

ACCELERATING
THE ENERGY TRANSITION

TRIPLING UP IN A VUCA WORLD

BUREAU VERITAS
GLOBAL ENERGY TRANSITION REPORT 2024



**BUREAU
VERITAS**

IN THIS REPORT

The energy industry faces unprecedented disruption—just as it is going through the deepest transformation in its history.

To limit global heating, the global energy industry needs to triple renewable energy capacity by 2030. Yet it is facing a perfect storm of vulnerabilities, uncertainties, ambiguities and complexities (VUCA) that threaten to derail the energy transition.

This report explores how energy executives, thought leaders and experts are navigating the disruptions shaping the world today. It examines barriers to acceleration and the pragmatic solutions the industry is finding to overcome them. In this way, it aims to set a path for a more secure, sustainable and inclusive energy system.

ABOUT THE SURVEY: Bureau Veritas' 2024 global energy industry survey is based on interviews with more than 800 respondents in 11 regions: Europe, North America, South & Central America, Central and South Africa, Middle East & North Africa, Northern & Central Asia, Northeast Asia excluding China, Southeast Asia, China, India, Australia.

INTRODUCTION	3
Key insights	4
The status quo	5
Achieving energy security	8
Tripling up in a VUCA world	10
GOVERNMENT	12
POWER GRIDS	18
SUPPLY CHAINS	22
INNOVATION	28
NUCLEAR	32
TRANSITION FUELS, HYDROGEN AND RENEWABLES GASES	35
METHANE EMISSIONS	39
HOW TO TRIPLE UP	43
About Bureau Veritas	46
Glossary	47

“ THIS IS THE MAKE-OR-BREAK DECADE FOR THE CLIMATE.”



It is during the next five years that we will set the world on course to limit the impacts of climate change—or utterly fail to do so.

Whether we meet that challenge rests on our ability to accelerate the energy transition. At COP 28, which I had the privilege to attend last November, 130 countries committed to triple renewable energy capacity. This is a huge ambition—but clearly possible if we further break down barriers.

Already, we have seen an enormous acceleration in progress. 2023 was a record year for renewable energy, with 510 gigawatts (GW) of capacity added. The global power mix will be transformed by 2028, with renewables set to surpass coal as the biggest source of energy generation in 2025. As an industry we have done remarkable work so far.

JOERG
GMEINBAUER

GLOBAL SENIOR VICE PRESIDENT

ENERGY

And yet, it is not enough. The magnitude of what needs to be achieved by the end of the decade—putting another 8 terawatts (TW) of renewable energy into operation—is enormous. We cannot simply do more of the same.

Accelerating the transition means challenging everything to design better, build faster, and operate more efficiently.

It means systemic transformation of energy systems, led by governments who are committed to providing a stable context for private investment. And it means tackling highly complex issues in areas ranging from financing and supply chains through to power grids.

All this needs to be done at a time of unprecedented VUCA: vulnerabilities, uncertainties, complexities and ambiguities.

War, cyberattack, supply chain weaknesses, a growing populist backlash against “green” policies: these are all facts that the energy industry needs to contend with as it goes through the biggest transformation in its history.

This is the second year that Bureau Veritas has conducted an in-depth survey of the energy industry. Between February and May 2024, we collected insights and opinions from over 800 market experts, thought leaders and senior executives from all continents and corners of the energy sector.

The result is this report, which explores the energy industry and its ambition to triple renewables capacity within the context of an increasingly VUCA world. It also revisits the practical barriers currently impeding an accelerated build-out of renewables.

Our conclusion is clear. We need collaboration and intense effort to reach our goal of tripling up by 2030. We cannot allow these interconnected uncertainties to derail momentum. To do so would be to fail the world, and the people living in it.

KEY INSIGHTS

FROM THE BUREAU VERITAS GLOBAL ENERGY TRANSITION REPORT 2024

VUCA ARE HERE TO STAY

Despite significant progress, only 30% of survey respondents believe the industry will manage to triple renewables capacity by 2030. This is in large part because vulnerabilities, uncertainties, complexities and ambiguities (VUCA) are **converging to create instability and raise existing barriers**. If supply chain costs dominate respondents' worries, war comes a close second. Unsurprisingly, the same VUCA tend to dominate energy security concerns.



CITE SUPPLY CHAIN UNCERTAINTIES AS THE TOP SHORT-TERM THREAT TO THE TRANSITION

ACCELERATE TO BOOST SECURITY

The 2024 survey busts the myth that more renewables means less energy security. Not only do a huge majority of respondents believe the transition will improve security, 67% believe that massively **increasing renewables investment is a priority** for energy security in the short term.

This is not to discount the role of fossil fuels. 55% of respondents see gas as a key transitional fuel to ensure a just and orderly transition.



BELIEVE THE ENERGY TRANSITION WILL BOOST ENERGY SECURITY

ALL EYES ON GOVERNMENT

This year's survey provides a stark reminder of the powerful role of government. Four in ten respondents have seen a marked **improvement in key pain points**, from permitting to fiscal incentives and regulatory context. Yet when it comes to identifying the factors with the biggest impact on the pace of the transition, respondents are unanimous. Whether it's about setting targets, or creating incentives for clean tech manufacturing—change comes from the top.



DEMAND FURTHER SIMPLIFICATION OF PERMITTING REGULATIONS

GRIDS NOW THE #1 BARRIER

One by-product of the massive acceleration in renewables build-out is that queue times to get connected to the grid have become a major issue. Massive **investment in public grids is seen as a top priority** if the industry is to reach its goal of tripling up by 2030. This includes investment in existing grids, where experts see a major opportunity for artificial intelligence to help manage smart grids efficiently.



CITE AN URGENT NEED FOR INVESTMENT IN GRIDS

STATUS QUO OF THE ENERGY TRANSITION

ONE YEAR ON, WHAT PROGRESS HAS BEEN MADE?

— The progress we make in the energy transition in this decade is pivotal. It is the crucial time for delivering a secure, sustainable, affordable, but also inclusive, energy system.

After two decades of continuous transformation, it is clear that we are now in an **accelerated delivery phase**, with renewable energy at the very core of the transition. In 2023, additions to global annual renewable capacity increased by almost 50% to nearly 510 gigawatts (GW), the fastest growth rate in the past two decades⁽¹⁾.

However, despite progress achieved, the current deployment of low-carbon technologies is **insufficient in speed and scale** to achieve the Paris Agreement goals. The transition requires an urgent and significant acceleration across energy supply, end-use sectors, and enabling technologies.

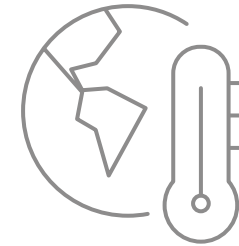
TRIPLING UP DEMANDS RAPID SYSTEMIC CHANGE

At COP28, 130 countries committed to tripling renewable energy capacity by 2030, which means putting another almost 8 terawatts (TW) of renewable energy into operation. That is almost exactly the size

of all power generation capacity in operation today—across all technologies—with fossil, nuclear and renewables put together. **Energy storage capacity** needs to expand in tandem, with cumulative global battery storage increasing from 17 gigawatt hours (GWh) in 2020 to 359 GWh in 2030⁽²⁾.

Rapid systemic change is required: the current energy system was built to meet the needs of the fossil fuel era. Tripling up renewable energy deployment will require collaboration between the public and private sectors to transform the system and tackle entrenched systemic barriers.

This involves **investing at scale in grids** to accommodate a growing share of renewable energy while establishing policies and regulation that facilitate an accelerated build-out of renewables by the private sector. It also requires **reskilling and upskilling the workforce** to build and maintain renewable energy infrastructure. Concerted action is needed—now.



1.5°C STILL NOT ON TRACK

The **COP 28** commitment to triple up renewables capacity by 2030 was a major step. However, **respondents to the BV survey** are acutely aware of the magnitude of the challenge and recognize that **the world is not on track:**

74%

BELIEVE **WE ARE NO MORE LIKELY TO REMAIN WITHIN 1.5°C** THAN WE WERE 12 MONTHS AGO

ONLY
30%

ARE CONVINCED THAT **TRIPLING RENEWABLES CAPACITY BEFORE 2030 IS POSSIBLE.**

ONLY
37%

BELIEVE THAT **THE INDUSTRY WILL SUCCEED** IN DOUBLING ENERGY EFFICIENCY BY 2030

Source: Bureau Veritas Global Energy Survey 2024

(1) Source: [IEA, Renewables 2023](#)

(2) According to IRENA's 1.5°C Scenario. Source: [IRENA, Tripling renewable power and doubling energy efficiency by 2030](#)

THE BV ENERGY TRANSITION BAROMETER

Huge progress has been made on some topics in the past 12 months—but in other areas the situation is getting worse.



GOVERNMENT



IN 2023

98%

cited **regulatory barriers and uncertainty**

IN 2024

36%

highlighted a more stable **regulatory context**

36%

chose **permitting** as the #1 topic governments should tackle

40%

said **speed of permitting** had improved



SUPPLY CHAIN



IN 2023

90%

cited **geographical concentration** of raw materials and components as a top challenge

IN 2024

50%

praised efforts to **improve diversification**

34%

said **lack of resilience** is a barrier

57%

said **supply chain resilience** has failed to improve



TECHNOLOGY



IN 2023

67%

called for further innovation in **energy storage**

IN 2024

53%

said the pace of **battery innovation** had improved



WORKFORCE



IN 2023

70%

were **struggling to recruit** skilled workers

IN 2024

58%

have seen **no improvement** in worker availability

STATUS QUO: LIFTING BARRIERS

— Our 2024 survey reconfirmed three main barriers to tripling up: the need for government action; a lack of investment in grids; and a complex supply chain struggling with scale-up and VUCA.

PROGRESS ON SPECIFIC CHALLENGES

Much progress has been made in addressing certain specific challenges cited in the 2023 survey—and this progress is accelerating.

A massive 98% of respondents cited regulatory issues as a barrier in 2023; just one year later, 41% of respondents say **fiscal incentives are more readily available**, while 32% mention the regulatory context is more stable. Simplifying permitting was the priority for action 12 months ago; this year, 40% see a marked improvement, with faster processing times **reducing project uncertainty**.

In terms of technology development, floating wind and solar, battery storage, and hydrogen are still the main priorities.

MARKED DECLINE IN CERTAIN METRICS

In 2023, 70% of survey respondents said they were struggling to **recruit skilled staff**. One year later, 58% have seen no improvement; 22% say that the situation is worse.

A third of respondents in 2023 identified **supply chain resilience** as a barrier to transition. In 2024, 57% believe it has not improved, while 14% say it has worsened. Specific issues highlighted range from supply chain disruption with contracted suppliers to accessing raw materials and rare earth minerals at a stable cost. The concentration of supply of key components in a single country or among a few suppliers, and suppliers' lack of ability to scale up fast enough, also featured prominently.

More encouragingly, half of respondents say that governments and companies are making a real effort to **diversify supply chains** geographically. The issue is that those efforts are not yet fully bearing fruit.



INNOVATION: MIND THE GAP

The energy transition is a puzzle which must be considered holistically, with the pace of innovation and scale-up running in tandem on **generation, storage and distribution**. For the backbone of the transition, the required power-generation technology (wind and solar), is in place, but needs to be further industrialized and scaled up. There remains a **gap in battery technology**, selected by respondents as the top R&D priority. In addition, 84% cite investing in power grids as essential to connect renewables projects faster.

Respondents are increasingly pragmatic about the **phasedown of fossil fuels** in power generation: 64% believe they will NOT be phased out by 2040, compared to 38% in 2023. While fast decarbonization of power generation is possible with the right level of political will and investment, this is not yet happening at the required pace.

ACHIEVING ENERGY SECURITY AND A JUST TRANSITION

— The twin challenges of energy security and the energy transition are closely linked. Creating a resilient, safe and affordable energy supply is key as we move toward an electrified, renewables-based system.

Policymakers and industry alike refer to the **energy trilemma**, a framework in which security, sustainability and affordability must be balanced when tackling demand and investment. Historically, conventional energy systems have tended to be viewed as a better guarantor of reliable and affordable power than renewables. However, policymakers and industry leaders are increasingly rejecting this position, due to the low levelized cost of energy (LCOE) of wind and solar power, and the risk associated with overreliance on imported fossil fuels.

In Bureau Veritas' survey, 84% of respondents believe the **energy transition will boost energy security**. However, 46% see this benefit emerging in the long run. Only 38% think the energy transition offers the chance to build a safer and more reliable energy system in the short term.

PREVENTING FUTURE ENERGY CRISES

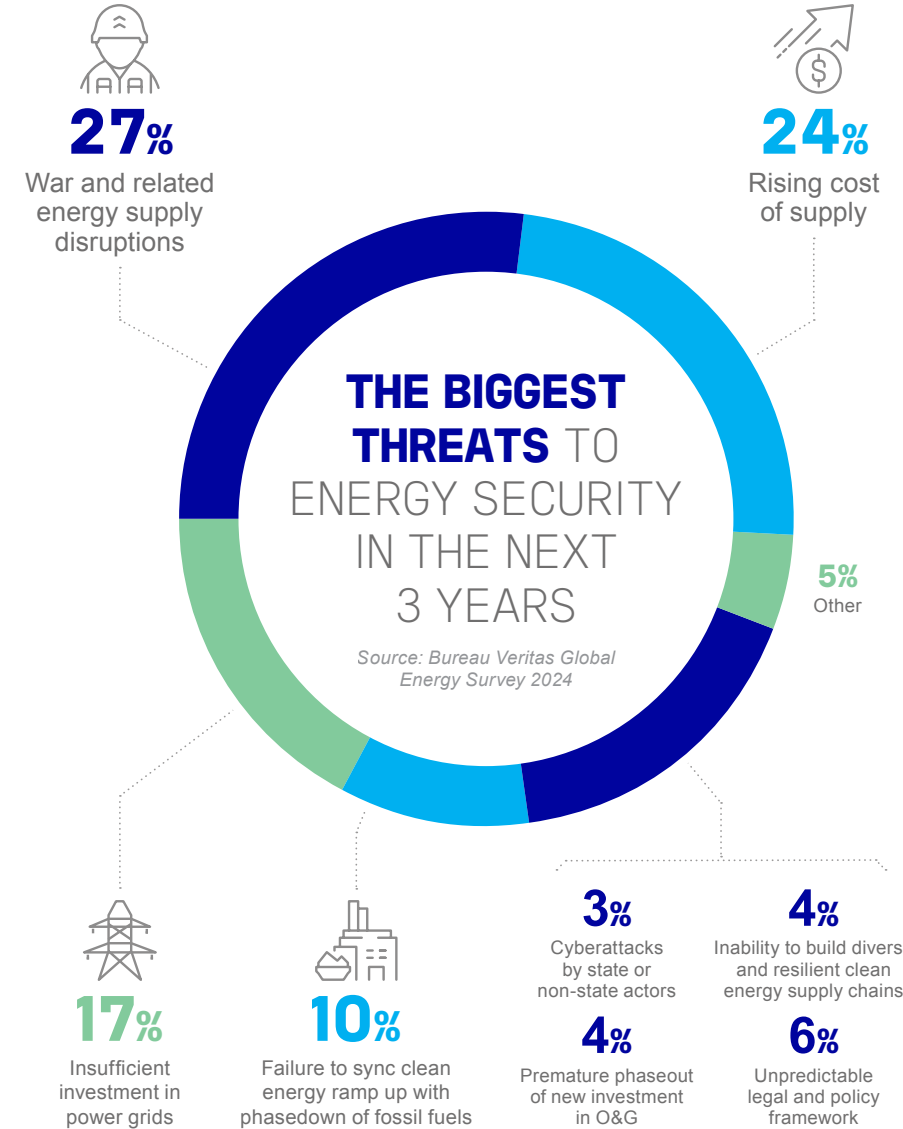
Three issues emerge paramount from the recent global energy crisis: risks to affordability, energy security, and the resilience of clean energy supply chains.

Respondents to Bureau Veritas' survey agree on the biggest threats to energy security over the next three years, with war and rising costs occupying the top spots (see opposite).

As the world moves toward a more electrified, renewables-based system, **security of electricity supply** is key, and survey respondents agree on the top two priorities between now and 2030.

First, **investing in power grids** is essential to get renewable projects connected faster: 84% cite this as a top priority. For 38% of respondents, this includes improving the efficiency of grids, by investing in artificial intelligence as an example. Second, a massive increase in **investment in renewables** projects is required: 67% of those polled rank it as a top priority.

While energy security is within our grasp, achieving it means overcoming significant vulnerabilities, uncertainties, complexities and ambiguities (VUCA) that are also central to accelerating the energy transition.



“THROUGH THE DIVERSIFICATION OF RESOURCES, CLEAN ENERGY TRANSITIONS IMPROVE ENERGY SECURITY AND CREATE A CHEAPER ENERGY SYSTEM OVERALL.”



Laura Cozzi is categorical: “Russia’s invasion of Ukraine and instability in the Middle East are clear reminders that traditional energy security concerns remain salient.”

This issue goes to the heart of Cozzi’s role as Director of Sustainability, Technology and Outlooks for the International Energy Agency (IEA), as improving energy security was the organization’s mandate at its inception in 1974.

Cozzi believes clean energy is the answer—for both security and affordability. “By adopting renewables and other low-carbon resources, **energy systems enhance resilience** against fuel supply disruptions,” she explains. “Price spikes for fossil fuels during the energy crisis made energy unaffordable for many. Clean energy transitions can help **lower the costs** of delivering energy, and reduce exposure to volatile prices. Even with higher upfront expenditure, clean technologies’ operating costs are competitive with conventional technologies’, with added benefits for emissions and air quality.”

Transition does not come without risks, however. “In the IEA’s Net Zero Emissions by 2050 Scenario, critical minerals demand quadruples by 2030, making it crucial for stakeholders to manage vulnerabilities such as price volatility

LAURA COZZI

DIRECTOR OF SUSTAINABILITY

TECHNOLOGY AND OUTLOOKS

INTERNATIONAL ENERGY AGENCY

and supply security. Some governments have already implemented measures to support domestic manufacturing and critical mineral exploration and refining. However, in a low-trust world, this risks tipping over into **more widespread barriers to trade**, which could delay clean energy transitions by increasing costs and complexity.”

Despite these challenges, Cozzi sees a **new clean energy economy** emerging. “The IEA found that in 2023, clean energy added around \$320 billion to the world economy, representing 10% of global growth. Clean energy growth accounted for nearly one-third of the European Union’s economic growth in 2023, 6% in the US, 5% in China, and nearly 5% in India, which shows the scale and widespread impact of the clean energy economy.”

However, Cozzi goes on to point out that while global spending on clean energy is breaking records, financing in emerging markets lags behind.

“Emerging market and developing economies other than China account for over one-third of global GDP and around two-thirds of the global population, but only 14% of clean energy investment,” she explains. “The **cost of capital** for solar photovoltaics (PV) and storage projects in developing economies can be more than double that in advanced economies, making it more challenging to get projects off the ground.”

Looking ahead, Cozzi is clear about what needs to happen next, to meet the global tripling pledge and improve energy security: “As clean energy comes to the fore, it is now crucial we see **clarified policy priorities**, increased investment in storage and grid infrastructure, and shortened processes for permitting and grid connections.”

TRIPLING UP IN A VUCA WORLD

— Today’s disruptions are here to stay, presenting the energy industry with the challenge of rapidly scaling up deployment of renewable energy projects at a time of unprecedented uncertainty.

The BV survey shows that costs, **geopolitical instability, and supply chain issues** pose a threat to the pace of the energy transition (see opposite). Converging vulnerabilities, uncertainties, complexities and ambiguities (VUCA) are creating political instability and in many countries, a rejection by some parts of the population. In a VUCA world, **trust becomes a valuable commodity**, and both public and private companies need new ways to build and maintain it against ever-shifting backdrops.

RISING COSTS AND THREATS TO SUPPLY CHAINS

Inflation and cost of financing have slowed build-out. This is a **major issue in emerging economies**, where the cost of capital for PV solar panel projects is over twice that in advanced economies⁽³⁾. This reflects higher real and perceived risks at country, sectoral and project levels. But volatile financing also impacts mature market dynamics. In the U.S., inflation and interest rates disproportionately impacted offshore wind, which saw a 50% rise in LCOE between 2021 and 2023⁽⁴⁾.

War, and the threat of war, also continue to impact supply chains. Disruptions in the Red Sea are **fueling the case for nearshoring**, as buyers faced with the complexity of sourcing from Far Eastern suppliers favor suppliers closer to end markets. However, with Chinese supply capacity outstripping global demand for solar equipment, lithium-ion batteries, hydrogen electrolyzers and wind turbine nacelles, the economic case for nearshoring remains shaky.

The **risk of cyberattacks** is also growing exponentially, since smart grids are more susceptible to cyberattack than legacy infrastructure. The energy transition has introduced a two-way flow of energy and information between renewable power generators, batteries and the grid. As a result, 44% of energy organizations are spending more than \$50m per annum on their cyber capabilities⁽⁵⁾.



(3) Source: *Source: IEA, Reducing the Cost of Capital*

(4) Source: *Deloitte, Renewable energy industry outlook*

(5) Source: *EY, How cyber security can keep pace with the energy transition*

For Homa Bahrami, our society has reached an inflection point. “Look at current geopolitical challenges, climate change, the pandemic, and digital acceleration,” she says. “In combination, they have created a perfect storm.”

As an educator, advisor, and author specializing in organizational flexibility, team alignment, and dynamic leadership in global, knowledge-based industries, Bahrami is uniquely positioned to take a long view of the challenges today’s VUCA world is creating for the energy industry.

“We are dealing with major systemic issues, which are also a huge challenge from a social and legislative point of view”, she explains. “We need to work out how to persuade people and organizations to adopt renewables, even if we have to incur transition costs in the process. We also need new legislation, like carbon tax, to move to a more energy-efficient future.”

So how can organizations in the energy industry scale in a VUCA world?

It is imperative to develop our adaptive capabilities so we can respond to uncertainty with a positive, entrepreneurial mindset, according to Bahrami. “The next frontier of innovation lies in our leadership capabilities and organizational systems. If you don’t lead and organize for adaptability, you can’t execute your strategy. The energy transition requires adaptation on a scale never seen before; it needs an entirely new operating system.”

To make this shift, Bahrami believes energy **companies can learn a lot from the tech industry.**

“One of the lessons we can learn from tech is to start small, launch several experiments and let the fittest survive,” she explains. “The energy industry needs to embrace this spirit

of experimentation by exploring different approaches rather than by only focusing on big bang strategies.”

“Much can also be gained from learning from the experiences of others and tapping into the collective intelligence of the ecosystem,” she adds. “Third parties have a role to play in bringing players together and facilitating conversations, in a way that does not compromise confidentiality.”

Bahrami adds that energy companies must get into the habit of learning from, and **recycling, failed ideas.** “Energy companies need to take a step back and see their challenges through a much broader lens,” she says.

Accelerating the energy transition in a VUCA world is placing specific demands on leaders. **“There are five adaptive capabilities needed to move us forward,”** concludes Bahrami. “Leaders must exhibit robustness and have a vision for the future; resilience, the ability to experiment, learn from mistakes, and bounce back; hedging, the capacity to use scenario thinking and consider different options; agility, by inculcating a sense of urgency and momentum; and versatility, the capacity to deal with different players, and adapt their interaction styles.” As Charles Darwin said in 1858, “It is not the strongest or the most intelligent that ultimately survive. It is the most adaptable.”

HOMA BAHRAMI

SENIOR LECTURER & FACULTY DIRECTOR

HAAS SCHOOL OF BUSINESS

UNIVERSITY OF CALIFORNIA, BERKELEY

TO NAVIGATE
TODAY’S CONVERGING
COMPLEXITIES, ENERGY
LEADERS NEED THE MINDSET
OF AN EXPLORER.”



GOVERNMENT



40%

DEMAND FURTHER
SIMPLIFICATION
OF PERMITTING
REGULATIONS

REGULATORY POLICY: WHAT DO SURVEY RESPONDENTS WANT?

— The policy decisions of the world’s governments continue to drive the energy transition. However, while progress has been made, the overall picture remains mixed.

Last year’s BV Global Energy Survey cited regulatory issues as the number one barrier to accelerating the transition.

One year on, and the picture is encouraging (see opposite). Four in ten respondents say the **availability of fiscal incentives has improved**, with a similar number feeling that permitting timelines have accelerated. Interestingly, a third report a **more stable regulatory context**, despite its rapid evolution and the continued need for close monitoring and expertise on the ground.

Consequently, respondents’ expectations of government have evolved. Respondents are looking for **clear policy signals that promote systemic change**. Incentives for carbon-intensive businesses to reinvest profits in renewables emerge as a top priority for 45% of respondents; clean manufacturing incentives are cited by 39%. More stringent national targets for carbon reduction set by governments are a priority for a further 35%.

DISAPPOINTMENT CLOSE TO HOME

Worryingly, respondents are least optimistic about **progress in their own countries**. Almost half of respondents (49%) do NOT think their country has taken the necessary steps to create a stable policy framework for the energy transition, while 46% do NOT believe their country is prepared to triple renewable energy capacity by 2030.

It is important to note that several **governments have recently backtracked** on some of their less popular initiatives in response to growing public opposition to “green” policies. The UK reversed some flagship net zero policies in 2023, while in France, the proposed energy sovereignty bill includes no targets for renewables. Public perception of the energy transition is clearly a risk to acceleration. Election results are cited by 1 in 5 respondents as a major threat to the transition, particularly in 2024, a year in which over 2 billion people go to the polls in more than 60 elections around the world.⁽⁶⁾

POLICY IMPROVEMENTS ON THE GROUND



22%

HAVE SEEN
**FASTER
PERMITTING**



41%

PRAISE INCREASED
AVAILABILITY
OF **FISCAL
INCENTIVES**



36%

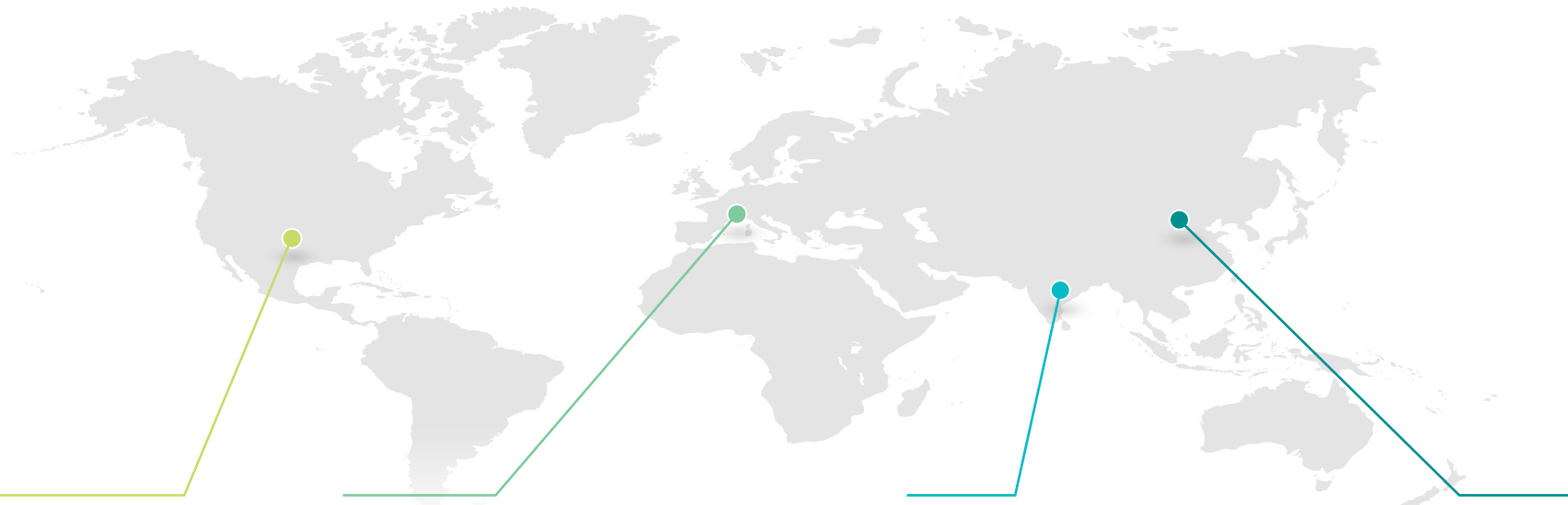
OBSERVE A
MORE **STABLE
REGULATORY
CONTEXT**

Source: Bureau Veritas Global Energy Survey 2024

(6) Source: Ipsos

THE POLICY CONTEXT IN 2024

Ambitious government policies—from fiscal incentives to regulation aimed at accelerating processes—remain a key variable setting the pace of the energy transition between now and 2030. The last 12 months have seen significant new policies and progress.



THE UNITED STATES

rolled out its 2022 Inflation Reduction Act, which aims to reduce carbon emissions by around 40% by 2030. In 2023, a total of 280 clean energy projects were announced across 44 states, representing \$282 billion of investment⁽⁶⁾, including in local manufacturing for renewables components.

THE EU

adopted the new Renewables Energy Directive (RED III) to increase the share of renewable energy in the bloc's energy consumption to at least 42.5% by 2030. This is part of the "Fit for 55" package, designed to help the region cut emissions by at least 55% by 2030.⁽⁷⁾ It also presented the Wind Power Action Plan.

INDIA

implemented its 14th National Electricity Plan, putting it on course to more than triple its renewable energy capacity by 2030. It aims to reach 500 GW of installed electricity capacity from non-fossil fuel sources through initiatives such as a Production-Linked Incentive scheme for PV panels.

CHINA

pursued its ambitious Five-Year Plan to achieve 33% of electricity generation from renewables by 2025. In 2023, China commissioned as much solar PV as the entire world did in 2022, while its wind additions grew by 66% year-on-year.

(6) Source: Goldman Sachs
(7) Source: European Commission

PERMITTING POLICY: THE DOORWAY TO GROWTH

— Speeding up permitting is crucial to accelerating the energy transition. Ambitious yet fair and transparent policy change holds the key.

The length of time and complexity of obtaining permits for renewable energy projects remain undisputedly one of the **biggest barriers to acceleration** of the energy transition. Encouragingly, nearly 40% of respondents to Bureau Veritas' survey said they believe the speed of permitting processes has improved over the past year.

This can be credited in part to **concerted policy action** yielding rapid results. Europe, for example, approved significantly more permits in 2023 for onshore wind farms than in previous years, largely thanks to a more favorable regulatory context.⁽⁸⁾ Both Germany and Spain approved 70% more permits in 2023 than in 2022. This is critical given that, in many countries, obtaining the permits needed for a wind project can take as long as five years.⁽⁹⁾

PRACTICAL, FAIR AND TRANSPARENT POLICY

Even so, nearly 60% of respondents in the BV survey demand further **simplification of regulations** and consultation mechanisms relating to permitting.

Recognizing the criticality of the issue, policymakers continue to introduce **legislation to speed up permitting**. In 2023, the US enacted the Fiscal Responsibility Act, which included several permitting reforms.⁽¹⁰⁾ Meanwhile, the European Commission presented a Wind Power Action Plan, integrating actions to accelerate deployment through faster permitting.⁽¹¹⁾ France's "Green Industry" law aims to more than halve lead times for issuing permits and creates a simplified procedure for large-scale projects of major national interest.⁽¹²⁾

Policies to accelerate project approvals, such as Europe's overriding public interest clause and a proposal to **digitalize permitting processes**, are generally pragmatic. However, to continue to shape public trust in renewable energy, it is important that processes are also fair. Transparent communication with stakeholders, backed by thorough environmental impact assessments and certifications, remain essential.

TOP 3 POLICY ACTIONS NEEDED TO SPEED UP RENEWABLES PERMITTING



22%

CREATING A
"ONE-STOP SHOP"
FOR PERMITS
FROM MULTIPLE
DEPARTMENTS



20%

IMPROVING
**BUREAUCRATIC
EFFICIENCY** AND
EMPLOYING
MORE STAFF



17%

SETTING
A **TIME TARGET**
FOR GRANTING
PERMITS

Source: Bureau Veritas Global Energy Survey 2024

“DOUBLING ENERGY EFFICIENCY AND TRIPLING RENEWABLE CAPACITY ARE THE ONLY WAY WE’LL STAY ON TRACK TO 1.5°C, BUT WHILE IT IS POSSIBLE, IT IS NOT YET INEVITABLE.”



BRUCE DOUGLAS

CEO

GLOBAL RENEWABLES ALLIANCE

Bruce Douglas is convinced that renewables will be the dominant power source of the 21st century. He is well positioned to comment, as the CEO of the industry body behind the "Double Down, Triple Up" campaign that led to COP 28 world leaders agreeing to triple global renewable energy capacity and double energy efficiency by 2030.

While the Global Renewables Alliance (GRA) achieved a major milestone in uniting world leaders around a common objective, the reality behind the commitment is a huge challenge. "Tripling up means building and connecting 3 GW every day," says Douglas. "We are currently installing only half that, as there are significant barriers to overcome. **As an industry we believe it is possible, but right now we are way off track. It is time for action.**"

Time4Action is the rallying cry of the GRA's latest campaign, which argues that work is needed on four fronts. First, Douglas says that "**permitting process bottlenecks** should be streamlined to accelerate project development", and second, "we need to ensure a **strong, diversified supply chain** across clean tech to avoid slow rates of renewables deployment at inflated costs." All renewable generation technologies are needed to

work together, alongside storage and flexibility (supply and demand). Third, Douglas encourages urgent "**grid modernization and expansion** to ensure these extra green electrons can "flow".

Last, Douglas turns to finance, the most difficult but also the most important pillar of the campaign: "To ensure investment reaches countries currently underserved by the energy transition, we need a comprehensive mix of policies and regulations, with an emphasis on market incentives, fiscal policy, and the mobilization of public and private finance."

"600 million people in the world don't have access to electricity," he continues, "**so for many emerging economies it's not even a transition, it's about getting access to electricity for the first time.** Often, they face a perfect storm of development and supply chain risk, inflation, and interest rates that increases projects' risk profile. The cost of capital is one of the biggest criteria as to whether a project goes ahead. We are breaking records in renewable deployment, but acceleration is not as fast as it could be, especially in emerging markets. This is one of the most important and urgent actions to guarantee a fast, fair and equitable transition."

Douglas remains optimistic that change can be achieved: "As one of the only countries in the world that is tripling renewables and deploying at scale, China is proving it can be done." He concludes, "We have the technology, it is cost-competitive, and we are seeing great policy initiatives around the world—the EU's recent emergency measures for permitting acceleration, for example. Our campaign title says it all: now it is time for action."

As CEO of CLP Holdings Ltd, one of the largest investor-owned power businesses in the Asia-Pacific region, T.K. Chiang knows from experience that policy and positive change go hand in hand.

“Our investments in the energy transition in China have benefitted from the Government’s commitment to decarbonization as well as the competitiveness of Chinese low-carbon energy technologies.”

CLP has a long history of operating in the region. Founded in Hong Kong more than 120 years ago, it has expanded to as far as India and Australia, with operations spanning the electricity value chain from generation, transmission and distribution to retail. CLP began operating in mainland China in 1979, where it has become one of the largest external investors in the energy sector.

The group has three strategic priorities: **decarbonization, digitalization and workforce transformation**. Chiang identifies decarbonization as CLP’s top priority; he believes CLP has the commitment and roadmap needed to reach net-zero emissions by 2050. Since launching its Climate Vision 2050 blueprint in 2007, CLP has regularly updated its targets according to the latest climate science and international guidelines.

Digitalization is also key as CLP delivers industry-leading customer experiences and enhances its operational performance. The group has rolled out smart meters, cloud-supported solutions, advanced analytics platforms, robots and more.

These priorities have primed CLP for expansion in China, a core market alongside Hong Kong. “Our longstanding commitment, our growing non-carbon energy portfolio and strong partnerships with corporate customers on renewable energy and Energy-as-a-Service solutions position us well,” Chiang observes. “These factors enable us to support the **accelerating decarbonization**

of China, which will continue to lead the way in the global transition to a lower-carbon economy.”

China is at the vanguard of the energy transition, and CLP is well-placed to support this. Renewable and nuclear energy account for nearly 70% of CLP’s installed capacity in the country. CLP helps corporate customers in China decarbonize with power purchase agreements (PPAs) for renewable energy and Green Electricity Certificates (GECs).

Chiang emphasizes the need to **transform power grids to meet consumers’ growing needs** while decreasing emissions. In Hong Kong, for instance, the group is strengthening smart grid development. It has connected 80% of its customers to smart meters that improve efficiency while balancing power demand and supply. It is also expanding transmission assets in India, through Apraava Energy, a joint venture.

Finally, Chiang knows that energy storage has a vital role to play in **making grids more reliable, efficient and sustainable**. To this end, CLP has ramped up development of battery and pumped hydrogen storage projects.

“CLP’s continuing investments in transmission and distribution infrastructure enable us to deliver a reliable, world-class electricity supply as energy needs evolve” concludes Chiang.

T.K.
CHIANG

CEO

CLP HOLDINGS LTD

“CHINA’S CONTINUED LEADERSHIP IN DECARBONIZATION UNDERSCORES THE IMPORTANCE OF A SUPPORTIVE POLICY ENVIRONMENT.”



POWER GRIDS



84%

OF RESPONDENTS CITE
**AN URGENT NEED FOR
INVESTMENT** TO ENABLE
RENEWABLE PROJECTS
TO GET CONNECTED FASTER

MASSIVE INVESTMENT REQUIRED IN POWER GRIDS WORLDWIDE

— Electricity is essential for the technology that will accelerate decarbonization over the coming decade. This makes power grids a vital piece of the energy transition puzzle.

For countries to achieve their national energy and climate goals, **global electricity use needs to grow 20% faster⁽¹³⁾** in the next decade than it did in the previous one. Expanded grids are essential as people adopt electric vehicles and install more electric heating and cooling, and as industry ramps up green hydrogen production.

A CLEAR SENSE OF URGENCY AND SCALE

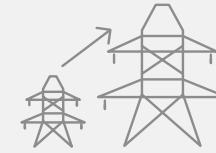
BV Global Energy Survey respondents cite massive investment in the public grid as a top priority if the energy industry is to reach its goal of tripling up renewables capacity by 2030. One in three names underinvestment as the **biggest threat to energy security** over the next three years. Meanwhile, 40% think that their own government has not invested sufficiently in power grids.

It is true that, in most major economies, the **queue of connection requests** is enormous. In the US, projects face an average wait of up to five years to

connect to the grid.⁽¹⁴⁾ In Europe, it can take up to eight years,⁽¹⁵⁾ while in the UK it can take up to 15 years.⁽¹⁶⁾ Curtailment, when renewable production is deliberately reduced to manage demand and supply, is also a growing issue in economies including California, the EU and Chile. This can **impact the economic viability** of projects in operation.

It is therefore not surprising that 84% of survey respondents believe that investing in the grid is essential for enabling renewable projects to get connected faster. That investment should serve both to develop new grid infrastructure and to **improve efficiency**: developing artificial intelligence to manage smart grids is in the top three investment priorities for 38% of survey respondents. The prize is considerable: the US Department of Energy estimates that AI and other grid improvements could free up as much as 100 GW in transmission and distribution capacity in the next five years.

ENABLING ELECTRIFICATION



38%

OF RESPONDENTS SAY LARGE-SCALE INVESTMENT IN GRIDS IS VITAL TO **TRIPLING ELECTRICITY PRODUCTION BY 2030**



1 in 2

RESPONDENTS CITE INVESTING IN POWER GRIDS AS A TOP PRIORITY TO **INCREASE ENERGY SECURITY**

Source: Bureau Veritas Global Energy Survey 2024

(13) Source: IFA, *Electricity Grids and Secure Energy Transitions report, 2023* • (14) Source: *Federal Energy Regulatory Commission*
(15) Source: *BloombergNEF, Tripling Global Renewables by 2030* • (16) Source: *The Economist*

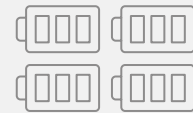
GRID-ENHANCING TECHNOLOGIES

Power cables have not evolved significantly in the past 100 years. Utilities companies and startups are investigating the efficiency potential of emerging technologies.



MATERIALS

Replacing the aluminum and steel used in traditional cables with **advanced conductors**—such as carbon fiber—would enable cables to carry more power.



ENERGY STORAGE

Installing energy storage systems—batteries, hydrogen, pumped storage, compressed air storage or heat storage—at **strategic points** along power lines enables storage of power from renewables during sunny or windy periods, and discharge when the grid is uncongested.



SENSORS

In dynamic line rating, sensors monitor local conditions including temperature to assess how much power can be sent down the line and **increase throughput safely**.



DATA

Innovations ranging from digital twins to data banks enable grid operators and high-load end users to **anticipate supply**, manage resources and make informed decisions. Data can also drive demand-side management.



AI

By better forecasting energy demand and supply, AI would enable providers to adjust production and distribution to **increase flexibility** and reduce the risk of blackouts.

“SIMPLY PUT,
WITHOUT THE RIGHT
GRID INFRASTRUCTURE
IN PLACE THERE WILL BE
NO ENERGY TRANSITION.”



“Build out, particularly at the distribution level, is crucial, and the required scale is substantial.” As CEO of E.ON, one of Europe's largest operators of energy infrastructure, Leonhard Birnbaum is acutely aware of the urgent need for an accelerated scale-up of power grids.

“The growth of renewables and demand from consumers—for example, from electrical vehicles and heat pumps—will increase the number of connections to be processed significantly”.

E.ON recently achieved a significant milestone in connecting the one millionth renewable energy plant in Germany, but Birnbaum notes that further acceleration is needed. “At E.ON alone we will have to make 8 million connections between now and 2030- that’s one connection every seven seconds.”

Birnbaum clearly sets out the **link between increasing electrification and the need for investment** and for policymakers to create a framework that attracts capital.

“Whilst electricity will fuel our economy, we have to fuel electrification with capital. Eurelectric’s Grids for Speed study says we must double our current yearly investment in distribution grids to around €67 billion. That’s not something that happens by itself. We need the EU, national governments and industry all pulling in the same direction to make it happen and time is ticking.”

LEONHARD
BIRNBAUM

CEO, E.ON

Birnbaum emphasizes the value of this approach, **noting that anticipatory investment and increasing flexibility** geared to contain grid congestion could reduce the need for investment to around €55 billion per year.

“Infrastructure must come before the wave, not after. As grid operators we must be able to build the grid out ahead of the huge influx of new connections that are coming our way. And flexibility that does not increase grid load—for example the synchronization of EV charging—is important for balancing the system and ultimately bringing down annual investments required.”

Even so, **financing this transformation remains a challenge** for the industry. “Attractive returns on investments are needed to ensure capital flows in the right direction. The Capital Market Union should be deepened and made more liquid.”

For E.ON and the wider market, scale-up is increasingly powered by digital. **“Everything in our energy system must be digitized as much as possible,”** says Birnbaum. “It’s not a choice but a prerequisite of our future energy system.” Ever-growing digitalization of networks and processes means constantly being a step ahead on a key threat: cybersecurity. “Those attacking critical infrastructure are getting smarter, and the frequency is increasing. We need lean, fast and collaborative procedures: we have a European electricity market, we must be able to protect it as one Europe.”

Looking ahead, Birnbaum is clear on what needs to be done to double investment in grids and triple up renewables capacity. “The targets are set and clear. The focus now must be on implementation.”

SUPPLY CHAINS



57%

**HAVE SEEN NO
IMPROVEMENT** IN SUPPLY
CHAIN RESILIENCE IN
THE LAST 12 MONTHS

THE STATE OF SUPPLY CHAINS

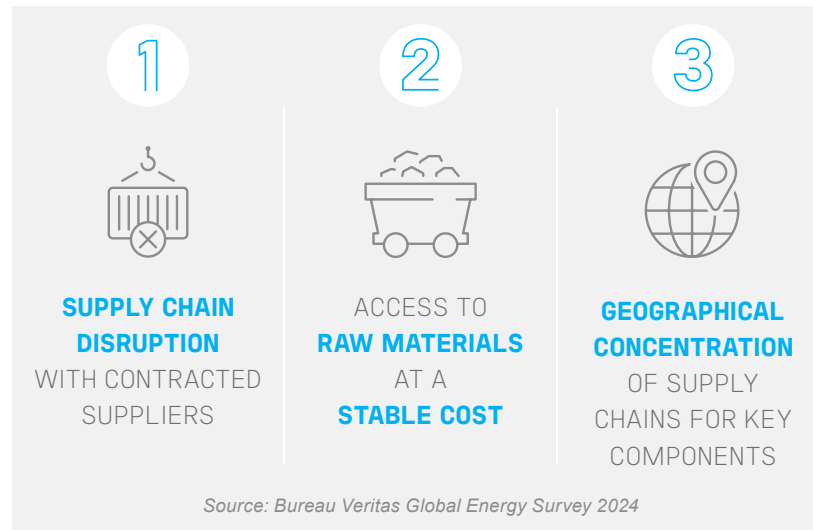
— In last year’s survey, respondents identified supply chains as one of the principal barriers to accelerating the energy transition. This year, issues persist in both the short and the longer term.

In the short term, **production delays and lengthened shipping routes** contribute to supply chain disruption, and accessing raw materials and rare earth minerals at a stable cost is a challenge. Despite the best efforts of regulators, supply chains for key components are often concentrated in a single country or among a handful of suppliers.

Looking forward over the next three years, 25% of BV survey respondents cite **price increases for components** as the number one VUCA threatening the energy transition. A further 44% place it in the top three threats, while 27% add the unavailability of raw materials to the podium ranking.

There is indeed a clear risk that mining, processing and manufacturing will **fail to scale up** quickly enough to meet demand, increasing costs and slowing the transition. And respondents are scarred by experience: in 2021 and 2022, higher input prices for critical minerals, semiconductors and bulk materials drove up prices for key clean energy technologies.

TOP 3 SUPPLY CHAIN ISSUES IN THE NEXT 12 MONTHS



SKILLS SHORTAGES IN SUPPLY CHAINS

Additional challenges remain downstream. A shortage of skilled labor continues to contribute to project delays and disruptions.

While the biggest impact has been felt in the offshore wind sector, skills shortages have also hampered construction progress of grids and nuclear power plants, as well as the installation of heat pumps.⁽¹⁸⁾

Survey respondents confirm that the availability of qualified contractors remains a major issue: 58% have seen no improvement in the availability of skilled engineers and technical staff in the last year, with 22% saying that the situation has actually worsened.

(18) Source: IEA, World Energy Outlook 2023

BRINGING CLEAN TECH MANUFACTURING HOME

— While local clean tech manufacturing can reduce risks created by today’s highly concentrated supply chains, multiple challenges remain for companies looking to move manufacturing closer to home.

For 39% of Bureau Veritas survey respondents, boosting **fiscal incentives for clean technology manufacturing** and plants is a top priority if the energy industry is to reach its goal of tripling up by 2030.

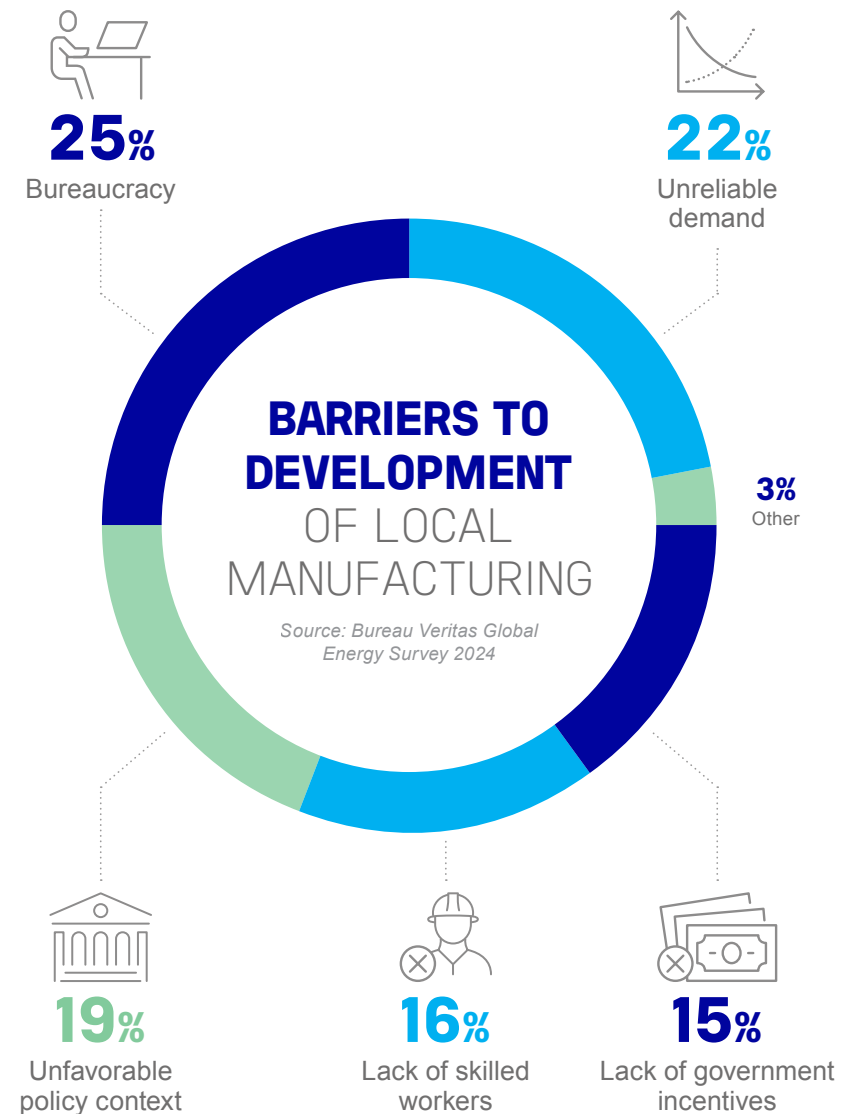
This is necessary to counter the risk created by supply chains for both clean technology and critical minerals remaining **highly concentrated** in a limited number of countries. The three largest producer countries account for at least 70% of manufacturing capacity for key mass-manufactured technologies, with China dominant across the board.⁽¹⁹⁾ Similarly, the top three producer countries for critical minerals account for over 80% of the supply of cobalt, rare earth elements, lithium and platinum.⁽²⁰⁾

NAVIGATING SUPPLY AND DEMAND

Despite these problems, the case for **nearshoring remains complex**. Chinese production is at overcapacity, weakening the case for Western countries to invest in clean tech manufacturing. Companies also face

multiple obstacles to setting up new manufacturing in their home markets. While one in four respondents identifies the main culprit as bureaucracy, others point to a demand problem. Volatile demand at the right price for locally produced components, coupled with weak policy signals and a lack of public financial incentives, can be a killer for fledgling businesses.

With massive scale-up comes the need for **more sophisticated management** of complex and highly diversified supply chains. These will remain an issue for years to come as geopolitical tensions disrupt traditional shipping and supply routes. Companies need to develop **dynamic risk approaches** that take into account shifting VUCA and allow for flexible responses. Companies need to know that the components they source will be supplied reliably and consistently at the right price, and to the right quality.



(19) Source: IEA, Energy Technology Perspectives 2023

(20) Source: IEA, World Energy Outlook 2023

LOCAL MANUFACTURING **AROUND THE WORLD IN 2024**

While half of Bureau Veritas Global Energy Survey respondents believe that governments and companies are making a real effort to improve the geographical diversification of supply chains, 40% say that their own government has not invested sufficiently in developing a clean manufacturing industry.



NORTH AMERICA

The United States has put in place tax credits and federal support for investment in clean energy manufacturing, following the adoption of the 2022 **Inflation Reduction Act**. In 2023, it announced investment of \$26.8 billion in the construction or expansion of 83 manufacturing facilities for utility-scale clean energy across solar, on- and offshore wind, and energy storage.⁽²¹⁾

Canada established funding and tax credit support mechanisms for critical minerals, clean energy technologies, and clean energy manufacturing.



EUROPE

Various regulatory mechanisms have been implemented to boost regional supply chains, including the EU's **Green Deal**, which targets increased public and private investment in clean technology manufacturing.

The European Commission also proposed the **Critical Raw Materials Act** targeting domestic extraction, processing and recycling.

Meanwhile, the **European Wind Power Action Plan** was launched with the aim of accelerating investment and financing for wind manufacturing by facilitating access to EU financing and de-risking guarantees.⁽²²⁾



AUSTRALIA

Australia has earmarked AU\$3.2 billion (€2.0 billion) over the next decade for the **Australian Renewable Energy Agency**, with just over half that sum going to the **Future Made in Australia** Innovation Fund for clean energy technologies, including batteries and low-carbon fuels.

Aiming to onshore clean energy manufacturing and turn Australia into a renewable energy leader, Future Made in Australia makes it simpler for global and domestic capital to be invested in the country by creating investment proposals aligned with the national Net Zero Economy Authority.⁽²³⁾

INTEGRATING SUSTAINABILITY

— For renewable energy to be seen as a credible solution to the climate crisis, it needs to be sustainable.

As well as demanding greater access to renewable energy, today’s citizens are also pushing for higher standards and transparency on environmental impact and circularity. Companies need to source components that are **sustainable by design**, and which can be recycled or reused at the end of their life, while also proving their environmental credentials through audits and certification.

Bulk and critical material production generate the most emissions within clean technology supply chains, so policies need to zero in on **expanding lead markets for low-emission materials**, while also raising minimum recycled content requirements, traceability standards, and environmental, social and governance regulations.

IMPROVING AWARENESS—AND ACTION

Bureau Veritas’ 2024 survey reveals that companies’ thinking on environmental sustainability issues is rapidly evolving. It finds that 67% of companies have taken **circular economy considerations** into

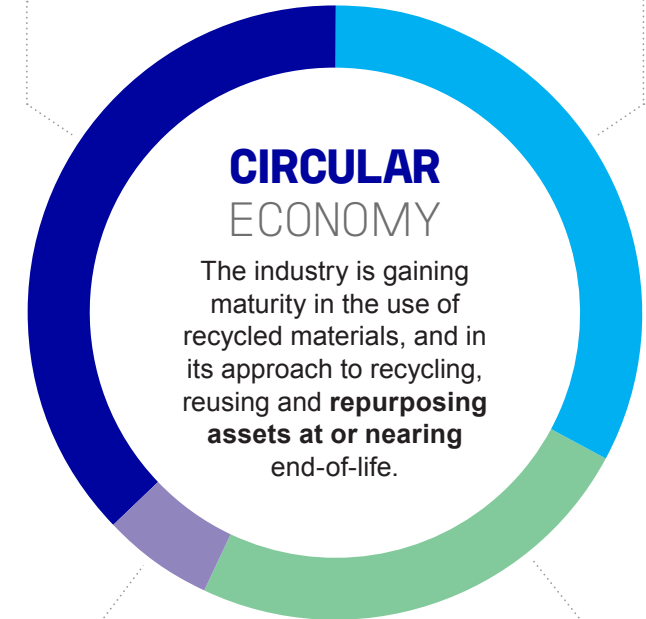
account—up on last year’s 40%. Meanwhile, 53% have a plan to **address embedded carbon** in the manufacturing of components and assets, and 65% apply sustainable design thinking or lifecycle analysis to developing new technology or assets.

Social sustainability is also in the spotlight, thanks to regulation and public scrutiny. In March 2024, the European Council adopted the Corporate Sustainability Due Diligence Directive, which requires companies carry out due diligence to avoid adverse environmental and human rights impacts and ensure accountability.

A full 64% of survey respondents say their company has implemented a plan to address social sustainability in upstream supply chains or is in the process of doing so (up from 46% last year). This increased focus on sustainability is creating the need for more intensive verification of supplier practices and traceability as companies seek to manage strategic risks, ensure compliance, and demonstrate best practice.

37%
Advanced in implementation

33%
Have a plan



6%
Never considered

24%
Discussed

Source: Bureau Veritas Global Energy Survey 2024

“THROUGH REGULATIONS, WE CURB THE GROWTH OF SITES AND SUPPLY CHAINS. IT IS IN THE INTERESTS OF BOTH THE INDUSTRY AND SOCIETY TO KEEP BARRIERS AS LOW AS POSSIBLE.”



LARS HOLM

PARTNER & DIRECTOR

CENTER FOR ENERGY IMPACT

BOSTON CONSULTING GROUP

For Lars Holm, “the goal of tripling renewables capacity by 2030 provides a major opportunity to build strong supply chains.”

As a Partner & Director at the Boston Consulting Group, and an author of the Global Wind Energy Council (GWEC) report, ‘Mission Critical: Building the Global Wind Energy Supply Chain for a 1.5°C World’, Holm is an authority on the barriers facing the wind sector as it scales up.

He notes that while wind power offers almost unlimited possibilities, it has to be installed in the right locations. “Greenhouse gas emissions (GHG) travel around the world, so mitigation measures should be made where they can unfold the biggest impact. **Wind power must be installed where there is both wind and a connection to grids, so we can mitigate GHG emissions and contribute to the resilience of the energy supply.**”

Holm discusses the “curse of innovation”, explaining: “Wind capacity has doubled three times in the past 15 years. In tandem, the levelized cost of energy (LCOE) has plummeted by 65% to 34 \$/MWh, and is expected to fall to just \$24 by 2030. This is good news as it highlights that technological improvements are happening in smaller steps now.”

Therefore, supply chains need to shift focus from major innovations to industrializing, volume advantages and perfecting. **The ‘curse of innovation’ can be lifted by finding a fine balance between innovation and industrialization.** “Solar tech is an example of very high commoditization,” details Holm. “Innovation is happening in wafers whereas the specifications are the same the world over”. Holm does not expect wind turbines to go down the same route. “Wind turbines and their supply chain take into account regional differences in grid infrastructure and the local environment.”

The required massive increase in new wind installations provides industry with the opportunity to scale up its manufacturing footprint. But to industrialize wind energy, says Holm, three major **government-related barriers must first be overcome.**

“The first problem is **bad auction design** which attracts gamblers rather than the most competitive industrial players.” To change this, Holm says auctions must be well prepared and timed so that the winner can and will have financial close within 12 months after winning the auction. This minimizes risks of any changes in material costs and technology changes and ensures that wind parks are operational quickly. Second, he says that, “**boom and bust cycles** in the wind industry are a reflection of policies expiring and new policies being launched. Wind power and PV have the lowest costs and LCOE: they need no subsidies, just the right market context and infrastructure to take off.” Lastly, Holm notes that we need to **resolve bottlenecks** in the permitting process and grid build out, something which can only be resolved by policy change.

INNOVATION



35%

PRIORITIZE
**TAX INCENTIVES AND
GOVERNMENT GRANTS**
TO DRIVE INNOVATION

EVOLVING PRIORITIES IN INNOVATION

— The focus of innovation may have shifted—but the energy industry still looks to government to create the right conditions for it to thrive.

While in this year’s survey a number of factors—notably government policy and grid build-out—trumped innovation in respondents’ ranking of challenges to overcome, its continuing importance should not be underestimated.

The main power generation technologies needed for the energy transition already exist. In our survey, solar panels and wind turbine components rank lowest in the respondents’ list of priorities for technology development. **Innovation in wind is now more about industrialization:** designs need to become global and modular to enable scale-up and a return to profitability for manufacturers. For solar PV panels, innovations similarly target greater efficiency and integration.

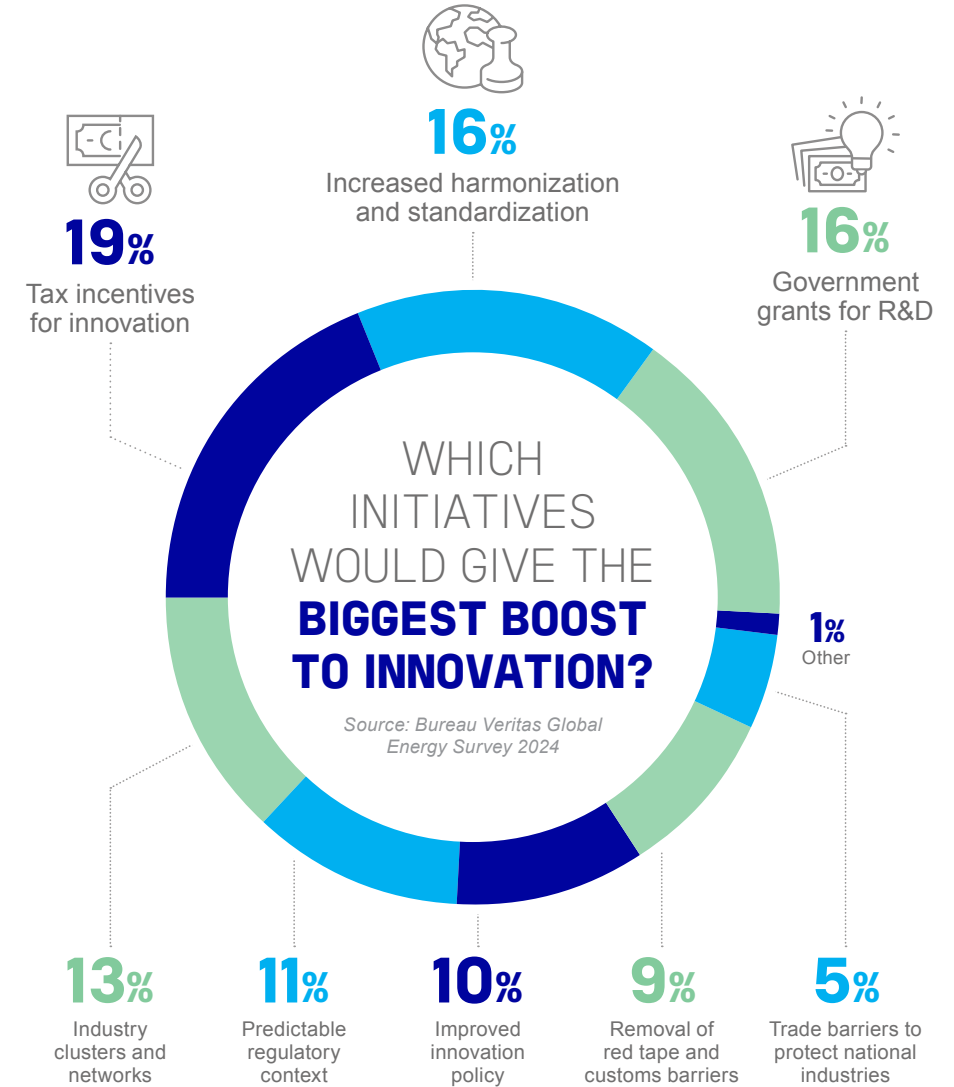
Technologies that enable energy storage are considered much higher priorities. These solve both the problem of the intermittent nature of many renewable energies and the need to store energy for later use or, as with hydrogen, to convert renewable energy into fuel for hard-to-abate industries. Encouragingly, survey

respondents say this year that that the pace of innovation and cost reduction for battery storage technologies (53%) and electrolyzers (40%) has improved.

THE ROLE OF GOVERNMENT IN INNOVATION

Whatever the domain of innovation, the energy industry looks primarily to government to create the right conditions for research, development and commercialization.

In Bureau Veritas’ survey, a third of all respondents say they believe **tax incentives and government grants** to be of the highest importance in driving innovation. A further 16% say that increased international harmonization and standardization are necessary to level the international playing field, while just over a tenth of respondents feel that a predictable regulatory context is a crucial prerequisite for innovation to thrive.

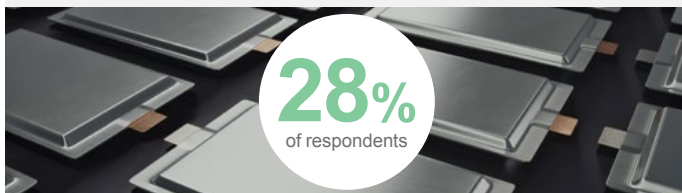


3 AREAS OF FOCUS IDENTIFIED FOR INNOVATION

Trust is a prerequisite to technology development and adoption, as customers need to know that solutions are safe, reliable and perform as required. Approvals in Principle and certification help shape the trust needed for new technologies to take off.

BATTERIES

Due to **increased deployment of intermittent renewable energy** sources like solar and wind power, innovations in battery technology for renewable energy storage have become crucial. Efficient solutions are needed to store and distribute the excess energy generated during favorable conditions for later use. Significant advancements have been made in battery technologies such as lithium-ion, flow, solid-state and redox flow batteries. These innovations aim to improve energy density, cycle life, safety, and scalability while reducing costs.



FLOATING TECHNOLOGIES

The next frontier for renewables' star technologies, wind and solar, is getting them to float. Floating wind and solar technologies are at pilot stage and **require further industrialization**, but offer considerable advantages to their fixed counterparts. They enable access to suitable windy or sunny areas where the sea is much too deep for fixed installations. Floating systems are also less reliant on large and expensive installation vessels. Plus, solar and wind farms out at sea have reduced environmental impact and have a greater capacity than fixed farms.



ELECTROLYZERS

The cost premium for green hydrogen versus grey remains a giant barrier to scale-up of projects. Since electricity represents around 45-60% of the levelized cost of hydrogen, improving electrolyzer efficiency and flexibility is **key to reducing costs**. While alkaline technology is currently the least expensive, it also consumes the most electricity. The industry is therefore focusing on improving the cost competitiveness of next-generation technologies like proton exchange membrane (PEM) electrolysis, and industrializing high-temperature electrolysis, for example in solid-oxide-electrolyzer-cell technology.



For Marco Arcelli, CEO of ACWA Power, innovation and rapid expansion go hand in hand.

Founded in Saudi Arabia two decades ago, ACWA Power has been a major international energy player since expanding abroad in 2009. It now develops, invests in, and operates power, desalinated water, and green hydrogen plants, boasting a portfolio of 82 assets across four regions. Today, the company prides itself on being at the forefront of the energy transition, championing a decarbonized and more sustainable future.

“Our experience demonstrates the value of government sending a strong signal to the market,” says Arcelli. “Saudi Arabia’s Vision 2030, which came out in 2016-17 with the goal of diversifying the domestic market, gave us a significant base to build on. With the promise of scale came the ability to leverage it. It created a springboard to develop technology, expand internationally, and scale up in a cost-competitive way.”

A key factor in ACWA’s success is its **commitment to cost leadership**, and central to this position is innovation. “We foster an open innovation environment,” explains Arcelli. “We select technology that can be commercialized within three to four years, and choose suppliers from around the world. We bring them to the best technology centers in Saudi Arabia and then, if the results are good, we bring them in on our projects.” ACWA is currently focusing on innovation in electrolyzers to make green molecules cheaper; boosting electricity storage options through both batteries and air storage; and carbon capture, utilization and storage (CCUS) technologies.

ACWA’s innovation approach extends to all aspects of its business. **The company’s strong emphasis on cost leadership is underpinned by its approach to project financing.** It identifies innovative suppliers in areas or geographies where they are needed, for example, sourcing providers able to customize solar panels adapted to the very high temperatures in Saudi Arabia. “Then we set up the project financing and invite equity partners to participate,” says Arcelli. **“For every dollar we invest, we obtain 10 from equity and financial partners.** This enables us to scale up faster and makes us an attractive partner for both countries and equity partners.”

Arcelli is cognizant of the need for speed in the energy transition, and he believes this depends on factors beyond technology and finance. **ACWA’s approach is to invest heavily in training.** “We know that acceleration depends on having the right personnel,” explains Arcelli. “We have two training academies in Saudi Arabia and Uzbekistan, from which 1,000 people graduate each year. Our ambition is to triple the size of the company by 2030, and to do this we are investing \$20 billion each year.”

MARCO
ARCELLI

CEO

ACWA POWER

⚡ THE ENERGY
TRANSITION NEEDS
TO BE SUSTAINABLE,
AFFORDABLE AND SECURE.
I HAVE ZERO DOUBT THAT IT
WILL HAPPEN – THE QUESTION
IS JUST HOW QUICKLY.”



NUCLEAR



45%

BELIEVE THE TRANSITION TO
A LOW-CARBON ECONOMY
IS **IMPOSSIBLE WITHOUT**
NUCLEAR POWER

AN EXPANDED ROLE FOR NUCLEAR

— Nuclear energy has the potential to make the transition faster and more secure. Developing it requires investment and innovation to prolong the life of existing plants and build new ones.

The global energy crisis underlined the importance of reducing reliance on imported fossil fuels. At the same time, achieving net zero by 2050 demands accelerated and complete decarbonization of electricity and heat production.

Nuclear energy provides a solution to both these challenges. With 413 gigawatts (GW) of capacity worldwide, it avoids 1.5 gigatons (Gt) of emissions and 180 billion cubic meters of global gas demand every year. It is also dispatchable, making it a useful complement to intermittent renewable energy.

For these reasons, the IEA envisages **more than doubling nuclear electricity generation** by 2050. Increasingly, governments are embracing this reality: since COP28, 25 countries have pledged to work toward tripling nuclear capacity by 2050.

The Bureau Veritas survey supports these projections. Nearly half of participants believe that transitioning to a low-carbon economy is impossible without nuclear power, while 34% believe extending the life of existing nuclear power plants is a top-three priority.

NEW REACTORS— AND EXTENDED OPERATIONS

To meet these aims, investment, innovation and political will must be leveraged to construct **new pressurized water reactors** (PWRs), including European pressurized reactors (EPRs) with a focus on cost control. Small modular reactors (SMRs) will increasingly play an important role (see box).

China completed two large reactors in 2022, with four more in construction. The same year, France agreed to construct six large nuclear reactors, while the UK is now targeting eight new large reactors, as well as SMRs. In 2023, Finland completed Olkiluoto 3, Western Europe's first new nuclear reactor in 15 years, and Flamanville 3 in France has commenced startup.

It will also be necessary to **extend the life of existing plants** safely. Belgium has extended the operation of two reactors from 2025 to 2035, while Japan has legislated to allow power companies to operate nuclear assets for longer, in some cases over 60 years. In the US, tax credits for zero-emission nuclear power have dramatically improved the economics of existing reactors.



23%

PRIORITIZE INVESTMENT IN SMRs

Source: Bureau Veritas Global Energy Survey 2024

SMRs are advanced nuclear reactors with a power capacity of up to 300 MW(e) per unit, about one-third the capacity of traditional reactors. Nearly a quarter of BV survey respondents believe that their development is a top-three priority for innovation investment.

SMRs offer myriad benefits. Their small size allows them to be used on sites unsuitable for larger nuclear power plants, and their components can be prefabricated and installed on site, making them more affordable than large reactors. In addition to generating electricity, they can supply heat for industrial applications, district heating, as well as for production of hydrogen. As well as offering cost and construction time savings, they can be deployed incrementally to match increasing energy demand.

Rafael Mariano Grossi believes that, to achieve its full potential, nuclear energy will require a massive increase in investment, at least doubling from current levels to \$100 billion annually.

As the Director General of the International Atomic Energy Agency (IAEA), Grossi has a perfect vantage point from which to assess what is needed for nuclear power to play its full role in the energy transition. “Nuclear currently provides about **25% of all low-carbon electricity** and avoids more than 1 gigaton (Gt) of CO₂ emissions annually, while supporting energy system reliability, climate resilience, and energy security,” he explains.

Nuclear is particularly useful as it can help **decarbonize hard-to-abate sectors** by enabling the production of low-carbon heat and hydrogen, as well as seawater desalination and district heating for buildings. “Advanced nuclear reactors, including small modular reactors (SMRs), can play a key role in the energy transition, providing flexible power and non-power applications for countries and end users,” says Grossi. “However, regulatory harmonization and industrial standardization are needed to deploy at scale.”

The kind of scale-up the IAEA is calling for requires both the **extension of the lifespan of existing reactors** and new builds. “Extending the operations of existing reactors is the most economical investment in low-carbon electricity generation available today,” says Grossi. “A further 59 nuclear power reactors, almost all of them large pressurized water reactors (PWRs), are currently under construction in 15 countries.”

Countries are currently seeking solutions that address not only climate change, but also energy security and price stability. “More than 30 countries are now considering or implementing nuclear power—primarily through large conventional reactors like PWRs, but also through SMRs. These **promising technologies can boost efficiency** and, when operated in a closed fuel cycle with fast reactors, make nuclear power sustainable for thousands of years.”

Grossi is cognizant of the challenges facing the nuclear industry. “While financing is the nuclear industry’s main challenge, we also need bigger and better supply chains and a new generation of trained human talent. That includes inculcating **proper safety culture and management systems** to ensure safe, secure and efficient operations across the fuel cycle. Crucially, this implies enhancements in the management of spent nuclear fuel from reactors, a topic that is at the heart of the public acceptance question.”

On this note, Grossi concludes that “there has been a clear **evolution in public perception** of nuclear power over the last few years. The world’s leading climate scientists see a vital role for nuclear energy in reaching net zero, and the energy crisis raised awareness of nuclear power as a means to energy security and price stability, in addition to climate action.”

RAFAEL MARIANO
GROSSI

DIRECTOR GENERAL

INTERNATIONAL ATOMIC ENERGY AGENCY

“FINANCING REMAINS THE BIGGEST CHALLENGE FACING NUCLEAR POWER. THIS MUST BE OVERCOME FOR COUNTRIES TO DOUBLE NUCLEAR CAPACITY TO MEET NET ZERO, OR TRIPLE IT TO FULFILL THE COP28 PLEDGE MADE BY MANY OF THEM.”



TRANSITION FUELS

HYDROGEN AND RENEWABLE GASES



45%

**BELIEVE GREEN HYDROGEN
IS ESSENTIAL TO DECARBONIZE
HARD-TO-ABATE INDUSTRIES**

THE ROLE OF GAS

— As we move toward a low-carbon economy, conventional fuels continue to play a key role in delivering affordable energy, with natural gas in particular an important transition option.

Gas retains a privileged position among conventional fuels when it comes to the energy transition. A majority (55%) of survey respondents believe the recognition of liquefied natural gas (LNG) and natural gas as transition fuels is **essential to ensure energy security and a just transition**. An even larger number of respondents (73%) agree that the transition from coal to natural gas is a necessary step in the path to a low-carbon future.

Nonetheless, recent geopolitical tensions have spotlighted energy security and exposed the **danger of relying on imported hydrocarbons**. During the 2022 energy crisis, industry was more exposed to high commodity prices than households, paying on average 70% more for natural gas than in 2021, and around 25% more for electricity.⁽²⁴⁾

DIVERSIFICATION AND DECARBONIZATION

For this reason, many countries are actively seeking to **diversify their energy supply** with alternative sources of natural gas from “friendly” countries. A surge in new LNG projects will add 250 billion cubic meters (m³) per year of liquefaction capacity by 2030,

equal to almost half today's global LNG supply. Over half of all new projects are in the United States and Qatar.

In addition, policymakers and industrial companies are looking to low-carbon fuels such as **biogas and biomethane**, which can be easily injected into existing gas networks.

As part of its REPowerEU Plan, the EU is looking to scale up biomethane production to produce 35 billion m³ (bcm) of biomethane, in the form of biogas or its upgraded version, per year by 2030. To this end, it has launched the **Biomethane Industrial Partnership**, intended to promote active engagement between the Commission, EU countries, industry representatives, feedstock producers, academics, and non-governmental organizations.



73%

BELIEVE THAT NATURAL GAS HAS
**AN ESSENTIAL ROLE TO PLAY IN THE
TRANSITION TO A NET-ZERO FUTURE**

Source: Bureau Veritas Global Energy Survey 2024



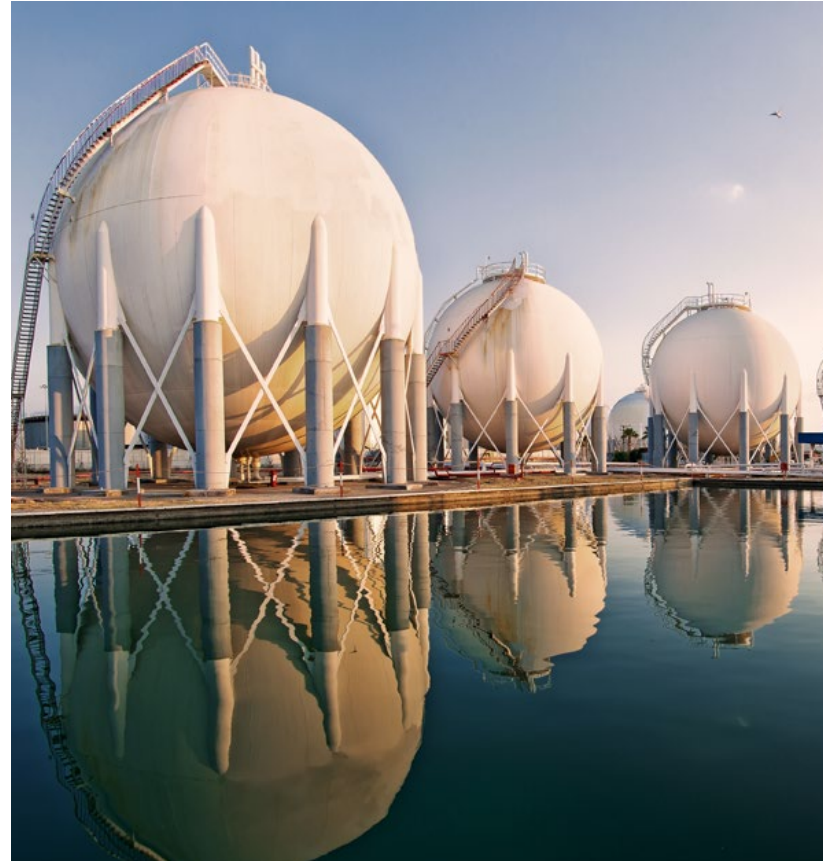
(24) Source: IEA, World Energy Outlook 2023

DECARBONIZING **HARD-TO-ABATE SECTORS**

RENEWABLE HYDROGEN

Renewable hydrogen has an important role to play in **decarbonizing hard-to-abate sectors** and enables energy storage, supporting the integration of variable renewables in the electricity system. In Bureau Veritas' survey, 46% of respondents say investment in the hydrogen value chain has improved, while 45% believe developing renewable hydrogen at scale is the only answer to decarbonizing hard-to-abate industries.

However, uncertainty around future demand, regulation and certification, plus a lack of infrastructure, have been slowing down investment decisions in the last 24 months. Governments must act quickly, implementing policies that boost demand for low-emission hydrogen and open up investment. This includes significant capacity additions in electrolyzers (see page 28), a critical technology for producing low-emission hydrogen from renewable or nuclear electricity. Incentives to develop electrolyzers are identified by one in five survey respondents as today's most important government initiative.



CARBON CAPTURE

For **hard-to-abate sectors**, including cement, steel or chemicals manufacturing, carbon capture, utilization and storage (CCUS) offers a route to reducing emissions. It can also be used in low-carbon hydrogen production to support **decarbonization of transportation**.

One in two Bureau Veritas survey respondents believes carbon capture to be a crucial technology offering. A further one in three says that CCUS should be made an R&D priority over the next three years.



“GAS HAS A THREEFOLD ROLE TO PLAY IN THE ENERGY TRANSITION: REPLACING COAL IN POWER GENERATION, ADDRESSING THE ISSUE OF INTERMITTENCY IN RENEWABLES AND CONVERTING ITSELF FROM NATURAL GAS TO CARBON GASES IN THE NETWORK.”



DIDIER HOLLEAUX

EXECUTIVE VICE PRESIDENT

ENGIE

For Didier Holleaux, “gas is an important part of the energy transition both for the short-term replacement of coal and longer-term development of biogas and biomethane.”

With over 30 years’ experience in the energy sector, Holleaux has been the Executive Vice President of French energy giant ENGIE for nearly a decade. From 2021 to 2024, he was President of Eurogas, the main professional association for the European gas industry.

“Coal still supplies just over a third of global electricity generation even though it is the most carbon-intensive fossil fuel,” he explains. “Gas provides an **excellent lower-emission alternative** in the short term. As we move toward renewable power sources, gas also offers an option to compensate when the production of clean energy fluctuates. In addition, the advantage of a gas network is that you can use **existing infrastructure while introducing cleaner gases** like biogas and biomethane.”

In addition to cutting carbon emissions, **biomethane offers the advantage of improving energy security and autonomy**. “Today, Europe is facing huge uncertainty in gas supply as we are dependent on too few countries for supply,” explains Holleaux. “The biggest risk is with

the supply of natural gas from Russia, of course, but the US election also represents a risk to liquefied natural gas supplies. Biomethane deals with the issue of energy security as it is produced in Europe, and its potential is huge as it has same characteristics as natural gas and can be certified CO₂-free.”

Holleaux adds that while customers are prepared to pay more for green gas, they require **workable, verified accounting**: “We need an efficient system of guarantees of origin that allows renewable or low-CO₂ gas to be taken out of the network with the correct certificate, so that each clean gas molecule reaches the customer prepared to pay most for green gas.”

Priorities for the development of the use of gas are **efficiency and methane emissions mitigation**. “It is important we focus on the most efficient ways of using gas, which often means taking a hybrid approach, for example, by using efficient burners or combining gas with the use of waste heat and heat pumps where possible,” explains Holleaux.

“We also have to do whatever it takes to fight methane emissions, both to avoid contributing to global warming and to boost efficiency even further by using that methane as a fuel. The gas industry as a whole recognizes the need for this; according to the IEA methane tracker, in the last three years the share of the gas industry in global methane emissions has gone from 8 to 5%. To go further, we need an international, coordinate share of the position on methane emissions, with one idea being to ask the International Organization for Standardization (ISO) to work on a common standard, for measurement, reporting and verification of methane emissions.”

METHANE EMISSIONS



45%

**CITE LEAK DETECTION
AND REPAIR PROGRAMS
AS THE #1 WAY TO CUT
METHANE EMISSIONS**

METHANE: A SENSE OF URGENCY

— Methane plays an outsized role in global warming. This makes mitigating emissions a top priority.

Methane is a short-lived greenhouse gas but has greater heat-trapping potential than CO₂: on a 20-year timescale, **methane is 84 times more potent**. The energy sector, including oil, natural gas, coal and bioenergy, accounts for nearly 40% of human-generated methane emissions, estimated at 356 Mt.⁽²⁵⁾

Efforts to address the problem have historically faced the challenge that the location and magnitude of emissions have not always been clear. Methane data are incomplete for different reasons, including **uncertainties in methane estimation methods** (based on emission factors) the challenge of quantifying diffuse methane and lack of focus on methane's global heating potential until relatively recently.

Due to the fact that **methane has not been a political priority** until recently, the availability of measurement-based quantification at different scales remains limited. Most emission estimates at the national and entity levels currently rely on standard emission factors.

SOLUTIONS TO REDUCE EMISSIONS

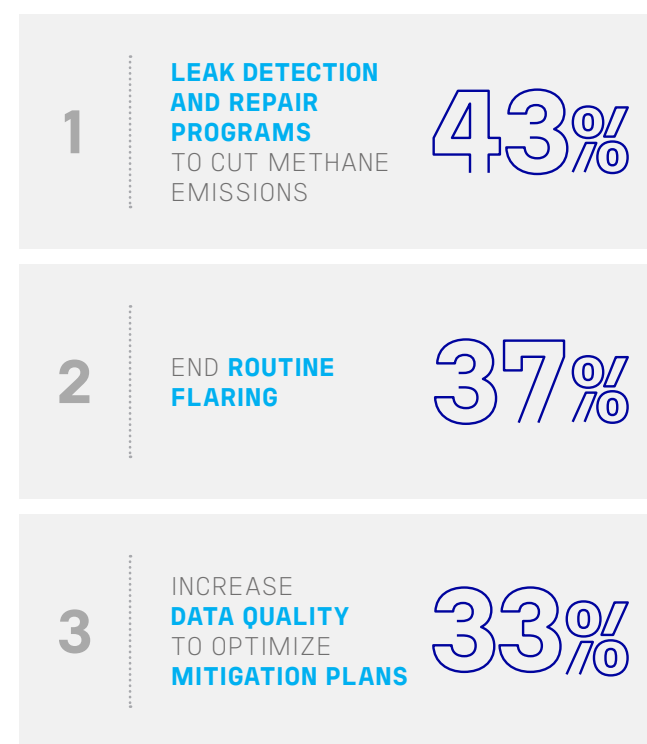
Reducing **methane emissions from oil and gas production** is one of the most effective contributors to help achieve the Paris Agreement objectives. A growing focus on emissions reduction is encouraging energy players to shift from generic estimation to state-of-the-art, multi-scale, measurement-based emission quantification. The final aim of these methods is to provide actionable data that can be used to further reduce emissions and track changes in emissions evolution.

Technologies and measures to eliminate methane emissions from oil and gas operations include **leak detection and repair campaigns**, installing emissions control devices, replacing components that emit methane in their normal operations, and methods to limit non-emergency flaring and venting. The IEA estimates that adopting these measures worldwide would **halve worldwide emissions** from oil and gas operations.⁽²⁶⁾

Bureau Veritas' survey highlights the urgency of these actions. When asked to identify the biggest opportunities to cut emissions from fossil fuel production, methane mitigation initiatives dominate the ranking (see opposite).

CUTTING METHANE EMISSIONS

Survey respondents highlight three main ways to cut methane emissions from fossil fuel production.



Source: Bureau Veritas Global Energy Survey 2024.

(25) Source: IEA

(26) Source: IEA

POLICY ACTION ON METHANE

— Numerous international initiatives and policy actions, backed by monitoring and verification, have been launched to cut emissions.

Over 130 companies have joined OGMP 2.0, UNEP's comprehensive, measurement-based reporting framework for the oil and gas industry that improves the accuracy and transparency of methane emissions reporting.

OGMP 2.0 established **five reporting levels** that increase in granularity and accuracy: the highest of these levels, Level 5, requires emission estimates that include the reconciliation of source-level estimates with site-level measurements.

THE EU METHANE REGULATION

Most recently, the **EU's Methane Regulation**, adopted in May 2024, obliges energy producers to report and verify their methane emissions and take action to reduce them. It comprises three main elements.

First, it includes a mandatory requirement to build a **reliable inventory of emissions** covering all the potential sources to be assessed. As far as possible, this assessment must be carried out through measurement-based quantification at a granular level.

Then based on the emissions inventory, energy producers need to leverage the best available technology to **measure and quantify** the different categories of emissions, ranging from fugitive, venting, stationary combustion and flaring.

Finally, based on the mitigation plan data-driven, they can **reduce emissions** via actions such as leak repair and optimizing operational parameters. They can also stop avoidable and routine flaring and limit flaring and venting to emergencies, technical malfunctions or situations in which it is necessary for safety reasons.

The regulation will also gradually apply to companies exporting to the EU and the Commission will put in place a **satellite data-based tool** to monitor high-emitting methane sources around the world to help energy players to move forward based on identified priorities and deep dive at more granular level.



REducing methane emissions is the easiest, fastest way to reduce global warming in the short term. We need to run the methane sprint to win the CO2 marathon.”



Giulia Ferrini believes that “methane emissions reduction has a huge mitigation potential in the energy sector: the International Energy Agency estimates that oil and gas could reduce 70% of emissions, including 40% at no net cost.”

The United Nations Environment Programme (UNEP) has been a leader on the subject of methane for over a decade. As UNEP Programme Officer, Ferrini heads up the Oil and Gas Methane Partnership 2.0 (OGMP 2.0), the organization’s flagship reporting and mitigation program for the oil and gas sector. She also oversees the International Methane Emissions Observatory (IMEO)’s operations.

OGMP 2.0’s aim is to support companies to build **comprehensive and reliable emission inventories** and shift from estimation to measurement. Increasing emission data quality boosts companies’ ability to take reliable data-driven decision to implement emission mitigation plans. “We have implemented a framework that companies across the globe can use,” says Ferrini. “By equipping companies with better empirical data, they can target their emissions efforts to the largest sources.”

OGMP 2.0 establishes five reporting levels, with the highest (Level 5) requiring that companies reconcile their source-level (Level 4) emission inventories with measurements at the site

GIULIA FERRINI

PROGRAMME OFFICER

UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP)

level. This is crucial to ensure that inventories do not overlook any major sources and give companies the necessary **insights to drive mitigation initiatives.**

Ferrini offers an example of how this helps companies. “One company compared their OGMP 2.0 Level 3 reporting with that at Level 4 and found they were emitting more than twice the previously estimated amount, and in completely different places. If they had based their strategy on estimates without empirical data, they would have wasted significant efforts and resources. Accurate data enables companies to channel resources to the right places, increasing efficiency in mitigating emissions.”

“In fact,” adds Ferrini, “with **increasing investor attention on methane and emissions reporting**, OGMP 2.0 is seen as a credible indicator of a company’s ability to manage these liabilities. This makes it an important component of companies’ environmental, social and governance strategies.”

OGMP 2.0 is part of a wider effort to put open, reliable, and actionable data into the hands of individuals with the power to reduce emissions. “UNEP’s International Methane Emissions Observatory collects, synthesizes, and publishes data from multiple sources, including OGMP 2.0. It is a core implementing partner of the 150-nation Global Methane Pledge to **reduce global methane emissions by 30% by 2030** from 2020 levels. Meanwhile, the EU’s new Methane Regulation – which is based on OGMP 2.0 – obliges energy producers to report and verify their methane emissions and take action to reduce them.”

“We are seeing more and more calls for companies to join OGMP 2.0,” concludes Ferrini. “The benefits for the environment and the bottom line are clear, and companies can enjoy unparalleled access to a community of best practice and collective learning.”

HOW TO TRIUPLE UP



45%

WANT TO SEE FINANCIAL INCENTIVES FOR CARBON-INTENSIVE BUSINESSES TO INVEST IN RENEWABLES.

SCALING UP IN A VUCA WORLD

— This is a pivotal decade for the energy transition. It is in our power to deliver a more secure, more sustainable, more affordable, but also more inclusive energy system.

At COP 28, 130 countries made a commitment to triple renewable energy capacity by 2030 in order to limit global temperature rises to 1.5°C. This is a hugely ambitious goal, which relies on the collective efforts of the energy industry and government to accelerate further.

We are starting from a strong point. More renewables capacity was added in 2023 than in any year in the past. After two decades of continuous transformation, it is clear that we are now in an accelerated delivery phase with renewable energy at the very core of the transition.

However, we face two issues. The first is that the scale-up achieved to date is impressive, yet insufficient for the world to meet its climate goals. The second is the very real possibility that progress will be derailed by the multiple vulnerabilities, uncertainties, complexities and ambiguities (VUCA) that dominate the world we live in. In short, the energy industry needs to achieve its biggest ever transformation at a time of unprecedented disruption.

TACKLING SYSTEMIC BARRIERS

A key theme to emerge from last year's report was the importance of strong signals from government. The past 12 months have underscored this view. One of the biggest barriers identified in last year's report—permitting—has seen the most significant progress precisely because policymakers have chosen to tackle the issue and enact ambitious legislation. The result is faster permitting and greater certainty for project developers.

To triple up requires this type of **ambitious thinking across the board**. This is because the energy transition represents a massive systemic change at a global level. It cannot be achieved by individual companies or countries.

The public and private sectors need to work together to address complex, interlinked issues. These range from scaling up clean manufacturing—seen as a top priority by nearly 40% of industry leaders and experts—to creating additional sources of finance (23%) and training or upskilling thousands of engineers worldwide (22%).

TRIPLING UP
RENEWABLE
ENERGY
DEPLOYMENT
**DEMANDS RAPID
SYSTEMIC CHANGE.**

SCALING UP IN A VUCA WORLD

(Cont.)

In some cases, respondents are **actively looking for regulation** to create a level playing field for investment. Just over a third of respondents want more stringent national targets for carbon reduction and 45% are keen on financial incentives for carbon-intensive businesses to reinvest profits in renewables.

It is unsurprising that the topic that emerged most frequently in this year's survey was **power grids**. No other issue or technology better exemplifies the huge challenges and opportunities the energy industry faces as it works to triple up. For 84% of respondents, investment in grids is essential to enable projects to get connected fast enough. At the same time, 40% believe their own government is failing to invest sufficiently. Thousands of new turbines and solar panels are only useful if they're plugged in.

NAVIGATING A COMPLEX WORLD

VUCA are not new. Supply chains have been in flux for several years. Populism emerged as a serious trend to be reckoned with in the middle of the last

decade. Inflation in many countries looks to be trending downwards. The strongest growth in renewables capacity has been achieved during this period.

To move forward as industry leaders, we need to get used to the fact that **VUCA are here to stay**. To deal with major systemic issues, in an ever-shifting world, we need to hone our adaptive capabilities, find new ways to collaborate and put all our energy toward finding solutions to break down barriers and find solutions.

**THIS IS HOW
WE WILL TRIPLE UP
IN A VUCA WORLD.**



ABOUT BUREAU VERITAS

AT BUREAU VERITAS WE WORK TO MEET THE WORLD'S ACCELERATED NEED FOR SECURE, SUSTAINABLE, AND AFFORDABLE ENERGY.

As an independent technical advisor to the energy sector and pool of trusted experts, we play a pivotal role in **accelerating the energy transition**.

We leverage our global reach, close to our customers' assets and supply chains, to support energy developers and operators along the entire energy value chain to shape a secure net zero future.

By building on the **technical expertise** acquired over decades of energy industry leadership, we ensure continuity of knowhow and best practices, and that the right skills are available to build the energy sector of tomorrow.

Our goal is to contribute to a **decarbonized, reliable, and flexible** energy system that works for all. Meeting the goals of the Paris Agreement means rapidly scaling up deployment of renewable energy projects while achieving deep cuts in emissions from legacy energy assets.

We provide the expertise our clients need to **remove barriers to massive investment** in clean energy; and work hand-in-hand with producers to maximize the efficiency and sustainability of new and operational conventional energy assets. Our late-life asset & decommissioning expertise ensures the energy transition, and the retirement and reuse of legacy assets, are handled in an orderly way, and with care.

An accelerated energy transition brings new risks and vulnerabilities. Bureau Veritas' **technical advisory, engineering, verification, and certification** services shape trust at every stage of a project. They enable our clients to tackle

complex challenges, from regulatory context and new technology development to the transformation and scale-up of supply chains, and the massive mobilization of a reskilled workforce.

THIS IS HOW WE ARE SHAPING TRUST IN ENERGY SYSTEMS AND SUPPORTING THE WORLD ON A SECURE JOURNEY TO NET ZERO.



To find out more about how Bureau Veritas supports the energy industry

www.group.bureauveritas.com

GLOSSARY

CARBON FOOTPRINT: The total greenhouse gas emissions caused by an organization, event, product or person.

CCUS (CARBON CAPTURE, UTILIZATION AND STORAGE): the capture, typically close to the source of emissions, and permanent sequestration of carbon dioxide or recycling into a new application.

CIRCULAR ECONOMY: A model of consumption and production based on refurbishing, recycling and reusing existing materials and products to reduce waste.

CRITICAL RAW MATERIALS ACT: A legislative proposal by the European Commission to increase the EU's autonomy in the supply of key raw materials.

DECARBONIZATION: Reducing with a view to elimination emissions of greenhouse gases, generally by replacing energy produced from fossil fuels.

EMBEDDED CARBON: the carbon dioxide emissions associated with materials and production or construction processes throughout the whole lifecycle of a product, building or infrastructure.

ESG (ENVIRONMENTAL SOCIAL GOVERNANCE): a framework used to assess an organization's business practices and performance on various sustainability issues and corporate governance topics and measure risks in those areas.

EUROPEAN GREEN DEAL: a set of legislative proposals to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels.

EU DIRECTIVE ON CORPORATE SUSTAINABILITY DUE DILIGENCE: a draft legislative proposal to identify, prevent, stop, mitigate and account for negative human rights and environmental impacts in a company's own operations and those of their subsidiaries and suppliers.

GREEN FINANCE: the broad range of financial instruments used to finance sustainable investments, from green bonds and social bonds to equity financing based on ESG criteria. GHG: Greenhouse gases including carbon dioxide, methane, ozone, nitrous oxide and hydrofluorocarbons responsible for heating the earth's atmosphere.

GREEN HYDROGEN: hydrogen that is generated from renewable energy, such as wind or solar power.

IEA (INTERNATIONAL ENERGY AGENCY): a Paris- based autonomous intergovernmental organization, that provides policy recommendations, analysis and data on the entire global energy sector.

INFLATION REDUCTION ACT: a set of legislative proposals approved by the US Congress in 2022 to reduce domestic inflation while tackling climate change, notably by reducing carbon emissions by around 40% by 2030.

IPCC (INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE): a body of the United Nations whose role is to advance scientific knowledge about climate change caused by human activities.

IRENA (INTERNATIONAL RENEWABLE ENERGY AGENCY): an intergovernmental organization whose role is to facilitate cooperation, advance knowledge, and promote the adoption and sustainable use of renewable energies.

LCOE (LEVELIZED COST OF ENERGY): the minimum constant price at which electricity needs to be sold in order to break even over the lifetime of a project.

LOW-CARBON ENERGY / CLEAN ENERGY: all energy generated from sources that emit lower emissions, including wind, solar, hydro and nuclear power.

NET ZERO: the ambition by organizations or countries to cut emissions to as close to zero as possible.

NET ZERO INDUSTRY ACT: a legislative proposal by the European Commission as part of the Green Deal to scale up the manufacturing of clean technologies in the European Union.

PARIS AGREEMENT: a binding international treaty adopted at the UN Climate Change Conference (COP21) in 2015. Its goal is hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C above pre- industrial levels.

RENEWABLE ENERGY: all energy produced from sources that are not depleted when used, such as wind, solar or tidal power.

SMR (SMALL MODULAR REACTOR): next-generation nuclear reactors that have a power capacity of up to 300 MW(e) per unit, around one-third of the generating capacity of traditional nuclear power reactors.

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Marco Arcelli

CEO
ACWA Power

Homa Bahrami

Senior Lecturer & Faculty Director
Haas School of Business,
University of California, Berkeley

Leonhard Birnbaum

CEO
E.ON

T.K. Chiang

CEO
CLP Holdings Ltd.

Laura Cozzi

Director of Sustainability,
Technology and Outlooks
International Energy Agency

Bruce Douglas

CEO
Global Renewables
Alliance

Giulia Ferrini

Programme Officer
United Nations Environment
Programme (UNEP)

Rafael Mariano Grossi

Director-General
International Atomic
Energy Agency

Didier Holleaux

Executive Vice President
ENGIE

Lars Holm

Partner & Director,
Center for Energy Impact
Boston Consulting Group



SHAPING A WORLD OF TRUST

Bureau Veritas is a world leader in inspection, certification, and laboratory testing services with a powerful purpose: to shape a world of trust by ensuring responsible progress. With a vision to be the preferred partner for customers' excellence and sustainability, the company innovates to help them navigate change. Its technical experts support customers to address challenges in quality, health and safety, environmental protection, and sustainability.

For more information,
contact Bureau Veritas:

Tour Alto
1 Place Zaha Hadid /
4 Place des Saisons
92400 Courbevoie
FRANCE

[bureauveritas.com](https://www.bureauveritas.com)



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