ACCELERATING
THE ENERGY TRANSITION

BUREAU VERITAS
GLOBAL ENERGY TRANSITION REPORT 2023

BUREAU VERITAS

IN THIS REPORT

Is the world able to meet the Paris Agreement goal to keep global heating within 1.5°C?

The energy industry has a crucial role to play in achieving a transition to a low-carbon economy. But significant acceleration is needed if we are to **boost capacity growth in renewables** and decarbonize the energy system at the required pace.

This report explores the major **barriers to accelerating the energy transition.** It unveils insights from energy leaders and experts on the very real constraints the industry faces, and practical solutions to removing them. In doing so, it aims to set a roadmap for change.

THE TIME TO ACT IS NOW.

ABOUT THE SURVEY: *Bureau Veritas' 2023 global energy industry survey is based on interviews with 806 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.*

EDITORIAL

"ACCELERATING THE ENERGY TRANSITION MEANS REMOVING BARRIERS, RIGHT NOW."

JOERG
GMEINBAUER
Global Vice-President, Power & Renewables

"It can be done. It must be done: the world is in deep trouble on climate change, but if we really put our shoulder to the wheel, we can turn things around."(1) That's the key message of the 6th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), released in March this year. The warnings, however, couldn't be clearer.

"The pace and scale of climate action are totally insufficient."
"Adverse impacts from human-caused change will intensify."
"We are now really out of time."

The speed of change required to turn things around and head off the worst disasters will need to be remarkable.

2023 marks the 35th anniversary of the IPCC's creation. During that time, a tremendous amount of work has been accomplished to provide scientific evidence to understand climate change, shape public opinion and provide guidance to decision makers all around the world. Almost nobody today would deny that we are facing one of the biggest crisis humanity has ever needed to overcome. Fighting climate change is the number one priority for our society.

The energy industry sits in the eye of this storm. More than two decades ago we embarked on what today we call the Energy Transition, a complete structural overhaul of our global energy systems to help move the world to net zero, before it is too late. Tremendous progress has been made, but today we know that the pace still isn't fast enough and that an enormous acceleration will be needed over the next years—or better, months.

Removing barriers is the key focus for the transition to be able to reach its full potential. From February to April 2023, Bureau Veritas collected insights and opinions from over 800 market experts and industry leaders from all continents and corners of the energy sector.

The outcome of the survey is this report. It looks into the short-term barriers we need to remove to keep accelerating the energy transition and stay within 1.5°C.

Not what we need to accomplish by 2040 or 2050. What we need to fix right now, this year or next year at the very latest.

We investigated why despite an apparent abundance of both private and public finance pouring into the sector, not enough projects are reaching ready-to-build stage. Our findings center on four pillars:

- **GOVERNMENT** policy including permitting
- **TECHNOLOGY** including the likely roles of renewables, energy storage and carbon capture
- **SUPPLY CHAIN** challenges relating to geographical concentration and scale-up
- **WORKFORCE** topics around recruiting, retaining and reskilling employees

The results confirm the IPCC's message: it can be done. **But only urgent action will secure a livable future for all.**

(1) Source: Frank Jotzo, Lead Author IPCC 6th Assessment Report

KEY INSIGHTS

FROM THE BUREAU VERITAS GLOBAL ENERGY TRANSITION REPORT 2023

THE WORLD IS AT A TURNING POINT

Respondents are truly divided when it comes to the ability of the world to transition at the required pace to reach the Paris 1.5°C target, and the **contribution the energy sector** will be able to make. If 81% agree that we will see a significant acceleration towards 2030, only 60% believe sufficient progress will be made in removing barriers in the short term.

81%

SAY THERE WILL BE A **SIGNIFICANT ACCELERATION** IN THE NEXT SIX YEARS

REMOVING BARRIERS: CHANGE COMES FROM THE TOP

Respondents firmly believe that **government policy is the number one factor** driving the transition. Lack of policy support, constantly changing regulation and red tape are all obstacles to developing new assets. By contrast, positive policy signals effectively open access to, and encourage investment in, new technologies and manufacturing hubs. The message? Get policy right, and everything else falls into place.

85%

BELIEVE **EFFECTIVE GOVERNMENT POLICY** HAS THE GREATEST POTENTIAL TO ACCELERATE THE TRANSITION

SUPPLY CHAIN TRANSFORMATION ALSO POSES RISKS

Geographical **concentration of raw materials and component** manufacturing is the number one concern today, cited by 90% of respondents as a top 3 challenge. Governments in the US, Europe and India have launched ambitious plans to develop domestic manufacturing. But this exponential scale-up is a fierce uphill battle given the enormous installation targets. It will need to go hand-in-hand with thorough assessments of supplier quality, sustainability and resilience.

50%

CITE **SUPPLIER QUALITY ISSUES** AS THEIR TOP SUPPLY CHAIN ISSUE AND SAY THEY LACK RESOURCES TO MONITOR COMPONENTS IN THEIR SUPPLY CHAIN

RECRUIT, RESKILL, RETRAIN—REPEAT

The scale-up in workforce required between now and 2030 will demand one of the **biggest recruitment and training programs** any industry has ever seen. Increased renewables deployment and manufacturing will require an additional 25 million people to join the energy industry. Companies are already feeling the pressure, citing recruitment of engineers and technical staff as an enormous challenge.

70%

SAY THEY ARE **STRUGGLING TO RECRUIT** SKILLED ENGINEERS, TECHNICAL STAFF AND CONSTRUCTION MANAGERS

Sources: Bureau Veritas Global Energy Survey 2023

THE STATUS QUO
OF THE ENERGY TRANSITION

INDUSTRY LEADERS ARE DIVIDED
ON WHETHER WE WILL REACH THE PARIS TARGET OF 1.5°C AT THE REQUIRED PACE

51% **PESSIMISTIC**

49% **CONFIDENT**

3 MAJOR BARRIERS EXIST

98% say **REGULATORY ISSUES** are among their top 3 barriers

50% point to a lack of available and feasible **PROJECT SITES**

34% say a **LACK OF SUPPLY CHAIN RESILIENCE** is a barrier

THESE NEED TO BE REMOVED URGENTLY

82% believe **CAPACITY GROWTH IN RENEWABLES** is the way to get to net zero

BUT ONLY

60% believe sufficient progess will be made in **REMOVING BARRIERS** in the short term

38% believe that **FOSSIL FUELS WILL BE PHASED OUT** by 2040

Sources: Bureau Veritas Global Energy Survey 2023

STATUS QUO / THE STATE OF THE ENERGY TRANSITION TODAY

Results from the Bureau Veritas Global Energy Transition survey are conclusive: the only way to limit climate change is to urgently remove the multiple barriers the industry faces around the world.

Can the world meet the Paris Agreement's 1.5 °C target? The votes from respondents to Bureau Veritas' Global Energy Transition Survey are split almost exactly 50/50.

While over 90% of today's global economy is now covered by net zero targets, the **scale of the challenge remains vertiginous.** Under 40% of power produced today is from low-carbon sources including renewables and nuclear.[2] It is estimated that average annual spending on the energy transition needs to triple to $4 trillion to reach the Paris goals.

An overwhelming 82% of the BV survey participants believe that the current **strategy of boosting capacity growth in renewables** is still the best way to cut global greenhouse gas (GHG) emissions in the energy sector and say that deployment will accelerate significantly towards 2030. However, many are only moderately optimistic that sufficient barriers will be reduced over the next three years and only 38% believe that fossil fuels will be fully phased out by 2040. The economic incentive to invest in carbon-intensive options is still too strong: money is always spent according to return on investment.

(2) Source: IEA

THE NEED TO REMOVE BARRIERS

So, with the majority of the world conscious of the need for change, what is holding the industry back?

A lack of well-designed **energy and regulatory policies** is considered the number one barrier to change. There is a broad consensus that the top priority for governments is to simplify permitting.

A lack of **available and feasible project sites** is an important factor for one in two participants. Developers need more certainty that selected sites are viable, can obtain a permit and able to deliver energy at the right price.

Finally, **weak supply chain resilience** is cited by over a third of respondents as a top barrier. A major concern highlighted is the current geographical concentration of key component suppliers and raw materials.

$4 TRILLION

AVERAGE ANNUAL SPENDING IS REQUIRED TO MEET THE PARIS AGREEMENT GOALS

STATUS QUO / WHICH TECHNOLOGIES WILL DRIVE THE CHANGE?

Survey participants come closest to consensus when discussing technology advancement. These are seen as a broad set of measures that all need to advance in parallel.

There is no magic wand. The industry does not have the luxury of betting on one or two disruptive technologies and few believe that current state-of-the-art technologies can deliver the Paris targets.

Scalability and levelized cost of energy (LCOE) are key, and will largely be driven by industry harmonization. The survey strongly reconfirms the widely-held industry view that hydrogen, energy storage and floating wind and solar will be key while acknowledging that all these technologies need to mature very quickly. Carbon capture and storage (CCS) is also seeing positive momentum, but with more questions to resolve.

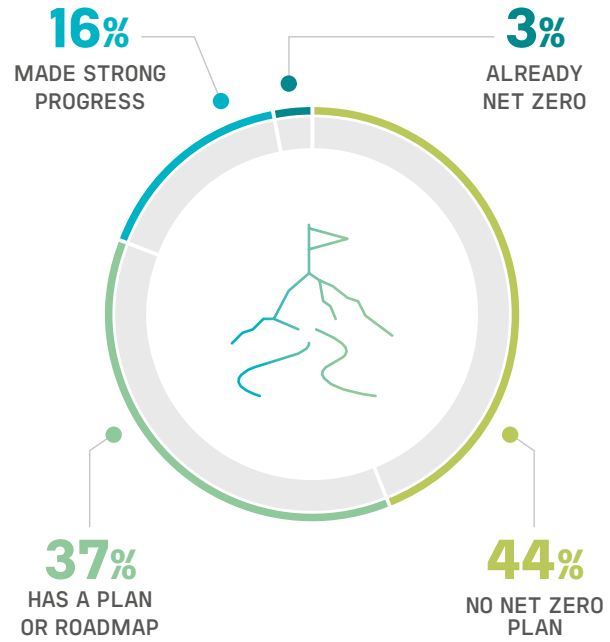
The picture is less clear when it comes to nuclear: around 44% of survey participants believe the energy transition will be supported by nuclear power—notably in the form of small nuclear reactors—however a similar proportion disagree. Overall, attitudes toward nuclear reveal strong bias depending on the participant's country. Interestingly, gas—a major transition fuel—does not seem to be a primary concern to address for a majority of survey respondents.

The BV survey strongly concludes that significant investment in R&D is needed to further advance technologies such as green hydrogen production and next-generation nuclear reactors. For existing and proven technologies, improvements are required to increase efficiency and performance, and industry scale-up to lower costs further is crucial.

WHY ISN'T THE INDUSTRY LEADING BY EXAMPLE?

The BV survey also explores the motivations behind corporate efforts to decarbonize. Almost half of participants said companies feel a moral obligation to curb climate change, and 57% named peer pressure due to disclosures in sustainability reports within the top two drivers. Regulatory and financial considerations were also cited, though to a much lesser degree. However, when it comes to decarbonization, not enough energy companies are leading by example (see opposite).

TOO FEW COMPANIES HAVE A ROBUST NET ZERO PLAN



Surprisingly, the companies playing a key role in the energy transition are often not far advanced in decarbonizing their own business: over 40% have no net zero plan in place, and over 43% do not even know their carbon footprint. This is of concern as it endangers trust in the energy sector: stakeholders need to know that providers of green energy are themselves walking the talk.

Source: Bureau Veritas Global Energy Survey 2023

THE POLICY CONTEXT

HOW MAJOR ECONOMIES ARE APPROACHING THE ENERGY TRANSITION

THE UNITED STATES

introduced the Inflation Reduction Act in August 2022. It significantly enhances support for renewable energy over the coming 10 years via numerous measures including a system of tax credits.

THE EU

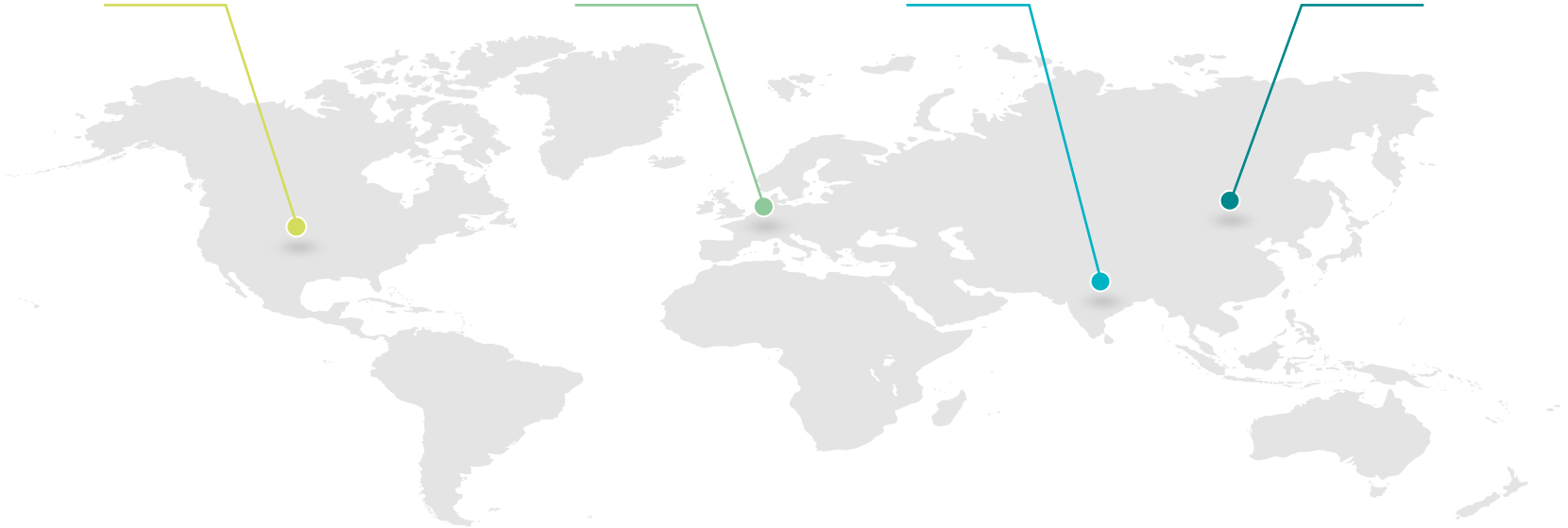
renewable energy target is 45% by 2030. Through the Green Deal, it launched several pieces of transition-accelerating legislation, including the Net Zero Industry Act to bring home clean tech manufacturing.

INDIA

has set 2030 targets of 500 GW of total non-fossil capacity and a 50% renewable electricity generation share, which is more than double the 22% share in 2020, as well as net zero emissions by 2070.[3]

CHINA

published its 14th Five-Year Plan in June 2022. It includes a target of 33% of electricity generation from renewables by 2025 (up from around 29% in 2021), with an 18% target for wind and solar technologies.



Policy actions between now and 2025 will be a crucial variable in the speed of the energy transition.

The regulatory landscape is changing faster than ever. Complex and continually changing government policies can create obstacles: but lack of regulation around specific pain points is equally problematic. Many major economies have launched flagship legislation to accelerate the energy transition, most of it in the past 18 months. Recent legislative packages created in the US and the EU will likely spur investment and create deeper domestic manufacturing markets that will diversify supply and reduce risk. However, navigating the complexity of regulatory requirements and taking advantage of available incentives in each country demands close monitoring and expertise on the ground.

(3) Source: IEA World Energy Outlook 2022

ACCELERATING THE ENERGY TRANSITION

VIA 4 KEY PILLARS

ADVANCES IN TECHNOLOGY

40%

DO NOT BELIEVE CURRENT TECHNOLOGIES CAN DELIVER 1.5°C AND THAT SIGNIFICANT INVESTMENT IN R&D IS NEEDED

SCALING UP SUPPLY CHAINS

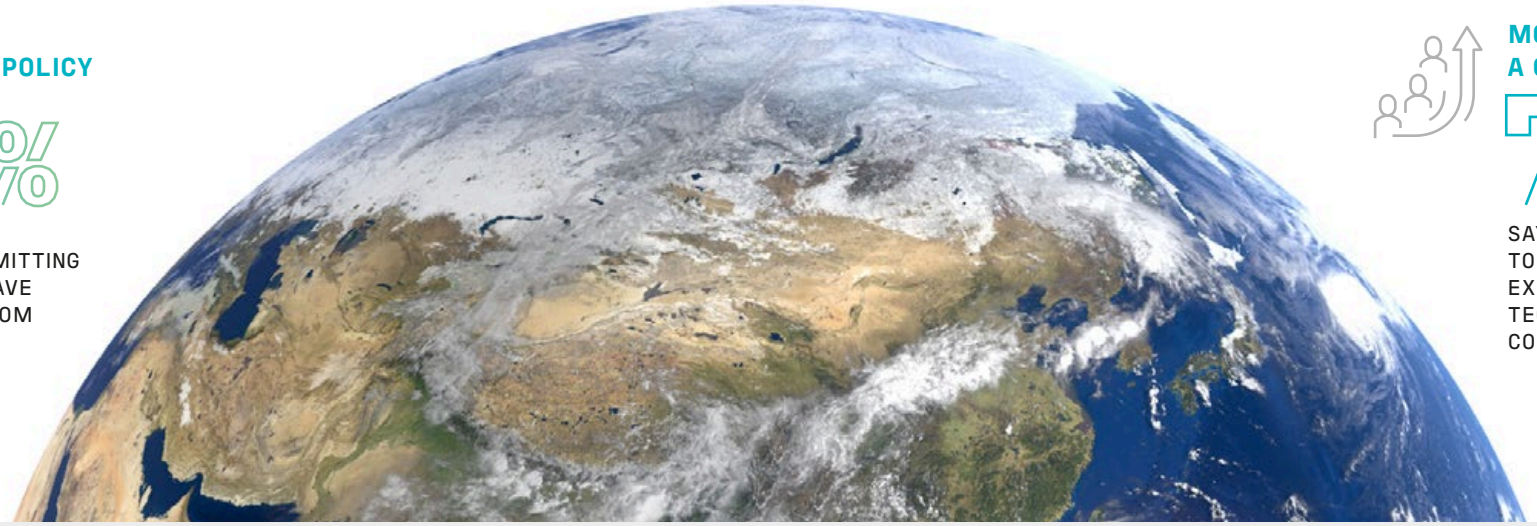
90%

SAY GEOGRAPHICAL CONCENTRATION OF SUPPLY CHAINS IS AMONG THEIR TOP CHALLENGES AND NEEDS TO BE RESOLVED NOW.

GOVERNMENT REGULATION & POLICY

36%

WOULD CHOOSE SIMPLIFYING PERMITTING IF THEY COULD HAVE ONE MEASURE FROM GOVERNMENT



MOBILIZING A GLOBAL WORKFORCE

70%

SAY THEY ARE STRUGGLING TO HIRE SKILLED AND EXPERIENCED ENGINEERS, TECHNICAL STAFF AND CONSTRUCTION MANAGERS

HOW TO ACCELERATE THE TRANSITION

Respondents identify four principal routes to speed up progress and stay in line with the Paris Agreement goal to limit global heating to 1.5°C.

FINANCE IS IN ABUNDANCE—BUT IS NOT FED WITH ENOUGH PROJECTS

One topic that surfaces during any discussion around the energy transition is financing. Indeed, one in three respondents in the BV survey cited access to finance among their top concerns. At first sight, this seems completely illogical. Lack of finance is not an issue in itself: governments and the private sector have promised massive investment in the energy transition in the coming decades. The real issue is that both public and private finance are **competing for a project pipeline that is too small and too uncertain.** The result is a $2.9 trillion shortfall in renewables spend—equivalent to the combined economies of Canada and Australia.

How can more capital be unlocked? Most would recognize that access to finance stems from two factors: a stable regulatory context—which sends a positive market signal—and project risk. The latter is of particular concern in developing economies, where **greater perceived risks of investment result in a higher cost of capital.** Since this is closely related to real and perceived project risks, identifying ways to reduce risk relating to safety, reliability and performance on projects is a key way to improving access to finance, and terms.

In short: **finance is not a critical issue for feasible projects.** The key challenge is to accelerate the build-up and development of an enhanced project pipeline that meets all the necessary investment criteria to unlock equity and debt capital.

For this reason, this report has not treated finance as separate problem. By contrast, other factors represent major opportunities and risks in their own right. Technology development—whether focused on renewables, hydrogen or energy storage—is considered the second most important energy transition enabler behind government. And **market players need to address what they see as major risks:** supply chain resilience and mobilization of a global workforce.

Respondents to the Bureau Veritas Global Energy Survey highlighted specific concerns around these four key topics. In the following chapters, we explore these concerns in detail, alongside possible solutions to reducing bottlenecks.

GOVERNMENT POLICY AND REGULATORY CONTEXT

#1

GOVERNMENT POLICY IS CONSIDERED TO HAVE THE BIGGEST OVERALL IMPACT IN ACCELERATING THE ENERGY TRANSITION

Source: Bureau Veritas Global Energy Survey 2023

WHEN IT COMES TO GOVERNMENT POLICY
WHAT DOES THE ENERGY SECTOR WANT?

The Bureau Veritas global survey highlighted multiple areas in which government policy can shape the pace of the energy transition.

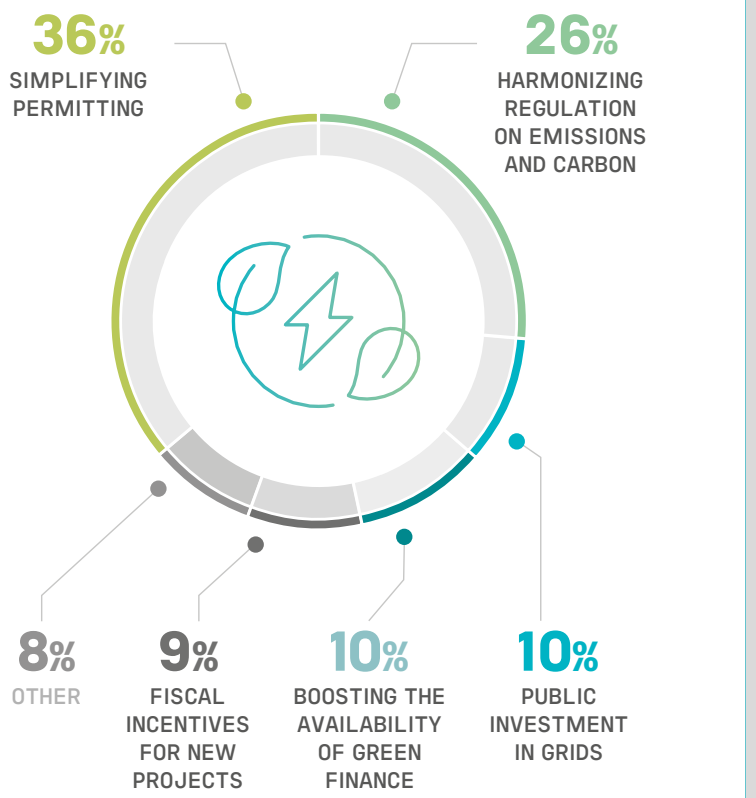
The top measure cited by respondents is **fast-tracking of development and permitting.** Over a third of respondents, if asked to choose only one measure, stated that simplifying permitting regulations and consultation mechanisms would do most to accelerate the energy transition. Regulators also needed to find better balance between the rights of local communities and their ability to block projects.

Leveling the playing field around carbon emissions came in second place. One in four respondents' policy choices focused on harmonizing regulations worldwide so that emissions are measured rather than estimated. They also wanted to see global carbon pricing.

Half of respondents believe that **accelerated investment in power grids** would significantly drive the transition, with one in ten citing it as their top concern. Power grids need to keep pace with development of renewable generation projects—which is not the case to date. This means that governments should invest massively in infrastructure, and update the mechanisms governing grid connections, to avoid further delays.

Finance comes in last place—both in terms of increasing availability of green finance (only 10%) and providing more fiscal incentives for new projects (only 9%). The importance of market incentives can increase during periods of tightening monetary policy—like the one we are currently experiencing—to help ensure that higher borrowing rates do not impact new renewable energy project construction. Government energy pricing and financial incentives are seen as enablers but crucially not as key accelerators for the energy transition.

WHICH POLICY INITIATIVE WOULD HAVE **THE BIGGEST IMPACT ON ACCELERATING THE ENERGY TRANSITION?**



Source: Bureau Veritas Global Energy Survey 2023

LICENSE TO BUILD:
ACCELERATING PERMITTING

The difficulties and lead times involved in obtaining permits for the construction of new projects is a particular focus for project developers.

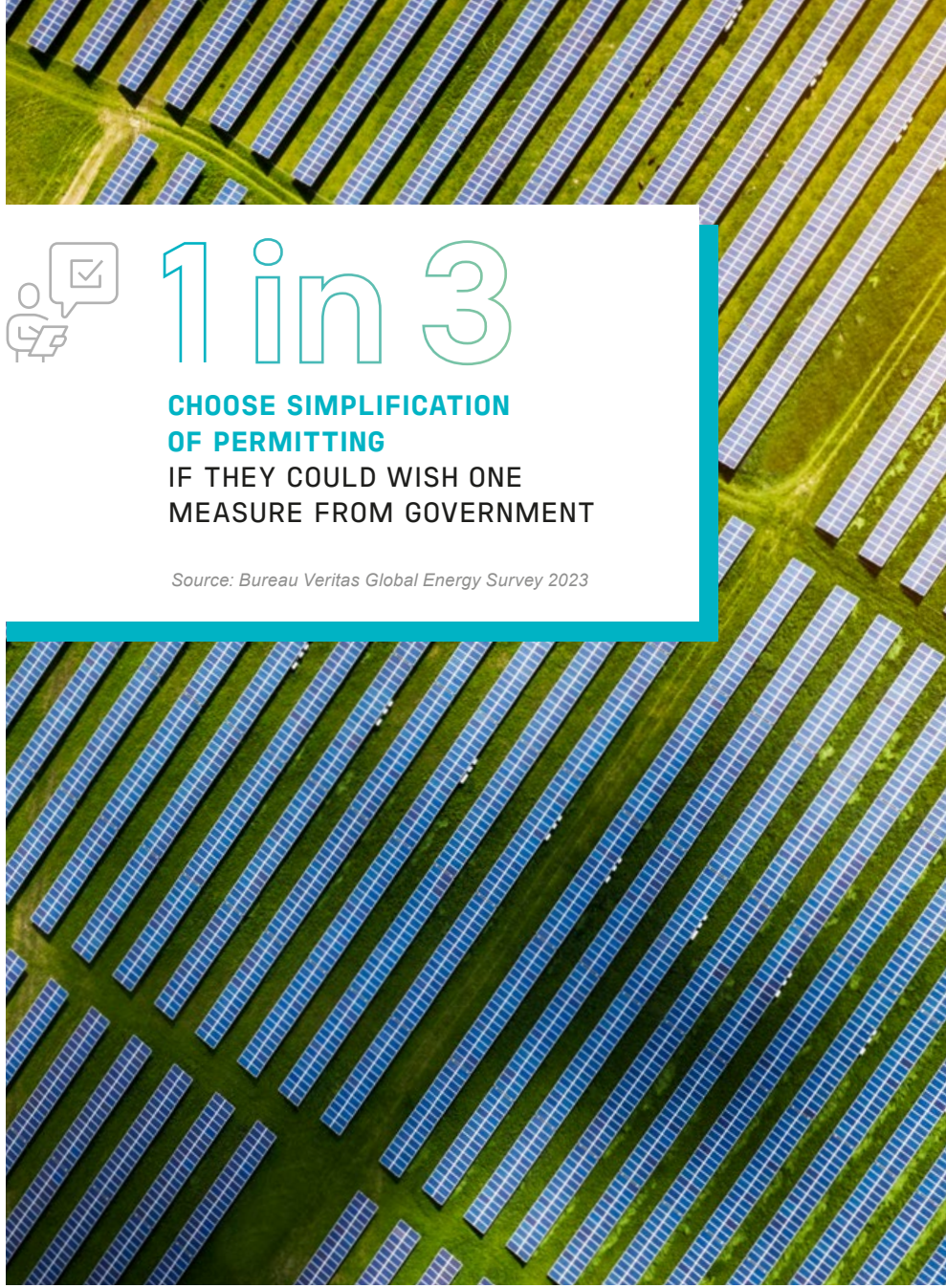
Faster permitting comes top of developers' wish-list when it comes to government policy measures—and with reason. Planning consumes the vast majority of time needed to develop a wind project, with technical installation taking just a comparatively short few months.

As a global average,[4] the planning process for a wind farm takes more than five years (63 months), with the permitting process alone occupying half that time (29 months). However, this average figure masks huge differences from country to country, varying from two years to over eight.

WHAT POLICY SOLUTIONS EXIST?

Proposals exist to accelerate project approvals. In Europe, for example, the one-stop shop for permitting introduced through the Net Zero Industry Act, is a pragmatic step forward. Experience from elsewhere—for example the use of Single Windows for trade and customs—shows that one-stop digital solutions frequently speed up administration and reduce risk. Europe's objective is to get permitting for clean energy projects of more than 1 GW down to 12 months. The Act requires the bloc's member states to set up one-stop shops that act as single points of contact for project promoters throughout the permit process and to issue a decision on time.

However, to continue to shape public trust in renewable energy, it is important that any processes put in place be transparent and fair. Honest, accurate and clear communication with stakeholders, backed by thorough environmental impact assessments and certifications, will be essential.



1 in 3

CHOOSE SIMPLIFICATION OF PERMITTING
IF THEY COULD WISH ONE MEASURE FROM GOVERNMENT

Source: Bureau Veritas Global Energy Survey 2023

(4) Source: World Wind Energy Association

"IN THE PAST 20 YEARS, OFFSHORE WIND HAS GONE FROM BEING A NASCENT DISRUPTIVE IDEA TO THE BACKBONE OF THE ENERGY TRANSITION"

JONATHAN
COLE
CEO,
Corio Generation

Corio Generation's Jonathan Cole is categorical: "Government policy is currently the most important driver for the energy transition – once you get that right the rest naturally follows."

As the CEO of one of the world's leading offshore wind developers, a portfolio company of Macquarie's Green Investment Group, Cole is in a position to know. He identifies three drivers vital to the development of renewable energies, citing the regulatory context as the clear number one, explaining, "In offshore wind, for example, you need a favorable regime for developers to get seabed licenses."

The second most important driver for Cole is infrastructure: "This takes years to implement, and almost every market will soon start finding the grid is a problem unless it starts to build out in a more strategic and anticipatory manner."

However, this too relies on government intervention. "Some countries are setting net zero targets, but not doing enough in terms of enabling regulations around grid and permitting," continues Cole. "The UK, for example, has several GWs of projects awaiting connection to the grid: fast development of renewable energy projects with insufficient grid investment creates bottlenecks."

Cole's **third driver is project viability.** "There are obviously differences between mature and developing markets in terms of margins and risk profile," he adds. Corio's approach to overcoming these challenges is to ensure we have a balanced global portfolio."

Huge technological advances have been made in recent years, and Cole believes it is now up to infrastructure and logistics to reduce costs. On this point, he expresses frustration. "Despite a brilliant track record, the offshore wind industry still struggles to get traction with policy makers to increase deployment by removing regulatory barriers and investing in enabling infrastructure," he says. This feeds into Cole's concern regarding global 2030 targets: "Projects and supply chains remain fragile; that will slow us down unless we are able to see a more progressive approach to pricing the energy from offshore wind. The price should take account of the wider value to society in terms of important matters like energy security, price stability, decarbonization of the economy and industrial stimulation," he says.

With a **global project pipeline of 30 GW** and the industrial capability to deliver, Corio's is a unique proposition in the sector. "Our current staff of 250 offshore wind experts will increase to 350 over the next year, and we have access to long-term capital to seed a long-term investment portfolio. Our organization is optimized for offshore wind; Corio's specialists take projects from origination and development into operations. Our unwavering focus gives us the agility, clarity and coherence to drive offshore wind projects forward and overcome any issue."

"THERE IS NO SILVER BULLET. THE ENERGY INDUSTRY NEEDS A HOLISTIC SOLUTION."

ANNE-LAURE
DE CHAMMARD

Group Executive Vice President,
Member of the Executive
Board of Siemens Energy

For Anne-Laure de Chammard, an approach combining solutions to challenges along the value chain is the only way to make the energy transition a success. "The energy transition is proceeding at different speeds at different parts of the world," she says, "and there is no single solution."

As Group Executive Vice President at Siemens Energy, which is behind the technology used to generate about a sixth of all electricity globally, Anne-Laure has a firm grasp of the multiple aspects of sustainable energy and decarbonization. The group's integrated approach includes low- and zero-emission power generation and grid technologies, and Anne-Laure is at the helm of its Transformation of Industry global business division.

Accelerating the energy transition will hinge on five key drivers, she explains. **To start, regulatory barriers must be simplified:** "It is essential that renewable energy use is massively increased worldwide by 2050 – tripled in the USA, tripled to fourfold in Europe, and tenfold to even 30-fold in the Middle East and North Africa."

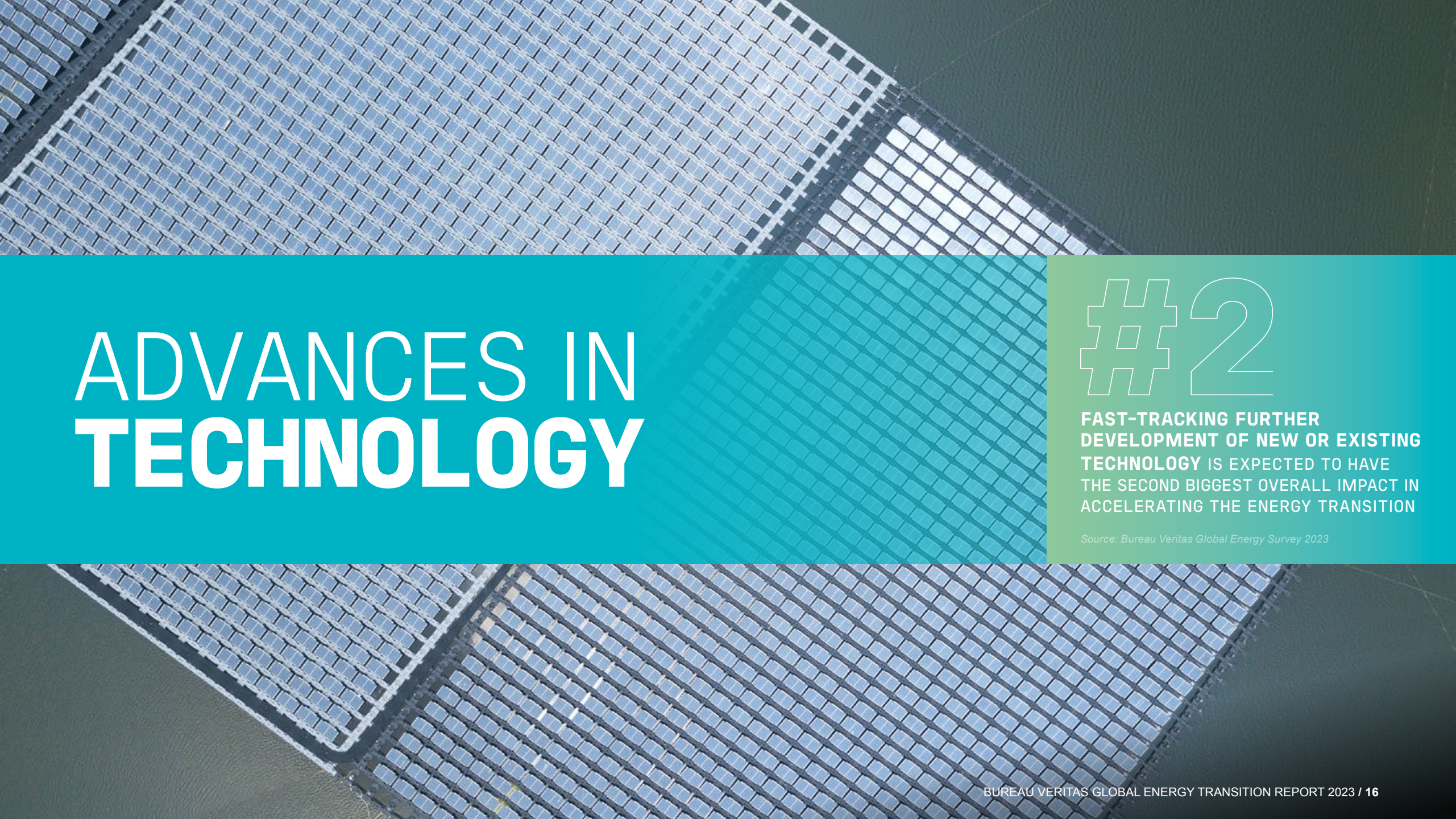
Another driver will be **improving energy efficiency,** Anne-Laure says: "The continuous increase in energy demand due to economic growth and population increase counteracts all current efforts to reduce emissions. We need to shrink the problem. Industry alone must save more than five gigatons of CO_2 per year."

Keeping up with the rise in renewables and electrification will require a much faster expansion of transmission networks, says Anne-Laure. The third driver will therefore be to **strengthen electricity grids.** When it comes to wider infrastructure, such as plants, she is pragmatic. "Existing infrastructure can and should be used – even if it is based on conventional technologies – to bridge the gap. We need to keep the balance between security and sustainability of supply to keep people warm and energy affordable."

Finally, Anne-Laure believes it is vital to get a handle on the **supply chain and the necessary minerals.** "More materials and minerals are needed for the energy transition. Ensuring access to them is the basis for the energy transition's success worldwide."

At Siemens, energy efficiency will be a key lever to enable the transformation of industry. In addition, "electrification, automation and digitalization will be essential solutions to reduce reliance on chemicals produced from fossil fuels and the main driver of decarbonization," says Anne-Laure. The company is also focusing on hydrogen, and eFuels produced from hydrogen.

However, to successfully deploy the necessary levels of renewables by 2030, Anne-Laure believes we need a **comprehensive global policy framework** that brings countries together: "The IRA and the EU Net Zero Industry Act are a good start on the right path but we need more specific and binding policies to accelerate action globally."



ADVANCES IN **TECHNOLOGY**

#2

FAST-TRACKING FURTHER DEVELOPMENT OF NEW OR EXISTING TECHNOLOGY IS EXPECTED TO HAVE THE SECOND BIGGEST OVERALL IMPACT IN ACCELERATING THE ENERGY TRANSITION

Source: Bureau Veritas Global Energy Survey 2023

PRIORITIZING INNOVATION TO ACCELERATE CHANGE

Advances in technology over the next decade will be key to reaching the Paris Agreement goals.

The BV global survey showed that **fast-tracking the further development of new or existing technology** is expected to have the second biggest overall impact in speeding up the energy transition, topped only by government energy policy for favorable regulatory context. An astonishing 40% believe current state-of the-art technologies are unable to deliver the 1.5°C Paris Agreement target at the required pace and cost.

Not only that, but there is no magic wand: industry insiders do not believe that one or two key technologies will make the difference. With the Paris Agreement targets getting closer and closer, we do not have the luxury of placing bets. Instead, **technology development is a broad set of measures** that all need to advance in parallel.

The BV survey broadly reconfirms the common industry view: over 80% of survey participants said they believe the **energy transition will be almost entirely driven by capacity growth in renewables.** For 69% of respondents, the development of green hydrogen projects at scale will be essential. Meanwhile, a significant proportion of those surveyed (44%) said they believe that the transition will be supported by nuclear power, citing new technology in the form of Small Modular Reactors as essential.

Despite strong belief in the potential of technology advances, challenges abound. Certain key technologies are far from being mature and have yet to be deployed at scale. **Significant investment in R&D is needed** to further develop technologies such as green hydrogen production units, floating structures and the next generation of battery technologies. For existing and proven technologies, further improvements are needed. Scale-up to lower costs will be key.

Perhaps for this reason, respondents recognize that **low-carbon technologies will co-exist with fossil fuels** in the medium term. Only 38% think that fossil fuels will be phased out by 2040. Within this context, 56% agree that carbon capture in combination with fossil fuel-fired sites are a viable solution to achieve swift decarbonization of the energy sector.

Collaboration along the value chain will be crucial. Industrial groups such as the Hydrogen Council and the Global Wind Energy Council are instrumental in bringing together governments, energy companies, technology manufacturers, advisors and investors to share knowledge, tackle obstacles, and build harmonized approaches to standardization for new applications.

THE NEED TO ACCELERATE **TECHNOLOGY DEVELOPMENT**

40%

BELIEVE CURRENT **TECHNOLOGIES ARE UNABLE TO DELIVER** THE 1.5°C PARIS AGREEMENT TARGET AT THE REQUIRED PACE AND COST

83%

STATE SCALABILITY, DECREASING COST AND LONGER PERIODS OF **BATTERY STORAGE AS KEY ENABLERS**

Source: Bureau Veritas Global Energy Survey 2023

CREATING THE RIGHT CONDITIONS FOR INNOVATION TO THRIVE

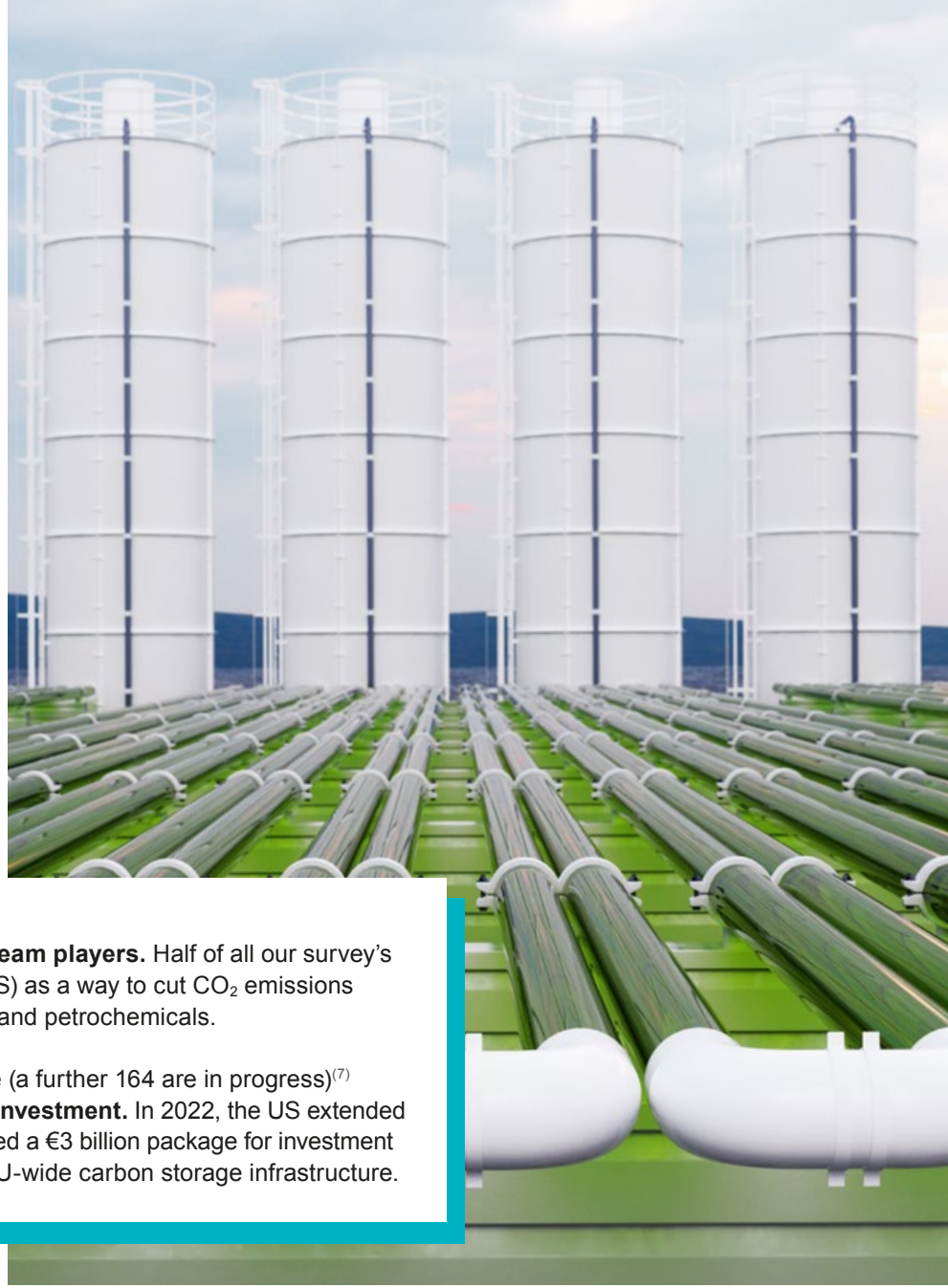
Technological development does not occur in a vacuum: it is the result of the timely alignment of multiple factors.

It all starts with favorable government policy providing the right context. With that in place, 46% of respondents to Bureau Veritas' survey cited scalability and reduction of LCOE as the next most important drivers in developing new technology.

The solar and wind industry are currently leading the way. Electricity from wind and solar photovoltaic (PV) is expected to **more than double in the next five years,** providing almost 20% of global power generation by 2027.[5] The cost of solar PV has fallen by 99% over four decades, and a study by MIT[6] found that stimulated market growth—in the form of feed-in tariffs and subsidies—accounted for around 60% of this decline in costs, while government-funded R&D accounted for around 30%.

Meanwhile, an **increase in wind capacity has been driven by technology improvements.** The capacity of onshore wind turbines has tripled over the past 20 years, from under 1MW in 2000 for a single turbine to 6-7MW today. Offshore, capacity reaches 14-18MW for the latest prototype models.

Energy storage solutions have also made substantial progress, with the emergence of innovative battery technologies that can store and distribute renewable energy more effectively, ensuring a steady power supply even during intermittent generation periods. Overall, these technological advancements have not only made renewable projects more economically viable but have also accelerated the transfer of manpower skills from conventional power industries to innovative and greener type of projects.



CAPTURING THE BENEFITS OF CCUS

Advances in technology are also a major topic for downstream players. Half of all our survey's respondents see Carbon Capture Utilization and Storage (CCUS) as a way to cut CO_2 emissions from hard-to-abate industries such as steel, cement, aluminum and petrochemicals.

While there are just 30 projects currently in operation worldwide (a further 164 are in progress)[7] and costs remain high, **CCUS is increasingly a focus area for investment.** In 2022, the US extended its carbon sequestration tax credit, and the EU recently announced a €3 billion package for investment in CCUS innovation and development, plus the creation of an EU-wide carbon storage infrastructure.

(5) Source: IEA Renewables 2022(6) - Source: MIT (7) - Source: LSE

DE-RISKING INNOVATION

For technology to be adopted, it must be trusted. However, gaining trust is complex when a technology is new, and the infrastructure and markets to support it do not yet exist.

Securing the basics is essential to the mass commercial deployment of any new technology. Innovations tend to be **judged on performance criteria,** such as capacity, emissions profile and reliability, but factors such as operational safety, quality and environmental impact are equally important.

To prove an innovation's credentials in these areas, companies can draw on a range of tools, such as assessments to recognized standards, risk assessments and Approvals in Principle (AiP). These can help determine both the **feasibility and commercial viability** of a new disruptive technology. Examples in recent years have included the early prototypes for floating wind turbines and, later, floating solar technologies.

Finally, it is essential to distinguish between the need to **ramp up manufacturing capabilities** as part of new technology development and the feasibility of projects themselves, which depends on both technology and its supply chains. Mass deployment requires a good combination of both.

40%

OVER OF RESPONDENTS BELIEVE THE ENERGY TRANSITION REQUIRES SIGNIFICANT **SCALE-UP OF FLOATING OFFSHORE WIND AND FLOATING SOLAR**

Source: Bureau Veritas Global Energy Survey 2023

70%

BELIEVE **DEVELOPMENT OF GREEN HYDROGEN PROJECTS AT SCALE** IS A KEY ENABLER FOR A SUCCESSFUL TRANSITION

67%

SAY **FURTHER INNOVATION IN ENERGY STORAGE** IS REQUIRED AS CURRENT TECHNOLOGIES CANNOT BE SCALED UP

"ULTIMATELY, THE SUCCESS OF RENEWABLE ENERGIES DEPENDS ON COST-EFFECTIVENESS: THEY WIN OUT TODAY AND WILL ALSO DO SO IN THE LONG TERM BECAUSE THEY DELIVER CHEAPER ELECTRICITY."

ANDREA
LOVATO
EVP, Global Head of Hydrogen, ACWA Power

For ACWA's Andrea Lovato, the energy transition is an epic journey, and the development of hydrogen "the current-next frontier".

As the head of hydrogen for a world-leading developer, investor and operator of power generation and desalinated water plants, Lovato is among the pioneers currently pushing back the boundaries of the power sector. In addition to 72 assets across 12 countries, ACWA is one of three developers behind the NEOM Green Hydrogen Project, the world's largest utility-scale, commercially-based hydrogen facility powered entirely by renewable energy.

"Hard-to-abate sectors cannot be electrified," says Lovato, "and hydrogen is an exciting solution for them, especially now that its scope has been extended to include things like industry, transportation and heating." When commissioned in 2026, NEOM will produce 600 metric tons of clean hydrogen by electrolysis per day; produce nitrogen by air separation; and generate up to 1.2 metric tons of green ammonia each year. Ultimately, the project will mitigate the impact of 5 million metric tons of carbon emissions annually.

For both this project and renewable energies generally, Lovato believes **economics are the crux of the matter.** "Government regulations are important," he says, "but the real key to getting new technologies off the ground is getting the end product such as hydrogen competitive from day one."

NEOM is a major stepping stone in ACWA's ESG roadmap, which includes targeting net zero by 2050. It is the first project of its scale in construction, and Lovato attributes part of its success to its technical-commercial structuring and project financing scheme. "Having an off-taker in place who is also an equity investor gives other equity and debt investors the confidence to invest. This lowers the overall cost of financing, which in turn also ensures the hydrogen end-product is cheaper."

Broadly the **market's target for green hydrogen** is at a rate in line with the cost of natural gas as LNG—and Lovato has no doubt the market and developers like ACWA Power will achieve this goal. NEOM is already priced competitively against the current price of green hydrogen in the market and fossil fuel in the target market. ACWA is already working on other similar projects in the region and beyond, targeting sectors such as fertilizer and green fuel for shipping.

"NEOM is the **first brick in our construction** of multiple green hydrogen projects," confides Lovato. "We plan to replicate this first project in other regions where we can develop hydrogen competitively and export it to Europe and Asia. Five years ago, green hydrogen wasn't on most people's radar. Now we're making it a reality – and a cost-effective one too."

"THE TRANSITION TO A LOW-CARBON FUTURE REQUIRES THE PARTICIPATION OF THE WHOLE WORLD, NOT JUST THE ENERGY INDUSTRY."

YANG
YUN

Executive Vice President,
Chief Safety Officer & General
Manager of New Energy
Department of CNOOC Limited

With nearly four decades of experience in the energy sector and as the Executive Vice President of CNOOC Limited, one of the world's largest energy producers and China's biggest offshore oil and gas producer, Yang Yun has a front-row seat to the energy transition.

His expertise and experience perfectly position him to play a decisive role in both his company's and his country's journey towards carbon neutrality.

Yang's opinion on the path to take is clear: "Advancements in technology," he says, "will have the biggest impact in accelerating the deployment of renewable energy and other energy transition-related projects. **Innovation drives a decline in costs,** which is the only way to provoke strong growth in the sector."

Recently, CNOOC Limited has become a prominent, active investor in offshore wind power in a bid to promote green and low-carbon developments. "Between 2021 and 2025, we plan to plow 5-10% of capital expenditures into new energy," explains Yang. "CNOOC Group has made a strong commitment to clean energy and **aim to peak our emissions in 2028** then achieve carbon neutrality by 2050."

As revealed in the company's 2023 Business Strategy and Development Plan, one focus for CNOOC Limited has been **supplying onshore power for offshore platforms.** "Our onshore power project will reduce greenhouse gas emissions and bring down power costs for offshore platforms," Yang says. "This will push forward the transition to low-carbon oilfields."

It is clear to Yang that finding ways to mobilize the workforce will also be critical to achieving green targets. "Our industry needs to offer people bright prospects for growth and provide advantageous remuneration in order to retain qualified staff in a competitive job market," he says. "Training will be our most important tool to equip them with the right skills."

Yang is **optimistic about the future of China's energy transition.** "Between now and 2030, China's energy transition will be faster than expected," he opines. "Our government's commitment to carbon neutrality and the active participation of relevant industries will be the major factors driving change."

He is somewhat **more circumspect regarding progress worldwide:** "While I also think the world's energy transition will progress steadily during this period, uncertainty regarding access to an affordable renewable energy supply poses a serious threat to the global energy transition," he warns.

SCALING UP SUPPLY CHAINS

90%

Say **geographical concentration of supply chains** for key components and raw materials are a top challenge

Source: Bureau Veritas Global Energy Survey 2023

SUPPLY CHAINS BECOME **A C-SUITE ISSUE**

Accelerating the energy transition requires massive scale-up globally and locally of reliable, diversified and sustainable supply chains beyond anything seen before in the industry. This is putting pressure on companies to source smartly.

One of the most essential aspects to accelerating the energy transition is **trust in supply chains.** The entire value chain needs to be able to trust that developers are able to deliver on projects. Meanwhile, players at every stage of the OEM supply chain have to be able to source the right component or material at the right time, in the right quantities, with the right sustainability approach, and at the right price. And all this has to be done at an **immeasurably bigger scale** than in the past or today.

This is easier said than done. The acceleration of the energy transition demands thinking in big numbers: multiples rather than incremental growth. Double-digit growth in renewables technologies over the next five years requires a **matching ramp-up in supply of components, from both existing and new suppliers.** For this reason, participants in the survey named supply issues as the third-largest obstacle to the move to greener energy. They identified multiple issues, both temporary and long-term (see opposite). Many, such as quality risks in the supply chain, are likely to significantly worsen in the next four years.

On a positive note, scale-up of global supply chains for crucial clean energy components—such as solar PV modules, batteries and electrolysers—is already underway. It is projected to meet or exceed demand globally in line with pledges made by governments. However, it falls short of the supply chain scale-up required for the world to remain within a 1.5°C temperature rise. **Acceleration is equally crucial here.**

To secure both global and local supply chains, companies need to adopt a proactive and detailed risk management approach. C-suites need to make sourcing and supply chain sustainability strategic priorities, thinking long-term and investing in supply chains. This means **managing supply chain risk**—from availability and resilience to pricing and sustainability—with as much care as financial risk.

Supply chains look likely to remain dynamic for years to come, with companies needing to continually select and onboard large numbers of new suppliers. They will also become more geographically diversified, which will demand a ramp-up in supplier scrutiny. As a result, companies will need to invest more in dedicated personnel to carry out technical assessments, procurement support and supplier audits including ESG audits—or outsource the work to a reliable third party.

TOP 3 **SUPPLY CHAIN** ISSUES

Supply chains for key components and raw materials are **concentrated in a limited number of countries**

A strong rise in demand has led to **quality issues in the supply chain**

Lack of resilience in the supply chain for some or all components

Source: Bureau Veritas Global Energy Survey 2023

MEETING DEMAND
WITHOUT COMPROMISE

The accelerated scale-up of the supply chain brings multiple serious challenges.

First, it will result in a huge overall **increase in the number of new suppliers in the chain.** This will create challenges for project developers and OEMs in terms of quality, safety and sustainability, which will go beyond ESG ratings. They will need to assess new suppliers precisely at a time when competition for components, materials and services—everything from wind turbine blades and PV modules to engineering and technical support—is at its highest. Plus, as supply chains ramp up, so will the need for **local manufacturers of key clean energy components** in line with countries' local content requirements as well as other cost and economic factors. This, in combination with a lack of local skilled workforce and experience will surely create significant quality, HSE and other related risks that need to be mitigated.

TACKLING QUALITY RISKS AT SCALE

Companies are already concerned. Around half cite supplier quality issues among their top issues, noting that they lack resources to fully monitor their supply chain.

As such, ensuring quality will clearly be a pressing concern for companies when sourcing new suppliers. Procurement teams will have to **invest significant time in identifying new suppliers,** and monitoring the quality of components coming out of their supply chain – whether from scale-up of production from existing suppliers or from new suppliers. A proactive approach to improving reliability starts with **skilled and trustworthy people on the ground** at supplier and loading sites to monitor new suppliers and reduce the risk of defects.

50%

CITE **SUPPLIER QUALITY ISSUES** AMONG THEIR TOP SUPPLY CHAIN CHALLENGES

29%

BELIEVE THERE SIMPLY ARE **NOT ENOUGH HIGH-QUALITY SUPPLIERS OUT THERE**

Source: Bureau Veritas Global Energy Survey 2023

BUILDING RESILIENCE IN SUPPLY CHAINS

Boosting domestic production is increasingly seen as a way to diversify supply chains and improve their resilience.

The supply chains for clean technologies are currently **concentrated in just a few countries**, with China being the undisputed frontrunner. The country handles 97% of the global manufacturing of wafers for PV cells and has 75% of the world's production capacity for battery cells.

As learned during the COVID pandemic, and again at the outbreak of war in Ukraine, this kind of geographical concentration creates a **real risk of supply chain disruption** for manufacturers of end-products, particularly at this time when a steady stream of components is needed.[8] Indeed, nearly a third of companies in our survey identified supply chain concentration as their number one procurement issue.

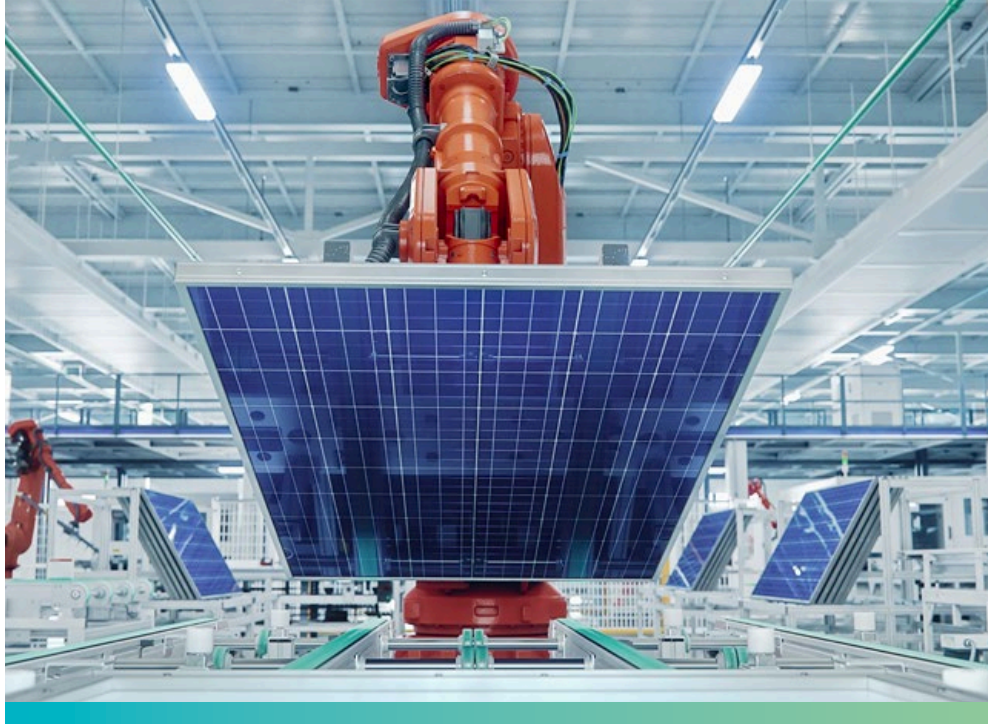
SCALING UP LOCAL MANUFACTURING, DEVELOPING NEW GLOBAL PRODUCTION HUBS

One of the obvious answers to this problem is to expand domestic production. The United States and the European Union have created the necessary regulatory conditions to **build clean technology manufacturing bases.** In the US, the Inflation Reduction Act promised $370 billion in tax credits to the renewable energy industry, of which $30 billion is expected to be allocated to US manufacturing of PV modules, wind turbines, batteries, and critical-minerals processing.[9] Meanwhile, Europe's **Net Zero Industry Act** sets an aim for manufacturing capacity to reach at least 40% of the bloc's deployment needs by 2030.

The growing demand for renewables has also caused **factory utilization rates** to reach unprecedented levels. Without additional capacity, supply chains will become more vulnerable to unplanned events.[10] To overcome this, it is necessary to increase capacity in large global production hubs, such as China and India. China continues to build on its strategic lead, adding capacity and bolstering global supply. In 2022, for example, its manufacturing capacity for PV cells and modules is estimated to have risen by around two thirds.[11]

However, to **enhance resilience,** new global production hubs in countries and regions with competitive advantages will be needed. This is likely to be an area of focus for governments in the months to come.

(8) Source: IEA World Energy Outlook 2022 - (9) Source: World Economic Forum - (10) Source: McKinsey - (11) Source: PV Magazine



#1

OVER 30% OF COMPANIES IDENTIFY **GEOGRAPHICAL CONCENTRATION** AS THEIR TOP SUPPLY CHAIN ISSUE

Source: Bureau Veritas Global Energy Survey 2023

50%

OF COMPANIES SAY THERE IS **A LACK OF RESILIENCE IN SUPPLY CHAINS,** WHICH HAS LED TO DISRUPTION IN THE PAST 3 YEARS

AVOIDING BOTTLENECKS
FOR CRITICAL RAW MATERIALS

Demand for the critical minerals used in clean energy technologies is accelerating to the point of creating a real potential issue for the deployment of renewable energies.

Bureau Veritas' global survey found that remedying **supply and demand issues around critical raw materials** was one of respondents' top priorities. Since 2010, the average amount of minerals needed for a new unit of power generation capacity has increased by 50%; to meet the goals of the Paris Agreement, mineral requirements would need to quadruple by 2040.

To boost the resilience of its critical raw materials supply chains, the European Union has introduced the **Critical Raw Materials Act** to increase domestic extraction, processing and recycling. The Act also emphasizes improved social conditions in raw materials supply chains.

ARE INTEGRATED SUPPLY CHAINS MAKING A COMEBACK?

In addition to supply chain reliability issues created by the geographical concentration of production, there is also a risk that **price increases in critical minerals** could push up the price of clean energy technologies. A potential solution to this concern is vertical integration. By developing long-term partnerships with mining companies and suppliers of key components, companies can **secure the materials they need with reduced price volatility.** Tesla,[(12)] for example, has signed agreements with mining companies in Brazil, China and the Democratic Republic of Congo to secure supplies of nickel, cobalt and lithium.

An accelerated transition relies on positive public opinion—which means being hyper-attentive to **sustainability in clean energy supply chains.** Citizens will demand greater transparency from companies regarding environmental impact and human rights in upstream supply chains. This will require a proactive approach to risk management, backed up with environmental and social supplier audits.

1 in 2

RESPONDENTS SAY **ALTERNATIVES TO CRITICAL MINERALS** WILL REMOVE A MAJOR BOTTLENECK TO ACCELERATED RENEWABLES DEPLOYMENT

Source: Bureau Veritas Global Energy Survey 2023

(12) Source: McKinsey

BEYOND CARBON: **MAKING SUPPLY CHAINS SUSTAINABLE**

Sustainability and transparency are both increasingly key issues in renewable energy supply chains.

Upstream supply chains have historically come with human rights risks. The mining of cobalt and nickel—both used in lithium-ion batteries (LIB), and copper, used in wind and solar PV assets, has been linked to human rights abuses. Growing awareness of issues, such as child labor in some countries, is forcing change. Regulation such as the German Supply Chain Act and the upcoming EU Directive on Corporate Sustainability Due Diligence oblige companies to assess supply chains, formalize informal work arrangements and enforce applicable labor standards. This is likely to impact where supply chain investments are made and which suppliers are chosen.

Environmental risks relate principally to resource extraction, use and waste. Until recently, not all components used in clean energy projects were recyclable, and asset owners often chose to dump components in landfill as it was the cheapest option. Today, technology has evolved and big improvements have been made, but the industry has still a long and hard way to go to become fully circular.

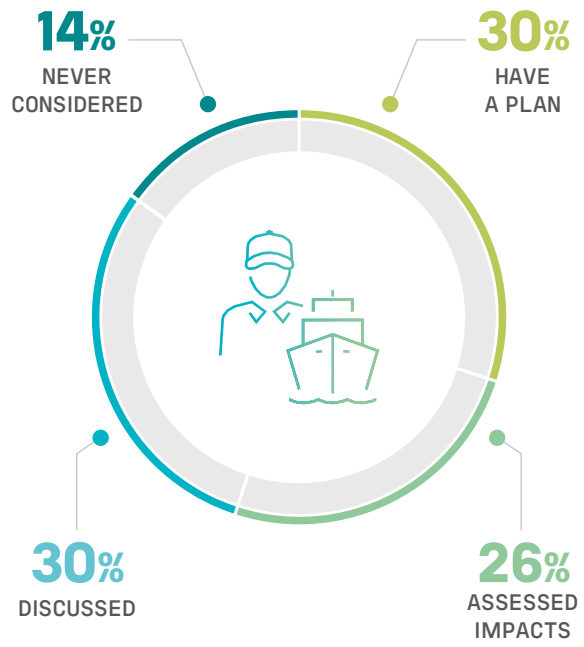
The BV survey shows that only 40% of companies today have an action plan to use recycled materials and recycle assets at end-of-life, while 16% have never considered the topic. And the industry is even less advanced on other key environmental sustainability issues: only 20% have a plan to reduce embedded carbon in the manufacturing of components and assets, while under a quarter proactively consider the biodiversity impacts of their projects.

SUSTAINABILITY AS A STRATEGIC RISK

C-suite leaders must remain vigilant to the strategic risks of supply chain sustainability. This means investing in supply chains and recruiting or upskilling employees regarding sustainability. Companies can also propel innovation to improve the sustainability of key components by adopting a collaborative approach with suppliers and through initiatives such as joint industrial projects. Ideally, these should include a broad range of players from OEMs, suppliers, and independent bodies to develop workable solutions that inspire trust.

SOCIAL IMPACTS

Companies are increasingly aware of social sustainability issues in their supply chain—but very few are taking meaningful action.



Source: Bureau Veritas Global Energy Survey 2023

"THE TRANSITION MUST SEEK TO ENSURE ENERGY SECURITY, AFFORDABILITY AND SUSTAINABILITY."

THOMAS
BROSTRØM
Executive Vice President,
Global Renewable Generation,
Shell

When it comes to the deployment of renewables, oil and gas supermajors have an important role to play, says Shell's Thomas Brostrøm.

"The experience, global reach and capabilities of a larger integrated player can help enable or accelerate growth at scale," he explains.

Shell plans to accelerate its transition to net-zero through its Powering Progress strategy. "The transition must seek to ensure energy security, affordability and sustainability," Brostrøm says.

"Shell is providing energy society needs today, as we work to develop tomorrow's energy supply." This strategy is leveraged by the company's integrated approach. "Being a global integrated energy company allows Shell to connect multiple parts of our business and maximize opportunities across the entire value chain, from production of energy to delivery to the customer," he says.

A resilient supply chain will be vital and Brostrøm stresses the importance of investing in sustainable industries—both in terms of robustness and the environment. "We seek to work strategically where it makes sense and where we believe the suppliers are competitive internationally," he says. Shell procures goods and services from local suppliers whenever possible and takes steps to support suppliers.

Shell also focuses on **speeding up the transition beyond its own operations.** "We continually work with our suppliers to find ways to reduce greenhouse gas emissions across our supply chains by understanding their energy needs and jointly identifying potential low-carbon solutions that are economically sustainable," notes Brostrøm. In 2021, the company launched the Shell Supplier Energy Transition Hub, a free-of-charge digital platform for suppliers, enabling them to set emission ambitions and track performance, share best practice and exchange emissions data with their own supply chains.

Meanwhile, Brostrøm is adamant that governments play a leading role in the energy transition. "Governments are already taking steps to increase grid capacity, for example, but what we need is a massive investment in infrastructure together with systemic improvement in processes like permitting," he explains.

Brostrøm imagines **better system integration across countries** – for example, through microgrids, battery storage and virtual power plants. "Governments can facilitate this through innovative policies, like offshore wind tender criteria that favors system integration and incentives for building hybrid solar and storage systems," he says.

According to Brostrøm, governments can also mitigate consumer barriers. "Demand-side policies and incentive programs will encourage more consumers to switch and in turn, provide renewable energy developers greater certainty that if they build it, customers will come."

MOBILIZING
A GLOBAL WORKFORCE

90 MILLION

PEOPLE WILL BE **EMPLOYED IN THE ENERGY SECTOR** BY 2030, UP 38% ON TODAY

Source: IEA

THE RIGHT PEOPLE
IN THE RIGHT PLACES

Hiring and retaining qualified staff is an ongoing challenge that must be overcome to achieve energy transition objectives. Engineers, technicians, construction workers: large numbers of people are required— today, not tomorrow.

The biggest workforce-related challenge for the energy transition lies in the **sheer quantity of people it requires,** with growth in employment driven by total energy investment. Global renewable capacity is expected to increase by almost almost 75% between 2022 and 2027, with almost half of this coming from China. The International Renewable Energy Agency (IRENA) estimates that over 38 million people globally could be employed in renewable energy by 2030.(13) Simply hiring and retaining people in those kinds of numbers is already a major challenge. Finding the **right people in the right places** is an even greater one, considering the massive difference in market maturity between geographies.

In Bureau Veritas' global survey, respondents identified this as a very real issue for the energy transition. They specified recruiting engineers and technical staff, retaining qualified staff, and recruiting construction site workers in the right location as the top three obstacles in mobilizing the necessary workforce.

Companies in the renewables sector will face the added hurdle of **recruiting engineering, technical and specialized construction staff** at a time of rapid project ramp-up and strong competition for the same profiles. For example, in 2022, Wind Turbine Technician was listed as the fastest-growing job on LinkedIn:(14) employer demand for this role grew 80% between 2020 and 2021.

In addition, in the short-to-medium term, **demand for jobs is geographically uneven**.(13) Nearly two-thirds of all renewable energy jobs are located in Asia, with China alone accounting for 42% of the global total, again stressing the critical concentration of supply chains, as more than half of that is in manufacturing. It is followed by the European Union and Brazil with 10% each, and the United States and India with 7% each.

(13) Source: IRENA Renewable Energy and Jobs Annual Review 2022 - (14) Source: LinkedIn

TOP 3
OBSTACLES
IN MOBILIZING THE WORKFORCE

Recruiting highly specialized engineers, technical staff **to expand engineering centers**

Retaining qualified staff in **a very competitive job market**

Recruiting construction site workers in places **where no skilled staff are available**

Source: Bureau Veritas Global Energy Survey 2023

SKILLED WORKERS: **MIND THE GAP**

Jobs in the energy sector are often highly skilled. With a massive growth in demand, employers are already struggling to fill vital roles.

Jobs in the energy sector are often highly skilled: whereas skilled jobs represent a quarter of all roles in the wider economy, around 45% of energy workers are currently in this type of role.(15) As the energy transition unfolds, training new workers and re-skilling the existing workforce—many of whom have valuable transferable skills—will be essential to meeting future needs and keeping salary inflation under control. Indeed, this is seen as the top HR challenge by over a third of companies who answered the Bureau Veritas survey. Engineers and technical staff are in particular demand, an issue of key concern to more than two thirds of respondents and cited as the number one challenge by almost half. Reskilling workers is also a social imperative, as many existing jobs in fossil fuel industries are likely to disappear.

70%

SAY THEY ARE **STRUGGLING TO RECRUIT ENGINEERS, TECHNICAL STAFF AND CONSTRUCTION MANAGERS** WITH THE RIGHT SKILLS AND EXPERIENCE

40%

SEE **RETAINING TALENT IN A COMPETITIVE JOBS MARKET** AS A KEY CHALLENGE

30%

SEE **RESKILLING THE EXISTING WORKFORCE** AND **THE ASSOCIATED COST** AS A KEY CHALLENGE

(15) Source: IRENA Renewable Energy and Jobs Annual Review 2022

MILLIONS IN CAREER TRANSITION
TRAINING AND RESKILLING

The next decade will see millions of people undergo training to work in renewables roles.

Industry bodies and governments will need to work together both to **promote renewable energy as an attractive career** and to address the skills gap. Around the world, wheels are already in motion.

The European Commission, for example, has launched a number of specialized Academies as part of the **Net Zero Industry Act** announced in March, 2023, to support the creation of a skilled workforce to manufacture net zero technologies. Meanwhile, India's Skills Council for Green Jobs, set up in 2015, is developing Green National Occupation Standards. Under its aegis, around 100,000 people were trained between 2015 and 2021.[16] Other governments and industry bodies are implementing initiatives such as energy transition training funds and tax credits.

UNDERSTANDING AND COMPARING WORKERS' SKILLS

As thousands of workers join the renewables sector, it is crucial that employers are able to assess and compare their profiles. With **qualifications varying from country to country,** and many skills self-declared, this can be complex. Third-party verification and certification to a recognized standard can be a useful way to achieve this.

A pre-requisite, as new job profiles emerge, will be the creation of **dedicated standards and certification programs** for specific jobs or skills. However, a cursory look at the numbers in one segment, wind, shows the scale of the challenge: nearly 570k trained technicians will be needed to construct, install, operate and maintain the global onshore and offshore wind fleet due to be commissioned by 2026.[17] Employers demand certification by GWO, a wind industry body which certifies technicians' safety knowledge and technical skills. However, 80% of technicians today do not yet hold a valid certificate.

Such standards will be vital for **certifying the renewable energy skills** of workers in fossil fuel or other adjacent industries looking to switch sector. They can also be used to certify specific skills and knowledge, thereby removing the need for lengthy academic courses for certain technical roles.

(16) Source: CEEW - (17) Source: Global Wind Organisation / Global Wind Energy Council

MANAGING RESOURCES: **MULTIPLE PROJECTS, AT GLOBAL SCALE**

A ramp-up in new projects in various locations around the world inevitably places strain on managers, particularly when staff working on projects are recent hires.

Managers face the challenge of ensuring that the right engineering resources are deployed to the right locations, something which becomes more complex with multiple projects. At the same time, they must guarantee that **safety standards are respected** by staff on the ground, which requires a strong safety culture and constant vigilance.

Bureau Veritas' global survey revealed that staff shortages are felt at every level—from project managers and engineers to local construction workers. The situation is made all the more complex by **local content requirements**—the obligation to source talent from the country in which the project is built—in place in numerous jurisdictions.

THE ROLE OF TRUST IN DELIVERING PROJECTS ON THE GROUND

Trust is key to achieving the energy transition, but creating it is hard when developers are under-resourced and recruiting extensively. EPCs and investors need to trust that construction safety standards will be enforced and followed, and that people hired have the skills they claim. Public authorities and investors need to trust that project developers have mobilized the right people to deliver the project safely as well as **at quality and on schedule.**

Long-term, the industry needs a **massive increase in the number of engineers and technicians** available for a rapidly growing number of projects – for the development, construction and operation asset phases. In the meantime, companies need to find ways to emphasize a culture of safety and quality while juggling multiple projects worldwide.

Source: Bureau Veritas Global Energy Survey 2023

27%

LISTED THE ABILITY TO **DEPLOY PROJECT MANAGERS WORLDWIDE** AS AMONG THEIR TOP CHALLENGES

30%

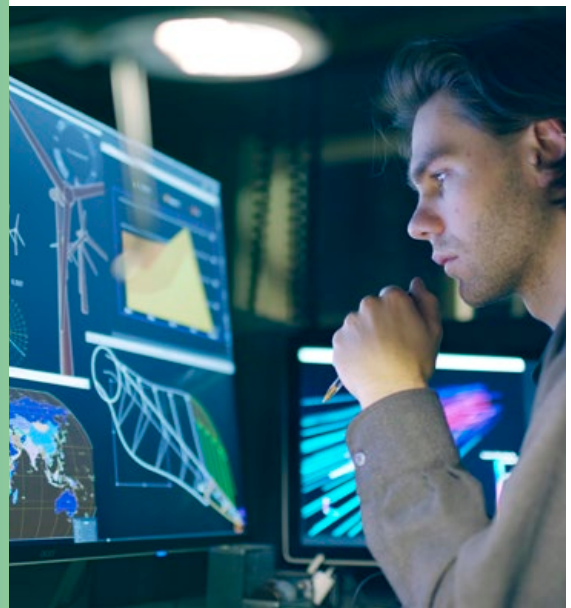
CITED **RECRUITMENT OF SKILLED LOCAL CONSTRUCTION WORKERS** AMONG THEIR TOP CHALLENGES

SPOTLIGHT

THE CHANGING WORLD OF **ENERGY EMPLOYMENT**

The most sought-after profiles in energy are changing. In addition to the obvious skillsets required—such as wind turbine technicians—the sector now needs more data and digital experts. Diversity and inclusion are becoming an essential part of the answer to the question of how to mobilize the necessary workforce for the energy transition.

DATA SCIENTISTS: THE RISING STARS OF RENEWABLES



Agility, sound management and digitization go hand-in-hand. In the coming years, project developers, owners and operators will increasingly rely on data and artificial intelligence (AI) at every stage, from design to asset management and maintenance.

Data science and AI also have multiple applications in optimizing renewable energy asset utilization and anticipating reliability issues. Scientists, for example, can use weather patterns to forecast energy supply from solar PV assets and wind farms. And through data collected from sensors on asset condition, utilization and feedback fed into machine learning algorithms—again managed by data scientists—predictive maintenance plans can be determined, for example by predicting future component failure.

All this **increases the need for specific worker profiles.** Data scientists, having made a fairly recent entrance to the energy job market, are in strong demand: nearly 70% of data science teams within energy companies were created in the last five years and today, 40% of companies find it very difficult to hire data scientists with the required skills.[18]

AN UNTAPPED LABOR POOL: **FEMINIZING THE ENERGY SECTOR**

While women make up 39% of the global labor force, they account for just 16% of the energy sector.[19] At management levels the numbers are even lower. The barriers women face in the energy sector are similar to those they face elsewhere in the economy, but their relative absence from the sector is clearly fueled in large part by gender biased beliefs about occupations.

Attracting more women to the energy industry is an obvious way to grow the clean energy workforce. By **raising awareness** of opportunities, more young women could be attracted into STEM and technical roles, thereby plugging part of the gap. However, this is an effort that has to start in schools, and should be further developed in higher education via education programs led by female role models.

(18) Source: Source: Catapult (19) Source: IEA

"RESKILLING EMPLOYEES TO WORK IN RENEWABLES IS ABOUT MORE THAN RETAINING TALENT. IT IS ALSO ABOUT KEEPING JOBS IN COMMUNITIES."

SALVATORE
BERNABEI
CEO, Enel Green Power

When it comes to ensuring Enel has the workforce it needs to lead the energy transition, for Salvatore Bernabei the watchword is reskilling. "People working in traditional coal plants have a deep understanding of important issues, like working safely with electricity, and company culture, so reskilling staff when we decommission plants is more cost-effective than training new people from scratch," he explains.

Enel Green Power manages more than 1,200 power plants on five continents, and has over 56 GW of installed renewable capacity from a mix of resources, including wind, solar, hydroelectric and geothermal. As the company pursues its mission to support decarbonization, it has not lost sight of its **commitment to people and communities.**

"We see every decommissioning project as an opportunity to install renewables and reaffirm our commitment both to helping customers decarbonize and communities flourish," says Bernabei.

The need to reskill workers is driven by Enel's **ambitious decarbonization roadmap.** "By 2040, we will produce zero emissions and operate no fossil-fuel based plants," continues Bernabei. "We currently have 6.5 GW of coal plants in Italy and Spain, which we plan to decommission by 2027. By 2040, we will have decommissioned our gas-based plants." To reskill workers from these decommissioned plants, Enel puts in place education schemes.

Enel's proximity to communities is mirrored by its closeness to customers. "Our projects will allow our end customers to access sustainable energy at competitive and stable prices" explains Bernabei. "Our integrated margin perspective means we know what customers are prepared to pay, and we have the capacity for a large pipeline and high-volume production. Our structure enables price efficiencies, which companies can pass on to end-consumers, making a switch to green energy a more attractive option."

The company also adopts an **integrated approach to the supply chain.** In 2010, it embarked upon a joint venture to expand a factory that produces high-performance bifacial photovoltaic modules. "There are plans to enlarge this factory to produce 3GW of PV panels per year by 2025, the objective being to reduce unit costs by scaling up," details Bernabei.

"For Enel, sustainability is a 360° concept," concludes Bernabei. "It encompasses everything from the creation of long-term community involvement to a transparent and, at times, fully integrated supply chain, strong relationships with customers, and responsible production practices, for example in the handling and reduction of waste."

ROADMAP **TO 2030**

81%

OF RESPONDENTS EXPECT **SIGNIFICANT ACCELERATION IN RENEWABLES CAPACITY GROWTH** BETWEEN NOW AND 2030

Source: Bureau Veritas Global Energy Survey 2023

THE TIME TO ACT IS NOW

This report began with a stark warning: that the current pace of action on climate is insufficient and that the speed of change required to turn things around will need to be remarkable.

The will to effect this change is largely there. The view on how best to do it—broadly, a massive scale-up in renewables capacity—is also widely shared by industry and policymakers. What is lacking in many cases is an in-depth understanding of the real, practical barriers facing the industry. It is these barriers that are preventing real progress.

In the in-depth interviews with industry leaders, the same statement came up time and time again: **"Get government policy right, and the rest will follow."**

Industry needs a clear direction from government. Tellingly, when asked what single government measure would do the most to accelerate the transition, most respondents did not focus on costly measures such as tax incentives: **instead, they chose simplified permitting and consultation mechanisms.** This is a recognition of the fact that thousands of potentially viable projects remain blocked in a planning quagmire.

New regulation in the form of the EU's Net Zero Industry Act and the United States' Inflation Reduction Act send a signal that major economies are taking the issue seriously—but the test of their effectiveness will be on the ground.

A regulatory context more visibly focused on getting projects built would send important signal on other important topics.

Only 40% of industry leaders believe that today's technology will enable us to reach net zero. Collaboration between industry players, throughout the value chain, will be essential to **develop the more efficient renewable assets and energy storage systems** the world needs. For new technology to be adopted, it must be trusted. Customers want to know that technology is safe, reliable and performs to the level required. This means that developers have to secure the basics. Performance criteria including capacity and emissions profile are the factors on which innovations tend to be judged, but factors such as operational safety, quality and sustainability are equally important.

INDUSTRY NEEDS A CLEAR DIRECTION FROM GOVERNMENT. GET POLICY RIGHT, AND THE REST FOLLOWS.

THE TIME TO ACT IS NOW

(Cont.)

But barriers to accelerating the transition are not solely related to demand: the industry also faces major supply issues.

Trust in supply chains is essential to accelerating the energy transition: public authorities need to be able to trust that developers are able to deliver on projects, and developers need to trust in the resilience of their supply chains. Yet leaders cite numerous supply chain issues, starting with the heavy geographical concentration for key components (90%) and quality issues (50%).

Rebalancing global supply chains will take some time, despite the best legislative efforts of countries including the EU, the United States and India. In the meantime, it befalls on companies to find ways to assess new suppliers thoroughly, and put in place rigorous processes to monitor the quality of components they produce and the sustainability of manufacturing processes.

Finally, the **energy industry is gearing up for one of the largest shifts it has ever seen in terms of employment.** To achieve the 38% increase in workforce numbers the transition requires demands creative approaches. Reskilling oil and gas workers is an attractive option. However over time, the sector will need to attract new, diverse profiles. Industry bodies and governments need to work together to promote renewable energy as an attractive career and address the skills gap. The effort to attract people from all backgrounds is one that should start in schools.

All these barriers are complex, but not insurmountable. The progress in the past decade is already unimaginable compared to the previous. Collaboration—and trust—between industry actors and government will take that progress even further. It can be done. It must be done.

ABOUT BUREAU VERITAS

BUREAU VERITAS SUPPORTS THE ENERGY INDUSTRY
TO ACCELERATE ITS TRANSITION TO A NET-ZERO FUTURE.

SHAPING TRUST IN ENERGY

Bureau Veritas works with the energy industry to meet the world's need for **safe, sustainable and affordable energy.** We leverage our global reach and comprehensive service portfolio to empower clients along the entire energy value chain to shape a net-zero future.

ON HAND, WORLDWIDE

Bureau Veritas plays a crucial role in **fostering stakeholder and public trust** in energy projects. Since accelerated deployment will increase or create risks, our worldwide network of energy experts is on hand to provide on-the-ground and end-to-end project support.

PARTNERS TO THE TRANSITION

We support our 4,000+ energy clients worldwide through a network of technical centers with dedicated renewables expertise. **Our owners' engineering and technical advisory services** enable us to help clients meet their acceleration challenges as they scale up projects worldwide.

ENABLING TRANSFORMATION

The energy transition demands new technologies and profound transformation of supply chains. Bureau Veritas' third-party assessments help **de-risk innovation,** while our audits and digital tools support supply chain resilience.

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.

EPC (Engineering, Procurement and Construction): a service provided by engineering contractors to develop energy assets and other large infrastructure; also used to describe the contractor delivering the service.

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.

German Supply Chain Act: known in full as the German Supply Chain Due Diligence Act, the regulation requires German companies to comply with environmental and human rights standards in their supply chain.

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. Inflation Reduction Act: a United States federal law that invests in domestic energy production and manufacturing and aims to reduce carbon emissions by around 40% by 2030.

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

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.

OEM (Original Equipment Manufacturer): a company that manufactures parts and equipment used and marketed by an end-customer as part of a large industrial product or infrastructure.

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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