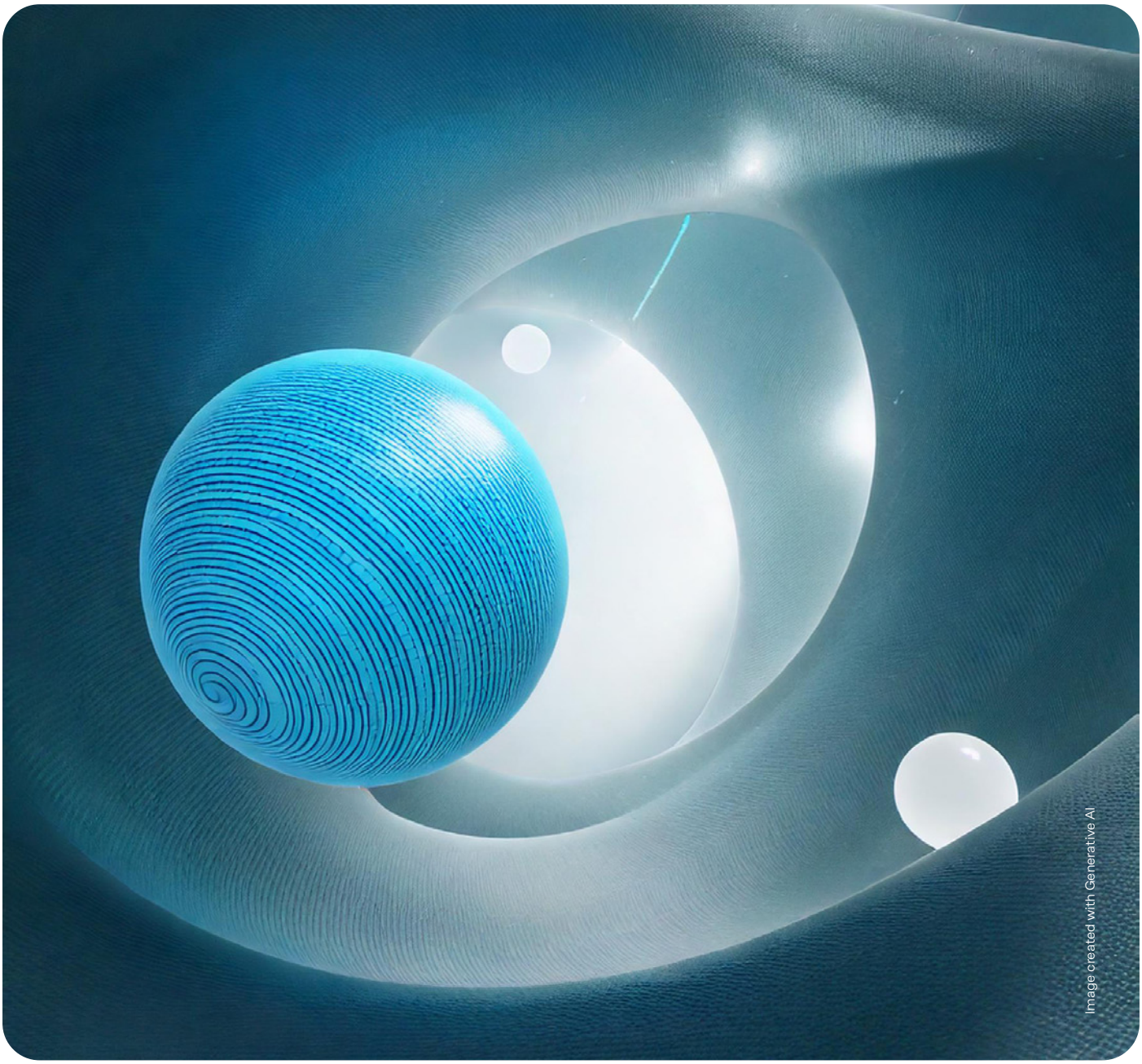
DECEMBER 2024

goZERO

RINA'S MAGAZINE ON THE ENERGY TRANSITION



RINA

Our experience. Your growth.

ContENTS

EDITORIALS

THE CONVERSATION

INTERVIEWS

FEATURES

goZERO, 2024, III Edition
Registration at the Tribunale di Genova N.9/2022 del 29/12/2022
Published in Genoa, December 2024
Printed at Sistemi Service S.r.l., - Via Borzoli, 135-137, 16161 Genova
Edited by Rina S.p.A. - Via Corsica, 12 Genova
A property of Rina S.p.A. – Managing Editor/Direttore Responsabile: Dino Ettore Cervetto
RINA editorial staff: Andrea Bombardi, Beatrice Cappa, Marco Compagnino, Federica Cugnach, Enrico Di Martino, Giulia Faravelli, Pasquale Fattore, Giorgio Gallo, Paolo Gallorini, Paolo Ghiggini, Antonio Lucci, Carlo Luzzatto, Alessio Pinzone, Stefano Sadowski, Laura Severino, Andrea Sola, Simone Ursino, Egidio Zanin.
RINA graphic staff: Chiara Bardelli, Elena Forte, Debora Pellegrino

The global race **is on**

Mitigating the cost of **green energy**

The global race to lead in the energy transition has seen significant investments in technology and infrastructure, particularly by the United States of America, the European Union and China.

The US, through its Inflation Reduction Act (IRA), is directing $369 billion into clean energy, focusing on expanding the domestic manufacture of critical technologies such as electric vehicles and renewable energy components. The legislation is designed not only to cut emissions, but also to reposition the US as a global leader in green technology production. President-elect Trump has also argued the US needs to increase energy production to be competitive in areas such as AI, which requires significant power to fuel its systems. However, some of these measures may go against existing measures in the energy transition.

It has also been announced that new natural gas pipelines will be encouraged, and US production of fossil fuels increased by making it easier to drill on federal land. Also, that US will be pulled out of the Paris climate agreement while supporting increased nuclear energy production. Given these facts, it is essential to strike a balance and reach a well-aligned solution.

The IRA act in the US parallels the European Union's Fit for 55 initiative, part of its broader Green Deal, which seeks to achieve climate neutrality by 2050, with key investments in offshore wind, hydrogen and grid modernization. It is necessary for Europe to continue grounding these investments to strengthen its global position, alongside the regulatory efforts it is pursuing.

Meanwhile, China, already the world's largest producer of solar panels, is leveraging its dominance in clean energy technology supply chains to further entrench its global leadership. In 2022, it produced 80% of the world's solar panels and dominated the global battery market. It also accounted for 60% of the new renewable capacity added worldwide in 2023, and its total photovoltaic generation is on course to exceed the total electricity demand of the US today by the early 2030s.

Resource-rich nations like Australia and Canada are also strategically benefiting from their vast mineral reserves. Australia, which accounts for more than half of the world's lithium production, is emerging as a critical player, capitalizing on the rising global demand for essential materials.

Finally, Africa has a significant role to play in the energy transition. The continent's success will depend on how governments use legal frameworks to support investment.

Before then, nations will be closely observing developments at the latest Conference of the Parties on Climate Change (COP). On this occasion, however, it was evident that a common approach was missing. As with COP28 in Dubai, COP29 in Baku opened with a dramatic twist. In an unexpected move, the Azerbaijani presidency immediately approved the creation of a carbon credit trading market, to be managed directly by a United Nations supervisory body. In principle, states will be able to exchange credits associated with reduced or unused emission quotas, helping each other to achieve the mitigation objectives of individual national commitments, known as NDCs (Nationally Determined Contributions).

Regardless of the participants, it's clear that the race towards a new global energy system remains wide open. The key takeaway is that this system must be collaboratively built and designed to endure. This means prioritising security, resilience and flexibility, and ensuring that the benefits of the new energy economy are shared between all citizens.

Carlo Luzzatto
CEO & General Manager, RINA

The global contest to provide the critical minerals needed for the energy transition is underway. However, as the price of raw materials and renewable technologies has soared, 'greenflation' and the rising cost associated with the energy transition has sparked concern.

Demand for raw minerals is set to outstrip supply, one element putting pressure on prices. The International Energy Agency (IEA) forecasts lithium for batteries consumption will increase 51x by 2040 versus today, while the growth figures for cobalt, nickel and copper are respectively 21x, 9.7x and 6.2x.

However, advances in technology and regulatory mechanisms are starting to mitigate inflationary pressures. Over the past decade, the cost of solar and wind energy has decreased by 85% and 55% respectively, due to improvements in manufacturing efficiencies and economies of scale.

While cutting-edge technologies are pricey, some more established forms of renewable energy are now cheaper than fossil fuels. The IEA confirmed that utility-scale photovoltaic solar is the 'least costly option for new electricity generation in a significant majority of countries worldwide'. According to a 2024 report from financial advisory firm Lazard, which uses US-focused data, the levelized cost of utility-scale solar ranges from $29 to $92 per MWh, versus $45 to $108 for gas. Onshore wind is even cheaper at $27 to $73 per MWh, although offshore wind is pricier.

Moreover, emerging technologies such as carbon capture and storage (CCS) and small modular reactors (SMRs) for nuclear energy offer the potential for cost-effective decarbonization. For example, the IEA projects that with sufficient policy support, SMRs could provide a scalable and affordable low-carbon energy source by the 2030s.

To find a balance with this fragility in today's energy markets is fundamental energy security, and the ways that more efficient, cleaner energy systems can reduce energy security risks.

The increasingly visible impacts of climate change, the momentum behind clean energy transitions, and the characteristics of clean energy technologies are all changing what it means to have secure energy systems. A comprehensive approach to energy security therefore needs to extend beyond traditional fuels to cover the secure transformation of the electricity sector and the resilience of clean energy supply chains.

Energy security and climate action are inextricably linked: extreme weather events, intensified by decades of high emissions, are already posing profound energy security risks.

In this goZERO edition, you'll find numerous insights on how to achieve balance not only in mitigating costs and security risks, but also in addressing the innovations and solutions required for a sustainable and equitable energy transition.

Andrea Bombardi
Global Market Development Executive Vice President, RINA

Conversation with **Gilberto Pichetto Fratin** Italy's Minister of Environment and Energy Security

Italy's Integrated National Plan for Energy and Climate (PNIEC) sets ambitious goals. Gilberto Pichetto Fratin talks to GoZERO about the government's strategic guidelines and how they are being implemented.

In the delicate global context of sustainability and energy supply, what are the main priorities of your Ministry?
We must leverage every available technology, carefully balancing costs and economic opportunities. A priority for the Ministry is to create a favorable regulatory framework for renewable energy development through simplification and reduction of bureaucracy. We are committed to achieving 8 GW of renewable energy annually.

The Russian-Ukrainian war and the conflict in the Middle East have further underscored the need to strengthen the diversification of energy supplies for European countries, especially for nations like Italy with limited domestic resources. We have increased regasification capacity and strongly believe in the potential of hydrogen.

Italy can play a pivotal role in the EU's hydrogen strategy, both in production and as a transit and export hub. Our country is focused on the South H2 Corridor, a transportation infrastructure connecting North Africa to Germany via Italy. Finally, we are also very interested in carbon capture and storage technologies.

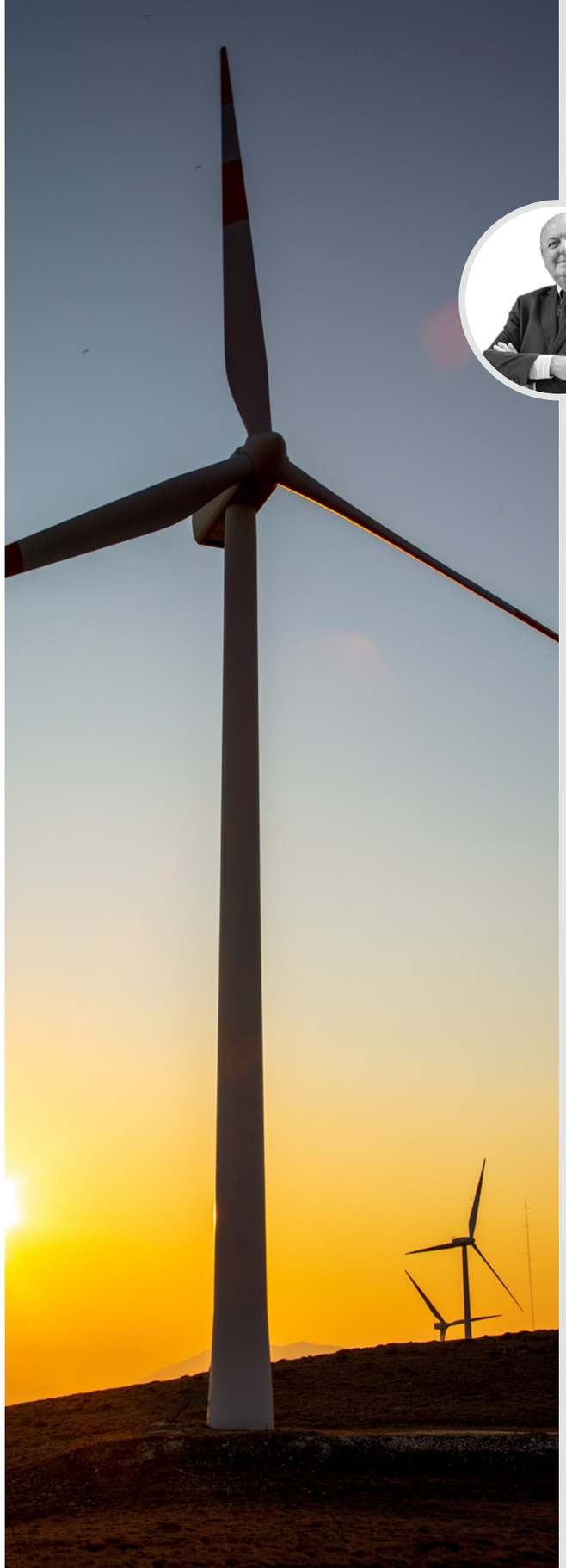
What role will nuclear power play in the transition?
At the Ministry for the Environment and Energy Security, we have established the National Platform for Sustainable Nuclear Energy.

We have encouraged the participation of key public research bodies, representatives from universities, scientific associations, public entities working in nuclear safety and decommissioning, as well as companies already investing in the nuclear sector, including the production of components and plants. The next step is to define the legal framework for new nuclear energy while advancing research and experimentation. I believe one of the most significant challenges is to continue engaging in dialogue about the energy transition, exploring all solutions without ideological constraints.

In line with this, the PNIEC sets goals of 131 GW of renewable energy by 2030 and 8 GW of nuclear energy by 2050. I see nuclear energy as a complement to a system increasingly dominated by renewables.

Nuclear energy is essential to ensure the power supply for our industrial system and to help keep final consumer prices in check.

What role can Italian companies play?
Italian companies have already demonstrated their ability to develop top-level technologies and expertise in this sector. We are now at a critical juncture where sustainability must become a driving factor for industrialization. The government's actions, aimed at ensuring the country's economic recovery and supporting those sectors that are struggling the most, will work synergistically toward enhancing the effectiveness of the National Recovery and Resilience Plan (PNRR) and achieving the National Plan for Energy and the Climate goals.



BIO.

Gilberto Pichetto Fratin is the Minister of Environment and Energy Security in the government led by Giorgia Meloni. He was elected to the Chamber of Deputies in the current legislature.

Born in Veglio, a municipality in the Biella province (Piedmont), in 1954, he is a Certified Public Accountant and Statutory Auditor.

During his political and administrative career, he initially held various positions in municipal and regional administrations, starting his parliamentary career as a senator in the 16th legislature (2008-2013).

Subsequently, he served as Vice President of the Piedmont Region with responsibilities for budget and finance.

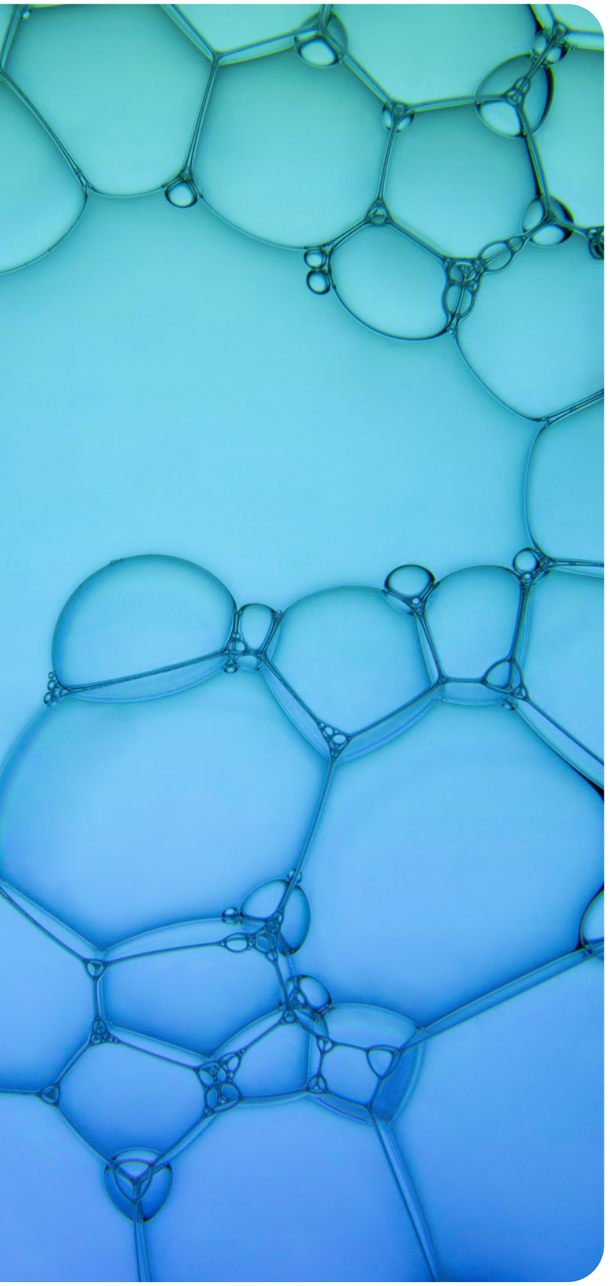
Elected to the Regional Council in 2014 after running as a Presidential candidate, Pichetto continued his work in the region until 2018. He was later elected again to the Senate in the Biella-Vercelli single-member constituency.

Under the government headed by Mario Draghi, he was appointed first as Undersecretary and then as Deputy Minister at the Ministry of Economic Development, with responsibilities related to the automotive sector, trade, and industrial policies.

Today, as Minister of Environment and Energy Security, he is focused on promoting a new model of sustainable economic growth, aligned with the EU decarbonization goals and the increasingly complex climate context.

Among his key commitments is ensuring Italy's energy supply, a challenge made even more pressing following Russia's aggression against Ukraine.

A new industrial **revolution**



The energy transition represents a new industrial revolution, and it will have a very significant social impact in addition to the economic and technological aspects.

Ensuring an efficient ecological transition is a challenge that will require great efforts to develop innovative, but also socially sustainable, technologies. As the technical body of reference for Italy's national gas industry, Comitato Italiano Gas (CIG, or the Italian Gas Committee), is committed to this challenge.

It is becoming increasingly evident there is a real need for a massive pre-normative activity which combines different skills and knowledge. Working together, we will be able to identify the necessary technological solutions needed for change.

The Italian Gas Committee, which is associated with Italy's national standards body UNI, actively participates in the most important associations and bodies in the sector both at European and global level.

In particular, at European level, CIG participates as a representative for Italy in the work of CEN/CT 234, which deals with all gas infrastructures.

The CIG is also a Charter Member for Italy in Marcogaz, the European technical association of the gas industry. Meanwhile, at a global level, CIG collaborates through CEN in ISO activities and is a Charter Member for Italy in the International Gas Union (IGU), which represents the global gas industry with more than 150 members in over 80 countries, covering over 90% of the global gas market.

The working organisation of IGU covers the complete gas value chain, from the supply of natural and decarbonised gas, renewable gas and hydrogen, through their transmission and distribution, and all the way to the point of use.

Globally, natural gas is set to grow until at least 2029 and in the long term, according to Wood MacKenzie, 25% of energy in 2050 will come from natural gas, boosted by significative growth in the emerging Asian economies.

The use of new energy sources will be complemented by a strong commitment to decreasing the impact of traditional fuels, reducing fugitive emissions and increasing process efficiencies. In this context, CIG and RINA have already had the opportunity to collaborate profitably on several important projects and issues related to the use of new green gases and the optimization of the national gas system.

We believe that this will be an excellent test also for future collaborations in the sector of the implementation of green gases in Italy's national system, and in general for the imminent challenges that the sector will have to face.

Among these is, of course, the EU Regulation on methane emissions reduction in the energy sector. There are also a number of specific factors that could greatly assist on the road to decarbonization.

First, it will be very important to have a clear strategy and road map to reach these decarbonisation objectives.

BIO.

Interview with **Dina Lanzi**
President of Comitato Italiano Gas

Dina Lanzi is the FSRU Commercial Interfaces Director for Italy's Snam group, and also the president of Comitato Italiano Gas (CIG), which is responsible for developing standards for Italy's combustible gas industry. In her role at Snam, she is responsible for the commercial activities of FSRUs and onshore plants.

With 25 years of experience in gas transmission, Dina developed her competencies in many sectors of the gas value chain, both technical and institutional. After a Master's Degree in Chemical Engineering at Politecnico di Milano, she began her career in an LNG plant. This was followed by both technical and institutional roles in pipeline maintenance management, metering and gas technical standards, where she also developed relationships with regulatory bodies.

In her previous roles, Dina was particularly responsible for decarbonization technical developments, with a special focus on hydrogen.

She is also a member of the board of Snam Rete Gas, and President of Teraga Holding.

Stable rules will also open the way for private capital, reducing risk for investors. Europe should have an agnostic approach to technology, and should also take into consideration geographical and social/economic differences among the countries.

Meanwhile, industrial partnerships could contribute real added value, bringing together experiences, competences and resources to both boost and accelerate development while mitigating risk. Finally, safety remains paramount at all times.

The gas and hydrocarbons market already has a high level of safety due to its relatively long existence, and adequate regulatory standards are already in place.

For synthetic methane or biomethane, these are practically interchangeable with natural gas, so there are no significant issues for hydrocarbons there.

However, for hydrogen, although is a well-known gas which is already widely used in industrial applications, we will need to guarantee standardization, technical procedures on O&M, and workforce training, to assure the same levels of safety.

Scan the QR code to learn more about **CIG (Comitato Italiano Gas)**

Cruise sector moves towards **net zero**

The cruise sector has a clear ambition to pursue net zero emissions by 2050, which is consistent with the IMO strategy on reduction of GHG emissions from ships.

Liquified natural gas (LNG) remains a strong option for the cruise industry - with investment already started 15 years ago in anticipation of more stringent IMO emissions limits on NOx and SOx. Aside from the immediate benefits offered by LNG technology, ships designed with LNG engines and fuel supply systems will be able to switch to alternative fuels such as bio or synthetic LNG in the future, without the need for modifications.

Today, more than half of our ships on the orderbook have LNG engines as the main propulsion - which makes the use of bio-methane and e-methane one of the key energy solutions for the coming years. We take seriously the concerns relating to methane slip and welcome the significant progress made in recent years to address this issue. Innovations by engine manufacturers have resulted in a four-fold reduction in the last twenty years.

Work is underway to reduce further, and methane slip is on a path to be solved within the decade. Interestingly, methanol has also recently emerged as another option for the medium term with the launch already this year of methanol ready vessels which will be capable of using this fuel. Meanwhile, in the short term, for the majority of ships in CLIA's member fleet, LNG and drop-in biofuels will remain the only option to meet the industry's decarbonization objectives. Alternative energy sources also remain significantly more expensive than traditional fuels. This presents a challenge in terms of how to finance the necessary energy transition. As a solution-oriented industry, cruise lines continue to invest substantially in new ships, engines, and energy technologies that will allow the use of sustainable energy sources. These sources include internationally certified sustainable biofuels and synthetic e-fuels such as e-methane and e-methanol. Other sources being explored as part of hybrid solutions include electric batteries, bio-LNG, e-LNG, methanol and hydrogen fuel cells.

Sustainability also poses commercial challenges. To remain competitive and attract sustainability-conscious customers, cruise lines must address these aspects effectively. Cruise lines are investing millions to install shore power capabilities for their ships. This technology, introduced for the cruise industry more than 20 years ago, can reduce emissions by as much as 98%, allowing ships to switch off engines while at berth, and to plug into an onshore power source to maintain onboard services. This year, we have seen a significant increase in the number of ships now equipped to be able to connect to onshore power.

CLIA and RINA collaborate on Global Investment Plan Study for the cruise sector

For sustainable measures to truly work, fuel availability remains a key issue. As with other forms of travel, the cruise industry faces the challenge that, today, sustainable alternative fuels are not available at the scale necessary to achieve its decarbonisation ambitions. This study, commissioned to RINA, will help our industry to substantiate more precisely the volume of alternative fuels needed, and where they will need to be available according to practical cruise decarbonisation scenarios. In this way, the study will support our industry discussions with ports authorities and governments to prioritise investment in the right solutions.

Already there are many collaborations taking place among stakeholders across the sector, and there are multiple pilot projects currently active. These include 24 ship trials with biofuels and 2 ship trials with synthetic fuels. The RINA study will boost collaboration efforts by providing more precise data on the investment needs to decarbonise the cruise sector. The findings will help governments to make the right policy and investment choices in infrastructure at ports in their countries, guided by a measured assessment of the GHG emissions reductions corresponding to these investments. There are many public misconceptions on the measures that the maritime industry adopts to reduce its environmental footprint.

RINA plays a key role in explaining to regulators and the wider community, in an objective and neutral way, what are the options and solutions to be considered and their benefits to meet GHG reduction objectives.

Today, more than 60% of the cruise fleet by capacity has the technology required to plug in at the small percentage of ports that currently have the infrastructure. That is an increase of nearly 20% over the past year.

By 2028, 238 cruise ships will have this ability, double the number of ships that were able to do so last year. Currently, only around 35 ports worldwide have at least one cruise berth equipped with onshore power, representing less than 3% of cruise ports globally. As part of the EU's Fit for 55 programme, by 2030, major ports in Europe will be required to have shoreside power, which will further accelerate investment in the necessary port infrastructure in that region, and we see ports in Europe making progress now to meet this timeline.

The cruise industry will continue to work with port partners as they evolve their shoreside sustainability offerings, given the pivotal role that onshore power can play in improving local air quality. Each year, CLIA produces a global cruise industry environmental technologies and practices report, which provides an inventory of the uptake of important technologies.

The latest report, published in September 2024, shows continued progress toward sustainability objectives across the cruise fleet. Cruise lines report progress in their sustainability reports, aligned with international reporting standards. Further, with the rest of the maritime sector, cruise lines publicly report their CO_2 emissions every year as part of EU obligations.

According to this publicly available EU MRV data, ships operating in Europe are showing encouraging reductions in absolute CO_2 emissions compared to five years ago, despite an increase in fuel use and an increase in the number of cruise ships sailing in the region. We are succeeding in decoupling our growth from our emissions, which is something to be celebrated.

BIO.

Interview with **Julie Green**
Deputy Director General, Europe, CLIA

Julie Green is Deputy Director General for CLIA in Europe. Julie joined CLIA in Europe in January 2020 as Vice President of Strategic Communications.

Previously, Julie worked in a series of international roles in corporate PR and public policy, including heading up global communications for the infrastructure business at engineering firm Bechtel.

During her time at Bechtel, she ran strategic communications and thought leadership programmes across multiple markets, including central and eastern Europe, and the Middle East.

Julie has also served in the European Commission Directorate-General for Communication.

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

Greece's infrastructure: **ready and prepared**

DESFA, established in 2007, owns, operates and develops the Greek national natural gas system, which is comprised of the country's natural gas transmission system, the LNG Terminal in Revithoussa, and a 20% participation in the newly established FRSU of Alexandroupolis. Paving the way for a more sustainable future, we have embraced the energy transition as the main pillar of our long-term strategy, aiming to halve GHG emissions by 2030 and achieve carbon neutrality by 2040.

In the short term, and in parallel with the efforts for the development of new decarbonized gases and carbon capture technologies, we are enabling the energy transition in two main ways. First, we are facilitating the transmission of natural gas to regions in Europe, through strengthening interconnections in the wider area, where it can serve as a replacement for lignite. This is especially important in the Balkans, where lignite remains a major energy source. At the same time, we are also exploring plans for the introduction of renewables gases, which will complement and gradually replace natural gas, thus leading to a substantial reduction of carbon emissions.
The second way is our contribution to the integration of renewables into the energy system. Greece has made significant progress with the penetration of wind and solar power, and some hydrogen, which together can account for up to 60% of total energy production. However, this achievement would not be possible without a robust natural gas system, which plays a crucial role in balancing the intermittent availability of wind and solar energy. This often-underappreciated role of the natural gas infrastructure highlights its essential role as a key partner in the adoption of renewable energy sources. In the longer term, we have several specific transition projects, evolving every day, working towards the faster integration of renewable gases, with a focus on hydrogen and biomethane, as well as promoting cutting edge energy solutions and technologies, such as carbon capture and storage (see right). We are developing fully hydrogen ready infrastructures, including the first hydrogen ready pipeline in Greece, spanning through Central and West Macedonia.

As part of this, we are collaborating with our counterparts from other countries in the promotion of a Southeast Europe Hydrogen Corridor (SEEHyC). Greece has a good potential for green hydrogen production, as it is expected to have renewable energy potential well in excess toward the domestic electricity demand. Such renewable energy can be efficiently transformed into hydrogen, which can be stored, used in industry and in dispatchable power and exported to countries where higher demand is planned, such as Germany. Going forward, sometime from 2030 onwards, we expect to progressively develop a comprehensive parallel transmission system for hydrogen. We are also engaged in developing a ground-breaking new carbon capture sequestration infrastructure system in Greece, known as the APOLLOCO$_2$ project (see right).

This project plans to develop a grid that connects the CO_2 generated by Greece's large-scale emitters, such as the cement and refinery industries, through a pipeline network to a central onshore and offshore liquefaction and export terminal. Once the liquefaction terminal is developed, the liquified CO_2 will be loaded on ships for transport to regions of Greece, using the country's depleted oil fields as storage sites, and in the future, to Italy and other Southeast European countries. In this respect, we are also strengthening our relationship with Egypt, which has a large potential to convert its own depleted oil fields for the storage of carbon capture. In short, we are well-equipped to support the energy transition with infrastructure that can safely transport energy molecules. Our extensive experience has provided us with a comprehensive understanding of energy networks, coupled with deep technical and business expertise. We are committed to leveraging this knowledge to effectively manage and operate Greece's future hydrogen network. RINA has been a longstanding and trusted partner for every TSO, and a key partner for DESFA too. We highly value their engineering expertise in energy infrastructure development, as well as their ongoing investment in knowledge, which keeps them ahead of industry trends and empowers them to deliver innovative solutions. In short, RINA has the proven capability to transform ideas into reality.

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

Interview with **Maria Rita Galli**
CEO at DESFA

BIO.

Maria Rita Galli is the Chief Executive Officer (CEO) of DESFA, the Hellenic Gas Transmission System Operator, overseeing the operation, development, and strategic direction of the company. She is an accomplished executive with over 25 years of leadership experience in the global energy sector. Prior to her role at DESFA, Maria Rita was the Vice President of Business Development & Portfolio Management at Snam, a global leader in energy infrastructure, where she led international expansion initiatives and chaired the SENFLUGA Energy Holdings consortium, which controlled 66% of DESFA's share capital.
Her career began at Eni in 1997, where she held various roles, including Head of International Business Development and Board Member, contributing to the company's strategic investments, mergers, and acquisitions in global energy markets. Throughout her career, she has demonstrated expertise in business development, portfolio management, mergers and acquisitions, and corporate governance, with a strong focus on driving growth and innovation in the energy industry.
Maria Rita holds a Master's Degree in Nuclear Engineering from the Polytechnic University of Milan. In 2022, she received the "Cavaliere dell' Ordine della Stella d'Italia", granted by the President of the Italian Republic Sergio Mattarella, a prestigious civil honor to personalities, who have distinguished themselves in promoting relations of friendship and collaboration between Italy and other countries, particularly in the social sphere.

DESFA Projects

APOLLOCO$_2$ | The main scope of APOLLOCO$_2$ is the creation of an open access Carbon Capture and Storage (CCS) hub. The project aims to become the first large-scale midstream CCS infrastructure in South-Eastern Europe, aggregating CO_2 from local emitters in Greece, through a pipeline network to a central onshore and offshore liquefaction and export terminal based at Revithoussa island, near Athens. The liquefied CO_2 will be transported by ship to Prinos or Ravenna, or other permanent storage facilities in the wider EU neighborhood. Capacity will initially be developed for 5 MTPA capacity, with the ability to be further expanded to 10 MTPA, and will involve 260 km of onshore and 15 km of offshore pipeline.

H$_2$DRIA | A new 570 km hydrogen pipeline to be constructed in parallel with the existing high-pressure gas pipeline, which will connect hydrogen production units located in the Greek mainland with Athens, Corinth and Thessaloniki, and subject to the relevant developments, with neighboring countries, namely Bulgaria and possibly North Macedonia in the future. This €1 bn CAPEX project will have a total capacity of compressor stations of 60 MW, and maximum capacity of 80 GWh/d. The project has been selected in the 1st Projects of Common/Mutual Interest List of the European Commission.

Green hydrogen as a **solution**

The outlook for the energy sector regarding decarbonization and the adoption of new energy sources is both exciting and challenging. The expansion of the sustainable energy system is a high priority given the urgent need for renewable energy supply and investments in new infrastructure makes.

In the long term, the energy sector will be dominated by renewable electricity, complemented by hydrogen and bio-based fuels for industrial processes and applications where electrification cannot replace fossil-based fuels. In the short term, the energy sector will continue to rely on a mix of renewables and traditional energy sources as a bridge to a sustainable future. The current transition phase is crucial for building the necessary infrastructure for renewables.

There will be a significant push for investments in renewable energy projects, such as solar, wind, and renewable hydrogen, to accelerate this transition.

However, there is a risk that short-term solutions may stimulate investments that create unwanted lock-in effects around fossil-based fuel sources, negatively impacting the climate and environment.

Governments, therefore, play a key role in setting clear policies and deadlines for the implementation of temporary solutions. Policymakers need to ensure that these temporary solutions are phased out over time, with a reliable but finite period for earning an adequate return on investments.

Additionally, regulators should closely collaborate with the scientific community to deeply understand any negative side effects of temporary solutions.

A recent study published by the Environmental Defense Fund (EDF) reported the high climate risks associated with producing hydrogen from natural gas with carbon capture (CCS).

This important example shows that careful consideration and a strict regulatory framework will be necessary when evaluating temporary solutions as a bridge to a sustainable system. Environmental groups in South Korea are already going to court over these low-carbon hydrogen solutions, which exhibit significant negative carbon emission side effects.

In short, intermediate solutions need more study and public scrutiny. At the same time, we can already see that the cost of renewable hydrogen is becoming competitive with low-carbon alternatives.

Therefore, accelerating investments in renewable energy infrastructure at the gigawatt scale is key for the rapid implementation of sustainable climate solutions. In terms of the most 'crucial' sectors in the energy transition, this depends on how you define crucial.

If we consider global CO_2 contributions, we need to address emissions from the steel sector, heavy-duty transport like shipping and aviation, and the built environment. In terms of solutions, the renewable energy sector must expand significantly by constructing large-scale wind and solar farms while reducing technology costs through scaling up, research, and innovation.

The financial sector will also play a crucial role. It's important to incentivize this sector to invest in renewable energy and technologies like hydrogen on a large scale.

While hydrogen projects at the megawatt (MW) scale can secure financing, they are often too small to be bankable without subsidies. Therefore, we need multi-gigawatt (GW) projects to compete with fossil fuels.

Developing incentive schemes for the financial sector to support GW projects is essential to accelerate their development. This should be complemented by regulations that allow for fast-track permitting.

There are other challenges. For instance, we have yet to find technological solutions for the transportation of hydrogen and the safety of using ammonia, which are needed in order to ensure the safe and efficient transport of clean energy vectors.

First and foremost, it is important to select a well-understood and regulated carrier, such as ammonia. Currently, 200 million tons of ammonia are produced annually worldwide, providing deep knowledge for its safe and responsible use.

BIO.

Interview with **Bart Biebuyck**
CEO of the Green Energy Park

Bart Biebuyck is CEO and founding member of the Green Energy Park (GEP). GEP's objective is to design, build, and operate hydrogen production infrastructure with ammonia and methanol as the long-distance renewable energy carriers of choice.

Bart graduated in Automotive Engineering Technology from the Netherland's HAN University of Applied Sciences, and subsequently joined Toyota Motor Europe in Brussels, eventually becoming Technical Senior Manager in the company's Fuel Cell department.

In 2016, Bart was appointed Executive director of the Fuel Cells and Hydrogen Joint Undertaking (now called the Clean Hydrogen Partnership), a public-private partnership between the European Commission, industry and the research community.

During his seven-year term, the Partnership oversaw the European Hydrogen Valleys Partnership involving around 40 European regions, and the introduction of the European Hydrogen Bank. Bart also successfully negotiated the €2.0 billion European "Clean Hydrogen Partnership" which was launched by the President of the European Commission in November 2021.

This is why Green Energy Park has teamed-up with a specialist in building ammonia terminals and world-scale storage tanks. Collaborating with companies and experts like RINA is also important for overcoming any technology gaps.

Working and learning together is the best way forward in the emerging hydrogen economy. Extensive knowledge of regulatory and legal frameworks for various climate solutions is crucial for customers, and RINA has an excellent track record of partnering with companies, supporting the energy transition around the world.

RINA's growing presence in South America is important for our future growth, as this continent will play a crucial role in the energy transition. It represents an enormous business opportunity which cannot be missed.

Green Energy Park welcomes RINA's expanding footprint in South America: as we build one of the world's largest hydrogen production plants in Brazil, we will need the specialized know-how and expertise that RINA can provide.

Scan the QR code to learn more about **Green Energy Park**

Driving the **transition**

At European Energy, our focus is on driving the transition to a fully renewable energy system. We are working across a broad portfolio of projects including large-scale solar farms, onshore and offshore wind, and Power-to-X facilities for hydrogen and e-methanol production.

Offshore wind, the company's first activity, which dates back to 2004 with our projects in Germany, remains a core technology. We are expanding our footprint in this sector by investing in new projects, particularly in northern Europe.

We have developed extensive partnerships with industry leaders in this area, and we are looking forward to expanding our presence in this area.

Meanwhile, one of our landmark projects is developing industrial-scale e-fuel facilities, where we will use renewable electricity to produce sustainable fuels. We are also committed to developing new energy storage solutions that can mitigate support grid stability as well as produce electricity when it is needed by the consumers.

In the short term, we are seeing a rapid acceleration in renewable energy adoption, driven by both policy and market demand. We see that (falling) costs for deploying wind and solar energy are leading this acceleration. However, challenges such as built out of the grid and grid balancing still require solutions. We have therefore started to focus on battery solutions to address this.

Hydrogen has a crucial role to play in decarbonizing sectors where direct electrification is not feasible, such as heavy industry, shipping, and aviation. At European Energy, we are investing heavily in green hydrogen production through electrolysis powered by our renewable energy assets. We see hydrogen derivatives, such as e-methanol, as key to creating sustainable fuels for hard-to-decarbonize sectors.

The next decade will be pivotal as hydrogen production scales and becomes more cost-competitive, positioning it as a critical energy carrier in the global economy.

However, to maintain competitiveness, the production of energy carriers like hydrogen must benefit from continued innovation and scale. In our company, we are constantly working on improving the efficiency of renewable energy production and driving down costs through economies of scale. Carbon pricing mechanisms, corporate demand for green energy as well as governmental regulation will all be essential in creating a market that allows renewable-based carriers to compete effectively with traditional fossil fuels.

As the market grows, we expect to see significant cost reductions in green hydrogen and other renewable carriers, making them even more competitive.

In the long term, we believe the energy sector will undergo a complete transformation. Decarbonization will be achieved not only through renewables but also by integrating new technologies like green hydrogen and carbon capture and utilization. The shift will also require innovative partnerships across industries and a massive scaling of renewable energy capacity to meet growing global demand. Europe is uniquely positioned to lead the global energy transition.

The European Union has made decarbonization a cornerstone of its policies through the European Green Deal, which sets ambitious targets for 2030 and net-zero by 2050.

Europe is at the forefront of adapting new renewable technologies as well as being the leader in many of the innovations in transitioning the energy production. Additionally, Europe's integrated energy market provides a strategic advantage in scaling renewable energy

BIO.

Interview with **Knud Erik Andersen**
CEO and co-founder of European Energy

Knud Erik Andersen is the co-founder of European Energy, a leading Danish renewables firm that builds wind and solar farms across the world. He started his entrepreneurial career while still at university, constructing and assembling a wind turbine in the early 80s.

Later he founded a company focused on software development for controlling wind turbines.

This company later expanded to make control software for not only wind turbines but also other electronic appliances and machinery.

After selling the company, he then proceeded to move into renewable energy development himself, founding European Energy in 2004 together with Michael D. Pedersen.

infrastructure, such as electric grids and hydrogen pipelines.

Our collaboration with RINA is invaluable, particularly in ensuring that our projects meet the highest technical and regulatory standards. RINA's expertise in certification, project validation, and technical consultancy is critical to the successful deployment of large-scale renewable projects, especially in areas like offshore wind and green hydrogen. Their ability to navigate complex regulatory environments and ensure the safety and sustainability of projects is something we deeply appreciate.

Looking ahead, our relationship with RINA will continue to evolve, particularly as we expand our portfolio of innovative projects in offshore wind, energy storage, and hydrogen production. Its expertise will become even more important as we navigate new regulatory challenges and technological advancements in these fields.

I foresee RINA playing a central role in certifying the new energy solutions that we develop, and in helping us scale our projects across Europe and beyond, making them key players in the energy transition we are driving.

Scan the QR code to learn more about **European Energy**

At the heart of energy transition: **renewables**

By **Marco Compagnino**
Head of
Environmental Engineering
marco.compagnino@rina.org

By **Stefano Sadowski**
Power Southern Europe
Director
stefano.sadowski@rina.org

Image created with Generative AI

The global energy landscape is undergoing a critical transformation. As we combat climate change, the transition to renewable energy sources has become of paramount importance. Renewable energy technologies, such as solar and wind, will play a pivotal role in reducing emissions from the electricity sector.

Today, nearly 40% of all carbon dioxide pollution stems from power plants burning fossil fuels. The International Energy Agency (IEA) projects that by 2050, almost 90% of global electricity generation will come from renewable sources, with solar photovoltaic (PV) and wind accounting for nearly 70%. However, it is estimated that at least $4 trillion a year needs to be invested in renewable energy until 2030 to reach net-zero emissions by 2050.

The good news is that solar panels and wind turbines are increasingly affordable. In several cases, they are already cheaper than coal and other fossil fuels. By making renewable energy a global public good, we can ensure that it benefits everyone, not just the wealthy.

This will involve removing roadblocks to knowledge sharing and technological transfer, including intellectual property rights barriers. Energy storage systems (such as battery and hydro), which allow energy from renewables to be stored and released when needed, will also enhance energy system flexibility.

A robust supply of renewable energy components and raw materials is vital. From minerals for wind turbines to electric vehicle infrastructure, we need widespread access to these resources. International coordination will be necessary to expand and diversify manufacturing capacity globally. Investments should focus on sustainable practices that protect ecosystems and cultures, while technologies should limit or avoid the use of rare and/or critical materials.

Correctly planned, the transition to renewables could create a large number of well-paying jobs, enforcing local communities' wellbeing. Research efforts, such as studying the impacts on the environment, on the biodiversity and ecosystem services, and the strengthening the acceptance of local communities, are essential for a fair transition.

In this framework, RINA is strongly committed in supporting its clients worldwide identify and design the most suitable project solutions. This includes project size, location, technology and funding. RINA also helps clients identify the more proper licensing path in order to secure full approval from the relevant authorities, and the local communities potentially affected by the installation and operation of the projects. Using multidisciplinary teams, we work with clients from the initial conceptual phase, accompanying them through the following design, licensing/permitting and funding phases, up until construction and operation.

In conclusion, renewables are not just an option, they are our lifeline. By embracing renewable energy technologies, we can pave the way for a sustainable, equitable, and net-zero carbon future.

Exploiting agro-energy for **biofuels**

By **Federica Cugnach**
Energy & Resource Efficiency
Senior Engineer
federica.cugnach@rina.org

Today, the energy transition and the drive towards decarbonisation are demanding a change in companies' business models.

For oil companies in particular, the concept of bioenergy will play a key role in this change, by providing sustainable biofuels for road transport as well as for the aviation industry. This trend is set to make mobility both smarter and more sustainable.

The European Renewable Energy Directive (RED II) has set a target that Member States must source 14% of their transport fuel from renewable energy by 2030.

The RED II also introduces the possibility to certify biofuels as "low ILUC-risk", providing an opportunity for economic operators to demonstrate that their fuels have a low risk of indirect land-use change impacts.

The concept of low ILUC-risk biofuels relies on the concept of "additionality", producing additional biomass either through extra yields in existing crop systems, or through new crop production on formerly unused, abandoned or severely degraded lands.

The requirements of this certification scheme were first outlined in the delegated regulation (EU) 2019/807 and further specified by the implementing regulation (EU) 2022/996 of the European Commission.

In compliance with the above-mentioned regulations, the oil companies have the possibility to implement a green transition model linking agriculture and energy through the sustainable production of biofuel from vegetable oil.

"Agro-energy", or energy derived from agricultural activity, for biofuels promotes the concepts of additionality and circular economy, pivoting on agro-processing facilities that convert locally produced agricultural raw materials that do not compete with the food value chain, as well as agro-industrial waste and residues, into oil and by-products such as valuable proteins for animal feed and biofertilizers.

This model allows oil companies to directly produce significant quantities of vegetable oil from agri-feedstock in an otherwise challenging environment in terms of price and growing energy demand. This encourages territorial regeneration, creating new job opportunities and ensuring market access for local communities.

Today, some major oil players are already implementing this model. The sustainable model of "agro-energy" for biofuels represents a promising pathway towards net-zero. This will mean integrating new competences and skills into oil companies in order to identify and develop new business models, and create the required know-how. In this context, "Business to Business to Society" companies can support their customers by keeping pace with the changes.

RINA is committed to advancing the "agro-energy" sector, providing expertise which spans the entire biofuels value chain, thereby promoting efficiency, sustainability, and compliance with the evolving regulations.

Image created with Generative AI

A key role for **import terminals**

By **Andrea Sola**
Head of Energy Transition Technologies Project Management
andrea.sola@rina.org

As the world shifts towards more sustainable energy sources, the role of import terminals in this transition has become increasingly critical. Import terminals are vital infrastructures for the reception, storage, and distribution of energy resources. Their significance can be understood from various perspectives:

- Economic, since they serve as gateways for energy resources, allowing countries to secure and diversify their supply and stabilize relevant prices. As renewable energy sources become more mainstream, import terminals will be pivotal in accommodating biofuels, hydrogen, e-fuels (as well as LNG, which is a "transition fuel" in the decarbonization process), thus fostering economic resilience in the energy sector

- Environmental, by playing a crucial role in reducing greenhouse gas emissions by facilitating the import/export of cleaner fuels. In this respect, the strategic positioning of import terminals can significantly influence the carbon footprint of entire regions

- Logistical, by enhancing the efficiency of energy distribution networks, helping to manage fluctuations in the demand and enhancing energy independence

As global energy markets evolve, nations with well-developed import terminals are better positioned to adapt to changes in supply chains and energy policies.

For existing terminals looking to adopt new energy vectors, it is essential to conduct a thorough assessment of available spaces, safety distances, and compatibility with existing infrastructures.

Analyzing space ensures that new technologies can be integrated without compromising operational safety (also during the Terminal conversion/upgrade). Safety distances must be strictly observed to prevent accidents and protect operators and the environment.

Finally, the possibility of adding new vectors to those already in use should be carefully evaluated to optimize energy efficiency and reduce risks associated with managing different types of energy. In this context, it is crucial to verify from the early design stages that all the new installed equipment is compatible with the existing industrial environment.

RINA has already developed significant experience in this sector, gained from its more than 20-year history in the LNG field.

It has subsequently built on this experience, starting from 2021 when it began supporting several European operators in assessing the conditions necessary for accommodating storage tanks, processing equipment, piping, and transfer systems for both liquid hydrogen and liquid CO_2.

RINA's success in these fields can be attributed to our multidisciplinary teams, which possess high-level expertise in process design, layout and safety. Among other things, these teams can carry out main equipment preliminary sizing and plant layout optimization based on the outcomes of preliminary Quantitative Risk Assessment and HAZID session, contributing to the overall success of the project.

Green fuels subject to **certification**

By **Laura Severino**
Head of Decarb & Chain of Custody Product Management
laura.severino@rina.org

Since 2009, Europe has set renewable energy targets for its member states. The current 2018 Renewable Energy Directive (known as RED II) mandates that 32% of gross final energy consumption be met by renewables by 2030, with a target of 14% for the transport sector.

On November 20, 2023, the Third Renewable Energy Directive (Directive 2023/2413, known as RED III) came into force. Member States have 18 months from this date to meet the Directive. RED III sets more ambitious renewable energy targets for 2030: 42.5% of gross energy from renewables by 2030 and 29% in the transport sector.

The renewable fuels that count towards achieving the targets are: liquid biofuels (to be used in the transport sector); bioliquids (in the fields of power generation, heating and cooling); solid and gaseous biomass fuels (in power generation, heating and cooling, and transport); recycled carbon fuels (RCF) (transport sector); and finally liquid and gaseous fuels from non-biological renewable sources (RFNBOs) (transport sector, and subsequently all sectors including industry when RED III is adopted).

Fuels derived from raw materials such as waste or residues or raw materials that do not compete with the food sector are particularly favored, with additional targets and forms of incentives. The Renewable Energy Directives establish criteria according to which these fuels must be certified: greenhouse gas savings, the impact of land use change, social impact and in the case of waste and by-products, the risk of fraud.

Compliance with these criteria is a prerequisite for receiving government support. RINA is the ideal partner for the certification of fuel sustainability according to the Renewable Energy Directives. Specializing in certification, inspection, testing and consultancy for the energy, environment, transport and infrastructure sectors, it is accredited for several certification schemes:

- ISCC EU, voluntary scheme developed by ISCC System GmbH
- 2BS – Biomass Biofuels Sustainability voluntary scheme, a voluntary scheme developed by the 2BS Consortium
- The National Certification System for the sustainability of biofuels defined by the Decree of 14 November 2019 and the very recent Decree of 7 August 2024, applicable to organizations in every part of the world when the final purchase market is Italy

RINA has issued more than 3,500 certificates under the ISCC EU scheme, more than 450 certificates according to the National System and more than 20 according to the 2BS scheme. In Italy, RINA is the leader in certificates issued on biomethane (more than 50). This expertise has become more urgent with a new decree on 7 August 2024 governing Italy's national Certification system for the Sustainability of Biofuels, the Certification of Renewable Fuels of non-biological origin and that of Recycled Carbon Fuels contains important innovations. Crucially, users of biofuels for electricity and/or thermal energy production, and ETS subjects, have now been included in the organizations that must be certified.

Sun shines on **agrivoltaics**

By **Alessio Pinzone**
RINA Prime Value Services Director
alessio.pinzone@rina.org

The sun is currently shining brightly on agrivoltaics. This practice - combining land use for farming and electricity generation using photovoltaic solar panels - is a rapidly growing sector which brings together the common interests of farmers and energy developers to optimize crops, produce clean energy, and maximize revenue. Boosted by new regulatory approval processes and tenders for access to the CFD system, the sector offers numerous advantages and could play a key role in supporting European climate change goals.

These include land value enhancement through leasing practices, increased passive income for tenants, reduced water waste and energy costs, support for more sustainable agricultural practices, and minimization of greenhouse gases.

Agrivoltaics also makes land more versatile by creating new microclimates resulting from the combination of agricultural and solar panels, leading to cooler temperatures and increased shading. These developments intersect with the profound structural and cyclical changes within the agricultural property system. According to a study by the University of Gloucestershire, farms are increasingly becoming larger and more structured, fewer in number, and with higher capital investment. Today's farmers must reposition themselves in a modern and technological system where land stewardship and sustainability are not mere details but the focal point of specific activities. This emerging field will require specialized professionals capable of developing innovative and constructive solutions.

RINA Prime is the first player to establish partnerships with major companies specializing in the structuring of agricultural and livestock activities. In this highly dynamic environment, RINA is emerging as the first agricultural asset manager, offering a complete and professional service. These services range from overseeing activities in full compliance with all IPP requirements, particularly regarding health and safety, to the use of sophisticated monitoring systems, software, and apps for 4.0 management of land and livestock practices. These tools will be able to bridge the gap between the traditional world of farmers and the futuristic world of engineers, investors, and energy professionals, as the agricultural sector evolves.

RINA projects include the care of a 150-hectare forest, the management of over 2,000 dairy sheep, and the production of over 100 hectares of beehives for honey and cereal production, using an innovative system that will reduce water consumption by 30% and increase protein value by 30%, as well as legume, oil, and orchard management with experimental projects. Most of the crops are and will be cultivated using specific innovative techniques, adhering to regulations for DOC, DOCG products, and more. RINA believes that agriculture can represent a turning point in reducing CO_2 emissions. Through the data collected via its platforms, RINA is already implementing new schemes and certifications aimed at renewing agricultural activities with a more sustainable approach, with the goal of making this one of the leading platforms and a reference point for an increasingly CO_2-free future.

Image created with Generative AI

Image created with Generative AI

A key to the future: **battery storage**

By **Enrico Di Martino**
Energy Research, Development & Innovation Director
enrico.dimartino@rina.org

As we move toward a more sustainable future, the demand for battery storage systems is set to experience a remarkable surge, projected to reach an impressive 5.1 terawatt-hours (TWh) by 2030. This growth is primarily fueled by the mobility sector, which is expected to contribute a staggering 90% of the overall demand.

China is expected to capture a significant share, dominating 40% of the global market. With this rapid expansion, we can expect substantial growth across the entire battery value chain, particularly in cell components and production processes. The intricacies of battery supply chains are evolving, leading to enhanced tracking systems and localized value chains. The development of gigafactories is essential for the growth of the market, with investments projected to exceed $350 billion by 2030. However, this growth is not without challenges.

The industry faces hurdles related to securing financing, accessing skilled labor, and ensuring a consistent supply of raw materials. In response to these challenges, the EU Battery Regulation has been implemented, establishing a comprehensive framework for environmental, social, and governance (ESG) practices. This regulatory landscape presents new opportunities for stakeholders within the battery market. It is worth noting that this push for regulation extends beyond Europe; the US and the UK are also working on establishing robust regulations for battery production and usage. Another significant opportunity lies in battery recycling, which is expected to evolve into a crucial business sector. By 2040, an estimated 17.3 million tons of materials will be available for recovery, reducing reliance on virgin resources while contributing to sustainability efforts.

The electric vehicle (EV) battery market is anticipated to experience impressive growth, with a compound annual growth rate (CAGR) of 16.6%, reaching $6.46 billion by 2032. As safety becomes increasingly critical, stringent testing requirements for battery installation and integration will dominate the sector. Companies are now prioritizing strategic partnerships, collaborations, and acquisitions to bolster their product offerings and expand their market presence. The demand for innovative energy storage systems (ESS) is on the rise, particularly as traditional methods like pumped hydro face geographical limitations. Lithium-ion batteries are expected to play a pivotal role in meeting these increasing storage needs, facilitating the integration of renewable energy sources (RES) into our power systems.

RINA is at the forefront of these transformative trends, actively participating in the Horizon Europe GR4FITE3 project (Project number: 101103752). This initiative aims to advance sustainable battery technologies and enhance energy storage solutions while promoting the adoption of innovative materials. Aligning with the European Green Deal, RINA is also backing a circular economy in the battery sector. As Europe and the global community move towards decarbonization, the battery market stands as a strategic cornerstone for future investments. The ability to adapt to regulatory changes, innovate sustainable practices, and leverage the growing mobility market will be crucial for success.

The new frontier: **hydrogen powered yachts**

By **Giorgio Gallo**
Yachting Sector
Senior Business Development Manager
giorgio.gallo@rina.org

By **Pasquale Fattore**
Head of
Inspection Product Management
pasquale.fattore@rina.org

Image created with Generative AI

Baglietto's B-ZERO project is a groundbreaking development in the yachting industry, focusing on hydrogen as a clean energy source to propel yachts.

It represents a significant step towards a sustainable future in the yachting industry. By leveraging hydrogen fuel cell technology and hybrid propulsion systems, the project is paving the way for zero-emission yachting, aligning with global environmental goals and setting a new standard for the industry. Developed by La Spezia-based boat builder Baglietto, the project acknowledges that there is currently no renewable energy source that can completely replace fuel oil alone. Hence, the focus is on hybrid yachts, which can be propelled by a combination of diesel and electric propulsion systems.

RINA was chosen by Baglietto to oversee and certify the development of the B-ZERO prototype, ensuring that the system meets the highest quality and safety standards. To fulfill the demands of the brief, RINA's team addressed the way to create a project of a Hybrid Power Yacht which includes various navigation modes such as full electric, diesel-electric, diesel shaft generation, and diesel traditional. The vision extends up to 2035, with a focus on hydrogen and batteries, e-fuels, and advanced biofuels to achieve zero emissions and GHG net-zero targets. Already the B-ZERO hybrid yacht incorporates several technological innovations:

- H2 Production: electrolyzes on board are used to produce up to 20kg of hydrogen per day, addressing the lack of a hydrogen distribution network
- H2 Storage: solid-state storage at low pressure and ambient temperature, ensuring green and safe storage
- H2 Power Unit: PEM fuel cell with a 200 kW module, enabling zero emissions

RINA supported Baglietto's team in the project development, after which RINA tested and examined the result, approving the principle of the concept. The hybrid yacht's concept performance in zero-emission mode delivered significant energy savings. For the prototype certification, RINA will rely on the ISO 22734 standard. This standard plays a crucial role in the development of components and systems for hydrogen applications, where structural integrity is essential for safety. The certification phases will proceed from project analysis, to on-site inspections, tests and trials and documentation verification.

Going forward, the certification issued by RINA will bring numerous benefits to the yacht's builders and owners. This includes increased credibility, both in terms of reliability and safety; the potential for continuous improvement; and access to new international markets that are increasingly demanding in terms of sustainability and safety. The collaboration between Baglietto and RINA is a clear example of how innovation and rigor can go hand in hand. The project also embodies the best of Italian excellence, with RINA and other important partners from Genoa, Bologna, Pisa, and Milan working together.

Thanks to this partnership, the B-ZERO project is destined to become a benchmark for the entire yachting industry, contributing to a more sustainable and clean future.

Crete Island as a **clean energy hub**

By **Paolo Gallorini**
Corporate Finance & Strategy Consulting Manager
paolo.gallorini@rina.org

The REPowerEU plan proposes that the European Union should produce 10 million tons of renewable hydrogen by 2030. Additionally, the EU Hydrogen Strategy aims for 40 GW of installed renewable hydrogen electrolyser capacity by the same year. Achieving these ambitious objectives requires the rapid development of large-scale green hydrogen production plants. Such installations depend on both mature and emerging technologies, with a critical focus on the integration of diverse solutions. Furthermore, given the typical low energy density of hydrogen, it is essential to optimize the production and handling of hydrogen carriers, with ammonia being one of the most promising options.

In this context, ProEuropean Trading GmbH is developing the H2CRETE Valley Project (H2CRETE) on the island of Crete. Through this initiative, the Munich-based company aims to transform the Greek island into the largest low-carbon hydrogen and ammonia hub in the Mediterranean Sea.

H2CRETE is a pioneering clean hydrogen and ammonia production project, designed to deploy state-of-the-art technology integration solutions on a large scale in a strategic location for the European Union. The project is situated in Atherinolakos, in the southeast of Crete, Greece, an area officially recognized as an "energy centre" and designated as the endpoint for several energy interconnection projects.

The H2CRETE Valley Project includes a seawater desalination system, a 100 MW electrolysis production plant, an ammonia production unit, storage facilities, and ancillary equipment. The hydrogen and ammonia produced by H2CRETE will serve various off takers, including import terminals, mobility, maritime, and the cement industry. H2CRETE is officially recognised and certified by Mission Innovation and the Clean Hydrogen Partnership as a global Hydrogen Valley flagship project.

RINA is providing technical, financial, and market advisory services to develop the H2CRETE Valley Project from concept design to feasibility study and beyond. RINA has provided ProEuropean Trading with a multidisciplinary team composed of process engineers, civil engineers, electrical engineers, management engineers, chemical engineers, health, safety & environment engineers, floater engineers, pipeline engineers, economists, marketers, and project management experts. RINA's support for the H2CRETE Valley Project includes:

- Business Planning
- Financial Modelling
- Concept Study
- Technical Feasibility Study
- Technical and Financial Advisory
- Funding Scouting
- Application to Funding opportunities
- Dissemination activities (e.g. European Hydrogen Week 2023, World Economic Forum Annual Meeting 2024 – Greek House Davos)

H2CRETE is an ambitious and innovative project, set to support the European Union in achieving its decarbonisation targets. Thanks to initiatives like this, the island of Crete has the potential to become a true clean energy hub, acting as a gateway for renewable energy from North Africa and the Middle East to Europe.

Image created with Generative AI

The next hydrogen carrier: **ammonia**

By **Antonio Lucci**
Global Energy Transition
Strategic Streams Director
antonio.lucci@rina.org

Fuel	Density (t/m³)	LHV (GJ/ton)	Volumetric Energy Density (GJ/m³)	Normalized Volume (m³/GJ)
MGO	0.835	42.7	35.7	1
LPG	0.49	46	22.6	1.58
LNG	0.45	49	25	1.2
Ammonia (liquid)	0.61	18.6	11.4	3.14
H2 (liquid)	0.071	120	8.52	4.18
H2 (compressed 350 bar)	0.023	120	2.8	12.75

Ammonia (NH_3) has long been known for its role in agriculture as a key ingredient in fertilizers. Now it is emerging as an unexpected, yet promising, player in the energy sector, particularly as a hydrogen carrier. The molecular composition of ammonia includes three hydrogen atoms, making it a practical and efficient medium for hydrogen storage and transport. Ammonia is synthesized through the Haber-Bosch process, which uses nitrogen and hydrogen. If green hydrogen-produced through renewable energy sources-or low-carbon hydrogen is used, ammonia becomes a low-impact energy carrier with significant potential in global energy supply chains.

At first glance, it may seem counterintuitive to use ammonia as a medium for transporting hydrogen, which can be produced directly from renewable sources via electrolysis. However, for the same liquid volume, ammonia contains 1.7 times more hydrogen than liquid hydrogen. Ammonia is a more energy-dense carrier per unit of volume, offering significant advantages when transporting energy across long distances. This makes it a strong contender in scenarios where volume efficiency is key, especially for regions like Europe that rely on importing renewable energy from production hubs.

Ammonia holds another significant advantage over hydrogen when it comes to transportation. While hydrogen liquefies at an extremely low temperature of -252.87°C, making its storage and transport technically challenging and costly, ammonia can be liquefied at -33.34°C at atmospheric pressure. This relatively mild temperature enables the use of existing, well-established technologies for its storage and transport-technologies that have been perfected over decades due to ammonia's widespread use in industry. In contrast, hydrogen storage and transport remain highly complex. Few projects have successfully demonstrated long-distance hydrogen transport, and those that do exist are mostly experimental.

A new market for ammonia is emerging-one focused on its role as an energy carrier. IRENA (International Renewable Energy Agency) projects that global ammonia demand could rise from 183 million tonnes today to an astonishing 688 million tonnes by 2050, driven by its expanded use as an energy carrier. There are still challenges, the principal one being ammonia's toxicity. Exposure to ammonia at concentrations as low as 500 ppm can be fatal within minutes, and even lower concentrations can cause severe discomfort and irritation. Therefore, ammonia storage and handling require stringent safety measures. For example, the port of Amsterdam has rejected proposals for ammonia storage due to public health concerns. By 2030, it's predicted that 50% of Europe's energy will come from renewables. However, due to limitations in infrastructure and local production capacity, achieving 100% renewable energy will be a challenge. This is where energy carriers like ammonia can play a crucial role, helping to transport renewable energy from regions with abundant resources to those with less capacity.

Material solutions for **Gen IV reactors**

By **Egidio Zanin**
Nuclear Industry Cluster
Senior Business Development Manager
egidio.zanin@rina.org

Fourth-generation (Gen IV) nuclear reactors are designed to improve efficiency, safety and sustainability compared to current reactors. However, this technology presents significant material-related challenges, as operating conditions are extremely severe.

Material issues in Gen IV reactors represent one of the main technical barriers to their technological development. Today's research is focusing on innovative developments that ensure resistance to extreme conditions, in order to achieve safety and efficiency goals. The main problems are related to the different operating modes linked to specific technologies, such as high working temperatures, the corrosive phenomena induced by coolants, and the presence of neutron radiation.

Gen IV reactors use innovative coolants (gases, liquid metals, molten salts) to better exploit fast reactions, but the substitution of water with these new coolants creates specific challenges. In particular, the use of lead or their alloys as coolants is attractive due to their safety and non-nuclear proliferation aspects, however they also present criticalities such as embrittlement and corrosion phenomena to steels.

For some components, the phenomenon of neutron irradiation is also present, causing crystalline defects and alterations in the chemical composition, which in turn changes the mechanical properties of the materials. For these reasons, new structural steels are being developed and qualified that can withstand the new working conditions required.

An alternative strategy is the use of ceramic coatings applied superficially. This allows damage phenomena to be decoupled, and by using a structural material capable of resisting temperature and neutron radiation conditions, it leaves the coatings the task of protecting the surface from chemical attack.

Finally, the recovery and management of these materials at the end-of-life stage must also be taken into account. Many problems can be reduced by considering this aspect in the material design phase.

In this area, RINA has been working for several years on the development of innovative materials and the production of component prototypes and alloys, and these are currently being studied in collaboration with the main stakeholders worldwide.

Image created with Generative AI


RINA
goZERO
online
PRINTED ON 100%
RECYCLED PAPER
CONTACT
US ON
Image created with Generative AI