



The Baker Hughes Energy Transition Pulse 2023

Can industries stay focused on cleaner energy in uncertain times?

Baker Hughes 

 LONGITUDE

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Executive summary:

A turbulent 2022 has challenged many assumptions about the energy transition.

“Energy markets and policies have changed as a result of Russia’s invasion of Ukraine. Not just for the time being, but for decades to come.”

Fatih Birol
Executive Director,
International Energy Agency

Many companies were basing their emissions-reductions promises on affordable and abundant natural gas, but Russia’s invasion of Ukraine was an unforeseen driving factor that pushed natural gas prices to record highs within a matter of weeks.

By mid-year, it became clear that many government and organizational strategic roadmaps to lower or zero-emissions energy needed to be revisited.¹

“Energy markets and policies have changed as a result of Russia’s invasion of Ukraine,” says International Energy Agency (IEA) Executive Director Fatih Birol.² “Not just for the time being, but for decades to come.”

Now, a bearish outlook for the global economy is putting additional strain on energy-intensive and hard-to-abate industries, including cement, steel, mining and heavy industrial manufacturing. They will have to continue to develop and invest in emissions-abatement strategies against a backdrop of higher energy and raw materials prices, potential energy shortages and weaker business conditions. Oil and gas companies, as part of the larger energy ecosystem, will have to find a way to balance supplying renewed demand with reducing greenhouse gas emissions to as close to zero as possible – a net-zero future.

The energy trilemma

The energy security crisis is forcing society to reconsider the dynamics between:

- Energy security
- Sustainability
- Affordability

“What used to be a dual dilemma of affordability and sustainability has now become a trilemma of security, sustainability and affordability,” says Lorenzo Simonelli, Chairman and CEO of Baker Hughes. “We are seeing a heightened need for more available energy sources, as well as clear mitigation of high energy prices as a result of inflation and supply-demand imbalance, to ensure energy remains affordable in every region.”

As organizations and governments progress through 2023, the priority will be to implement the strategies that can create a secure, sustainable and affordable supply of energy while also keeping society on the path to net zero. In doing so, leaders and their organizations will be playing their part in balancing the energy trilemma.

In 2021, we surveyed 500 senior executives, active in energy and hard-to-abate industries across the Americas, Asia-Pacific, Europe, and the Middle East and Africa, about their readiness to achieve net zero by 2050.³

To find out how much progress there has been, given so many new variables, we conducted a new survey with 555 executives in 2022.

The questions we asked these leaders included:

Will the energy security crisis accelerate or set back the transition to net zero?

How can we build more resilient energy systems in the future?

Which energy sources and technologies will underpin the transition over the next few years?

Which strategic factors can accelerate that process?





Key findings

Economic uncertainty

The uncertain outlook for the global economy is a continuing barrier to energy transition investments: **41%** of our respondents say that **economic uncertainty** coupled with rising inflation is the greatest barrier to investing in energy transition technologies. Against this economic backdrop, new **technology risks** rank equally high as a top barrier.

Existing business

The highest priority among respondents over the next two years is to invest in existing lines of business (**40%**).

Net-zero preparedness

Despite the geopolitical challenges and the energy security crisis, confidence in net-zero preparedness is at a similar level to 2021 in EMEA and is slightly higher in the Americas. But confidence has decreased in Asia-Pacific.

Energy trilemma

Tackling the energy trilemma by balancing energy security and access to sustainable, affordable energy is the challenge of our time. For respondents, the top three ways to tackle this challenge are to prepare for operational disruptions from climate change, reskill for an energy transition-ready workforce and invest in lower-carbon energy sources, including natural gas.

Natural gas and LNG

The majority – **57%** – say they are making or planning to make new investments in natural gas/liquefied natural gas (LNG).

Energy transition

Almost half (**47%**) of respondents overall say they are not worried that their companies are deprioritizing the energy transition as a result of the energy crisis. But a significant percentage – **39%** of respondents – are worried their companies may reverse the course on net zero. It remains to be seen if net zero can survive changed energy markets.

Can net zero survive a changed market?

Despite geopolitical headwinds and heightened energy market volatility, respondents' confidence in whether they will reach net zero by 2050 has not declined – in most regions.

High energy prices, a gloomy economic growth outlook and geopolitical developments affecting global energy markets highlight the complex and uncertain environment we will have to navigate as we transform into a net-zero economy.

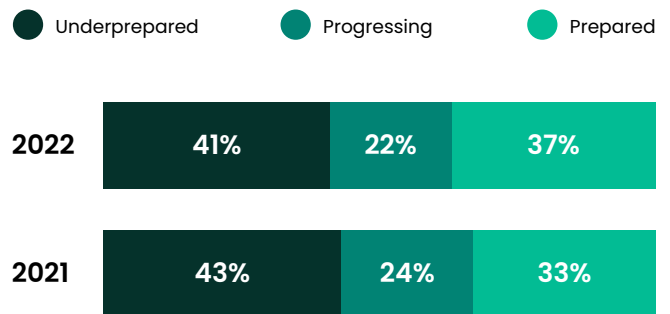
In the short term, the events of the past year are making it more difficult for energy-intensive and hard-to-abate industries to proceed with their net-zero strategies. Since Russia's invasion of Ukraine, energy prices have spiked because of the disruption to Russian exports.

Meg O'Neill, CEO of Woodside Energy, believes that for society to embrace the energy transition the conversation has to include energy security for consumers. "Europe is in a very difficult situation," she says. "Addressing climate change and bringing down emissions intensity remain important, but there is recognition that it needs to be done in a more balanced way."

The tight gas supply caused much of the world to shift back toward burning coal for power generation, which is cheaper but more emissions intensive. Demand is rebounding to levels last seen in 2013.⁴

Yet responses to our survey indicate that senior executives are generally confident that their organizations are on course for net zero. More respondents in 2022 say they are prepared to achieve net zero by 2050 than in the previous year's poll.

In 2022, more organizations say they are prepared to transition to net zero by 2050 than they did in 2021



Question: How prepared do you think your organization is to transition toward having net-zero greenhouse gas emissions by 2050? (On a scale of 0%-100%, where 0-40% is underprepared, 50% is progressing and, 60-100% is prepared).

Net-zero confidence drops sharply in Asia-Pacific but holds up elsewhere

Respondents in EMEA and the Americas are most confident in their progress to net zero, which could be because both the US and the EU have embarked on significant climate legislation in the past two years. The US Inflation Reduction Act provides tax credits of at least \$370 billion for clean energy investments, and Europe responded to the energy crisis with its REPowerEU plan, which includes accelerating goals for the rollout of renewable energy and green hydrogen.^{5,6}

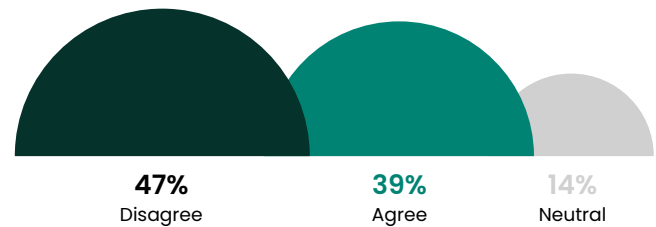
“One should never waste a good crisis,” says Ilham Kadri, CEO and President of the Executive Committee of Solvay. The multinational chemicals company is committed to staying on track for carbon neutrality by 2040, and by 2050 for its hard-to-abate soda ash business.

“The big learning from this crisis is that we really need to rethink the type and the way we use our energy,” says Kadri. “It’s painful in the short term, but it doesn’t change our climate initiatives.”

It is different in Asia-Pacific, where coal still accounts for most of the power generation.⁷ Respondents there show the biggest drop in confidence since last year: 36% said their organization was unprepared in 2021, and 50% say the same in 2022.

However, in line with the IEA’s forecast that the upside for coal will be short-lived, optimism about cleaner energy does remain high: 47% of our respondents say that their companies are not deprioritizing the energy transition as a result of the energy crisis.

Nearly half of respondents are not worried that their companies are deprioritizing the energy transition



Statement: As a result of the energy crisis I worry that my company is deprioritizing the energy transition.

Priorities adjust to necessity as businesses play it safe

More respondents say they are not worried about their company deprioritizing the energy transition than say they are. So what practical approaches are these companies taking to cope with the high energy price environment while still moving toward net zero?

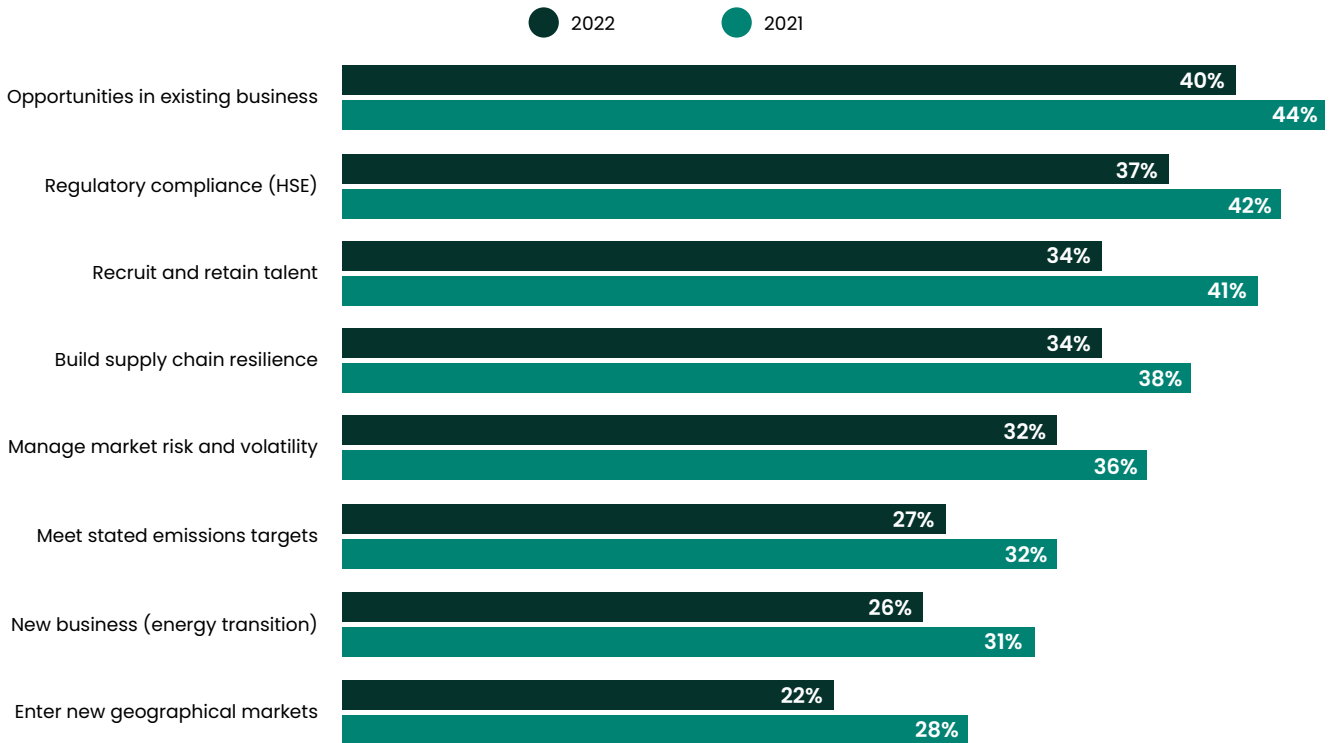
For companies dealing with hydrocarbons, there is renewed need to invest in existing lines of businesses to meet hydrocarbon demand for this decade. They are also reinvesting the profits from the current rise in oil prices into energy transition initiatives.

“Hydrocarbons are going to play a role for decades,” says Lorenzo Simonelli, Chairman and CEO of Baker Hughes. “The most important thing is applying technology we have today to reduce the emissions

of those hydrocarbons and to clean them as much as possible. It’s about reducing emissions, not fuel sources, and we cannot forget that.”

In other industries that are impacted by the higher cost of energy, the current market may be reducing appetite for riskier investments. Our survey shows that 40% of companies are prioritizing opportunities in existing lines of business over the next two years. Respondents are hesitant about new and possibly untested lines of business related to the energy transition, new geographies or ‘frontier’ technology that is not yet mature or commercialized. For them, the focus is on reducing their carbon footprint with existing infrastructure and technology.

Existing opportunities are businesses’ top priority for the next two years



Question: What are the priorities for your organization over the next two years?

“Growing lower-carbon solutions to serve your customers starts with pragmatism. The things that we need to do for the public and the shareholders are the same,” says Mark Nelson, Executive Vice President of Strategy, Policy and Development at Chevron, which is one of the world’s biggest producers of renewable fuels. “We can accelerate the lowering of carbon emissions by using what we have and being smart about the whole value chain.”

“One of the fastest ways to help in the transportation sector is to provide renewable fuels – renewable liquid fuels and renewable natural gas that can be turned into compressed natural gas,” he adds. “You can make progress faster now by using the manufacturing assets you have around the globe, using internal combustion engines that are already travelling all over the world. And it gives you time to think through longer-term solutions.”

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Mark Nelson

Executive Vice President of Strategy, Policy and Development , Chevron

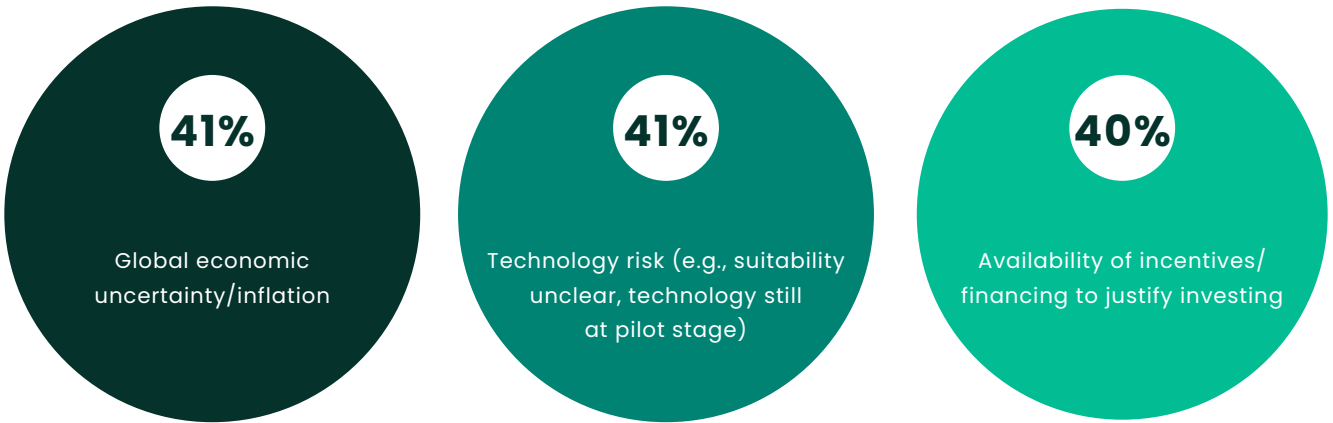


Current risks are holding businesses back

Respondents' hesitation extends from new lines of business to new technology. A depressed global growth forecast and technology risk – for instance, where the technology is still at pilot stage – are curbing their appetite for investing in new technology.

The current market might be a challenge for energy and industry, but energy and industry are not giving up on getting to net zero by 2050. Some progress is possible through emissions reductions with existing infrastructure and technology – but the consensus remains that long-term goalposts require more action.

Economic uncertainty, technology risk and financing are the top three barriers to investing in energy transition technology



Question: What are the three greatest barriers or challenges to your organization investing in energy transition technologies?



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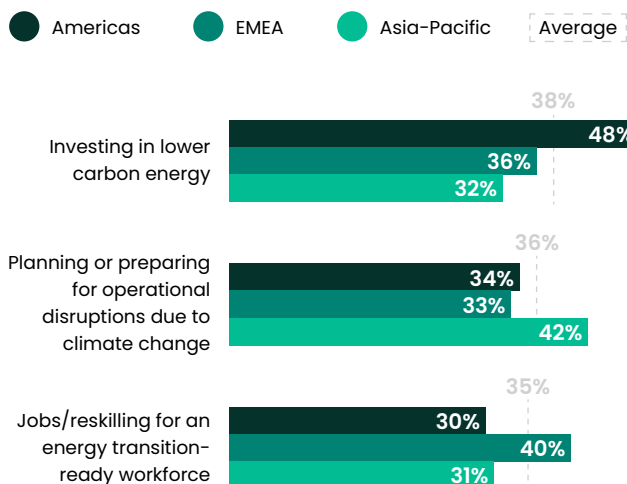
Diversification is fundamental to the transition

Society can tackle the energy trilemma by diversifying the energy mix.

“The energy transition is about economic prosperity, energy security – which is both reliability and affordability – and, of course, protecting the environment,” says Mark Nelson, Executive Vice President of Strategy, Policy and Development at Chevron. “Any time you over-index on any one of those, you may create an imbalance that can have unintended consequences.”

However, every region and every country has different natural and financial resources available for energy generation, and must therefore follow a bespoke roadmap to address the energy trilemma. This may result in regions pursuing net zero in different ways and at a varying pace. Understanding the areas that need to be addressed most urgently can help understand the future trajectory of the transition.

What will it take to balance energy security with access to sustainable, affordable energy? For the survey respondents, three activities are most important:



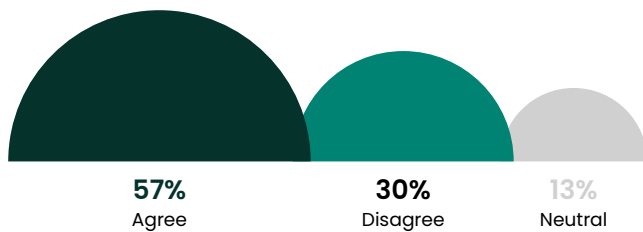
In Asia-Pacific, for instance, where many countries are experiencing the effects of climate change and extreme weather, preparing for operational disruptions is the most important way to secure access to energy. In EMEA, respondents say that creating jobs and reskilling for an energy transition-ready workforce is the most important way to balance energy security and access to sustainable energy. In the Americas, investing in lower-carbon energy is the top choice, possibly because of the region’s low share of renewables compared with its huge potential and the abundance of shale gas in the US.

Question: Which of the following are you planning to prioritize to help balance energy security and access to clean energy in the regions and communities where you operate? (Top 3 choices)

Balancing with natural gas

In response to Europe’s energy crisis, companies are making or planning to make new investments in gas/liquefied natural gas (LNG).

The majority of respondents are investing or planning to invest in natural gas/LNG as a result of the energy security crisis



Statement: We’ve made or are planning to make new investments in natural gas/LNG as a result of the energy security crisis. (To what extent do you agree or disagree with the following statement about your organization?)

Baker Hughes’ Chairman and CEO Lorenzo Simonelli says he has been encouraged by the speed at which European countries are installing regasification units. “There’s a lot more discussion and concentrated effort in Europe around the diversity of supply now,” he says. “Previously, it would have taken considerable time to get through all the different permits. Some countries are accelerating these processes now.”

Beyond Europe, the renewed demand for gas has also prompted investments globally. Analysts predict that US LNG export capacity alone will increase by 84% to 21.7bcf per day by the end of 2027.⁸ In 2022, on the US Gulf Coast, for instance, there has been Cheniere’s final investment decision to expand liquefaction capacity in Corpus Christi and Venture Global’s LNG terminal in Plaquemines Parish, Louisiana.^{9,10}

Another recent example is Woodside Energy’s expansion of gas processing capacity with the construction of a second LNG train at the existing Pluto LNG site in Western Australia.

“For the global supply and demand balance for both oil and LNG, and increasingly hydrogen, we do expect that the world is going to need all of those products in the time period where those assets will come online,” says Meg O’Neill, CEO of Woodside Energy. “So we do try to make sure we are not caught up in the dark days of 2020 or the heady days of 2022.”

Another project that awaits a final investment decision, targeted in 2023, is Woodside Energy’s Oklahoma-based hydrogen project H2OK.

Hydrogen is on the move

Among our respondents, 30% say they will prioritize the use of or investment in hydrogen in the future, more than synthetic fuels or gases; carbon capture, utilization and storage (CCUS); or nuclear power. However, blue and green hydrogen need a more extensive infrastructure transition than other sources of clean energy, and new value chains that unlock cost competitiveness but have not yet been proven.

“A few things need to continue to happen for hydrogen to be what we all want it to be,” says Mark Nelson, Executive Vice President of Strategy, Policy and Development at Chevron, who expects the carbon intensity of hydrogen use to come down over time.

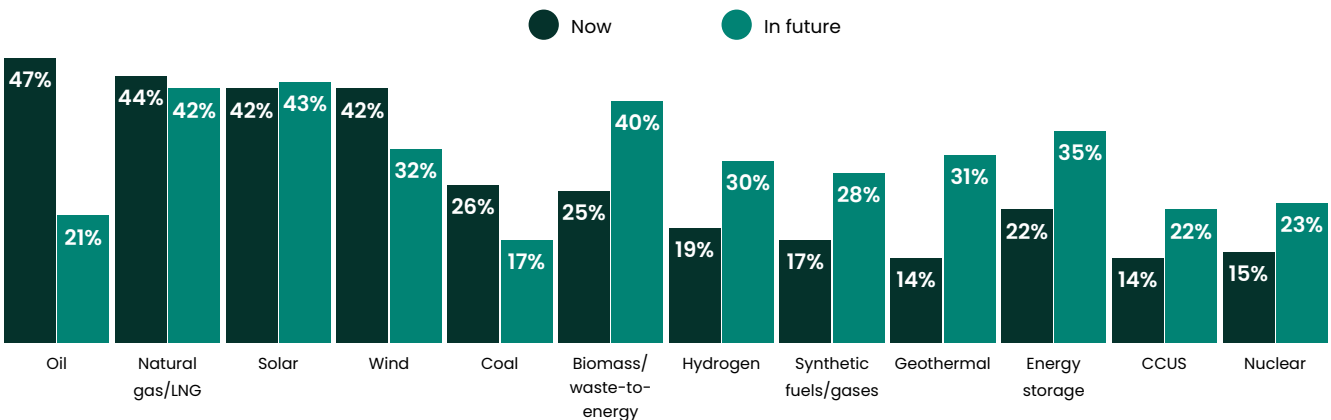
“We need more technology development that helps with the cost of manufacturing and transportation,” adds Nelson. “We’re also working hard on the economies of scale, which will help the transportation of hydrogen. Then, on the evolution of the demand side, the industry needs to have equipment that can use hydrogen in ways it is not being used today. We are building partnerships so we can get industrial applications and transportation applications moving.”

Chemicals multinational Solvay, which uses gas to run about 32 of its 45 manufacturing plants in Europe, is looking at ways to mitigate the impact of the energy security crisis.

“We are using LNG and alternative fuels, while really trying to live with less gas,” says Ilham Kadri, CEO and President of the Executive Committee of Solvay. As the Russia-Ukraine crisis brings into focus the need to develop alternative energy sources sooner rather than later, investment in new energy ecosystems has become critical. “The crisis is an opportunity to build that infrastructure faster and with less permitting time, and it’s vital for the competitiveness of the European industrial footprint,” says Kadri.

“For us, it’s another good reason to accelerate our energy transition plan and convert our plants to alternative cleaner energy sources sooner rather than later.”

Use of and investment in biomass, energy storage, geothermal and hydrogen are expected to increase the most in future compared with today.



Question: Which of the following energy sources/technologies are you prioritizing the use of, or investment in, now? And in the future?

Partnerships power up the transition

However, the scale of the transition requires strong collaboration between government, society, industry and the wider business community. Alternative fuels in industry, such as biomass or waste-to-energy, often require new types of supply arrangements that can function commercially.

Solvay, for example, is converting its emissions-intensive coal-fired soda ash plant in Rheinberg, Germany, to run on wood waste, while its plant in Dombasle, France, will be supplied with household and industrial waste as fuel by a new joint venture with waste management company Veolia.

Collaboration and partnerships are also needed for risk-sharing and offtake agreements for large infrastructure projects, including hydrogen hubs and CCUS projects. In particular, collaboration with national and supranational entities will bring certainty to

regulation and thereby investment. Recent examples of this include the US Inflation Reduction Act, which contains tax credits for green hydrogen that could halve its cost in some locations,¹¹ and the EU's Fit for 55 proposals, which aim to provide a framework for reaching the bloc's climate objectives.

Baker Hughes' Lorenzo Simonelli says that society is at a turning point in the energy transition. "What the current situation has brought to the forefront is a better appreciation of diversifying the energy mix and bringing back abundant supply," he says. "We have to balance the immediate need for energy with continuing the long-term path toward decarbonization. So how do we make sure that we protect the energy supply going forward? By having good differentiation and a full energy mix including renewables, oil, gas and hydropower."



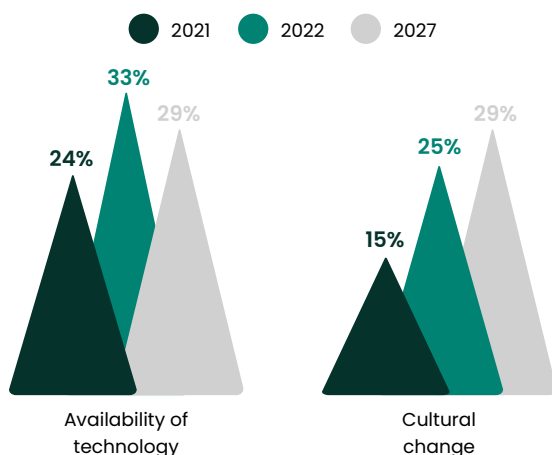
Acceleration comes from technology, culture and finance

The pace of the energy transition will be determined technology, culture change and finance.

Businesses need to invest in diversifying the energy mix and make plans for scaling up lower-carbon fuels and decarbonization technology.

“The need for technology and a continued dual approach associated with sustainability and affordability is clearly there,” says Lorenzo Simonelli, Chairman and CEO of Baker Hughes.

Technology and the right culture act as energy transition catalysts



Question: Which of the following factors are the most important in accelerating energy transition strategies in your organization today? And in five to ten years' time?

Respondents say that the availability of energy transition technology is the most important factor accelerating the transition to net zero.

However, there is a barrier to availability in the lack of regulatory frameworks, starting with a “workable definition of clean hydrogen” by regulators.¹² “As the world thinks about these new types of energies, right now the regulatory frameworks in a lot of these areas do not exist or are under development,” says Meg O’Neill, CEO of Woodside Energy. “For example, the regulatory frameworks to do CCUS or use hydrogen are still evolving.”

Supply chain constraints and the cost of technology are two other barriers. “Technology is going to be absolutely imperative to start driving down the cost of some of the elements required to make this energy transition viable,” says O’Neill. “We need to apply that same technology and manufacturing model to bring down the cost of things like electrolyzers and make sure that hydrogen opportunities are even more cost competitive.”

Culture that transforms

Cultural change in energy and industry organizations is becoming as important as consumer demand and the availability of technology. Culture can be a nebulous concept, but for new technologies and energy systems to develop companies need to be able to encourage innovation and collaborative thinking.

Recent research by PwC shows that some 75% of oil and gas executives believe a reasonably high tolerance of failure and risk and hands-on involvement by senior management in innovation projects are the most important ways to build a solid innovation culture.¹³

Simonelli believes that culture is a defining part of any company's success. "It is critical that organizations take the time and resources to align all their employees to a culture around sustainability. A company's mission and purpose must also reflect this changing dynamic – to drive a sustainable future, helping to connect employees, customers and partners," says Simonelli.

But a culture change also has to take place in wider society. While new energy technology and innovation are important, there is a lot that both companies and consumers can do to reduce their emissions and manage costs while using existing technology and sources of energy.

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Lorenzo Simonelli

Chairman and CEO, Baker Hughes



Private equity is on the rise

Another important way to accelerate the transition is by using a mix of sources of finance. Given estimates of the capital spending needed to decarbonize the global economy and achieve net-zero emissions by 2050 vary up to \$9 trillion a year, private sector contributions are required to complement public sector funding.¹³

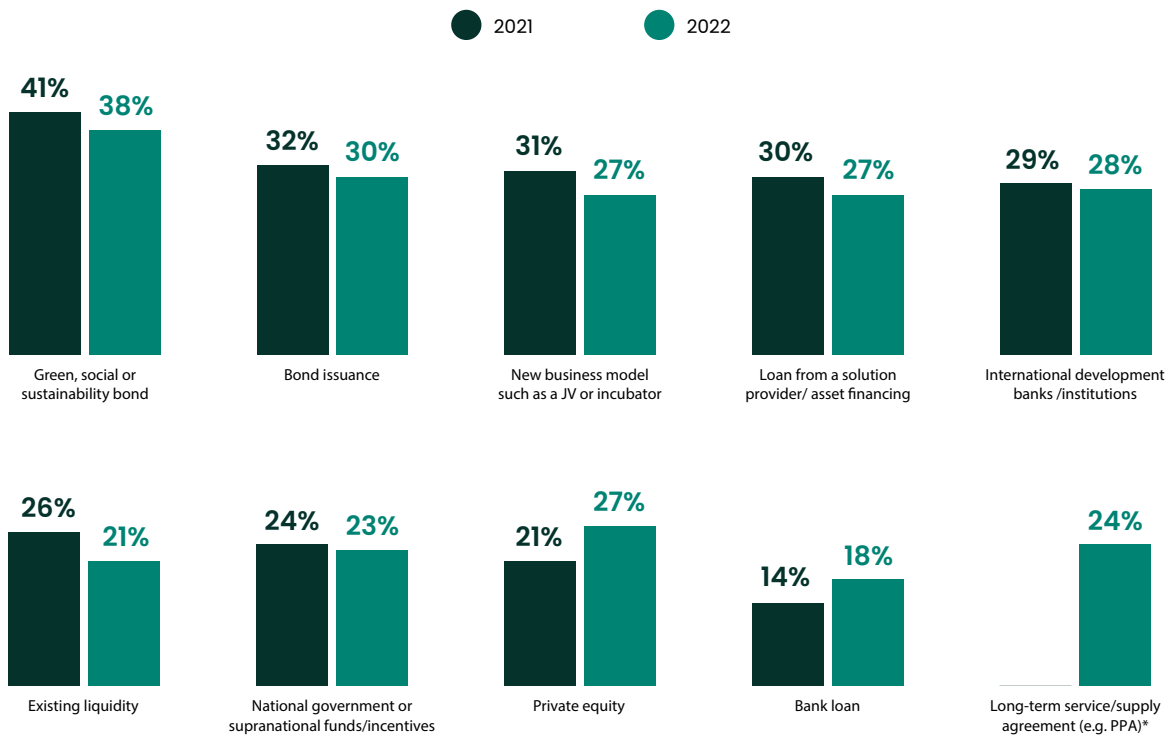
In a continued trend from 2021 – albeit with a slight dip – survey respondents in 2022 say they are primarily looking into green or sustainable bonds to raise finance for the energy transition over the next five years.

Sustainable debt markets were resilient in the first nine months of 2022, with green bonds raising \$312 billion, down 13% year on year – slightly more subdued than in 2021 amid wider macroeconomic volatility.¹⁴

More respondents in 2022 say they are interested in private equity capital for financing energy transition initiatives than in 2021.

But to unlock private sector capital to accelerate the energy transition, policy certainty is needed and a solid understanding of how to commercialize new technology and the role it can play in new and emerging low- and zero-carbon energy ecosystems – on both a national and international level.

Green, social and sustainability bonds are respondents' preference for financing their energy transition initiatives in the next five years



Question: Which of the following types of finance is your organization most likely to tap into within the next five years, to fund any energy transition initiatives that you are planning?

* New answer option in 2022.

– IN CONCLUSION

The energy trilemma requires a foundation of new energy partnerships

In 2022, political and economic crises forced companies to re-examine the dynamics between energy security, sustainability and affordability that are necessary for reaching net zero. This is the energy trilemma.

The success of solving the trilemma will depend to a large degree on addressing three hard truths:



Making technology available:

New and mature technologies need to be de-risked and scaled up to abate greenhouse gas emissions at scale.



Hydrocarbons:

Hydrocarbons use is here to stay the next few decades to balance the immediate need for energy. But energy must be managed with efficiency, and emissions must be captured to ensure climate change mitigation.



Partnerships:

The public and private sectors have to work together to accelerate and commercialize new clean-energy value chains and systems.

– IN CONCLUSION

As the world strives to achieve net zero by 2050, companies are expediting near-term investments in lower-carbon energy such as natural gas and LNG, while also working to implement a new generation of solutions and systems with hydrogen, waste-to-energy, geothermal, battery storage and CCUS – albeit with a longer-term horizon.

The survey shows that, so far, respondents' confidence in the transition has not wavered. Net-zero roadmaps will, however, face major challenges in 2023, including:

- **An ongoing crisis in geopolitics and supply chains**
- **Upheaval in energy markets**
- **A depressed economic outlook**

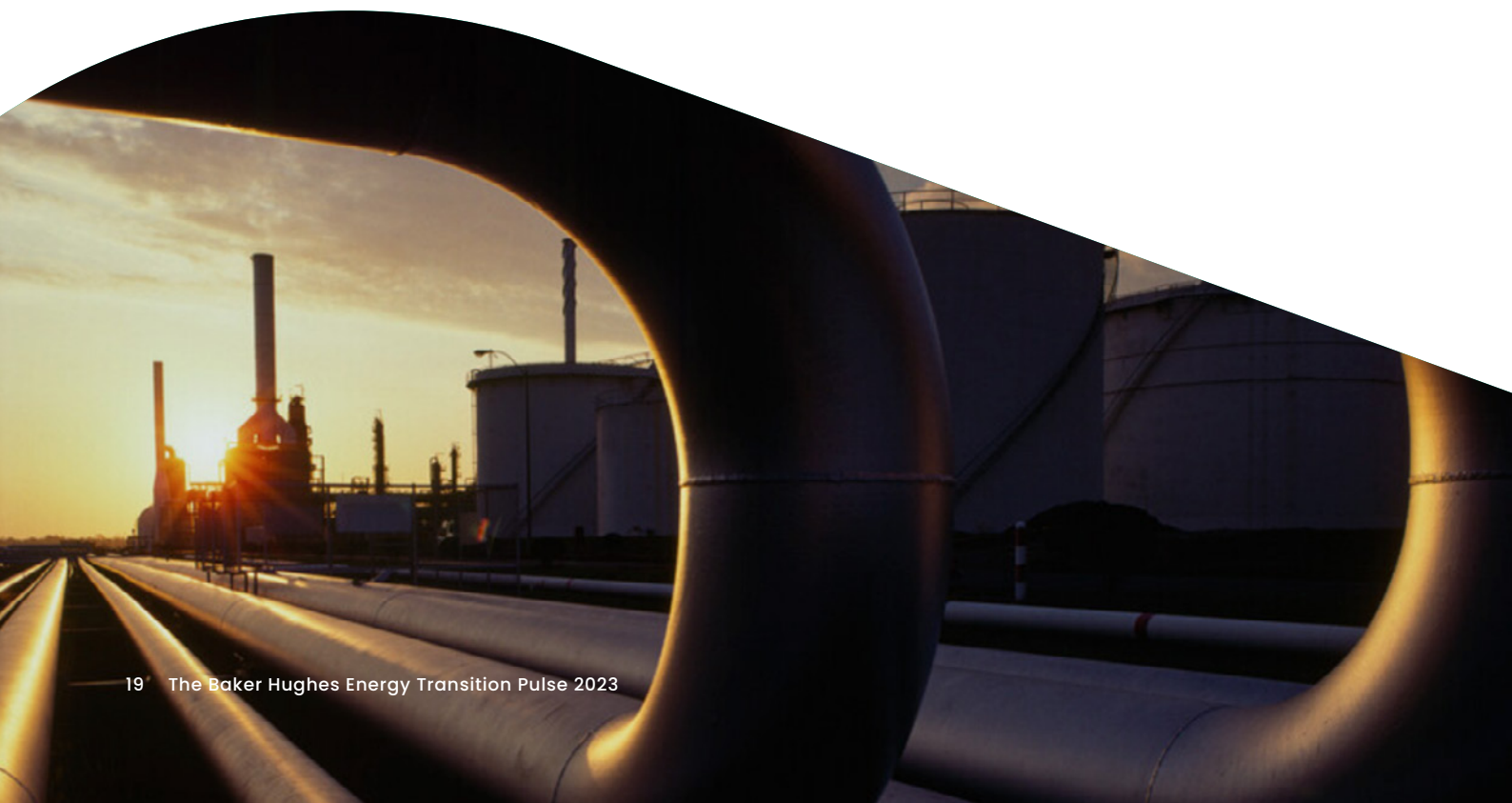
"We have to manage this inflation 'speed bump' and get more supply onto the marketplace while continuing to drive sustainability over the long term," says Lorenzo Simonelli, Chairman and CEO of Baker Hughes. "Hydrocarbons are going to play a role for decades and it's crucial we apply the technology that we have today and work together as partners to reduce those emissions."

Partnerships and collaboration can unlock the energy systems of the future, supported by the adoption of new technology and aligned with a forward-looking hydrocarbons strategy, as we work together to solve the energy trilemma of energy security, sustainability and affordability.

"Hydrocarbons are going to play a role for decades and it's crucial we apply the technology that we have today and work together as partners to reduce those emissions."

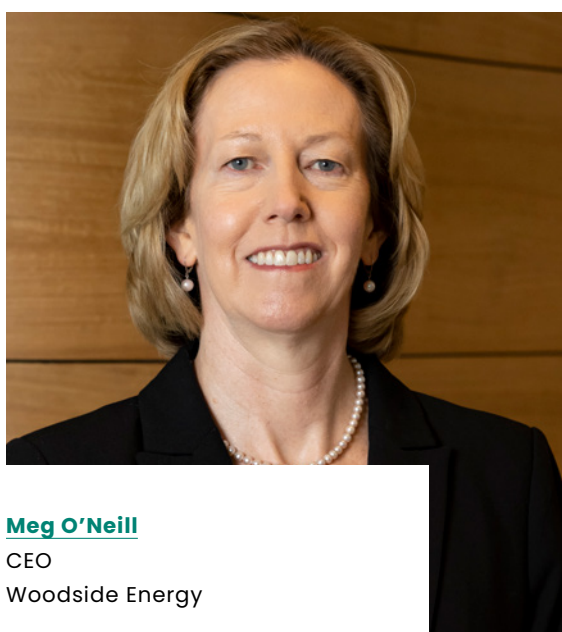
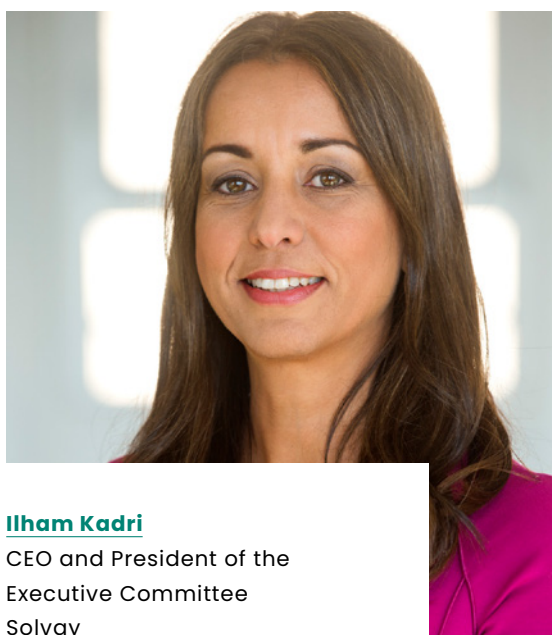
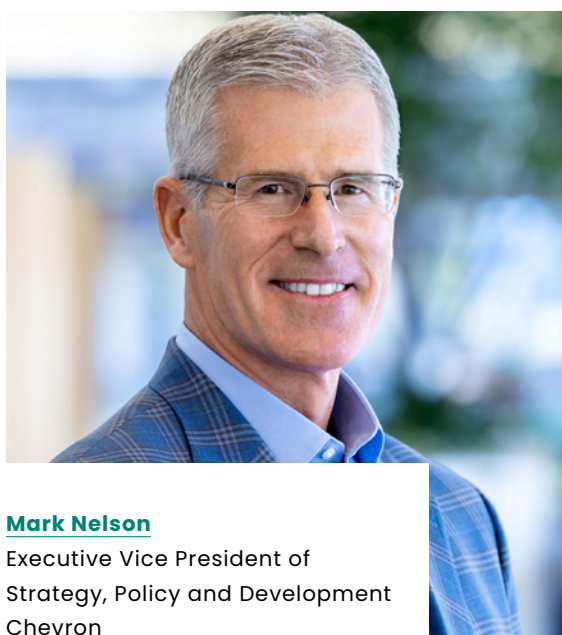
Lorenzo Simonelli

Chairman and CEO, Baker Hughes



Acknowledgments

We would like to thank the following executives for the time and insights they have given us:



About the research

Baker Hughes, in collaboration with FT Longitude, a Financial Times company, surveyed 555 global executives across 21 countries in Q3/4 2022. The preceding survey was conducted in Q4 2021 and polled 500 global executives across 20 countries.*

Countries:

- Australia
- Brazil
- Canada
- China
- France
- Egypt
- Germany
- India
- Italy
- Japan
- Malaysia
- Mexico
- New Zealand
- Nigeria
- Norway
- Qatar
- Saudi Arabia
- South Africa
- UAE
- UK
- US

* Respondents based in Russia were included in the 2021 survey but not in 2022. Respondents from Egypt and South Africa are included only in 2022.

Sectors:



Oil and gas



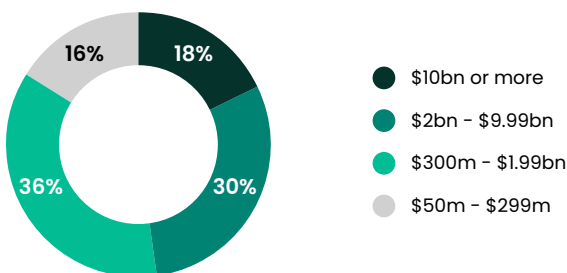
Renewable energy



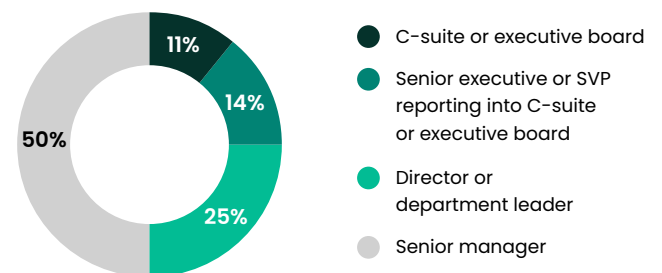
Hard-to-abate industrial sectors

(Automotive, cement, chemicals, industrial other, mining and minerals processing, pulp and paper, power generation excluding nuclear and renewable energy)

Global company revenue (US\$):



Seniority:



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- 1 <https://www.ft.com/content/93eb06ec-ba6c-4ad2-8fae-5b66235632b2>
- 2 <https://www.iea.org/news/world-energy-outlook-2022-shows-the-global-energy-crisis-can-be-a-historic-turning-point-towards-a-cleaner-and-more-secure-future>
- 3 The latest survey was conducted in Q3/4 2022, and the previous survey in Q4 2021. See the demographics for a country and sector breakdown.
- 4 <https://www.iea.org/news/global-coal-demand-is-set-to-return-to-its-all-time-high-in-2022>
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- 15 <https://www.refinitiv.com/perspectives/market-insights/sustainable-finance-sees-cautious-retreat-amid-wider-volatility/>



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