policies and - anchored in long-term planning instruments, regulatory solidity and alignment between the energy, economic and environmental dimensions - by creating a stable and attractive environment for investment, including in new technologies. This guarantees that Brazil will not only be able to maintain its energy matrix but also its expansion in parallel with economic and demographic growth.

Today, 90% of Brazil's electricity matrix is renewable, and by 2024 the total energy matrix will have exceeded the 50% mark for renewable sources.

The energy transition cannot be limited to technological change alone, and that it is essential to vigorously contemplate social inclusion and take care of the most vulnerable sections of the population, especially in the countries of the Global South.

Hydroelectric and solar power

Hydroelectric and solar power play an important and significant role in Brazil's renewable matrix, and are strategic sources on the path to compliance with our nationally determined contributions (NDCs) under the Paris Agreement. We are making significant progress in this direction. Solar power generation grew by 51% in 2023, making it the country's fastest-growing sector the last year.

In addition, the high technical and geographical potential of solar energy in the country, which has excellent irradiation in all regions, shows that it is ready to be considered as an important tool for meeting national decarbonisation targets.

Future export hub

Brazil is often mentioned as a future export hub for clean energy, especially green hydrogen and ammonia. We are working hard to strengthen the sector, with plans to excel in the global low-emission hydrogen market.

One of them is our 2023-2025 Three-Year Work Plan of the National Hydrogen Programme (PNH2), which sets targets and priorities for the consolidation of low-emission hydrogen hubs in Brazil, with important milestones in 2025, 2030 and 2035.

In 2024, we enacted the Hydrogen Legal Framework (Law No. 14,948/2024) and now the proposal for a regulatory decree for exploration, production and the incentives established in the Special Incentive Regime for Low-Carbon Hydrogen Production (Rehidro) and the Low-Carbon Hydrogen Development Programme (PHBC) is being finalised.

Another initiative also under development is the call for hydrogen hubs proposals to decarbonise Brazilian industry. This process is part of Brazil's application for funding from the Climate Investment Funds (CIF).

The production of biofuels, especially ethanol, also holds great potential. We are now working to transform the CO_2 generated in ethanol production into an opportunity to effectively reduce emissions. Bioenergy technology with carbon capture and storage, known as BECCS, also has the potential to make Brazil a world leader in negative emissions solutions.

Together with President Lula and the ministers who make up the National Energy Policy Council (CNPE), we launched the expansion of ethanol's blending share to 30% and the expansion of biodiesel's blending share to 15% in August 2025.

Oil and gas

Brazil has been working to ensure that oil and natural gas production continues to contribute to economic development, without compromising on climate commitments. We are proud to say that the exploration and production sector in Brazil accounts for just 1% of the country's greenhouse gas emissions. Our average emissions are one of the lowest in the world: under 10kg CO_2 per barrel of oil equivalent in the pre-salt, while the global average is 20kg.

We are expanding the technologies that make our production even more efficient. The capture and reinjection of CO_2 into pre-salt reservoirs is a clear example, as are legal instruments to accelerate the capture and geological storage of carbon.

Brazil has undoubtedly taken a leading role in global discussions on the energy transition, seeking to build bridges with different regions of the world. Integration

between countries can bring many benefits, opening up opportunities and creating solutions. As well as bilateral and multilateral partnerships with the UK, Denmark and Germany, we are also strengthening regional integration in South America, with an emphasis on natural gas.

In November 2024, we formalised the creation of a Bilateral Working Group with Argentina to expand the supply of natural gas in Brazil, including importing Argentinian production from the Vaca Muerta formation, which had its first results this year. We are also expanding electricity interconnections and already have electricity exchanges with Uruguay, Argentina, Paraguay and Venezuela and are working to expand connections with Bolivia.

Brazil is committed not only to being part of the global energy transition, but will continue to actively contribute to shaping it, with structured proposals, long-term vision and the concrete experience of a country that combines sustainability with real development.

RINA can be a valuable partner for Brazil, contributing to renewable energy projects and actions for sustainability in the mining sector.

BIO.

Alexandre Silveira de Oliveira is a Brazilian lawyer, former police delegate, businessman, and politician.

He served two terms as a federal deputy from Minas Gerais and later as a senator.

He also held state roles such as head of DNIT, Metropolitan Management Secretary, and Health Secretary in Minas Gerais.

On January 1, 2023, he was appointed Minister of Mines and Energy under President Lula.

Affiliated with the PSD, Silveira has authored key legislation including social welfare PECs and initiatives in security, infrastructure, and energy.

Focus on mining

Mining is a key sector in an important part of the Brazilian economy. Although it has an image of being a high-emissions industry, the sector represented just 0.55% of Brazil's total emissions in 2024, according to estimates by the Brazilian Mining Institute (IBRAM). Regardless, the Brazilian government is attentive to the need to further reduce this further. One initiative is the Climate Plan, which seeks to prepare mining for the challenges of climate change, focusing on water resources, disaster prevention and the protection of local communities. It also encourages the use of renewable energy, cleaner technologies and greater energy efficiency.

Minerals play a strategic role in the construction of new technologies needed for decarbonisation, such as batteries, wind turbines, solar panels, electric motors and energy storage systems. In this context, we are working to expand the supply of minerals considered critical to the energy transition, such as lithium, nickel, cobalt, copper, graphite and rare earth elements.

Accelerating the **technology cycle**

Global demand for energy is still growing, driven by population growth, deployment of AI and data centres, and rising power intensity across major developing countries. To meet this demand, we must leverage every source of energy with the best energy mix at regional level.

At Baker Hughes we take a portfolio approach to all climate technology solutions, recognizing there is no single answer but a co-existence of different solutions according to geographical constraints and policy supports.

Short term, the focus is on ensuring access to secure and affordable energy such as natural gas, which represents a key lever for reducing emissions, especially when combined with abatement and proven technologies.

Simply by leveraging existing technologies, upstream operators can reduce their emissions by as much as 70%. This includes highly efficient equipment like compressors, turbines, and pumps, alongside data management and AI for optimization.

In the medium and long term, alternative fuels like hydrogen and its derivatives will become increasingly central.

Priority is scaling alternative fuels

The primary consideration is therefore how to scale alternative fuels, like hydrogen. We believe investing in continuous R&D to drive innovation, paired with strategic partnerships to develop scalable solutions for hydrogen, is key to lowering costs.

In 2024 alone Baker Hughes invested $643M in R&D to deliver several advancements across our portfolio, including climate technology solutions for hydrogen production, transportation and storage, CCUS, emissions abatement and clean power solutions.

We participate across the entire hydrogen value chain, supporting customers from feasibility studies through technology provision to aftermarket services. Our decades of experience (started in the 1910s) with hydrogen, including over 2,250+ installed compressors (hydrogen specific) and wide experience burning hydrogen with turbine technology (over 70 projects worldwide), provides deep knowledge of materials and behaviours, allowing us to anticipate specific application needs.

Furthering the adoption of alternative fuels cannot solely fall on technology and project developers. Policymakers must share the responsibility to incentivize investment decisions through technology agnostic regulations. Policy is essential to overcome current barriers to alternative fuels and low-carbon technology adoption at scale. And scale is essential to unlock efficiencies able to increase alternative fuels competitiveness.

Three primary challenges

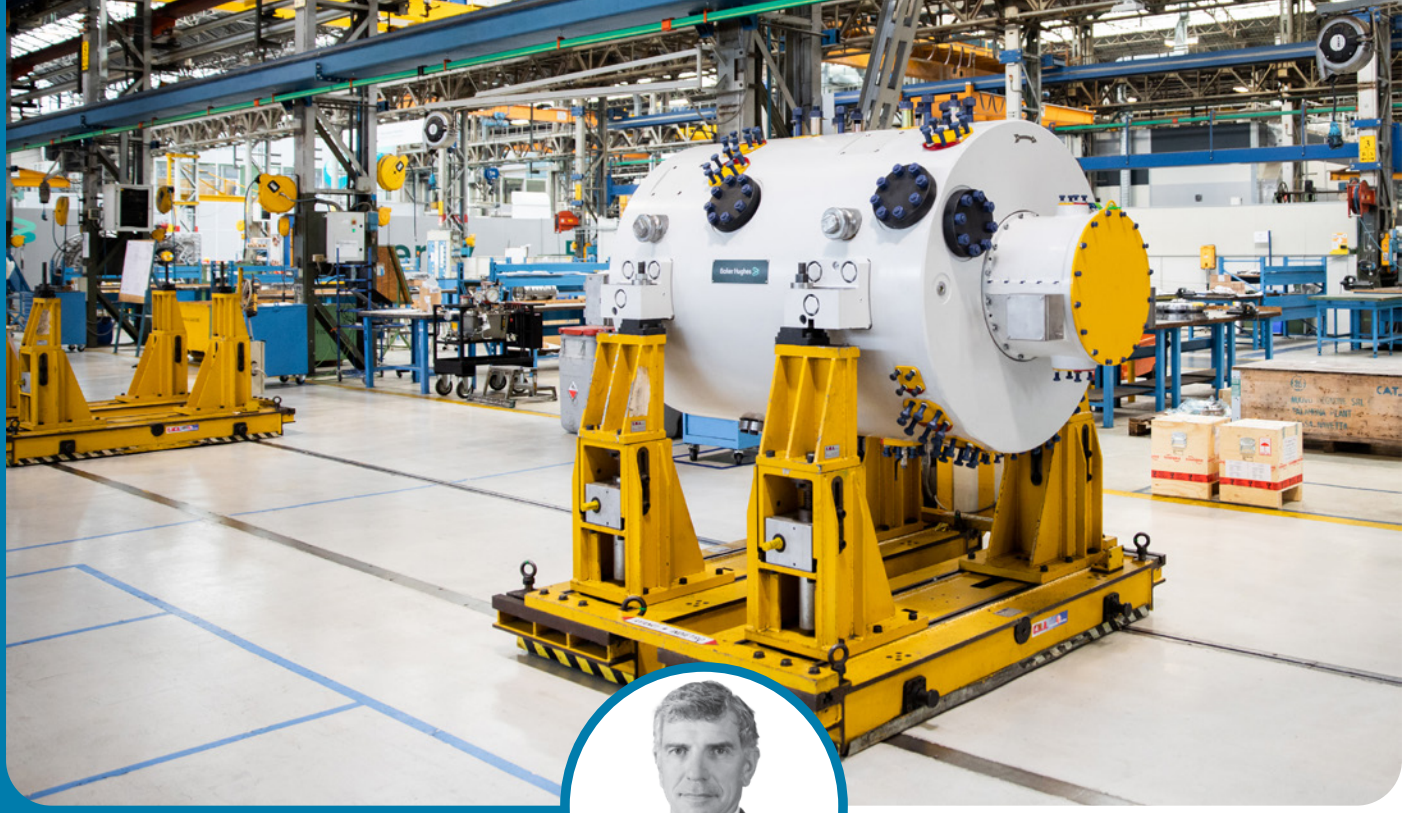
Across the market, Baker Hughes has identified three primary challenges in enabling the energy transition, though we view these not merely as obstacles but also as significant opportunities.

- Firstly, there is the adoption of technology. We recognize that technology innovation cycles and their subsequent adoption must be significantly accelerated. The emphasis should shift from merely the application of new technologies to the tangible outcomes they deliver

- Secondly, the establishment of reasonable and long-range policies is crucial. Such policies are vital for creating a level playing field, enabling a diverse range of energy technologies to attract investments and advance over the long term

- Lastly, access to capital and costs present a considerable challenge. In today's environment, investments must demonstrably produce returns, especially given the biggest cost driver is the production technology itself and incumbent technologies increasingly show their limitations. To address this, we have strategically invested in what we call second and third-generation technologies which we believe will leapfrog society into a lower cost base.

An interesting model countries could follow is China's approach to launch its domestic hydrogen economy, particularly in the mobility sector. Their approach is built on some key pillars: a massive build-up of renewable power generation, delivering low-cost electricity, which is the main cost driver of H2 (60-70% of levelized cost



BIO.

Interview with **Alessandro Bresciani** Senior Vice President of Climate Technology Solutions at Baker Hughes

Alessandro Bresciani is Senior Vice President of Climate Technology Solutions at Baker Hughes, part of the Baker Hughes Industrial & Energy Technology business segment. The company provides solutions for energy and industrial customers worldwide, focusing on carbon capture, utilization & storage, hydrogen, emissions abatement, and clean power solutions.

Alessandro holds a degree in Industrial Engineering, and a Master's Degree in Business Administration from SDA Bocconi. He has over 25 years of global experience in energy and industrial sectors, covering multiple roles including sales, commercial, operations, services, and business development. Prior to his current role he was Vice President, Services for the previously named Turbomachinery & Process Solutions business in Baker Hughes.

In his current role, Alessandro is responsible for defining the strategy and operationalizing product and solution management and project execution. He also sits on the Board of Directors of Nuovo Pignone International S.r.l. and is part of the RCS Academy Business School Advisory Board, as well as a supporting member of the Hydrogen Council.

of hydrogen derives from electricity price); a holistic commitment to technology innovation across the entire hydrogen value chain; the emergence of economically self-sustaining hydrogen projects in regions close to low-cost power combined with minimal transportation costs; and targeted support for end-users in big centres like Shanghai and Beijing.

Ensuring safety above all

The increasing use of new solutions such as hydrogen in various sectors where they were not previously implemented also underlines the absolute need for operational safety and, by extension, harmonized regulations and standards.

Linked to this, certification will represent a critical element as hydrogen and its derivatives scale up, and our collaboration with RINA will become invaluable.

We are leveraging RINA's strong expertise in certification, regulatory frameworks, and sector knowledge, particularly in the maritime sector. This is highly relevant as we look to deploy innovative technologies and solutions in this space, such as our new small-size turbine for ammonia applications, developed in collaboration with Hanwha Power Systems and Hanwha Ocean. RINA's commitment to fostering innovation through their Open Innovation Hubs (OIHs) further strengthens this synergy.

Scan the QR code to learn more about **Baker Hughes**

Nuclear offers path to **net zero**

On a lifecycle basis, nuclear energy has one of the lowest CO_2 equivalent emission rates, at 12 grammes CO_2-eq/kWh, comparable to that of renewables.

Nowadays, nuclear energy generates 24% of the EU's electricity demand, or some 50% of the decarbonized power in the region. Therefore, nuclear power is already an essential part of European decarbonization pathway.

Looking at the future, according to recent studies (e.g. Pathways to 2050, Role of Nuclear in a low-carbon Europe – nucleareurope October 2024), more nuclear power would enable a faster decarbonization, and would drive down EU electricity prices.

Taking into account the life extension of the current NPP fleet and new realizations of large LWRs and SMRs/AMRs, a realistic scenario backed by the European Nuclear Alliance foresees an increase in nuclear capacity in the EU from today's 100 GWe to 150 and even 200 GWe by 2050.

This would not only impact the decarbonization pathway, but also EU-27 economic output. In the 200 GWe scenario, the nuclear industry over 2025-2050 would support annually 1,667,000 full-time jobs and generate €71.9 billion of additional cumulated state revenues.

Change in European approach
In recent years, Europe has presented a fragmented nuclear landscape, with some countries heavily investing and others opting out. However, this changed in 2022 with the energy crisis triggered by the current conflicts in Ukraine and the Middle East.

In recent months we have seen several EU countries lifting their bans on nuclear energy and shifting to new, even aggressive, nuclear programmes. This is the case for Sweden, Belgium and Italy, as well as nuclear newcomers like Poland and Estonia.

Even countries traditionally against nuclear power deployment like Denmark are re-evaluating their long-standing ban, and I would not be surprised if in coming months even Germany reconsiders its anti-nuclear energy policy.

The case of recent blackout in Spain, which may have been triggered by excess of intermittent renewables on the grid and lack of inertia, deserves to be carefully investigated. Meanwhile, the Spanish Parliament recently approved the admission for consideration of a bill to ensure the continuity of nuclear energy in the country.

Bringing safety regulations up-to-date
European safety regulations must evolve to keep pace with the new nuclear technologies. Several ongoing initiatives in the EU and worldwide aim to streamline the certification and licencing process for new nuclear plants.

Even if the authorisation of nuclear installation remains the sovereign responsibility of the States, a cooperation between regulators on the pre-assessment of new nuclear technologies is considered valuable.

In particular, in the case of SMRs, collaboration among regulators of countries interested in the same concept to conduct a preliminary joint safety assessment of selected designs has proved to be effective in view of the subsequent national licensing process. Many safety regulation initiatives regarding SMRs have been launched at an international level in different fora (IAEA NHSI, SMR Regulatory Forum, NEA Committees, WENRA, EUR, ENISS, CORDEL).

A resilient supply chain
Strengthening the nuclear supply chain is also critical for Europe's energy independence.

This issue is being addressed in particular for SMRs and AMRs as standardization and modularization are considered particularly critical for their large deployment.

On the basis of the analyses conducted so far, the main issues are: modularization, new tools and methods in SMR manufacturing, new methods able to increase productivity, fuel and fuel cycle services.

Suppliers have indicated as main possible bottlenecks nuclear grade pumps and valves, generators/turbo generators, control rods, fuel elements, pressure vessels, criticality monitors/systems, uranium enrichment.

SMR are particularly suitable to be coupled with renewables. Thus, the SMR business model should extend the nuclear Value Chain beyond the reactor and the associated fuel cycle, towards energy storage solutions, hydrogen production etc.

Support for SMR programmes
SMRs have generated great expectations not only for electricity production but also for other applications like cogeneration, district heating, maritime transport, AI and data centres, etc.

Currently the EU lags behind other regions of the world like China, Russia and North America where SMRs are

TopFuel2024, the largest edition of the conference on nuclear fuel technologies, organised by ENS, 2024. Credits: ENS

BIO.

Interview with **Stefano Monti** President of the European Nuclear Society

Stefano Monti is the President of the European Nuclear Society, whose main goal is to promote and advance science and engineering related to peaceful uses of nuclear technologies.

Stefano is also President of the Italian Nuclear Association and Chair of the Advisory Board of the Italian Joint Research Partnership on nuclear. He also assists the Italian Government within the National Platform for Sustainable Nuclear Energy, and the European Commission for the evaluation of EU projects of various Euratom Programmes.

Prior to this and between May 2011 to November 2022, Stefano was Head of the Nuclear Power Technology Development Section in the Department of Nuclear Energy of the International Atomic Energy Agency (IAEA).

From 1999 to 2006, Stefano was Scientific Secretary of the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) Scientific Council, and Scientific Advisor to the President of ENEA.

He has held many other positions in the international nuclear industry. Stefano holds a doctorate in nuclear engineering from the University of Bologna and is a professional licensed engineer.

in operation or under construction. To facilitate the first SMR projects in Europe in the early 2030s, in 2024 the European Commission launched the SMR Industrial Alliance with more than 330 organizations throughout the EU.

The Alliance has selected 9 SMR concepts to reach the demonstration and deployment phase, and supports the fast development of these projects with 8 cross-cutting TWGs with elaborated roadmaps in different key areas (industrial applications, supply chain, skills, R&D&I, etc.).

Across all these areas, RINA has shown a robust and proven experience: from concept and design, to construction and commissioning, from safety regulation to permitting, from certification to AI and digital solutions.

It also has key capabilities and skills in marine applications which are gaining increasing interest in the nuclear industry to address one of the most hard-to-abate sectors.

Scan the QR code to learn more about **European Nuclear Society**

Indonesia's island challenges

Indonesia's roadmap to reducing emissions is anchored in the 2025-2034 Electricity Supply Business Plan (RUPTL), which is the greenest in the country's history.

The Plan targets the addition of 42.6 Gigawatts (GW) of new renewable energy generation and 10.3 Gigawatts (GW) of Energy Storage, which will account for 76% of the total new generation capacity.

In the 2025-2034 Plan, the 42.6 GW of renewable energy consists of 17.1 GW PV, Hydro 11.7 GW, Wind 7.2 GW, Geothermal 5.2 GW, BioEnergy 0.9 GW and 0.5 GW Nuclear.

Meanwhile, the 10.3 GW storage consists of 6 GW Pump Storage and 4.3 GW BESS. Some of the key technologies that we believe will be game-changers in Indonesia's energy transition are Smart Grid and Energy Storage Systems (ESS), Biomass Co-firing, and Carbon Capture, Utilization, and Storage (CCUS).

A unique geography

Indonesia's unique geography presents particular challenges when it comes to the integration of renewable energy into the national grid.

Grid stability and energy storage are crucial. Given Indonesia's archipelagic geography, our strategy is multi-layered, with:

- Smart Grid Development: we are modernizing our network into a smart grid to enable real-time monitoring and control, which is vital for balancing supply
- Energy Storage Development: we are investing in a Battery Energy Storage System (BESS) and are developing several large-scale pumped storage projects
- Finally, an Interconnection System: we are expanding the inter-island interconnection system through submarine cables, with the goal of creating an Electricity Highway" that transfers energy from areas rich in renewable resources to demand centers.

High voltage submarine cable technology

Underwater infrastructure is key in an island nation. To ensure efficient distribution, we have implemented High Voltage Submarine Cable Technology (HVDC/HVAC), both direct current (HVDC) and alternating current (HVAC).

This enables us to transfer large amounts of power with minimal losses between islands (Sumatra to Java, Sumatra to Batam to Bintan, Kalimantan to Java, Kalimantan to Sulawesi).

In addition, we have started adopting digital twin technology for critical infrastructure such as submarine cables. This allows us to monitor structural integrity, perform predictive maintenance, and ensure long-term safety and resilience against risks such as seismic activity or marine traffic.

The design and installation of our subsea infrastructure takes into account the complex geological and oceanographic conditions in Indonesian waters to ensure operational resilience.

The energy transition presents a unique set of opportunities and risks for a country like Indonesia.

For the former, we can highlight the job creation opportunities in the renewable energy sector. Renewable energy plants such as hydro and geothermal, which are often located in remote areas, also promotes local infrastructure development and increases electrification in these areas.

Overall, Indonesia will also improve its energy security and independence by reducing dependence on imported fossil fuels.

Ensuring energy affordability

The risks are centred on energy affordability, and the transition must not burden the public with high electricity tariffs. The country must also ensure a balance between the retirement of fossil plants and the readiness of new RE plants to avoid a supply crisis. There is also some supply chain risk with the imported technologies needed for some renewables.

To track and measure the country's greenhouse gas emission reductions, we have a structured monitoring, reporting and verification (MRV) system.

The most important indicators are: Emission Intensity (tCO_2e/MWh) which is our key metric; the Renewable Energy Mix by percentage; and the Absolute Emissions Reduction (tons CO_2e), which tracks total GHG emission reductions from various initiatives. Finally, we have the Realization of PLTU Early Retirement Program, which shows the amount of power plant capacity that we successfully retire on schedule.

To ensure security of supply while pursuing sustainability goals, we will continue to rely on gas as a transition energy that is cleaner than coal. The biomass co-firing program also plays an important role in reducing the carbon footprint of existing power plants while waiting for large-scale renewable energy plants to be fully operational.

Interview with
Ricky Cahya Andrian
Vice President Decarbonization Business Development and Energy Management at PLN

BIO.

Ricky Cahya Andrian is the Vice President of Decarbonization Business Development and Energy Management at PLN Indonesia, the state-owned electricity company.

Ricky has over 20 years' experience in the planning, operations and maintenance of Power Systems and HV Substation Systems.

He is also closely involved in Green Hydrogen Production, Storage, Distribution and Utilization at PLN, which is the leader in Green Hydrogen Ecosystems in Indonesia.

Ricky is also Chairman of Smart Energy Society, and a member of the association Fuel Cell Hydrogen Energy (IFHE), Indonesia.
He is an electrical engineer by background.

We are also actively building a domestic biomass supply chain to support this program and create a circular economy ecosystem.

Partnering with RINA
Collaboration with an international partner that has proven expertise like RINA can add significant value to the whole process. We see great potential in several areas, including certification where RINA's expertise in certification helps us ensure that our RE projects meet the highest international standards, which is important to for investor and stakeholder confidence.

RINA's experience in engineering renewable energy projects worldwide, including offshore and underwater technologies, can also help us in the design and implementation phase of complex projects such as offshore wind farms or subsea interconnections, while RINA's expertise in risk analysis and infrastructure resilience engineering is invaluable given Indonesia's geographical risks.

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

The "Climate Bank"

Climate action is one of the top priorities of the European Investment Bank Group (EIB). As the European Union's public bank, our lending criteria are directly shaped by EU policies. For instance, we no longer finance unabated fossil fuel energy projects, and we require all investments to be in line with the Paris Agreement on climate change. The EIB has taken a pioneering role in sustainable finance, most notably by issuing the world's first green bond, the Climate Awareness Bond, in 2007.

The bank continues to innovate in sustainable finance instruments, for instance via a landmark € 3 billion Climate Awareness Bond under the new European Green Bond Standard. This attracted investor demand of over € 40 billion and was oversubscribed 13 times.

These instruments are setting standards that many others follow, as we consolidate our role as "the Climate Bank".

Private capital expands in green space
Private capital is playing an increasingly pivotal role in Europe's decarbonisation, with investors directing funds toward sectors that promise both strong environmental impact and attractive financial returns.

Battery recycling and green hydrogen are particularly prominent, as they align closely with EU climate targets and benefit from supportive policy frameworks and public-private partnerships.

In battery recycling, private equity and venture capital are backing advanced technologies that support the circular economy, while green hydrogen is drawing significant investment thanks to ambitious EU production targets and de-risking measures that help overcome early-stage challenges.

Beyond these, private investors are also focusing on offshore wind and ocean energy, as well as industrial decarbonisation in sectors like steel and chemicals.

These areas are gaining traction due to clear regulatory support, innovation finance tools, and the growing maturity of technologies, which together reduce risk and increase confidence.

Overall, Europe's sustainable transition is becoming more investable as enabling ecosystems - combining policy, finance, and innovation - make it easier for private capital to support the continent's green ambitions.

The right risk-return
We believe Europe's ambitious decarbonisation goals are both sustainable and pragmatic from a financial risk-return perspective. When the right enabling conditions are in place - such as clear policy signals, robust regulatory frameworks, and targeted de-risking instruments - private capital is willing to engage, even in emerging or capital-intensive sectors.

We have seen this in practice: in 2024, nearly 60% of EIB Group financing supported climate action and environmental sustainability, putting us on track to achieve our goal of supporting €1 trillion in green investment by 2030. Institutions like the EIB Group play a crucial role in bridging policy ambition with market reality.

Among these enabling conditions, robust permitting processes are essential - they help ensure that new infrastructure meets high standards for environmental protection and public safety. However, the complexity and length of permitting procedures can sometimes delay urgently needed projects. By simplifying and harmonising procedures while maintaining strong safeguards, Europe could accelerate its energy transition and attract the investment needed to meet its goals.

Climate is one of eight priorities
The EIB has eight key priorities, including climate action, for the near to medium term future, which we have set out in a Strategic Roadmap.

Apart from decarbonisation, a second priority is digitalisation and technological innovation, and the European Union's strategic autonomy, including cleantech, biotech, robotics and artificial intelligence. We have just launched TechEU, the largest-ever financing programme for innovation in Europe, to mobilise € 250 billion by 2027.

A third priority, security and defence, is perhaps the area where we have seen the greatest progress in the last year. We invest in surveillance, spectrum protection and control, cybersecurity solutions, infrastructure, and military mobility to keep Europe safe and resilient.

Our other priorities are social and territorial cohesion, which means investment in less-advanced EU regions to close gaps in prosperity, as well as investments outside the EU, especially in Ukraine but also in Africa, Asia and Latin America.

Interview with
Emmanuel Chaponniere
Head of Division in the Projects Directorate of the European Investment Bank (EIB)

BIO.

Emmanuel Chaponniere is Head of Division in the Projects Directorate of the European Investment Bank (EIB), the long-term lending institution of the European Union. He is responsible for Circular Economy and Sustainable Development.

The directorate is composed of sector specialists and is tasked with project appraisal, the monitoring of project implementation, sector studies and policy development.

Prior to joining the EIB, Emmanuel Chaponniere worked as a water sector specialist as well as a waste expert in Europe and Africa. He graduated from the École Nationale Supérieure de l'Aéronautique et de l'Espace (France) and holds a Master's degree in Water Management from the École nationale du génie rural, des eaux et des forêts (France).

Reflecting the growing importance of the circular economy, the EIB Group provided a total of € 5.5 billion across approximately 153 projects between 2020 and 2024, split between Industry and Services (40%), Agri-forestry and Bioeconomy (29%), Waste Management (12%), and Urban Development & Buildings (11%). The Bank plays a key role in advancing the circular economy by financing operations focused on material recovery and recycling.

Critical metals and the circular economy
The EIB Group also plays an active role in securing Europe's supply of critical raw materials (CRM), particularly given the continent's limited natural resources.

Recycling, substitution, and more efficient use of precious metals and rare earths are essential to meeting the goals set out in the EU's Critical Raw Materials Act, which will help reduce Europe's reliance on imports.

In 2024 alone, we provided € 1 billion in financing for projects across the CRM value chain, and we aim to double this to € 2 billion every year going forward.

A key driver for the Bank's future investments is the EU's Critical Raw Materials Act, which seeks to ensure that by 2030 at least 25% of its annual demand for critical minerals is met through recycling.

Looking ahead, we are preparing the next phase of our Climate Bank Roadmap and will seek EIB Board approval ahead of the COP30 United Nations climate conference, which will take place in November in Belém, Brazil.

Here, we are focusing increasingly on competitiveness and energy security, climate resilience, natural capital, global engagement, the circular economy, and making the green transition fair and inclusive for everyone.

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HYDRA: **decarbonizing steel**

By **Orazio Manni**
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Today, the use of hydrogen in the steel sector as a reducing agent of iron ore or in reheating furnaces is relatively limited. Instead, steel production relies heavily on carbon-intensive methods such as using coke in blast furnaces, which leads to significant CO_2 emissions.

The HYDRA project aims to advance the global adoption of hydrogen in the steel industry, in order to boost the decarbonization process of this 'Hard to Abate' sector.

Among the challenges are: the development of efficient hydrogen production and storage systems, the adaptation of existing infrastructure, and the economic viability of hydrogen-based processes.

Funded by the European Commission's NextGenerationEU plan, and backed by the Italian Ministry of Enterprises and Made in Italy through RINA's Centro Sviluppo Materiali (CSM) in Castel Romano (Italy), the €88M R&D Hydra project is part of the IPCEI (Important Projects of Common European Interest).

The project objectives are:

- A concrete contribution to the decarbonization of the steel production process through up to 100% hydrogen utilization
- The development of a first-of-a-kind experimental line of DRI – Direct Reduction Iron and EAF – Electric Arc Furnace
- The acquisition of deep industrial knowledge of the metallurgical aspects involved in up to 100% hydrogen steel production
- The development of Methodologies and Laboratories for testing and qualifying materials in the presence of hydrogen (from high to low pressure, from small to full scale)
- The development of an Advanced Training Centre in order to build new skills and competences related to the decarbonization of 'Hard to Abate' Industries.

More specifically, the hydrogen-fuelled pilot plant will comprise a 30m high direct iron ore reduction (DRI) tower, an electric arc furnace EAF and a reheating furnace that will all operate with near zero emissions for the production of all types of 'green steel'.

The DRI tower, which reduces iron ore (oxide) into metallic iron, is designed and will be realised to use a gas mixture with increasing levels of hydrogen and, ultimately, 100% hydrogen.

The testing results will establish the quality of steel produced using hydrogen as the reducing agent in the DRI tower with the EAF, and characterise the material and infrastructure needed for the steel industry to use this gas in production.

The project team, including up to 120 engineers, will further evaluate the effects of different mixes of raw materials using metallic iron from the DRI tower and steel scraps within the process.

The construction of the EAF is scheduled for completion by 2025, while the validation of DRI technology is scheduled for Q1 2026. When fully operational, the EAF will produce up to seven tonnes of steel per hour for research.

The truly unique nature of this project is its position as an open research facility. It is not intended or designed to provide a commercial advantage to any one steel producer but rather move the industry and the world forward in the use of 100% hydrogen production with near-zero emissions.

This is why the Hydra project has been supported since its inception by leading European steel producers, plant suppliers, utilities, and major stakeholders in the sector.

There are many infrastructure and industry projects underway for the use of hydrogen, and it is hoped this project will also help move these forward by establishing a clear supply chain need within the steel industry.

As part of Hydra, RINA, thanks to extensive experience in hydrogen-based decarbonisation technologies, will provide a testing and qualification hub of materials and components for H2 transportation and storage.

It will also launch an international centre of excellence for the dissemination of hydrogen know-how, fostering collaboration and research among stakeholders in the steel and energy sectors.

The laboratories and the advanced training Hub are also expected to be completed by 2025.

ENGIMMONIA project **wins awards**

By **Andrea Pestarino**
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The ENGIMMONIA project (www.engimmonia.eu) is a cutting-edge initiative aimed at addressing one of the most pressing environmental challenges: the decarbonization of the shipping sector.

The project focuses on the use of ammonia as a fuel in marine engines, which has the potential to significantly reduce greenhouse gas emissions.

In addition, ENGIMMONIA is integrating several low-carbon technologies on board ships, including an absorption chiller, photovoltaic panels, an Organic Rankine Cycle system for waste heat recovery, and an Energy Management System to optimize energy use.

Together, these innovations represent a comprehensive approach to reducing the carbon footprint of the maritime transport industry, and advancing sustainable shipping practices.

To achieve our vision for a sustainable maritime future, ENGIMMONIA is focusing on three key objectives and strategies:

First, it is important to study and confirm how ammonia could potentially become a safe and green fuel. This means having not only a clearer picture of its technical behavior, but also an idea of the implementation challenges in new vessels, or on existing ones by retrofit.

The second strategy is to leverage low-carbon technologies which are already proven to work onshore but still require some technical adjustments for usage on board.

The third, challenging objective is to bring to the same table the high number of relevant stakeholders. This revolution can only take place when the full value chain is committed.

This includes not only ship owners and builders, but also policy makers who will create a framework of rules and recommendations for the next generation of fuels. Ports also play a crucial role in the game, as they will need to be ready to invest in the facilities and infrastructure necessary for the new fuels.

During the 42 months of research and development, RINA acted as main coordinator of the project, supporting all 24 partners. RINA also oversaw the installation of prototypes, issuing recommendations to the developers in the design phase, and later the green light for their installation.

Furthermore, RINA advised the Port of Genova on a feasibility study for ammonia bunkering infrastructure, and managed the project's relationship with the International Maritime Organization (IMO), discussing policies around green hydrogen and ammonia.

ENGIMMONIA has now been recognized for its exceptional contribution to sustainability and innovation. At the prestigious Waterborne Days event, the project was honored with two distinguished awards: the Environmental Impact and Climate Change Prize, and the Outstanding Innovation Prize.

By continuously advancing these solutions, we strive to set a new standard for environmental responsibility in the sector, and lead the way towards a decarbonized maritime industry.

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Certifying skills for the new green era

By **Antonio Manna**
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As the energy transition transforms industrial processes, infrastructures and technologies, it will also redefine the roles of those who operate, maintain and manage them. Up-skilling and re-skilling will be critical enablers of decarbonization.

At RINA, we are developing a new generation of learning models designed to accelerate workforce readiness, with competence certification at their core.

As part of our global strategy, RINA is establishing a network of seven Open Innovation Hubs in regions with high growth potential - the Middle East, Latin America, the USA, Europe, and Asia. All seven hubs will be fully operational within the next two years. These hubs are designed to be centers of applied innovation and talent development, using training programs that are closely aligned with specific industrial ecosystems.

In Singapore, our first Open Innovation Hub is focused on the green transition of the maritime sector. We are deploying this model to address skills gaps in alternative fuels (such LNG, but also ammonia and methanol), electrification of port systems, and energy efficiency technologies onboard and ashore. These programs are targeted at the backbone of decarbonization efforts: engineers, ships' crew, yard operators, maintenance technicians, and energy system integrators.

Similar needs are emerging across other hard-to-abate sectors. Whether it's mastering carbon capture systems in industrial sites, implementing hydrogen-ready infrastructure, or integrating digital monitoring tools for predictive maintenance, workers must navigate new safety protocols, operational standards, and multidisciplinary workflows.

Our approach is powered by innovation and artificial intelligence. RINA is building a digital learning framework that helps organizations and individuals to measure current skill levels, receive personalized guidance during the learning journey, and track improvements to identify further development opportunities.

This smart model not only makes learning more effective, it also enables companies to align training investments with measurable business impact.

Crucially, we embed third-party certification schemes to formally recognize the competences acquired through training. Certification validates not only what people have learned, but what they are capable of doing in real operational contexts. It supports compliance, workforce mobility, and credibility in front of regulators and stakeholders.

In an era where technologies evolve faster than job titles, certifying competences means preparing the workforce for tomorrow's challenges.

Through our integrated model - linking innovation, digital learning, and certification - RINA is helping companies build the human capital required to drive sustainable growth in the age of decarbonization.

Fruit seed offers new biofuel path

By **Federica Cugnach**
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The global energy transition and the EU's commitment to decarbonization are compelling companies to rethink their business models. Bioenergy is pivotal in this transition. In particular, under the EU Renewable Energy Directive (RED), oil companies can embrace a green model that connects agriculture and energy by producing sustainable biofuels from vegetable oils.

The agro-energy model focuses on converting locally sourced agricultural raw materials - those not competing with food production - and agro-industrial waste into oils and by-products.

This approach enables oil companies to produce significant quantities of vegetable oil for biofuels sustainably, promoting territorial regeneration, job creation, and market access for local communities.

Among the potential feedstocks, rubber tree fruits containing seeds are a notable residue from latex production. The oil extracted from these seeds can be suitable for advanced biofuels, defined by the EU RED as biofuels derived from waste, agricultural residues, or non-food crops, and which do not compete with food or feed crops.

RINA contributed to a study aiming to analyze the production chain of rubber tree seeds, classifying them within the EU RED framework, especially Annex IX, which identifies eligible feedstocks for advanced biofuel production.

Rubber tree cultivation spans over ten million hectares globally, primarily in tropical Asia, and involves mainly smallholders, significantly contributing to rural economies and poverty alleviation.

Currently, less than 1% of seeds are reused for replanting, with the majority left unused on the ground. These seeds represent a partially unused agricultural by-product with low indirect land-use change risks, as their use for biofuel production does not affect food crop land or land use.

From an agronomic perspective, collecting these seeds has a minimal impact on soil nutrients and could reduce greenhouse gas emissions from seed degradation. It may also improve agricultural practices by maintaining optimal plant density, aiding rodent control, and supporting biodiversity.

Under the EU RED III, Member States must achieve 29% renewable transport fuel by 2030, including a sub-target of 5.5% for advanced biofuels. Rubber tree seeds fit within category "p" of Annex IX Part A, classifying them as eligible advanced feedstock. Italian legislation further supports their classification as by-products.

Additionally, the International Sustainability and Carbon Certification (ISCC), endorsed by the European Commission, recognizes rubber tree seeds as residues within the RED III criteria. This classification has been confirmed by national authorities and recognized in at least one EU Member State.

Rubber tree seeds offer a sustainable, legally recognized feedstock for advanced biofuel production, supporting both the energy transition and rural development goals.

Synthetic fuels: a unique solution

By **Natalia Pierozzi**
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There is no silver bullet for the global energy transition. Achieving net zero will require a diverse mix of solutions, each tailored to the unique challenges of different sectors and geographies.

Among these, synthetic fuels are emerging as a key enabler for decarbonizing the so-called hard-to-abate segments of mobility, where direct electrification remains technically or economically out of reach.

Heavy-duty transport, maritime shipping, and aviation all depend on high-energy-density fuels to operate efficiently across long distances. Phasing out conventional fossil fuels in these sectors is essential for meeting global climate goals.

This is where synthetic fuels, or e-fuels, come into play.

Produced through chemical synthesis of low-carbon hydrogen and captured CO_2 (or nitrogen, in the case of ammonia), synthetic fuels offer a major advantage: they are compatible with existing engines, infrastructure and logistics.

These are drop-in solutions, allowing decarbonization without the need to rebuild entire fleets, ports or fuelling networks from scratch.

Synthetic fuels are part of a broader family of low-carbon alternatives, including advanced biofuels. Biofuels are already commercially deployed, yet their scalability is limited by land use, feedstock availability and sustainability concerns. Synthetic fuels, by contrast, are more scalable in principle but rely on abundant renewable electricity and a steady, cost-effective supply of captured CO_2.

At present, synthetic fuels are still in the early stages of market development. Production volumes remain low, and costs are significantly higher than fossil counterparts - typically seven to nine times more.

Still, momentum is growing. In Europe, the ReFuelEU Aviation regulation has set binding targets for Sustainable Aviation Fuels (SAF), including specific sub-quotas for synthetic fuels, starting at 1% in 2030 and ramping up to 35% by 2050.

Several large-scale initiatives are now underway, and by 2030, SAF production capacity in Europe could exceed 4 million tonnes-up from around 640,000 tonnes today-with synthetic fuels accounting for as much as half that volume.

The pace of growth will largely depend on two factors: the rapid deployment of low-carbon hydrogen at a competitive cost and the development of reliable CO_2 value chains.

In this context, RINA is contributing to the advancement of synthetic fuel technologies through applied research, innovation projects and techno-economic assessments.

The company is actively involved in initiatives such as POSEIDON, which explores the use of e-methanol as a sustainable propulsion solution for maritime transport, and CAPTUS, focused on the production of renewable energy carriers from industrial flue gases with low CO_2 content.

Synthetic fuels are not the only solution, but for hard-to-abate mobility they could be the key option that makes net zero possible.

RFNBO: why certification matters

By **Laura Severino**
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RFNBOs are Renewable Fuels of Non-Biological Origin, such as green hydrogen, produced exclusively from renewable energy sources (wind, solar, hydro) and not from biomass. They will play a key role in decarbonizing industrial and transport sectors, especially those that are hard to electrify, like aviation and maritime shipping.

Renewable energy can be taken from a direct connection to a renewable electricity installation, in the same installation of the RFNBO producer (direct connection), or from the grid (grid connection).

RFNBO certification is governed by the Renewable Energy Directive and two EU Delegated Regulations.

The main requirements for the RFNBO certification are:

- Greenhouse gas emissions savings from the use of RFNBO shall be at least 70% from 1 January 2021, quantified according to the methodology defined in the Delegated Regulation on GHG methodology (EU) 2023/1185
- The electricity used for the RFNBO production shall be of renewable origin, demonstrated according to the methodology defined in the Delegated Regulation on renewable electricity (EU) 2023/1184. Different main sub-requirements must be met:
  - Additionality*, which is applicable for both direct connection / grid connection scenarios: the Renewable electricity plant shall not have entered operation earlier than 36 months prior to the RFNBO plant. and has not received support in the form of operating aid or investment with some exceptions. For grid connection the "additionality" is not always applicable (i.e. if the RFNBO plant is located in a bidding zone where the average proportion of renewable electricity exceeded 90 % in the previous calendar year or in a bidding zone where the emission intensity of electricity is lower than 18 gCO2eq/MJ or if electricity taken from the grid is consumed during an imbalance settlement period
  - Power Purchase Agreements (PPA), are applicable for grid connection: the amount of electricity covered by the PPA(s) must be equal to, or greater than, the electricity used in RFNBO production
  - Temporary correlation and geographical correlation, which is applicable for grid connection. Here, there is the need for a temporary and geographical correlation between the electricity production unit with which the producer has a bilateral renewables power purchase agreement and RFNBO production.

The certification process involves several steps:

- First, choose a voluntary scheme recognized by the European Commission, such as ISCC EU owned by ISCC System GmbH (Official recognition in place as of 19th December 2024)
- Second, undergo an audit by an accredited certification body such as RINA, which verifies compliance with technical and regulatory requirements.

Why certification matters:

- Access to the European market: only certified RFNBO count toward RED II/III targets (i.e. 42% of the hydrogen used in Industry sector should come from RFNBOs by 2030, and 60% by 2035)
- Eligibility for incentives and subsidies: in many countries, including Italy and the Netherlands, certification is required to access public funding
- Competitive advantage: certification ensures transparency, traceability, and sustainability - qualities increasingly demanded by the market
- Certified RFNBOs are also eligible fuels under FuelEU Maritime and ReFuelAviation regulations.

* If a RFNBO plant comes into operation before 1 January 2028, the RFNBO plant is exempted until 1 January 2038

	DIRECT CONNECTION TO INSTALLATION GENERATING ELECTICITY (1)	VIA THE GRID			
		(2) Renewable Electricity in the bidding zone>90% of previous year	(3) Emission intensity of the Electricity in the bidding zone < 18 gCO_2e/MJ	(4) Electricity consumed during the imbalance compensation period	(5) Electricity from the grid with additional requirements
Additionality	✓	✗	✗	✗	✓
PPA	✗	✗	✓	✗	✓
Temporal Correlation Monthly until 31/12/29, hourly from 1/1/30	✗	✗	✓	✗	✓
Geographical Correlation	✗	✗	✓	✗	✓

Control of fracture propagation in **CCS pipelines**

By **Luigi Francesco Di Vito**
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Image created with Generative AI

Carbon Capture and Storage (CCS) will be of paramount importance if we are to reach net zero targets. For emissions that are unavoidable, it will be essential to sequester the CO_2 from the process that produces it and safely store it in proper underground reservoirs.

The pipeline that transports the CO_2 from the site of production and sequestration to the geological reservoir is a key element in the success of the system.

The pipeline transportation of CO_2 faces several technological challenges. In addition to corrosion problems, controlling propagating fractures along the pipeline remains the next most pressing issue. An accidentally generated crack on a pipeline can propagate along the line for distances of up to several hundreds of kilometres without any arrest, sustained by the intrinsic energy of the conveyed high-pressure gas.

This issue has been successfully resolved for traditional natural gas transportation. Thanks to a wide set of full-scale experiments, it has been possible to establish design rules to control the phenomenon in new pipelines.

A series of tests carried out over the years at RINA's test station in Perdasdefogu, Sardegna, made a significant contribution to these findings.

Notwithstanding, CO_2 transportation represents a further challenge. CO_2 is in fact transported in dense phase that, during decompression following an accidental leakage, undergoes a phase transition (i.e. dense to gaseous phase).

This corresponds to an additional, important driving force as the expanding gas, during phase transformation, does not reduce in pressure even while expanding its volume.

This impairs the validity of previously established phenomenological rules for natural gas transportation, and demands a new set of tests to be performed to establish and validate the design rules for propagating fracture control in CO_2 transportation.

In this context, RINA is at the forefront of industrial research efforts performing various fracture propagation tests at real scale.

An approximately 300 metre long section of pipeline has been constructed and filled with CO_2 with a composition that mimics the decompression behaviour of the anthropogenic CO_2 with its impurities. The line is then fractured in the centre of its length by a designed explosive charge. The generated longitudinal crack is sufficiently long, to propagate, thanks to the pushing force of the pressurized CO_2 in the pipeline.

The RINA trials test whether the material will be tough enough to resist the huge driving force of the expanding CO_2 in dense phase, and what material properties must be complied with to guarantee an intrinsic fracture arrest capability and thus a safe service.

RINA, with its full-scale testing expertise, is providing crucial answers on this subject to the industry, including to CCS projects, energy companies, pipe manufacturers and other major stakeholders.

Yachting looks to **nuclear power**

By **Giuseppe Zagaria**
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The world of yachting is embracing a new era with a different generation of owners and clients who expect innovation, digital solutions and, above all, care for the environment.

Already we have seen series of new yachts using hybrid propulsion and biofuels, and even yachts fuelled by green methanol and green hydrogen.

Among the potential new technologies, nuclear is also gaining traction mainly due to a new generation of reactors and a general consensus among various institutions that it represents a promising viable long-term solution.

Among the Generation IV nuclear reactors, several will soon reach a milestone of testing safety and performance in non-fissile conditions. This in turn will generate a wealth of information that can be used to build prototypes, leading to the first marine installations and commissioning. Indeed, the existing nuclear technology used for naval ships and icebreakers has a positive track record in terms of safety and operational life.

Generation IV nuclear reactors are intrinsically safe by design, and combined with SMR (Small Modular Reactors) technology are defined as AMR (Advanced Modular Reactors). Safety is assured with passive cooling systems and minimal operator intervention.

Additionally, a hybrid approach combining nuclear power with renewables, battery storage and electrical propulsion will further optimize efficiency and safety.

The development of more compact small reactors, suitable for middle size yachts, is expected to reduce installation costs over the longer term and enable a more efficient internal space design.

Regulations and costs management are two elements that still need to be addressed. The IMO Maritime Safety Committee during its 110th session agreed to consider a proposed revision of the IMO's Code of Safety for Nuclear Merchant Ships, with further cooperation with the International Atomic Energy Agency (IAEA) and other IMO bodies. Meanwhile, RINA already in 2023 published the Guide for Nuclear Installation on Board of Marine Units.

Nuclear energy and propulsion have many potential benefits to bring to the yachting industry, while emitting zero carbon.

First, it offers an extension of the yacht operational range, thanks to the extremely high energy density of nuclear fuel. This means yachts could cruise non-stop across oceans or even undertake transcontinental voyages, opening up a new world of possibilities for exploration even in remote regions.

Onboard comfort would also be enhanced by the minimization of noise and vibration, as nuclear reactors operate more quietly than diesel engines.

Ongoing tests are steadily bringing this powerful energy source closer to the commercial yacht world, in what promises to be a genuine alternative to traditional fuels.

Costing out climate resilience

By **Clemente Fuggini**
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Resilience to natural and climatic hazards has become essential, and must now be included in our vision for a sustainable and liveable future.

Some 80% of cities around the world have reported significant natural and climatic hazards since 2022, while extreme weather events in Italy have nearly quadrupled over the past decade. Whilst the financial resources available for climate adaptation vary according to political willingness, it is estimated that only 3% of extra investment worldwide would be needed to create global climate resilience.

To enable evidence-based decisions, and to provide viable and sustainable solutions to build climate resilience in the built environment, the MULTICLIMACT project (https://multiclimact.eu/) was launched in October 2023. The project aims to safeguard Europe's built environment against the rising threats of natural and climatic hazards.

MULTICLIMACT supports citizens and local authorities in understanding, improving awareness and measuring the resilience of the built environment, its assets and services delivered.

In doing so, MULTICLIMACT aims to proactively and efficiently tackle some of the increasing natural and climatic risks. These include urban and river floods, landslides, urban heat waves and heat islands.

The project has tested in 4 sites across Europe (Italy, Latvia, Spain and the Netherlands), focusing on different assets and urban areas that are subject to diverse climatic conditions and natural hazards.

Among other things, MULTICLIMACT deploys the Climate Resilience Maturity Assessment (CREMA) tool, developed by RINA. This is a practical, scalable framework for informed, resilience-based planning, measuring the resilience maturity of assets in the urban environment, as well as their vulnerabilities.

Subsequently, the system prioritizes interventions using scientific and economic insights, quantifying the damage impact in monetary terms, and supporting a Cost-Benefit Analysis for resilience planning.

This provides decision-makers with cost-benefit ratios for the different resilience interventions.

CREMA represents a significant advancement in the field of climate adaptation and resilience planning, enabling data-driven decisions which can protect communities and assets. Building resilience in the face of climate change is not just a necessity, it is our duty. Through initiatives like MULTICLIMACT, we are maintaining our built environment and cities, and shaping a sustainable future for the next generations.


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